



Carving a locomotive steam engine inside a cage

Use hand tools to make this moving locomotive replica in a cage

By Joseph A. Savarese

In 2014, my friend gave me an exciting carving challenge: create a personalized carving for his five-year-old son, Timothy. Knowing he liked trains, I wanted to incorporate that into the design as well as making it unique and fun for him to play with. Thinking back at all the positive reactions I get when someone sees my ball in cage carvings, I figured let's eliminate the ball and carve a train instead. Now two years later I plan on putting a smile on another five year old, my nephew and godson, Louie. This demonstration carving is for you buddy, Happy Birthday!

Design Notes

My goal is to demonstrate this project using only traditional hand carving tools but power tools can be used in some steps. For example you could use a drill press to remove the bulk of the excess wood, a scroll saw to roughly cut the train's profile, and a rotary tool to add the details. If you decide to use a scroll saw, make sure the blade tension is set properly. Make sure you don't force the wood into the blade; this will cause the blade to flex and make inaccurate cuts, causing both sides of the train not to match up and/or possibly damage the cage rails.

Before starting the project I would recommend that you read through the entire article so you understand how I designed the train to slide back and forth inside the cage. You will learn how some of the train's features are still gripping 1/8" (3mm) of all four of the cage rails.

After mastering the technique, you can challenge yourself by redesigning this blueprint. Perhaps, adding a passenger car and caboose. Have fun and keep your tools sharp and your fingers and eyes safe!

Getting Started

Cut the basswood blank to exactly 1 5/8" by 2" by 12" long with the grain running the length of the wood. Make sure the top and bottom is square and true to the sides. If you are using a scroll or band saw and find it difficult to cut the blank to the exact measurements, cut it oversized and use a disc sander to square up the blank. Use only the downward rotating side of the disc sander to keep the tool from pulling the wood block out of your hands.

The majority of my carving tools are by Pfeil. Other manufactures may have different sweep numbers. It is not necessary to use the exact size and

TIP

HELPFUL SUGGESTIONS

Rest the carving on a soft hand towel as you work so the block doesn't get dented. Consider wearing a magnifier headset when you are carving the smaller details.

sweep that I use; use whatever tools you have that are similar.

While carving this project I recommend that you rest the carving on a soft hand towel so the block doesn't get dented. I also recommend that you wear a magnifier headset to help carve the smaller detail.

Important Note: I only use a .5mm mechanical pencil and a combination square to transfer the measurements. The lead diameter stays consistent and there is no need to sharpen the point. The combination square will give you the most accurate measurements.

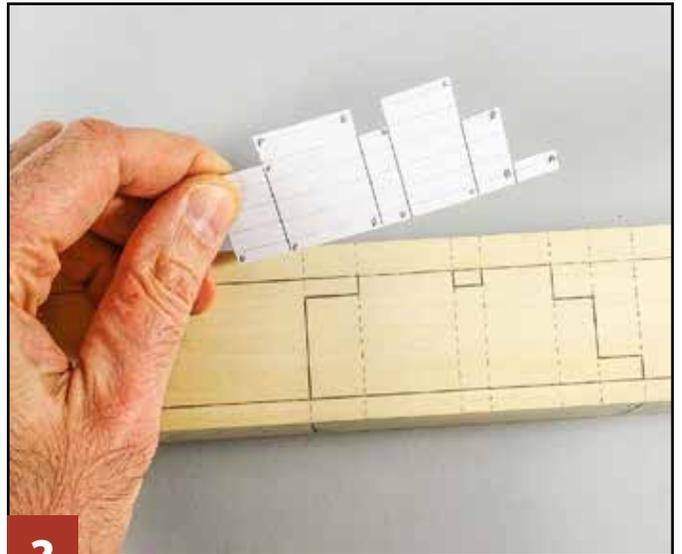
Make several photocopies of all the templates. Some templates will be glued directly onto the project. While others will be glued onto thin cardboard, then cut out using a hobby knife (X-Acto #11 blades) and held in place while you trace the template onto the wood with the mechanical pencil. Identify and mark the front, back, top, and bottom of the blank. Draw a centerline on all four sides. Transfer the measurement for the cage rails to all four sides. *Note: The dimensions for the top and bottom cage rails are different from the sides.*

TRAIN: ROUGHING OUT THE PROJECT



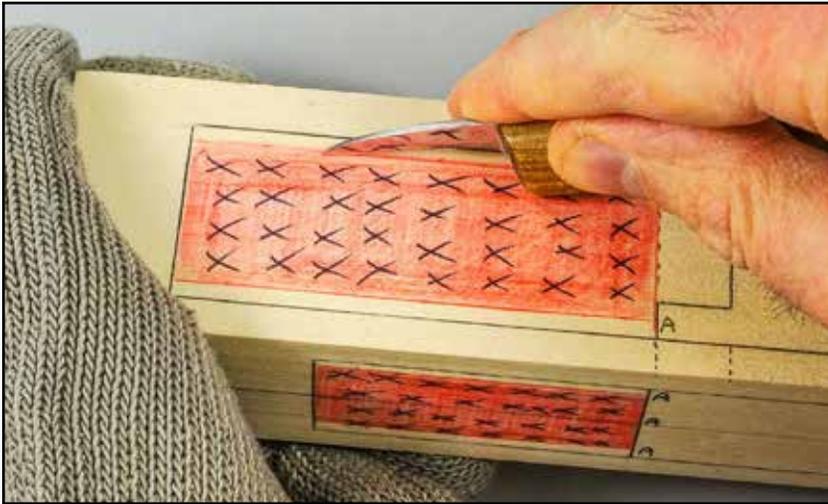
1

Identify and mark all sides of the block with its respective name: front, top, back and bottom. With a combination square, mark a centerline along the top, sides and bottom of the block. This will aid in keeping the carving symmetrical. Referring to the drawing, carefully transfer the measurements for the cage on all four sides. Please note: the measurements for the bottom of the block is slightly different from the rest of the sides.



2

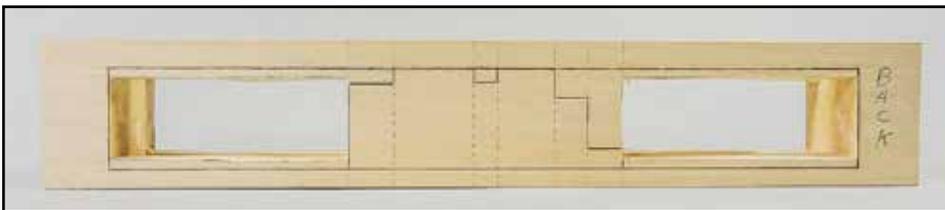
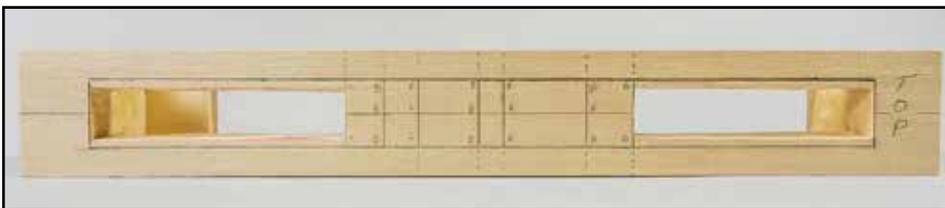
On the front of the block and towards the center, position and align template A on top of the bottom rail. Position the template with label A pointing towards the left. Positioning this template towards the center of the cage allows you to carve the train from all the sides with the least obstructions. Transfer the template onto the block. Using a combination square, extend lines A through G to the top, back and bottom of the block. Flip the template over and resting it on the bottom back rail align lines A-G (on this side, label A will be pointing towards the right). Trace the template to the wood.



3

Make stop cuts around the cage and locomotive.

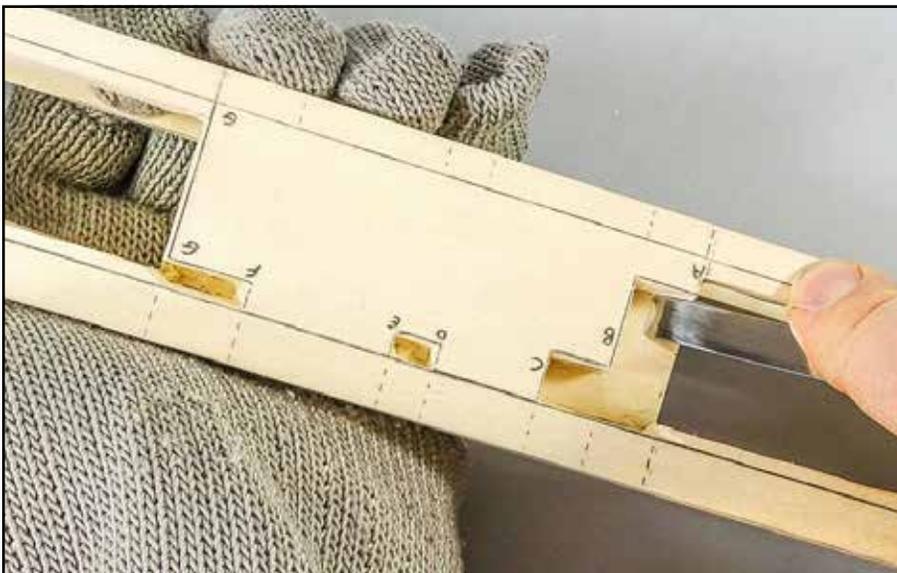
Start on the front side. To protect the cage rails from being damaged, hold your knife at a 90° angle to the wood and make stop cuts approximately 1/8" (3mm) in but parallel to the rails. We will finalize the rails towards the end of the project. Make a stop cut on both end sections of the block as well as the reserved section for the train (lines A and G). Start all these cuts from the corners and join them in the middle so your carving knife doesn't cut into the rails.



4

Remove the excess wood around the locomotive.

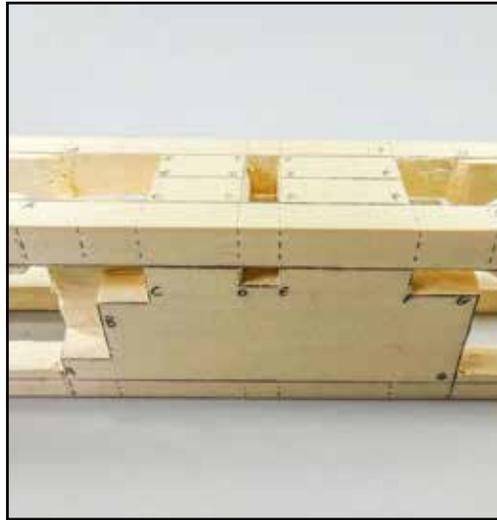
Use a 1/2" (13mm) to 5/8" (16mm) #2 or #3 gouge and carve up to the stop cuts. Repeat this step until you carve at least 3/8" (10mm) deep. Continue on the other three sides until all the wood is removed. Do not jump ahead and carve the V shaped bottom pilot pocket yet. This angle will probably change, so we will carve that towards the end of the project.



5

Block out the locomotive from both sides.

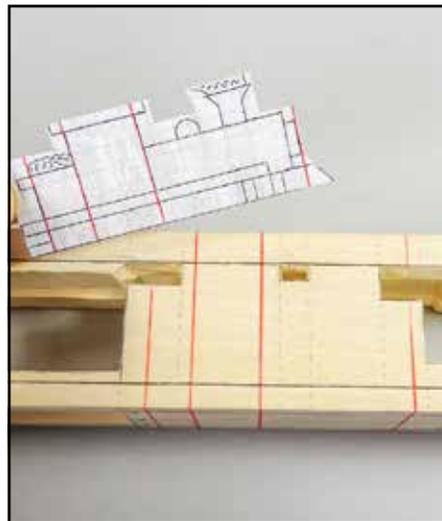
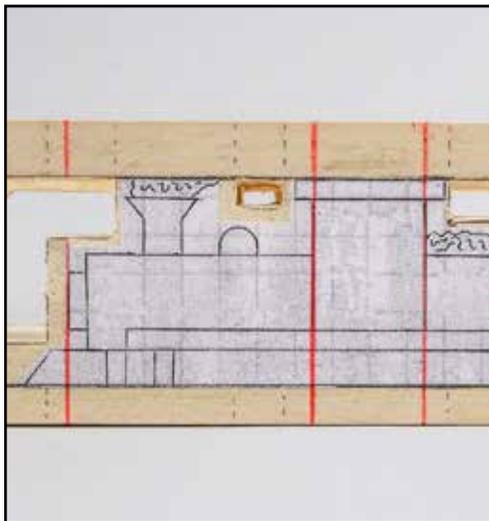
Redraw a centerline all the way around the reserved train block. Starting in the front, make stop cuts along the template lines with the carving knife. Remember to make the stop cuts away from the reserved train wood; we don't want to cut into it. Use a 1/2" (13mm) to 5/8" (16mm) #2 or #3 gouge to carve up to the stop cuts. Make sure each cut is square and true, and don't cut into the rails. Continue this process until you are approximately 3/8" deep. Repeat this process on the back of the block. A hobby knife with a #11 blade, 1.5mm chisel, 1.5mm, 1/8" (3mm), and 3/16" (5mm) #2 gouges are ideal for removing excess wood around the smaller sections (D - E and F - G). Again, use caution not to carve into the rails.



6

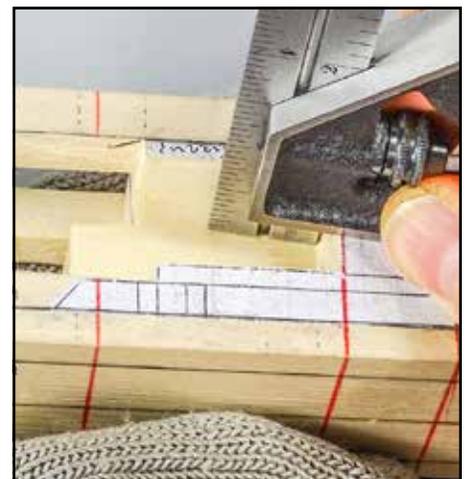
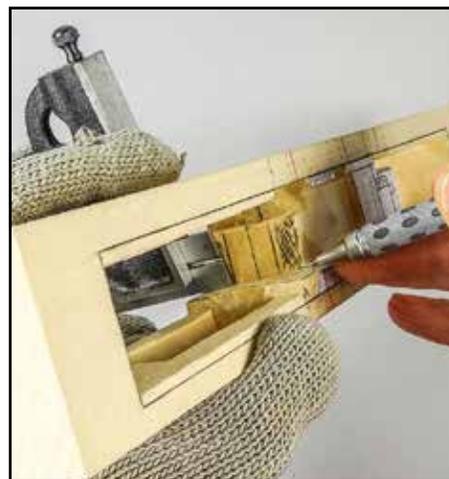
Block out the locomotive from the top.

From the top of the block, use the stop cut technique and $\frac{1}{8}$ " (3mm), $\frac{3}{16}$ " (5mm), and $\frac{5}{16}$ " (8mm) #2 gouges to remove the excess wood from lines A to C, D to E, and F to G. Continue this process until you carve pass the rail thickness. Use a carving knife with a blade length of at least $1\frac{1}{2}$ " (38mm) to remove the rest of the side profiles' excess wood. This technique helps keep the profile square and true.



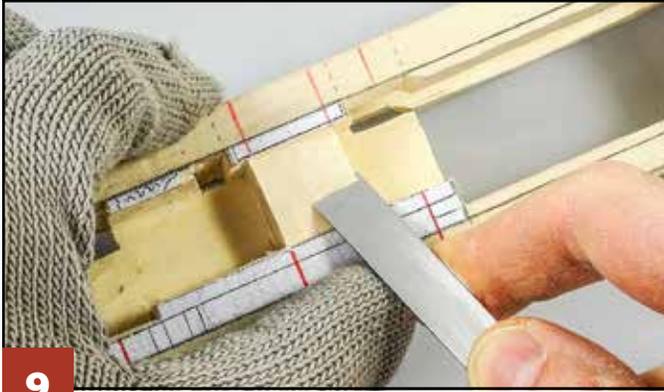
7

Align and glue Pattern B into place on the front and back. Use a glue stick to attach Pattern B Front to the front, and make sure the pattern fits in the reserved area between the rails and lines A-G. Using your combination square and a sharp pointed colored pencil, carry the lines of the front of the steam tank, front and rear section of the cab and the rear coal bunker to the top, back and bottom sides of the block. All lines need to connect all the way around the block so carefully align the templates. Use the lines to align and glue Pattern B Back to the back.



8

Block out the steam tank and coal bunker. If any part of Pattern B covers the rails, redraw that portion with a combination square. Using a carving knife and $\frac{1}{8}$ " (3mm), $\frac{3}{16}$ " (5mm), and $\frac{7}{16}$ " (12mm) #2 gouges, carve the steam tank and coal bunker section $\frac{1}{2}$ " (13mm) deep. Use the combination square as your depth gauge and periodically check that each section is square and true. Use caution not to carve into the smoke and roof ledge in this step. If you prefer the locomotive to have more smoke on the sides, this is the time to reserve the wood. Repeat this step on the back of the block.



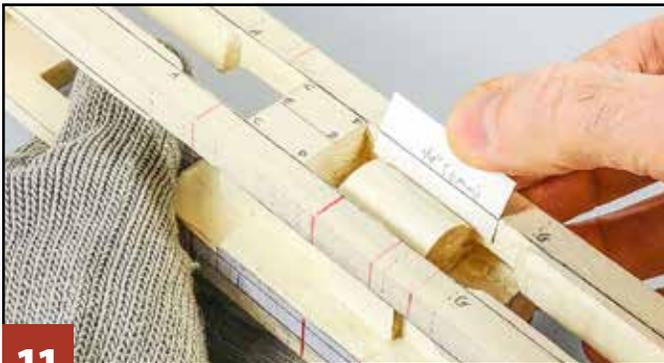
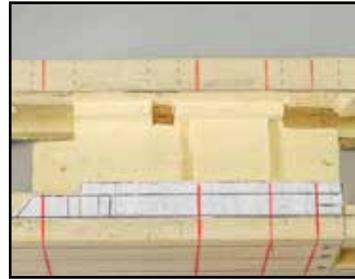
9

Block out the cab. Using the carving knife, make stop cuts along the roof ledge and train footboard. Take a $\frac{7}{16}$ " (12mm) #2 gouge and carve up to the stop cuts. Work your way down until this section is $\frac{3}{8}$ " (10mm) deep. Use the combination square as a depth gauge and periodically check that this section is square and true. If you prefer a thicker roof ledge now is the time to reserve more wood for that area.



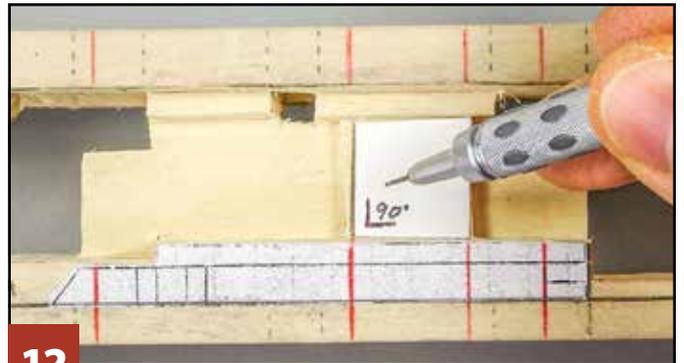
10

Block out the smoke and roof ledge. Use the combination square and a .5mm mechanical pencil to retrace the top cage section for the roof and smoke. Take a hobby knife (because of its thin blade) make a stop cut along the cage and the smoke and roof ledge. Use a $\frac{7}{16}$ " (12mm) to $\frac{5}{8}$ " (16mm) #2 gouge and carve up to those stop cuts until those sections are $\frac{1}{4}$ " (6mm) deep. Use caution not to damage the cage rail. Repeat this step on the back.



11

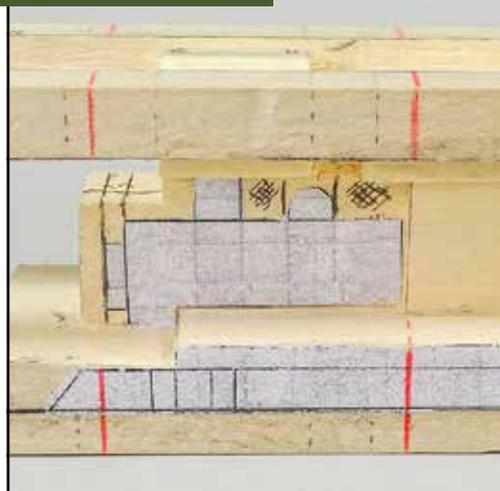
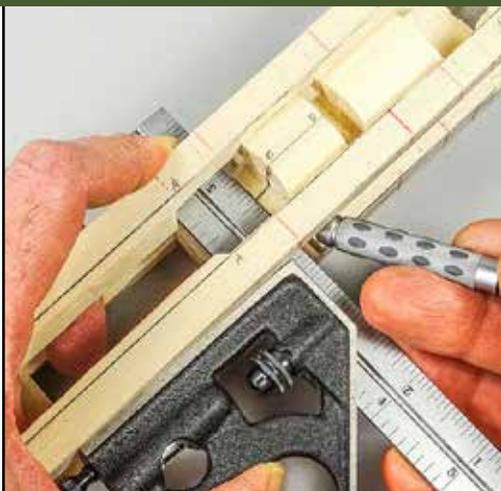
Block out the top smoke section and roof. With the hobby knife, make a stop cut along the top cage rails between lines E and F (the roof section). Carve up to those stop cuts using a $\frac{7}{16}$ " (12mm) to $\frac{5}{8}$ " (16mm) #2 gouge as you carve the roof with an arched shape. Use the centerline to aid in keeping the top of the roof symmetrical. Do the same for section C and D (the smoke), but the arc can be a lot sharper. The deepest depth of both sections arcs is $\frac{1}{4}$ " (6mm). Check the areas with a $\frac{1}{4}$ " (6mm) depth gauge made from thin cardboard.



12

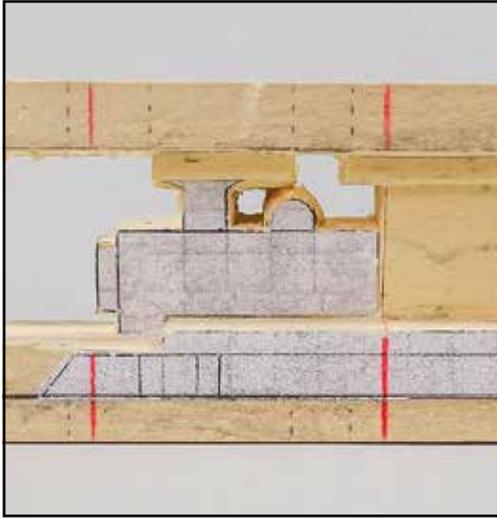
Fine-tune the footboard and cab section. Using the combination square make, sure the train's footboard is square and true with the front and back sides. Make any necessary adjustments with the #2 gouges and the carving knife. With the combination square, carry the red colored cab lines to the footboard up against the cab walls. Rest a 90° template (made from thin cardboard) on the footboard aligned with the red lines and mark the cab walls. Use a hobby knife with a #11 blade to carve these adjustments

TRAIN: ADDING THE DETAILS



13

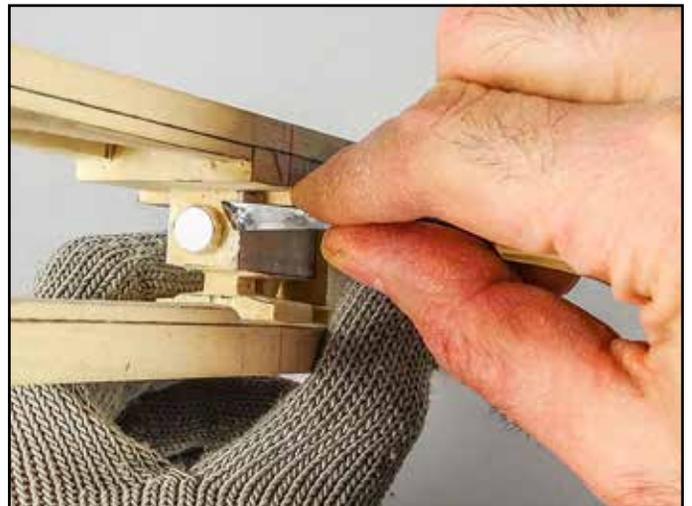
Cut the steam tank section from Pattern B and glue it in place. Using the combination square and 90 degree templates (cut to size to fit) carry the two front lines on the template to the top and back side of the block. Cut, align, and glue the back steam tank section from Pattern B Back into place. Don't worry if the entire templates smoke stack doesn't fit on the wood. We will be carving smoke around the trains smoke stack.

**14****Carve the steam tank**

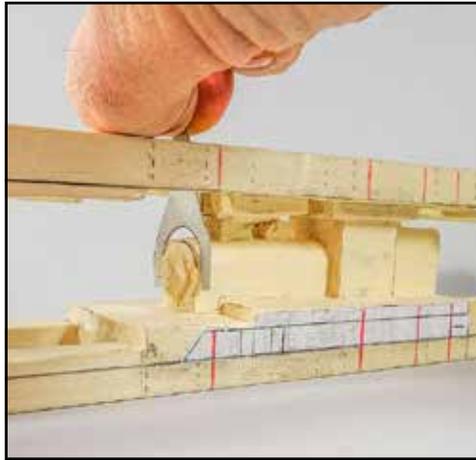
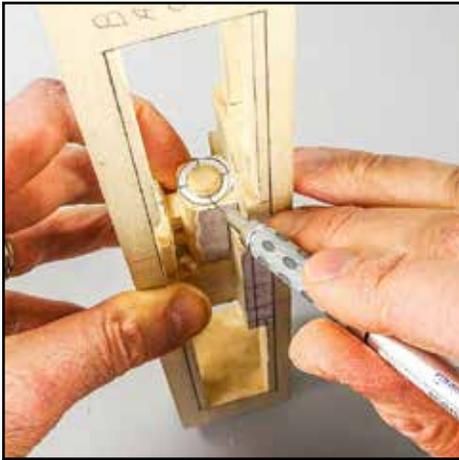
profile. Use a carving knife and $\frac{3}{16}$ " (5mm) and $\frac{5}{16}$ " (8mm) #2 gouges to remove all of the excess wood around the steam tank. Twist a $\frac{1}{16}$ " (2mm) or $\frac{1}{8}$ " (3mm) #11 gouge to drill out the excess wood around the steam dome and smoke stack. To avoid damaging the sections and carving out of square, work this step from both sides.

**15****Block out the steam**

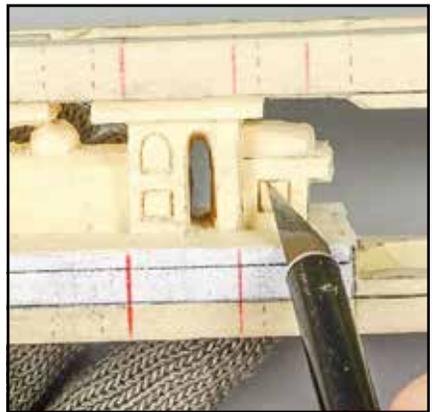
tank features. On the bottom of the block draw a line $\frac{1}{8}$ " (3mm) to the right and left of the centerline. Adjust your combination square to these lines so you have a depth gauge when blocking out the $\frac{1}{4}$ " (6mm) diameter steam dome and smoke stack. Using your carving knife and #2 gouges, carve these features to that depth from the front and back of the block. Use the same technique to block out the front $\frac{3}{8}$ " (10mm) diameter head lamp.

**16****Shape the front head lamp.**

Draw a centerline, center and glue the center of the head lamp pattern into place. Using a carving knife and a small skew chisel, carve the lamp round. Carve and shape it into a round dome shape. This is end grain, so make small cuts with sharp tools.

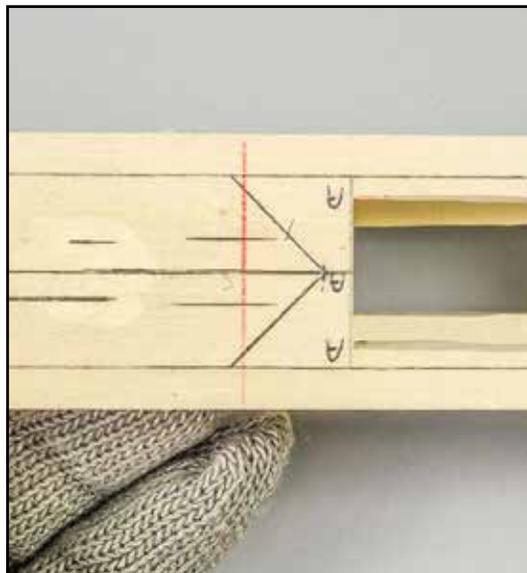
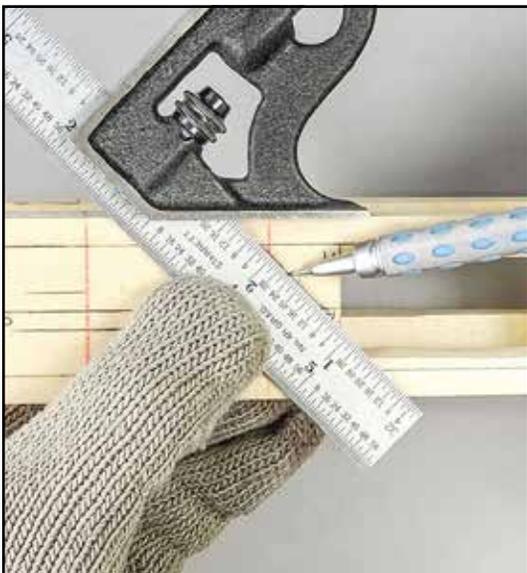


17 **Shape the steam tank.** Cut out the perimeter and center of the Headlamp Pattern and glue the remaining ring to the front of the tank over the head lamp. Use a carving knife, skew chisel and an assortment of #2 gouges to shape the tank, steam dome and smoke stack. Use the large arc template to assist. Use sharp tools and caution when shaping this area. At times you may need to carve against the grain due to the hard to reach areas. In that case, nibble at the wood so you don't chip off any wanted areas.

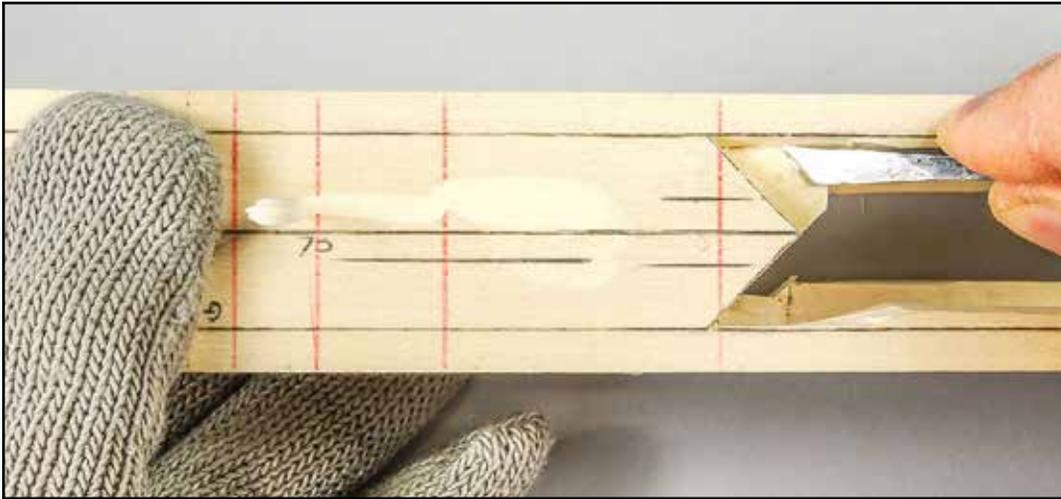


18 **Lay out the cab and coal bunker.** Cut out and glue the cab and coal bunker templates to thin cardboard. Use a hobby knife to cut the door, window, and trim detail on the templates. Position and transfer the details to the project. Flip the templates over and repeat on the back. Make sure the cab door matches on the front and back of the block.

19 **Detail the cab and coal bunker.** Twist a $\frac{1}{8}$ " (3mm) #11 gouge to act as a drill to bore a hole through the doorway. Drill half way through from the front, and then drill the rest of the way from the back. With a carving knife and $\frac{1}{16}$ " (2mm) to $\frac{3}{16}$ " (5mm) #2 gouges, carve out the doorway. Choose a gouge sweep that matches the doorway archway and carve that area. Use a hobby knife with a #11 blade to make V-shaped cuts to define the window and decorative panels (using a V-tool for these cuts will most likely tear the wood due to the woods cross grain in some areas. Use a 1.5mm micro #11 gouge to make $\frac{1}{32}$ " (1mm)-long cuts to represent the coal in the bunker.



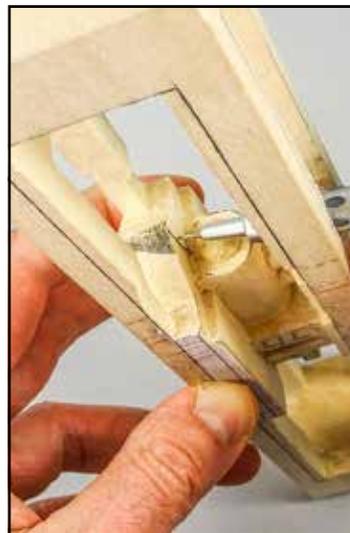
20 **Sketch out the pilot.** On the bottom of the block starting at line G, measure $3\frac{3}{8}$ " (92mm) and make a mark on the centerline. Position the 45° section of the combination square against the front of the block. Line the ruler up with the mark you just made on the centerline. Draw a line along the ruler stopping at the cage rail. Repeat on the back. This sets the outside of the train's pilot.



21

Block out the pilot.

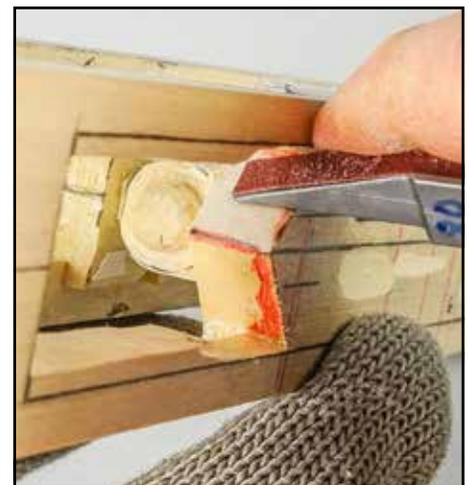
Take your knife and make stop cuts along the lines and the cage rails. Carve up to these cuts with a #2 sweep gouge and/or a skew chisel. Finalize any portion of the rail cage wood that is interfering from you working on this step.



22

Set the pilot's angle.

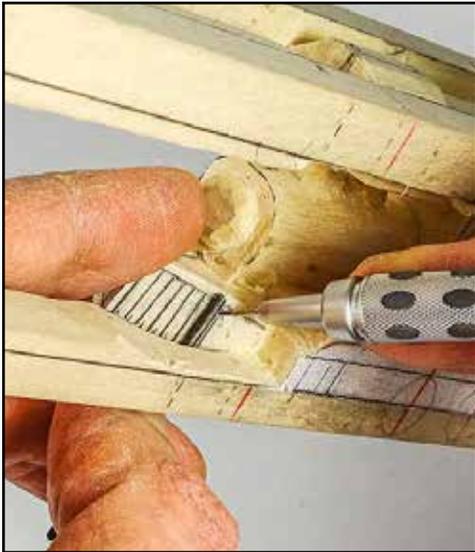
Hold the pilot template in place and transfer the angle on both sides of the block. Confirm that the angle is equal on both sides using dividers or calipers. With your carving knife and starting from the top (because its end grain), carve the angled line towards the bottom. Use caution not to cut into the cage rails.



23

Shape the pilot.

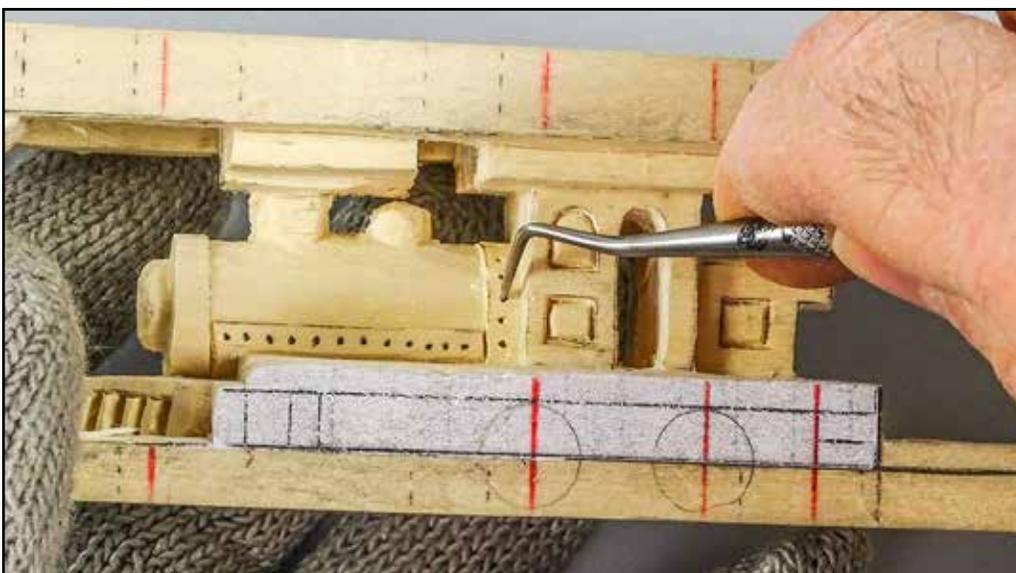
Redraw the pilot's centerline. With your carving knife, #2 gouges and a 1/4" skew chisel, carve the red shaded area to the centerline without changing the bottom profile that we set in step 21. A 120-grit sanding stick can also be used to help set the angle. Refer to the finished carving pictures to assist. Please note the angle stops right before the side horizontal cylinders. Use a straight edge to check that the angles are staying straight. Sharp tools are necessary and be aware of the grain direction.



24 **Add the details to the pilot.**
 Draw a $\frac{1}{8}$ " (3mm) horizontal line $\frac{1}{8}$ " (3mm) up from the bottom of the pilot (where visible) and a horizontal line $\frac{1}{16}$ " (2mm) down from the top of the pilot. Starting at the centerline, using a $\frac{1}{16}$ " (2mm)-diameter drill bit as a spacer, sketch the pilot's vertical bars. Shade in the bars that will be carved. With your hobby knife, make a stop cut around the shaded bars. Carefully recess the shaded area using micro 1.5mm wide chisels or micro #2 gouges. A dental pick helps remove/scrape out the excess wood. You can wood burn the pilot's detail or make V-cuts to represent this part of the locomotive.



25 **Add the engine tank details.**
 Cut $\frac{1}{8}$ " (3mm) wide strips from an index card or thin cardboard. Rest the strip against the tank areas that require strap details. Trace the strip lines to the tank with the mechanical pencil. Use a hobby knife to make stop cuts the lines and recess the engine tank approximately $\frac{1}{16}$ " (2mm) deep using a $\frac{1}{8}$ " (3mm) to $\frac{5}{16}$ " (8mm) #2 gouges.



26 **Add the rivet detail.**
 Using a dental pick, start in the corner in the center make an indentation. Use dividers set to $\frac{1}{16}$ " (1.5mm) wide to equally space each indentation. Continue this procedure until all of the straps have rivet holes. To get to the hard-to-reach areas, use a bent dental pick.



27A

Roughly shape the smoke section. Use the carving knife, #2 gouges, and a 1/4" (6mm) skew chisel.



27B

Add the smoke details. Using an assortment of medium to deep gouges like a 5/32" (4mm) to 1/4" (6mm) #7 gouges, 5/32" (4mm) to 9/32" (7mm) #8 gouges, and a 3/16" (5mm) #9 gouge, make randomly spaced stop cuts. Carve into those stop cuts using a carving knife, skew chisel, and the assorted mentioned gouges. Shape the smoke clouds so they overlap each other. Be aware you still want at least 1/8" (3mm) of the smoke clouds to be touching the front, top, and back rails.



28

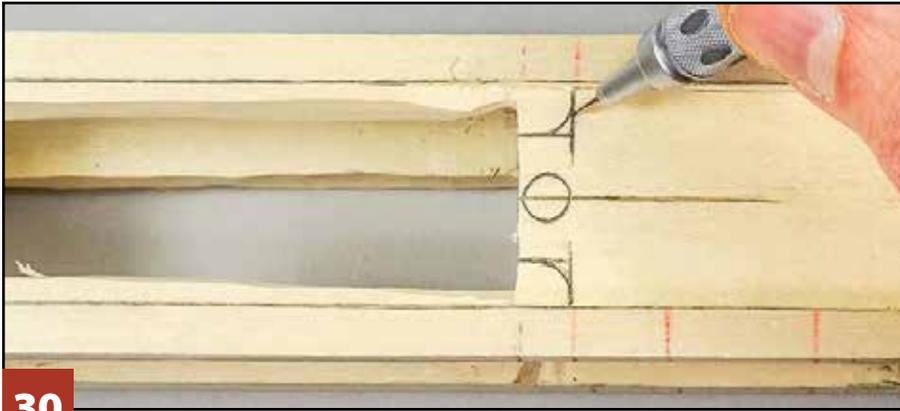
Block out the side rods. With your combination square, redraw the bottom rails. Make a stop cut around the cylinders. Recess the train wheel section 1/16" (2mm) using a 3/16" (5mm) #2 gouge, but don't recess the cylinder. Glue the Side Rod Pattern into place on both sides. Stop-cut around the side rods using a hobby knife and a 2mm chisel. Recess this area 1/16" deep using a 3/16" (5mm) #2 gouge, micro chisels, and a skew chisel. A dental pick also helps with the removal of wood in tight areas.



29

Shape the side rods.

Make sure the background area where the side rods will be carved is flat and level. Referring to the pictures, shape the side rods and the cylinder tank using the 1/16" (2mm) and 1/8" (3mm) #2 gouges, a micro skew chisel, and a hobby knife. Do not set in the wheels just yet. We are going to break the train free so it slides back and forth. Then we will add the wheel detail.



30

Carve the bottom and the train coupler. Redraw the bottom cage rails using your combination square. Measure from the front of the train back $\frac{3}{4}$ " (19mm) and draw a line. Towards the right of the line that we just drew use your carving knife, a deep sweep gouge and #2 gouges to recess the bottom $\frac{1}{8}$ " (3mm) deep. Redraw the centerline and referring to the bottom pattern and finished pictures sketch in the train's coupler. Use the gouges that best fit the shape of the coupler and carve the coupler from the bottom. Don't go too deep or you will damage the train's footboard. From the front and back, use a carving knife, $\frac{1}{16}$ " (2mm) #2 gouge and the 1.5mm #11 gouge to bore out the area between the coupler and footboard.

31

Fine-tune the carving. Before breaking the train free from the cage, look over the entire piece and make any final adjustments. Also lightly carve off any dirt smudges, pencil marks, etc. After referring to the pattern, I noticed I forgot to carve the roof top to its proper length. Also, using a #2 gouge, trim down the width of the train foot board by $\frac{1}{8}$ " (3mm) on each side.

32

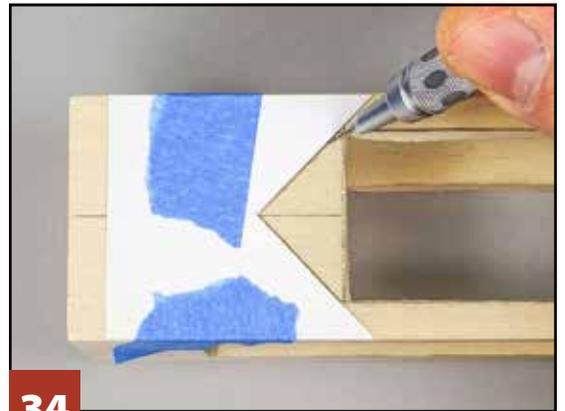
Finalize the cage rails. Use the combination square and redraw all the cage rails. With your carving knife, carve to the rail cage lines. Use caution not to carve past the line or against the grain. Periodically inspect that the area is staying square and true by using a straight wood block or metal ruler. We can also complete this step using 120 grit sandpaper wrapped on a rigid sanding block.

TRAIN: FREEING THE TRAIN FROM THE CAGE



33

Separate the train from the cage. Use a hobby knife or a thin-bladed knife to make stop cuts no deeper than $\frac{1}{16}$ " (2mm) per pass along the cage frame and the train. Work carefully and repeat the cuts until you hear small cracks, which indicate that the cuts are breaking through and freeing the train. Once the train is free, slide it back and forth, and if it binds up, carefully adjust, sand, and nibble away any imperfections. I left some resistance on my project so the train doesn't rattle back and forth and break!



34

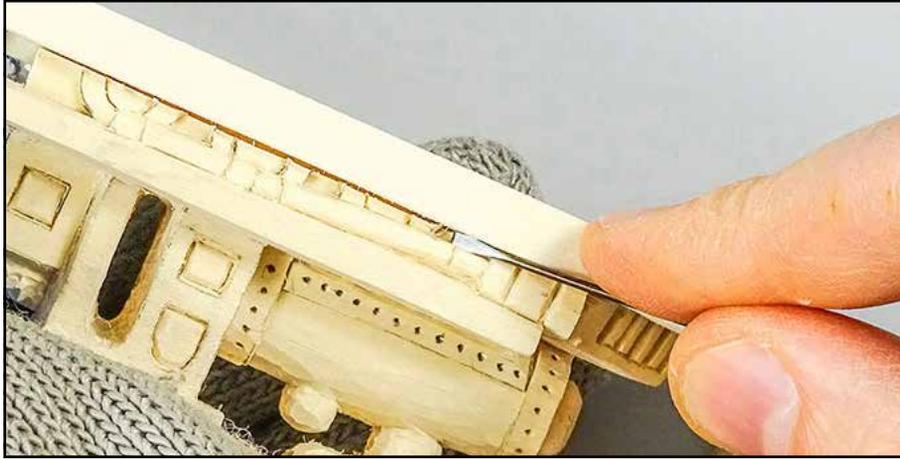
Carve the cage's pilot pocket. Trace the pilot angle onto thin cardboard. Cut the angle and secure it on the blank using blue painter's tape. Trace the angle to the wood. Use a carving knife to make the stop cuts. Use a $\frac{5}{8}$ " (16mm) #2 or #3 gouge and a skew chisel to remove the wood. You are carving thin wood with the grain so use caution with every cut.

TRAIN: ADDING THE FINAL DETAILS



35

Set in the wheels. Refer to the pattern and use dividers or calipers to set the location of all three $\frac{7}{16}$ " (12mm)-diameter wheels on each side. Using a hobby knife cut the wheel templates to fit around the side rods. Hold the template into place with the dental pick and trace the template on to the carving.



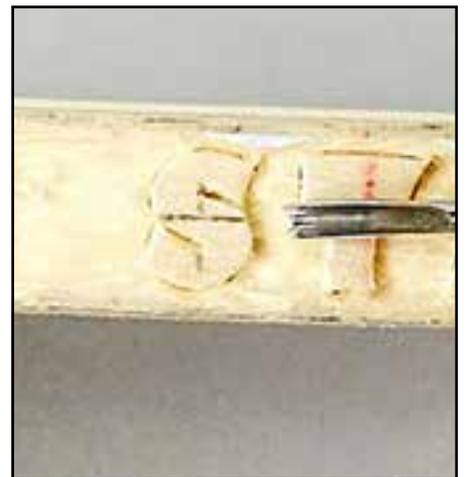
36

Finalize the wheel details. Position the train in the front pocket and secure it with blue painter's tape (which does not leave any residue) to keep it from moving. Using the hobby knife or a gouge that fits your wheel arc, make a stop cut around each wheel. Carve up to those stop cuts with 1.5mm to 1/8" (3mm) #2 gouges and a micro skew chisel. We need to remove approximately 1/16 (1.5mm) of the background. Sketch in each wheel's inner rim. Using the hobby knife, carve a V-cut to define this detail.



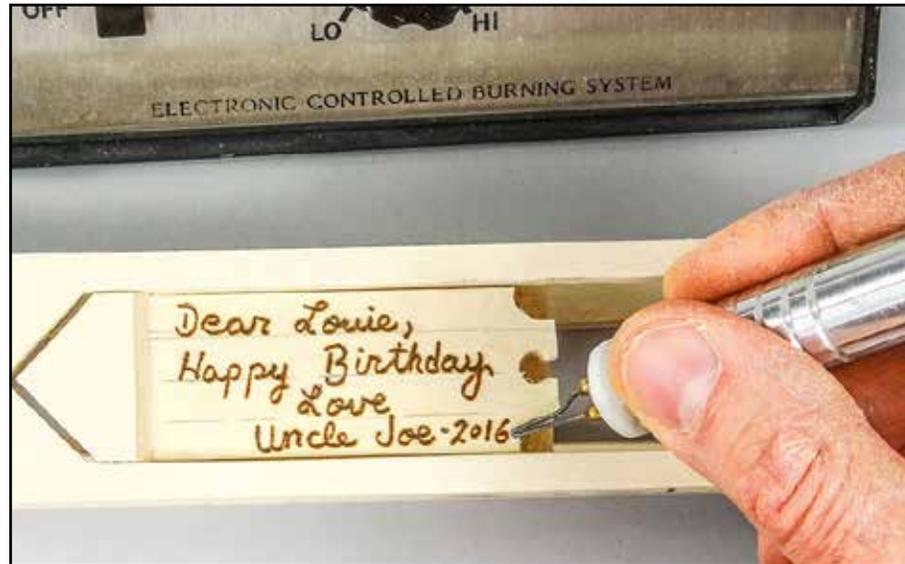
37

Design the sign. Use a word processor to create your pattern. The height of the letters should be no taller than 1/4". You can change the font size using computer software or a photocopier. Draw a straight line on the top and bottom of the pattern with a transparent ruler. Then, draw a horizontal centerline through the entire length of the pattern. With your hobby knife cut several small voids over the centerline to help align the pattern on the block. On the front top rail using a combination square, draw a horizontal centerline along the length. Center the pattern to the right and left of the block and make a mark. Apply glue stick to the back and position the pattern, aligning the pattern's centerline with the cage rails centerline as well as the right and left center marks.



5

Carve the sign. I used a magnifier headset to assist my eyes and replaced the #11 X-Acto blade with a new one. Using a hobby knife, carefully make stop cuts along each letter. Carve up to the stop cuts with 1/16" (2mm) to 3/16" (5mm) #2 gouges. Don't try to carve each letter in one step. Repeat this process to carve the letters deeper. This way you will have less of a chance of damaging them. Recess the background by at least 1/16" (2mm). For interior parts of the letters use micro gouges, chisels, a micro drill bit in a pin vise, and a dental pick to pop out the excess wood. I even use the dental pick to make indentations in the letters if I can't get a gouge to fit, for example the letter S. When you are happy with the depth of each letter use a 1.5mm #11 gouge to add texture to the back ground. To add texture around the top and bottom of the letters I hold the gouge on its side or use a hobby knife.



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Finish the carving. Place 150-grit sandpaper on a flat surface and carefully sand the entire exterior cage. Move to 180-grit sandpaper paper and repeat. Sign the bottom of the train using a wood burner with a writing tip or pen (test the pen for bleeding on scrap first). Apply a liberal amount of boiled linseed oil over the entire carving using a disposable brush. Let it soak into the carving for five minutes. Remove the excess by rubbing with a clean rag, and then let it dry for at least three days. Dispose of the rags carefully; as the finish cures on the rag, it generates heat and can spontaneously combust. Apply Howards Feed-N-Wax with a disposable brush. Let it set for at least 20 minutes then rub/wipe off the excess. Buff using a shoe brush. Set it aside to dry for 48 hours.

materials & tools

MATERIALS:

- Basswood, 1 $\frac{3}{8}$ " (41mm) thick: 2" x 12" (51mm x 305mm)
- Glue stick
- Index cards or thin cardboard
- Sandpaper: 120, 150, 180 grits
- Blue painter's tape
- Disposable rubber gloves
- Disposable paintbrushes
- Boiled linseed oil
- Rags
- Finish, such as Howards Feed-N-Wax
- Shoe brush
- #2 gouges: $\frac{1}{8}$ " (3mm), $\frac{3}{16}$ " (5mm), $\frac{5}{16}$ " (8mm), $\frac{1}{2}$ " (13mm)
- #3 gouges: assorted sizes from $\frac{1}{16}$ " to $\frac{3}{16}$ " (2mm to 5mm), $\frac{1}{2}$ " (13mm)
- #5 gouges: $\frac{1}{8}$ " (3mm), $\frac{3}{16}$ " (5mm)
- #7 gouges: $\frac{5}{32}$ " (4mm), $\frac{1}{4}$ " (6mm)
- #8 gouges: $\frac{1}{8}$ " (3mm), $\frac{5}{32}$ " (4mm), $\frac{9}{32}$ " (7mm)
- #9 gouge: $\frac{3}{16}$ " (5mm)
- #11 gouge: $\frac{3}{64}$ " (1.5mm), $\frac{1}{16}$ " (2mm), $\frac{1}{8}$ " (3mm)

TOOLS:

- Carving knife with at least 1 $\frac{1}{2}$ " (38mm)-long thin blade
- Hobby knife with #11 blades
- #1 chisels: assorted from $\frac{1}{32}$ " to $\frac{3}{16}$ " (1mm to 5mm) wide
- Micro pin vise with micro drill bit
- Saw: scroll, band, or table
- Disc sander
- Mechanical pencil: 0.5mm
- Eraser: kneaded artist type
- Combination square with 90/45° handle
- Transparent ruler
- Drill press with drill bits (optional)
- Woodburner with writing nib (optional)
- Magnifier headset with light (optional)
- Dividers and calipers
- Dental picks (available from woodcarving suppliers)

The author used these products for the project. Substitute your choice of brands, tools, and materials as desired.



This is Joseph A. Savarese's fourth article with Woodcarving Illustrated. He was inspired to carve when, at age 7, he saw his scoutmaster, Roy K. McGinnis, Sr., carve a deer from a block of sugar pine.

Joe would like to express all his love to Patricia and Christopher. Without their love, support, and patience (especially when finding an occasional wood chip throughout the house), these articles wouldn't exist. For more of Joe's work or to view several how-to videos on woodcarving, visit his website at www.whittleandchips.com or his YouTube channel, MisterSplinters.