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Bill Krier
Editor
WOOD® magazine

Adobe Acrobat Troubleshooting Guide

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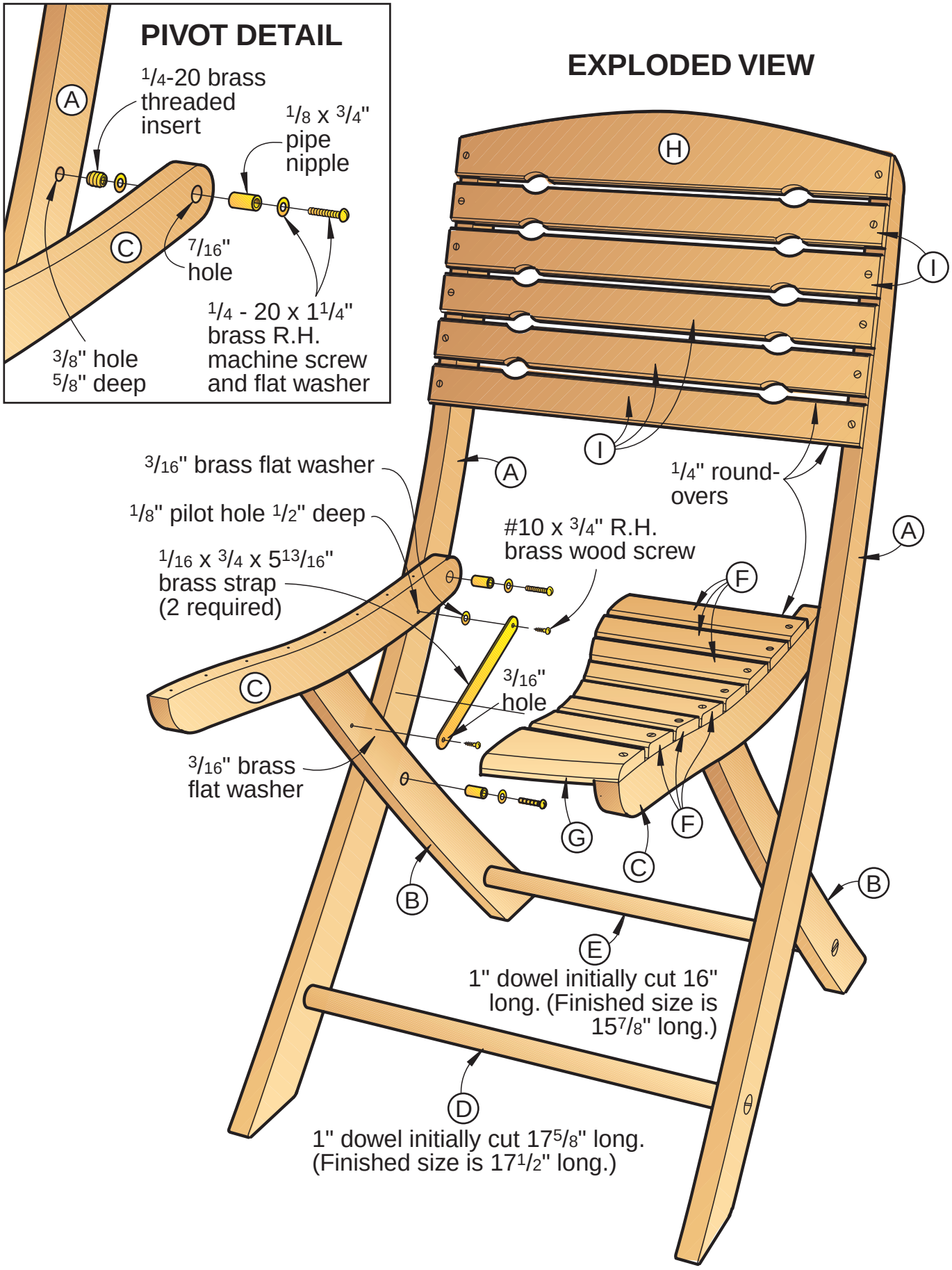
Sitting-Pretty

Folding Chair

Who says you can't make a great concept even better? Craftsmen have been incorporating the folding-leg concept into their designs since ancient Egyptian times, but there haven't been many that look better than our rendition.


PIVOT DETAIL
1/4-20 brass threaded insert
1/8 x 3/4" pipe nipple
A
C
7/16" hole
3/8" hole 5/8" deep
1/4 - 20 x 1 1/4" brass R.H. machine screw and flat washer
EXPLODED VIEW
H
I
A
3/16" brass flat washer
1/8" pilot hole 1/2" deep
1/16 x 3/4 x 5 13/16" brass strap (2 required)
#10 x 3/4" R.H. brass wood screw
1/4" round-overs
F
3/16" hole
3/16" brass flat washer
G
C
B
E
1" dowel initially cut 16" long. (Finished size is 15 7/8" long.)
D
1" dowel initially cut 17 5/8" long. (Finished size is 17 1/2" long.)

Bill of Materials

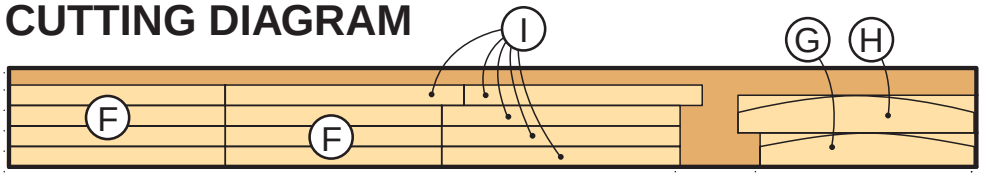
Part	Finished Size T	W	L	Matl.	Qty.
A front legs	¾"	4¼"	36⁵⁄₁₆"	O	2
B rear legs	¾"	2¹⁄₁₆"	19⅜"	O	2
C seat supports	¾"	2³⁄₁₆"	15¼"	O	2
D* front stretcher	1" dia.		17½"	O	1
E* rear stretcher	1" dia.		15⅞"	O	1
F seat slats	½"	1½"	15⅞"	O	7
G front seat slat	½"	2½"	15⅞"	O	1
H top back slat	½"	2¾"	17½"	O	1
I back slats	½"	1½"	17½"	O	5

*Cut part to final size during construction. Please read all instructions before cutting.

Material Key: O–white oak.

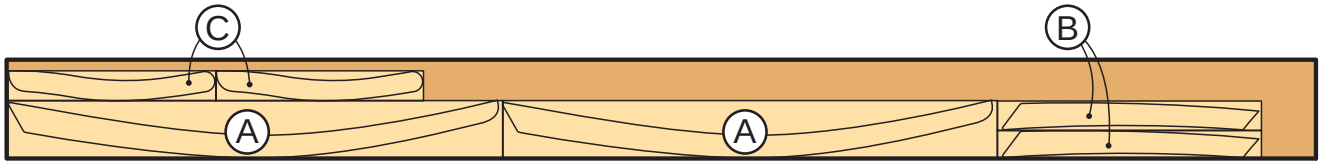
Supplies: walnut for wedges; 4–¼-20×1¼"-long brass roundhead machine screws; 8–¼" flat brass washers; 4–³⁄₁₆" flat brass washers; 4–⅛×¾"-long brass pipe nipples; 4–¼-20 brass threaded inserts; 28–#8×1¼ flathead brass wood screws; 4–#10×¾" roundhead brass wood screws; 2–¹⁄₁₆×¾×5¹³⁄₁₆" brass straps; finish.

CUTTING DIAGRAM



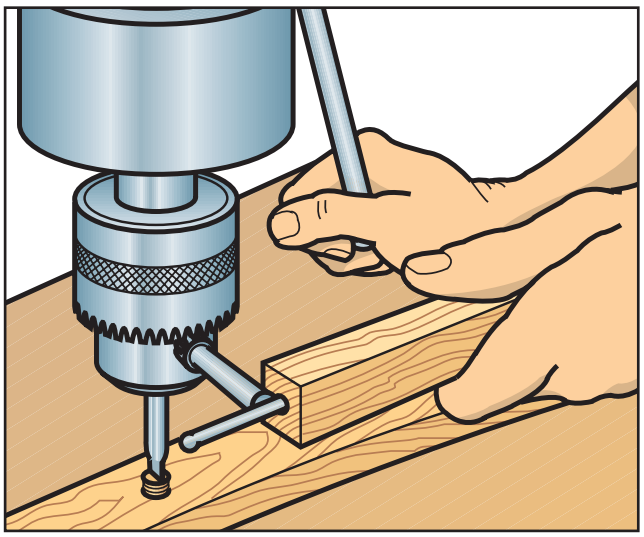
Also needed: 1 x 36" White Oak dowel

1/2 x 7 1/4 x 72" White Oak



3/4 x 7 1/4 x 96" White Oak

TIP **No. 1—A couple of ideas to ease installation of threaded inserts:** First, to get additional leverage on the chuck, drill a hole in the end of a ¾×¾" scrapwood stick to fit the chuck key handle as shown at right. Second, lubricate the threads with soft wax. A wax toilet bowl sealing ring is inexpensive and works great.



Make patterns, then cut the parts

1 Make and assemble photocopies of the full-sized patterns of the front leg (A), the rear leg (B), and the seat support (C). Adhere the patterns with spray adhesive to ⅛"-thick hardboard.

2 Cut just to the waste side of the pattern lines with a bandsaw, and then sand to the line. We used a disk sander for the outside curves, and a drum sander for the inside curves.

3 Use the hardboard patterns to mark two of each part A, B, and C on initially oversized blanks. ***Note:*** *We used white oak for the chair because of its strength and resistance to damage from moisture. Regardless of the stock you use, select straight-grained wood for maximum strength.* Then, cut the pieces to shape, using the same cutting and sanding procedures you used to make the patterns.

4 Use the procedure in the two-step Using the Pattern drawings *below* to drill 1/16" reference holes ¼" deep into each blank at the centerpoint of the holes. ***Note:*** *The pairs of parts are mirror images of each other, not identical.* Then, using the information on the patterns and Exploded View for reference, use your drill press to drill holes to the marked size and depth.

5 Install ¼–20 brass threaded inserts in the front legs where shown on the pattern. We used our drill press to make the installation easier. First, we chucked a ⅜" drill bit into the drill press, and lowered it into the previously drilled hole to center the chuck. Then, we clamped the front leg to the drill-press table. Next, we replaced the drill bit with a large screwdriver bit, and rotated the chuck by hand to drive the threaded insert. See Tip No. 1 for additional suggestions to ease installation of the threaded inserts.

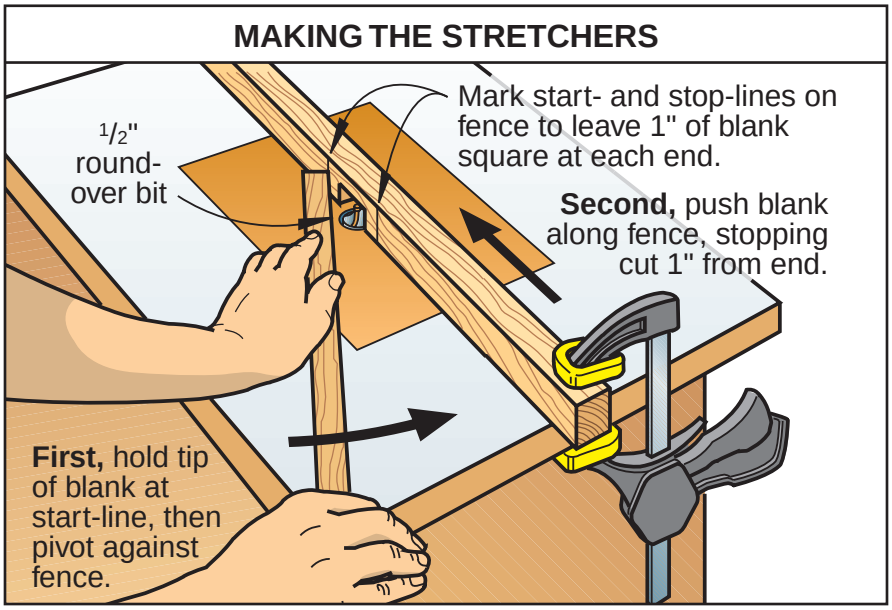
6 Sand all parts to final smoothness, and then set them aside for now.

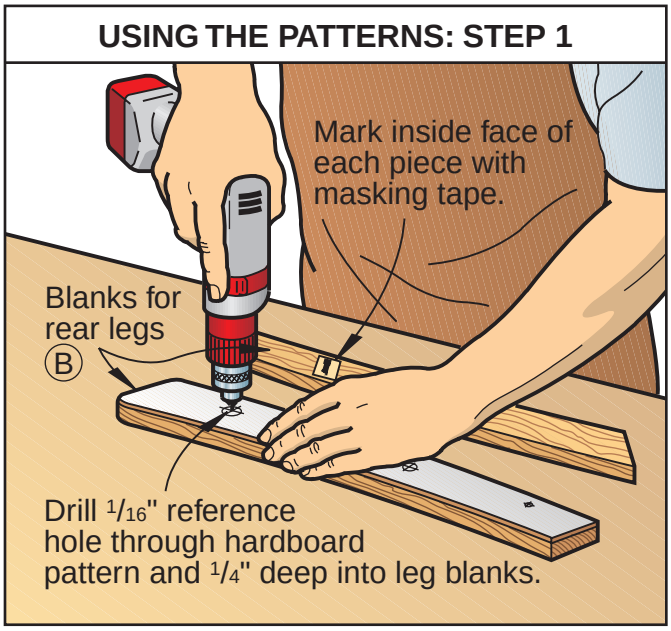
Make the stretchers next

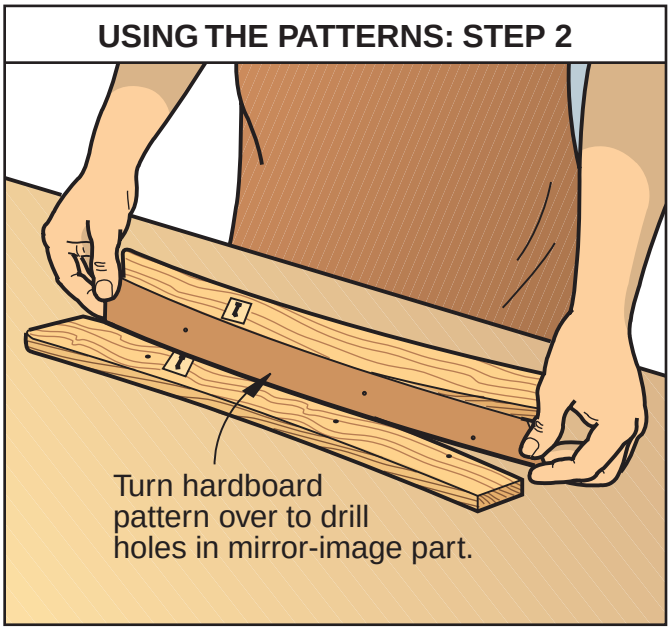
Note: *If you can find 1" dowels to match the lumber you chose for your chair, you can skip the dowel-making process described in steps 1 and 2 on page 5.*

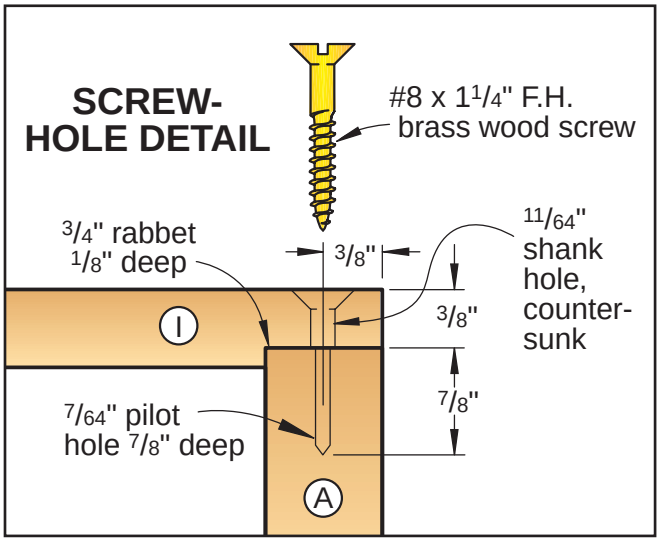
1 Prepare initially overlength blanks for the stretchers from 1×1" stock by crosscutting a 21⅛" piece for part D and a 19½" piece for part E. If you don't have 1"-thick stock, laminate two thickness of ½" stock. ***Note:*** *You may want to make an additional blank to check later machining setups.*

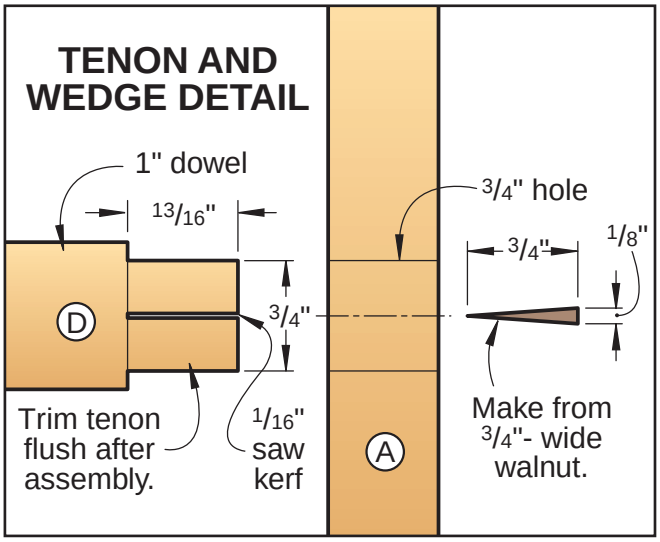
2 Chuck a ½" round-over bit into your table-mounted router, and adjust the fence flush with the bit's bearing. Then, rout the square blank into a dowel by using the procedure in the Making the Stretchers drawing above right. Mark start- and stop-lines on the fence to leave a 1" length of blank square at each end.

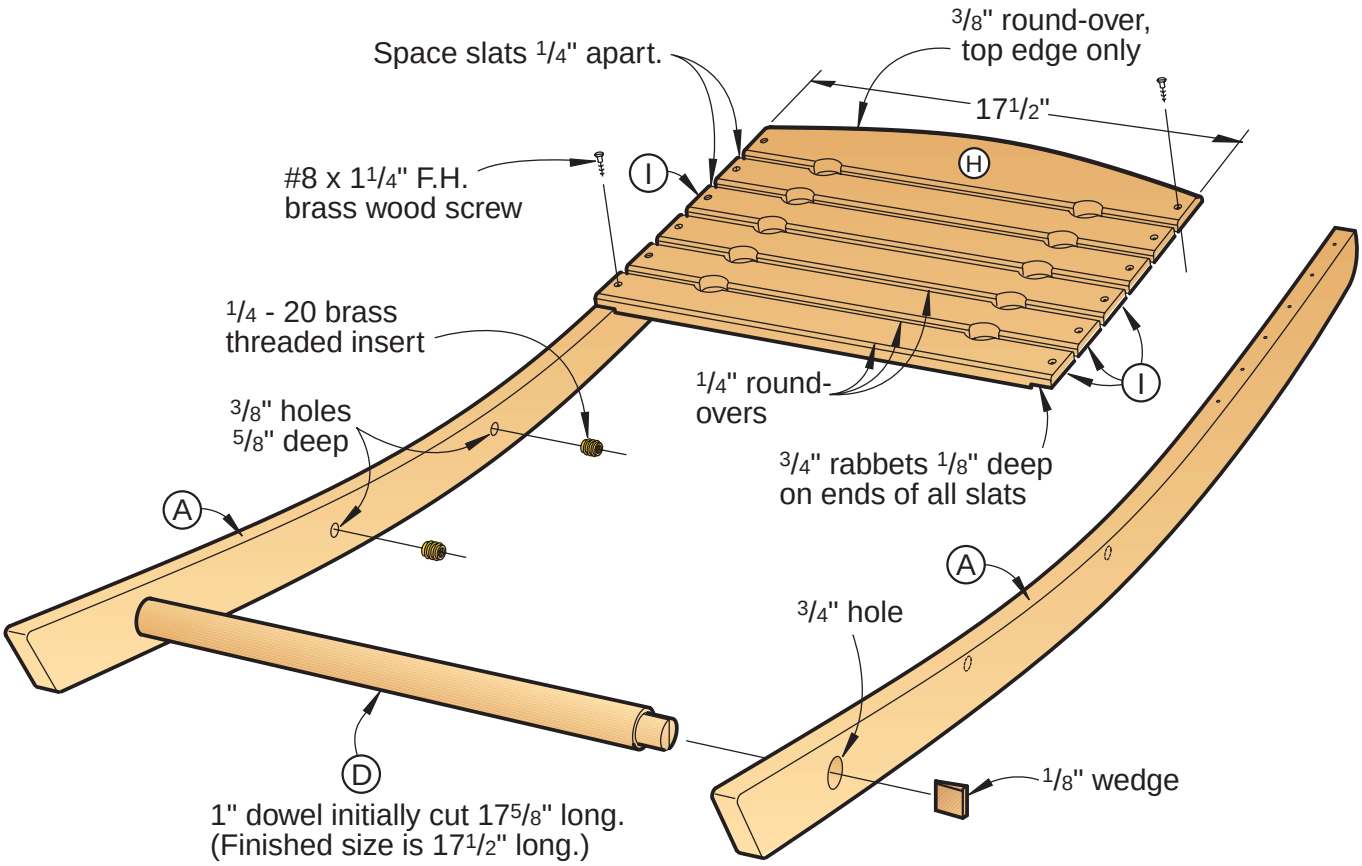






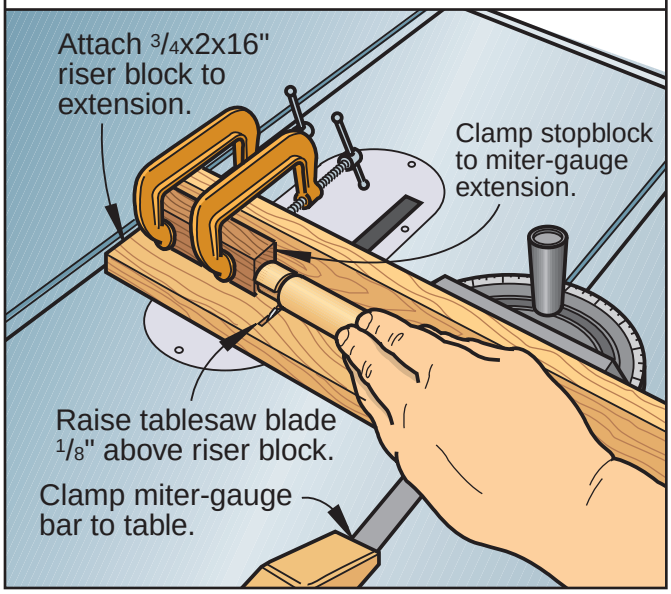




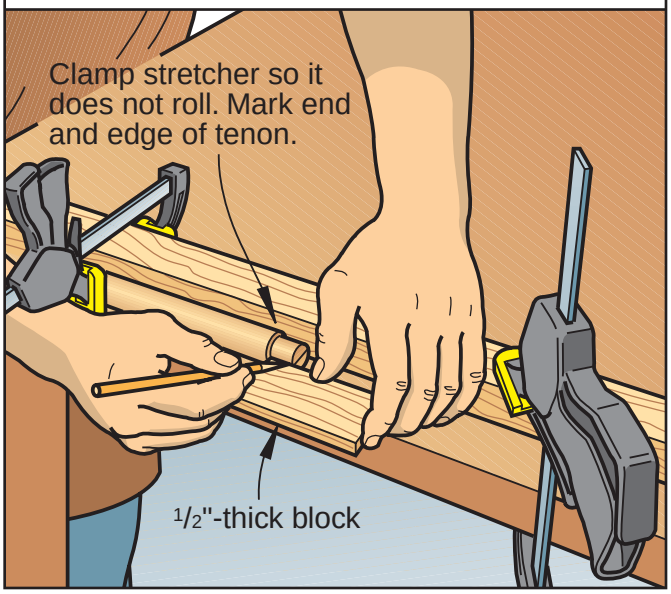


FRONT LEG ASSEMBLY

CUTTING THE TENON



MARKING THE WEDGE KERF



This will keep the blank from rolling as you rout.

3 Sand the stretcher blanks smooth. Then, cut the front stretcher (D) initially overlength to 17⅝" and the rear stretcher (E) initially overlength to 16". ***Note:*** *This additional length allows you to cut each tenon 13/16" long, permitting you to sand 1/16" from each end after assembly. Refer to the Tenon and Wedge detail accompanying the Front Leg Assembly drawing.*

4 Attach an extension to your tablesaw's miter gauge, then attach a ¾×2×16" riser block to the extension as shown in the Cutting the Tenon drawing. Clamp the miter-gauge bar to the tablesaw to secure the assembly. Turn on the saw, and raise the blade through the riser block until it is ⅛" above the riser block. Clamp a stopblock to the miter-gauge extension to cut a tenon 13⁄16" long. To cut a test tenon, push a length of dowel stock along the miter-gauge extension into the running blade until it contacts the stopblock. Rotate the stock clockwise to establish the shoulder of the tenon, then move the stock back and forth to remove the remainder of the tenon's waste. Check the fit of the test tenon in one of the ¾" holes you drilled in part A or B. Adjust the height of the blade until you get a test tenon that fits snugly, then cut the tenons on stretchers D and E.

5 Clamp a stretcher to your workbench as shown in the Marking the Wedge Kerf drawing top right. Then, mark the location of the kerf on the end and one edge of each tenon. ***Note:*** *This procedure ensures that kerfs on both ends of the stretcher will be parallel*. Then, cut the kerfs down to the shoulder of the tenon, using a fine backsaw. Refer to Tip No. 2 at *right* for a suggestion on this procedure. Sand the stretchers to final smoothness.

6 Bandsaw walnut wedges from ¾"-thick stock as dimensioned in the Tenon and Wedge detail accompanying the Front Leg Assembly drawing.

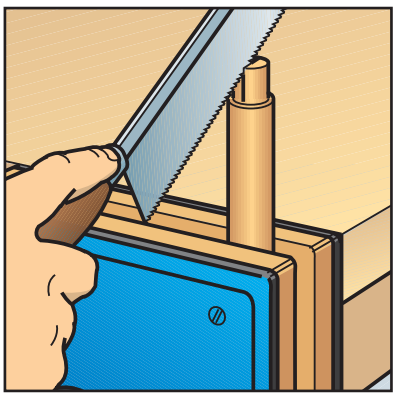
Now, assemble the legs and stretchers

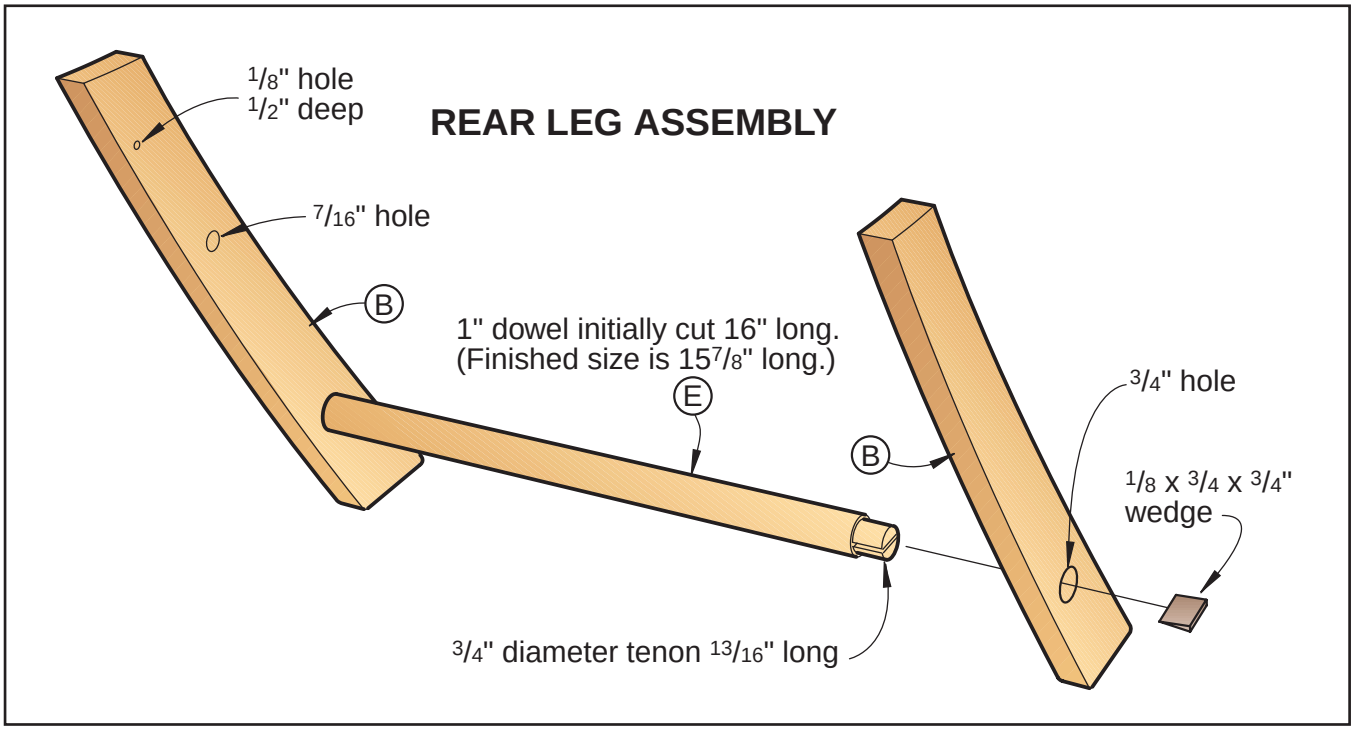
1 Dry-assemble (no glue) the front stretcher (D) between the two front legs (A), and the rear stretcher (E) between the two rear legs (B). Refer to the Rear Leg Assembly drawing. Clamp lightly to seat the shoulders of the tenons flush with the legs, then cut scrapwood spacers equal to the distance between the legs. (Ours measured 16" for the front-leg assembly and 14⅜" for the rear-leg assembly.) ***Note:*** *Double-check the width of the assemblies. For a proper fit, the overall width of the rear-leg assembly should be 1/8" less than the inside width (between the inner faces of the legs) of the front-leg assembly*. Then, take the assemblies apart.

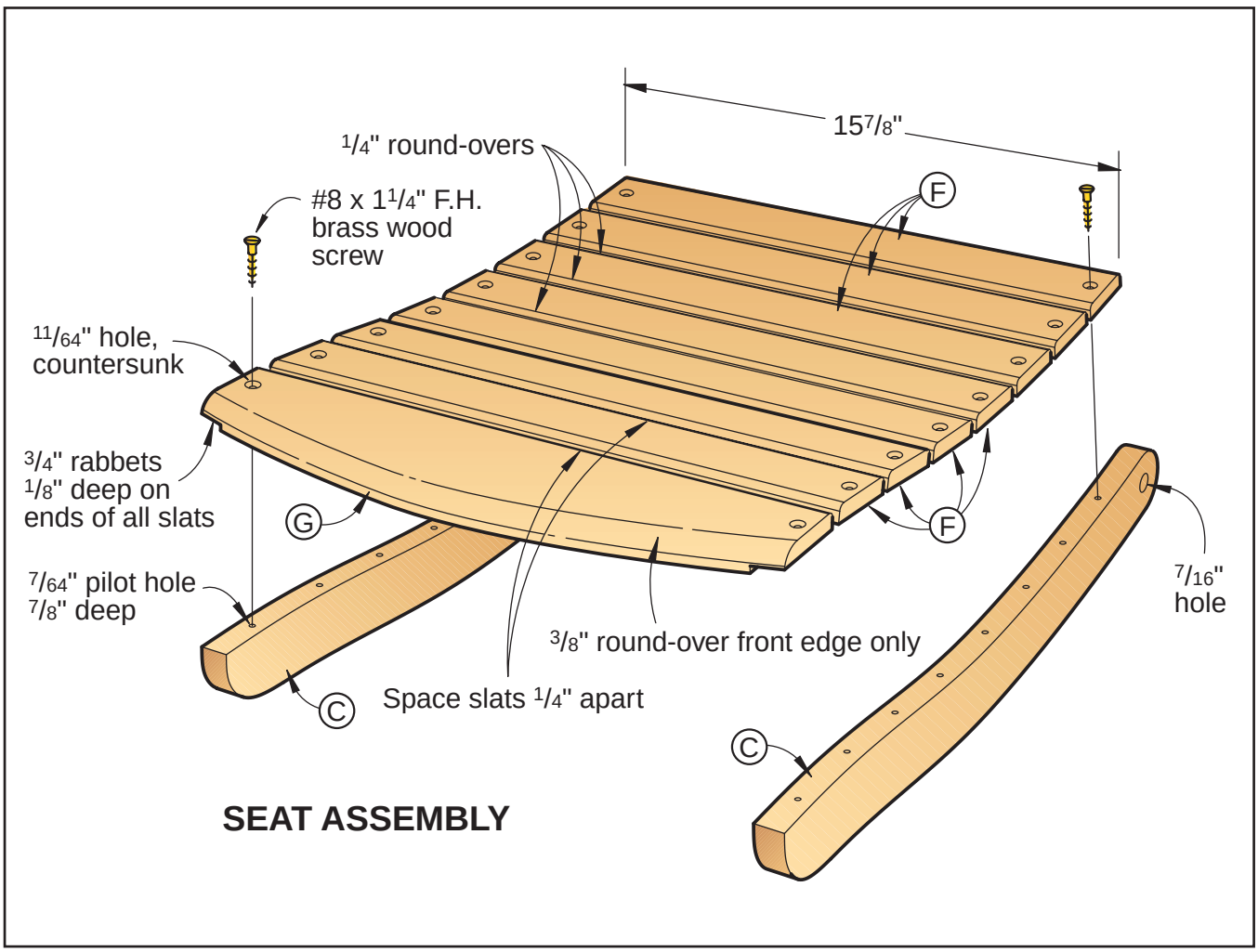
2 Using weatherproof glue (we used Franklin Titebond II), clamp the assemblies back together. Put the curved portion of the legs upward, so four points of the assembly touch a flat surface like your saw table. Clamp the scrapwood spacers between the legs at the end opposite the stretcher to maintain parallel spacing. ***Note:*** *It is critical that these assemblies are flat and square. Avoid excessive clamping pressure that can twist the parts*. Align the kerf in the tenon parallel to the angle of the foot in the legs.

TIP

No. 2—To make a cut that is straight across the end of the tenon and parallel to its length, start your backsaw in a diagonal position as shown below. You'll be able to sight both lines at the same time, keeping your saw right on course.




1/8" hole
1/2" deep
REAR LEG ASSEMBLY
7/16" hole
B
1" dowel initially cut 16" long.
(Finished size is 15 7/8" long.)
E
3/4" hole
B
1/8 x 3/4 x 3/4"
wedge
3/4" diameter tenon 13/16" long


15 7/8"
1/4" round-overs
#8 x 1 1/4" F.H.
brass wood
screw
F
11/64" hole,
countersunk
3/4" rabbets
1/8" deep on
ends of all slats
G
F
7/64" pilot hole
7/8" deep
7/16"
hole
3/8" round-over front edge only
C
Space slats 1/4" apart
C
SEAT ASSEMBLY

This way, the wedges will be level with the floor. Glue the wedges, then tap them into place with a hammer.

3 Unclamp when the assemblies are dry, and then sand the ends of the tenons flush with the legs.

Then, make slats

1 Adjust your tablesaw's rip fence 1½" from the inner edge of the blade, and rip ½"-thick stock for the seat slats (F) and the back slats (I). It is a good idea to rip a few extra pieces to set up later machining operations.

2 Rip ½"-thick stock 3" wide to make initially oversized blanks for the seat slat (G) and the top back slat (H). ***Note:*** *You will shape the arcs on these parts later.*

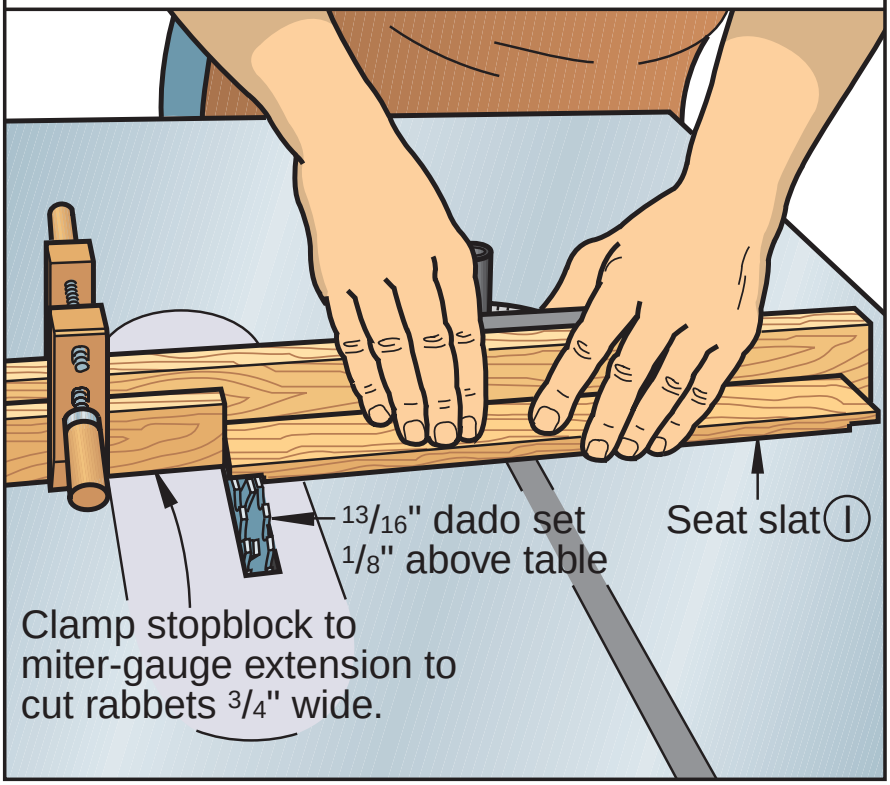
3 Double-check the finished length of the slats against the leg assemblies. Then, crosscut the seat slats (F, G) and the back slats (H, I) to length. We used a stopblock on an extension to our tablesaw's miter gauge to ensure that the parts were uniform lengths.

4 Set up your tablesaw as shown in the Cutting the Slat Rabbets drawing. Then, cut rabbets into the ends of each slat.

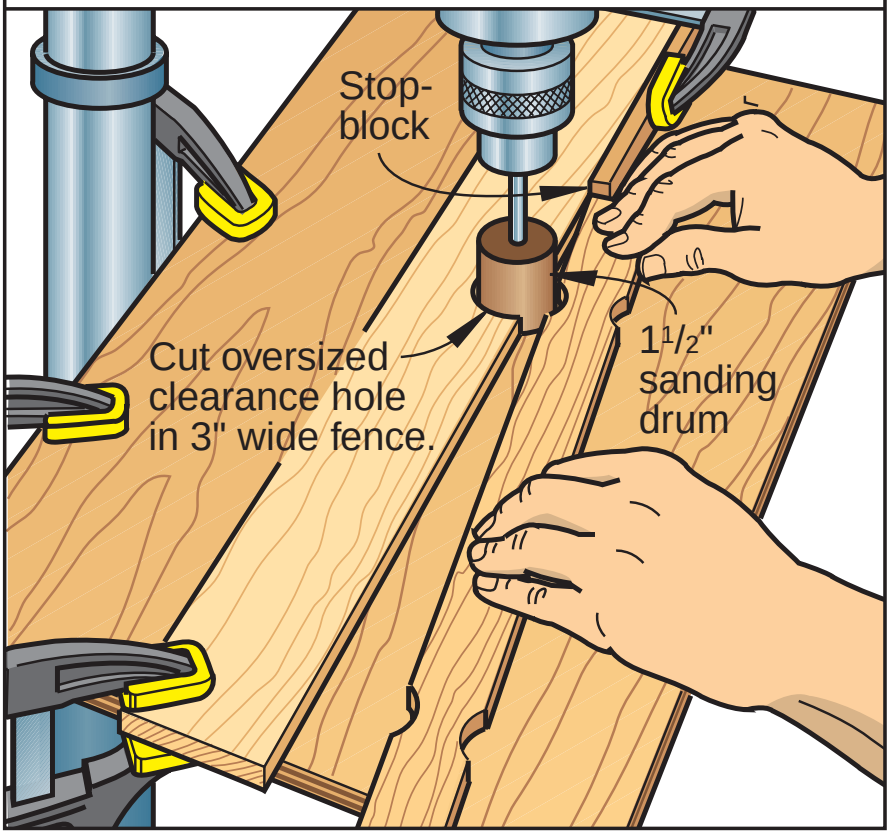
5 Make photocopies of the patterns of the front seat slat (G) and the top back slat (H). Then, attach them to ¼"-thick hardboard. Bandsaw just to the waste side of the arc, then sand to the line. A disk sander makes quick work of smoothing the curves. Mark the centerpoints of the screw locations by drilling a 1/16" reference hole through the pattern and hardboard. Use the patterns to mark ½"-thick stock for parts G and H, then cut these pieces to shape. See Tip No. 3 for a production idea. Using the holes in the patterns as guides, drill reference holes ¼" deep into the slats.

6 Bandsaw just to the waste side of the cutouts where shown on the pattern of part H. Then, chuck a 1½" sanding drum into your drill press, and position a 3"-wide fence below the drum, with ¼" of the sanding drum extending beyond the fence. Mark an oversized cutout in the fence to provide clearance for the sanding drum, and bandsaw it to shape. Then, clamp the fence to the drill-press table as shown in the Sanding the Cutouts drawing. Clamp a stopblock to the fence, and slowly pivot the slat into the sanding drum to smooth the cutout.

CUTTING THE SLAT RABBETS



SANDING THE CUTOUTS



Then use either part G or H to mark the cutout locations on the back slats. ***Note:*** *The bottom back slat is notched on one edge only. All other back slats are notched on both edges*. Then, cut and sand the notches.

7 Chuck a ¼" round-over bit into your table-mounted router, and adjust the fence flush with the bit's bearing. Roundover the straight edges, but not the ends, of parts F, G, H, and I.

8 Chuck a ⅜" round-over bit into your table-mounted router, and adjust the fence flush with the bit's bearing. Adhere the hardboard patterns to parts G and H with double-faced tape. Then, round over the curved edge of these parts.

9 Set up a fence and stopblock on your drill-press table to drill countersunk 11/64" holes in the slats where marked on the patterns of parts G and H, and ⅜" from each end of parts F and I, centered in the width of each slat where dimensioned in the Screw-Hole detail accompanying the Front Leg Assembly drawing. Sand all slats to final smoothness.

Next, attach the slats

1 Put the front seat slat (G) in position between the seat supports (C) where shown on the Seat Assembly drawing. To keep the assembly square, clamp seat slats to the seat supports. It is extremely important that all chair assemblies are square and flat. Using the holes in the slats as guides, drill pilot holes ⅞" deep into the seat supports. Then drive the screws. To prevent damage to the relatively soft brass screw, we first drove a steel screw into the pilot hole, withdrew it, then drove the brass screw. Again, you can use soft wax on the screw for lubrication. Apply weatherproof glue sparingly to the rabbets to avoid excessive squeeze-out.

2 Insert a ¼"-thick spacer between the front seat slat and the first seat slat (F). Repeat the process you used to assemble the front slat on all of the seat slats. Continue to check the assembly for square as you work on it.

3 Glue and screw the top back slat (H) and back slats (I) to the front-leg assembly. Sand the ends of the slats flush with the seat supports and front legs.

The brass parts are easy to shape

1 Make one photocopy of the brass strap pattern for each strap you will make (two per chair). To make the brass easier to handle, we attached it with double-faced tape to scrap pieces of ¼"-thick plywood. Cut the blank to shape, using a bandsaw with a medium to fine blade, or a scrollsaw. Use a disk sander to smooth the ends of the blanks.

2 Indent the centerpoints of the holes with a centerpunch or a scratch awl. Chuck a 3/16" bit into your drill press, adjust your drill-press fence, and drill the holes. You can stack the blanks with double-faced tape and drill through two at a time to ensure uniform spacing. See Tip No. 4 for a suggestion on preventing tarnish.

3 Cut ⅛" (nominal size) brass pipe nipple to ¾" lengths using your scrollsaw, or hacksaw. We started with 2"-long nipples. File the ends square after cutting.

You're ready for finish and assembly

1 Test-assemble the chair by attaching the seat assembly to the front-leg assembly with the bushings, washers, and screws. Then, attach the rear-leg assembly to the front-leg assembly. Attach the brass straps using washers and screws. Check the fit of all assemblies.

2 Disassemble the chair, and then epoxy the brass pipe-nipple bushings into place. Do any finish-sanding required.

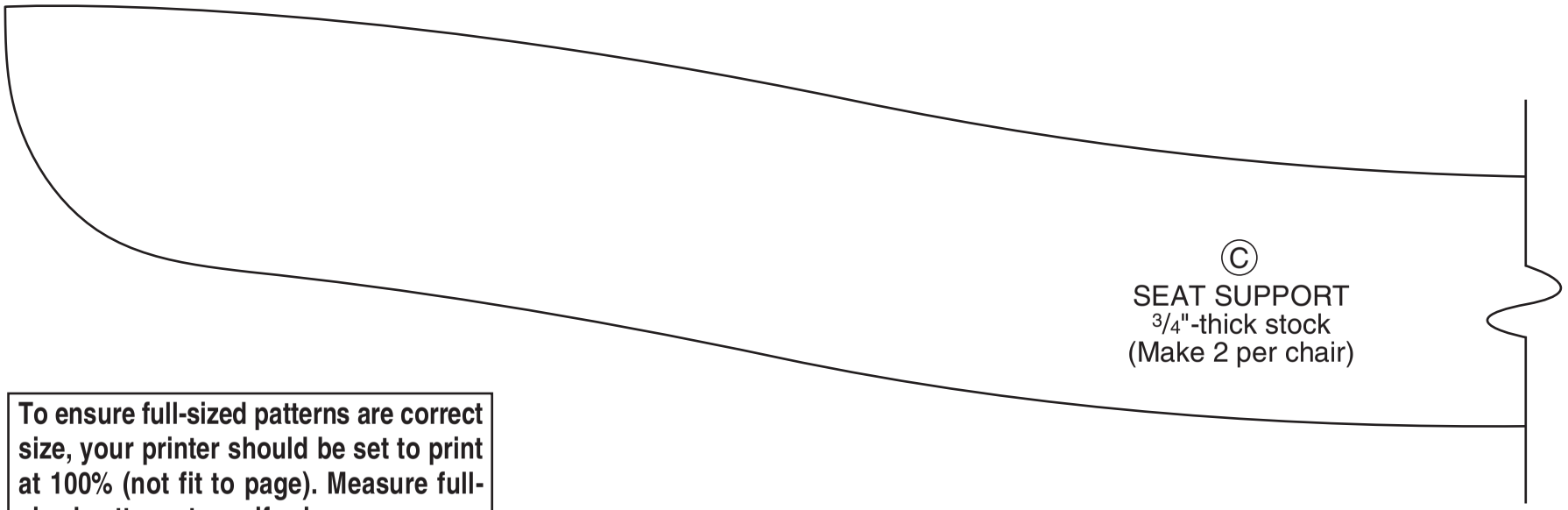
3 Apply a clear finish to all of the assemblies. We used four coats of Minwax Fast-Drying Clear Satin Polyurethane, which is suitable for interior or exterior use. We sanded between coats with 320-grit paper, then wiped with a tack cloth to remove the sanding dust.

4 Reassemble the chair, this time using a thread-locking compound on the machine screw/threaded insert connection We used Loctite 242 Threadlocker, available at auto-parts stores.

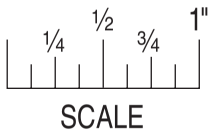
Produced by Marlen Kemmet
Project Design: James R. Downing
Illustrations: Kim Downing, Carson Ode
Graphic Design: Jamie Downing

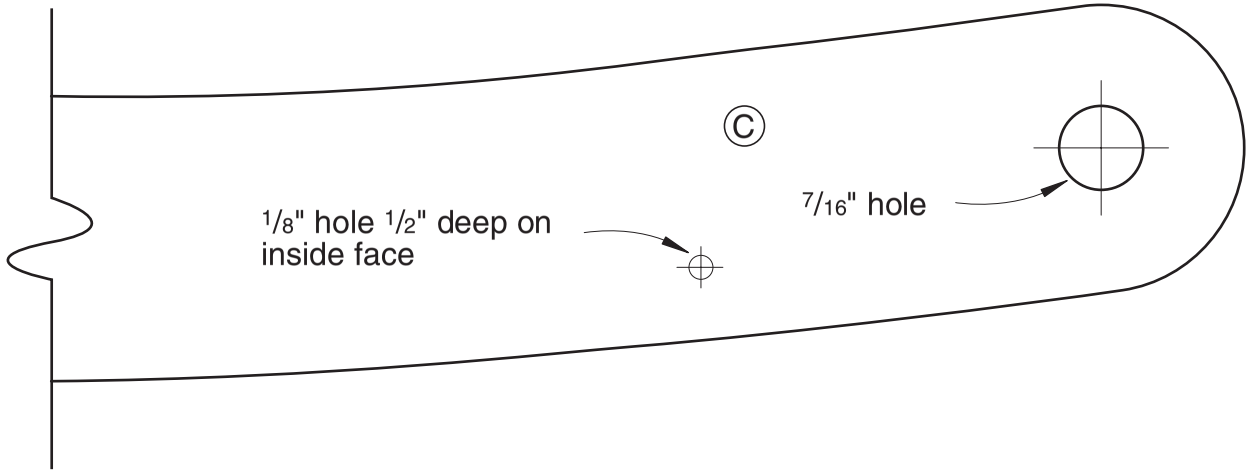
TIP **No. 3—Stack-cut matching parts with your bandsaw** if you are making a set of chairs. Adhere the blanks with double-faced tape, and do your edge-sanding before separating the parts.

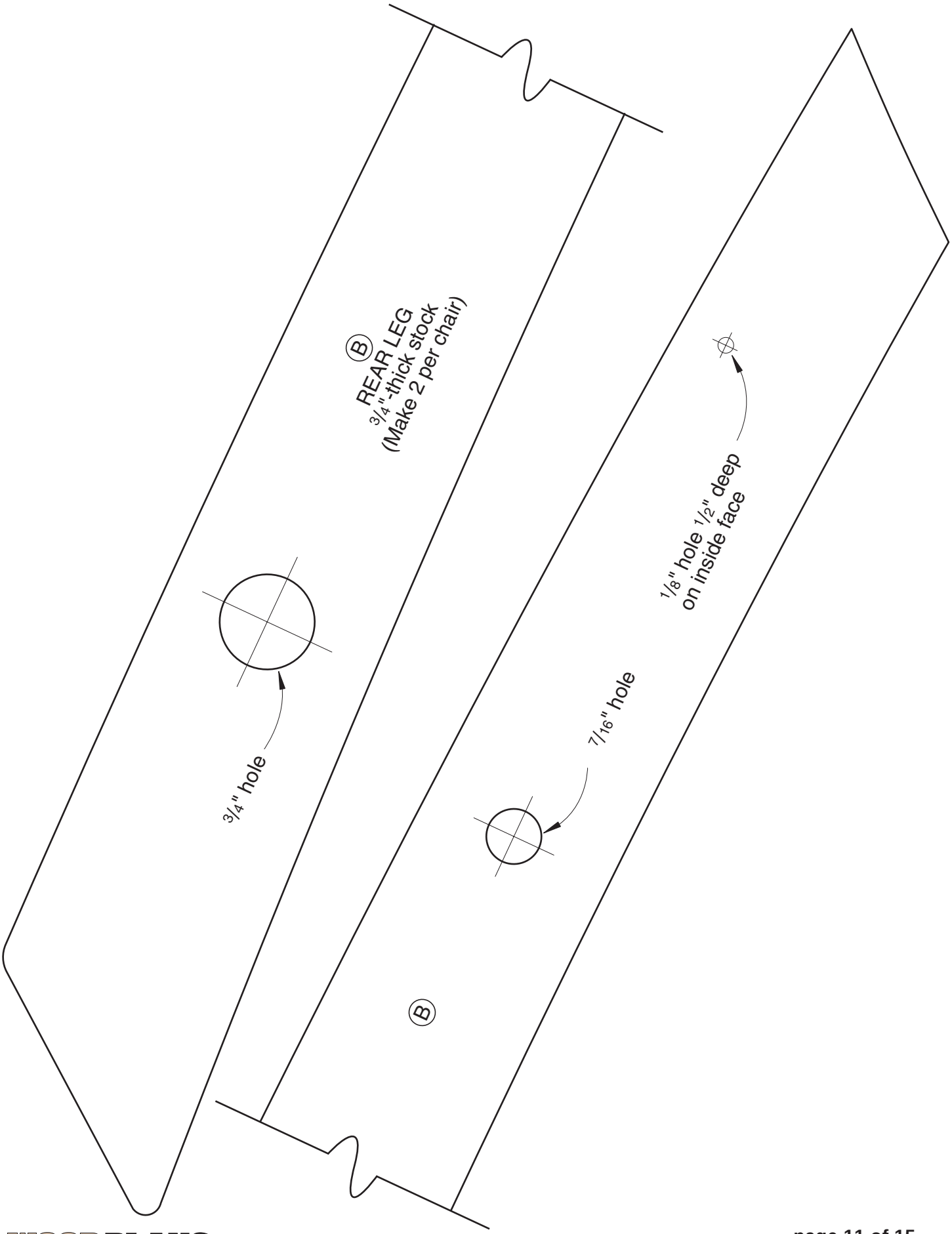
TIP **No. 4—Use commercial brass polish on the straps, then spray them with lacquer to prevent tarnish.** Handle polished brass with gloves or a cloth before you spray it. You can brighten brass screw heads and washers before assembly with the same treatment.

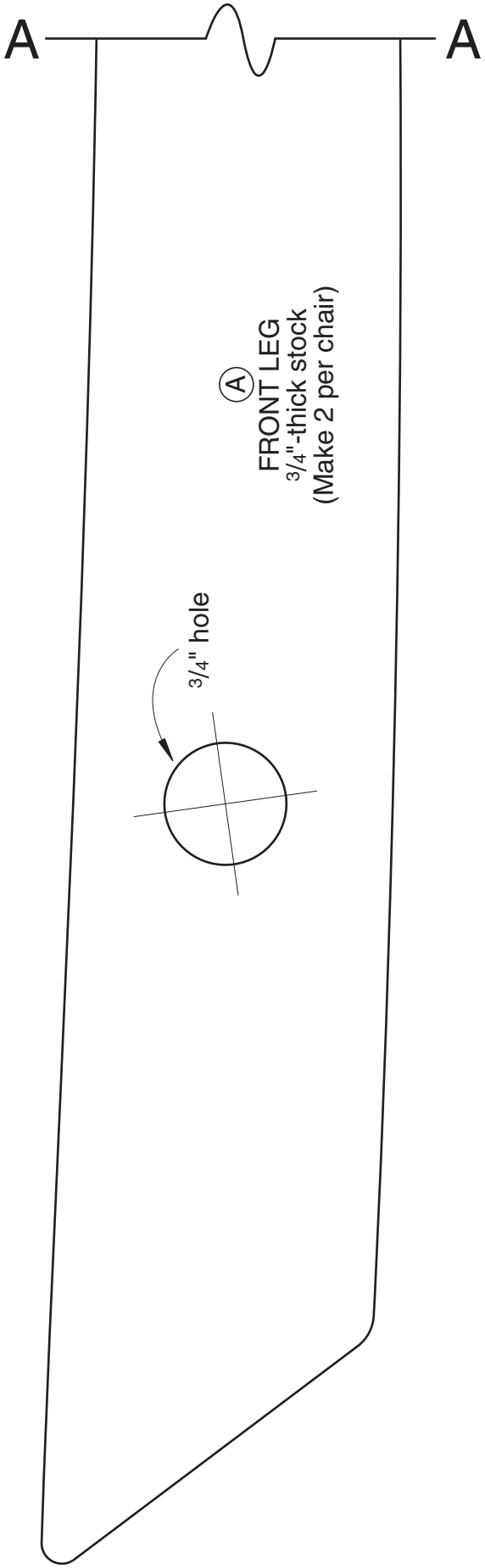


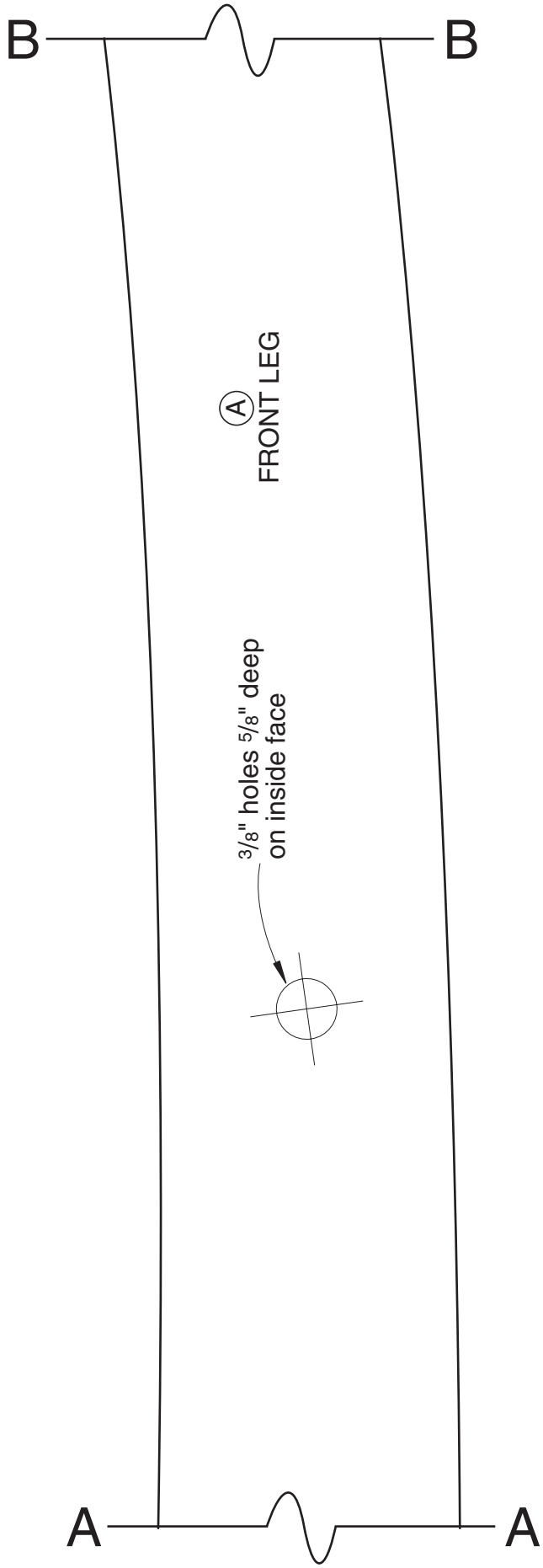
To ensure full-sized patterns are correct size, your printer should be set to print at 100% (not fit to page). Measure full-sized patterns to verify size.

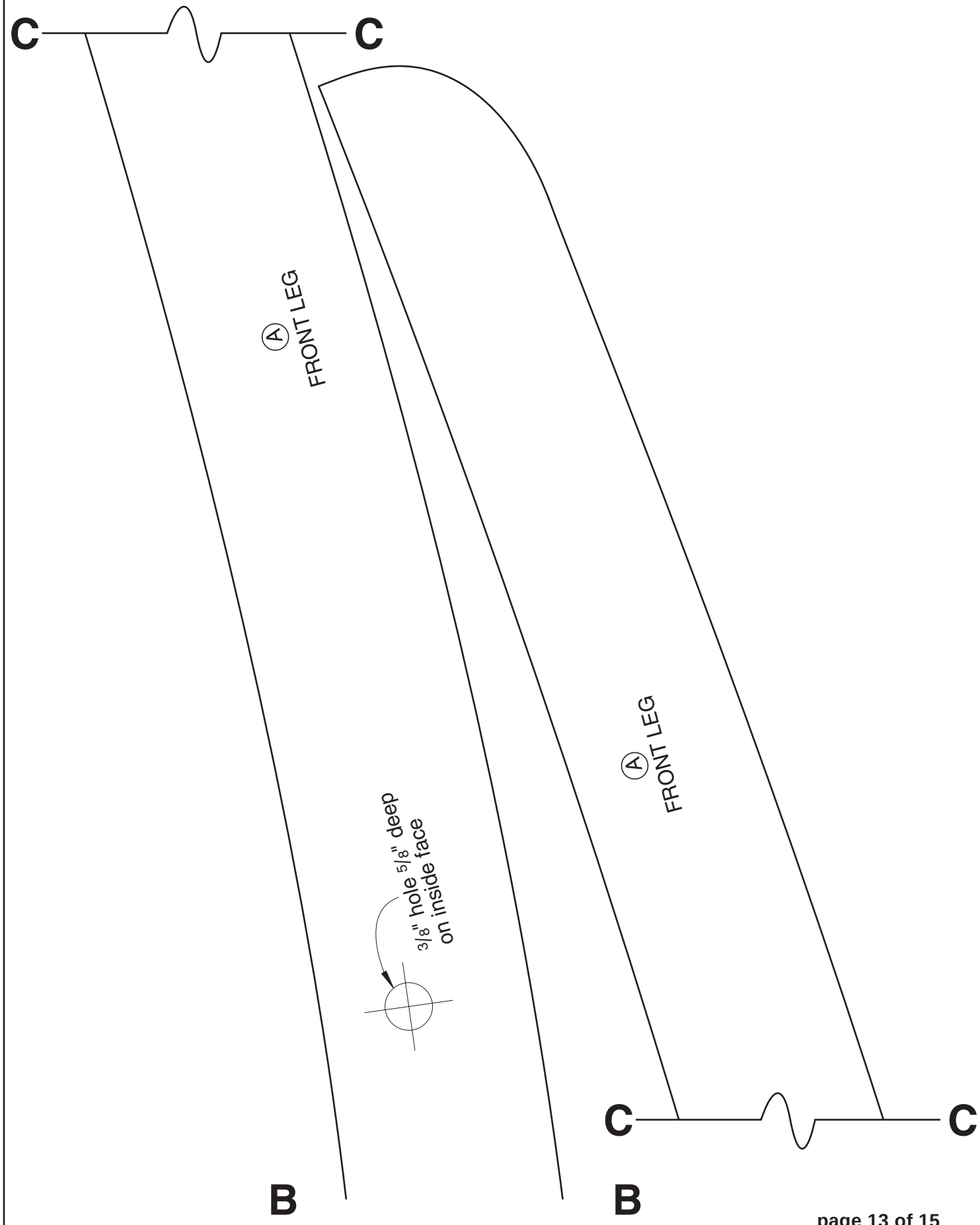


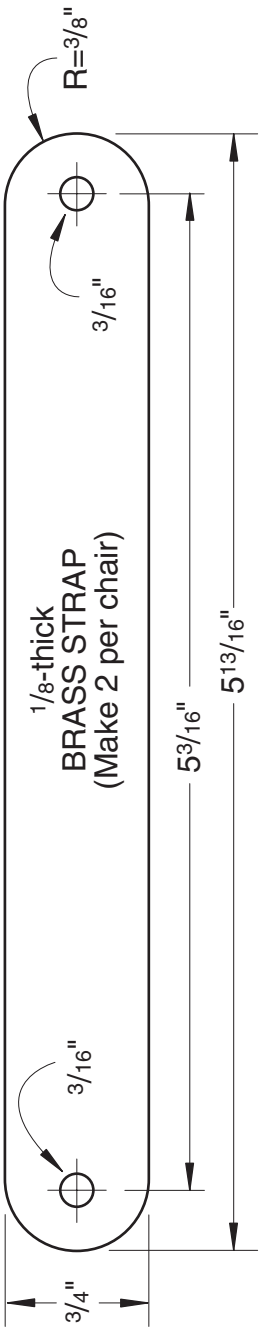


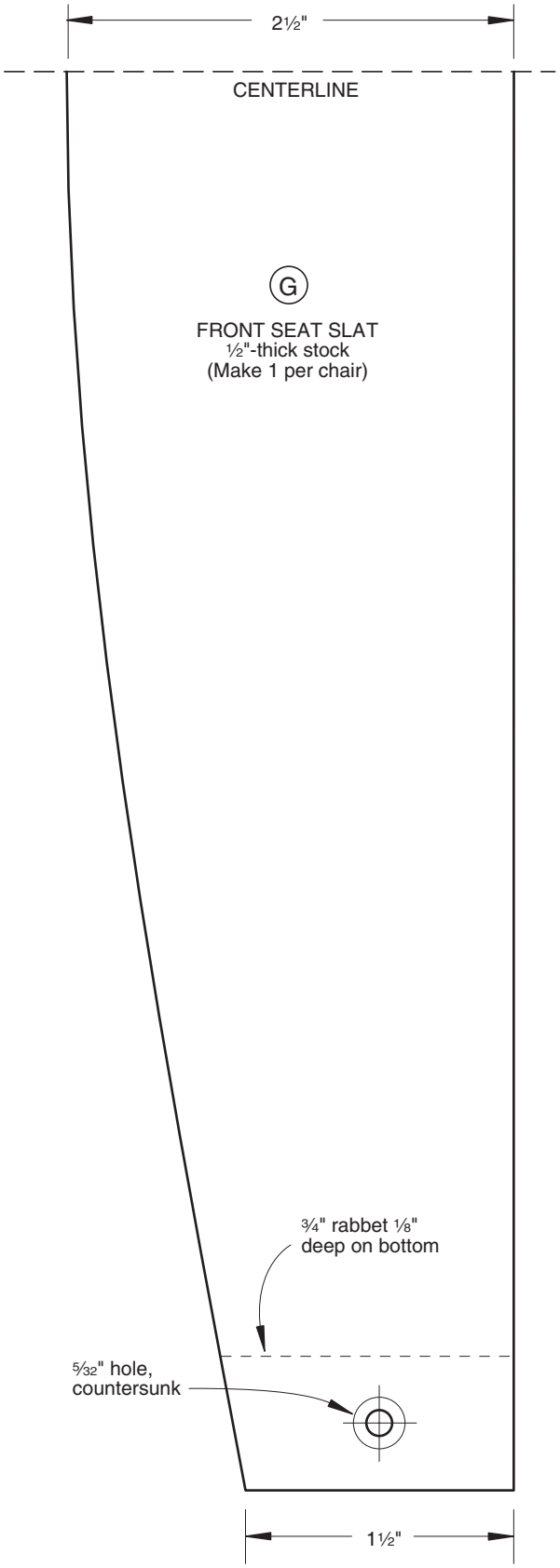

Ⓑ
REAR LEG
3/4"-thick stock
(Make 2 per chair)
3/4" hole
7/16" hole
1/8" hole 1/2" deep
on inside face
Ⓑ

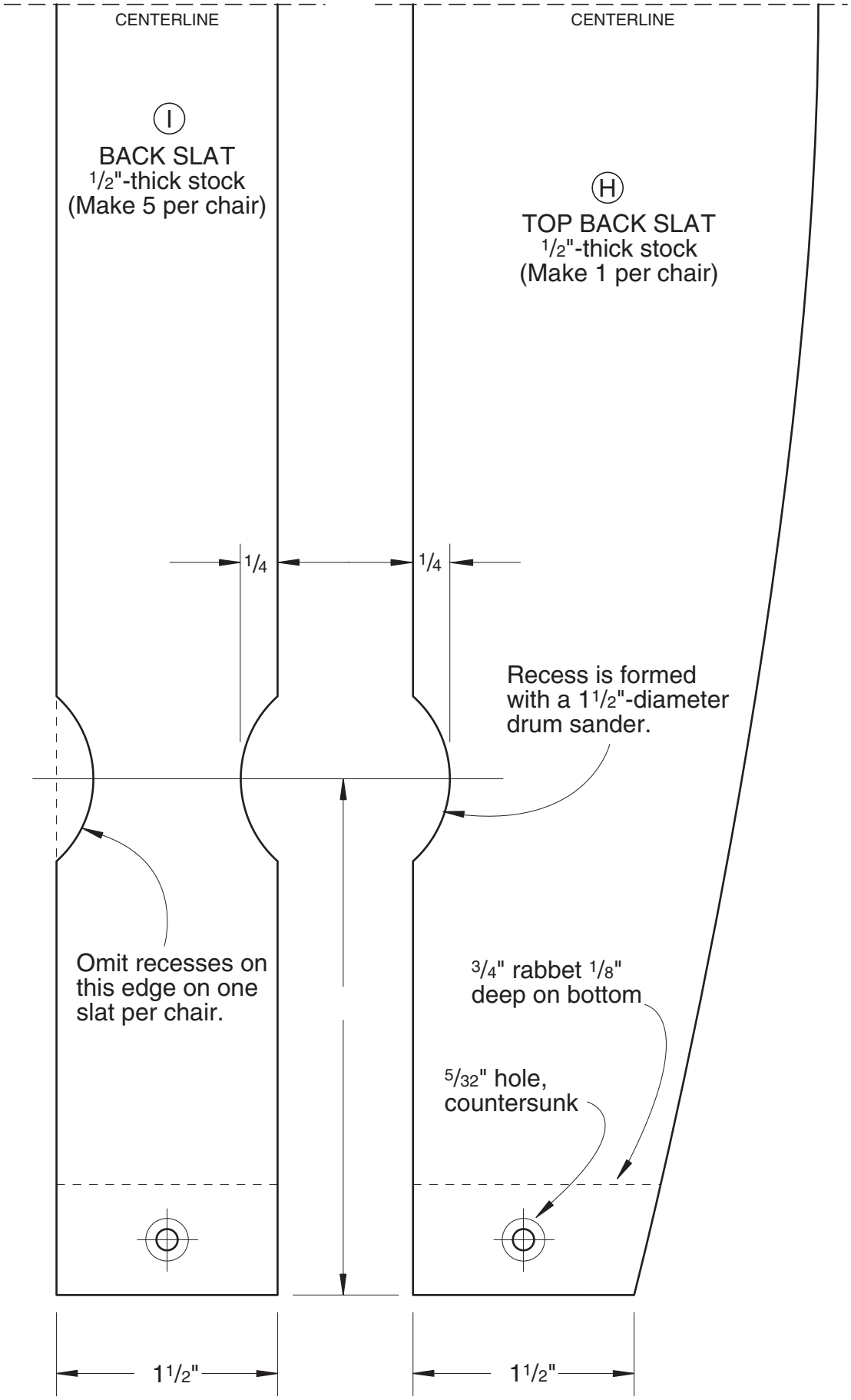

A
A
Ⓐ
FRONT LEG
3/4"-thick stock
(Make 2 per chair)
3/4" hole


B
B
Ⓐ
FRONT LEG
3/8" holes 5/8" deep
on inside face
A
A


C
C
A
FRONT LEG
3/8" hole 5/8" deep
on inside face
A
FRONT LEG
C
C
B
B


R=3/8"
3/16"
1/8-thick
BRASS STRAP
(Make 2 per chair)
5 3/16"
5 13/16"
3/16"
3/4"


2½"
CENTERLINE
G
FRONT SEAT SLAT
½"-thick stock
(Make 1 per chair)
¾" rabbet ⅛"
deep on bottom
5/32" hole,
countersunk
1½"


CENTERLINE
CENTERLINE
(I)
BACK SLAT
1/2"-thick stock
(Make 5 per chair)
(H)
TOP BACK SLAT
1/2"-thick stock
(Make 1 per chair)
1/4
1/4
Recess is formed with a 1 1/2"-diameter drum sander.
Omit recesses on this edge on one slat per chair.
3/4" rabbet 1/8" deep on bottom
5/32" hole, countersunk
1 1/2"
1 1/2"