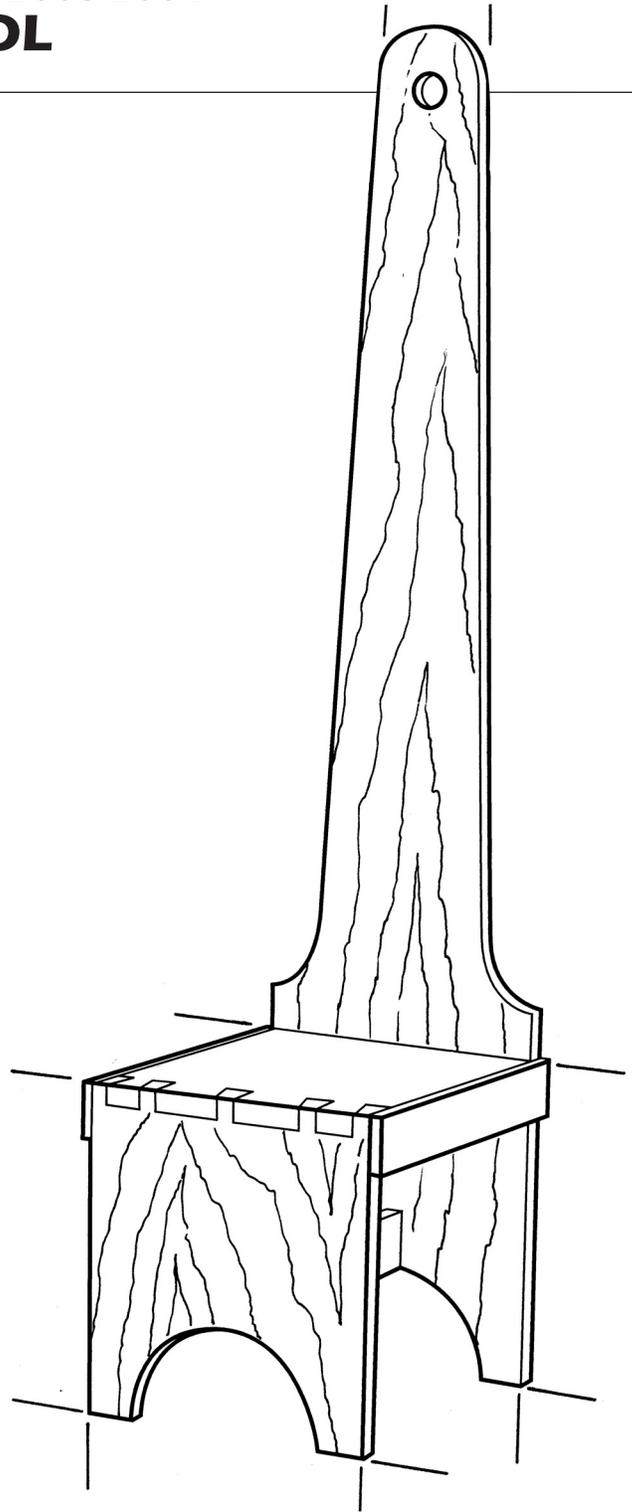


**WOODWORKS: ADVANCED PROJECT 2003-2004**  
**DOVETAILED STEP STOOL**



Here's a project that's sure to advance your skills while producing a practical, good-looking piece of furniture. The stool's extra strength comes from three different kinds of dovetail joints, which make the strongest connection between wide boards like the ones used in this project. When the joints fit tight, the mechanical interlocking alone is enough to make them rigid.

This project gives advanced students experience in using a router and jigs to make three different kinds of dovetail joints: tapered and straight-sliding dovetails and a through dovetail. The shape and details of some of the stool parts will also give you practice in making and using templates for precision, repeatable cuts. And after you build the piece, you'll learn how to apply and use finishes to protect the wood and keep it looking beautiful.

## TOOLS REQUIRED

### Hand Tools

- Dovetail jig
- Hand plane
- Half-round file
- Hammer
- Framing square
- Clamps

### Power Tools

- Table saw
- Jigsaw or bandsaw
- Router
- 1/2" flush-cutting bit
- 1/4" shank dovetail bit
- Router table
- Sander
- Drill

### Miscellaneous

- Pencil
- Safety glasses
- Carpenter's glue
- Sandpaper
- Masking tape
- Clean, lint-free cloths
- Respirator
- Gloves for finishing
- Mineral spirits
- Water-filled metal container with tight-fitting lid

- Minwax® Wood Finish Stain Brush, Minwax® Polyurethane Brush or other good quality, natural bristle brush (for oil-based stains and finishes)
- Minwax® Polycrylic® Brush or other good quality, synthetic bristle brush (for water-based stains and finishes)

## SHOPPING LIST

The recommended wood for the project is oak; cherry or maple are nice alternatives. You'll need a 1"-thick board at least 64" long and 10" wide to make the back, front and seat, in addition to smaller pieces for the stretcher and rails (see the CUTTING LIST). If using the template, you'll also need some 1/4" tempered hardboard and 1/4" and 1/2" plywood to make the back template and the router jigs.

Item	Material	Quantity
<b>Stool</b>	oak, cherry or maple	
Front, back, seat		1 pc. 1" x 10" x 64"
Stretcher and rails		1 pc. 1" x 2" x 12"
<b>Back template</b>		
Template	1/4" tempered hardboard	1 pc. 10" x 43"
Plywood base	1/2" plywood	1 pc. 10" x 43"
Spacer	1/8" hardboard	1 pc. 10" x 43"
<b>Tapering Socket Jig</b>		
Guide boards	1/4" plywood	2 pcs. approx. 8" x 11-1/2" (see step 11)
Reference rails	1 x 2 scrap	2 pcs., 21" long
<b>Straight-Socket Jig</b>		
Guide boards	1/4" plywood	2 pcs. approx. 8" x 12"
Front rail	1/4" plywood	1 pc. approx. 2" x 22"
Back rail	1 x 2 scrap	1 pc. approx. 22" (see fig. H)

## STOOL CUTTING LIST

42-1/4" H 9-1/2" W 11-1/2" D					
Key	Pcs.	Part	Thickness	Width	Length
A	1	Back	3/4"	9-1/2"	42-1/4"
B	1	Seat	3/4"	9-1/2"	11"
C	1	Front	3/4"	9-1/2"	10"
D	1	Stretcher	3/4"	1-3/4"	10-1/2" (approx.)
E	2	Rails	5/16"	1-3/4"	11-1/2" (approx.)

## WOOD FINISHING PRODUCTS

### Recommended Finish

- Prep: Minwax® Pre-Stain Wood Conditioner (if using soft or porous wood)
- Stain: Minwax® Wood Finish™ Sedona Red (or your choice of 20 Minwax® Wood Finish™ Stain colors)
- Finish: Minwax® Fast-Drying Polyurethane Satin

### Alternate Finish

- Prep: Minwax® Water-Based Pre-Stain Wood Conditioner
- Stain: Minwax® Water-Based Wood Stain Green Tea (or a Minwax® Water-Based Wood Stain of your choice, available in 6 wood tones and 60 custom colors)
- Finish: Minwax® Polycrylic® Protective Finish Satin

## BEFORE YOU BEGIN

Good craftsmanship begins and ends with good work habits, so make the following steps part of your routine workshop practice. If you have any doubts or questions about how to proceed with a project, always discuss them with your shop instructor.

- Carefully and fully review plans and instructions before putting a tool to the project lumber.
- Work sensibly and safely. Wear safety goggles when doing work that creates flying chips and sawdust; wear the appropriate respirator whenever making sawdust or working with thinners or other solvents.
- At the end of every work session, clean up your shop area and put away all portable tools.

## CUTTING AND ASSEMBLY PROCEDURE

### Preparing the Wood

1. Ideally, the wood for the back, seat and front are made from one board to give the finished piece similar grain. Flat wood is essential for successful dovetailing. Boards that are cupped across the grain will be nothing but trouble. Start by milling rough lumber to 7/8" thick, taking an even amount off both sides. Set aside some extra wood for setting up dovetailing operations. Store the board on sticks so that air can circulate all around.

2. After a few days, see if the board is still flat. If the faces show a curve, run them through the jointer again and then use the planer to take the wood down to the final thickness of 3/4". Make sure all your wood is exactly the same thickness. Refer to the project illustration (Fig. A) shown on page 7.

### Making the Back Template

**Woodworker's Tip:** *Making a template for the back is worth the effort. You could lay out the pattern directly onto the wood, but smoothing and sanding it will take more time than preparing a thin template. Also, having a template will allow you to make multiple projects.*

3. Using a jigsaw or bandsaw, cut a piece of 1/4" tempered hardboard the same width as the back and crosscut the bottom so it's square to the sides. Draw a centerline from top to bottom. Draw both arches and the two circles that form the curved sides of the back. Mark points A and B as shown in Fig. B, and then connect them to form the tapered sides. Lay out and draw the circles shown to represent the curves at the top, sides and bottom. Cut the sides to shape.

4. Smooth the roughly cut curves with a half-round file. Use a block plane to straighten the sides. Run your hand around the template to feel for any high or low spots. A smooth template will pay off in a back that needs only light sanding.

5. Assemble the template with the materials shown in Fig. C. Cut the top and bottom layers of this three-part sandwich 1/16" smaller than the template in the middle. Screw the layers together to make a permanent sandwich. The template is the middle layer of the sandwich in order to allow your router bit to clear the bench top.

6. Drill holes through the template sandwich in order to screw it to the workpiece. This is done so not to damage the finished piece. Later drill the finger hole and rout the tapered dovetail socket, thereby removing the pilot holes made by the screws.

### Shaping the Back and Front

7. Rip (saw wood along the grain) the solid wood for the back (A), seat (B) and front (C) to the same width. Crosscut the back and the front a bit longer than their final lengths.

8. Align the template with the bottom end of the back and trace around it. Saw out the back, staying at least 1/16" away from the pencil line. Fasten the template sandwich to the face side of the back. Clamp the whole assembly to the workbench.

9. Rout around the back in a counterclockwise direction. You'll have to move the back to avoid bumping into the clamps, but make sure you rout each curve in one continuous pass.

10. Rout the front board's arch in the same manner. You won't be able to screw the sandwich to this piece, so use clamps instead. Finally, drill a 1"-dia. finger hole at the top of the back.

### TAPERED SLIDING DOVETAIL

The seat is joined to the back with a long sliding dovetail. Both the tail and socket are tapered, which makes it easier to fit and glue up than one that isn't. The tail slides easily into the front of the socket. The last inch is the only tough part—you'll have to push hard to get the joint home—but you'll be amazed at the strength of this joint.

Making a tapered dovetail may sound difficult, but it's really quite easy. The secret is to create all the tapers with one shim that's about 1/32" thick. You'll make the tapered socket with the jig shown in Fig. E using guide boards made as described next.

### Table Saw Tapering Technique

11. Taper the guide boards for the socket jig on a table saw (Fig. D). Size them to fit your router base by subtracting the radius of the base from 9-5/8" to get dimension "A." Rip two pieces of 1/4" plywood to this width.

12. Tape a 1/32"-thick shim onto the corner edge of one piece as shown in Fig. D. Put this edge against the saw fence and rip the pieces again. Remove the shim and mark the wide end with an "X" on the lower right corner. Cut the second piece the same way and mark the wide end with a "Y" on the lower left corner.

### Tapering Socket Jig Assembly

13. Make two reference rails to the dimensions specified.

14. Nail the guide board marked "X" to one of the reference rails, as shown in Fig. E. Align the guide board with the end and side of the rail. Use a framing square to check your alignment. Nail the guide board to the second rail.

15. Nail the second guide board to the reference rail, positioning it so as to make an opening that is 1/8" wider than the diameter of your router base. Check the alignment before fastening the board to the second reference rail. When you're sure everything is right, put in screws to make the setup permanent.

**Cut the Tapered Socket**

16. Use a standard 1/4" shank dovetail bit with a 14-degree pitch and 1/2" width to cut the socket. Clamp the jig down and rout the socket 5/16" deep, as shown in Fig. F, running the router along both sides of the tapered opening.

**Cut the Tapered Tail**

17. The dovetail for the seat is cut on a router table. Shim both sides of the seat with a 1/32" shim to make the same taper as the socket (See Fig. G). Adjust the height of the router bit so it's exactly the same as the socket depth. The easiest way to do this is to unplug the router, lay the back board on the router table and raise the bit until it just touches the bottom of the socket.

18. Adjust the router fence by trial and error, using scrap wood to test the cut. Try sliding the test piece into the socket. It should start easily and gradually tighten up. You should be able to pound it home with your fist. Adjust the fence to change the fit. When it's right, rout the back edge of the real seat.

**Cut the Front Board**

19. Slide the seat in place, square it to the back and measure from the bottom of the back to the top of the seat to get the length of the front board. Cut the front board to the exact length.

**NON-TAPERED SLIDING DOVETAILS**

A stretcher just above the arches locks in the front and back, making a rigid structure. This sliding dovetail isn't tapered because a taper isn't necessary across a small dimension.

**Straight-Socket Jig**

20. To cut the stretcher sockets on the inside faces of the back and the front, make a straight-sided jig to fit your router as shown in Fig. H. Cut the guide boards out of 1/4" plywood, the back rail out of scrap and the front rail out of 1/4" plywood.

21. The position of the front rail determines how long the socket will be. Add 4-3/4" to the radius of your router base to locate the front rail. Make the opening between the guide boards 1/8" wider than the router base. After assembling the jig, mark the center of the front rail.

**Rout the Stretcher Sockets**

22. Mark the centerline of the back (A) and then set the straight-socket jig over it. Line up the two centerlines and clamp the jig and the back to the workbench.

23. Set the router in the opening and cut the socket 5/16" deep. When you bump the router into the front rail, you've reached the top of the socket.

24. Repeat steps 22 and 23 to cut the socket into the front (C).

**THROUGH DOVETAIL**

This joint is traditionally cut by hand, starting with careful layout, precise cuts with a dovetail saw and lots of chiseling. Many woodshops, however, are equipped with some kind of dovetail jig that is used with

a router to make precision joints quickly. Since different jigs typically have their own specific setups and procedures, ask your instructor about using the one in your shop. If you're using it for the first time, practice the setup and router work on scrap until you feel you're ready to make the joint on the wood for your stool.

**NOTE:** The way a particular jig must be set up and used may effect the width of parts B and C and the bottom of part A, so study the jig before cutting your lumber.

**Make the Stretcher**

25. Assemble the stool without glue and square the front and back to the seat. Set the uncut stretcher in place and mark the distance between the two dovetail sockets. Cut the stretcher (D) to length.

26. Shape the dovetailed ends of the stretcher on the router table. Test the fence setting with a scrap piece. The stretcher is quite narrow and it's not safe to merely stand it up on end on the router table. Instead, clamp a backer board alongside the stretcher so you have a wider bearing surface.

**FINAL ASSEMBLY**

27. Glue and assemble the front to the seat. Check for square and plane or sand the dovetails flush. It's easier to hold two pieces in your vise now than the whole stool later.

28. Glue and assemble the seat to the back, then turn the stool upside-down and drop in the stretcher. You won't need any clamps. After the glue is dry, plane all the sides flush.

29. Make the two side rails (E); determine their precise length by holding them against the sides and marking cut lines. Cut them to length and glue and clamp them in place. After the glue dries, sand them even with the seat.

**STAINING AND FINISHING**

*Woodworker's Tip: Though you may be tempted to cut short your sanding, preparation and application, don't do it. These tasks are very important steps in obtaining a high-quality finish. Remember, it is the finish, just as much as the fit and smoothness of the parts, that will determine how people judge your craftsmanship. To ensure an excellent result, follow the steps listed below and also the instructions the manufacturers put on their products.*

**FINISHING TIPS**

- Test the stains and finishes you are planning to use on scraps of wood. On the back of the scrap, mark the stain/finish combination and the type of wood. Allow all samples to dry thoroughly before making your final finish selection. Save your samples for quick reference on future projects.
- All stains and finishes must be allowed to dry thoroughly between coats. Remember that drying times can vary due to humidity and other climatic conditions.
- If you have some leftover stain or finish, wipe the can rim so that stain or finish in the rim won't dry out and prevent the lid from forming a tight seal.

- Brushes used for oil-based finishes must be cleaned with mineral spirits; for water-based products, such as Minwax® Water-Based Stains or Minwax® Polycrylic® Protective Finish, clean brushes with warm water and soap.

**30.** Before staining and finishing, finish-sand all surfaces and ease all the edges. Wipe down the piece with a cloth dampened with mineral spirits. If you're building the stool with a softwood, such as pine, or a porous hardwood, like maple, you'll need to prepare it for staining with a coat of Minwax® Pre-Stain Wood Conditioner if you are using an oil-based stain or Minwax® Water-Based Pre-Stain Wood Conditioner if you're using a water-based stain. Applying the conditioner will help to ensure even absorption of stain and prevent blotchiness that can occur with some soft or porous woods. Following the directions on the can, simply brush the conditioner over all the wood and allow it to penetrate for 5 to 15 minutes. Then remove excess conditioner with a clean, dry cloth.

### Recommended Finish

**31.** Apply Minwax® Wood Finish™ using a natural bristle brush or a clean, lint-free cloth following the directions on the can. Allow the stain to set for about 5 to 15 minutes then wipe off any excess. If a second coat is desired, allow the piece to dry 4 to 6 hours before applying the stain. Allow the stain to dry for 24 hours before applying the protective clear finish.

**Woodworker's Tip:** *When wiping off stain, make certain that your last wipe with the cloth goes with the grain of the wood.*

**32.** Apply Minwax® Fast-Drying Polyurethane following the directions on the can. Use a good quality, natural bristle brush intended for use with polyurethane. Allow the first coat to dry overnight.

**33.** The next day, lightly sand all surfaces with 220-grit sandpaper using with-the-grain strokes. Wipe all surfaces with a soft cloth. Apply a second coat of polyurethane and set the piece aside to dry.

**34.** When completely dry repeat step 33, applying the third and final coat of polyurethane. Allow the finish to cure for several days before using the stool.

### Alternate Finish

**35.** Apply Minwax® Pre-Stain Water-Based Wood Conditioner following the directions on the can. After 1 to 5 minutes, wipe off all excess conditioner using a clean, lint-free cloth. Wait 15 to 30 minutes and then use fine-grade sandpaper to sand off any "whiskers" raised by the conditioner. Proceed to the staining within 2 hours.

**Woodworker's Tip:** *Minwax® Water-Based Wood Stain is available in 6 wood tones, a White Wash Pickling Stain and 60 custom-mixed colors. This means that you are not limited to just traditional wood tones (pine, oak, walnut, etc.), so look over the entire range of the Minwax® colors before making your selection.*

**36.** Apply Minwax® Water-Based Wood Stain using either a nylon/polyester brush or a soft cloth. Allow stain to penetrate no longer than 3 minutes. While stain is still wet, wipe off all excess with a clean cloth

that's been lightly dampened with stain. Allow the piece to dry for 2 hours before applying a second coat, if desired. Allow the piece to dry thoroughly before applying the protective clear finish.

**37.** Apply Minwax® Polycrylic® Protective Finish with a nylon/polyester brush following the directions on the can. Stir the can contents thoroughly before starting and periodically repeat the stirring during your work session.

**38.** Working a small area at a time to maintain a wet edge, apply the first coat. Work quickly and make the final strokes in each newly finished section using with-the-grain brushstrokes.

**39.** Allow the finish to dry a minimum of 2 hours. Then sand lightly with 220-grit sandpaper. Thoroughly wipe off all surfaces with a soft cloth.

**40.** Repeat steps 37, 38 and 39 to apply the second coat and third coat, sanding only after the second coat. After the third coat, allow the finish to cure for several days before using the stool.

### PRODUCT SAFETY

For your safety and the safety of those you work with, always read the safety warnings, which manufacturers print on their labels, and follow them to the letter. Typical safety advice and instructions will contain information such as the following:

**WARNING!** Removal of old paint by sanding, scraping or other means may generate dust or fumes that contain lead. Exposure to lead dust or fumes may cause brain damage or other adverse health effects, especially in children or pregnant women. Controlling exposure to lead or other hazardous substances requires the use of proper protective equipment, such as properly fitted respirator (NIOSH approved) and proper containment and cleanup. For more information, call the National Lead Information Center at 1-800-424-LEAD (in US) or contact your local health authority.

### When using oil-based wood finishing products:

**CAUTIONS: CONTAINS ALIPHATIC HYDROCARBONS. Contents are COMBUSTIBLE.** Keep away from heat and open flame. **VAPOR HARMFUL.** Use only with adequate ventilation. To avoid overexposure, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headaches, or dizziness, increase fresh air, or wear respiratory protection (NIOSH approved) or leave the area. Avoid contact with eyes and skin. Wash hands after using. Keep container closed when not in use. Do not transfer contents to other containers for storage.

**FIRST AID:** In case of eye contact, flush thoroughly with large amounts of water for 15 minutes and get medical attention. For skin contact, wash thoroughly with soap and water. In case of respiratory difficulty, provide fresh air and call physician. If swallowed, call Poison Control Center, hospital emergency room, or physician immediately.

**NOTICE:** Reports have associated repeated and prolonged occupational exposure to solvents with permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling contents may be harmful or fatal.

**WARNING:** This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

**DO NOT TAKE INTERNALLY. KEEP OUT OF REACH OF CHILDREN.**

**When using water-based wood finishing products:**

**CAUTIONS:** Use Only With Adequate Ventilation. To avoid overexposure, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headaches, or dizziness, increase fresh air, or wear respiratory protection (NIOSH approved), or leave the area. Avoid contact with eyes and skin. Wash hands after using. Keep container closed when not in use. Do not transfer contents to other containers for storage.

**FIRST AID:** In case of eye contact, flush thoroughly with large amounts of water. Get medical attention if irritation persists. If swallowed, get medical attention immediately.

**WARNING:** Contains Alkyl propanols, ethylene glycol, n-methyl pyrrolidone. **VAPOR HARMFUL.** Use only with adequate ventilation. To avoid overexposure, open windows and doors or use other means to ensure fresh air entry during application and drying. If you experience eye watering, headaches, or dizziness, increase fresh air, or wear respiratory protection (NIOSH approved) or leave the area. Avoid contact with eyes and skin. Wash hands after using. Keep container closed when not in use. Do not transfer contents to other containers for storage.

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**DELAYED EFFECTS FROM LONG-TERM OVEREXPOSURE.**

Contains solvents which can cause permanent brain and nervous system damage. Intentional misuse by deliberately concentrating and inhaling contents may be harmful or fatal.

**WARNING:** This product contains a chemical known to the State of California to cause cancer and birth defects or other reproductive harm.

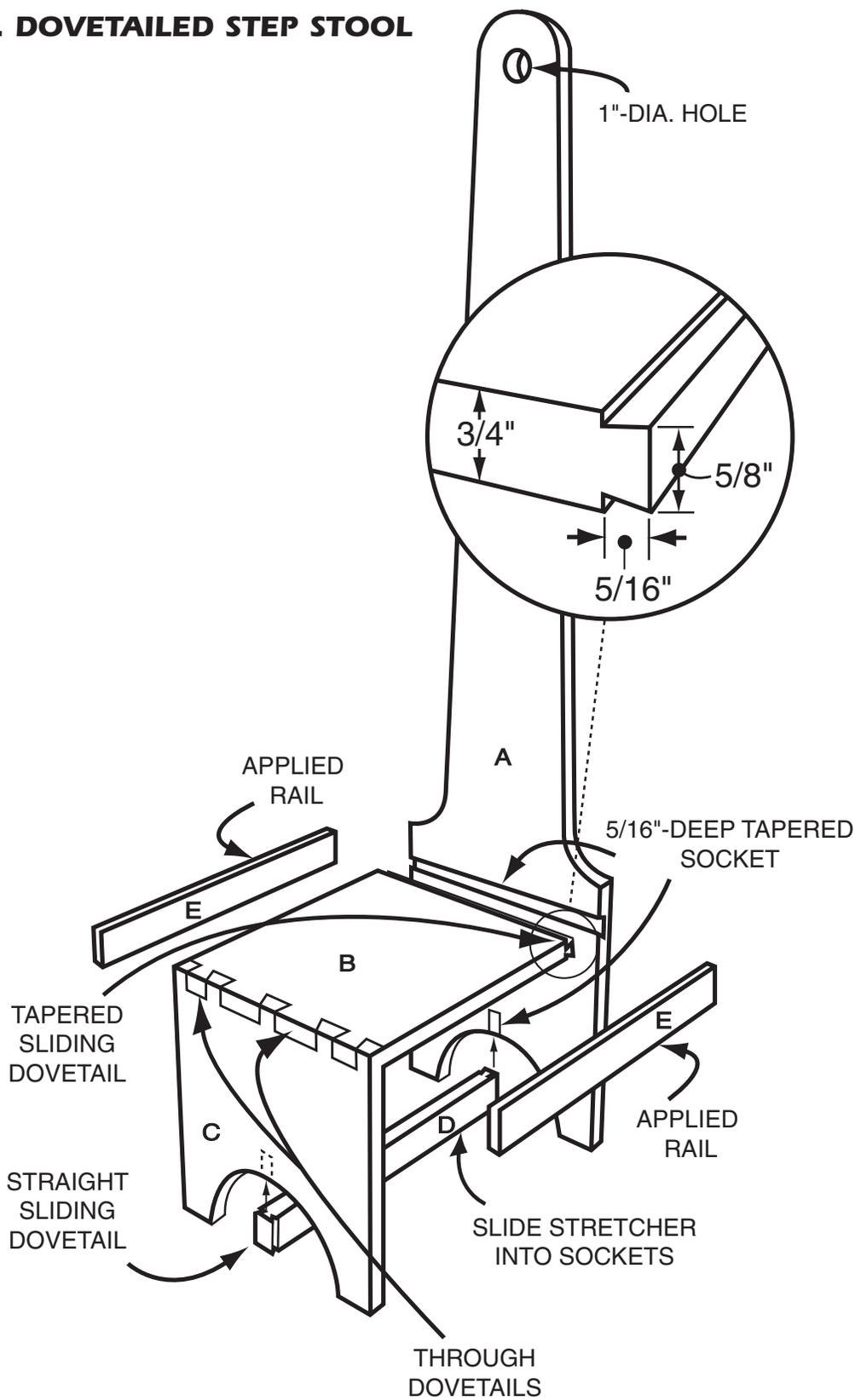
**KEEP OUT OF REACH OF CHILDREN.**

**SAFE DISPOSAL OF RAGS AND WASTE.**

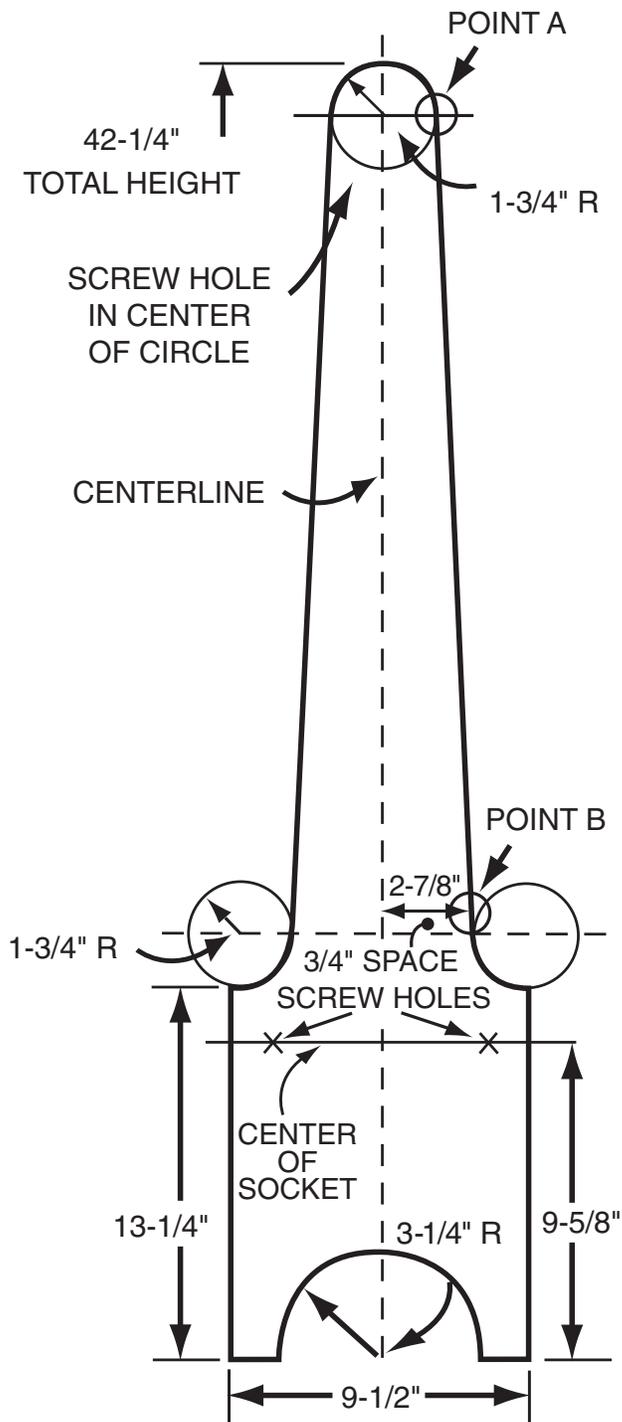
Please be mindful of the safe way to dispose of rags and other waste. Rags, steel wool and other waste products soaked with oil finishes or solvents may spontaneously catch fire if improperly discarded. Place rags, steel wool and other waste immediately after use in a water-filled metal container. Tightly seal and dispose of the waste materials in accordance with local trash removal regulations. Be sure to keep the waste out of reach of children.

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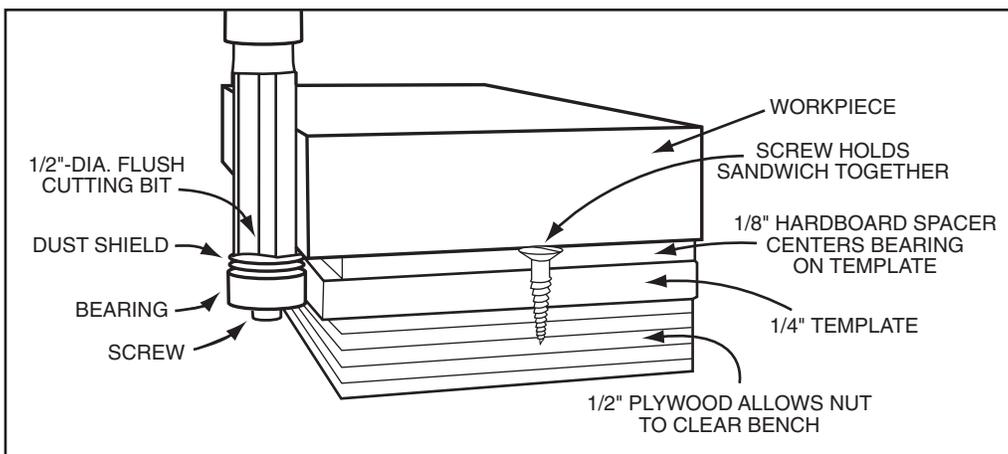
**FIG A. DOVETAILED STEP STOOL**



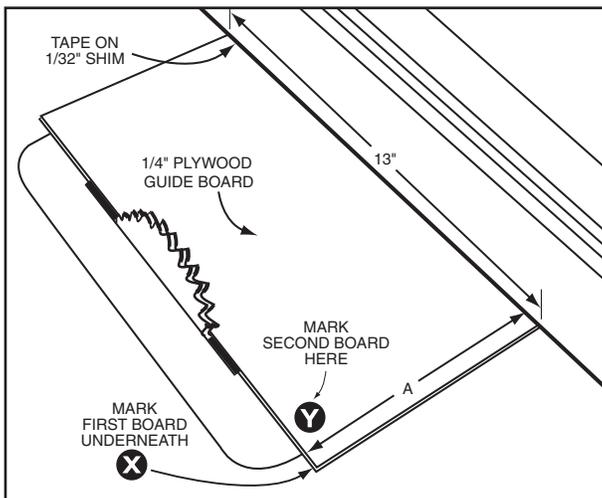
**FIG B. BACK TEMPLATE**



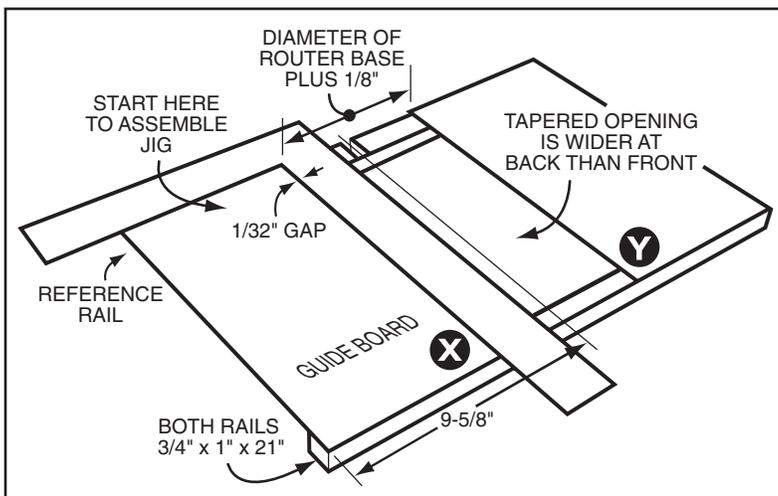
**FIG C. TEMPLATE SANDWICH**



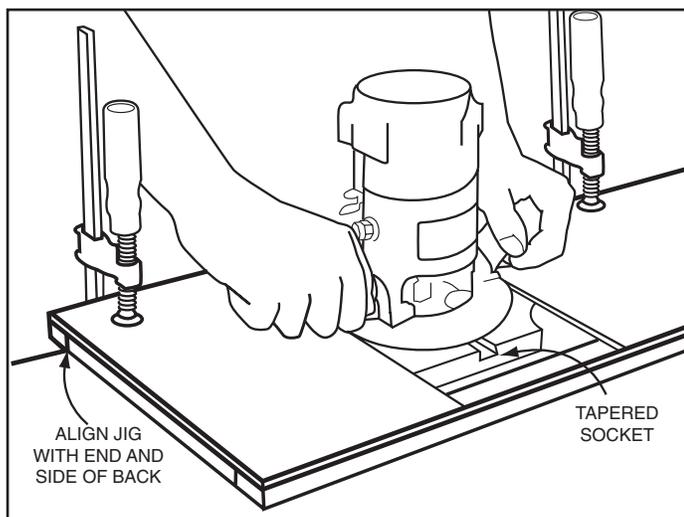
**FIG D. TABLE SAW TAPERING TECHNIQUE**



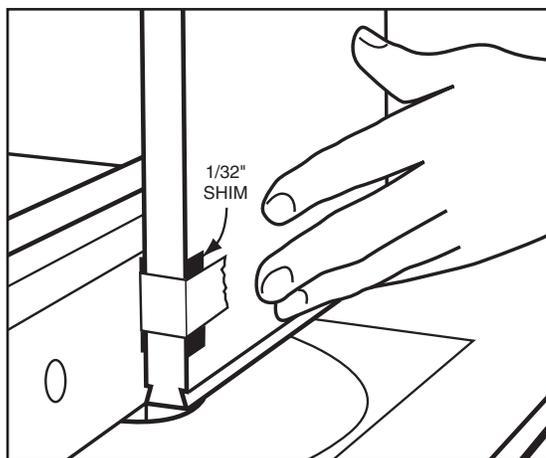
**FIG E. TAPERING SOCKET JIG ASSEMBLY**



**FIG F. CUTTING THE TAPERED SOCKET**



**FIG G. CUTTING THE SEAT DOVETAIL**



**FIG H. STRAIGHT-SOCKET JIG**

