

PERFECT WEEKEND PROJECT: Woven Paracord Bench



Popular Woodworking

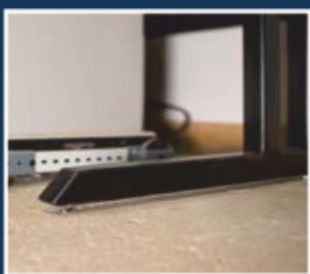
FEBRUARY 2020 | #251

SMALL SHOP

MITER SAW STAND



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the Modern Age

HEIRLOOM BUILD

Classic Cherry Dresser



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FINE MACHINERY®
SINCE 1983**

14" 1 HP DELUXE BANDSAW

- Motor: 1 HP, 110V/220V (prewired 110V), single-phase, 11A/5.5A
- Cutting capacity/throat: 13½"
- Max. cutting height: 6"
- Table size: 14" x 14" x 1½"
- Table tilt: 10° left, 45° right
- Floor-to-table height: 43"
- Blade length: 92½"–93½"
- Blade width: ½"–¾"
- Blade speeds: 1800 & 3100 FPM
- Overall size: 27" W x 30" D x 67½" H
- Approx. shipping weight: 246 lbs.



G0555LX ONLY \$625⁰⁰



17" HEAVY-DUTY BANDSAW 35TH ANNIVERSARY EDITION

- Motor: 2 HP, 110V/220V, prewired 220V, single-phase, TEFC capacitor 110V start induction, 60 Hz, 1725 RPM
- Amps: 20A at 110V, 10A at 220V
- Power transfer: belt drive
- Table size: 17" x 17" x 1½"
- Table tilt: 10° left, 45° right
- Floor-to-table height: 37½"
- Cutting capacity/throat: 16¼" L of blade
- Max. cutting height: 12½"
- Blade size: 131½" long
- Blade width range: ½"–1" wide
- Footprint: 27" W x 17¾" D
- Blade speeds: 1700 and 3500 FPM
- Fully-balanced cast aluminum wheels
- Overall size: 32" W x 73" H x 32" D
- Approx. shipping weight: 342 lbs.

**MADE
IN AN
ISO 9001
FACTORY**



G0513ANV ONLY \$1075⁰⁰



19" 3 HP EXTREME-SERIES BANDSAW WITH MOTOR BRAKE

- Motor: 3 HP, 220V, single-phase
- Precision-ground cast-iron table size: 26¾" L x 19" W x 1½" H
- Cutting capacity/throat: 18¼"
- Max. cutting height: 12"
- Blade size: 143" L (½"–1¼" wide)
- Blade speeds: 1700 & 3500 FPM
- Approx. shipping weight: 512 lbs.



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MAGAZINE
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9001 FACTORY**

**2015 WOOD
Magazine
TOP
TOOL
15-17" Bandsaw**

**EXTREME
SERIES**

**12"
RESAW
HEIGHT!**

G0514X2B ONLY \$1899⁰⁰



10" 2 HP BENCHTOP TABLE SAW WITH RIVING KNIFE

- Motor: 2HP, 120V, single-phase, 60 Hz, universal
- Amps: 15A
- Table size: 22" x 26¾"
- Arbor: 5/8"
- Blade tilt: Left, 45°
- Arbor speed: 2000-4000 RPM
- Max depth of cut @ 90°: 3½"
- Max depth of cut @ 45°: 2¼"
- Rip capacity: 28" right
- Dado capacity: 13/16"
- Dust port: 2½"
- Overall size: 27" L x 32" W x 21" H
- Approximate shipping weight: 72 lbs.



G0869 ONLY \$375⁰⁰

10" HYBRID TABLE SAW W/ RIVING KNIFE

- Motor: 2 HP, 115V/230V (prewired 115V), single-phase, 16A/8A
- Table size with extension wings: 40½" W x 27" D
- Floor-to-table height: 34¼"
- Arbor: 5/8"
- Arbor speed: 4000 RPM
- Max. depth of cut @ 90°: 3½"
- Max. depth of cut @ 45°: 2½"
- Max. rip right of blade: 31½"
- Max. rip left of blade: 11½"
- Overall dimensions: 63" W x 40" D x 48" H
- Footprint: 20½" L x 19½" W
- Approximate shipping weight: 449 lbs.

New!

MADE IN TAIWAN



**G0899
ONLY \$1275⁰⁰**



10" SLIDING TABLE SAWS

- Motor: 5 HP, 230V, single-phase, 19A (G0623X) or 7½ HP, 220V/440V*, 3-phase, 18A/9A (G0623X3)
- Main table size: 14¾" x 27"
- Sliding table size: 12¼" x 63"
- Main blade arbor: 5/8"
- Main blade speed: 4000 RPM
- Scoring blade size: 3½"
- Scoring blade arbor: 22mm
- Depth of cut: 3½" @ 90°, 2¼" @ 45°
- Max. rip capacity: 33"
- Approx. shipping weight: 688 lbs. (G0623X), 670 lbs (G0623X3)

**MADE IN AN
ISO 9001
FACTORY**



G0623X ONLY

**EXTREME
SERIES**

5 HP, SINGLE-PHASE

**G0623X
ONLY \$3395⁰⁰**



7½ HP, 3-PHASE

**G0623X3
ONLY \$3375⁰⁰**



G0623X
SHOWN

6" BENCHTOP JOINTER WITH SPIRAL CUTTERHEAD

- Motor: 1.5 HP, 120V, single-phase, 12A
- Max width of cut: 6"
- Min workpiece length: 8"
- Max depth of cut (per pass): 1/8"
- Cutterhead speed: 8,000 RPM
- Cutterhead diameter: 1½"
- Footprint: 19½" x 11"
- Table size: 30¾" x 6¼"
- Fence size: 22½" x 4¼"
- Dust port: 2½"
- Fully adjustable fence with 90° and 45° stops
- Approximate shipping weight: 56 lb.

**INCLUDES
FREE PAIR OF
SAFETY PUSH
BLOCKS**

**MADE IN AN
ISO 9001
FACTORY**



G0893 ONLY \$450⁰⁰

6" JOINTERS

- Motor: 1 HP, 110V/220V (prewired 110V), single-phase, 14A/7A
- Table size: 6½" x 47¾"
- Fence size: 29½" x 4"
- Cutterhead type (G0814X): 4-row V-helical, with 26 indexable carbide inserts
- Cutterhead type (G0814): 3-knife
- Maximum depth of cut: 1/8"
- Maximum rabbeting depth: 1/2"
- Cuts per minute: 15,000
- Cutterhead speed: 5000 RPM
- Overall size: 47½" W x 20" D x 42" D
- Approximate shipping weight: 260 lbs.

3-KNIFE CUTTERHEAD

**G0814
ONLY \$725⁰⁰**

4-ROW V-HELICAL CUTTERHEAD

**G0814X
ONLY \$1175⁰⁰**



G0814X SHOWN



8" JOINTERS

- Motor: 3 HP, 240V, single-phase, TEFC, 3450 RPM, 15A
- Max. depth of cut: 1/8"
- Max. rabbeting capacity: 1/2"
- Precision-ground cast iron table size: 9" x 72½"
- Cutterhead diameter: 3", Speed: 4800
- Cutterhead knives: 4 HSS; 8" x 3/4" x 1/8" (G0656)
- Cuts per minute: 20,000 (G0656), 21,400 (G0656X)
- Deluxe cast iron fence size: 35" L x 5" H
- Approx. shipping weight: 522 lbs. (G0656), 524 lbs. (G0656X)



4-KNIFE CUTTERHEAD

**G0656
ONLY \$950⁰⁰**

SPIRAL CUTTERHEAD

**G0656X
ONLY \$1350⁰⁰**



G0656X SHOWN



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15" HEAVY-DUTY PLANER

- Motor: 3 HP, 240V, single-phase, 14A
- Max. cutting width: 15", depth: 3/16"
- Max. stock thickness: 6 3/8", min.: 1/4"
- Min. stock length: 6 3/8"
- Feed rate: 16 and 30 FPM
- Cutterhead diameter: 3"
- Number of knives: 3 HSS
- Knife size: 15" x 1" x 1/8"
- Cutterhead speed: 5000 RPM
- Table size: 20 1/8" x 15" x 3 1/2"
- Overall size: 32" W x 28" D x 23 1/2" H
- Approx. shipping weight: 382 lbs.

OPTIONAL
STAND
AVAILABLE



G0815 ONLY \$1095⁰⁰



15" FIXED TABLE PLANERS WITH HELICAL CUTTERHEAD

MADE IN AN ISO
9001 FACTORY

- Motor: 3 HP, 230V, single-phase
- Table size w/cast-iron wings: 15 1/2" W x 49" L
- Maximum cutting width: 15"
- Maximum cutting height: 6"
- Minimum cutting height: 3/16"
- Maximum cutting depth: 1/8"
- Minimum length of stock: 6"
- Feed rates: 16, 28 FPM
- Cutterhead diameter: 2 5/8"
- Cutterhead speed: 5200 RPM
- Overall depth: 49"
- Overall height: 47 1/2"
- Approximate shipping weight: 300 lbs.

3-HSS KNIFE CUTTERHEAD

G0890

ONLY \$1395⁰⁰

HELICAL CUTTERHEAD

G0891 ONLY \$1850⁰⁰



15" EXTREME SERIES PLANER WITH HELICAL CUTTERHEAD

EXTREME
SERIES
MADE IN AN ISO
9001 FACTORY

- Motor: 3 HP, 230V, single-phase
- Max. cutting width: 15"
- Max. cutting height: 6"
- Min. stock thickness: 3/16"
- Min. stock length: 6"
- Max. cutting depth: 1/8"
- Feed rate: 16 FPM & 28 FPM
- Cutterhead speed: 5000 RPM
- Table size with extension rollers: 15" x 50"
- Approx. shipping weight: 553 lbs.



G1021X2 ONLY \$2050⁰⁰



1 HP SHAPER

- Motor size: 1 HP, 110V, single-phase, 10A
- Table size: 15 5/8" x 17 3/4"
- Floor-to-table height: 34 1/4"
- Table counterbore: 3" Diameter x 5/16" Deep
- Spindle travel: 7/8", Diameter: 1/2", Length: 3"
- Spindle capacity under nut: 2 3/8"
- Spindle speed: 8900 RPM
- Overall width: 27"
- Overall depth: 23"
- Overall height (includes fence): 40 1/4"
- Approx. shipping weight: 172 lbs.



INCLUDES 1/4" &
1/2" ROUTER BIT
ADAPTER



G0510Z ONLY \$395⁰⁰

2 HP SHAPER

- Motor: 2 HP, 120V/240V, prewired 240V, single-phase, 18A/9A
- Large precision-ground cast-iron table
- Table size: 24" x 21"
- Spindles: 1/2" and 3/4" (included)
- Spindle travel: 3"
- Spindle speeds: 7000 & 10,000 RPM
- Spindle openings: 1 1/4", 3 1/2", 5"
- Micro-adjustable split fence system
- Heavy-duty miter gauge
- Motor reversing switch
- 3" Dust port
- Split-fence has independent micro-adjustment feature
- Cast-Iron table & handwheel
- Lockable reversing switch
- Footprint: 19 1/4" x 18 1/2"
- Approximate shipping weight: 293 lbs.

INCLUDES
1/4" & 1/2"
ROUTER
BIT
ADAPTER



W1674

ONLY \$999⁹⁵



3 HP SHAPER

- Motor: 3 HP, 240V, single-phase, 12A, with reversing switch
- Precision-ground cast iron table
- Table with standard wing attached: 30-1/2" x 28-1/4"
- Floor to table height: 34"
- Spindle travel: 3"
- 3 interchangeable spindles: 1/2", 3/4", 1"
- Spindle openings on table: 1-1/2", 3", 4", 7"
- Spindle speeds: 7,000 and 10,000 RPM
- Maximum cutter height: 2-1/2"
- CSA certified
- Approximate shipping weight: 392 lbs.



G1026 ONLY \$1295⁰⁰



1 HP CANISTER DUST COLLECTOR

- Motor: 1 HP, 120V/240V, single-phase, prewired 120V
- Motor amp draw: 9A/4.5A
- Air suction capacity: 640 CFM with elbow, 800 CFM without elbow
- Maximum static pressure: 3.3"
- Lower bag capacity: 2.1 cubic feet
- Number of 4" intake holes: 1
- Impeller: 10", balanced steel, radial fin
- Portable base size: 15 1/4" x 26"
- Lower bag size: 14 1/2" x 22"
- Overall height: 59"
- Approximate shipping weight: 74 lbs.



G0583Z ONLY \$375⁰⁰



2 HP CANISTER DUST COLLECTOR

- Motor: 2 HP, 240V, single-phase, 9A
- Blower/impeller: 12 3/4" aluminum, radial fin
- Air suction capacity: 1700 CFM
- Static pressure: 10"
- Sound rating: 83-85 dB
- 6" inlet has removable "Y" fitting with three 4" inlets
- Canister filter size (dia. x depth): 19 5/8" x 23 5/8"
- Bag capacity: 4.5 cubic feet
- Overall dimensions: 31 1/2" W x 37 3/8" L x 71" H
- Approx. shipping weight: 150 lbs.



MADE IN AN ISO
9001 FACTORY

G0548ZP ONLY \$535⁰⁰



1 1/2 HP CYCLONE DUST COLLECTOR

- Motor: 1 1/2 HP, 110V, 3450 RPM, 15A
- Intake hole size: 6"
- Impeller: 12 3/4" welded steel
- Collection drum size: 35 gallons, max. capacity: 20 gallons
- Suction capacity: 868 CFM @ 2.6" SP
- Max. airflow: 868 CFM
- Max. static pressure: 9.7"
- Approx. shipping weight: 375 lbs.



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G0860 ONLY \$775⁰⁰



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- Narrow stock guides deliver accurate results down to 1/4".



Parallel Guide System
with Systainer Case....\$429.99

Saw not included.

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- Keeps your clamps upright & evenly spaced.
- Works with parallel jaw, bar or pipe clamps.
- Elevates work off clamps, eliminates black marks.
- Aids in squaring and aligning boards.



Clamps not included.



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- Ribbed surface grips stock without marring.



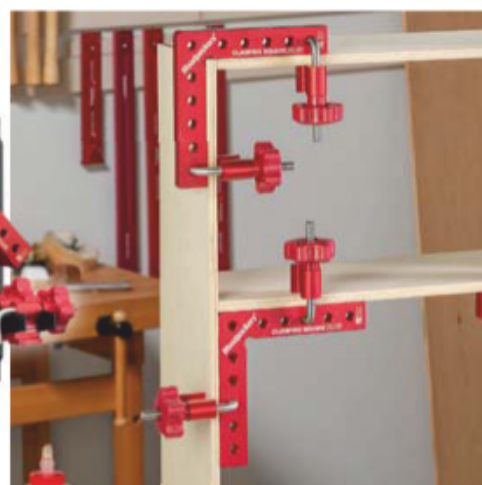
Clamps not included.



MCT-75 - Set of Two....\$21.99
MCT-150 - Set of Two....\$24.99

Clamping Squares PLUS & CSP Clamps

- Positions stock at right angles for joinery & fastening.
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- Works with any clamp.
- CSP Clamps add speed & convenience.



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Rack-It Kit....\$239.99

Clamp Rack-It™

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- Installs on any stud or solid wall surface.
- Simple installation with (2) lag bolts (included).



Clamp Rack-It 4-Pack....\$119.96



Clamps not included.

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- Trims pen blanks square & flush with insert.
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- Cleanest cutting, longest lasting pen mill on the market.

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- Eliminates need to sharpen.
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- Perfect for pens & other small turnings.
- Square, round and detail tools available individually or as a set.

Pen-Size Woodturning Tool Set\$219.99



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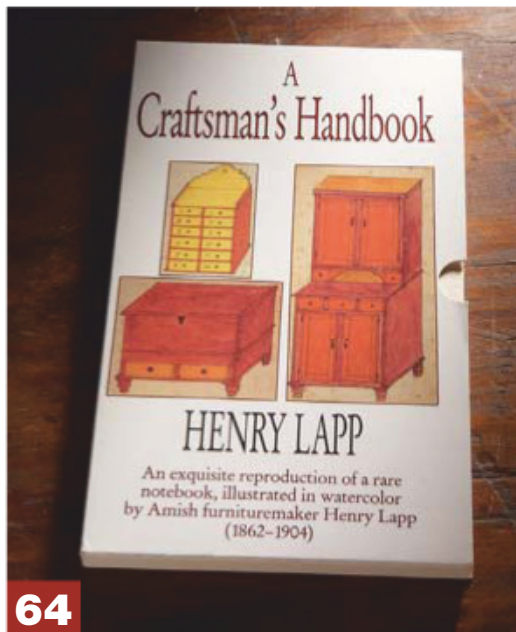
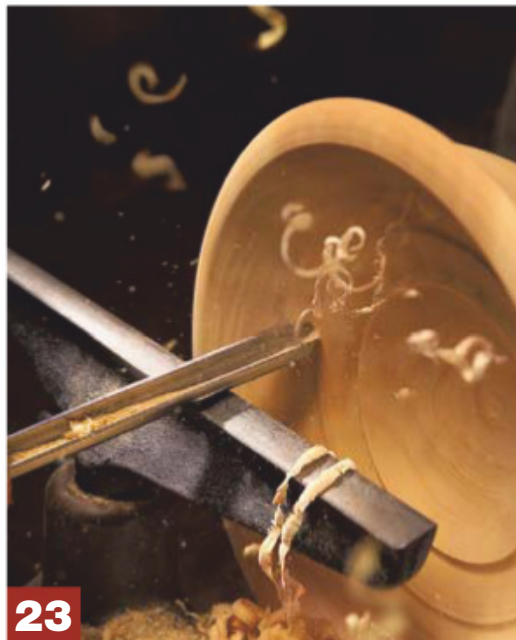
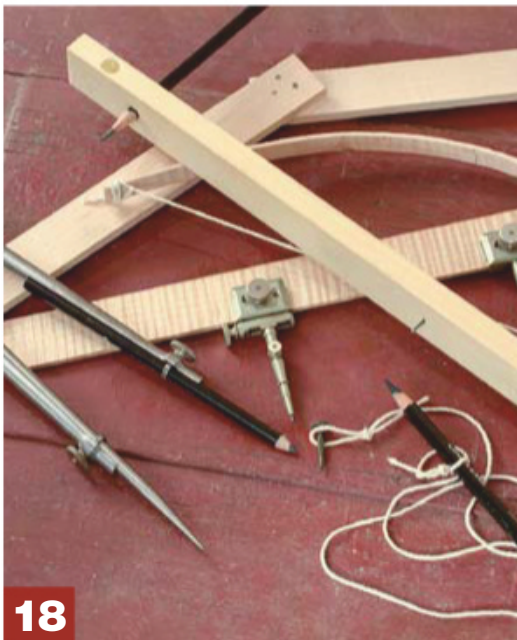


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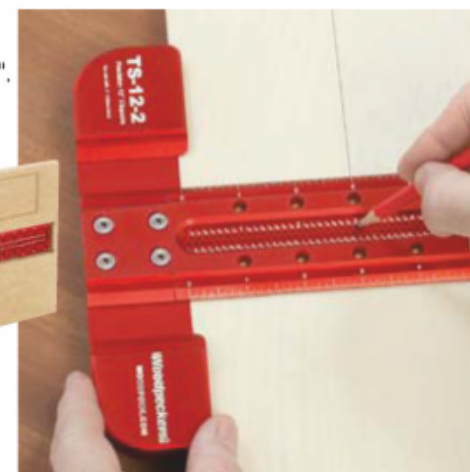


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12" 1282SS Stainless Steel Square.....\$159.99

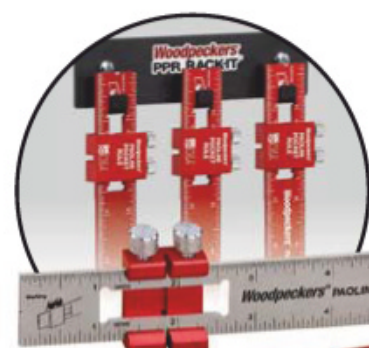
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- Stop doubles as stand to set router bit & saw blade height.
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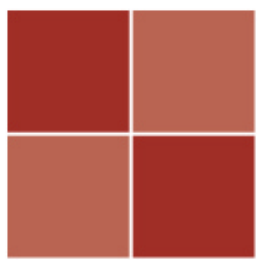
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Connect

■ FROM THE EDITOR

Woodworking Every Day

By Andrew Zoellner

I'm a sucker for new year's resolutions. As a pragmatic optimist, I really like the idea of a fresh start, a time to make your life better, for no other reason than a pope in the 16th Century decided that January 1 was the first day of the new year.

Some of my more memorable resolutions involve various food-stuffs. (I gave up pizza, my favorite food, for an entire year once. Another year, it was sweets.) Lots of resolutions are about health. This year, my resolution is to work with wood every day. Not just think about woodworking, or write about woodworking, or watch a bunch of YouTube videos about woodworking. Actual hands-on, making chips and sawdust, every day.

I don't think it's going to be easy. But I also don't think it's going to be as hard as I'm thinking it is right now. Wood surrounds us. There's a shop waiting for me out my back door. There's a second stash of tools in the basement. I usually have a pocketknife.

Really, it's more about priorities. Would I rather watch TV or woodwork? Do I want to get up early and get an hour in the shop before I sit down at my desk for the day? Do I pack a couple knives and spoon blanks for a roadtrip? In 2020, my answer is yes.

Studies tell me that many of our readers are empty-nesters or retired, that the right time for most people



In 2020, I'm challenging myself to work with wood every day. That means you'll likely be able to find me here (in the garage behind my house in Minnesota).

to start woodworking is when they have more time. My resolution means that I'll have to make time and likely sacrifice other things. I've spent more time than I care to admit watching football this fall. There's really no reason I can't have the game on in the shop.

Writing this seems daunting, but I'm excited about the opportunities. Exploring ideas both good and bad, learning and practicing new skills and likely spending more time in the shop than I ever have before.

2020 also holds a lot of promise for *Popular Woodworking*. You'll see more content from our archives of *Popular Woodworking*, *American Woodworker* and *Woodwork* on the website. Our goal is to turn it into one of the best resources for woodworkers at any point in their journeys. We're also going to continue working with some of the best makers, writers and

builders to develop new stories, seek out new tools and techniques, and do our best to inspire more people to make more furniture and functional objects.

We're planning a few more recurring departments (including Turning, page 23). We're making more room for design (see page 18). And we're going to continue to incorporate materials beyond wood into our builds (see pages 26 and 40). I can't guarantee you'll want to build everything you see in these pages, but I'm hoping you'll be inspired to step outside your comfort zone and try some new things in 2020.

P.S. Want to tell me something? Contact me here: azoellner@aimmedia.com

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WORKSHOP TIPS



Strike Plate Mounting Magic

When I had to install a bunch of magnetic catches recently, I came up with this simple method to mark the doors for the strike plate. It requires no measuring and the results are neat and clean.

Just insert the mounting screw in the plate and attach it to the magnet. Then press the door firmly against the screw so the tip leaves a mark. Drill a hole centered on this mark and then fasten the plate. —*Tim Howell*



Fender Washers for Mounting Pictures

I enjoy making picture frames but always found it a pain to use tacks or staples to hold the picture in place. Plus tacks and staples are hard to remove when you want to change the picture. That's why I developed this method for holding the picture, glass, matting, and backing board in the frame. I use 1-in.-diameter fender washers and #6 by 3/8-in. pan head screws. I drill the recess for the washer with a Forstner bit and make the recess deep enough so the washer will bear against the backing board to hold everything snug. —*Larry Jenkins*

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The guide consists of four pieces of 1/8-in. MDF glued so one pair of pieces shoulders the sole of the plane. On the sole, this shoulder must extend slightly beyond the blade. The magnets are epoxied into their predrilled holes.

Right-Angle Guide for Jointing

Planing the edge of a long board perpendicular to its face is a real challenge. To make the job easier, I built a guide that attaches to the side of my plane with rare earth magnets. Now jointing an edge is much easier. I simply alter my grip to take full advantage of the square-cornered support that the fence offers. —*Frank Penicka*

Pop Rivet Center Pin

I make lots of lazy Susans in my cabinet business, so I cut circles of many diameters. Changing diameters is easy on my circle-cutting jig, because I use a pop rivet as a removable center pin.

The jig is an MDF piece with an attached rail that's sized to slide in the miter gauge slot on my band saw. Draw a perpendicular line on the MDF. Install the jig, cut to the line and clamp on a stop block. Remove the jig and drill holes for the pop rivet center pin, measuring from the cut you've made.

To use the jig, fit the pop rivet in the appropriate hole and install a blank. Its bottom must have a center hole sized for the pop rivet. Make a straight cut to the stop block. Rotate the blank clockwise to cut the circle. When I cut large circles, I support the jig with an adjustable roller stand.



Cut the pop rivet to 3/8" and sharpen the tip. Drill and counterbore holes to accommodate the rivet's shank and collar.

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Elegant Tabletop Fasteners

On my best work, I want the bottom of my project to look as good as the top. That's when I make an old-fashioned set of wooden tabletop fasteners, or "buttons," rather than use the modern stamped-steel type.

A button allows a solid-wood top to expand and contract through the seasons. When the top's grain runs parallel to the rail, the button slides in and out of the slot as the top slowly moves. When the grain runs at right angles to the rail, the button slides side to side.

To make the buttons, cut dados in a long block. Drill and countersink holes for screws, then chamfer the long edges. Saw apart the blocks and chamfer the ends with a file or disc sander. —*Tom Caspar*



Good-Looking Panels

Nothing makes a cabinet look worse than door panels with unattractive grain that runs at weird angles. It pays to be picky about grain direction, even if it means wasting some plywood.

After assembling your door frames without glue, slide them around on the sheet of plywood until they frame attractive panels.

Look for symmetrical grain patterns that you can center. Avoid patterns that run off one side.

I try to find grain that resembles mountains or cathedral arches. These A-shaped patterns make doors and cabinets appear taller and more graceful. Tight grain patterns, where the early and late growth is closely spaced, usually look better than patterns with wide grain.

Mark your good-looking panels



by tracing around the inside of the door frames. Cut out the traced panels at least $\frac{1}{2}$ " larger on all four sides. Then trim them to fit the frames. Use the ugly plywood that's left over for jigs or in other places where appearance doesn't matter. —*Tim Johnson*

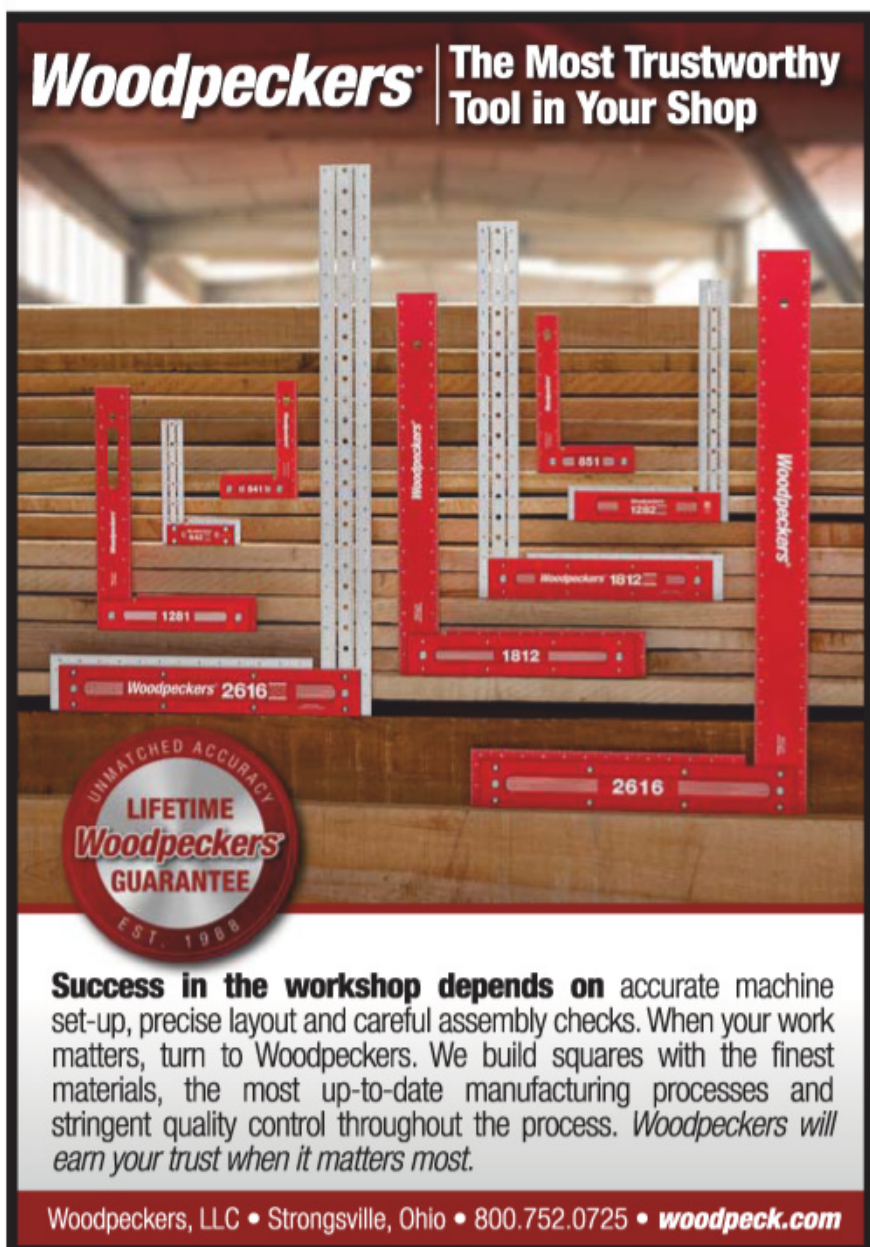


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TOOLS

A Cordless Vacuum Contender

As I replace old and worn out tools, I've made it my goal to find a cordless equivalent. Their convenience cannot be overstated especially given they often times outperform their corded counterparts. I'd used and

36V MultiVolt Wet/Dry Vacuum-Pod Style

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Price: \$500 (bare tool)

seen several cordless vacuums but had never been impressed. Most of them top out at or below 80cfm (with some advertising sub 40!) and can't replace any of my

corded vacs. While speaking to my local Metabo HPT rep, he mentioned a new 124cfm cordless wet/dry vac that would be hitting the shelves soon and asked if I'd be interested in testing one for him. He assured me this vac would outperform any I'd seen, so I agreed.

After unboxing the vacuum, one thing that immediately stood out to me was the sleek design. It's low profile "pod" style is complimented by smooth rolling casters and simple controls. The telescoping wand is well made and easy to use with no slippage once it is locked. An indentation in one side of the vacuum accepts a hook on the zoom pipe for storing when not in use. The floor attachment does an excellent job on both hard surfaces and carpet. There is an air damper on the floor attachment you'll want to open for hard surfaces as this vacuum has the power to suck it to the floor. At this time, a rear mounted tool storage tray is being sold separately as an optional accessory. I do hope Metabo HPT includes it in the future, as it improves the convenience of transporting the unit.

The included filter is an L-class cage type that doesn't need to be removed when using the vacuum in water. Metabo HPT noted in their manual however, that prolonged use of the included filter with water can cause a loss of suction and they recommend purchasing the nylon filter for water use. Paper bag filters with lower micron ratings will also be available.

The vacuum had no problem removing debris from my shop floor, the carpet in a client's house, and water from buckets I used for testing. I found its suction to even be adequate enough for hooking to my miter saw, although without HEPA filtration, the fine dust is undoubtedly



getting through. On more than one occasion it has been a real lifesaver when there were no extra outlets available and I needed to plane the backside of a cabinet or door with my cordless planer. It managed to contain every bit of visible dust that my plane could throw at it, which meant less cleanup down the road.

Although it holds two batteries, the vacuum is designed to use one at a time and is able to run with only one battery installed or the sold separately adapter. Regardless of whether you use batteries or the adapter, the max run time on high is billed at 14 minutes. Even though it's plugged into the wall, the adapter will get overheated and go into fan mode at 14 minutes. The chart below shows run time and specs. If you look at the first column you will see a 75 minute run-time at 57 CFM. That is more than enough time for most sanding operations that require a lower CFM. And, if you think about how you use a vacuum most of the time (short bursts of a couple minutes), this unit can be used for most of a day on two batteries.

So, if you are in the market for a powerful, compact, vacuum where you would not have to bother with cords or worry over electrical availability, the Metabo HPT has proven itself to be a tool worth looking into.—Nathan Rinne

Mode	Suction Power	Maximum Airflow	Maximum Vacuum Pressure	Run Time (1 Battery)	Run Time (2 Batteries)
Eco (1)	25 W	57 CFM (1.6 m3/min)	0.6 PSI (4.2 kPa)	75 minutes	120 minutes
Standard (2)	80 W	85 CFM (2.4 m3/min)	1.2 PSI (8.0 kPa)	32 minutes	52 minutes
Turbo (3)	300 W	124 CFM (3.5 m3/min)	2.9 PSI (20.1 kPa)	8 minutes	14 minutes

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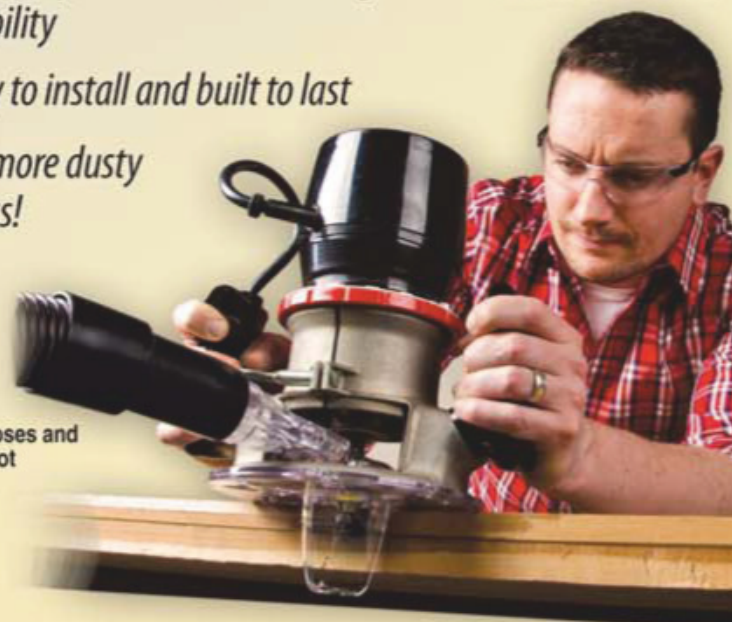
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The Restorer is unlike any other sander you have, and it won't replace any other sander, but it can add flexibility and creativity to many finishing prep tasks. Porter-Cable calls the Restorer a "multi surface restoration tool", while

■ PXRA2676 4" Restorer

Porter-Cable
portercable.com
Price: \$150

other competing brands call their tools burnishers or wheel sanders. My best description of the Restorer is a handheld spindle sander that fits

different abrasives for sanding, stripping, and polishing various materials. I tested the version that comes with six sanding sleeves, two polishing sleeves, one stripping wheel, and a fabric kit bag. I also added two accessory brushes, the 180-grit nylon bristle and the stainless steel wire brush for just under \$50 each.

The tool fits proprietary 2 ¹³/₁₆" diameter by 4" wide sleeves and wheels, with basic accessories available from Porter-Cable and a wider selection of accessories available from the inventor's web site (*imarestorer.com*).

The Restorer has a variable speed dial ranging from 1,000 to 3,200 rpm and a lock-on trigger so you can keep working without finger strain with a one- or two-handed grip. The vac port on the tool only fits one of my slender European vac hoses, so some sort of adapter (or some wraps of duct tape) may be needed. On a serious note: if you are abrading any paint that contains lead, be sure to use a HEPA-rated vac and follow the other procedures as detailed by the EPA's RRP Rule.

I started out using the Restorer for evening up the tone of lightly weathered cedar shakes. For this task, the 180-grit abrasive nylon brush was just the thing. The fine bristles worked perfectly to transform the dusty gray surface of the shakes to a warm brown while leaving the irregularities of the split wood intact. I was even able to work the edge of the brush into most of the nooks and crannies I encountered. While the nylon brush excels at cleaning up this very soft wood while leaving its rustic character, it may burnish harder woods to an unwanted sheen, especially after the bristle tips get worn smooth.

The key to using the Restorer for this type of delicate work is to maintain a light touch and to keep the tool moving—drawing the tool backward with a smooth motion and downward force ("painting" the work surface with the tool). For more aggressive applications you can dig in a bit harder, but the modest 3.5-amp motor will bog down (as it rpms dip under significant load).

Forward motion is more difficult to control, but you can manhandle the Restorer easily enough to make it work well with a back and forth scrubbing action. In fact, its mild-mannered performance makes this tool relatively easy to use one-handed. With the wire brush on the Re-



storer, it's almost like a freehand carving tool for custom surface finishes. You can use it to clean up wood that is too rustic, or to artificially rusticate wood surfaces that are too smooth. The wire brush provides a much sharper cutting action, good for removing wood to accentuate the earlywood/latewood texture of some wood species. It's also the choice tool for stripping the cambium and thin bark left after the bark is peeled from a winter-cut log.

The wire brush bristles are noticeably uneven in length. On curved log surfaces the Restorer handles pretty well, but on firm flat surfaces like sheet metal, the irregular profile of the brush makes the tool bounce up and down. Dressing it down on some rough concrete may alleviate the problem, but really, you shouldn't have to fix a \$50 accessory. The wire brush's spiral construction also makes the Restorer nearly impossible to control on soft wood, especially with the full width of the brush engaged. The spiral-wound bristles pull sideways while tracking in the wood grain, making it very tricky to move the tool straight back along a board. You'll want to experiment with your own materials, but I found that cranking the rpm down to half-speed and applying a very light touch improved control.

I think the standout uses of this tool for woodworking are provided by the accessory wire and nylon abrasive brushes. The Restorer is a welcome addition to my specialty tool kit as a lighter and sportier complement to my old burnisher for select rustic wood and metal-finishing uses, but the Restorer won't be replacing it.

—Michael Springer



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Adding Curves to Your Toolkit

Moving beyond the world of straight lines opens new design ideas.

By George Walker

A lot of woodworkers shy away from curves. There's plenty of reasons for this. For starters, some of the common power tools are built for rectangular construction, a table saw is a good example. Limitations imposed by our machines can nudge us away from curves. A second reason is that curves add an extra level of complexity to any design. Doors can be fussy to fit even if they are flat. Why up the ante and mess with a curved door and the extra headaches that take us beyond our comfort zone?

Yet the biggest reason folks avoid the curvy road is stepping out into the unknown. Curves are wild things like the flight of a falcon, beautiful yet unpredictable. A curved line can easily crash into the weeds. In fact it's a sure thing you need a bigger trashcan next to your drawing board if you venture into the land of curves. Added to that are the challenges of scaling up a curve from a small drawing to a life sized layout and it's not surprising that some woodworkers avoid designs with curves.

Curves Beckon

Oddly enough, those reasons for avoiding curves are also the strongest temptations to venture off road and take the scenic route. It's exciting to push beyond the fenced in back yard that's dictated by the table saw and take a bit of risk and to create designs with life and movement. Technical challenges in joinery and layout can add spice and satisfaction to the build process.

The good news is that there are a few basic skills that can help you visualize and unpack curves so you can gain more confidence working with arcs and sweeping lines. Before we discuss a basic tool kit



A tool kit for moving beyond the world of straight lines.

to generate curves, let's pull back the curtain and understand some basics about simple curves. Dig out your compass and follow along. This is knowledge that's better caught than taught.

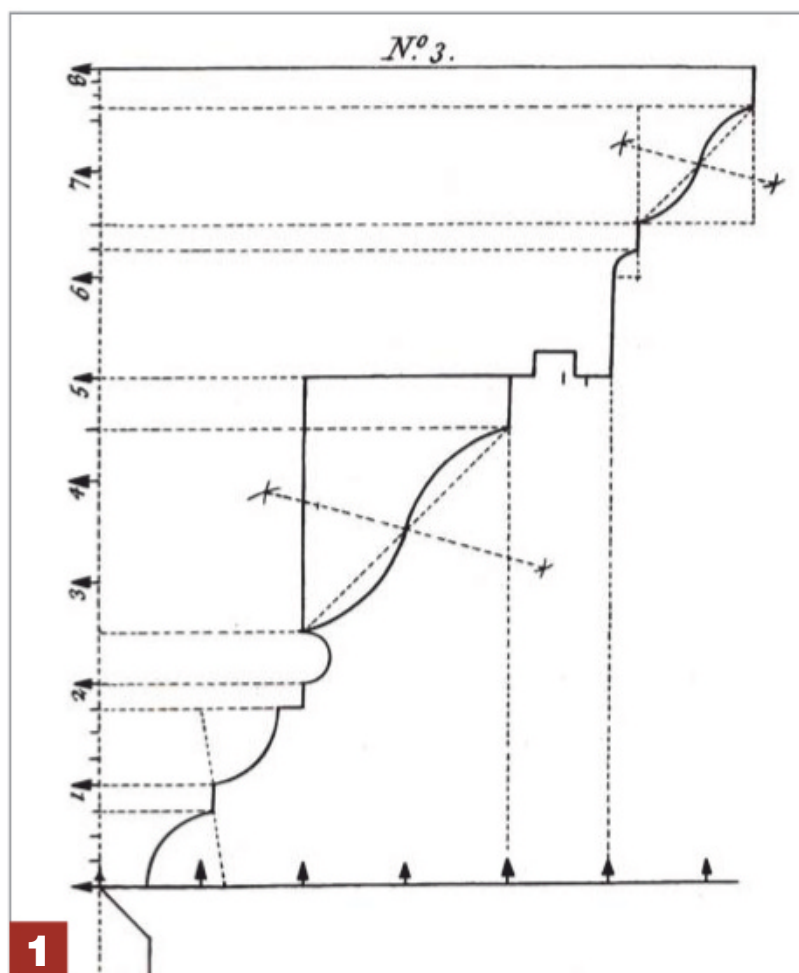
Simple Beginnings

One of the first things to learn about curves is that you can draw an endless array of curved compositions with just three simple compass arcs. I stumbled on this nugget while studying historic design books from the eighteenth century. I found that what often looked like complex and dramatic curves were made from a small trio of simple compass arcs. Sort of like how an artist can create many colors from the three primaries of red, yellow and blue. This is a good way to learn to get comfortable working with curves.

The Three Musketeers

Let's begin with these three arcs. All share one thing in common, they all begin with a straight line. This is important for two reasons. First, a straight line gives us a visual reference to gage the boldness or speed of a curve. Curves can be fast, slow or somewhere in between. A fast curve is like a sharp bend in the highway while a slow curve is gentle. A straight line gives us a visual reference to gage whether our curve is fast or slow. Secondly, the straight line provides anchor points to establish the beginning and ending of our arc and allows us to locate the exact spot where a complex curve transitions from concave to convex.

Let's begin with an aggressive fast curve, a half circle. Mark the start and stop points on your straight line and then locate the

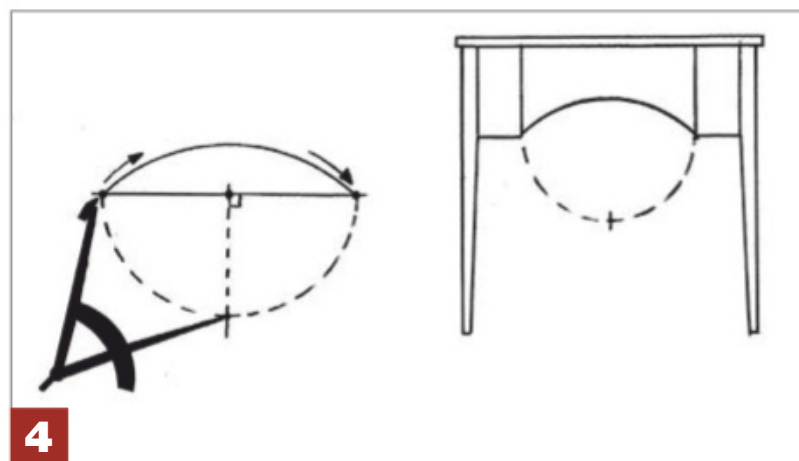
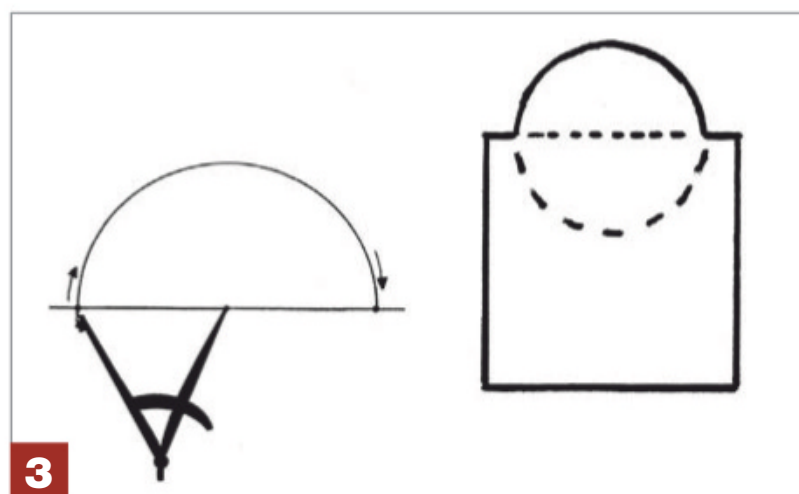
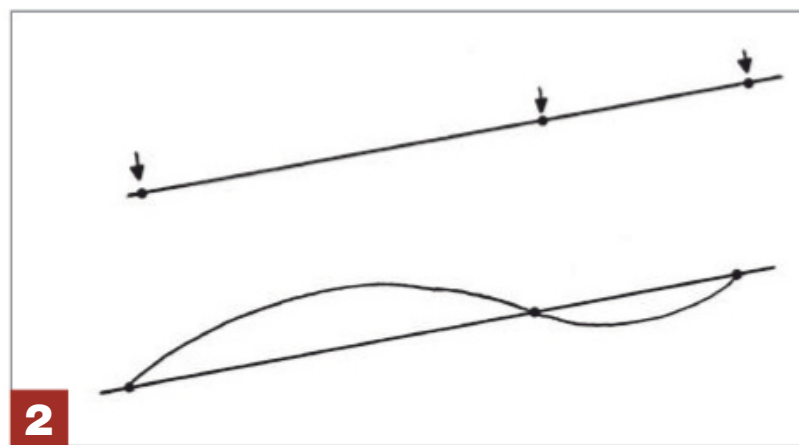


1 The layout lines on this period drawing offer clues to drawing the curved moldings. (Rules For Drawing the Several Parts of Architecture, By James Gibbs, Public Domain)

2 This curve snakes along this straight line, but you control it by marking the start, transition, and ending.

3 The half circle is a fast curve and the first of our trio of simple curves.

4 We drop a half circle below our line to locate a fulcrum to draw a quarter circle.



halfway point between the two marks. This halfway point is your fulcrum. Place the point of your compass there, adjust the pencil out to the start point and swing an arc from start to finish. This fast curve can be found in simple forms like a tombstone arch in a clock face dial or a raised panel on a door.

Now let's ease it down to a slower more gradual curve, a quarter circle. The layout begins the same as a half circle except we drop a perpendicular down from our midpoint. Using the midpoint as a fulcrum we strike a half circle downward till it strikes our perpen-

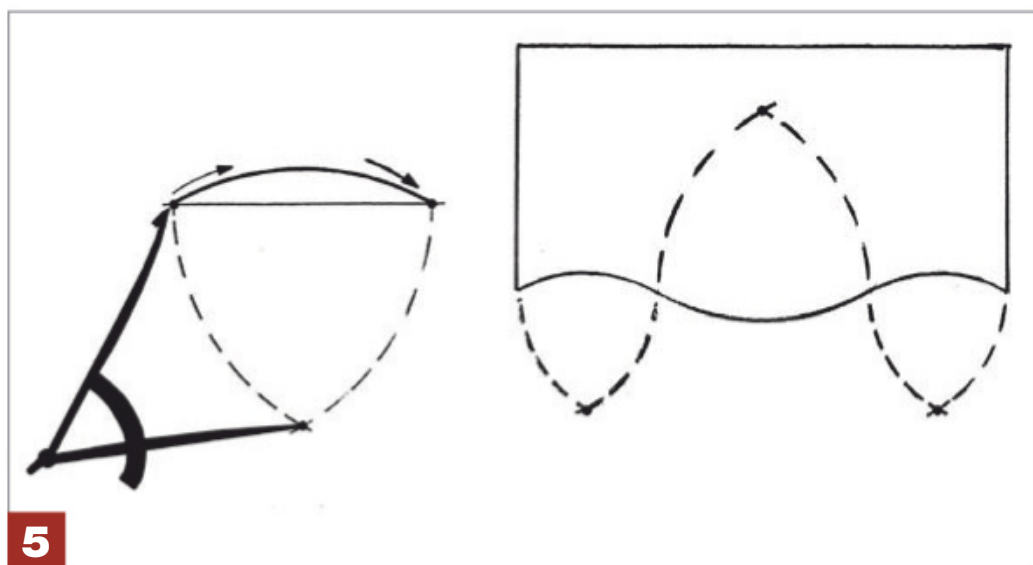
dicular. The spot where it meets at the south pole is our new fulcrum. Set the compass point on the new fulcrum and reset the pencil out to the original start point. Swing the arc from start to finish creating a gentler or slower arc. This arc is often used for a curved pediment on a doorway or the opening under a desk.

Finally let's draw a slower "Goldilocks curve". It's one of those curves that are just right and shows up again and again in furniture and architecture, one sixth of a circle. Adjust our compass to span the width between the beginning and

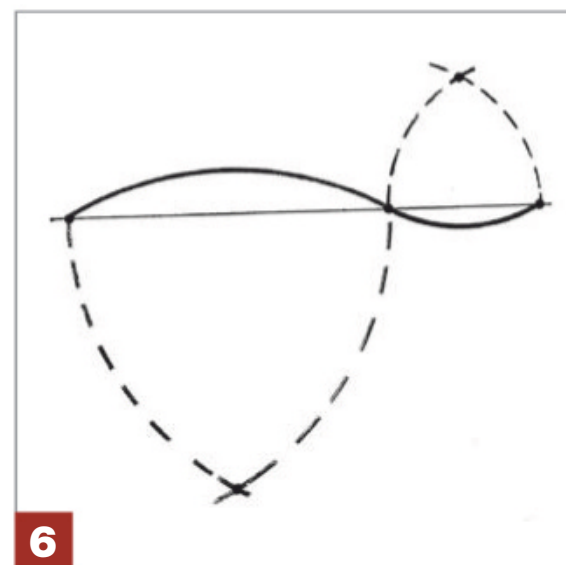
ending of our arc. Swing the pencil down from one side then flip it and swing it down from the opposite side. Where these two arcs cross is our new fulcrum. Without changing our compass setting, swing an arc from start to finish point. This gentle sweeping curve is the basis for many curved molding profiles as well as for curved and serpentine shapes on cabinets and drawers.

Compound Curves

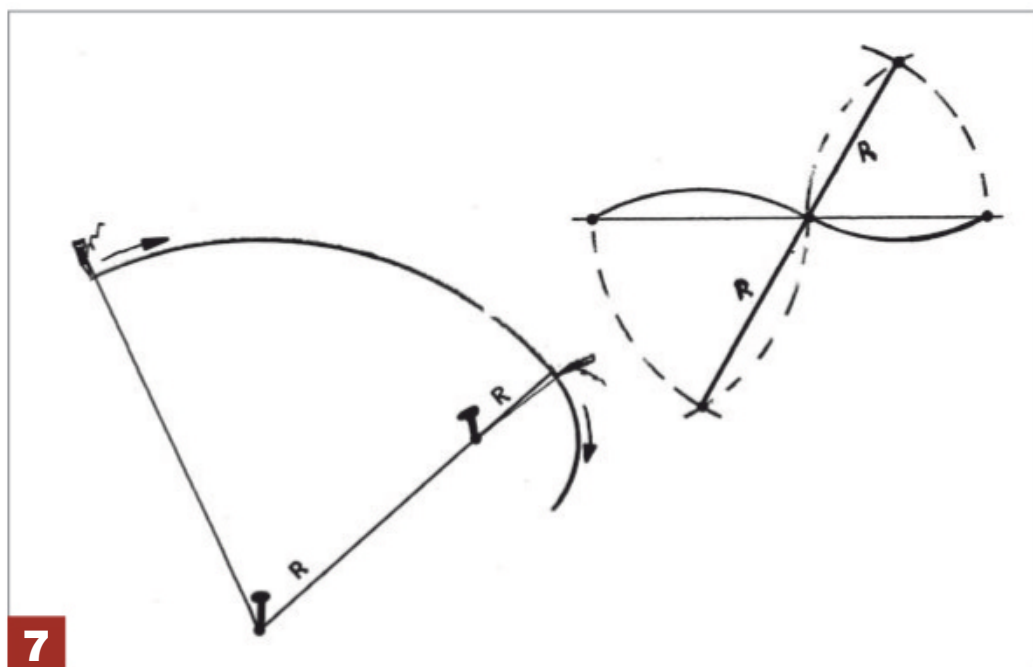
Now let's play with combinations of curves, stringing together convex with concave arcs. This is where the combinations can explode with



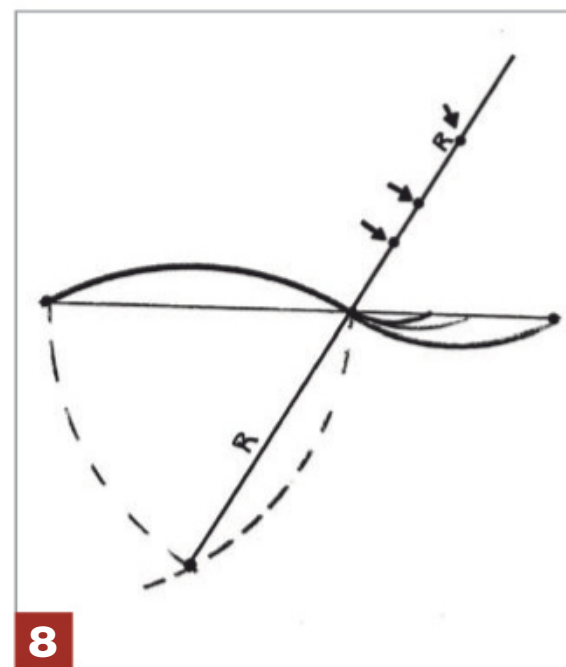
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endless possibilities from just these three simple arcs. A few techniques can help you combine arcs into graceful flowing lines. Just to get comfortable, let's begin with some pairings of arcs using our one sixth curve. Start by drawing a straight line that will extend from the beginning of our first arc and continue to the end of our second arc. Next, mark between these two endpoints a spot that will locate where our curves will transition from concave to convex. In reality this transition point is simply the end of the first curve and the beginning of the second. To draw the first arc draw one curve above our line between our start point and the transition point. Then reset the compass and draw the second arc below the line. You can shift the transition point to

5 One sixth of a circle is used in molding profiles and also the contours of a bow front chest of drawers.

6 Draw a straight line and draw a series of curves above and below. Possibilities are endless.

7 Whether drawn with a compass or string, the arcs flow seamlessly when radii align.

8 As long as you place a fulcrum on the shared radii, the second curve will flow.

different locations to create differing pairs of curves. The combination and possibilities are endless.

Is it Fair?

A fair curve simply means it flows smoothly without bumps or interruptions. When laying out curves that flow organically, the transitions are key. Combining different curves so that they flow smoothly

is simple if you understand that paired arcs always share a common radius. Note on the drawing for the serpentine curve, that the radii align at the transition point. Conversely if you draw one arc on one section of a straight line, by simply extending the radius where it meets the transition, anywhere along that radius you can establish a second fulcrum to draw a second

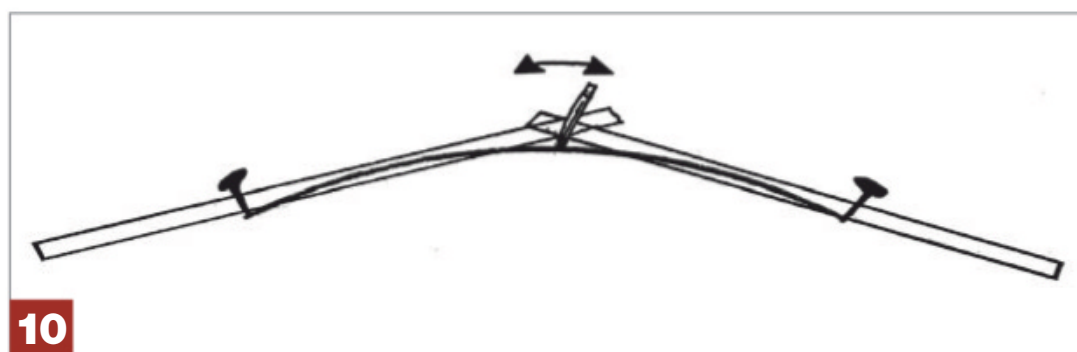
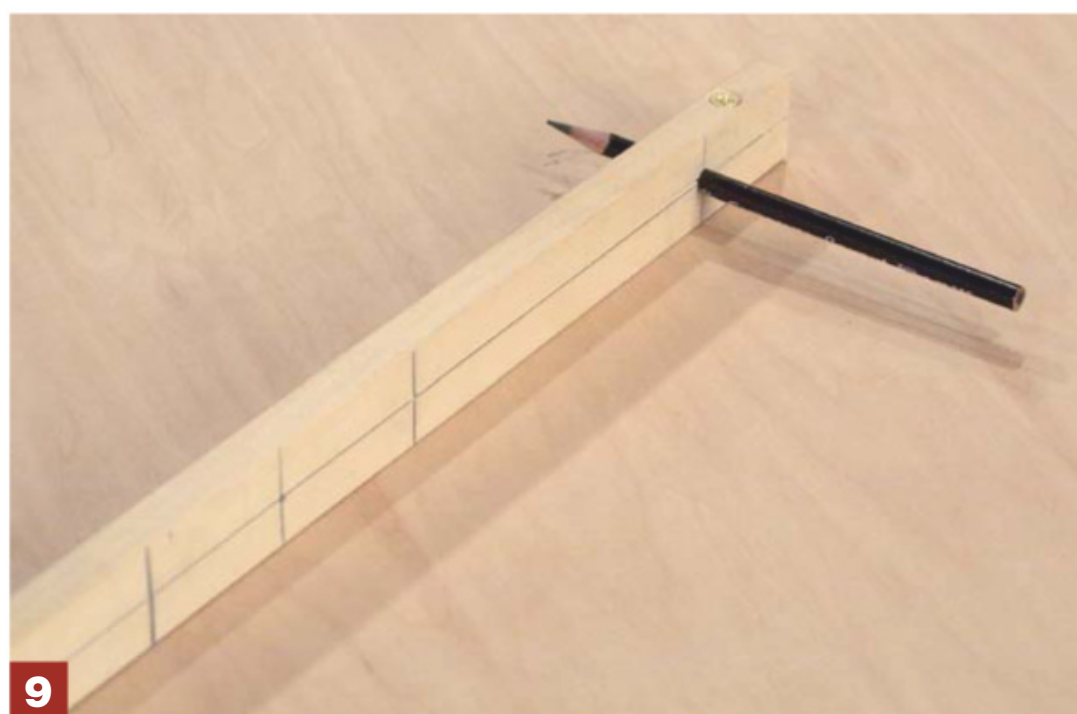
curve that flows seamlessly with the first. This also works when combining curves that change speed. This is easy to see when using a string attached to a nail. One nail marks the fulcrum for the larger slower curve, a second nail marks the fulcrum for a smaller faster curve. Notice that when our string swings around and touches our second nail, both arcs share a radii at that point so the smaller arc flows smoothly.

Tool Kit for Curved Layouts

It's obvious that a compass (dividers equipped with a pencil on one end) is a go to tool for generating curves. My advice is to shy away from compasses that are made for the drafting table, they tend to be lighter weight and won't hold a setting when making layouts on wood. Regardless of whether you use a compass with a screw adjustment or friction fit, it should hold it's setting securely. I recommend two compasses, a 6" and a 10" or 12" size. These will cover most small scale layout tasks both at your drawing table as well as on the workpiece.

Going Big

To draw larger arcs that go beyond the reach of your compass there are a number of methods for large scale curves. Possibly the simplest is to use a string anchored on one end to a nail and looped over a pencil on the other. Care must be taken to make sure to apply even tension on the string and being mindful to keep the pencil upright. Trammel points act like a large pair of dividers and are available to purchase both vintage and new. A set of trammels turns any scrap of wood into a precise layout tool. Trammel points designed for the drafting table, unlike compasses will work with wood layouts. Reason being the trammels depend on the wooden beam to keep them solid. If you lack a set of trammel points,



9 Center line and cross marks on shop made trammel make this a precision layout instrument.

10 The power of geometry and a couple of sticks to lay out giant arcs.

it's easy to improvise a shop made trammel. It's a stick with a point driven through one end and a pencil attached on the other. A few easy tricks added to this home made tool can up the accuracy and ease of use. I mark a centerline down the length of the beam and locate both pencil and point directly on this centerline. I also strike perpendiculars right over where the pencil and point are located. This makes it easy to measure the exact radius I need or also to relocate the point if required. Instead of just hammering a nail through for the point, I drill a hole with a $\frac{1}{16}$ " drill, then grind the shank end of the drill to a smooth sharp point. I snap off the business end of the drill bit and tap it into the beam point first. I find a

hardened point gives a positive grip and easier to clean up than a hole left from a nail. I drill a hole for the pencil and make a kerf with a saw to clamp it securely with a screw. It takes less than ten minutes to fabricate this tool.

Going Way Big

You may want to draw a slow gentle arc that exceeds what you can do with a trammel (or exceeds the space to swing a large arc in a crowded workshop). For example if you wanted to lay a gentle curve along the long edge of a large conference table. This could be a section of a circle with a twenty foot radius. The solution is to use the power of simple geometry to draw the arc. Start by placing a nail at the start and stop points of

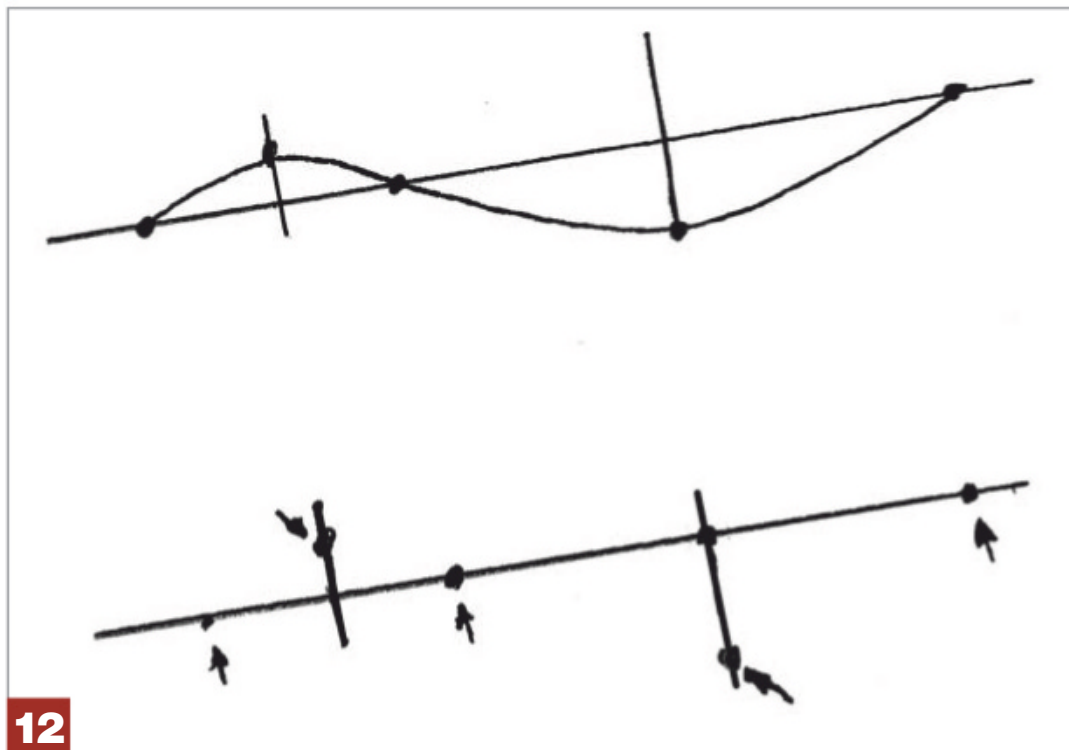


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the arc. Then, find the midpoint and set a third nail out to a distance that would be the highpoint of the arc. Then take a pair of sticks that are longer than the distance between our start and center pin and set them so they meet just over our center nail. Lock them together securely with a couple of screws and remove the center nail. Now place a pencil in the apex where our sticks meet and draw our slow arc by sliding our sticks over the start and stop pins, making sure that our sticks stay in contact with our two pins.

Irregular Curves

Up to now we've discussed regular arcs that have a constant radius to a center point. Yet in nature we often see a curve that begins slowly and gradually gets faster. Think about



12

11 Just taper a scrap of straight grained wood and you have a flexible pattern for graceful curves.

12 Freehand curves are made easy if you use a straight line and mark the important boundaries. With a bit of practice, you'll surprise yourself.

how a stalk of wheat bends as the grains ripen. One way to draw these arcs is to make use of a tapered batten. Think of it like a fishing rod that's stout at the bottom and tapers down to much slimmer tip. Select a strip of straight grained wood about three foot long and $\frac{3}{8}$ " square. On one end draw a small square in the center that represents the small end of the taper. Lay it flat on the bench and use a block plane to take a shaving on that last six inches of the batten. Then move the plane back six inches and take a second shaving down to the tip. Keep working back six inches at a time making successive passes. You should finish with one pass that extends the whole length of the batten and comes close to our layout mark on the small end. Repeat the process on the remaining sides till you have a tapered batten capable of using as a template to draw graceful irregular curves. To use just tack it to your work using small brads and bend the batten to suit your eye.

Bushwhacking

This knowledge about generating curves with a compass is a great way to layout curves but also offers clues to proficient freehand drawing. I find it helps to first draw a straight line and mark where you want your arc to begin and end. Then mark the midpoint of your arc and mark a reference where you think the highpoint of the arc should lie. Drawing a freehand arc is much easier if you have these reference points to guide your hand and eye.

Please take practice time to walk through these drawing sequences yourself. They will help to train your eye and also help you to unpack curves you see in nature and the built world. For more practical information about curved layouts you can refer to "By Hound and Eye" published by Lost Art Press. **PW**

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George is the co-author of three design books and writer of the *By Hand & Eye* blog (with Jim Tolpin).

Bowl Gouges

All you need to turn a gorgeous bowl is one tool.

By Alan Lacer

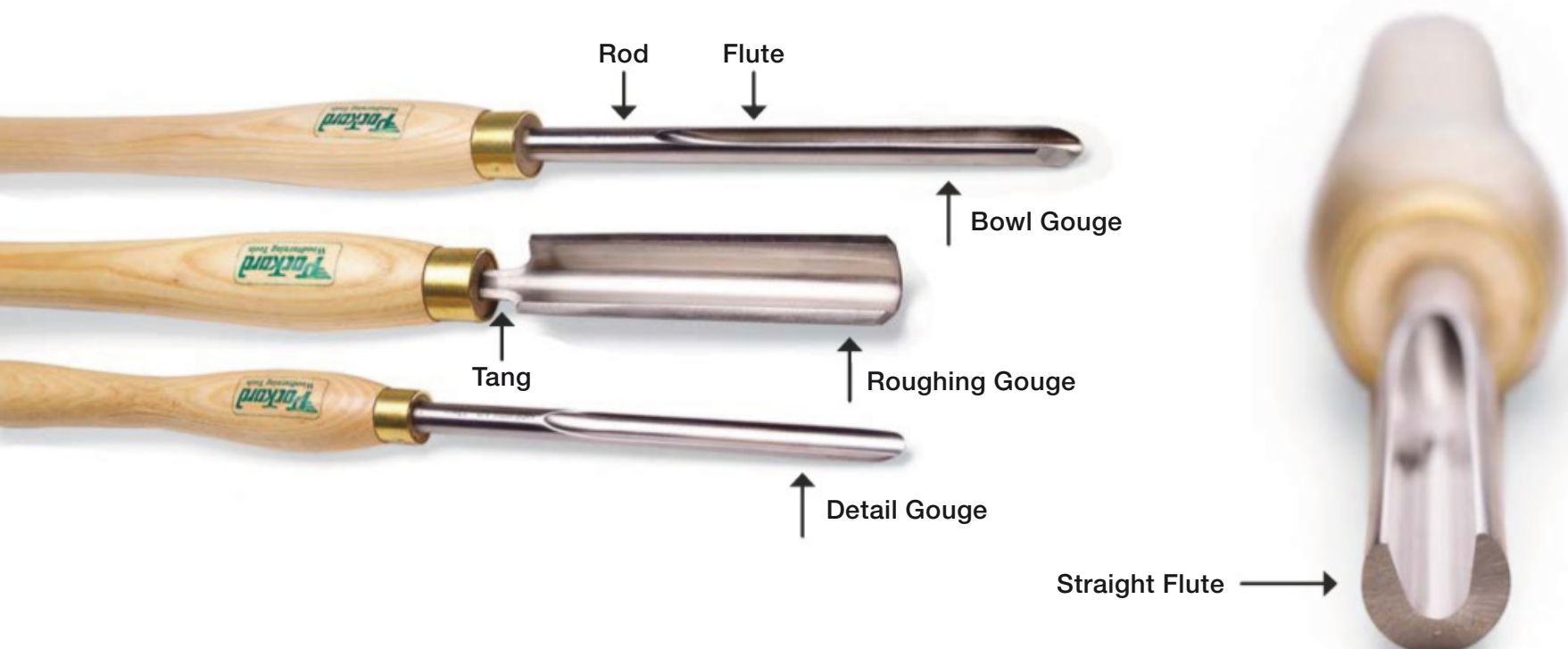
Bowl turning is a blast! Thanks to advances in lathes and tooling, lots of woodworkers have now discovered how fun it is to turn a hunk of green wood into a beautiful bowl. Start to finish, it only takes a few hours, and the wood is usually free.

Whatever the bowl's shape, you need one basic tool: a bowl gouge. I've been asked countless questions about how to buy a bowl gouge during my 40 years as a professional instructor. There's a lot of confusion about what a bowl gouge really is, how it's sized and ground, and which type is best. Here's what you need to know to get started.

What is a Bowl Gouge?

A modern bowl gouge has three parts: a rod, flute and handle. A solid round rod makes the tool very strong. The rod's flute is generally a deeply cut oval, which improves the tool's chip-cutting action. A bowl gouge usually has a large handle, about 16" long, for increased leverage.

A bowl gouge is often confused with a roughing gouge. A roughing gouge is used in spindle work, such as turning a table leg, to remove a blank's square corners or cut a



Bowl Gouges



cylinder or taper. It should not be used for faceplate work, such as turning a bowl. A roughing gouge has a tang, which isn't designed to take as much downward pressure as a rod. The tang could bend or break under the larger force involved in turning a bowl.

Bowl gouges are also often confused with detail gouges, which are also called spindle, fingernail or shallow gouges. A detail gouge has a shallower flute than a bowl gouge. A detail gouge is designed for shaping small elements, particularly in spindle work, although it is used in bowl turning for shaping rims, bases and feet.

Flute Shapes

The flute is the inner, milled portion of a bowl gouge's rod. The flute's shape varies among manufacturers. Its deep oval may have round or straight sides. Both types are easy to learn how to handle, so it doesn't really matter which one you get. Individual turners have their favorites, but no single design is a runaway winner.

Bowl Gouge Sizing Systems

Manufacturers use two different, competing systems to size bowl gouges, which can be confusing. In the commonly used English system,

a gouge's size is approximately the width of its flute. In the less commonly used North American system, the gouge's size is exactly the diameter of the rod (which I think makes a lot more sense). As a result, the same gouge is usually labeled $\frac{1}{8}$ " smaller in the English system than in the North American system. For example, a $\frac{1}{2}$ " gouge in the English system is the same size tool as a $\frac{5}{8}$ " gouge in the North American system. Note which system a dealer uses before you order.

Bowl Gouge Sizes

Bowl gouges are available in a wide range of sizes. You don't

Edge Profiles

Bowl gouges come with many different edge profiles. This shape is also called the tool's grind, because it's created and altered on the grinding wheel.

Each profile has its pros and cons. You don't have to worry too much about which profile a new tool has, because you can reshape it. Whatever its profile, or price, a new tool often needs reshaping or more sharpening.

TRADITIONAL GRIND

Many bowl gouges come with a traditional profile. This shape is easy to sharpen but has limitations. For some bowl shapes, it's difficult to rub the bevel on either the inside or even the outside of the bowl.

FINGERNAIL GRIND

I call this profile the fingernail grind. It's more versatile than the traditional profile, so I recommend it for beginners. Few gouges come with this profile, though; usually, you must grind it yourself.

IRISH GRIND

This swept-back profile has been called many names, including Irish, Celtic, side grind and Ellsworth. This is the most versatile profile, allowing you to rough, scrape and finish a bowl with a single tool. It is a bit more difficult to sharpen and use than other profiles.



Bowl Gouge Steel

Look for a bowl gouge made from high-speed steel (HSS) rather than high-carbon steel. A HSS gouge resists wear much longer and can't normally be softened by overheating on the grinder. There are three general grades of HSS to choose from (see chart); all can be made equally sharp to begin with, but higher grades hold their edge longer. Most HSS gouges are made from M2 steel, which is an excellent alloy. I recommend you buy an M2 gouge first, before you become an expert sharpener, because the extra steel you'll remove while learning how to sharpen is less expensive!

Type of HSS Steel	Average Price of 1/2-In. Gouge	Approximate Wear Factor*
M2	\$50	5
M4 and 2030	\$75	15
A11 and 2060	\$100	22

*Average ability to resist wear compared to high-carbon steel, according to manufacturers.



1 1/2" bowl gouge is a nicely balanced size for most bowl turning on a standard-size lathe. With this workhorse tool, you can turn 5" to 24" dia. Bowls.

2 3/8" bowl gouge is a better choice if you own a mini-lathe. This gouge is large enough to turn a bowl as big as the machine can handle, but it's not so aggressive that it will bog down a mini-lathe's smaller motor.

3 1/4" bowl gouge was traditionally used for finishing the inside or outside of a bowl. I prefer to make a light finishing cut with a 1/2" gouge that has a fingernail profile.

4 5/8" or 3/4" bowl gouge is useful for making heavy, aggressive cuts on bowls larger than 14" in diameter. Turning a monster bowl usually requires a heavy-duty, large-capacity lathe with a 2HP or larger motor.

need a whole set. If you own a standard-size lathe with a 12" to 14" swing, buy a 1/2" gouge, English System (5/8" North American). All the gouges shown here are sized by the English System. **PW**

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Alan has been a turner, teacher, writer and demonstrator for more than 40 years. See more at alanlacer.com



PROJECT #2001

Skill Level:

Beginner

Time: 2 Days

Cost: \$100

■ Woven Paracord Bench

If you can cut a lap joint, you can make this bench.

By Andrew Zoellner

When I started woodworking, it was driven by necessity; I needed something that didn't exist, so I made it. My woodworking was also driven by a desire to spend my time doing something productive and learn some new skills. It was also helpful if the project could be completed with readily available materials in a couple of days, because my first "shop" was just a bin full of modest tools I kept stashed in my room in a college house. That's where this design started.

I bought the materials at the home center: two 8' red oak 2x2s and 300' of 1/8" paracord. I dug through the handful of oak 2x2s in the bin to find a pair that were pretty much riftsawn (meaning the grain runs vertically on all four sides) and mostly straight. Like most home center materials, they aren't a true 2" x 2"; the nominal dimension is 1 1/2" x 1 1/2".

I landed on paracord as the seat material because there were a bunch of colors available (white, black,

lime green, high-visibility orange, red/white/blue, etc.), it's very durable and relatively inexpensive (about \$30 for 500'). Plus, in an emergency, this bench provides all of the paracord I'd need to survive. (Should it be called a survival bench? Should you make one for your bunker?). All in all, I spent about \$75 on materials at the home center. I did need to order the Danish nails online (about \$15 shipped for a box of 100).

I built this bench with only a cou-

PHOTOS BY THE AUTHOR

ple power tools (a circular saw and random orbital sander), a few hand tools (chisel, block plane, stapler) and some clamps. All of the joints are lap joints (lots of half laps and a few cross laps), cut using a simple straight edge jig with a circular saw.

I used some scrap 2x2 to dial-in the cut depth of the circular saw. The base of my jig was a true $\frac{1}{4}$ " piece of veneered MDF, so I was able to use the saw's depth guide (minus $\frac{1}{4}$ ") to get close to the $\frac{3}{4}$ " deep cuts I needed to make. After cutting a few practice joints (all of the laps needed to be $1\frac{1}{2}$ " wide and $\frac{3}{4}$ " deep), I moved onto the real thing.

Joinery

First, cut all of my pieces to length with the circular saw (if you have a miter saw, this is also a good use for it). Then mark out the first joints, using actual stock (instead of measuring $1\frac{1}{2}$ ") for spacing. Clamp the first four like pieces together and made the first cut with the circular saw, establishing the shoulder. Then, it's just a few more relatively equally space cuts through the waste. Take your chisel and pry out the waste—it should snap out relatively cleanly.

Then come back and clean up the waste with the chisel and block plane (a shoulder plane would be helpful here, too, if you have one). Work through the rest of the joinery in batches like this; you'll see some of the parts are the same dimensions. When you get to the cross laps in the legs and top pieces, pay attention to where you've positioned the joints—this is the part that can get a little confusing if you're not careful.

Glue and Finish

With all of the joinery cut, dry fit the bench together and fine-tune the fit of your joints if needed. Rehearse your clamping sequence to make sure it'll all come together when you have glue on it. Then, disassemble and add the glue and clamp. I try to wipe up any squeezeout with a damp rag, especially when I'm going to be sanding after the fact.



After the glue has cured, remove the clamps and clean up any missed glue squeeze out. If you have any gaps in your joinery, now is the time to fix them. Sawdust and wood glue mixed to a putty consistency works well for filling in small gaps. Small slices/shavings with a bit of glue work well for larger gaps. Then, sand up to 180 grit. I added a few chamfers with the block plane to knock down some sharp edges and help the pieces blend together a bit.

I've been experimenting with different hard wax oils lately, and used Briwax's hard wax oil on this piece.

1 Just a few tools are needed to make this bench.

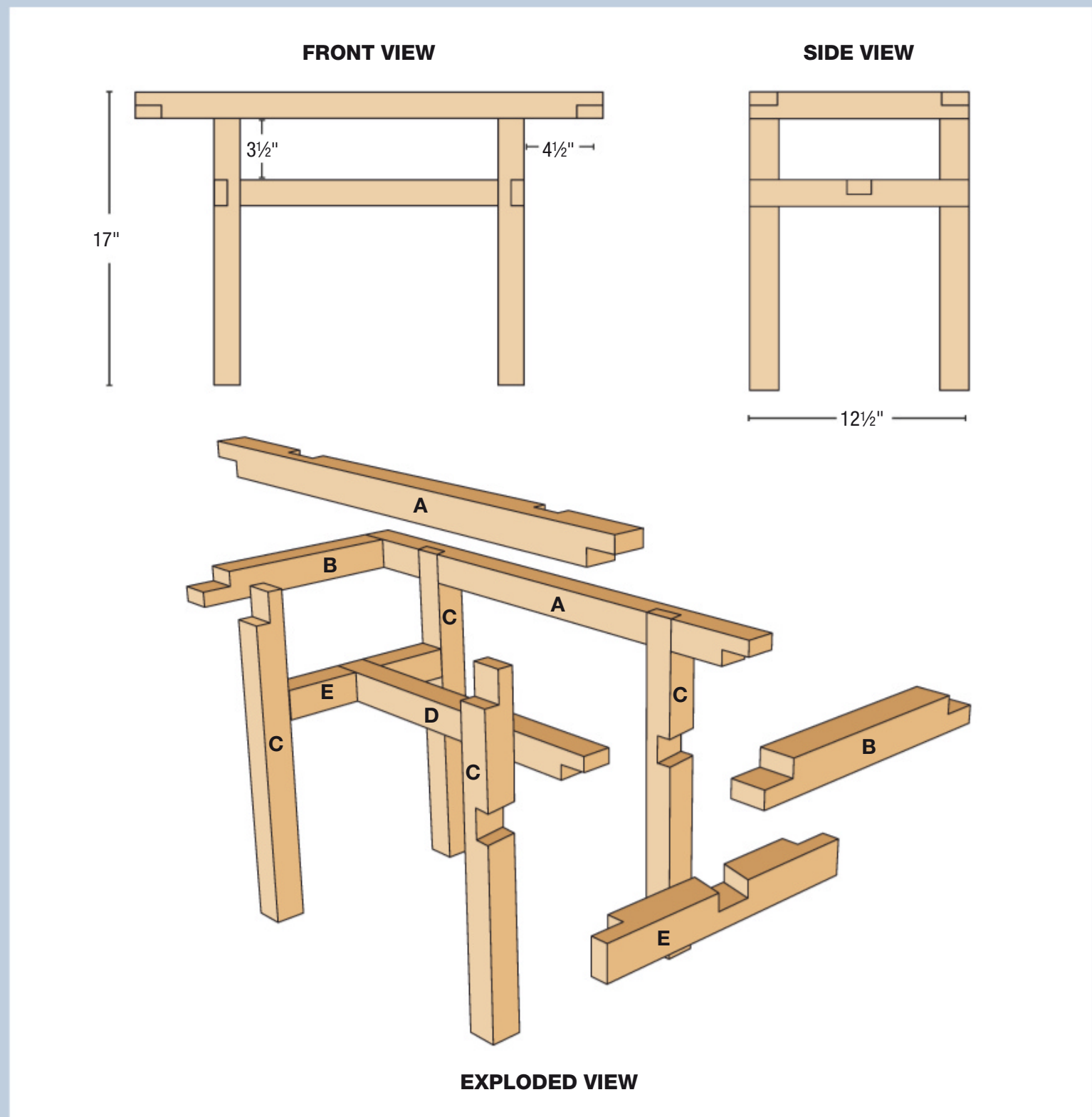
2 Start by cutting the joinery. Use your actual parts to mark out each joint and batch parts where you can.

3 A simple edge guide for your circular saw establishes the shoulder of the joint. Then make a few more cuts and pop out the waste with a chisel.

4 Clean up the joints with a chisel and block plane, refining the fit as needed.

5 Dry fit all of the pieces, then add glue and wait for it to cure.

■ Woven Paracord Bench



Cut List

No.	Item	Dimensions (inches)			Material
		T	W	L	
2	A Seat Rails	1 1/2	1 1/2	27	Oak
2	B Seat Sides*	1 1/2	1 1/2	12 1/2	Oak
4	C Legs	1 1/2	1 1/2	17	Oak
1	D Stretcher	1 1/2	1 1/2	18	Oak
2	E Supports*	1 1/2	1 1/2	12 1/2	Oak

*These are the same length. End joinery can be cut at the same time.

It's a very easy finish to apply (wipe on liberally and wipe off excess). And, it builds a nice, satin-y finish and the oil imparts a nice color.

Seat Weaving

Insert Danish nails around the perimeter of the seat, with the points sticking up. Use a small drill bit to make pilot holes for the nails and then tap them into place with a hammer. The spacing isn't critical—aim for a nail every inch or so. Then, it's time to start weaving.

Start with the warp (the rows of cord you'll weave through). Staple the end of your paracord inside the frame. Then wrap it around the outside edge of the frame, across to the other side. Go over the edge and then loop your cord on the nail and come back out over the outside edge (and repeat). It's confusing at first, but you'll get the hang of it. You'll loop over each nail more than once. Try to keep things neat. When you need to add another length of cord (I kept mine in 100' increments), secure the ends with staples, and keep weaving.

When you get the end of the warp, wrap the end of the warp around a nail and loop up around the side of the seat. Now you're working on the weft (the part of the seat where you're going over and under the warp). I use a pair of dowels separate the warp so I can slide the cord through quickly.

With the first row of cord through, wrap the cord around the edge of the seat five times, and on the sixth weave the cord back through the warp to the other side. Loop over a nail then wrap around the edge five times (starting next to the previous row). With the sixth wrap, cross over the cord and wrap five more times. Weave the cord back across to the other side on the sixth and repeat.

This sounds complicated, but after a few tries it'll start to click. You want the outside of the bench to look nice and orderly, but the inside



will be a bit more chaotic. And, as you proceed through the weaving, things will start to tighten up. The last few rows were slow going as I couldn't get my dowels in place and used a spare metal knitting needle to push the cord over/under the warp.

You'll likely not have perfectly straight rows. That's fine, because the last step is to eyeball everything and adjust the weave to make things appear nice and straight. Now take a seat and plan your next project.

Andrew Zoellner is Popular Woodworking's editor in chief. He now has a place to sit near the door to take off his boots.

6 I predrilled slightly-undersized holes for the Danish nails, spaced about 1" apart, around in the inside of the bench seat.

7 Start weaving by stapling one end of the cord to the interior of the seat.

8 The warp is created by wrapping over the seat and around the Danish nails.

9 The weft is started by wrapping around the seat.

10-11 I landed on wrapping the cord around the seat five times between each pass through the warp. The weave gets tighter as you go, so I used a metal knitting needle to finish the last few rows.



PROJECT #2002

Skill Level:

Advanced

Time: 5 days

Cost: \$500

■ A Shaker Dresser

Use the power of the sliding dovetail. **By Will Walker**

The Shakers were a Protestant sect of English Quakers that immigrated to the U.S. in 1774. They founded largely self-sufficient communities from Maine to Kentucky and lived by the three guiding principles of honesty, utility, and simplicity. To support their communities, the Shakers would sell the food they grew, but also made furniture for sale to the world outside of their communities. For the Shaker furniture makers, their

mission was to instill utility and longevity to the pieces they sold, all while sticking to their devout religious beliefs without adorning the pieces with any veneers, which they considered dishonest, flashy brass hardware, which they considered prideful, and simple lines without much adornment. They utilized stout joinery, and wooden pulls, giving Shaker furniture a distinct style. When the last shaker villages were dwindling in the 1930s, Faith

and Edward Deming Andrews recognized the Shaker movement disappearing from history and sought to document it before it disappeared. It is no coincidence that around this time the famous Arts and Crafts movement centered around craftsmanship and form over production, post-industrial revolution, followed by the Modernist movement of the 1930s, and the “mid-century modern” style found so ubiquitous today. All of

PHOTOS BY THE AUTHOR

these styles draw from the work ethic and design elements found in Shaker furniture with an emphasis on clean lines, attention to detail, and furniture that will last.

Prepping Stock

As with any project, stock preparation is key. I'm using cherry, a favorite of the Shakers. The majority of my stock is rough sawn 4/4 cherry that I milled flat and true in my shop, but you could also use S4S lumber. I prefer to mill my own stock so I can acclimate the rough sawn lumber to my shop, so it doesn't move very much while I'm working with it. I also like to lay out all of my parts before milling, keeping in mind I'll want to have grain continuity across my drawer fronts. Laying out different project parts in pen, marker, or chalk is a helpful visualization to maximize your lumber so there's less waste and you can utilize different grain patterns that lend themselves to components.

Gluing the Top

Panel glue-ups shouldn't be too stressful if you've properly prepped your stock. Face jointing then planing the opposite face, then edge jointing and finally ripping your stock to width at the tablesaw will provide a stress-free glue-up. I used a biscuit joiner to help me align the pieces, but you can skip this step if you pay close attention to board alignment.

When gluing up panels, make sure you spend most of your efforts on properly jointed boards and not applying too much clamping pressure, while also alternating clamps on the top and bottom of the glue up. This will help ensure a flat panel after balanced clamping pressure. My top finished at 19 7/8" deep by 60" long.

Casework

With the top glued up I started work on the casework of the base. The two sides of the carcass were glued up in the same manner as the top measur-



1-2 I used a shop-made parallel jig and my router with a dovetail bit to cut "dovetailed dados" in the sides of the case.

3 At the router table (in the wing of my tablesaw), I cut mating parts to fit. The jig that holds my parts in place rides on the tablesaw fence.



4 I did a dry fit of the parts once everything is milled. This is also essential to lay out the top stretcher, which uses half-blind dovetails.



5 I used a marking gauge to establish a baseline for the dovetails.

ing in at 19" wide and 30" tall.

I ripped some more Cherry stock down to 3" wide for the stretchers of the casework. I'm using the power of the sliding dovetail to make the assembly of the carcass much less stressful. With a shop-made parallel jig clamped square and perpendicular to the case side and a dovetail bit installed in the router, I cut the dovetail dados that would house the sliding tails into the sides equally spaced along the front edge of the interior of the two case sides.

Once I had my dovetailed dados cut, I could install the same bit into my router table and use a sled that rides over the fence of my router table/tablesaw to safely cut the sliding tails on the ends of the stretchers. I snuck up on this cut using matching thickness scrap to get a perfect fitting tail before committing to using my actual stretcher stock.

With the tails cut, I put a small chamfer on the leading edge of the tail for easier installation.

A dry fit of the casework thus far is essential to laying out the top stretcher. In the case of the top

stretcher, a sliding dovetail was not an option since the top stretcher would be flush with the top of the case sides. In this instance, I used half-blind dovetails to keep in the same theme of a clampless glue-up. Pocket hole screws could also be used in place of the dovetail, but these dovetails will likely never be seen by anyone, so this is a great excuse to practice cutting your dovetails.

After laying out my tail and socket boards, I gang cut my tail boards at the bandsaw. You could easily do this by hand, but the bandsaw saves time.

Once your tails are cut and the waste removed with a mallet and chisel, transfer your tails to the socket board (case sides), and start to cut your sockets. A lot of people are intimidated by half-blind dovetails but in reality, they are far more forgiving than "through" dovetails since there is one less show face to be concerned about.

Sawing on an angle, with either a Japanese pull saw (Dozuki or Ryoba) or a Western dovetail or rip filed backsaw, cut down to your layout

lines and finish the rest of the work with a chisel. Within the waste portion of your dovetail sockets, a firm blow of the mallet to the back of the chisel in the baseline of the socket to sever the fibers of the wood, followed by a tap of the chisel into the endgrain working in shallow passes evacuates the waste efficiently.

PRO-TIP: A cardscraper and mallet can be used in the kerf of the saw cut to help finish severing the fibers in the bottom of the dovetail socket.

Once the majority of the waste is cleared out, pare back to your knife lines to result in tight-fitting half-blind dovetails.

With the casework dry-assembled I marked the center divider of the case and the two middle stretchers for halved joints to be cut at the tablesaw utilizing a shop-made crosscut sled. The top and bottom stretchers would be getting the same sliding dovetail treatment as the case sides.

With all of the joinery cut for the casework I started the assembly. This is where the power of sliding and half-blind dovetails is



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6 Use dividers to lay out the spacing of the tails.

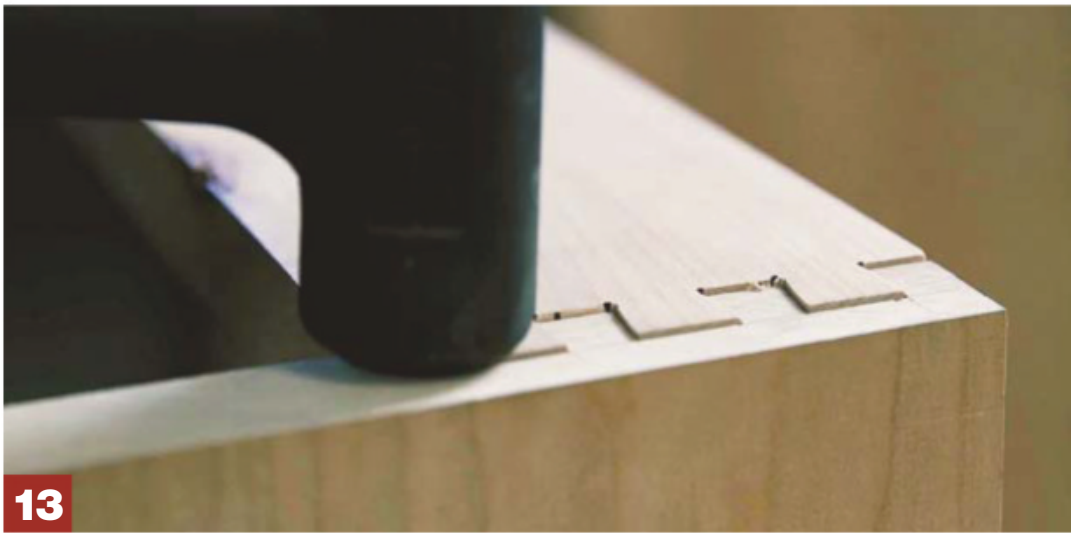
7 I then go to the bandsaw to quickly cut the tails.

8 Chop out the waste between the tails with a chisel.

9 Transfer the tails to top of the carcass sides.

10 Mark your waste, then cut until you're just shy of the baselines.

11-12 Then it's all chisel work. Carefully chop out the rest of the waste and pare to the layout lines.



13

13 Dry-fit the half-blind dovetail stretchers on the top of the case, then layout the center divider joinery.

14 Cut the halved joints in the two center stretchers at the tablesaw, sneaking up on a perfect fit.

15 The center divider is held in place with sliding dovetails on the top and bottom stretchers, and halved joints in the middle stretchers.



14

very apparent. At 5' long, I would have been starved for long enough clamps in my shop. These dovetails provide a stressfree, clampless assembly taking advantage of opposing geometry to bring these joints together.

Making the Drawer Boxes

As the glue dried on the carcass, I started work on the drawer boxes. For the drawer boxes I chose to use poplar, an excellent secondary wood that is affordable and easy to work. I started with 5/4 rough sawn stock and milled it flat and smooth at the jointer and planer. I find that 4/4 S4S lumber is too bulky for drawer boxes so I like to resaw my 5/4 stock at the bandsaw giving me box sides of 1/2" - 5/8". Resawing, for a lot of woodworkers, is daunting due to poorly setup bandsaws. With a properly set up bandsaw, and a sharp blade, resawing is easily one of the most satisfying tasks I do in my shop and opens up the quality of work you can produce with bookmatched panels. I follow the method of Alex Snodgrass. A quick web-search should provide ample results.

Back at the tablesaw with my crosscut sled and a stop block on the fence, I cut all of my box sides at once. I do a lot of commissioned work so, while I could have cut the half-blind dovetails for the boxes by hand, I invested in a commercially available router jig for dovetails. It has paid for itself many times over with the time it has saved me. It's a



15

fairly clever design in that it cuts the tails and sockets at the same time. With six drawers adding up to 24 corners to dovetail, you can see how this is a timesaver. After all the dovetails were cut, I cut a quarter inch groove to accept the $\frac{1}{4}$ " drawer bottoms, being sure to cut through the bottom dovetail so the groove didn't show on the outside of the box.

Assembly of the drawers goes fairly quickly assembling three sides of a box with glue, sliding in the $\frac{1}{4}$ " Maple ply bottoms and installing the fourth side. I always pull diagonal measurements to ensure the boxes are square before the glue dries. If there is any discrepancy, a clamp placed diagonally over the offending corners pulls the box into square.

The Bottom Aprons

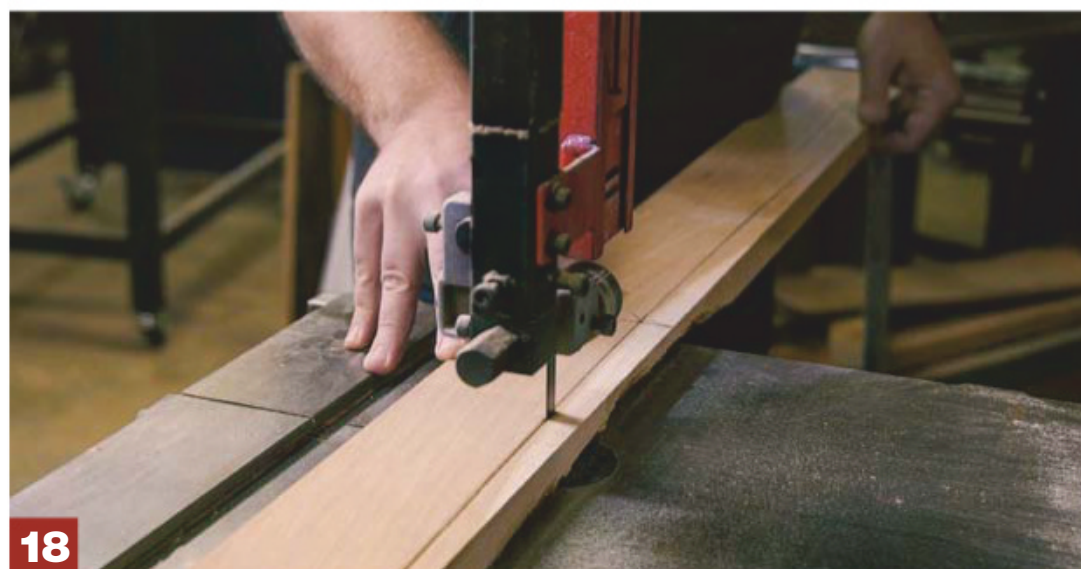
For the bottom of the carcass, a decorative and functional bottom apron is added. For this piece, I paid close attention to grain and found a piece

16 I turned to a router jig to cut the half-blind dovetail drawer joinery.

17 I cut a $\frac{1}{4}$ " groove around the bottom of the drawer parts, making sure it's centered on the bottom tail so it doesn't show on the outside.

18 I added a subtle curve that follows the grain on the bottom apron.

19 In true utilitarian fashion, I attached the bottom aprons with pocket holes and screws.





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of Cherry with an arching grain and followed that. A piece of scrap $\frac{1}{4}$ " plywood is used to make a makeshift drawing bow to trace out a sweeping curve. I cut close to my line at the bandsaw and cleaned up the cut with a spokeshave to get down to my line.

The Shakers were a pragmatic culture. They used pocket hole joinery in their furniture and so, I decided that I would too. The bottom apron, both front, and back, is secured with glue and pocket holes. I then added a Luan back to the casework.

Finishing the Casework

On the underside of the case sides, I added a small chamfer to mitigate the chance of the grain splitting out as the piece of furniture is surely going to be slid along a floor at some point in its life. This Cherry had some beautiful subtle curly figure that could only be enhanced by the use of a card scraper or smoothing plane.

The underside of the dresser top received a light cove profile cut with the router and cove bit. The case and top were finished with Danish Oil. This is a very easy finish to apply though it isn't as bulletproof as say a wiping varnish or polyurethane, it's easily renewable which is always a plus.

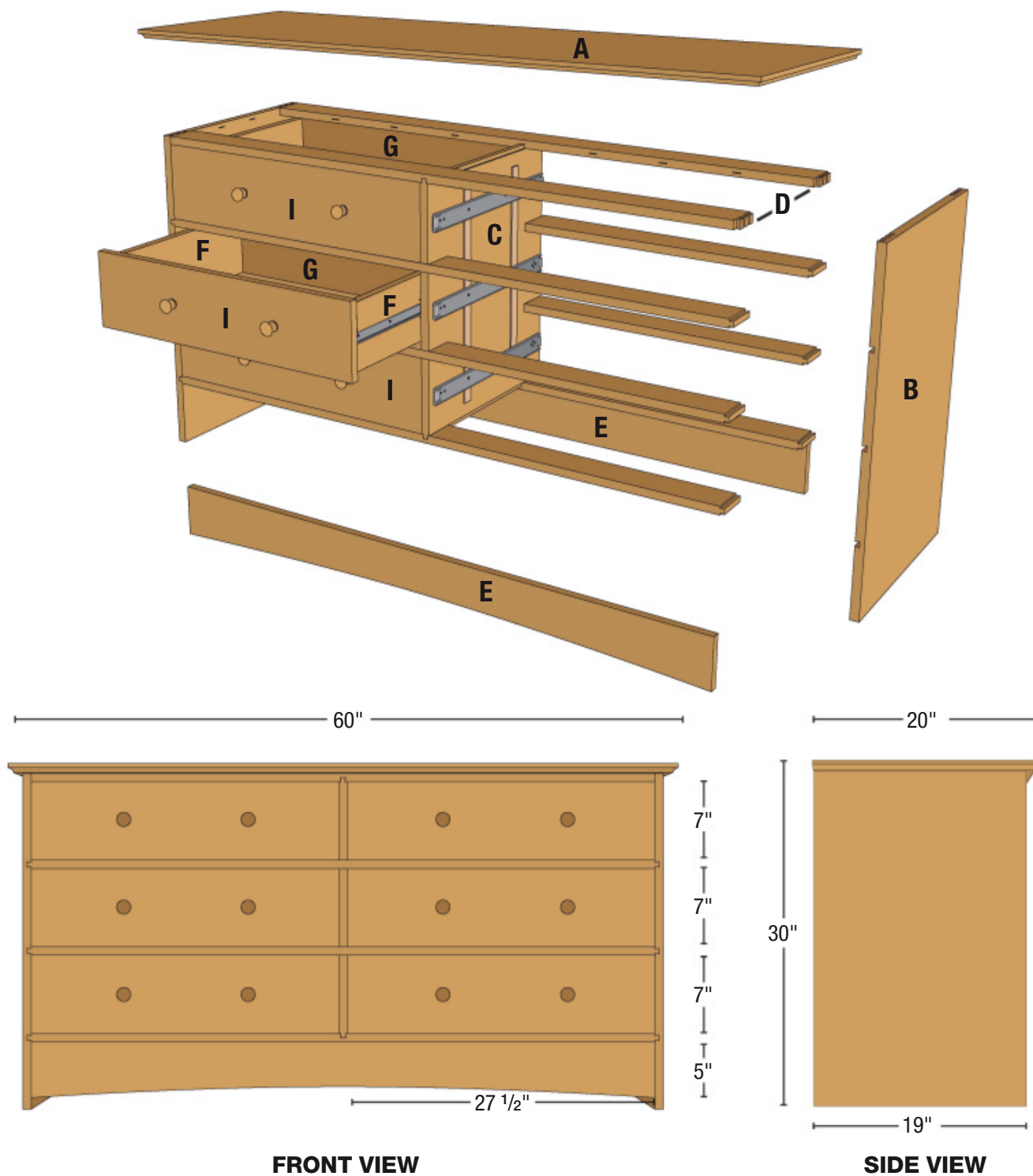
The dresser top is mounted using metal Z-clips to allow for seasonal wood movement. Slots are cut around the perimeter of the inside of the carcass with a biscuit joiner, though a router and slot cutting bit would also work.

20 I attached the back apron with pocket holes and screws, then added the Luan back panel.

21 The top of the dresser got extra love with a plane and scraper to reveal some beautiful grain.

22 I finished the whole dresser with Danish oil. While not as protective as other finishes, it's easy to apply and renew.

Shaker Dresser



Cut List

No.	Item	Dimensions (inches)			Material	Comments
		T	W	L		
1	A Top	3/4	20	60	Cherry	
2	B Sides	3/4	19	30	Cherry	
1	C Center Divider	3/4	19	24	Cherry	
2	D Stretchers	3/4	3	60	Cherry	Slightly overlong. Cut to length during dovetailing.
2	E Bottom Aprons	3/4	5	60	Cherry	Trim to fit final opening.
12	F Drawer Sides	1/2	6	18	Poplar	Slightly overlong. Cut to length during dovetailing.
12	G Drawer Fronts/Backs	1/2	6	26 1/2	Poplar	1" narrower than drawer opening to accommodate slides.
6	H Drawer Bottoms	1/4	17 1/2	26	Maple Plywood	Trim to fit.
6	I Drawer Show Fronts	3/4	7	27 1/2	Cherry	Trim to fit final opening size.
1	J Back Panel	1/4	30	58	Luan Plywood	



23-24 A biscuit joiner makes perfect slots to attach the top with Z-clips.

25-26 I used side-mount ball bearing drawer slides for the drawers to make sure the drawers open and close effortlessly during all of the seasons here in Virginia.

27 I made circular mortises for traditional wooden pulls at the drill press.

28 The wooden pulls are just glued in place. A drinking straw cut at an angle is the best way I've found to remove glue squeezeout in close quarters like this.



29 Playing cards help me get the perfect reveal around the drawer fronts.

30 I attach the drawer fronts with hot-melt glue, then drive in screws from the back to secure them.

31 Add finish to the drawer fronts and touch up the rest of the dresser, and it's done.



Installing the Drawers

I installed the drawer boxes using soft-close side-mounted ball-bearing drawer slides, though you could use more traditional wood slides, or the sleek undermounted ball-bearing slides depending on your budget. With the boxes installed I could then fit the drawer faces. The drawer faces feature a continuing grain pattern across the front of the dresser. Attention to details like this show you put thought and care into your furniture which can help your work stand apart. To fit the drawer fronts, I use playing cards as shims to get an equal reveal around the drawers.

Once the drawer fronts had been fit, I installed traditional wooden shaker pulls, cutting the round mortises at the drill press. A good trick for removing any glue squeeze-out is using a disposable drinking straw to get into hard to reach places. The way I like to temporarily secure the drawer fronts is with hot melt glue to hold them in place until you can open the drawer and permanently secure them from the inside with screws.

After the drawer fronts were installed the only thing left to do was apply the same danish oil finish to the fronts and pulls and call this a completed Shaker dresser. **PW**

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Will Walker is a custom furniture maker and Youtube creator located in Barboursville, VA. Will was raised in the trades and has been honing his woodworking craft since 2012. He started the Wm. Walker Co. in 2015.



PROJECT #2003

Skill Level:
Intermediate
Time: 2 days
Cost: \$250

■ Small Shop Miter Station Stand

A welded base provides tons of strength for a versatile platform. **By David Lyell**

PHOTOS BY THE AUTHOR



My shop is a 12x24, one-car garage. I've fought (myself mostly) to optimize every square foot of that space to create a shop I enjoy spending time in and doesn't leave me perpetually frustrated. I've worked in this space for a little over a year and recently made a major layout change with a new miter station.

The purpose of the change was to find a place on one of the long walls, preferably in the middle of my shop,

for my jointer. It was the last large power tool that didn't have a home. For the last year, I've parked it against the garage door, and I had to drag it out to the middle of the shop when I needed a decent amount of infeed and outfeed space. That process wasn't awful, but one that I dreaded enough that I wasn't using my jointer for quick tasks because of the hassle. My solution was to park the jointer under my miter station.

To do this, I designed a cantilevered stand that would allow my jointer to slide under the miter station for storage and back out from under the miter station—right into the long walking path through my shop for use. I have at least 8' of infeed and outfeed by placing the jointer in this location. After researching available options for cantilevered worktables, I decided to build my own.

I sketched out the design for the stand in a few minutes based on some measurements of my jointer and the miter station top that I already had on hand. I wouldn't have felt comfortable building the frame in the style that I wanted with wood stock that was less than 3"x3", and that would have made it very bulky (and taken up more space). So I made a quick decision to use tube steel. I've used 2"x2" before and liked the aesthetic of it. Also, I tend to use 1/8" wall material in my shop because I run flux core wire in my MIG setup. That gives the tube enough meat that I won't easily blow through the material, and there's plenty of material to feather in any welds that need extra grinding. Plus, a shop project is the perfect time to practice my welding skills.

Totally Tubular Frame

Cantilevered frames are typically very simple. They're essentially a regular table with the front legs pushed back toward the rear legs. Some forgo the four "legs" and will use a wide piece of material in their place. Either way, the front of the table acts as a lever upon the legs, so everything must be robust. I've seen commercially available cantilevered tables for as low as \$500 and for more than \$2,000. I am happy to report that the steel for this project clocked in at just north of \$125. A bargain for a custom tool stand that will accommodate my needs perfectly. In my neck of the woods, we have several metal suppliers that will sell to individuals and will



provide cutting services for a small charge. Online vendors will do the same, but shipping can be pricey.

For this project, I purchased two full pieces of 2"x2" tube with a 1/8" wall thickness. From the supplier, a full piece of that stock is 24' and for this project, I elected to have them cut all of the stock to 48" pieces (so I could pick it up on my lunch break in my car). You'll also need some 2" wide flat stock—I had some leftover from my last build.

Start with the Feet

The bottom feet and the horizontal top supports receive a 45° cap on



1 I had my stock rough cut to 48" sections. Convenient for transport and a reasonable rough size for this project.

2 Capping the square tube isn't necessary, but it looks much nicer. Here's the cap, the part with the 45° cut and the finished product.

3-4 It's easy to go overboard when grinding welds. Once the weld is ground flat, there's a tendency to grind surrounding areas and your part will look bad once the paint is applied. Here I'm working the bead down until it's flush with the tube.



the front end for aesthetic purposes. The idea is to relieve some of the chunkiness of the tube frame. The top supports and the feet are both 24" long, so you should fit all 4 parts into 2 sticks of precut, 48" stock. I made the angled cut on my cold cut miter saw and then cut flat stock for the caps to 2 1/2" long.

Grind down every edge that will receive weld. Think of the caps as sitting upon the face of the angled cut. Once the cap is welded on, there will be a considerable amount of grinding to bring everything flush. Had I cut my cap to fit inside the tube, I'd have less grinding to contend with. But with the 2" flat stock on hand, I decided to put it to use.

Tack the top corners of the cap and then quickly tack the bottom two corners. If you allow the top tacks to cool before the bottom of the cap is tacked on the cap will pull up as the tack welds contract. This is an issue we'll address more thoroughly while assembling the frame.

While I was welding all four caps on, I found that a thick bead was best for the top and bottom of the cap, so as to compensate for the angled nature of those surfaces. The sides of the cap need a much smaller bead, as there isn't much room for anything else. Grind down the welds, but be mindful of exactly what you are grinding.

It's easy to get carried away and to attempt to make everything smooth, only to find out you changed the shape of the whole front of the tube. Focus your grinding on the bead itself and work it down until you are essentially flush with the surface of the tube. Then you can gently smooth everything together.

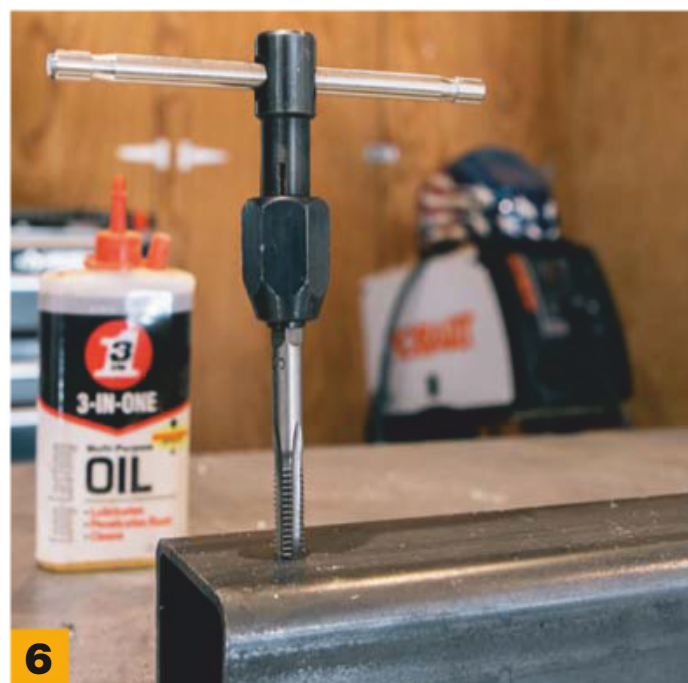
Tap Your Levelers

When you start working with metal, you'll find that drilling and tapping is a really handy skill to have. For the leveling feet, I am using standard 1/4"x20 bolts—nothing fancy. Taps are paired with a specific drill size. In



5 A 1/4"x20 tap and #7 drill bit. These are often sold as a pair, but if you lose the bit, you can use a 13/64" bit in place of the #7.

6 When running the tap through the pilot hole, make sure to break the chips every turn (at least). A short counterclockwise movement will cause the chip forms on the cutting edge of the tap to break off.



this case, a #7 drill. The closest drill bit size to this is 13/64", 0.002" larger than a #7, but it will work in a pinch (especially in a non-critical application like this). When drilling your pilot hole for the tap, make certain you're drilling as close to 90° to the workpiece as possible. A drill press is ideal, but I did it with a hand drill.

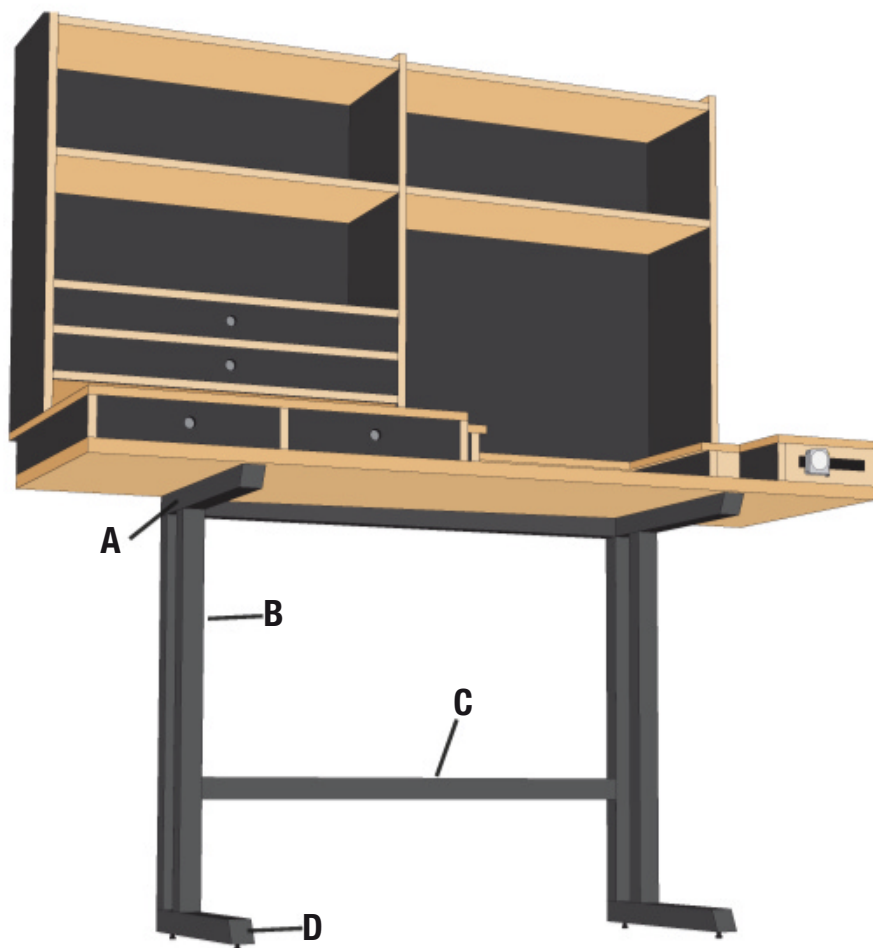
Drilling holes in metal tube is something you'll develop a feel for. I mark my location with a center punch because unlike drilling in wood, your bit will wander before it engages with the material. Once you are fully engaged with the drill bit, you can progress quickly, but there will be feedback in the hand drill as the bit nears the backside of the tube. It'll almost feel like the mate-

rial starts to give and that's when I back off of the downward pressure and punch through slowly.

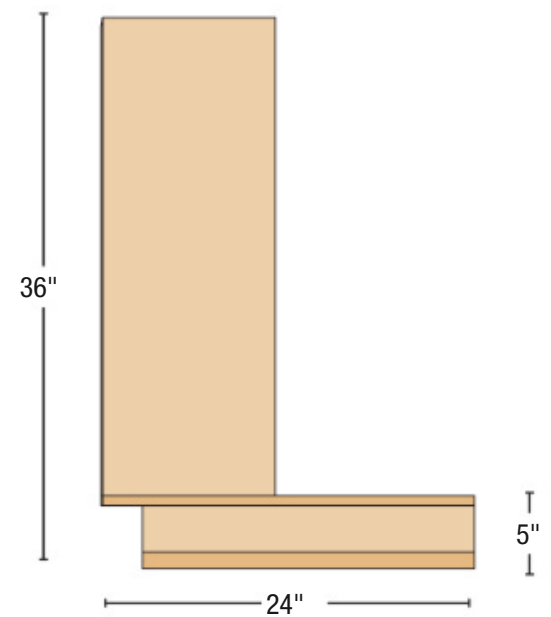
With the hole drilled, you can start tapping. I add a drop of oil to the tip of the tap and start tapping slowly. The tip of the tap has a small amount of cutting surface, widening as you move deeper into the tap. Keep the tap as perpendicular to the work as possible. It's easy to allow the tap to pull to one side and create threads that are off of 90°.

Tapping by hand is slow, but there's less chance of the tap breaking. Taps are brittle and a pain to remove if you break it in the hole mid-cut. Once you get some experience, you can run a tap in hand drill, but that comes with time.

Small Shop Miter Station Stand

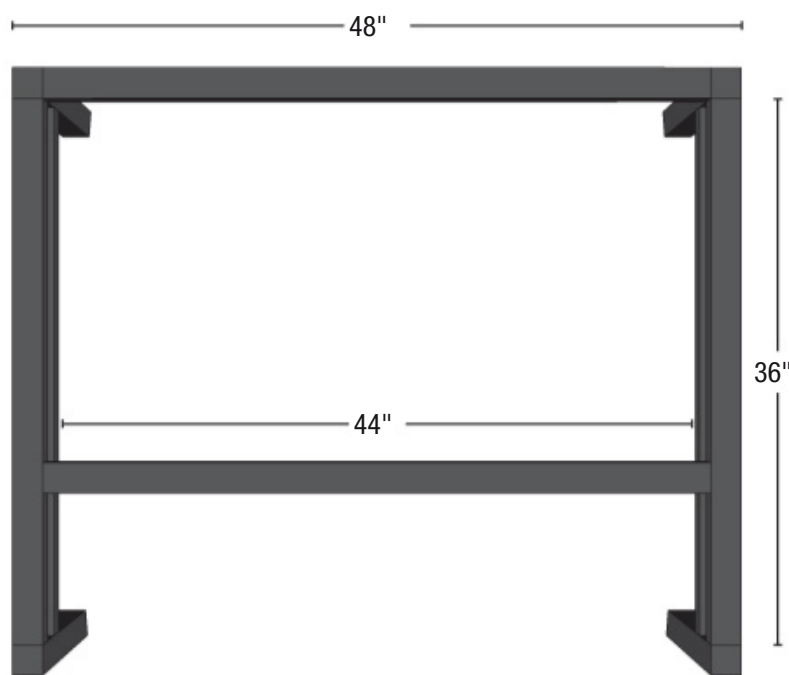


SIDE VIEW

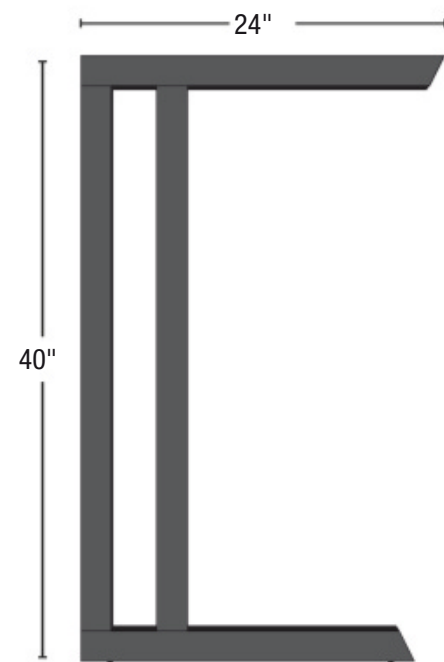


Metal Cut List

No.	Item	Dimensions (in.)		
		T	W	L
4	A Top/Bottom Supports	2	2	24
4	B Legs	2	2	36
2	C Horizontal Supports	2	2	44
4	D End Caps	1/4	2	2

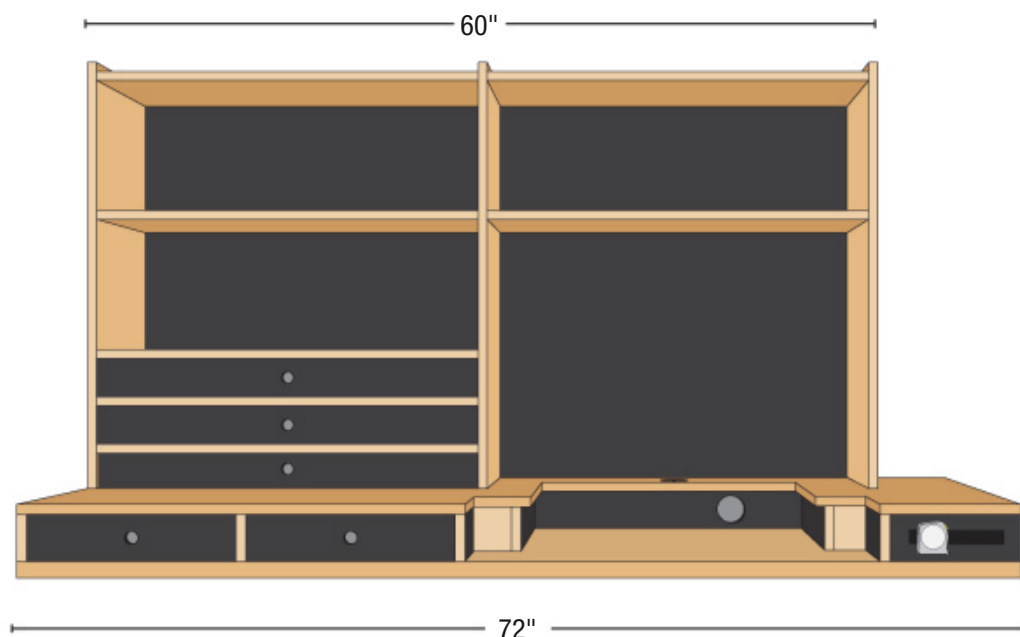


BACK VIEW



SIDE VIEW

ORGANIZER VIEW



EXPLODED VIEW

Planning Your Saw Station

The real key to this miter saw station is the cantilevered steel base. That was what unlocked the design for me—the ability to store a jointer and a miter saw in the same spot, and have them both easy-to-use.

Building the cubbies, drawers and shelves on top of the stand are what took this idea from good to great. It's also very specific to my needs in the shop, the footprint of my 6" jointer and my specific miter saw.

So, put some thought into your needs before breaking out your welder. More storage is almost always useful, but pay special attention to what you're actually going to be storing. Maybe more drawers make sense for you, maybe you only need open shelves. Maybe you want doors on your shelves? And if you change your mind later, removing some screws and making modifications isn't the end of the world.

Shop projects like these really push my design skills, and often I'm iterating and designing as I go. Maybe that's why some of my favorite builds are from scrap sheet goods and cutoffs. For a woodworker, building shop furniture is one of the most satisfying activities I've found. But if my wife asks, I had to finish this so I could get to building that next piece of furniture for her. — D.L.

Leg Assembly

Cut the next four pieces of your leg assembly, two 36" sections for each side. I work on a small folding welding table, and this project just about maxed out its capacity. If your work table is flat, you can clamp the feet (or the top supports, depending on which end you'd like to start with) and ensure everything is square. I really appreciate the quick action of the Bessey lever clamps for this work, there's very little metal in their construction and they're bite is ridiculously powerful. Once engaged, your work isn't going anywhere.

Tack each corner where the legs and supports meet. I once heard that you can think of this process akin to tightening lug nuts. You want to move around the work in a star pattern. If you tack everything on one side, you'll end up warping the frame and you'll have to grind every tack off and start over.

Miter Station Stand



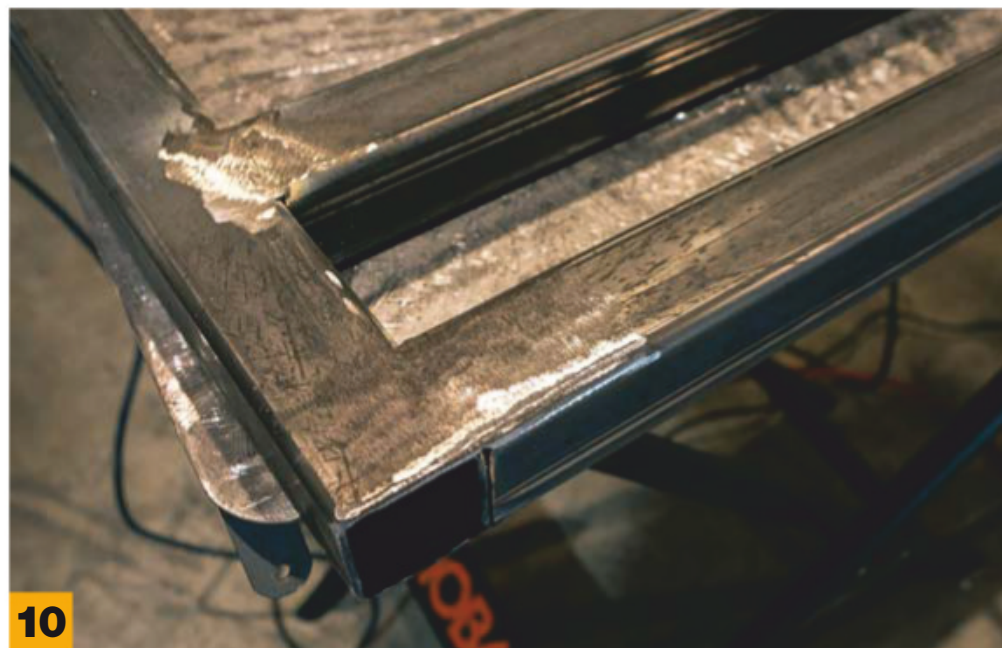
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7 I did not cap the back of the feet and the top supports. These will never be seen when the miter stand is backed against a wall.

8 A tack weld will pull as it cools. Here I am demonstrating what will happen if you don't tack your part in the correct order or use strong clamps.

9 Avoiding inside corners is one way to save time and create a clean looking joint. These welds haven't had the flux chipped off yet, but the inside corners are visible. Carry the bead all the way to the corner.

10 Attention to your feathering and sculpting here will pay dividends when you apply your paint.

A full weld is not necessary on every single edge. For a frame like this, I did not weld inside corners. This gives a very clean corner and you're really not jeopardizing the strength of the stand in this application.

Once you have each assembly tacked together, you're ready to grind down all the welds on each of the legs. Follow the same process as before, you may need to feather the grind into the radius on the side of the tube to achieve a clean look.

Stretchers

It's unlikely that your welding table will be big enough to bring the final assembly together, time to move to the floor. Make sure you're working on a single slab, not across an

expansion joint if you can help it. When working on the ground, you'll need to move the ground clamp for your welder to the actual part you are working on.

The upper stretcher sits flush with the top of the stand and is 44" long. I used a clamp below the stretcher to support the weight while putting the tacks welds on. Again, as long as you have full beads on at least two sides, you'll be in good shape.

The bottom stretcher sits 12" off of the bottom of the ground. And will add the final rigidity to the frame that is necessary for the miter station.

Final Touches

Once you've degreased the stand, you can spray the frame with a can



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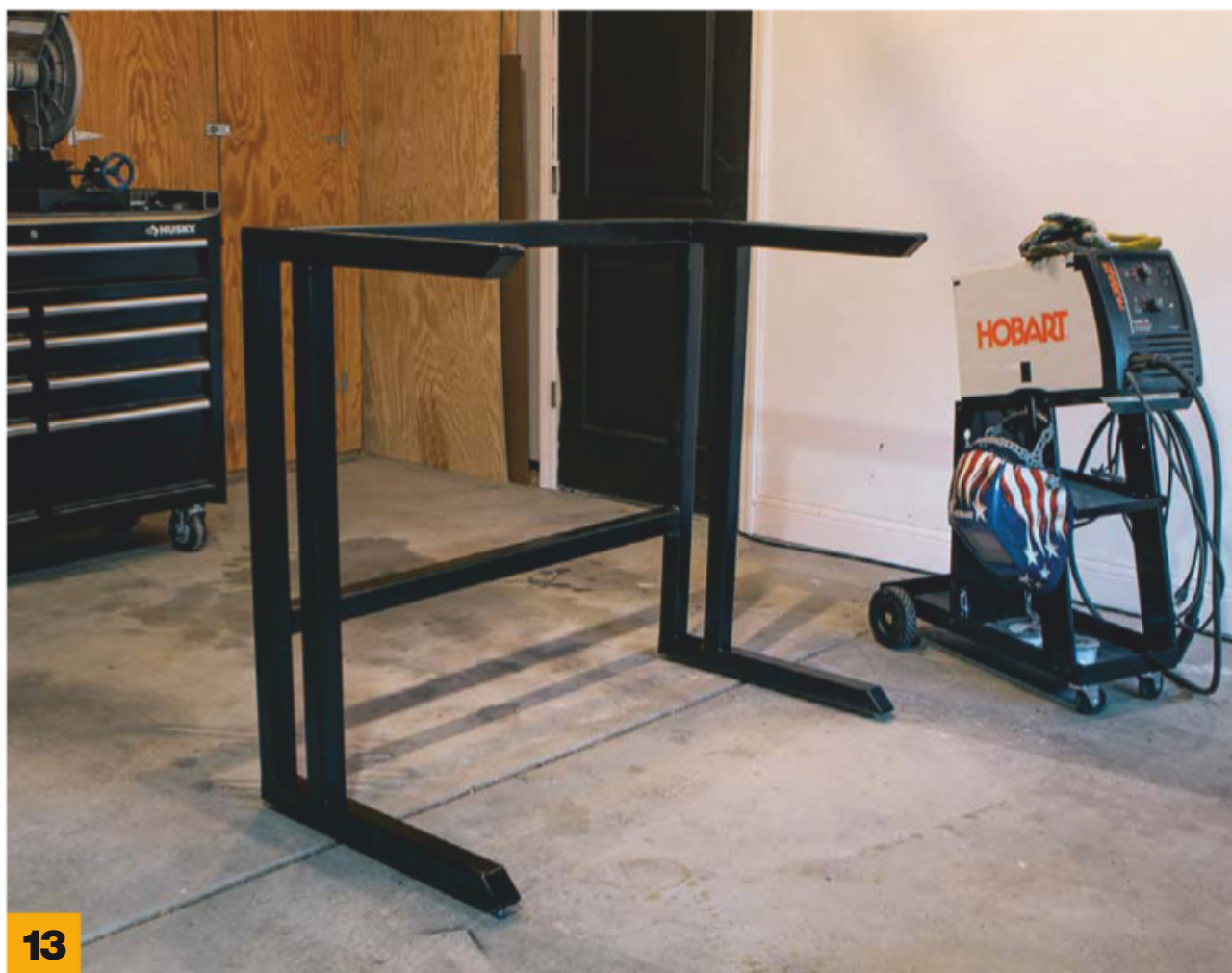
12

of spray paint. I find that a simple rattle can lays nicely on the tube steel. Add your 1/4" x 20 bolts to the feet and make sure the frame sits level. I drilled straight through the two-inch tube to attach the miter station worktop to the frame. If you have a solid wood benchtop, you may want to create larger holes in the frame to allow for wood movement or weld tabs to the inside of the top supports. Then, you can get to work on kitting out the top.

My first iteration of this stand was just my miter saw on a benchtop. Eventually, I added supports on either side, flush with the surface of my miter saw. I noticed empty space in those supports and added drawers. There was a bunch of wasted space behind the miter saw, so I enclosed it, added a couple port for dust collection, and made a series of shelves.

Like all good shop furniture, it's just plywood, butt joints and screws. With a sturdy base in place, I packed a surprising amount of utility into this compact spot. And, my jointer takes just a minute to slide out for use. **PW**

.....
David Lyell makes furniture in his small shop after his kids go to bed.



13

11 Both legs standing on their own. Time to weld the stretchers into place.

12 Wrapping your beads across all four sides would be nice, but two full sides are enough for this build.

13 The finished stand, freshly painted. Now it's time to work on the platform, drawers and whatever other storage you want to include.

Time for Tea:

The Restoration of a Mackintosh Landmark

Restoring one of Charles Rennie Mackintosh's greatest accomplishments 150 years after it originally opened.

By Kieran Binnie



MACKINTOSH
AT THE
WILLOW

LOCATED AT:

215 Sauchiehall Street
Glasgow G2 3EX, United Kingdom
www.mackintoshatthewillow.com

Willow Tea Rooms Trust
www.willowteamroomstrust.org

PHOTOS BY THE AUTHOR

As an architect and designer, Charles Rennie Mackintosh is synonymous with Glasgow—the city where he spent most of his life, and where several of his most significant commissions can be found. It is therefore unsurprising that his mercurial approach to design, which encompassed symbolism, Arts and Crafts, and Art Nouveau, ultimately became known simply as “the Glasgow style.”

In July 2018 a devastating fire destroyed much of the Glasgow School of Art, one of the most recognised and celebrated buildings designed by Mackintosh. However, only a three-minute walk around the corner, another significant Mackintosh landmark was undergoing a dramatic rebirth. After four years of painstaking restoration to both the structure and fitout of the building, costing nearly £10m, Mackintosh at the Willow re-opened its doors 150 years after it originally launched.

Introducing Tea Rooms

The Willow Tea Rooms at 217 Sauchiehall Street were first opened on October 29, 1903 by the entrepreneur Catherine Cranston, who took advantage of the rise in popularity of the temperance movement to present tea rooms as a morally appropriate recreation and meeting place. Despite being the fourth such tea rooms at which Mackintosh had been engaged by Miss Cranston, the Willow Tea Rooms were the first where Mackintosh was given total control over the design, both internal and external. The result was a tour de force in design, allowing the noto-



1 The Front Saloon and Back Saloon are furnished with Mackintosh's black stained box arm chairs and ladder back chairs. The Gallery mezzanine features the same furniture as the Front and Back Saloons.

2 The sumptuous Salon de Lux is furnished with silver furniture, requiring an involved finishing process.

riously perfectionist and detail-orientated Mackintosh to design every element of the Tea Rooms, from remodelling the exterior of the building (an 1860's tenement block), to the interior decoration, to each item of furniture and even the cutlery.

As an exercise in design, the Willow Tea Rooms are breathtaking in terms of both scale and the astonishing level of consistency in design language. Recurring motifs echo across plaster friezes, stained glass, and furniture throughout the four floors. Sadly, through changes of use and ownership much of the original furniture was lost, and the Willow fell into a serious state of disrepair until an ambitious plan to rescue the important Mackintosh landmark was hatched in 2014. Prompted by a forced sale which would have likely resulted in the closure of the tea rooms and the remaining Mackintosh pieces being acquired by private collectors, the Willow Tea Rooms Trust was established as a charity in 2014 and purchased the building with the intention of faithfully restoring the tea rooms to the condition they would have been in when first opened in 1903. That project came to fruition when Mackintosh at the Willow (as the tea rooms are now known) opened its doors on 2 July 2018.

Restoration—Introducing the Makers

The restoration project was undertaken with an almost obsessive focus on returning the tea rooms to precisely the condition they were in in 1903. The result is a 200-seat restaurant, containing 400 items of reproduced furniture, and which faithfully follows the designs and layout originally envisaged by Charles Rennie Mackintosh. The ground floor comprises a Front and Back Saloon typified by ladder backed chairs and box armchairs in black stained oak. The first floor Gallery is a mezzanine looking down onto the ground floor, and shares the same furniture with



3 The booths of the Billiard Rooms echo the black stained furniture of the Front and Back Saloon.

that lower floor. The second floor houses the iconic Salon de Lux with its eye-catching silver highbacked chairs and matching tables. Finally, the Billiard Room on the third floor echoes the ground and first floors with black stained booths.

Reproducing 400 pieces of furniture is a significant undertaking, and the Trust undertook a rigorous process to identify craftsmen who could produce high quality Mackintosh pieces, while working from a paucity of original designs and extant examples. That process included inviting a shortlist of six furniture makers to construct a sample chair for evaluation. Three Scottish furniture makers were ultimately engaged to reproduce all of the furniture:

1. Glasgow based Bruce Hamilton has an international reputation for producing Mackintosh furniture, and constructed the 33 arm chairs used in the Front Salon, Back Salon, and Gallery;
2. Furniture maker and artist Angus Ross has an international reputation for design and is frequently included in exhibitions in the UK and United States, and was commissioned to produce the 125 ladderback chairs used in the Front

- Salon, Back Salon, and Gallery; and
3. A team from Character Joinery—experts in joinery and furniture for conservation and listed building projects—comprising of three cabinetmakers, two apprentices and a French polisher, headed by director Kelvin Murray, reproduced the furniture for the Salon de Lux together with the waitress stools and the iconic curved cashiers' order chair in the Back Saloon.

Design and Research

The lack of surviving scale drawings, and only a few surviving original pieces of furniture, represented a significant challenge, all the more so because the Trust insisted on exact reproductions in material, scale and finish. That challenge became an opportunity, as Kelvin Murray explains: “with hindsight it was the best thing that could have happened, as it really got me to understand Charles Rennie Mackintosh and his cabinetmakers.” The reproduction process therefore started with detailed research, following a trail of the few surviving original pieces, sketches



4



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6



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4 Table ready for tea in the Gallery.

5 What first seems to be a simple piece is brought to life with curves and chamfers.

6-7 Front and rear views of the box arm chair designed by Mackintosh.

Life is the leaves which shape and nourish a plant, but art is the flower which embodies its meaning.

— Charles Rennie Mackintosh

by Mackintosh, previous research by other makers, and piecing together fragments of materials or processes.

One constant thread that runs through the investigatory phase of the restoration is how willing Mackintosh collections or scholars were to provide the furniture makers with access to examples of the furniture, or research materials. All of the makers were given access to original pieces held by the Glasgow School of Art from which to take measurements and drawings. Bruce Hamilton observes that: “during the inspection of the original chair at the Glasgow School of Art I had to take into account slight discrepancies in some measurements which I put down to shrinkage or the possibility of inaccurate manufacture of the original piece.” This variance in

dimensions was also noted by Angus Ross when comparing two different ladderback chairs.

Following the fire at the Glasgow School of Art in 2014, no known surviving examples of the Salon de Lux tables or coat stands exist, and so those pieces were developed entirely from photos of the tea rooms taken from 1905 and 1980, as well as sketches by Mackintosh. Fortunately, Spanish luthier Josep Melo had studied Mackintosh in the 1970s and 80s, including taking drawings of the Salon de Lux round table and hat stand. Josep provided Character Joinery with his drawings, which then allowed the team to not only reproduce the round table, but to transfer the proportions and construction details to the square and rectangular tables.

Timber selection was also approached through analysis of surviving furniture, as well as fragments of furniture destroyed in the Glasgow School of Art fire. All of the chairs were constructed from oak, while the coat stand was mahogany, and the Salon de Lux tables from birch and tulipwood.

Far from the Finish Line?

Determining the appropriate finishes for the furniture was a critical stage of the research, not least because the black-stained furniture had to be consistent while being produced by three different makers. A microscopic examination of a fragment of an original black stained Mackintosh stool led to the use of a black stain, black oil, and topped with black wax, which the Trust



mandated all three furniture makers to use.

The silver finish for the Salon de Lux furniture required a different approach. While the surviving chairs had been repainted in the intervening years, some time before the Glasgow School of Art fire a sample of the original silver finish had been discovered on a coat stand, where it had been protected from subsequent paint applications by the coat hook. The original finish was sent for analysis, and Kelvin recalls that “to my horror, the results came back with the finish layers. A white undercoat primer, then gold flake, finally finished in aluminium flake. This sent me back to the research books and two months of research and study.” The silver topcoat was reproduced by brushing on a mixture

of 12 micron sized aluminium flake with resin, in a similar technique to that used for gilding, following which the aluminium would be buffed and polished to a high sheen. While not a straightforward or simple process, it is one which Kelvin considers to have been worthwhile as “this resulted in a real metallic look but also in the correct light you can see the gold leaf underneath which gives the finish on the chairs a real depth.”

Building the Furniture— An Opportunity to Improve

While many of Mackintosh’s designs call for bold forms, a close examination reveals many subtle design elements, such as the changing depth of chamfers, subtle tapers, and slight curves. These elements, according to Kelvin Murray, “completely lift

the designs and adds so much to the meaning of the pieces.” In practical terms, Kelvin’s team approached the restoration on a hand tool only basis, as “to actually work with modern machines in a batch production was impossible and many components could only be shaped with hand tools. This determined our approach. We machined the timber to square stock sections, and then everything was made by hand.”

If there is a weakness to Mackintosh’s furniture designs, it is that they do not always take into account the structural attributes of the natural material. Put simply, Mackintosh was an architect and designer, not a furniture maker, and as Kelvin Murray explains “one of the reasons that the chairs from the salon don’t survive was that they were designed



8-9 The front and back view of the ladder chair. The back makes wonderful use of negative space.

10 Reproducing the 125 ladder back chairs involved cutting 3250 mortises and tenon joints, all of them cut by hand.

11 The rush seats were woven using traditional techniques, which each set taking a day to weave.

12 The curved cashier’s settle separating the Front and Back Saloon.



aesthetically first and foremost and construction came second.” Indeed, reliance on undersized tenons, or ignoring the strengths and weaknesses of woodgrain, has meant that many original pieces have failed in the intervening years. While the Trust was clear that the furniture needed to be visually faithful to Mackintosh’s designs, the makers recognised that to reproduce furniture which would withstand the daily rigours of use in a busy tea room would require some hidden improvements.

Kelvin recalls of reproducing the tall salon chairs “The backs of the tall salon chairs were tapered and curved as were the backs of the small chairs” and the originals “were made from one solid oak plank then carved and shaped by hand”, an approach which has the potential to increase grain runout and weaken the structure. In contrast, for the reproductions Character Joinery “constructed the backs from oak veneers laminated to the overall thickness, then using a spoke shave worked them to the shape. This gave a stronger back panel which would work better in a modern central heated environment.” Similarly, “the mortise and tenons on the legs and seat frames were so fine that they would be the first to break down, and so we changed the internal joints to dominos where necessary, as this gave us more glue surface and a stronger joint.”

Angus Ross also found that many of the original ladder back chairs had failed, and that many of the surviving examples have avoided failure due to the addition of reinforcement to the curved rails. The primary reason for the failure seems to have been that the curved rails were cut out of solid timber, rather than being steam bent, and it is possible that stock selection for the rails did not always minimise grain run out. As much of Angus’ work involves steam bending for chairs or sculptural elements, that method of construction was adopted in order to achieve stronger components. Once the 13 rails for each chair



13 The high back chairs in the Salon de Lux were built with laminated oak to mitigate the structural weakness of the originals.

14 The iconic high back chair from Salon de Lux.

15 Chamfers of changing radii are a common feature in Mackintosh’s designs.

16 188 petals are required for the furniture in the Salon de Lux, most of which are hidden from view by table cloths, offering a wonderful surprise for those who look carefully.

17 The umbrella stand in the Salon de Lux.

had been steam bent, the tenons were then cut by hand.

One of the most challenging reproductions was the curved cashier’s order chair in the Back Saloon which features a large crescent-shaped latticework back atop of a coopered base, and which Kelvin estimates took six weeks to complete. Kelvin explains that while this iconic piece has been reproduced many times, often “the components have been simplified for production, for instance the front vertical rails which in most reproductions are straight, but in the original they are tapered and shaped as is the front base cabinet.” This was therefore another piece where the design required a hand tool approach, particularly reproducing the latticework, which

was a painstaking process as “every little lattice infill has to be shaped and fitted individually” in order to fit the curvature of the back. The latticework also offered an opportunity to improve on the original construction, in which the cross pieces were pinned in place. In contrast, Character Joinery dowelled each infill so as to create a stronger frame.

Hidden Details

The strict attention to detail continued in the Salon de Lux, particularly with the glazed petal details of the table legs which echo the floral themes of the stained glass and artwork found throughout the tea rooms. It fell to Kelvin to prepare the petals, “individually carving 188 timber petals for the tables, a task





18



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18-19 Stained glass in the door to the Salon de Lux echoes the motifs found in the furniture and decoration in the other areas of the Tea Rooms such as the fire place in the Back Salon.

20 Mackintosh created a consistent design language for the Willow Tea Rooms, which ties together the furniture, internal and external decoration as a unified whole.



20

that took me just under 3 weeks.” The process for making the petals started with marking “all the petals out onto tulipwood timber and cutting out the centres with a fret-saw,” before cutting a 2mm x 2mm rebate for the glass insert “with a small hand held router then cut out the outside shape on the fret saw.” After this everything was shaped and carved by hand then finely hand sanded ready for gluing into the leg frames. What is remarkable about

this devotion to accurate detail, at least to the outside observer, is that the petals are obscured when the tables are dressed with table cloths. Kelvin explains that, “For me is the reason that the Willow Tea Room is such an important piece of architectural heritage. It is the minute detail to attention that creates the whole grand experience.”

A Landmark Rescued
Mackintosh at the Willow offers

a unique opportunity for Mackintosh aficionados to see, and use, faithfully reproduced Mackintosh designs in the context for which they were intended. As an exercise in reproduction and craftsmanship, the restoration is breath taking in terms of both the attention to detail and scale of work. As Kelvin Murray observes, “With every batch of reproduction ever done on Mackintosh, not one is produced exactly to the original, it is too time consuming and would not be profitable to attempt. This is what made this commission so important; for the first time the pieces had to be done exactly as before.” The restoration is also a celebration of the very best of Scottish craftsmanship. As my family sat in the Front Saloon for afternoon tea, I could not help but wonder what Charles Rennie Mackintosh would make of the restored tea rooms. I rather think that he would have approved of the focus on accuracy and detail pursued by the Trust. **PW**

Kieran Binnie is a writer and wood-worker based in Birmingham, UK. See more at overthewireless.com.

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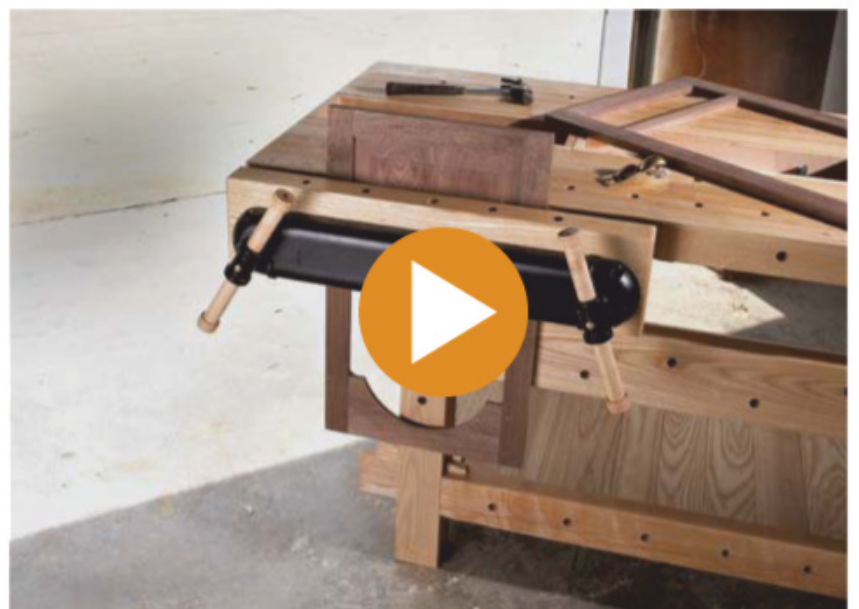
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Finishing for Beginners

We all have to begin somewhere, and this is actually the most difficult time.

By Bob Flexner

Years ago I remember teaching a class about finishing that included one student who said he had never used a stain or finish, and to make matters worse, he had never even painted anything. This was a two-day class in which I go through all the products and application methods. How was I going to address this student's lack of any experience at all? Here's an attempt, addressing you the reader, rather than him. The steps are sanding the wood, deciding on the color and maybe applying a stain, and deciding on a finish and applying it.

Sanding

The first step is to sand the wood so flaws won't be highlighted by a stain or finish. Flaws in the wood, like machine milling marks, scratches, gouges, etc., have to be sanded out or filled with wood putty before applying a stain or finish, or these flaws will be highlighted. Begin with a grit sandpaper coarse enough to remove the flaws efficiently, usually with 80 or 100 grit. Sand in the direction of the grain when possible and back the sandpaper with a flat block when sanding flat surfaces. Then remove the coarse-grit scratches with finer grits: 120, 150, and 180. You can usually skip a grit, but it depends on how long you sand with each.

Unfortunately, knowing which grit sandpaper to begin with, when it's time to move to the next finer-grit, and when the wood is ready to be stained or finished, can be learned only from experience. You can look at the wood in a low-angle, raking light, and even wet the wood with mineral spirits (paint thinner) as an aid to spotting remaining flaws. But even these tricks don't always work.



1 Machine milling marks, also called “washboarding,” are caused by a jointer or planer, and sometimes a shaper or router, that isn't tuned perfectly. The reason for the name washboarding is pretty obvious.

2 When sanding a flat surface like a tabletop or cabinet door, back the sandpaper with a flat block to keep from hollowing out softer spring-growth grain.

Staining

You can see what the wood will look like with only a finish applied by wetting the wood with a liquid, such as paint thinner. If the wetted wood isn't dark enough or the right color, you'll have to use a stain. Oil stains are easier to use than water-based stains, which dry very fast.

No matter which stain you use, the method of application is the same. Using any application tool, apply a wet coat and wipe off the excess before it dries. Begin working on smaller surfaces such as legs and drawer fronts to get a feel for

the drying time. If the stain dries too hard to wipe off, reliquify it by applying more stain right away, then remove the excess immediately.

Apply the stain and remove the excess from one or more complete surfaces at a time. Don't overlap the stain onto a surface that has already dried or the double application may cause a difference in color.

Finishing

A finish is necessary to protect the wood from water damage, dirt, stains, etc. You can apply a finish either directly to the wood or over

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a stain after it has dried. It's always better—that is, more attractive and protective, to use a stain and finish packaged separately than a stain-and-finish combination.

In my opinion, the two best finish choices for a beginner are oil-based polyurethane in a satin sheen and wiping varnish. Wiping varnish is oil-based varnish or polyurethane thinned about half with paint thinner. You can make your own if you like. Common brands are Waterlox, Seal-a-Cell, Profin, Formby's Tung Oil and Salad Bowl Finish.

Just like water-based paints, water-based finishes dry faster, are easier to clean up and have less odor, but they raise the grain and are more difficult in combination with stains.

Polyurethane is best for surfaces that get a lot of wear. Wiping varnish is best when you want a thinner, more flawless, finish.

Applying Polyurethane

Apply polyurethane using a bristle or inexpensive foam brush about two inches wide. You can apply the first coat full strength or thinned up to half with paint thinner, making, in effect, a wiping varnish. (Use a separate can or jar.) Thinning leaves less actual finish on the wood so the finish dries hard faster and is thus easier to sand sooner.

Always sand the first coat of finish smooth to the touch after it has dried (usually overnight in a warm room) using 280-grit or finer sandpaper. Remove the dust with a tack rag (a sticky cloth you can buy at paint stores) or a vacuum and apply a second coat full strength. Brush the polyurethane just like brushing paint. If there are bubbles, brush back over the finish lightly to make them pop out. Brush with the grain of the wood when possible.

On flat horizontal surfaces like tabletops, spread the finish onto the wood working from side to side (with the grain) and front to back. Stretch out the finish as thin as possible. After every six-to-twelve inches of surface covered, line up

3 The basic way to apply a stain is to wipe or brush it onto the surface and wipe off the excess stain before it dries. Try dividing large projects into smaller areas so there's a better chance of avoiding drying.

4 To brush vertical surfaces without runs and sags, arrange the lighting so you can see what's happening in a reflected light. When you see the finish begin to run or sag, brush over the problem with the brush fairly dry from wiping it with a clean cloth to remove the excess.

5 To make your own wiping varnish, thin some varnish or polyurethane about half with mineral spirits (paint thinner). Do this in a separate container.

the brush strokes. Do this by lightly bringing the brush down near one edge in an airplane-like-landing motion and moving the brush across and off the other side, back and forth until all the brush strokes are lined up and the bubbles gone.

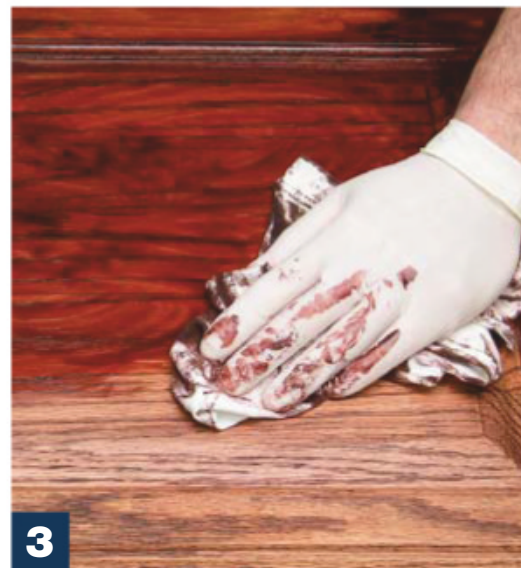
Then brush the next six-to-twelve inches in the same manner, working the finish back into the last inch or so of the previous application. Continue until the surface is covered.

The trick to reducing problems, such as bubbles, runs, and sags, is to work in a reflected natural or artificial light. This is the critical instruction that is rarely given. If you move your head so you can see your work in a reflected light while you're brushing, any problem that occurs will become quickly apparent, and the solution will be obvious, usually to brush back over the finish and stretch it out thinner or remove it.

Always use as clean a brush as possible and work in as clean a room as possible, but there will still be some dust nibs when the finish dries. Sand these out between each coat. For the last coat you can rub lightly with a folded brown paper bag.

Applying Wiping Varnish

You can apply wiping varnish exactly like polyurethane by brushing, or



you can wipe on, then wipe off, most of the excess. The more excess you leave, the greater the build.

Wiping is easier and this is the way wiping varnish is usually applied. It's an almost foolproof finish when applied in this manner. Work in a reflected light.

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Bob Flexner is author of Wood Finishing 101, Understanding Wood Finishing and Flexner on Finishing.

Infrared Compression Knee Support Helps

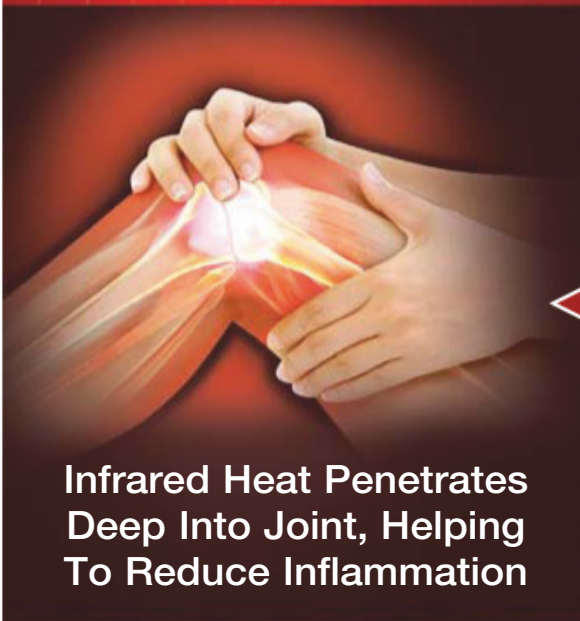
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The Sketchbook of Henry Lapp

An illuminating look at the life of a 19th century country cabinetmaker.

By Tom Caspar

Daydreaming in my shop, I'm imagining a warm summer day way back in 1899. Just after supper, Henry Lapp sits at a pine table outside a tavern on the Lancaster Turnpike, a few dusty miles past the long bridge over the Schuylkill River. He's a cabinetmaker from the heart of old Amish country in Lancaster County, some forty miles away—from a town called Bird-in-Hand, to be exact—and he's on his way to Market Street, in Philadelphia, to drum up some business.

Henry has a new idea for a washbench, an important piece of furniture back home in the country. It typically holds water buckets for scrubbing freshly-pulled vegetables or dirty hands. Most washbenches were humble affairs, but this one is stylish: It will have a two-level, tin-lined recessed top, graduated drawers and compound bun feet. It's an ambitious piece.

Henry is busy sketching his washbench in a small store-bought notebook which has a plain, soft cover and a sewn binding. As the sun goes down, he slips the notebook into his coat pocket. Eventually, this book will contain over 50 pages of projects that Henry has built or would like to build—everything from a drop-leaf table to a set of ingenious mousetraps. It's his catalog.

This sketchbook is Henry's only way of communicating with his customers. Henry Lapp was born deaf and is partially mute. He's learned his trade just by observing other men at work.

Fast forward fifty years. Henry's sketchbook has lain, untouched, in the top drawer of a small bureau—one that Henry may well have made

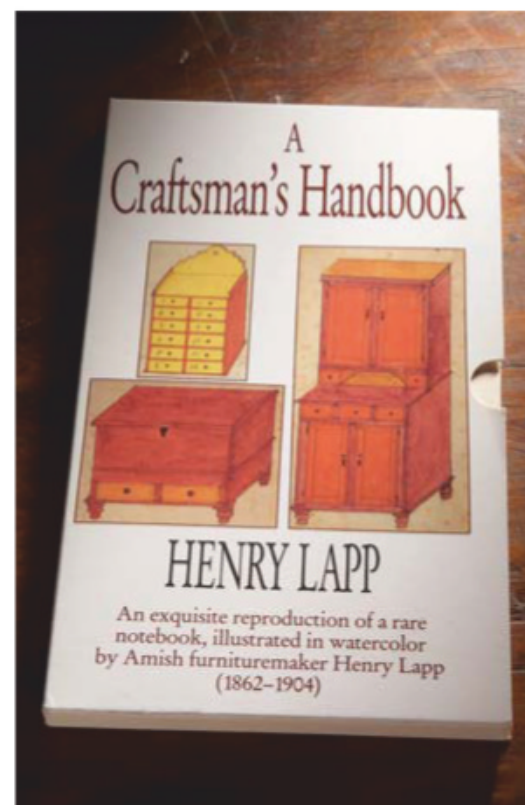
himself, although we'll never know, for he didn't sign his work. The bureau is a quaint antique that's just been sold by one of Henry's descendants. The dealer who bought it is removing the odds and ends typically left in an old chest when he discovers this slim volume, one of the most valuable documents illuminating the life of a typical country cabinetmaker in the 19th century.

Today, Henry Lapp's book sits in the archives of the Philadelphia Museum of Art. Back in 1975, at the height of America's interest in folk art, the museum published a facsimile edition of this book. It's still available through used bookstores on the web at a very low price. Each page is accompanied by a fascinating commentary by Beatrice Garvan, a curator at the museum.

Henry's sketchbook is a beautiful object in its own right. A skilled artist, Henry painted all of his pencil drawings with yellow, red and green watercolors. Like the Welsh immigrants who lived just to the east of Lancaster County, Henry used washes with vivid colors to brighten up inexpensive poplar and pine furniture.

The pages of Henry's sketchbook are so evocative that the Philadelphia Museum has reproduced many of them as posters and art prints. One of the finest prints is bursting with ideas, with drawings of an egg-beater, a salad sower, a cutlery box, two pie crimpers and three bent-wire bread toasters, cheek by jowl.

These everyday objects, along with seed drawers, trellises and those mousetraps, fill the back pages of Henry's inventory of designs. The front pages—no doubt the



ones he would show first to those customers on Market Street—display Henry's finest pieces: his furniture. The breadth of his work is amazing to a modern woodworker, but would probably be no surprise to any of Henry Lapp's neighbors. In a way, Henry was ultramodern. He served his community making simple, functional objects using a local resource—the trees of Lancaster County.

For more information on Henry Lapp, see "A Craftsman's Handbook: Henry Lapp," published by Good Books in 1975, and "Two Amish Folk Artists: The Story of Henry Lapp and Barbara Ebersol," by Louise Stoltzfus, also published by Good Books in 1995. **PW**

Tom Caspar is the former editor of *Woodwork and American Woodworker*.

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