

## Instructions for making a drawer with through dovetail joints using WoodRat®, digital scale, spiral & dovetail bits, brush, gauge bars and stop



In these instructions we will demonstrate step by step how to cut through dovetails and other joinery to make a drawer using WoodRat and our digital scale mounted in east/west orientation.

With our technique you have WoodRat's versatility with dead-on accuracy.



### Dimension boards

Our drawer is approximately 12" x 14" x 5" deep. We selected contrasting woods for visibility. Front/rear (pin) boards are  $\frac{5}{8}$ " walnut, side (socket) boards are  $\frac{1}{2}$ " poplar.



### Index boards

For indexing purposes, pick a front and side pair and a rear and side pair and mark pairs with a single X, best faces inward. Draw the Xs as shown with center at intersection of the two boards. That is sufficient markup when both pin boards are equal thickness and socket boards are equal thickness.



### Make a layout board for dovetail pins

Draw a dovetail pattern on a scrap board that is same width as the drawer boards. Each of the lines represents a pin center. Normally we place a half-pin on each side and one or more pins in middle.

Our technique uses a single pattern that reverses on each board end. Because of this pattern reversal, an equally spaced or a symmetrical layout will generally look best.



### Mount layout board

Clamp the layout board to WoodRat's sliding bar with the pattern marks on top.

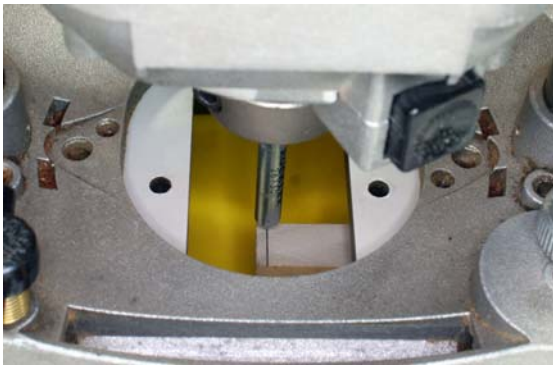


### Chuck a centering bit

Chuck a centering bit or any bit that has a sharp point in the center.

The centering bit and digital scale will be used to register all pin locations.

Tip: You can also use our laser guide for this operation.



### Position bit at first pin location

Align point of centering bit with first mark on left side of the layout board.

Accuracy is not critical since pin location is your option, but for a half-pin the center of bit must be inset no more than  $\frac{1}{2}$  the width of dovetail bit.



### Zero digital scale

Set digital scale to read in thousandths of inch as shown. Press "0" button on digital scale to zero it.

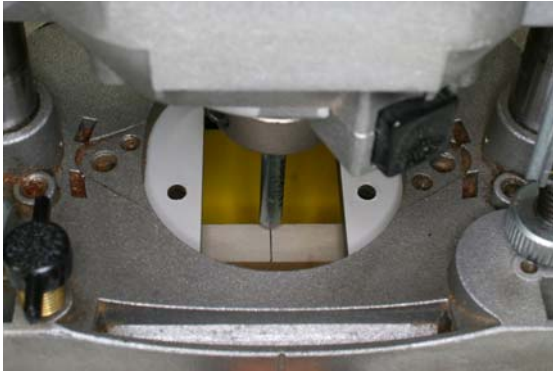
Be careful not to zero the scale again unless you intend to reposition the pins. All of the pins are indexed from this first pin location.



### Register first pin location

On paper or a scrap board record the zero digital scale setting for first dovetail pin.

From this starting position we will record an offset to all other pin locations.



### Position bit at next pin location

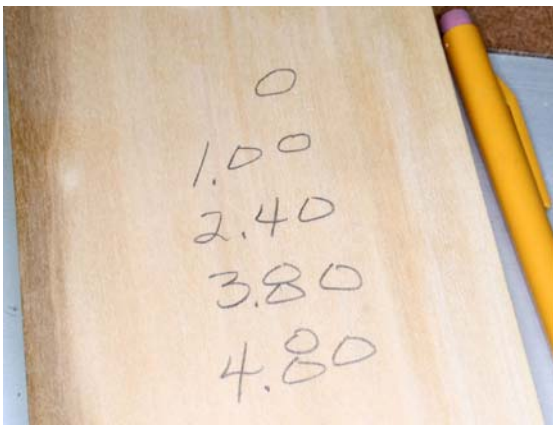
Align point of centering bit with next mark on the layout board.



### Read and register second pin location

Read scale and record reading for this pin location. Round to hundredths (e.g., 1.00).

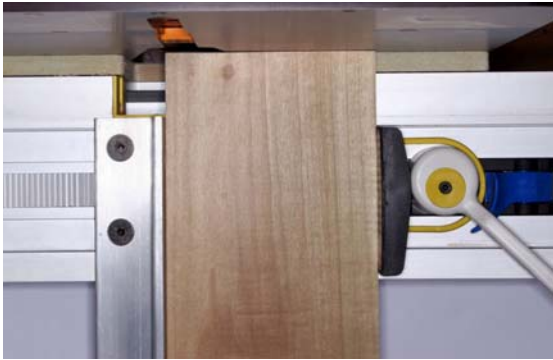
For simplicity we round all readings to hundredths. This may slightly change pin position, but it does not affect fit of joint.



### Complete registration

Register all remaining pin locations.

You are now ready to proceed with cutting the socket boards for dovetail joint.



### **Mount socket board**

Dovetail sockets are always cut in the side pieces of a drawer. Pins are cut in the front and rear pieces

Mount socket boards (side pieces) on sliding bar, flush to underside of base plate.



### **Indexing rule (Very important)**

When mounting either socket or pin boards to WoodRat, the angle bracket formed by half X must point away from machine face.

If this board's end is cut with angle bracket against fixed fence then, to cut other end, cartwheel the board so the angle bracket is against cam clamp and still points away from machine face.



### **Chuck dovetail bit**

For socket cuts you need the aluminum guide rails and a dovetail bit.

Our 8-degree dovetail bits have a cutting length twice their width. The pin board determines height of socket (the minimum dovetail bit length). With our  $\frac{5}{8}$ " pin board we choose a  $\frac{3}{8}$ " wide dovetail bit.



### **Set socket height**

Socket height is set to pin height.

Plunge bit to top of socket board and set plunge lock. Insert one of the pin boards into router depth stop mechanism and set the depth stop to the board thickness.

Tip: Best if turret removed from depth stop.



### Position for first socket cut

Turn handle on WoodRat to crank the sliding bar left until digital scale reads 0.00 within +/- .0025. This is first cut position.

The .0025 tolerance is sufficient for a good joint fit. It is about 1/6<sup>th</sup> of 1/64" and much finer than pencil marks.



### Make first socket cut

Start router, plunge bit to depth stop and make first socket cut (for left half-pin).

To reduce breakout its best to use a climb cut. For the left half-pin cut front to rear. For right half-pin cut rear to front. Middle sockets can be cut half way from both rear and front. Proceed slowly and use sharp bit.



### Make next socket Cut

Observing digital scale, crank handle to move sliding bar to the next recorded digital reading within .0025 tolerances and make second socket cut.



### Complete additional cuts

Repeat above for remaining digital readings until all the socket cuts are complete.



### Reverse board ends and repeat

Cartwheel the board so that angle bracket is now on cam clamp side and repeat the cuts made on other end.



### Cut other socket board(s)

Repeat above cuts for other socket board(s).

Tip: You can cut two socket boards at same time. To do this, mount both on sliding bar with the angle brackets on same side then clamp together.



### Change setup

If you are making multiple drawers of same size, cut all socket boards before cutting pin boards.

To cut pin boards you must remove the aluminum guide rails and add the spirals and center plate, plus it is likely you'll need to reposition base plate to its second position.



### Chuck a spiral bit

Replace dovetail bit with a spiral or straight bit. Use the widest bit that will fit between the pins when cut. We used a 1/2" spiral bit.

## Button (Center Plate) Setting Calculator

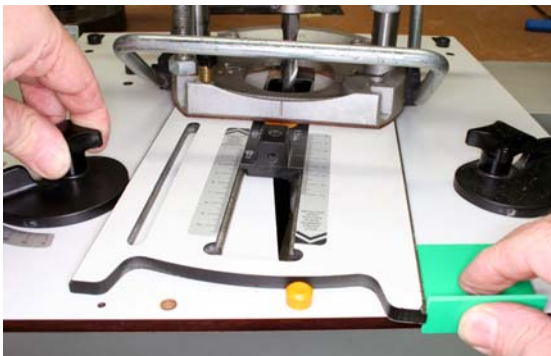
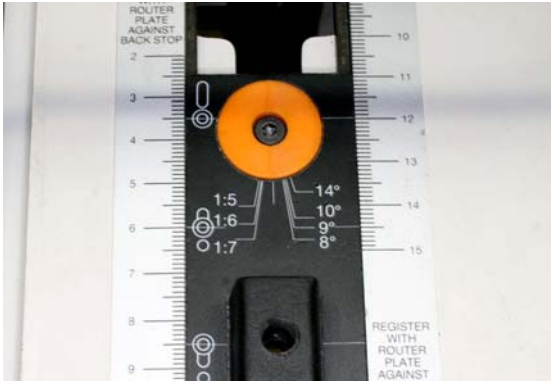
1> Select a Dovetail Bit Width measurement:  millimeters  inches

2> Select a Dovetail Bit Width:

3> Select a Dovetail Bit Angle:

4> Select a Straight Bit Width:

Button Setting:




## Determine button (center plate) setting

Use [button calculator](#) on our [chipsfly.com](#) web site to determine button or center plate setting for the bits you are using.

Record these settings for future use.

## Position button at setting

If base plate is positioned in second position, then button setting is read from router plate scale next to middle icon  with router plate positioned against rear stop. The scale reads in mm with a 6 representing 60mm. (distance from pivot point to machine face).

Before first use, the scale on your router plate must be calibrated (see appendix).

## Lock button in place

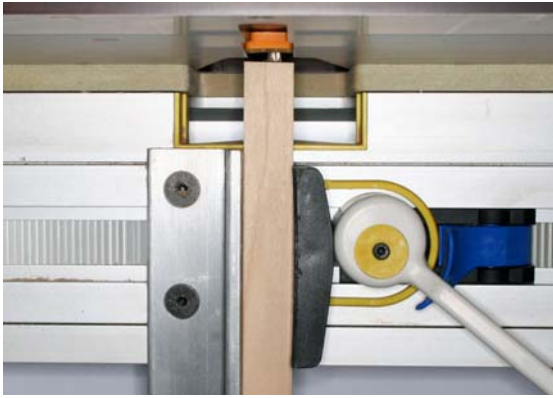
With button in correct position tighten button cap screw.

The button is pivot point on which the router swings to cut at an angle controlled by the spiral stops. This infinite range of variability sets the WoodRat apart and provides you the capability to use any dovetail bit.

## Set spiral stops

Bring right side of router plate flush against a Craftsman Gallery dovetail gauge or a bevel set to dovetail bit angle (see picture). Turn left spiral until flush with router plate then tighten star knob. Rotate router plate counter clockwise and set right spiral stop in same way.

Machine is now set to cut dovetail pins.



### Mount a stick for trial pin cut

You should test for pin fit and alignment before cutting the pins for your drawer.

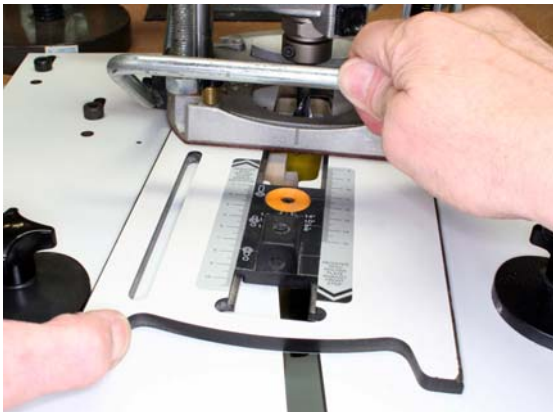
To test for fit, mount a narrow board or stick on the sliding bar flush to underside of base plate. The stick does not need to be same thickness as pin boards.



### Set pin length

Pin length is set to socket depth.

Plunge bit to stick top and set plunge lock. Insert one of the socket boards into router depth stop mechanism and set the depth stop to board thickness.



### Cut right side of trial pin

Move bit behind stick board and plunge to depth stop. Start router then while holding left side of router plate against left spiral pull bit through stick to cut right side of trial pin.

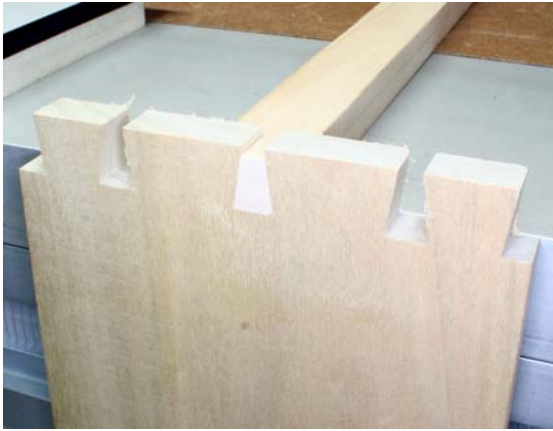
We are climb cutting to minimize break out and to help hold plate against spiral stop.



### Cut left side of trial pin

With bit now in front of stick rotate router plate against right spiral then hold it against the spiral while pushing bit back through stick to cut left side of trial pin.

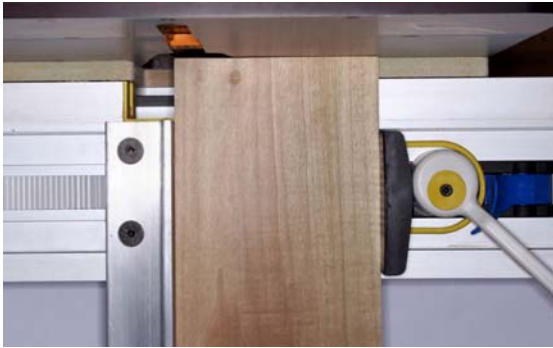
Both front and rear orange stops should be in place to prevent cutting into base plate.



### Observe fit

Insert the trial pin into one of the socket boards. It should be close to snug fit if you have calibrated your router plate scale and accurately set the spirals to bit angle.

Adjust the fit by moving the button to a slightly lower number to loosen fit or to a higher number to tighten. Tap lightly; you'll probably need less than 1mm of movement.



### Mount layout board

The pin setup changes may have relocated bit position which will cause edges of mating pieces not to align.

To test alignment it's best to cut a full test joint and for that we'll use our layout board. Mount the board with pattern on bottom.

Tip: Save button and spiral settings from above and return to them next time you use same bits. You could then skip trial pin test and start here instead.



### Position for first socket cut

Turn handle on WoodRat to crank the sliding bar left until digital scale reads 0.00 within +/- .0025. This is first cut position.



### Make first pin cut

Start router, plunge bit to depth stop and make first pin cut. For the left half-pin use the left spiral stop only.

Start with bit behind wood then pull bit through wood while keeping router plate against left spiral with thumb. Push bit back through wood continuing to keep router plate against left spiral.



### **Position for next pin cut**

Observing digital scale, crank handle to move sliding bar to the next recorded digital reading within .0025 tolerances.



### **Make next pin cut**

For middle pins use both the left and right spiral stops.

Start with bit behind wood. Pull bit through wood while keeping router plate against left spiral with thumb. Rotate router plate counter clockwise then push bit back through wood keeping router plate against right spiral.



### **Cut remaining middle pins**

All the remaining middle pins are cut the same way. Move to each recorded digital reading and make the cuts.



### **Clear wood between pins**

Any wood remaining in space between pins should be removed. The extraneous wood will look like a reverse pin (i.e., triangle pointing away from you).



### **Make final pin cut**

For right half-pin use right spiral stop only.

Locate bit to front of wood then push bit through wood while keeping router plate against right spiral.

Following these instructions, all the pin cuts are climb cuts that reduce break out and help prevent bit from being pulled into wood.



### **Measure any misalignment jog**

Insert the test board pins into one of the socket boards with angle bracket on socket board pointing in direction shown. Using depth gauge of an electronic caliper measure any jog between the pin and socket boards.

The edge of our test board projected beyond edge of socket board. We measured .028".



### **Offset digital scale**

Subtract jog from digital scale starting point.

If left edge of test board projects then move sliding bar right until it reads the jog as a negative number. If test board is indented then read the jog as a positive number.



### **Reset digital scale starting point**

Push "0" button on digital scale to reset all pin positions by jog amount.

You are now ready to cut pin boards that fit and mate perfectly with the socket boards.



### **Cut all pin boards**

Cut the pin boards exactly as the test board was cut.

You make the cuts, but now everything has been precisely set and is machine controlled. Depth of cut is controlled by router depth stop, angle of cut by spirals, width of pin by button and position of cut by digital scale.



### **Mate up the parts**

We'll assemble a side and front, a side and rear and then put the 2 assemblies together.

Match a socket and pin board as shown with angle brackets pointing in same direction then rotate pin board into socket board.



### **Join sub-assemblies**

Every joint should fit snug and perfect. You'll wonder if you'll need glue. If not a perfect fit, then check your procedures. Were all cuts made with angle brackets pointing outward? Are angle brackets on top edge of assembled drawer pointing inward on sides and outward on front/rear pieces?



### **Mark edges for bottom groove**

While the pin and socket boards are assembled mark an X on each board to indicate drawer bottom location. We'll cut a 1/4" groove all around for the drawer bottom.

Disassemble the pin and socket boards.



### Mark where groove starts/ends

The socket board's grooves should be stopped so they do not show on assembled drawer. For  $\frac{1}{4}$ " deep grooves place a mark slightly more than  $\frac{1}{4}$ " into bottom sockets.

Exception: For solid wood bottoms leave the groove open in back for wood expansion.



### Mount brush

When cutting grooves use our  $\frac{3}{4}$ " hog bristle brush as a feather board. It keeps the wood flush to underside of base plate and it stops kick back. To protect hands from bit, clamp brush directly below bit. Support the board under base plate with brush then remove the board and raise brush slightly so that the bristles bend when board is reinserted.



### Chuck spiral bit and set depth stop

We used a  $\frac{1}{4}$ " bit to cut a  $\frac{1}{4}$ " deep groove.

Chuck  $\frac{1}{4}$ " bit and plunge until it touches top of board. Use  $\frac{1}{4}$ " gauge bar to set router depth stop then remove the gauge bar.



### Set precision stop

We set a stop for  $\frac{3}{8}$ " offset of groove from bottom of drawer.

Plunge bit and bring to side of board then lock router plate with star knob. Using a  $\frac{3}{8}$ " gauge bar to represent desired offset plus a  $\frac{1}{4}$ " to represent width of bit (which moves inside) set precision stop  $\frac{5}{8}$ " from stop bar then remove the gauge bars.



### **Cut groove in socket boards**

Raise bit and pull router forward until stop bar meets precision stop. Lock router plate with star knob. Start groove on right side by plunging bit into wood with wood supported by brush and secured to base plate with a clamp. Engage plunge lock, remove clamp and push wood from left to right to make cut, stopping at mark on other end.



### **Cut groove in pin boards**

Use same depth and stop setting for groove in pin boards, but the pin boards have through cuts since their groove is hidden by socket board. Simply plunge bit and push wood left to right through brush and cutter.

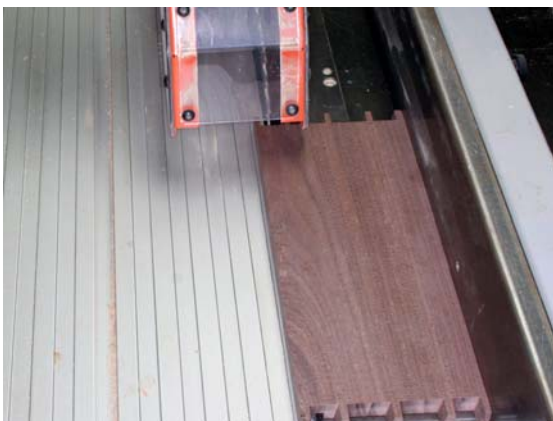
Tip: A climb cut is unsafe when wood is not clamped. So a good practice is to push the wood left to right when hand feeding.



### **Measure boards for bottom**

Measure inside of joints then add twice depth of grooves minus a 32<sup>nd</sup> to determine width and length of bottom piece.

If drawer has a plywood or MDF bottom then cut bottom and assemble sides and bottom with glue to complete the drawer.



### **Saw rear board if solid wood bottom**

For a solid wood bottom, room must be allowed for wood expansion. This can be done by sawing off bottom of rear pin board at top of groove.

Assemble and glue drawer without bottom.

Note: When determining length of solid wood bottom include full width of rear board.



### Insert solid wood bottom

From back of drawer, insert solid wood bottom into side and front grooves and secure with a single screw in back in an elongated slot cut in drawer bottom.

Wood expands across grain, not with grain, so bottom grain should run side to side. The elongated slot allows front/rear movement.

### Completed Drawer



If you are making cabinetry for a kitchen or bath then you may want to add a false front. For fine furniture consider either a false front or half-blind dovetails in front.

WoodRat combined with our digital scale can match the accuracy and repeatability of any dovetail jig without sacrificing flexibility or individual craftsmanship. With similar precision you can also cut box joints, mortises, tenons and sliding dovetails. We know of no other router based jig or machine that matches its versatility.

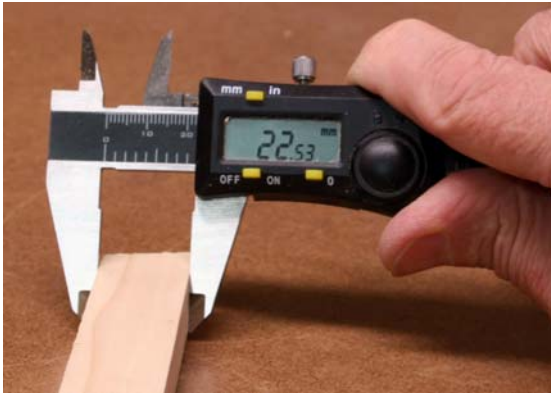
## Appendix

### What is a "climb cut"?

A climb cut occurs when a bit cuts in same direction as its spin (clockwise). If you cut clockwise around a wood piece then breakout is minimized, but the bit will try to climb or push itself away from the wood which it cannot do if the wood is clamped and the router machine held. Climb cutting is not safe when you are hand holding the wood or router, but with wood clamped it is the best way to cut.

## Calibration of router plate scale

The WoodRat center plate or button determines width of pins and thus how a joint will fit. Based on bits being used, the button needs to be set a certain distance from face of machine. The scales on WoodRat's router plate are used to set the button at this distance. However, there are manufacturing variances in plate size and scale positioning creating a need for calibration. The scale readings represent distance in millimeters from face of machine to center of the button. We can measure this distance, compare our measurement to router plate scale reading and determine the difference. This difference becomes an adjustment that is used each time we set the button.



### Measure a stick or narrow board

A wood stick can help us determine distance from face of machine to center of button.

Use an electronic caliper to measure width of the stick in millimeters.



### Then measure stick to button

Clamp the stick so its side is against face of machine and extends through base plate and router plate. Measure distance from edge of stick to center of button and add stick width. This total (e.g., 78) should equal your current button setting. If it does not then subtract it from your current setting and use this difference in all future button settings.

For example, in our case we measured 78mm from face of machine to center of our button. However, the button reading on our router plate scale was 81. Therefore, when we determine a button setting from the WoodRat manual or [chipsfly.com](http://chipsfly.com) [button calculator](#) we need to add 3 to the setting.

This calibration is required only one time, unless you replace your router plate.

Please email us at [info@thecraftsmangallery.com](mailto:info@thecraftsmangallery.com) with any corrections or improvements to these instructions. Check our web site [www.chipsfly.com](http://www.chipsfly.com) for our products and additional information.