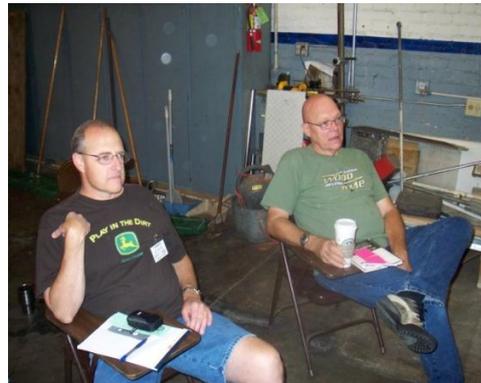


## Introduction to Woodworking Series: Rail, Stile and Panel Construction by Richard Pierce

The woodworking classes hosted by the San Joaquin Fine Woodworking Association continued at Ideal Saw Works on Saturday August 22<sup>nd</sup> with member



Chris Grothe instructing on Rail, Stile and Panel construction. Chris retired from Pacific Bell in 1996 as a trouble shooter and began woodworking as a hobby. He has been an active member of SJFWA since 1998. Members in attendance were Bill Bridger, Glen A. Grey, David Dunlap, Mike McClelland, John Harkless and yours truly Richard Pierce.



Chris began the presentation with a disclaimer that he wasn't really an instructor and was nervous about teaching the class. However as a class we found Chris to be an excellent instructor, well organized and knowledgeable about the subject matter. He was easy to listen to and understand and answered all questions with an ease clearly gained from practical experience. Chris worked from a prepared outline, brought along an example of a milled rail and stile for each student, a dry assembled oak frame and panel door, a coping bit, stile bit and a raised panel bit with a back cutter. If you do not know what all these terms mean, you should have attended the class. The bits can be pricey and may be purchased separately or as a set. Ideal Saw has available on display a variety of panel door bits offered individually or in sets.

Chris shared with the class the importance of using dry, straight grained wood without defects such as knots or irregular grain. Start by cutting pieces about 1/4 inch oversize and set them aside for a few days before milling to ensure they don't twist. It is essential that the material be square, flat and of the same width & thickness before milling the cope and stile cuts.

It is also helpful to closely examine the several pieces you prepare for milling and determine which side you wish to face outward after milling and assembly. Mark that side with an "X" preferably with white chalk. The chalk "X" always faces down on the router table while milling rails and stiles. If you look down at the piece while milling and you see a white "X" facing up at you, stop, throw that piece away and reach for one of the numerous spares you previously milled to the same dimension. Chris encouraged us to mill plenty of extras of the "same" width & thickness to use as spares because we would need them!

## Milling the Rails and Stiles

It is useful to make trial cuts of the cope profile (rail) and the stick profile (stile) in scrap stock with the same thickness dimensions as will be used in the finished project and check the accuracy of the joint. This is extremely important when working at maximum thickness of 7/8". Check again to ensure your stock is flat and cut straight with square edges. If your stock is not exactly the same thickness when you start you will most likely not achieve a quality joint.

Sanding these type joints level on the front and/or back side after milling produces unsatisfactory results.

In order to re-set the correct height of the cope and stile bits when you achieve an acceptable joint save some spares as templates. Commercial templates are also available to match most all makes of router bits.

## Milling Rails

Rails join the two upright Stiles using a variation of the mortise and tenon joint. The router bit used to mill the cope cut is the one with the bearing in the middle of two cutters.

Milling the cope cut will create a tenon and a profile on each end of the rail pieces. Some cope cutters create 3/8" tenons (Rockler & Amana), others create 1/2" tenons (Sommerfeld) and still others create 7/16" tenons (CMT). Determine what length tenon the cope cutter you are using will produce.

One must first cut the rails to length before cutting the cope profile into each end of the rail. The length of the rail must be calculated by the following equation:

Width of the door, minus the width of the two stiles, plus the length of the two tenons equals rail length. (Using a 1/2" overlay on all sides of the door is usually the best practice) Following the above formula, test the cuts and dimensions in scrap pieces first.

Then.....

A. Cut all rails to length.

B. Set the cope cutter to the correct height in the router.

1) The correct height is obtained when, after the cut is made, the reveal on the front side is 1/8" minimum to 3/16" maximum. The thickness of the back cut should also be 1/8". However if one is to be bigger, make the front reveal thicker for strength of panel.

C) Set the fence even with the bearing

D) Use a wooden sacrificial push block to prevent tear out at end of cope cut on the rail and push both by the cope cutter using hand pressure only to hold the push block against the rail and the rail flat on the router table and square to the fence or;

E) Use a coping "sled" with a wooden sacrificial push block & clamp(s) which hold the rail in place flat and square to the fence as it passes by the cope cutting bit or;

F) Use clamp(s) to hold the rail firmly in place to the push block and use hand pressure only to hold the rail flat on the router table and square to the fence as it is pushed by the cope cutter.

Whatever method you choose, acceptable cope cuts are achieved by setting the cope cutter to the correct height, the rail remaining flat and square to the fence as it passes through the cutter. Anything less will result in a substandard joint.

E) Run stock through with the good side down ("X") at 14,000-16000 RPMs.

Then....

Set the stile bit to the correct height and mill the stile profile lengthwise into all rail and stile pieces. The bit with the bearing on top of two cutters is the stile bit. Milling the stile profile after the cope cut will help eliminate tear out on the inside edge of rails that may have been caused by the cope cut. It is not necessary to cut the stiles to finished length before milling the stile profile. Finished stiles are cut to the height of the door.

### Arched Top Rails

Arched panel doors will require an arched top rail which is milled using an arched top rail template. Arched top rails should be dimensioned to at least 4" wide or larger depending on design. Cut the copes before creating the arch in the top rails. Center a template (self made or purchased) on the back side of the coped arched top rail. Attach the template securely with small nails driven through pre-drilled holes in the template into the copes that were just cut. Rough cut to within 1/8" of the template with a jig or band saw then flush trim the top rail using a flush trim bit. Then proceed as above with the stile profile cut.

### Milling the panel

After milling rails and stiles it is time to create the panel. Panels of one piece or glued up 3/4" stock will shrink/expand about 1/8" per 12" of width but do not move in length. Plywood panels of course do not move but pay attention to the thickness of the plywood as compared to the width of the milled slots because a loose fit will result in rattle.

Accordingly, size the panel to provide about 1/16" space on the top and bottom and about 1/8" on each side of solid stock panels. It may also be necessary to deal with misalignment caused by the movement of solid panel doors. A variety of products are available to insert into the stile and rail slots which will expand and contract with the panel but will always hold it firm & centered. You may need to adjust the size of the panel to accommodate these devices. Space balls & panel align strips are two commercially produced products which can be used for this

purpose. But other material which can expand or contract with the movement of the panel may be used.

Make trial cuts in scrap stock so the top of the panel is flush with the top of the rail and stile pieces. Some enjoy adjusting the cutter depth to create raised panel doors in which the top of the panel protrudes outward beyond the face of the rails and stiles.

A panel cutter bit is ordinarily used to cut the profile on the solid stock panel. These cutters are large, heavy and expensive. It is best to buy one with a back cutter which mills the edge of the panel to fit into the rail and stile slots while cutting the front profile of the panel. Two different sized bearings are provided with the cutter bit. Slow the router down to about 10000 rpms and use a push block. Set the fence even with the large bearing, the good side face down and make the first cut across the grain; turn the panel counter clockwise for your second third and fourth passes. Use the same technique for all panel blanks. Then switch to the smaller bit and repeat the process to finish milling the panel. Milling in this manner minimizes any tear out as you clean up the cross grain cuts with each subsequent cut with the grain. Depending on the capability of your router, additional shallow cuts may be required before the finish cut. You may accomplish this by adjusting the router fence several times. Panel cutters are capable of hogging out a lot of material requiring a substantial horsepower router. And if you plan on creating significant numbers of panel solid stock doors consider a 3 1/4 horsepower router with variable speed adjustment.

#### Arched raised panels

Use a panel template to flush trim the panel to shape before milling. Center a panel template onto panel and nail template to panel about 1/2" in from each side and near the bottom of the template. Drive the nails in about 1/4 to 3/8". The nail holes will be machined out when raised panel cut is made. Cut the stock to within 1/8" of the template then flush trim the raised panel in the same manner as you did the top rail with the template on top.

Milling arched raised panels requires a variation from milling rectangular raised panels as described above. Set fence so it is even with bearing on panel cutter. Run router slow 10000 rpms. Use push blocks. Make first cut across grain on the bottom end of the panel with good side down then cut with the grain on the left side. Remove fence and use a half fence. Start by redoing the left side (which you have already cut) and come on around and cut the curved top of the panel freehand. Reinstall full fence and complete right side.

### Glue up & finishing

Chris recommends placing the stain/finish onto the parts before assembly to avoid unfinished parts showing because of shrinkage. Be sure not to get stain/finish onto the tenons and where they meet pattern cuts where glue will be applied. Nip the four corners off the panel enabling excess glue a place to gather to minimize glue squeeze out onto the corners of the joint formed by connecting the rail & stile. However if you do get squeeze out white vinegar may be used to dissolve dried glue without effecting the finish. Chris concluded the session by recommending creating some practice frame, stile and panel doors before jumping right into a project.

Members are encouraged to attend these educational opportunities provided by the San Joaquin Fine Woodworkers Association.

The next session will be Drawer Case and Drawer Construction taught in two sessions by long time member Al Sindlinger on August 29 and September 12<sup>th</sup>.