



## 1 Flatten a face



## 2 Plane the opposite face parallel

# The Fundamentals of Milling

## Key machines and smart strategy for making boards foursquare

So much in woodworking depends on starting with accurately milled stock—boards whose faces, edges, and ends are flat, straight, square, and parallel. But lumber doesn't come that way, and even if a board is that way today, it may not be tomorrow. This is why strategic milling is so crucial. With the right machines and the right approach, you can produce reliably foursquare boards—the foundation of successful furniture making.

BY BOB VAN DYKE

While you can use hand tools to mill a board, three machines—the jointer, the thickness planer, and the tablesaw—are an incredibly powerful, efficient, and accurate milling system when used correctly and in the right sequence. The process starts with the jointer, which flattens and smooths one face of the rough board. The planer is next. It makes the opposite face of the

board parallel to the face you just jointed while bringing the stock to thickness. Then it's back to the jointer to mill one edge of the board straight, smooth, and square to a face. Last is the tablesaw, which excels at straight cuts that reference off the rip fence, crosscut sled, or miter gauge.

### Start with oversize lumber

Careful milling shouldn't be rushed. It begins with lumber selection. I always buy roughsawn boards that are considerably



# Back to the Jointer

## 3 Square an edge



⚡ **Online Extra**

To watch Van Dyke flatten a board that many would consider too warped to use, go to [FineWoodworking.com/276](http://FineWoodworking.com/276).

# Tablesaw

## 4 Cut to width and length



# Rough out the parts

Chalk out parts before bringing them down to a manageable size using the bandsaw and chopsaw.

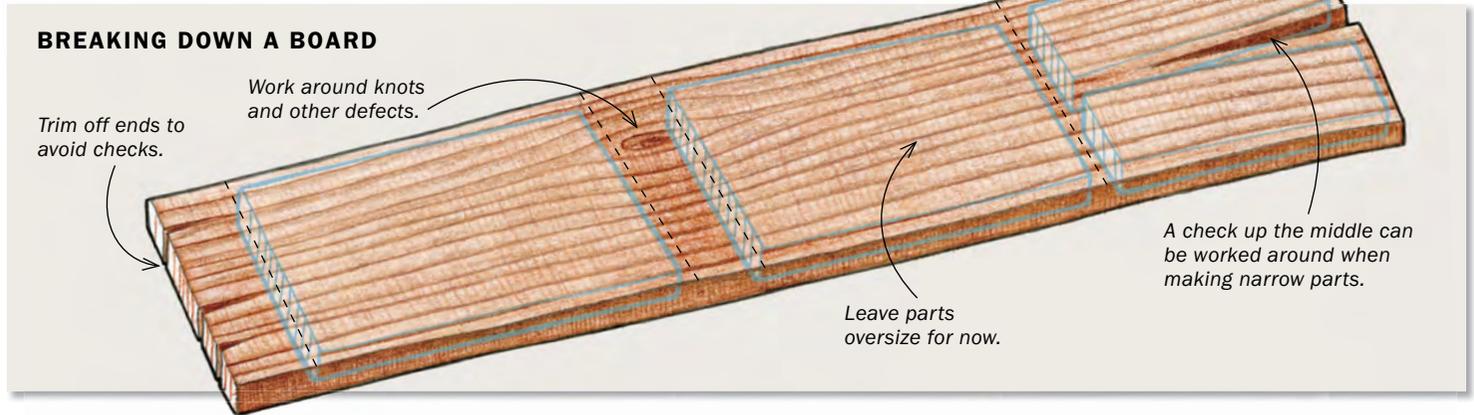
## BREAKING DOWN A BOARD

Trim off ends to avoid checks.

Work around knots and other defects.

Leave parts oversize for now.

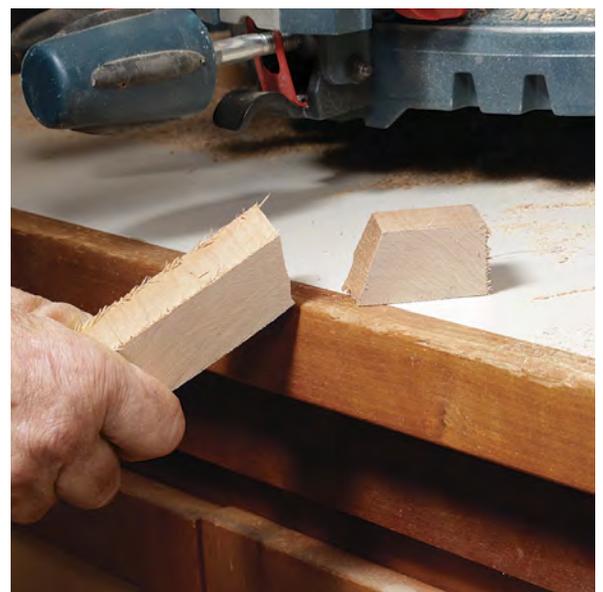
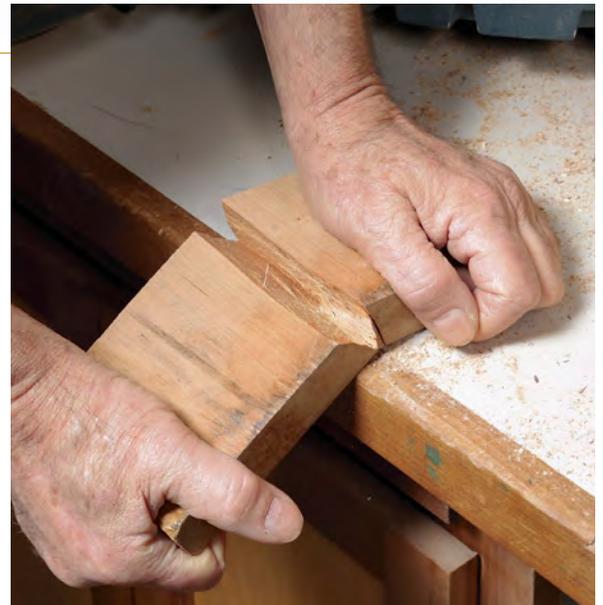
A check up the middle can be worked around when making narrow parts.



## CLEAN THE ENDS



**Cut off visible end checks.** Splits from the end of a board weaken the stock significantly (right). Trim these off.



**Retest for hidden checks.** Take another inch or so and rap the offcut on the corner of a table (above). When a cutoff won't break, you're into good wood.

thicker than what I want to end up with. This extra bulk allows me to eliminate cup, bow, or twist without blowing past my target thickness. I also select stock as straight and square as I can find. Misshapen boards are usually that way because they contain internal tensions, and these stresses will continue to plague you as you mill the board. Either leave misshapen boards behind or accept the extra headache that comes with them.

Lastly, plan ahead. Bring the rough lumber into your shop weeks before milling it. This lets it acclimate to the environment there, stabilizing the stock before you work it.

### Prep the boards

Next, chalk out your parts on the rough boards. But before committing to anything, inspect the ends of the boards for checks. Chop off at least 1 in. and test how strong the offcut is. If it breaks easily, you have an end check. Chop another inch off and test that. You might lose 5 in. or 6 in., but it is important to find that out before laying out the parts.

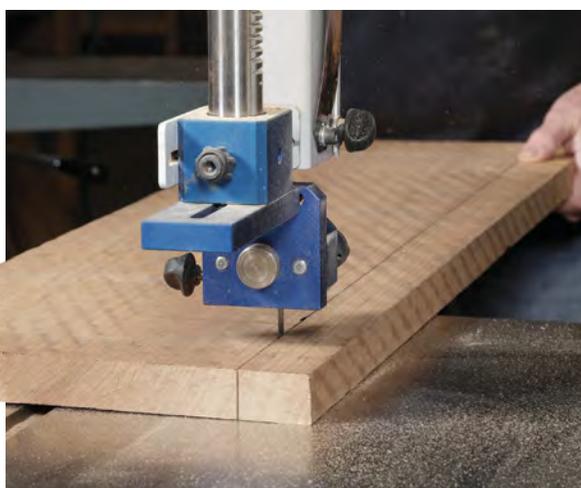
With the end checks out of the way, roughly lay out the parts on the boards. Chalk is best at this point because it is easy to erase as you change your mind—and you will change your mind.

### Cut parts to rough size

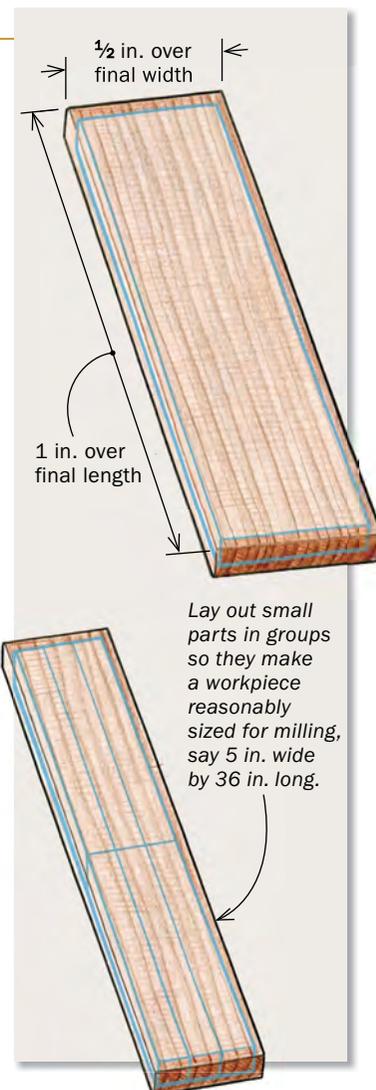
Strategic milling starts with sawing parts to appropriate size. This doesn't mean cutting parts to final dimension, but to a size that makes sense for the jointer and planer while avoiding waste. This involves trade-offs you need to consider. It frequently makes sense—for efficiency and safety—to mill smaller parts together in the board before crosscutting and ripping them out. But the longer and wider the plank, the more wood that must be removed to create a clean, flat face, and that could leave you with stock that's too thin.

To bring parts to rough size, I use the chopsaw and bandsaw. They are safer to use with roughsawn stock, which is likely to be warped in some way. Do not use the tablesaw here. An unmilled, crooked board going past a tablesaw blade can shift, causing the stock to contact the back of the blade and dangerously kick back toward you.

## LEAVE PARTS BIG FOR NOW



**Cut to rough length and width.** Rough boards are unsteady, making the chopsaw and bandsaw the safer tools.



**Label the ends.** Cleaning the board's surfaces at the jointer and planer will remove your marks there; moving them to the ends lets you keep track of the parts.

# Flatten the faces

The jointer and planer are the key machines here.



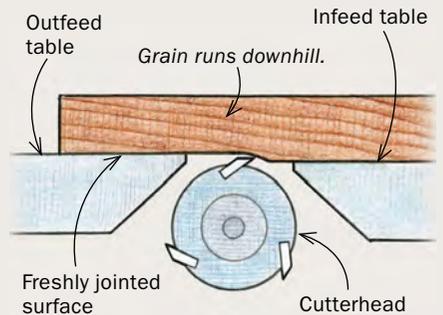
**Pick the correct face to joint.** Typically it's best to place the bowed face down, since it is more stable that way.



**You don't need a finished surface.** It's sufficient to joint enough wood so the stock will not shift as it goes through the planer.

## THE JOINTER

When you push stock past its spinning cutterhead, the jointer smooths and flattens one face of the board. It won't make opposite faces parallel, however. That's the planer's job. The jointer's outfeed table is locked in place at the height of the cutterhead's apex. You adjust the infeed table to be lower than the apex by the amount of the intended cut.



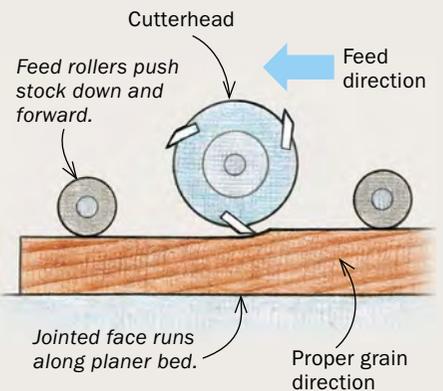
**Plane the second face parallel to the jointed one.** After planing until the second face is completely clean, begin flipping the board end for end between passes to take off an equal amount from each side. Leave the stock  $\frac{1}{8}$  in. too thick.

**Sticker and cover.** Separate the freshly milled stock with  $\frac{1}{2}$ -in.-square strips to equalize airflow. A plywood sheet on top makes sure no face is overexposed.



## THE PLANER

The planer cuts the top face parallel to the bottom face. It can't flatten a board that's not jointed. Feed rollers push the stock firmly against the planer bed and propel it beneath the cutterhead, so the cut mirrors the downward face of the stock.



## Flatten the wood, then let it rest

Wood is forever moving, and when you joint and plane it, you're exposing new fibers to the air, changing the internal tensions. To let the wood settle before you bring it to final dimension, mill in stages, spacing the milling sessions apart by days or even weeks, if possible.

Mill in two stages. However, if the rough stock is wide and more than  $\frac{3}{8}$  in. too thick, mill it in three sessions, removing about  $\frac{1}{8}$  in. each time.

## Final thickness

When the stock has stopped moving (or you are just out of time), go back to the jointer and planer.

Start by jointing a face. Next, use the planer to make the opposite face parallel to the jointed face. Once the second face is entirely surfaced, begin flipping the workpiece end for end between passes as you continue thickening. Take roughly equal amounts off each face to try to minimize inevitable wood movement. Do this until the stock is about  $\frac{1}{8}$  in. over final thickness.

Last, sticker the wood. Jointing and planing exposes fresh fibers, which changes internal tensions, causing the board to warp. Sticker—stacking boards with spacers in between—lets the wood move freely by allowing air to circulate evenly around the parts. Stack the boards with long strips of wood about  $\frac{1}{2}$  in. square—these are called stickers—between each layer. Remember to sticker a scrap board on the top layer, too, to cover it like the rest of the stock.



**Watch for cup.** Every few days, check to see how much the boards have cupped. When the board stops cupping, the stock is done moving and is ready for final milling.



**Joint a face.** Place the cup down and maintain pressure on the outfeed table. Van Dyke marks the correct grain direction, helping him avoid tearout, which is particularly important during final milling.

Let the stack sit for a few days. Then, with a straightedge across the width, measure the cup on a sampling of the boards. Put the stack back together and check again the next day. More than likely the cup will have increased a little. Keep checking. When the cupping stops, the stock is done moving and is ready for final milling.

### Bring parts to final thickness, width, and length

At this final stage, it is particularly important to pay attention to grain direction to avoid tearout. Normally you can read the grain by looking at the edge, but the jointer will tell you if you're right. After jointing a face without getting tearout, mark your feed direction.

Many people joint an edge right after they joint a face. I rarely do this because



**Plane to thickness.** Once the top face is completely planed, flip the board end for end between passes, trying to take off approximately the same amount from both faces.

# Final width

After jointing an edge, it's time for the tablesaw, which excels at making straight cuts parallel to the rip fence.

## JOINT THE EDGES



**Square jointer fence means square jointed edge.** Always check for square on the outfeed table a few inches past the blade. If the stock has a bowed edge, place it down for two points of contact.

## RIP TO WIDTH



**Rip to width.** Keep the jointed edge against the rip fence; either face can be on the table.

## GANG NARROW PARTS



**Rip slightly overwide.** Instead of ripping groups of identical narrow parts to final width, first cut them  $\frac{1}{16}$  in. or so wide.



**Rejoin the wide workpiece after each rip.** This guarantees that each ripped part will have one jointed edge.



**Edge-plane as a bundle.** Placing their jointed edges down, grip the parts tight as they enter and exit the planer so they act as one board.

TIP

MARK YOUR SQUARE SURFACES



It's important to clearly mark square surfaces. They'll be references for milling and joinery.

it limits my options when it comes to feed direction. So the next step for me is the planer, where I mill the stock to final thickness, again flipping the board end for end between passes.

Now joint one edge straight and square to the face. If the stock is crooked, I usually joint the concave edge because it gives me two points of contact and results in taking off less stock overall. However, if there is sapwood, unattractive grain, or a knot by one edge, I joint the other edge and rip the sap or knot off at the tablesaw. After jointing an edge, mark it and the face you kept against the fence.

With two flat faces and one straight edge, you can finally safely and accurately rip

the board to width before cutting it to length.

When ripping a number of pieces to the same narrow width, say under 3 in., I frequently take a different route. Here, I will rip each piece a light  $\frac{1}{16}$  in. over width, rejoining the wider board between rips. Then I will gang them together and edge-plane them to final width before cutting them to length. This ensures all of the parts are exactly the same width, which makes for much easier and more accurate joinery. It also gets rid of the machine marks from the tablesaw.

Once I have all the parts cut to width, I use a crosscut sled or miter gauge to square an end and cut the boards to length.

### Stack without stickering

I frequently see people stickering finish-milled parts. I believe this is misguided, since stickering is a way to let the wood move—the last thing you want after you take the pieces to final size. Instead, you want to stop air from getting to them. For this, I stack like-size pieces directly on top of each other—again topping things off with a scrap board—or, when I'm really concerned about maintaining flatness, keep them in a plastic bag. I have a wide tabletop that's been stored in a garbage bag for more than three years, and it's still dead flat. □

*Bob Van Dyke runs the Connecticut Valley School of Woodworking, where he is also a teacher.*

## Final length

Use a crosscut sled or miter gauge in the tablesaw's miter slots to produce square crosscuts.



**Square an end.**  
Cut off at least  $\frac{1}{4}$  in. Anything less can allow the blade to flutter, making an end that's not square. For improved accuracy, the jointed edge should be against the fence, with no crumbs of wood between them.

**Cut to length.**  
For repeatability, attach a stop to the fence, referencing the just-cut square end against it.



## Storage



**No stickers.** After final milling, Van Dyke stacks the boards and adds a plywood top. This eliminates airflow around the faces, discouraging wood movement.



**Plastic bag keeps boards from moving.** Van Dyke uses trash bags for especially wide boards and for longer-term storage.