Stop Guessing at Wood Movement

Figure out exactly how much of a gap to leave in drawers and floating panels, no matter the wood or season

BY CHRISTIAN BECKSVOORT

Seasonal changes in humidity cause wood to expand and contract (shrink) in width. Woodworkers refer to this phenomenon simply as "wood movement." In relatively narrow boards, say, under 5 in., this movement is rarely an issue. But, as boards get wider, wood movement becomes an important consideration. Ignore it, and problems wait in ambush.

If you build a snug-fitting drawer in midwinter, when humidity typically is low and the wood has shrunk to its minimum width, you'll almost certainly have problems come the end of summer, when humidity is high and the wood has expanded to its maximum width. A drawer cut too wide, if it expands, can end up jammed in the drawer opening and stuck fast. It also can push against the drawer opening and stress the joints. By the way, humidity has no measurable effect on the length of wood.

When I teach case construction, the two most frequent questions are "How much gap do I leave over this drawer?" and "How far should my door panel fit into the frame grooves?"

Most woodworkers make such decisions based on little more than a guess. But luck doesn't have to be your best friend here. You can predict pretty accurately how much a board will move simply by knowing: (1) the species, (2) the grain orientation (flatsawn or quartersawn), (3) the width, (4) the current moisture content (MC), and (5) the expected highest and lowest MC.

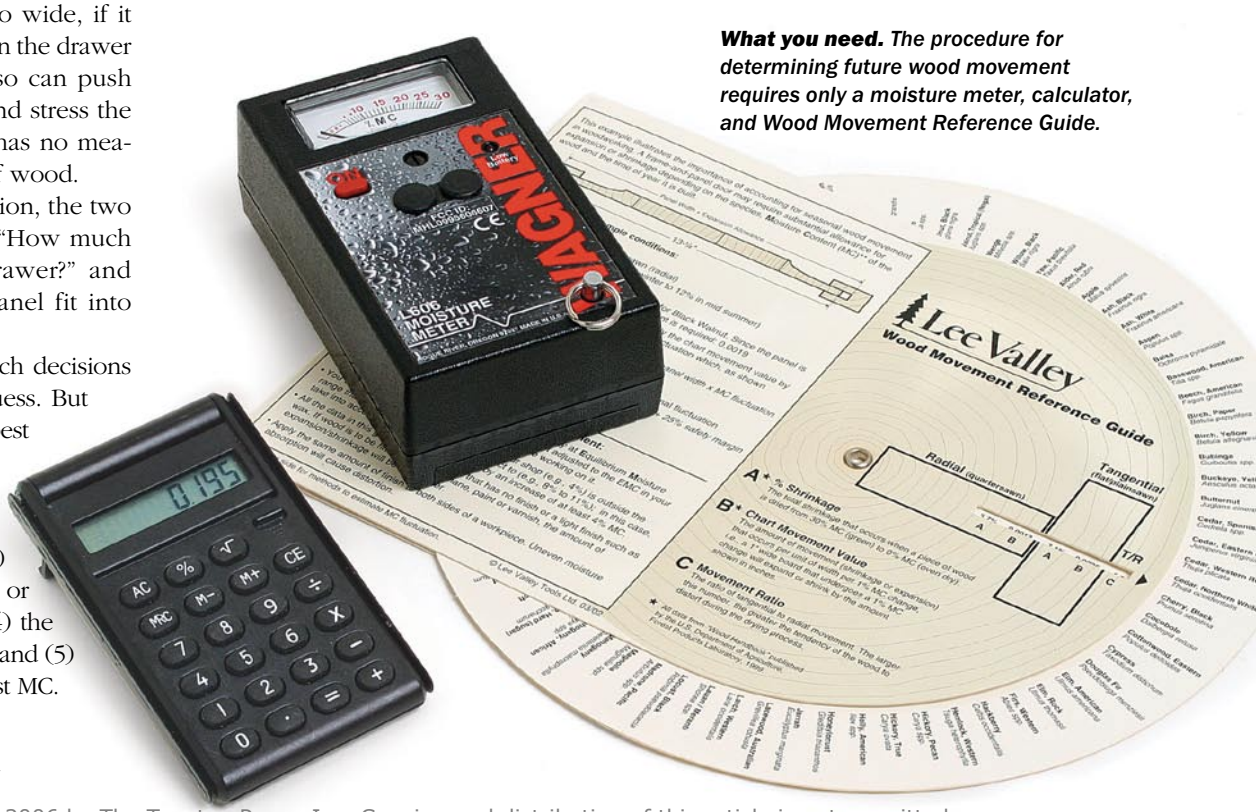
To collect this data, you'll need a Wood Movement Reference Guide (available from Veritas, www.leevalley.com, for about $6), a moisture meter, a calculator, a ruler, and a dial (or vernier) caliper. Or, you can skip the guide and use a chart and formula (see p. 81). A decent moisture meter can be had for around $100.

Determining the width of a drawer

To determine wood movement for an inset drawer front and sides, I first cut the drawer front and sides for a friction fit.

Sizing a red-oak drawer in winter—To determine the final drawer width, though, I need to collect the pertinent information and use the Wood Movement Reference Guide. As an example, let us assume an 8-in.-wide drawer opening. The wood is flatsawn red oak. Because it's Maine in late winter, the MC is 6%, as low as it will ever get.

I have no way of knowing where in the world my furniture pieces eventually will be shipped, so I assume a potential worst-case scenario of 16% MC—a 10% increase. The guide shows a movement value of 0.0037 for flatsawn red oak. To calculate the worst-case wood expansion, I multiply the movement value (0.0037) by the width



What you need. *The procedure for determining future wood movement requires only a moisture meter, calculator, and Wood Movement Reference Guide.*

Fitting a drawer

A drawer cut and fitted to just the right width offers a smooth, sliding fit even on the most humid of summer days, with as narrow a gap as possible when the drawer shrinks in winter.

1. MEASURE THE OPENING

Measuring the drawer opening, top to bottom, provides the maximum width for the drawer.

2. DETERMINE THE MOISTURE CONTENT OF THE WOOD

Use a moisture meter to measure the moisture content (MC) of the drawer front, back, and sides. By the way, if the parts come from more than one board, make sure the boards have the same moisture content, within plus or minus 2%, or so. If a drawer has parts with radically different MC, the parts won't move the same amount, which could stress joints.

(8 in.), by the worst-case increase in MC (10%). Doing the math I get [0.0037 × 8 × 10] = 0.296 in., or 19⁄64 in., just under 5⁄16 in. Therefore, I cut the drawer front and the two drawer sides to 7 11⁄16 in. (8 in. minus 5⁄16 in.).

If I am making lipped drawers, a standard ¼-in.-wide lip won't fully cover the gap when the board is at 6% MC at the end of winter. So, I'd make a 5⁄16-in. lip.

After assembling the drawers and the case, I use a handplane to trim the ends of the front and the outside faces of the drawer sides to create 1⁄64-in. to 1⁄32-in. clearance on each end.

Sizing a red-oak drawer in summer—Now, let us assume we are building the same drawer in Maine at the end of summer. The MC measures 13%. Again, with 16% MC as a potential maximum, the board would experience an increase of 3% (16% minus 13%). Written out, it looks like this: [0.0037 × 8 × 3] = 0.088 in., or just under 3⁄32 in., meaning an inset drawer would be cut to 7 29⁄32 in. (8 in. minus 3⁄32 in.). The same drawer, at the end of winter, will have an MC of 6%. That's a decrease in MC of 7% (13% minus 6%). Calculating the shrinkage, I get [0.0037 × 7 29⁄32 in. × 7] = 0.205 in., 13⁄64 in.

Keep in mind that these numbers are based on unfinished wood. To a certain extent, applying a finish slows the transfer of moisture to and from the wood, and adds a margin of safety.

Determining the ideal width of a panel

Frame-and-panel construction has lots of eye appeal and is a very stable construction system. That's because it gives solid-wood panels the freedom to expand and contract in width as the humidity changes, without affecting the size of the frame.

For woodworkers, the challenge is to determine the ideal width to cut the panel. If a panel is cut too wide and expands in width, it will bottom out in the grooves, and apply pressure to the frame joints.

But if the panel is cut too narrow, it will shrink so that the side edges are no longer in the grooves. When that happens, you'll see dreaded daylight along each side. You can solve the problem by adding a vertical divider (effectively making two narrow panels rather than one wide one) or by widening the groove cut in the frame parts.

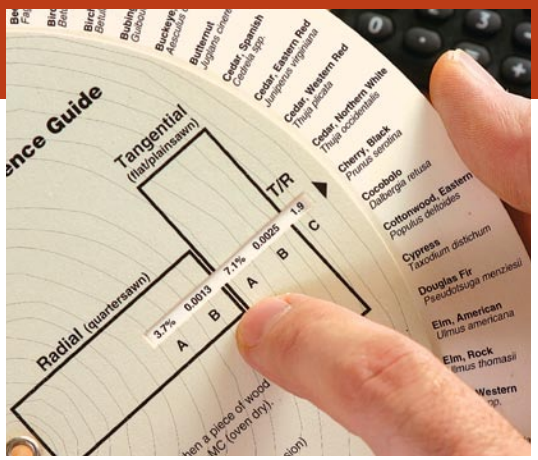
Sizing a cherry panel in winter—Let us say it's the end of February and I've made a cherry door frame. Dry-clamped, the inside edges of the frame measure 10 in. between stiles and 26 in. between upper and lower rails. Centered on the inside edges of all four frame parts is a ¼-in.-wide by ½-in.-deep groove. Therefore, the dimensions, bottom-of-groove to bottom-of-groove, measure 11 in. wide by 27 in. long.

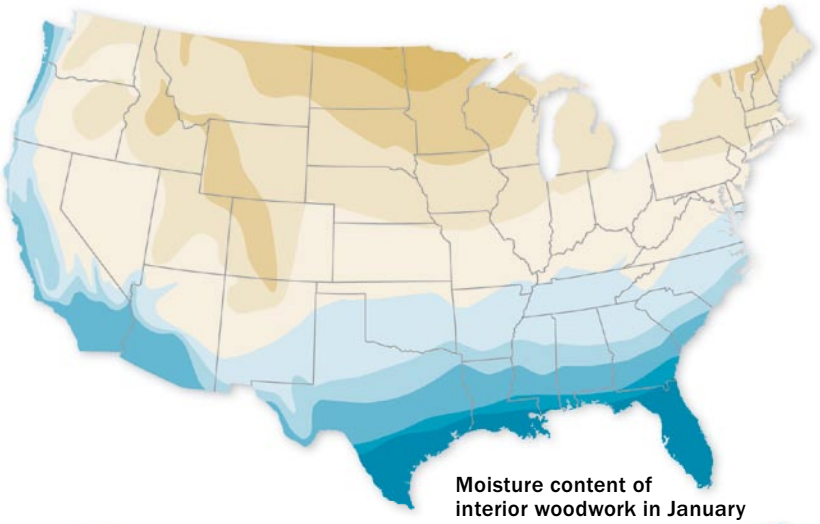
Determining the length to cut the panel is a no-brainer. Because the length changes little as the humidity changes, I simply cut the panel 1⁄16 in. shorter, to

Photos: Tom Begnal; drawings (facing page): Rodney Diaz

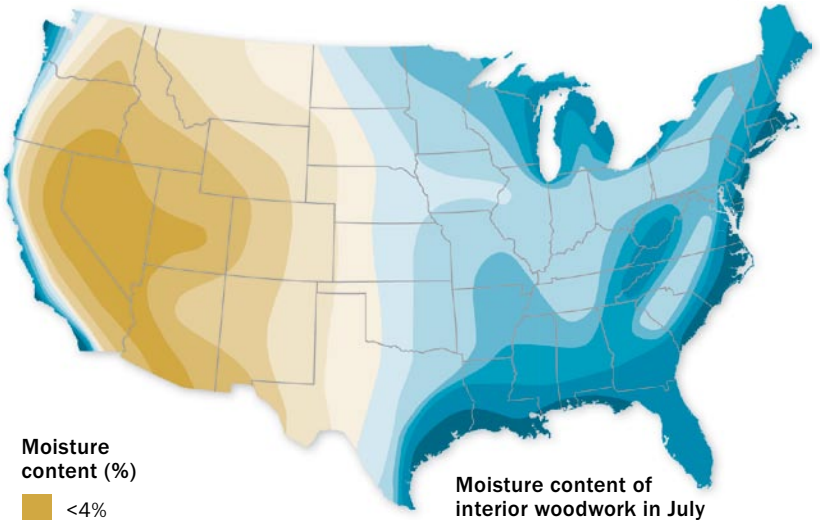
3. CALCULATE THE MOVEMENT

Use the maps below to determine the maximum seasonal change in moisture content (MC). Then use the provided formula to calculate anticipated wood movement.





Moisture content of interior woodwork in January



Moisture content of interior woodwork in July

Moisture content (%)

- <4%
- 4-5
- 5-6
- 6-7
- 7-8
- 8-9
- 9-10
- 10-11
- 11-12
- 12-13
- >13%

SEASONAL MOISTURE CONTENT

In most of the United States, the average MC of interior woodwork varies from winter to summer. It's those seasonal changes that cause wood to shrink in winter and expand in summer. Because Becksvoort does not know where his furniture will be shipped, he always assumes a 10% increase from winter to summer.

USE THIS FORMULA WITH A REFERENCE WHEEL OR A CHART

To determine how much a board will expand or shrink, use this formula. For the movement value (MV), use either a reference wheel or the chart below.

Expected expansion or shrinkage = (MV) x (board width) x (expected change in moisture content)

REFERENCE WHEEL

The Wood Movement Reference Guide isn't a necessity, but it conveniently puts in your hands the quartersawn and flatsawn movement value (MV) for over 70 wood species.

CHART

If you'd rather not buy the guide, you can use the chart below to get the movement value (MV). The formula and abbreviated chart are adapted from the *Wood Handbook*, published by the U.S. Department of Agriculture, Forest Products Laboratory. For the complete chart (Table 12-5) listing more than 120 species of wood, go to www.fpl.fs.fed.us.

SPECIES	QUARTERSAWN	FLATSAWN
Alder (Red)	.0015	.0026
Ash (White)	.0017	.0027
Aspen (Quaking)	.0012	.0023
Basswood (American)	.0023	.0033
Beech (American)	.0019	.0043
Birch (Yellow)	.0026	.0034
Butternut	.0012	.0022
Cherry (Black)	.0013	.0025
Fir (Balsam)	.0001	.0024
Mahogany	.0017	.0024
Maple (Red)	.0014	.0029
Maple (Sugar)	.0017	.0035
Oak (Red)	.0016	.0037
Oak (White)	.0018	.0037
Pine (Eastern White)	.0007	.0021
Pine (Longleaf)	.0018	.0026
Pine (Ponderosa)	.0013	.0022
Pine (Sugar)	.0010	.0019
Poplar (Yellow)	.0016	.0029
Sweetgum	.0018	.0037
Sycamore (American)	.0017	.0030
Teak	.0010	.0019
Walnut (Black)	.0019	.0027

Fitting a drawer (continued)

4. TRIM THE DRAWER TO FIT

Becksvoort planes the top edge of the drawer front and sides until he hits the trim-point. A quick test shows a perfect gap between the top edges of the drawer and the drawer opening.

TIP

DIAL CALIPER SIMPLIFIES LAYOUT
After determining how much to trim from the drawer front and sides to allow for future expansion, Becksvoort saves layout time by simply setting his dial caliper to the calculated distance and using a knife to mark the trim-point directly on the drawer front.

26 15⁄16 in. Figuring the panel's width again requires the guide. The panel is cherry and flatsawn. The maximum panel width is 11 in.; the minimum is 10 in. The moisture meter measured the MC at 6%, and considering it's late winter in Maine, that's as low as it will get. So the MC can only increase. Again, I assume a potential worst-case scenario—16% MC—a 10% increase.

Using the above information, and with the guide in hand, I determine that the movement value for flatsawn cherry is 0.0025. To calculate the worst-case wood expansion, I multiply the movement value (0.0025) by the width (11 in.), by the worst-case increase in MC (10%). Written out, it looks like this: [0.0025 × 11 × 10] = 0.275 in.

To be on the ultraconservative side, I add another 1⁄16 in. and come up with about 11⁄32 in. That's how much this board could expand. So, to make room for it in the frame, I subtract 11⁄32 in. from my total available space of 11 in., resulting in a panel width of 10 21⁄32 in. Rounding it down to an easier number, I cut the panel to 10 5⁄8 in. wide.

Sizing a cherry panel in summer— Now, let's assume that I'm building that same frame-and-panel in August. Because it's well into a humid Maine summer, the moisture meter reads 12% MC.

Again, I anticipate a potential worst-case maximum MC of 16%. But now the difference between the current MC and the worst-case MC is 4% (16% minus 12%). Multiplying the movement value (0.0025), by the width (11 in.), by the anticipated increase in MC (4%), and you get [0.0025 × 11 × 4] = 0.110 in., which is just under 1⁄8 in. Adding 1⁄16 in. as an extra safety factor, I'd cut my panel to a width of 10 13⁄16 in.

Next, I run the numbers to find out how much that 10 13⁄16-in.-wide panel will shrink come the end of winter, when the MC could be as low as 6%. With an expected decrease of 6% (12% minus 6%), the numbers look like this: [0.0025 × 10 13⁄16 × 6 = 0.162 in., or about 11⁄64 in. So, in winter, when the moisture content of the panel drops back to 6%, the panel cut to 10 13⁄16 in. wide would shrink to just over 10 5⁄8 in. (10 13⁄16 in. minus 11⁄64 in.). As a result, the side edges of the panel would extend a comfortable 5⁄16 in. into each stile groove.

At first, this process might seem a bit daunting. After you've done it a few times, though, the entire procedure will take only a few minutes. The payoff is the peace of mind knowing that wood movement won't be a problem. As a professional woodworker, that's important to me. □

Christian Becksvoort is a contributing editor.

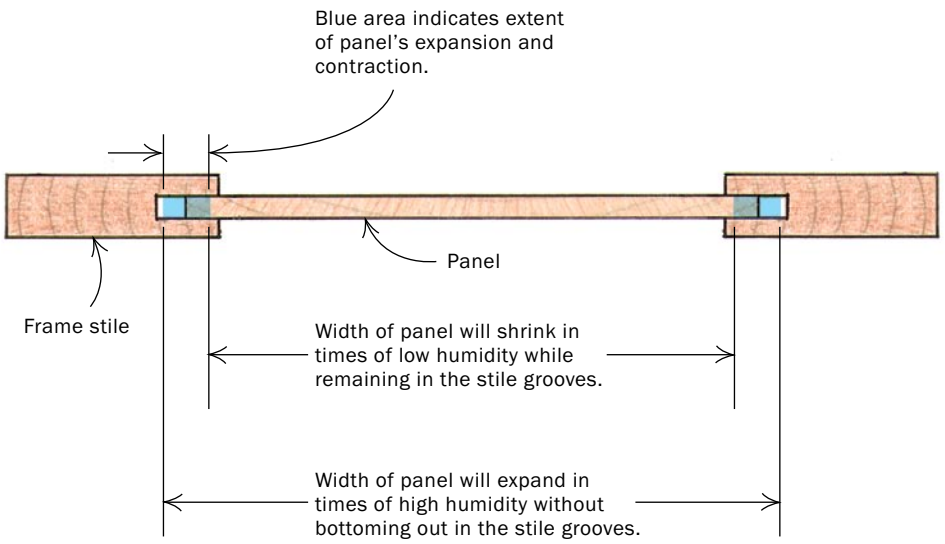
Drawing (facing page): Vince Babak

Fitting a panel

In frame-and-panel construction, a solid-wood panel cut too wide or too narrow will cause problems down the road (see drawing, below). If too wide, an expanding panel will push on the frame stiles, causing stress on the frame joints that could ultimately lead to failure. If cut too narrow, the panel may shrink to the point that it's no longer in the stile grooves, and you'll see a line of daylight along the two side edges. By calculating the future panel movement, you can anticipate a problem, and add a divider or cut a deeper groove to permit additional movement.

Measure for the panel. *To determine the maximum available width for the panel, Becksvoort marks the groove depth all around a dry-fitted frame, then measures from groove-bottom to groove-bottom.*

SIZE SOLID-WOOD PANELS TO COMPENSATE FOR EXPANSION AND CONTRACTION



Cut the panel to size and check the fit. *After measuring the moisture content of the panel and doing the math to determine the appropriate width, the panel is cut to final size and checked against the dry-fitted frame.*