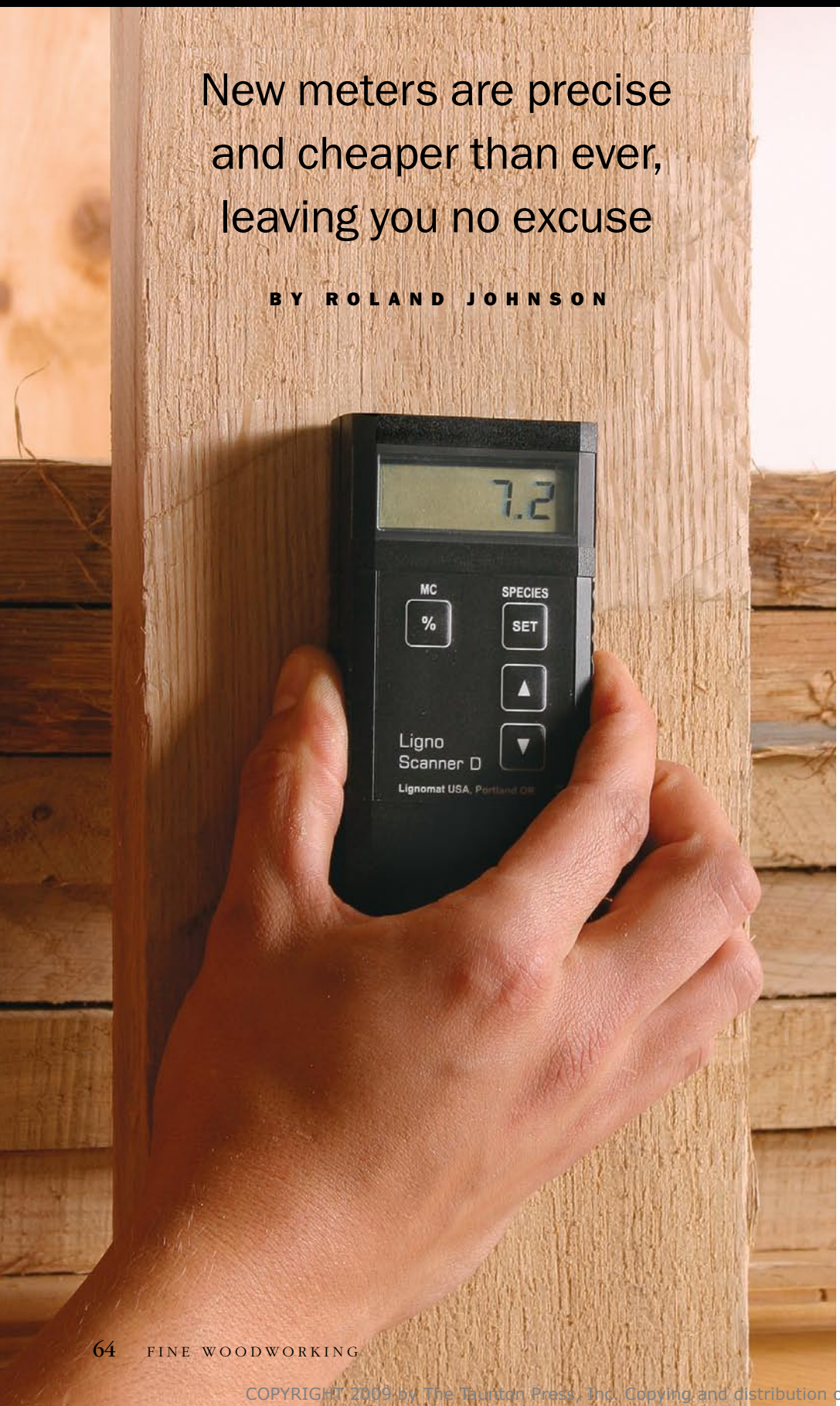
TOOL TEST

Everyone Needs a

New meters are precise and cheaper than ever, leaving you no excuse

BY ROLAND JOHNSON



Wood movement is one of the most perplexing situations for woodworkers. Increases or decreases in moisture can warp panels, crack tabletops, delaminate glue-ups, loosen or split joints, and generally wreak havoc.

Knowing how much moisture is trapped in a board helps you during the milling process, when fitting parts, and even when making repairs. It's essential to know when the moisture content (MC) is low enough in a pile of rough lumber to start milling it to size (below 12%, depending on the region and season). If the wood continues to move after milling, you'll have finished parts that warp and cup. You also need to know that all the boards for one project have the same MC, which helps ensure that movement occurs at the same rate in all the parts.

You can determine the MC of lumber using a mathematical formula, but it's not easy. You need to cut a section of the board, weigh it, dry it in an oven for a period, weigh it again, then put it in the oven and repeat until the board stops losing weight. Finally, you have to dig out a calculator and punch in some numbers. The process can take a couple of days—not very convenient.

A much quicker way to monitor MC is to use a moisture meter. According to our surveys, most *FWW* readers don't own one. That's a shame, because these tools can help any home-shop woodworker avoid the damaging effects of wood movement in a project. And today's moisture meters are more affordable than ever.

For this article I started by testing a whole range of meters, both pin-type and pinless, from bargain brands to high-end models suitable for a lab. Many of the expensive models simply offered more options than most home shops need, with no more accuracy. So I pared down the list to meters under $200—a good entry-level price point. After using both types, I concluded that pinless are the best choice

Photos: Thomas McKenna

Moisture Meter

Know when wood is ready to use

Be a smarter lumber buyer. *A meter will give you an idea of how long the wood will have to sit before it's dry enough to use.*

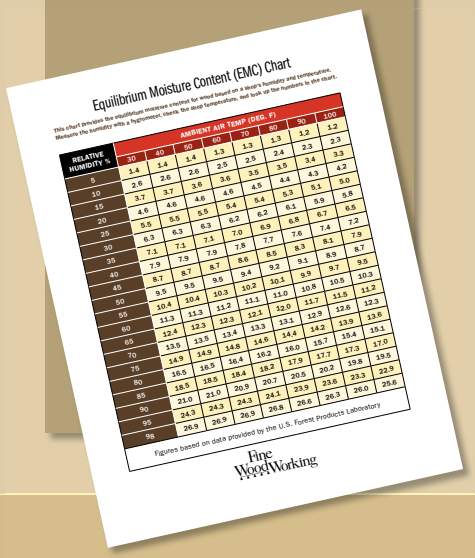
Most woodworkers discover the relationship between moisture content and wood movement by accident. Ever had a board warp after you've milled it to final size? You can avoid problems like this by using wood that is dry enough. Many articles suggest you leave rough-milled lumber alone until it "acclimates," meaning it has reached equilibrium with the moisture content of your shop—that's the point at which the wood is no longer taking in or losing moisture. The surest way to know the wood is ready is to check it with a moisture meter and then compare the reading to your shop's equilibrium moisture content (EMC).

EMC is determined by temperature and relative humidity levels. To find the number, first print out the EMC chart (see Online Extra). Measure the relative humidity and temperature with an inexpensive hygrometer (Amazon.com) and look up those numbers in the chart. Let's say your shop is at 70°F with relative humidity of 55%. In that setting, wood will reach EMC at about 10%. (If your shop has an EMC consistently above 12% or 13%, you'll have wood movement problems when you bring furniture into the drier environment inside your house. In that case, you may want to take measures to reduce your shop's humidity levels, which is beyond the scope of this article.) You also can use your shop's EMC number at the lumberyard. Bring the meter and that figure with you so you can check the MC of the wood you plan to buy. This will give you an idea of about how long it may take the board to acclimate to your shop. Again, when the MC of the new wood is the same as the EMC of the shop, the lumber has acclimated and will remain stable.

Compare new wood to old. *New lumber should have the same MC as the other wood that's being used in a project to ensure that all parts will move at the same rate.*

Online Extra

To download a printable EMC chart, go to **FineWoodworking.com/extras.**



Equilibrium Moisture Content (EMC) Chart

This chart provides the equilibrium moisture content for wood based on a shop's humidity and temperature. Measure the humidity with a hygrometer, round, the shop temperature, and look up the numbers in the chart.

RELATIVE HUMIDITY %	AMBIENT AIR TEMP (DEG. F) 20	40	50	60	70	80	90	100
5	1.4	1.4	1.4	1.3	1.3	1.3	1.2	1.2
10	2.6	2.6	2.6	2.5	2.5	2.4	2.3	2.3
15	3.7	3.7	3.6	3.6	3.5	3.5	3.4	3.3
20	4.6	4.6	4.6	4.6	4.5	4.4	4.3	4.2
25	5.5	5.5	5.5	5.4	5.4	5.3	5.1	5.0
30	6.3	6.3	6.3	6.2	6.2	6.1	5.9	5.8
35	7.1	7.1	7.1	7.0	6.9	6.8	6.7	6.5
40	7.9	7.9	7.9	7.8	7.7	7.6	7.4	7.2
45	8.7	8.7	8.7	8.6	8.5	8.3	8.1	7.9
50	9.5	9.5	9.5	9.4	9.2	9.1	8.9	8.7
55	10.4	10.4	10.3	10.2	10.1	9.9	9.7	9.5
60	11.3	11.2	11.2	11.1	11.0	10.8	10.6	10.3
65	12.4	12.3	12.3	12.1	12.0	11.7	11.5	11.2
70	13.5	13.5	13.4	13.3	13.1	12.9	12.6	12.3
75	14.9	14.9	14.8	14.6	14.4	14.2	13.9	13.6
80	16.5	16.5	16.4	16.2	16.0	15.7	15.4	15.1
85	18.5	18.5	18.4	18.2	17.9	17.7	17.3	17.0
90	21.0	21.0	20.9	20.7	20.5	20.2	19.8	19.5
95	24.3	24.3	24.3	24.1	23.9	23.6	23.3	22.9
98	26.9	26.9	26.9	26.8	26.6	26.3	26.0	25.6

Figures based on data provided by the U.S. Forest Products Laboratory

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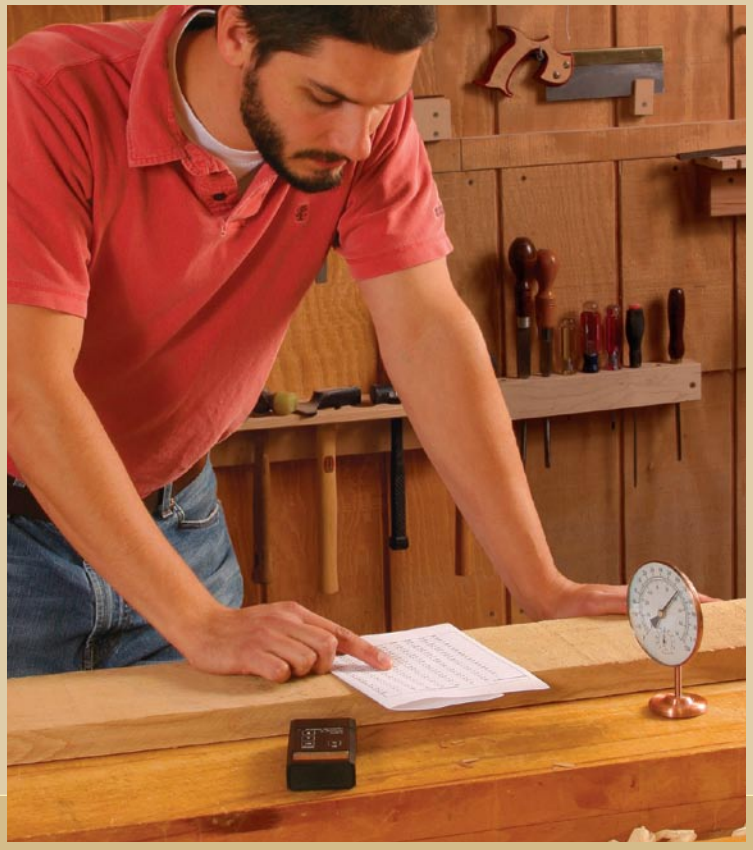

Know when to mill. *When wood reaches its equilibrium moisture content (EMC), it has acclimated to the shop environment and will remain stable. To find the EMC figure, measure the relative humidity and temperature with a hygrometer and plug those numbers into our EMC conversion chart.*

Know how to build for the season

You must pay attention to the season in which you are building and understand how wood will behave based on that season. In most places, the average EMC doesn't vary that much. But even a 2% change can mean a lot. In general, a 1% moisture change in hardwood will result in a bit less than 1/32 in. of expansion or contraction per 10 in. of board width. A 2% moisture difference results in a dimensional change of 1/16 in.

If your locale experiences seasonal moisture changes, drawers, doors, and any other trapped part must accommodate those changes. If you are making drawers during winter in the Midwest, you'll need a fair amount of drawer-height clearance between the sides and carcase or those drawers won't open in July. Conversely, if you fit a solid-wood door to its frame during summer, you want the gaps almost too tight so they'll still look good when dry winter shrinks that door. If you want to get really precise, you can compare the EMC of your shop to the EMC of your house to determine whether you need to leave extra space or keep parts tighter.

Mind the gap. *If your shop location experiences seasonal changes, humidity will rise and fall. That means furniture parts will move, so adjust the gaps in doors and drawers to accommodate future expansion or contraction.*

for home-shop woodworkers. I'll explain why, and compare five pinless meters.

How moisture meters work

A moisture meter sends what amounts to an electrical charge into the board. Wood is a good electrical insulator, and water is a good conductor. As the wood's MC goes up, electrical conductivity increases; as the MC decreases, conductivity decreases. Meters measure that conductivity and generate an MC reading.

Two types of meters—With pin-type meters, you drive two pins into the wood. The meter measures the resistance (absence of moisture) between the pins and converts the number to a percentage of moisture in a certain specific gravity of wood fiber.

Pinless meters are held against a board and generate a radio-frequency field (electromagnetic wave) that passes through the wood and bounces back. It's like sonar for wood. The meters check for power loss or changes in electrical capacitance (which vary according to moisture content and wood density), interpret the data, and then generate an average number for the MC.

Why pinless is better for woodworkers—Frankly, pin-type meters, which were originally designed for the softwood lumber industry, are hard to use in hardwood. Manufacturers recommend that the pins penetrate one-quarter the thickness of the board—that's about 3/16 in. for a 3/4-in.-thick board. The thicker the wood, the deeper you have to push the pins. That's OK if you are working with Douglas fir, but pushing the pins into white oak or hard maple takes some effort and you could bend or damage the pins. On top of that, the pins poke holes in the wood.

Pin-type meters are ultimately better than pinless meters only for determining the exact moisture content of a specific area on a board. That's not very useful for the typical home-shop woodworker who just needs an average reading of a board's MC. However, if you consistently work with thick wood and are willing to do a bit of destructive testing, pin-type meters can be used to show the exact core MC of the board. For those interested in that kind of testing, check out my ratings of pin-type meters at FineWoodworking.com/extras.

Pinless meters are dirt-simple to use, and you don't need to disturb the surface of a board to take readings. They work not

5 good meters under $200

WAGNER L609 SHOPLINE

Source: www.amazon.com

Street price: $190

Accurate: Yes

Species correction: Take reading, consult chart

Comments: Reads to ½-in. depth; narrow sensor pad allows MC reading in materials as narrow as 1 in.; must hold down button to maintain reading; LED display doesn't provide an exact MC number.

LIGNOMAT LIGNO-SCANNER S

Source: www.lignomat.com

Street price: $185

Accurate: Yes

Species correction: Program meter

Comments: Reads to ¼-in. depth so it's hard to get accurate readings in thick stock; comes with carrying case; easy-to-read digital display.

ELECTROPHYSICS CT100 DIGITAL

Source: www.electrophysics.on.ca

Street price: $200

Accurate: Yes

Species correction: Program meter

Comments: Reads to 1-in. depth; species correction knob is located on top of meter and is easy to knock out of adjustment when taking a reading; easy-to-read digital display.

ELECTROPHYSICS CT12

Source: www.electrophysics.on.ca

Street price: $112

Accurate: Yes

Species correction: Take reading, consult chart

Comments: Easy to operate; reads to 1-in. depth; large knob makes it harder to fit into a pocket; gives reading via a dial and indicator light, which doesn't provide an exact MC number.

LIGNO-SCANNER D

Source: www.lignomat.com

Street price: $185

Accurate: Yes

Species correction: Program meter

Comments: Easy to operate; reads to ¾-in. depth; comes with carrying case that hooks onto belt; shuts off automatically; easy-to-read digital display.

SPECIES CORRECTION

All meters are calibrated for a specific wood species. To get the accurate MC of other woods, you need to make a species correction by reprogramming the meter or by adding a conversion amount from a chart. Programming the meter is a more convenient option: Once it is done, the meter holds that setting.

only on rough stock but also for checking the MC of a finished piece, which is especially important for repair or restoration work. They also come in handy when you make a mistake in a nearly completed piece. Say you botched a drawer or door but don't have enough lumber to make another one. Before you make the replacement part, you can use a pinless meter to determine if the MC of the new wood matches the project wood.

The best pinless meters

I tested the meters for accuracy and consistency, eliminating models that proved inaccurate. I used them in thick and thin lumber, narrow and wide stock, and in roughsawn lumber. I checked the MC in lumber that had been indoors for a while and in wood that was stored in my shed, exposed to outdoor temperature and humidity swings.

I chose the Ligno Scanner D for best overall. This is a sophisticated meter that's easy to use. I picked the Electrophysics CT12 as best value. It's easy to use and has a very appealing price. □

Contributing editor Roland Johnson knows the moisture content of all the wood in his shop.

How to get accurate readings

Remove the fuzz. *Roughsawn lumber can throw off the reading of a pinless meter by as much as 2 percentage points. It helps to shave an area smooth near the center of the board to get a better reading. Most lumber dealers will allow this if you ask first.*

Steel and metal can throw off results. *Avoid taking a reading while the board is on a tablesaw top or other steel surface. The thinner the board, the more the reading will vary. On this ¾-in.-thick board, the reading varies by a full percentage point when placed on the tablesaw (left) vs. when held above it.*

TIP CHECKING THIN STOCK

If you are checking the MC of stock thinner than the maximum reading depth of the meter, don't place the wood on a bench. The meter will factor in the MC of the benchtop and throw off the results. Either hold the stock in midair (far left) or stack similar boards to get a reading (left).