TOOLS OF THE TRADE

More on Moisture Meters

Two new units on the market combine functional design with proven technology.

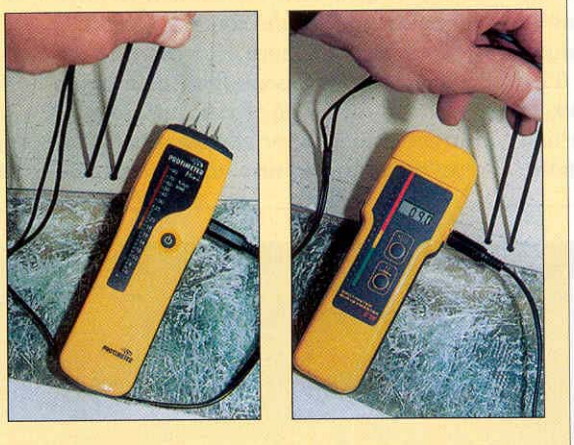
Text and photos by Jonathan Klopman

Technology marches on, and with it moisture meters. So, why is it news when a manufacturer introduces products that focus on *old* technology? After playing with the Protimeter Surveymaster SM and the Protimeter Mini, I found that the simplicity and reliability of some traditional meters, when combined with new field techniques, make these tools welcome additions to my gadget bag.

A little background: Protimeter is a British firm that is best known in the marine industry for its Aquant meter, which I reviewed in *Professional BoatBuilder* No. 60. The Aquant transmits radio frequencies from its "head"; the signals are amplified by the mass of moisture in the laminate; and the unit receives the signals through its "body." Results are compiled and displayed on an LED readout. One feature on the Aquant worth mentioning is that it's not affected by anomalous surface moisture.

As with other moisture-meter manufacturers, Protimeter designs and builds many of its units for the construction industry. The most common—and the oldest—type of meter works on the resistance principle. Two pin probes must be jammed into a substrate (usually wood), and a reading is relayed based on the relative conductivity between the two points. However crude this may seem, the system is simple, reliable, and repeatable.

The Protimeter Surveymaster SM and the Protimeter Mini operate on this tried-and-true resistance principle. The Surveymaster SM is a dual-mode meter featuring both the resistance pin probes and the radio-frequency (RF) method found in the Aquant. The Protimeter Mini is a basic pin-probe meter only, offered at a reduced price. Both are equipped with a remote socket that will accept either a pair of pin probes on a long extension cord (for hard-to-reach areas), or a set of "deep wall" insulated probes that read moisture deep inside a part.



*The Protimeter Mini **(left)** and the Protimeter Surveymaster SM **(right)**, with attachable deep-wall probes, display a safe 9% relative-moisture content in a balsa-cored deck that registered a very high reading with a non-contact meter (i.e., one that operates by capacitance). When the deck was taken apart, the core proved to be dry—demonstrating that a limited amount of semi-destructive testing can sometimes be worthwhile.*

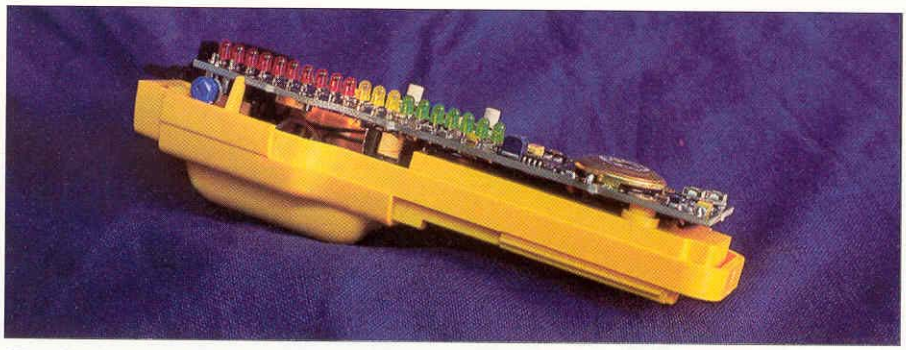
The reason I have spent so much time trying to see how much fiberglass a non-contact meter can punch through and still return an accurate reading is that assessing cored laminates remains the most daunting task for moisture meters. Using non-contact meters alone to bless or condemn a hidden core material still makes me nervous. *Professional BoatBuilder*'s technical editor Bruce Pfund advises surveyors to use meters, yet *believe* in hole saws, which is still the most prudent advice.

In the case of a prepurchase survey, however, boat owners generally don't warm to the idea of some surveyor making holes in the boat just to satisfy a buyer's curiosity. Who could blame them? Such situations can leave everyone with an uncomfortable feeling, since there is no quick and easy opportunity to confirm or disprove the meter reading. Which brings me back to pin probes.

For a long time, I had dismissed this type of meter. After all, you won't really impress clients if you try to jam pin probes into gelcoat. Nevertheless, I have come to find situations where these meters shine.

Conventional resistance-type meters may be less destructive for taking a reading directly off core material, which sidesteps the problem with some non-contact meters. The above-mentioned remote deep-wall probes that plug into the Surveymaster SM or the Mini seem to offer a solution. By drilling a pair of 5/32" holes through the outer fiberglass skin, the probes can be inserted to get a reading straight from the core material itself.

Although any hole in a laminate must be defined as "destructive," even the most finicky boat owners would be hard pressed to object to a pair of vampire-bite holes discreetly drilled through the hull's inner skin. Sealing the holes back up with five-minute epoxy is simple. The value of this approach is obvious; it's an opportunity to get to the heart of the matter and settle unanswered questions that



The Surveymaster SM runs on a circuit board controlled by a CPU. The manufacturer has hard-wired the LED display and micro-switches, which greatly increases the unit's reliability.

may have been raised during initial inspection.

Divining Deck Core. I was recently contacted by a boatyard that was in the middle of a deck-core repair on a small production sailboat. The yard had used a popular brand of non-contact moisture meter to test the condition of the deck. All of the readings were uniformly high. After chopping into the deck, however, the crew found the balsa-wood core white and dry to the touch.

The problem here had more to do with the meter's scale and calibration than with whether or not the unit was functioning properly. Virtually all of the popular meters in the marine industry are set for a maximum reading based on 20% to 25% moisture content in wood. While most species of wood require a minimum moisture content of 20% to 25% to support fungal growth, this does not mean that balsa wood or foam core at this moisture content will be deteriorated or even wet to the touch.

Although the non-contact meter may have been pegged, the scale cannot discern between 20% moisture and full saturation. This is one noticeable difference in the Protimeter resistance-type meters, both of which offer a full 0% to 100% scale. By using the Protimeter Mini and the deep-wall probes, I was able to pull a "true" reading directly from the balsa core, which was actually in the range of 9% to 10% moisture content.

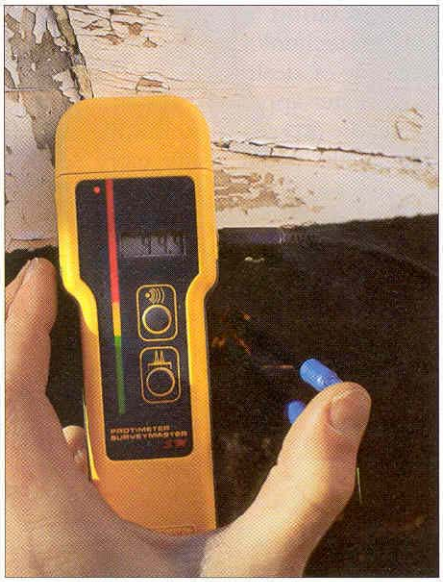
Getting Back to Wood. Up to this point, I had never seriously considered surveying a wooden boat with a moisture meter. After all, only a true dimwit would put a sensitive Tramex meter on the underbody planking of a boat that had been stored in salt water—and expect to get meaningful results. At the same time, surface salts and residual moisture under paint film can also give false readings.

I'm sure, though, there are many surveyors who, like myself, have seen the surface condition on a wooden boat and wondered whether they are looking at an anomaly, or the "tip of the iceberg." It's often the case that, by the time rot is visible on the surface of a timber, the underlying condition is dramatically worse.

Wood is not a sponge. Although a boat may be wet stored, generally the core of a healthy timber will not reach moisture levels greater than 25%. The saturation point of healthy wood fibers reaches an equilibrium. Exceptions include rotten areas where the deteriorated cell structure frequently spikes up to 90% or 100%.

Last spring, when probing a rot pocket on a stemhead, I knew that the infected wood probably extended along the grain and deep inside the part. But, suspecting something based on experience and *proving* it to my client can be two different things. I drilled two small holes deep into the planking rabbet, more than a foot away from the visible problem area. Using my meter's deep probes, I was able to draw readings of 99% moisture. Boring down the holes with an auger bit, I pulled out soft, crumbly fibers after hitting a rot pocket deeper than an inch below the surface. The scary thing was that the face of the stem sounded solid only a few inches away from the surface rot.

Destructive, Nondestructive, and Semi-destructive Testing. Whether you're talking about metal, wood, or complex laminates, destructive testing yields the most accurate information regarding materials, construction, and condition. Barring this, we are left with instruments and techniques that are often imprecise or require a lot of



After inserting the Surveymaster SM's deep-wall probes into a suspect timber, the LED display read 99% moisture content. Boring into the 5/32" probe holes with an auger bit revealed a soft white pocket of rot.

interpretation. Focusing on a long-proven technology with only a limited amount of destructive probing might be a better approach. The cost is minimal, the impact is unobtrusive, and the results could justify more serious removals. Who knows: You might find that the core is bone dry, and everyone can breathe a sigh of relief.

Construction Details. Protimeter's newer line of products are all encased in high-visibility yellow plastic. The material is more flexible (and less brittle) than the thermoset injection-molded plastic found in the older Protimeter Aquant and other popular meters.

The case halves are seated in a gray rubber H-shaped gasket, which helps seal the sensitive electronic innards and provides a secure finger grip around the perimeter of the case. Both meters have rounded contours and are remarkably compact. The units aren't equipped with a lanyard, but they can be pocketed easily.

Although it may seem superficial, the meters' outward design and feel are professional and contemporary, especially compared with the tools we are accustomed to using. Let's face it: There are times in the field when a surveyor is confronted with a certain credibility gap as other parties question the mysterious beeps and boops made by these little plastic boxes. It doesn't hurt to have test equipment that appears to have been designed within recent decades.

In terms of usability, the layout and mode of display is the most important feature of any meter. As a dual-function meter, the Surveymaster SM offers separate displays for non-contact/RF as well as pin-type resistance. The RF display has a colored 20-light LED bar. The lights on the new meters are clearly marked 6–20 in the green-to-yellow zone (roughly corresponding to percentage moisture-content in wood), while the range is extended from 20 to 90 throughout the red zone to give a better feel for "how bad is bad." The resistance probes on the Surveymaster SM read out on an LCD display that ranges from 0 to 99.

The Protimeter Mini also uses an LED display, but there are 64 separate little lights. The effect is a smooth transition as the light runs up and down the scale.

There's no doubt that lighted LED displays are difficult to read in direct sunlight and from certain angles. Traditional analog meters will always be easier to read, but LEDs are generally considered more durable.

Both meters come equipped with a reference block to check the calibration of the resistance in the probes. Obviously this is a reassuring detail that allows the surveyor to routinely check the relative accuracy of the meter without having to send it back to the factory.

The guts of both meters consist of compact microcircuit boards run by

CPUs. The switches are hard-wired onto the board and are equipped with an "auto off" setting to conserve power. These are very desirable features for longevity and durability. Both meters are powered by a pair of easily accessible AA batteries.

The Protimeter Mini and the Surveymaster SM appear to have high-quality design and construction overall. The more modern approach of integrating all components (battery, switch, display, logic) onto a single board should dramatically affect long-term reliability.

Moisture Meters for Painters? Protimeter offers a number of different moisture-reading devices. The Protimeter Hygromaster measures ambient air temperature, relative humidity, and dew point. There's also an optional sensor that plugs into the head of the meter and records surface temperature. While this information may not be of much use to the average surveyor, it's crucial to coatings application.

Each sensor is calibrated and marked with a serial number at the factory and, if needed, can be certificated. You test the sensors by measuring against a known constant for 75% relative humidity. Here too, the operator has the ability to verify the accuracy of readings without sending the tool to the factory.

This gadget's usefulness should be apparent. By logging all temperature and condensation variables before beginning a job, the applicator provides quality assurance for his or her work. With the amount of money involved in virtually any coatings job, a simple tool such as this could be valuable insurance against possible future accusations of poor quality control.

This product review is not intended as an endorsement of one brand of meters. Other manufacturers may offer similar products, such as the deep-wall probes, for their own resistance meters. No meter can be expected to give consistent and accurate readings without plenty of field testing and common sense on the part of the operator. PBB

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The topic of moisture meters and their ability to reliably read the percentage of water in a laminate has been covered extensively in previous articles in *Professional BoatBuilder*. For more information, see "Moisture Meters," PBB No. 23, page 42; and "Moisture Meters Revisited," PBB No. 60, page 48. —*Ed.*

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