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Guide for Using Portable Electric Moisture Measures on Lumber

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Introduction

Electric moisture meters get that name because they measure an electrical property of a piece of wood and convert that measurement to a corresponding moisture content (MC) value, usually read directly on the meter. Depending on the type and manufacturer of the meter, the electrical property measured may be resistance, conductance, dielectric constant, or power-loss factor.

Electric moisture meters, if used properly, provide a rapid, convenient, and, for most purposes, sufficiently accurate means of determining moisture content of wood when the wood is less than 30% MC. When wood is treated with certain wood preserving or fire-retardant salts, electric moisture meter readings are reliable only in a narrow range; see "Special Situations" section on page 4.

Both the producers and the users of dry lumber have gained an increasing awareness of the importance of correct moisture content during manufacturing and in the eventual performance of a quality product. They are both using portable electric moisture meters more often to monitor MC and to provide data for statistical process control programs. The moisture content values obtained from electric moisture meter readings are becoming an important factor in the acceptance or rejection of loads of lumber at secondary wood products manufacturing plants.

Following the suggestions in this guide will help achieve the best results with a portable electric moisture meter. Note that we do not recommend one type of meter over the other; most mills need to have both types in order to take advantage of the special characteristics and advantages of each.

Types of Electric Moisture Meters

There are two types of portable electric meters in widespread use today--pin-type and non-pin-type.

Pin-type meters. With these meters (also called resistance meters), pin or needle-like electrodes are driven into the wood. The electrical resistance or conductance between the pins (electrodes) is measured and converted to a MC reading. In meters with the pins mounted in the meter case, the pins are usually uninsulated and about 3/8-inches long.

Another style of pin meter has the pins mounted in some type of hammer or device for driving the pins into the wood, and this 'hammer' is connected to the meter by a cable. These designs usually use 1-inch long pins that are insulated except at the tips. Pin or resistance meters read the moisture content of the wettest area that contacts the uninsulated part of the pin/electrode. Effective measurement range of resistance or pin meters is from 7 to 30% MC. These meters are specialized ohm meters, and below 7% MC, the electrical resistance is too high for reliable readings. For example, at 7% MC the resistance for red oak is about 15,000 megohms, and for hard maple 72,000 megohms. Above 30% MC, the electrical resistance has too much variability and too little change for reliable readings. At 30% MC the resistance for red oak is about 0.50 megohms and for hard maple it is about 0.60 megohms.

Non-Pin or dielectric meter. This design or type of electric meter uses a sensor plate that does not physically penetrate the wood. Rather, the sensor plate is held in intimate contact with the wood surface and an electric field is projected into the wood. An electrical property such as the dielectric constant or power-loss factor is measured and converted to a MC reading. Effective range of non-pin or dielectric meters is from about 5 to 30% MC. Note that the lower limit of the range is about 2% MC lower than the pin/resistance meter; both meters have the same upper limit of 30% MC.

Because both types of meters are measuring an electrical property rather than MC directly, some natural variation will occur. This means that two meters measuring the MC of the same piece of wood may, from time to time, have slightly different readings. If the meter reading will be one basis for accepting or rejecting lumber, it is prudent to indicate the brand and model number of the meter that will be used for such testing.

Preferred Procedure for Use of Pin-Type Meters

1) Turn meter on and check that battery has ample power. (See calibration discussion on page 4.)

* All meters have a button or switch to check that the battery is OK. If check does not show that battery has required amount of power, replace battery with a fresh one.

* If meter has adjustment knob/screw, turn to bring the needle or digital readout to the position recommended by meter manufacturer.

2) Select a location to make the MC measurement.

* For lumber, the location should be at least 1 foot from the end of piece and about the middle of the wide face of the board.

* If measuring pieces of molding, turnings or other products less than 4 feet in length, select a location in about the middle of the piece.

* For piled lumber, readings may be taken on the edge or narrow face of the board. However, remember the edge pieces may not represent the MC of the interior pieces. Readings taken from the end grain of boards will not usually represent the average MC of the piece.

3) Position the pins on the wood surface with needles parallel to the grain. (A few meters require the pins to be across the grain; check the instruction book.)

* Having the pins parallel to the grain is important when the MC is above 15% MC.

For readings below 15% MC, pin alignment is not very critical.

4) Force the pins into the wood --- How deep?

* When using meters with pins mounted in meter case, (pins usually 3/8-inch long, uninsulated) DO NOT hammer or pound on case. Apply only hand pressure. Try to push pins to their full length into the wood. For oak, hickory and other dense woods, force pins as deep as possible without striking the meter.

* Meters with electrodes (pins) attached by cables typically have some type of hammer to drive longer pins (usually 1 -inch long, insulated except at tip) to desired depth in wood.

* To determine the average MC of the piece, drive insulated pins 1/5 to 1/4 of the thickness of the piece. Example: for 4/4 lumber, drive to 1/4-inch depth; for 8/4 lumber, drive to 1/2inch depth.

* To determine if moisture gradients exist, take readings at different depths from surface to core. A shell wetter than the core would indicate moisture regain after kiln drying.

* To determine core MC of the piece, drive pin tips to center of piece.

5) Read current MC values and record

* If meter readings drift, use the reading taken immediately after electrode reaches desired depth in piece.

6) Take MC readings at more than 1 location per piece.

* To give indication of MC variation, if any, along the length or width of the piece.

* To help locate wet pockets in piece.

7) Make temperature corrections if lumber temperature is below 60°F or above 90°F.

* Meters are usually calibrated for 70-80°F. If lumber is above or below this temperature by 20°F or more, corrections should be made. Correction tables are available from the meter manufacturer and many general wood drying reference books. Readings at room temperature are usually best.

* Some meters have provisions for presetting temperature correction on meter. If the meter has this feature, use it.

* The meter, including the electrode pins, should be at room temperature if at all possible.

8) Make species correction as needed.

* Some meters have provisions for presetting species or species groups on meter. If the meter has this feature, use it.

* Species corrections are usually very slight (1% MC or less) for most North American woods; corrections may be greater for some tropical woods. Correction tables are available from the meter manufacturer and many general wood drying reference books. Most meters sold in the U.S. are factory calibrated for Douglas-fir or for Southern pine, so no correction is needed when used on these species.

9) Turn off meter when finished taking readings.

Preferred Procedure for Use of Non-Pin Dielectric Meters

1) Turn meter on and check that battery has ample power. (See calibration discussion on page 3.)

* All meters have a button or switch to check that the battery is OK. If check shows weak battery, replace or recharge the batteries, as appropriate, until indicator shows OK.

2) Select the proper location to make the MC measurement.

* For lumber, the location should be at least 1 foot from the end of piece and about the mid-width.

* Position meter so that there are no metal rollers or supports on the back side of the board opposite the meter location. It is best to have the back side of the board exposed to air.

* If measuring pieces of molding, turnings, or other products less than 4 feet in length, select a location in about the middle of the piece.

* Use on edge or narrow face of piled lumber ONLY if sensor plate does not overlap adjacent boards. Often there is a minimum contact area required to get a reliable reading on a particular board; in other words, the sensor plate must be entirely covered.

3) Press sensor plate of the meter firmly against surface of the wood.

* Non-pin meters are designed to give readings of the average MC of the cross-section of lumber up to about 2-inch thick. Consult manufacturer's literature for precise limits.

4) Read current MC value at this location and record.

5) Take MC readings at more than 1 location per piece.

* Since no holes are made in the wood, numerous readings can be made along the length of the board without marring the surface. Taking several reading per board gives an indication of MC variation along the length and easily locates wet spots in species prone to this drying problem.

6) Make allowances or adjustments for species/specific gravity (SG) of wood.

*Non-pin meters can be heavily influenced by the (SG) or density of the wood

* Some meters have species adjustments built into the meter, check the meter instruction sheet. If the meter has this feature, use it.

7) Turn off meter when finished taking readings.

Calibration

Calibration blocks or standards are available, from the manufacturer, for both pin and non-pin electric moisture meters. We recommend that appropriate calibration blocks be obtained and used regularly to ensure the most accurate readings. Some meters have built in calibration checks; if so, perform the calibration check as part of Step # 1 .

Special Situations That May Affect Reliability Meter Readings

1) **Wood is wet on surface due to rain, snow, or ice**.

   It is difficult to obtain accurate readings in this situation. Liquid moisture on the surface of the lumber can be dragged down with the probe on pin-type meters, and may give incorrect (too high) readings even with insulated pins. Do not use non-pin meters when surface moisture is present, readings will not be accurate.

   2) Taking meter from room temperature into hot humid kiln or from room temperature to very cold outdoor conditions.

   If a meter or probe is brought from a cold into a warm environment and the equipment is colder than the dew-point temperature of the warm air, then moisture will condense on the cold equipment. The condensation may give an extremely high reading or may just give a reading of 10% MC. Low MC's cannot be measured until the moisture is evaporated from the equipment, it may take several hours to evaporate. So, the recommendation is "Don't take the meters into a hot kiln and expect to take accurate readings unless the meter is warmed to approximately the temperature of the kiln." It is preferred if the meter and pins are at room temperature.

   3) Non stable readings from pin-type meters in very low humidity conditions.

   In a very dry environment (under about 30% RH) or when very dry lumber is planed, a static charge can develop on the lumber or on the cable of the meter. This static charge will result in erroneous reading by the electric meter. Often the meter will show erratic behavior of the MC readout. The meter may also begin to indicate a MC value before the needles even touch the lumber. In extreme cases, it may be necessary to take the MC readings on a grounded metal table to dissipate the static charge.

4) Wood treated with certain wood preservatives or fire retardants.

Wood treated with oil-borne preservatives generally does not affect moisture meter readings. Wood treated with water-borne salt solutions of either wood preservatives or fire retardants will generally give meter readings that are too high when the wood is wetter than about 10% MC. Wood treated with water-borne oxide solutions of wood preservatives such as CCA-C will give fairly accurate readings up to about 25% MC.

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