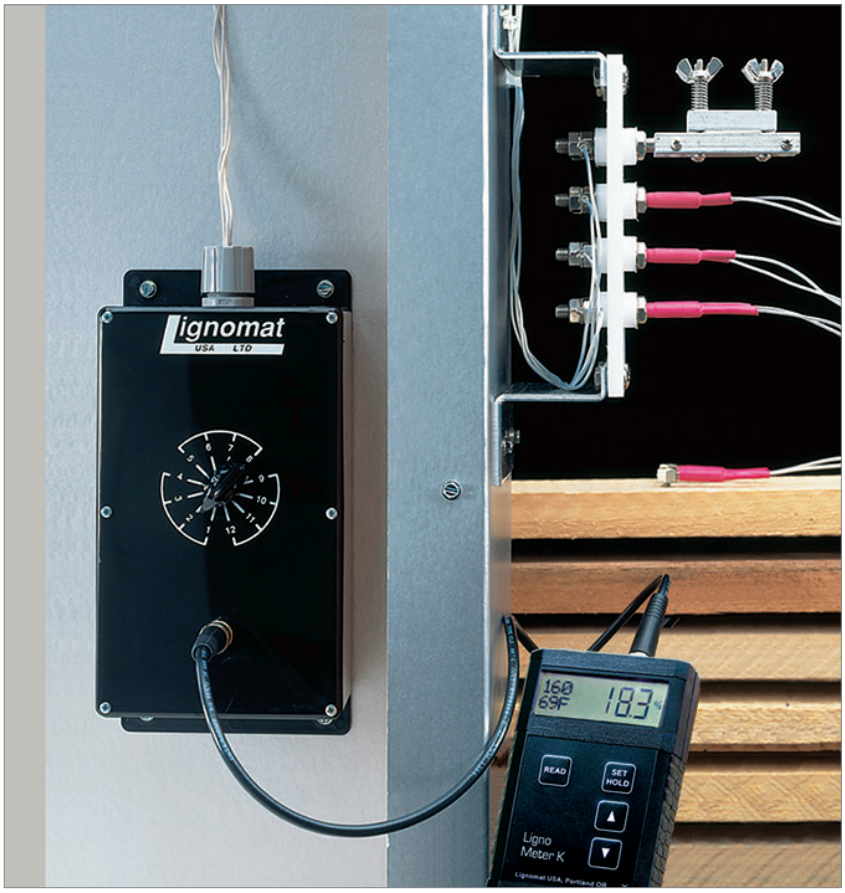
# Installation and Operators Manual for Lignomat's PK System
# In-Kiln-Moisture-Monitor with 4-Station Plate




Lignomat offers everything from 1 PK-Probe Set with a Moisture Meter up to a computerized kiln control system.
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# Installation Manual

The PK system (in-kiln-moisture-monitor) gives reliable and easy obtainable information about EMC (equilibrium moisture content) and MC (wood moisture content) from several different probes distributed throughout the kiln. Moisture readings can be obtained at the switch box outside of the kiln. The kiln operator can take readings whenever necessary. After evaluation of the moisture readings against the predetermined drying schedule, necessary changes in the climate settings can be made. Thus the kiln operator will be able to run the kilns following the changing moisture content; there will be less degrade, output and quality can be optimized.

*1.1 Layout*

The switch box mounted outside the kiln is connected with teflon cable to the 4-station plate mounted inside the kiln wall. A set of removable PK-H cables is used inside the kiln to make the connection from the 4-station plate on the wall to the probes in the lumber.

First, the location of the switch box and the location of the station plate should be determined. The switch box should be mounted close to the station plate on the outside wall. The drawing on page 4 shows cable connections to be installed between switch box and 4-station plate for 4 MC or 3 MC and 1 EMC measuring point. When determining the cable routing, consider that all permanently mounted cables should be installed where no damage from lumber packages being moved in and out of the kiln may occur.

*1.2 Installation of Station Plate*

Once the layout has been determined the station plate should be mounted first - directly to the wall with plastic anchors on cinder block kilns or sheetmetal screws on metal kilns. All screws must be stainless steel. A silicon base caulking should be used to seal all holes including screw holes. Most silicon caulks have acetic acid bases, which will cause masonry to deteriorate. There are caulks available with non corrosive bases.

*1.3 Installation of Switch Box*

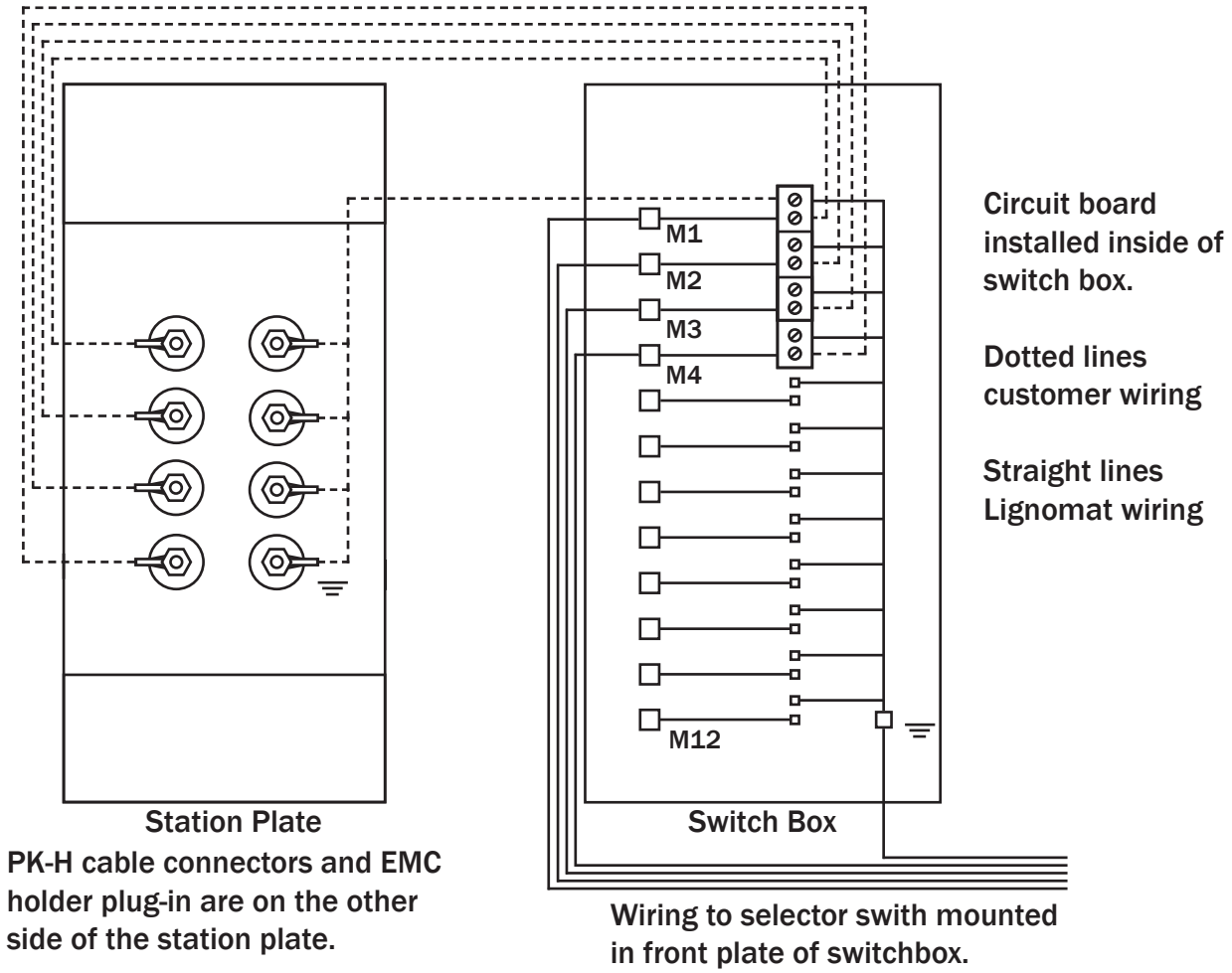
All cables coming from the station plate to the switch box are pulled through the exit hole in the kiln wall, which should be made as small as possible. To avoid electrical interference no other cables should be pulled through the same hole. The exit hole should be sealed completely. Allow the caulk to dry before completing the connections, thus, maintaining a good seal. Pull cables inside of switch box and mount the box. Strip cable ends and connect each pair to the appropriate terminal on the circuit board mounted inside the switch box.

*1.4 Connections, Checking Cables and Switch Box Positions*

Connect the cables according to the diagram below. All connections on the station plate are customer wired. Jumpers can be used to connect the ground wires on the station plate.

To find out which position on the switch box connects to which position on the station plate, connect the meter to the switch box and connect a cable to one position on the station plate. Short the cable ends by pressing the banana plugs together with your fingers, press READ on the meter and dial through all positons on the switch box until the reading on the meter is high. Then you know, which connection on the station plate goes to which dial position on the switch box. Mark the station plate accordingly.

**Diagram of Station Plate and Switchbox**



*2.1 Probing Packages*

Usually the packages are probed while loading the kiln. This way while unloading the kiln the measuring cables and probes can be retrieved from the packages coming out of the kiln and used for the next kiln charge. This way only one set of measuring cables and probes is necessary. If production flow requires probing the package earlier, two sets of measuring cables might be required.

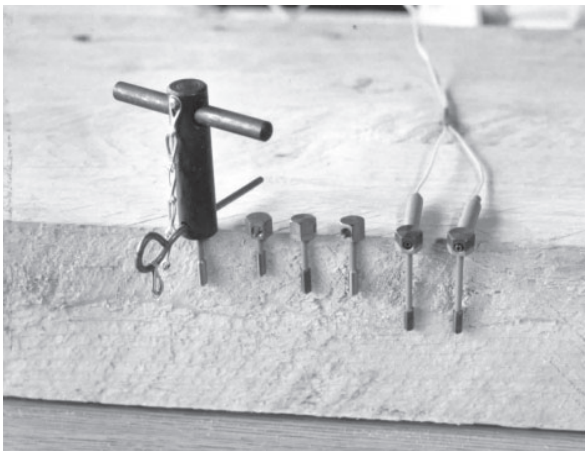
If certian boards in a stack should be probed, an easy way to identify the selected board within the stack is to put an “X” on the layer in which the board is, and an “X” on the end grain of the board. The probed board should never be located close to the “edge” of the package because the outer zone might dry faster and not be representative for this package.

**There are two ways to probe a package:**

1. Part of the package is lifted with a forklift. If the row is marked with an “X”, lift everything above the “X”. Pull out the marked board and place the probes.

2. From the top of the package the upper layers of boards are put aside and a board in the center of the layer is equipped with probes.

Two holes have to be drilled for the probes with a 5/32 inch drill bit 1 1/4 inches apart, making sure the probe will bottom out in the hole. To hammer the probes into the board put the pulling tool on the probe head. Do not put pin through holes. Hammer on top of the pulling tool until the tool touches the wood. The probes are now placed correctly so that the probe head does not touch the wood and prohibit the drying process just above the measuring point. The tip of the probe should penetrate at least 1/3 of the board. Attach the PK-H cable to the probes and put the package back together making sure the cable is not squeezed by lumber or stickers. The other end of the cable is left hanging outside the package. Once the package is loaded, PK-H cable(s) are plugged into the 4-station plate. Now check that probes and cable(s) are producing a reading.



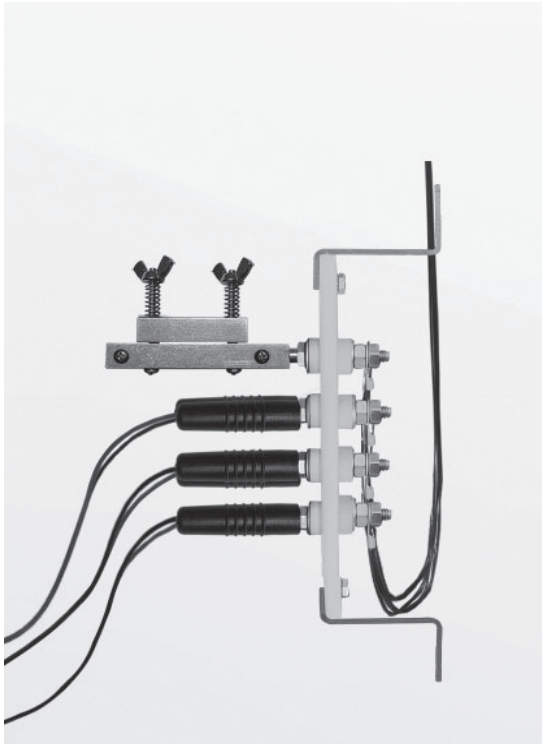
PK probes can be used in many materials other than wood, such as concrete, brick, tile, roofing. They monitor changes in moisture content at the depth where the tips of the probes are placed. Pulling tool helps to insert and remove PK probes properly.

PKA: measuring depth 1/2” (1.2cm) 4/4 lumber
PKB: measuring depth 3/4” (1.9cm) 6/4 lumber
PKC: measuring depth 1” (2.5cm) 8/4 lumber
PKD: measuring depth 1 1/2” (3.8cm) 12/4 lumber
PKE: measuring depth 2 3/4” (7cm)

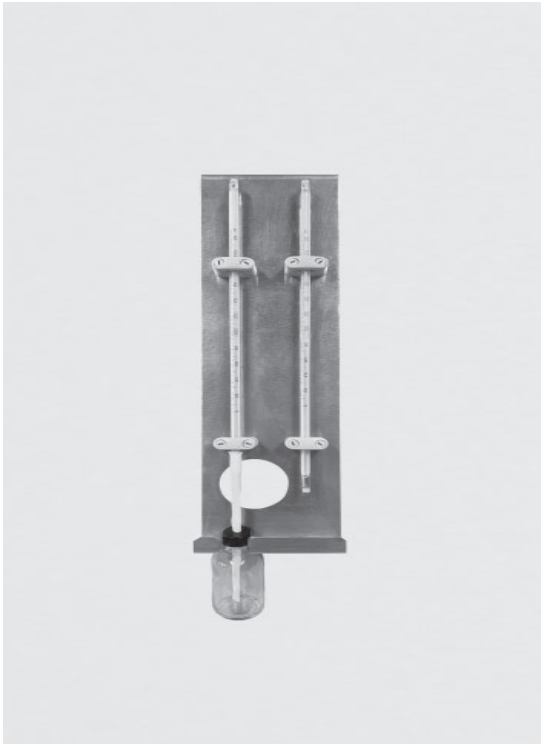
Measurements from PK probes can be obtained with
- switchbox and meter
- MC Tracker data logger
- wireless transmitters

*2.2 EMC Measuring Station*

Once the kiln has been loaded the last thing to do is place the EMC holders. A new cellulose wafer should be used for every kiln charge. Check and clean the EMC station if necessary. Dirty station plate and EMC holders affect the EMC readings. EMC readings can also be used to check a dry-bulb-wet-bulb measuring station.

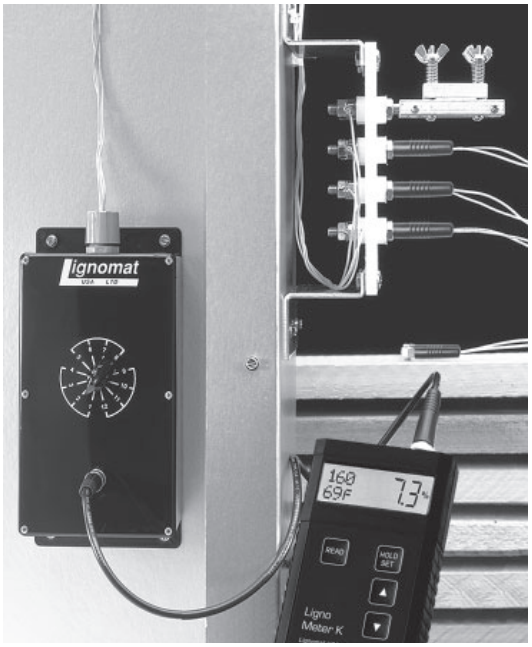


Station Plate with EMC holder and EMC wafer for direct measurements of EMC, 3 PK-H wood probe cables



Dry-bulb-wet-bulb thermometers with measuring plate and wet sock bottle.

*2.3 Obtaining EMC Readings*




The EMC can be read with the Lignometer K and the Ligno-VersaTec directly in percent. For EMC readings the meter should be set to the setting specified on the wafer package. All EMC values should be temperature compensated by dialing the drying temperature inside the kiln at the moisture meter Lignometer K or Ligno-VersaTec.

After dialing the wood group and the air temperature in the moisture meter and selecting the corresponding station at the selector switch, the EMC can be read at the moisture meter directly in percent. Conversion charts are not necessary. 2 Charts are included

*2.4 Obtaining Moisture Readings*

Once the kiln has been brought up to temperature, accurate moisture readings can be taken. Set the wood group switch as indicated by the specification chart provided. Find the actual temperature inside the kiln after heating-up has been completed and the temperature inside the kiln is stabilized; the drying temperature is the same as the wood temperature. All MC values should be temperature compensated by dialing the drying temperature inside the kiln at the moisture meter (Lignometer K or Ligno-VersaTec).

After dialing wood group and temperature at the moisture meter, temperature and wood group compensated moisture readings can be obtained directly in percent. Connect the meter with the BNC connector at the switch box and dial each station seperatly at the switch.

To fully benefit the PK system, readings should be taken every day and recorded with the temp/humidity conditionsin the kiln. Before each change of climate settings the readings should be evaluated against the predetermined drying schedule.

Evaluation of recordings throughout several drying cycles is an important tool for the kiln operator to work towards the most efficient and economical drying cycle for their kilns.

*2.5 Optimization of Kiln Performance*

Due to the flexibility of the PK system, the location of probed packages can be changed with each kiln charge to determine if there is a difference in the drying process between top, bottom and center packages. Monitoring different loactions in your kiln will help evaluate overall kiln performance and show slow drying areas.

Specific boards can be selected for probing with high initial or low initial moisture content. Comparing measurements will indicate which boards should be probed in the future for an optimized kiln schedule.

If too much lumber is degrading, the drying schedule should be changed and a moisture content based schedule can be applied to be assure high lumber quality at the end of the drying.

With the PK system the kiln operator has a tool on hand to optimize kiln performance and to produce high quality, perfectly dried lumber.

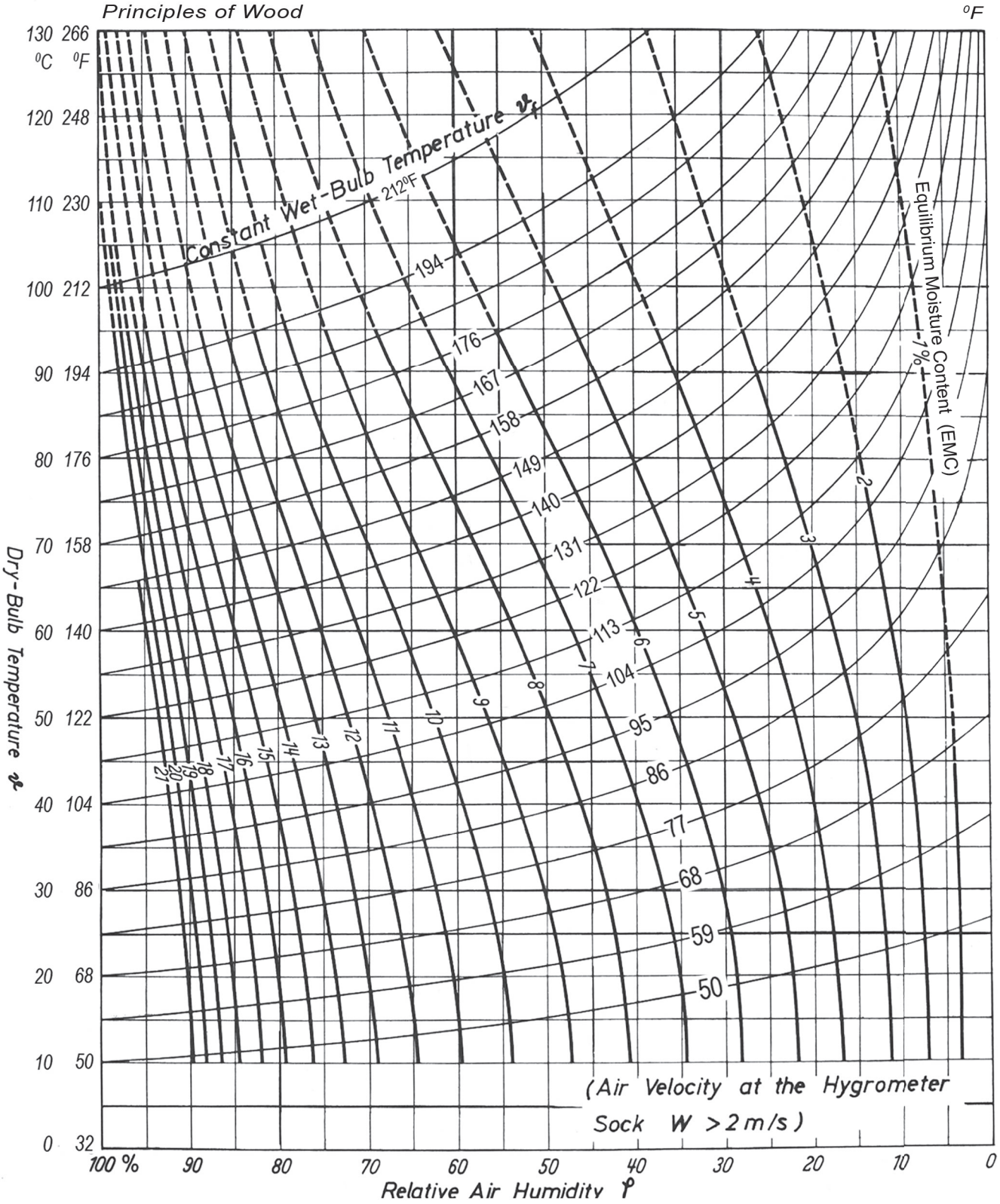
### *2.6 Maintenance and Check-Up*

Before every kiln charge a visual check should be performed to see if the permanently installed cables are intact. The station plate and the EMC holder can be cleaned with alcohol or aceton. The cables going from the measuring stations to the wood probes should also be visually checked for worn or broken insulation.

For a thorough check, all measuring cables should be tested as follows: Plug each cable into the station plate and take a reading with the moisture meter with nothing connected to the probe end of the cable. Now emerse the whole cable into a bucket of water making sure the cable ends are not shorted or in the water. Take another reading; if that reading is higher then the first, the cable is bad. If the damaged part of the cable can be located heatshrink could be applied to fix the insulation. If not, the bad cable needs to be replaced.

| | Relative Humidity EMC Table | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| T °F | 5 | 10 | 15 | 20 | 25 | **30** | **35** | **40** | **45** | **50** | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 |
| 30 | 1.4 | 2.6 | 3.7 | 4.6 | 5.5 | 6.3 | 7.1 | 7.8 | 8.7 | 9.5 | 10.4 | 11.3 | 12.4 | 13.5 | 14.9 | 16.5 | 18.5 | 21.0 | 24.3 |
| 40 | 1.4 | 2.6 | 3.7 | 4.6 | 5.5 | 6.3 | 7.1 | 7.8 | 8.7 | 9.5 | 10.4 | 11.3 | 12.4 | 13.5 | 14.9 | 16.5 | 18.5 | 21.0 | 24.3 |
| 50 | 1.4 | 2.6 | 3.6 | 4.6 | 5.5 | 6.3 | 7.1 | 7.9 | 8.7 | 9.5 | 10.3 | 11.2 | 12.3 | 13.4 | 14.8 | 16.4 | 18.4 | 20.9 | 24.3 |
| **60** | 1.3 | 2.5 | 3.6 | 4.6 | 5.4 | 6.2 | 7.0 | 7.8 | 8.6 | 9.4 | 10.2 | 11.1 | 12.1 | 13.3 | 14.6 | 16.2 | 18.2 | 20.7 | 24.1 |
| **70** | 1.3 | 2.5 | 3.5 | 4.5 | 5.4 | 6.2 | 6.9 | 7.7 | 8.5 | 9.2 | 10.1 | 11.0 | 12.0 | 13.1 | 14.4 | 16.0 | 17.9 | 20.5 | 23.9 |
| **80** | 1.3 | 2.4 | 3.5 | 4.4 | 5.3 | 6.1 | 6.8 | 7.6 | 8.3 | 9.1 | 9.6 | 10.8 | 11.7 | 12.9 | 14.2 | 15.7 | 17.7 | 20.2 | 23.6 |
| 90 | 1.2 | 2.3 | 3.4 | 4.3 | 5.1 | 5.9 | 6.7 | 7.4 | 8.1 | 8.9 | 9.7 | 10.5 | 11.5 | 12.6 | 13.9 | 15.4 | 17.3 | 19.8 | 23.3 |
| 100 | 1.2 | 2.3 | 3.3 | 4.2 | 5.0 | 5.8 | 6.5 | 7.2 | 7.9 | 8.7 | 9.5 | 10.3 | 11.2 | 12.3 | 13.6 | 15.1 | 17.0 | 19.5 | 22.9 |
| 110 | 1.1 | 2.2 | 3.2 | 4.0 | 4.9 | 5.6 | 6.3 | 7.0 | 7.7 | 8.5 | 9.2 | 10.0 | 11.0 | 12.0 | 13.2 | 14.7 | 16.6 | 19.1 | 22.5 |
| 120 | 1.1 | 2.1 | 3.0 | 3.9 | 4.7 | 5.4 | 6.1 | 6.8 | 7.5 | 8.2 | 8.9 | 9.8 | 10.7 | 11.7 | 12.9 | 14.4 | 16.2 | 18.6 | 22.0 |

# **EMC Graph:** Wet - Dry - Bulb - RH - EMC - MC (°F)




Equilibrium moisture content of wood (EMC) according to R. Keylwerth and data from the U.S Forest Products Laboratory in Madison, Wisconsin 1951.
Example: When the dry-bulb temperature is 95°F and the relative humidity is 45%, then the corresponding wet-bulb temperature is 77°F and the equilibrium moisture content (EMC) is 8%.