

# **WIRELESS PROBES REVOLUTIONIZE MOISTURE MEASUREMENT WHEN DRYING WOOD**

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## **Introduction**

The moisture content (MC) of wood as well as the air humidity (EMC) are important values when drying lumber, no matter if in kilns or in an air drying yard. Many key players in the wood drying industry rely on a probe-based system. This type of system, where readings for MC and EMC are based on the electrical resistance of wood and wafers, provides the best compromise in accuracy, user-friendliness and cost.

The technology for placing the measuring circuitry in the hostile environment of a kiln was not available in the past. For that reason, long Teflon-coated cables were needed to connect the sensors (MC probes driven into the wood and EMC wafer holders) to the measuring device located outside of the kiln. These long cables reduce the accuracy of the readings because the sensitive, low-level analog signals being carried can easily be distorted by leakage currents along the cable (especially at the connectors) or by interference from electromagnetic noise (generated by fan motors, variable speed drives, etc.). The cables are also cumbersome for the kiln operator when loading and unloading the kiln as well as easily damaged when entering the kiln during the drying process.

With the introduction of the Wireless Probe System (WPS), patent pending, the sensor cables become obsolete, thus eliminating the problems described above. The sensors, probes for MC and wafers for EMC, remain the same.

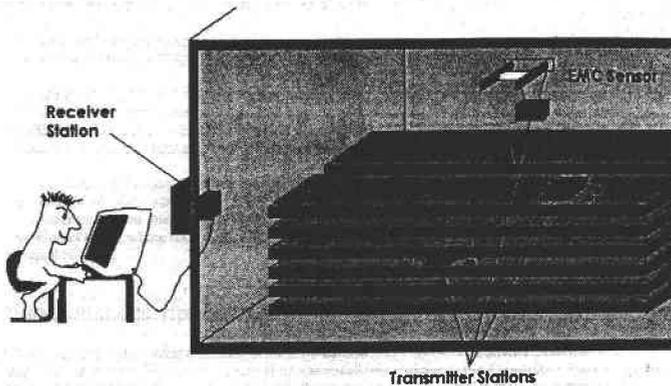
## **WPS Applications**

The wireless probe system can be used for many applications due to its flexible design and easy interfacing the standard equipment. The system is ideal for replacing in-kiln wiring for less maintenance. For open air drying, any number of transmitters can be used to monitor the entire yard from a PC using standard tools like Microsoft Access. Force-air drying sheds, drying yards, and pre-dryers can now be easily monitored from one central location. Anywhere accurate moisture and temperature monitoring is needed without the hassle of cables, the WPS can be used.

## **WPS Configuration**

Every sensor has its own local battery powered Transmitter Station for measurement and data transmission. This is connected to the sensor via a very short cable.

The analog sensor signal is converted to a digital reading by this unit and transmitted by radio frequencies to a Receiver Station mounted on the inside kiln wall (Figure 1). Since measuring errors in analog signals are difficult to compensate, reducing the analog domain as done with the WPS significantly increases the accuracy of the system. Digital transmission errors can be easily recognized and corrected.



**FIGURE 1.** Probe system installed in a kiln.

Moving the measuring circuitry closer to the sensor is now possible because it can withstand temperatures and high air humidity present when drying lumber. The hardware is insulated by sealing the entire unit in a protective epoxy compound.

Sealing the entire Transmitter Station including the battery is possible for two reasons. The measuring accuracy is maintained over time because calibration is checked and automatically adjusted before each new measurement. The power consumption is so small that the life span of the unit approaches the shelf life of the lithium battery used (approximately 10 years).

The Receiver Station must be located inside the kiln if the kiln walls are made of aluminum, since the radio waves can't pass through metal. They can also be equipped with one or two PT100 temperature sensors and serve in this configuration as Dry Bulb and/or Wet Bulb Sensors.

The Receiver Station is connected with a 4-conductor cable to a data processor, located outside the kiln, such as a standard PC, a PLC or any other device with a serial port.

Two wires are used to power the Receiver Station with 24V DC. The other two wires are needed for the 2-wire RS485 serial interface. Multiple Receiver Stations can be multi-dropped on the same RS485 line. They can be addressed by using their individual serial numbers. Receiver Stations only download data when requested by the data processor,

Multiple Receiver Stations increase the reliability of the system because more than one path exists for the radio signal. Data transmission can fail even if a transmitter Station is located in close proximity of a Receiver Station due to "dead spots" that exist in most buildings. Reflections of metal objects create dead spots, where reception is very difficult. Therefore at least two Receiver Stations should be installed in a kiln.

## **Functional Description of WPS**

Measuring and transmitting a reading is initiated automatically by the Transmitter Stations approximately every 30 seconds. There is no synchronization between the Transmitter Stations and/or the Receiver Stations. It is therefore possible that two or more Transmitter Stations transmit their readings, data transmission will fail in this case. But since both the MC and the EMC change at a fairly slow rate when drying lumber, readings can be updated at relatively long time intervals (approximately every 1 to 3 minutes). Since transmitting a reading to the Receiver Stations takes only a couple of milliseconds every 30 seconds, it is unlikely that the readings don't get updated often enough even with 16 or more MC stations.

The Receiver Station checks the validity of received digital data by means of a checksum that is included in the transmitted data string. In addition to the reading, the individual serial number of the Transmitter Station is also included, so that the Receiver Stations can assign measurements to the corresponding wood probe station or EMC station.

The Receiver Station stores valid data coming from the Transmitter Stations. Up to 32 transmitter readings can be stored simultaneously. If more than 32 transmitters are in range of the receiver, the data must be downloaded frequently enough to make sure all readings arrive at the data processor.

### **WPS Advantages**

Besides the improvements in measuring accuracy and user-friendliness described above, wireless probes bring additional advantages when compared to the conventional wirebound system.

#### **No Maintenance Cost for Cables and In-Kiln Connectors**

Leakage currents caused by build-up on the in-kiln cables and connectors caused measurement errors in the past. This could only be prevented by regular inspection, cleaning, and replacement. The elimination of the cables make the WPS a virtually maintenance free system.

#### **Reduced Down Time**

By using a separate set of Transmitter Stations, the next kiln charge can be prepared even before the current charge is pulled from the kiln. The set of Transmitter Stations used with the current charge can be removed when the next charge is already in the kiln and drying.

With the WPS, no potential drying time is wasted for connecting and disconnecting cables on a charge.

Note: On sites with multiple kilns, only one extra set of Transmitter Stations is needed because a spare set becomes available when removing the Transmitter Stations from the charge that is done.

## Reduced Energy Cost

Kilns can waste significant amounts of heat in the last quarter of the drying cycle, when the desired EMC in the kiln is low and the desired temperature is high, due to over-venting. If the EMC reading is higher than the true EMC in the kiln (this is what happens when leakage currents build up along the cable), then the true EMC will be forced to a level below the desired EMC. This is because the actions of the control system's regulator are based on the inaccurate EMC readings.

In other words, the kiln will vent to make the EMC equal to the desired EMC, leading to a true EMC in the kiln that is lower than the desired EMC. In the worst case, when leakage currents are very high, this can lead to permanent venting, wasting huge amounts of energy. The WPS eliminates over-venting caused by leakage currents.

## Standard Serial Interface

The WPS can be connected to any data processor with a serial port, such as a PC, a PLC, etc. Off the shelf RS485 to RS232 converters interface the Receiver Stations to PCs and other devices with RS232 ports. Software is available for PCs to monitor multiple Receiver Stations, creating a table of time stamp and data from the Transmitter Stations. A Microsoft Access Database can be used to analyze the data.

## Summary

The new Wireless Probe System further improves the accuracy, user-friendliness and cost of data acquisition systems used for lumber drying. Thanks to its standard serial interface, it can be part of any kiln control or moisture monitoring system. The first units were installed in March 1998. For further information, please contact Lignomat USA, Ltd. at 800-227-2105.

## Technical Specifications

### Transmitter Station

- General:** Power Source: Lithium Battery 3.6V  
Life Expectancy: Up to 10 years  
Ambient Temperature Range: -20°C to +85°C (-5°F to 185°F)
- Transmitter:** Radio Frequency: 916.50 MHz for unlicensed operation in the USA and Canada  
433.92 MHz for unlicensed operation in Europe  
Operating Range: approximately 20 m (60 ft) inside kilns up to 75 m (225 ft) where a straight line of sight exists.
- Moisture Meter:** Measuring Range: MC, from 100% to approximately 2.5% (depending on species and temperature) EMC: from 25% to approximately 2.0% (depending on temperature)

### Receiver Station

- General:** Power Source: 24VDC  
Ambient Temperature Range: -20°C to +85°C (-5°F to 185°F)
- Receiver:** Radio Frequency: 916.50 MHz for unlicensed operation in the USA and Canada  
433.92 MHz for unlicensed operation in Europe