

TECHNICAL NOTE NUMBER 239

FOREST PRODUCTS LABORATORY
MADISON, WISCONSIN

UNITED STATES FOREST SERVICE
MARCH, 1932

AN INSTRUMENT FOR MEASURING WOOD EQUILIBRIUM MOISTURE CONTENT

A simple indicator has been designed by the Forest Products Laboratory as a means of measuring variations in equilibrium moisture content in the woodworking shop, dry shed, or any type of lumber storage shed. "Equilibrium moisture content" corresponding to a particular humidity condition of the atmosphere in a dry shed, for instance, means the moisture content to which the wood in the shed will attain if the atmospheric condition is maintained long enough. If the temperature of a storage shed is, say, 70° F. and the relative humidity 30 per cent, the equilibrium moisture content is a trifle over 6 per cent.

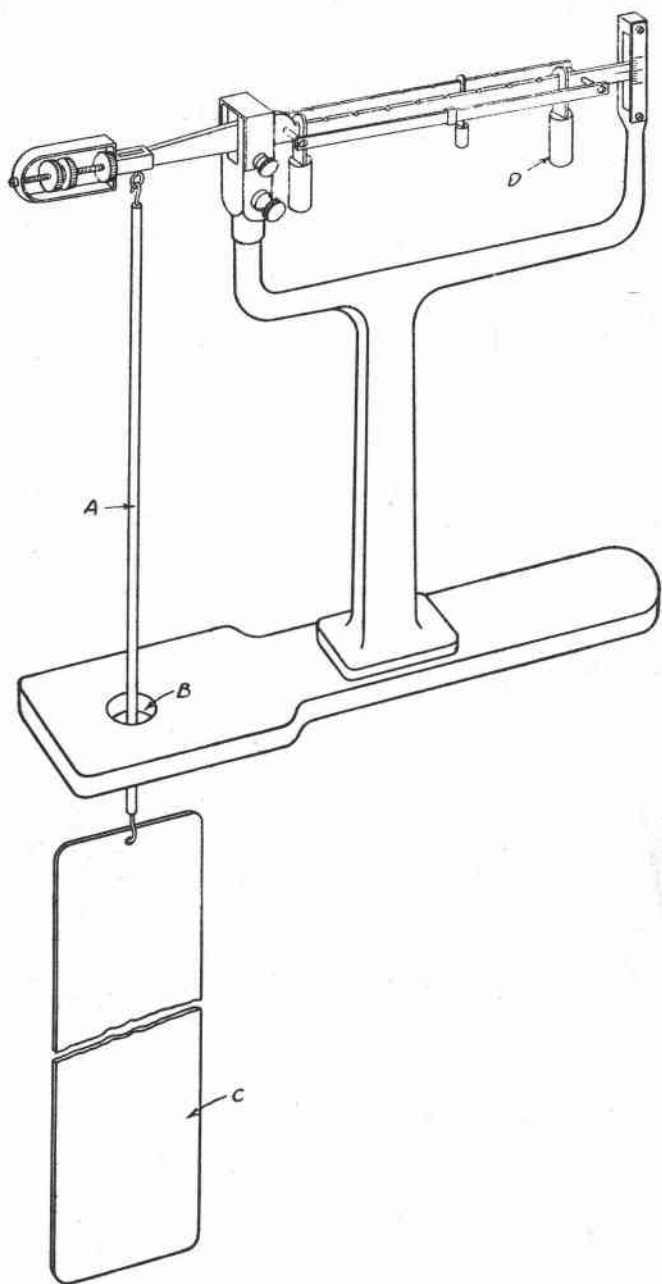
The operation of the indicator is based on the fact that wood becomes heavier upon absorbing moisture and lighter upon losing moisture. The instrument consists essentially of any simple balance, on one side of which is suspended a strip of wood cut to a calculated weight of exactly 100 grams, ounces, or any other convenient unit of weight when oven dry. The instruments made up at the Laboratory, as illustrated in the accompanying diagram, have used the ordinary triple-beam balance familiar to the dry-kiln operator. The pan and pan hanger of the balance are removed and replaced by a brass tube, A, which extends through a hole, B, bored in the base of the balance. The weight of this tube, with a suspension hook at each end, is adjusted by loading it with lead shot until it weighs exactly the same as the pan and pan hanger which have been removed. A wood strip, C, having a weight of 100 grams when oven dry, is suspended from the tube and is counterbalanced with the main scale poise, D, or with an extra weight. The percentage of moisture that the wood strip has

taken up in coming to equilibrium with the surrounding air can be determined directly by balancing the strip with the poises on the three beams of the balance and subtracting 100, the oven-dry weight of the strip. In practice, the main poise should be kept permanently at 100; the moisture percentage of the strip is then shown directly by the setting of the smaller poise or poises required to bring the beam to balance.

The percentage of moisture in the strip is the equilibrium moisture content which any wood in the immediate vicinity tends to assume under the influence of the atmospheric conditions present.

The device is useful in connection with lumber storage problems. Where extreme sensitiveness is desired for immediate control of a ventilating system or the like, it is best to use a very thin sheet of the sapwood of a species that responds quickly to changes in moisture atmospheric conditions, such as basswood or white pine. Where a daily average reading is sufficient to check conditions of storage or the progress of drying, a strip about $\frac{1}{8}$ inch thick will be found sensitive enough to record any important changes.

Although the oven-dry weight of the wood strip must be 100 units as nearly as possible, the strip itself must not be actually oven dried, for in so doing the hygroscopicity is reduced, and hence the equilibrium values found with the instrument using this oven-dried element will be in error. A simple procedure to obtain a true wood specimen without oven drying is to take either a green or fairly uniformly dried plank and rip it into wood strips about $\frac{1}{8}$ inch in thickness, 4 or 5 inches in width, and 30 inches or more in length. Weigh all of the strips immediately and mark their weights on the pieces as well as identifying their location in the plank. Oven dry one of every two strips ripped out of the plank. Subtracting the weight of each oven-dried strip from its former weight as marked, dividing the difference by the weight when oven dry, and multiplying by 100 gives the percentage moisture content of each



at the time of cutting. For the strips that were not oven dried, the moisture content at time of cutting is found by averaging the moisture content of the strips that were next to it when cut and which were oven dried. Knowing the moisture content of the strip at the time it was cut and weighed, its oven-dry weight can be determined by dividing 100 times its original weight by 100 plus its original moisture content. Its moisture content then at any time is its present weight minus its oven-dry weight divided by its oven-dry weight, and the result multiplied by 100.

To adjust the weight of the strip so that its oven dry weight is exactly 100 grams or units, determine its present moisture content, and then plane down its edges until its weight is 100 grams (or other units) plus its present moisture content. If its present moisture content is, say, $6\frac{1}{2}$ per cent, and its weight is in grams, plane the edges of the strip until it weighs $106\frac{1}{2}$ grams. This will produce a wood element whose true oven-dry weight will not differ from 100 grams by more than + or - 0.2 gram.