

TECHNICAL NOTE NUMBER 238

FOREST PRODUCTS LABORATORY
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A DUFF HYGROMETER FOR MEASURING FOREST FIRE HAZARDS

A simple hygrometer, for showing the moisture content of the needles, twigs, wood debris, etc., collectively known as "duff," on the floor of the softwood forest, has been designed by the Forest Products Laboratory as an aid in forest fire studies of the U. S. Forest Service. It can be made by any practical mechanic. The utility of the duff hygrometer is based on the fact that the probability of fires occurring, spreading rapidly, and becoming destructive is related directly to the moisture content of the ground litter in the forest.¹ The instrument is a reliable guide in recognizing and — when used in conjunction with U. S. Weather Bureau forecasts of temperature, precipitation, and winds — forecasting fire weather. It gives a direct moisture content reading without appreciable lag when left inserted in the duff permanently at a field station, or accurate single readings within half an hour when inserted in the duff temporarily. It is, therefore, greatly to be preferred to sampling-and-drying methods of moisture content determination, which require considerable time and do not show the moisture content of the duff in place. Other advantages of the duff hygrometer are its portability, sturdiness, and relatively low cost.

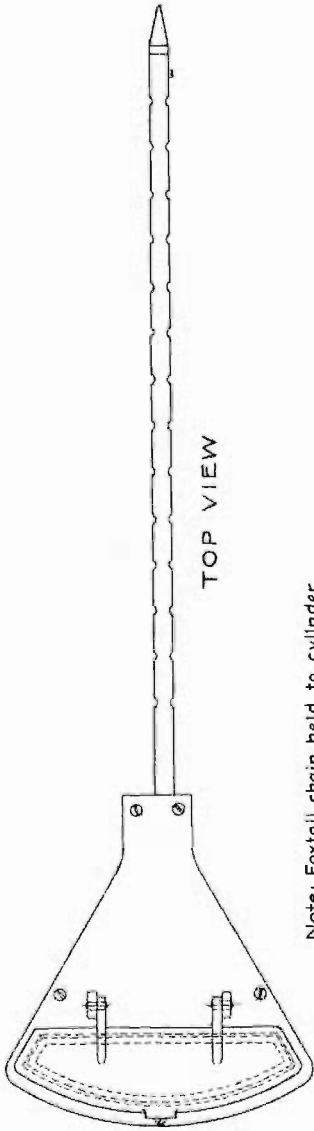
The operation of the duff hygrometer is based on the fact that rattan changes length to a marked degree

¹In northern Idaho the relative inflammability of the top layer of duff has been found to have a relationship to its moisture content about as follows: Over 25 per cent moisture content, noninflammable; 25 to 19 per cent, very low inflammability; 18 to 14 per cent, low inflammability; 13 to 11 per cent, medium inflammability; 10 to 8 per cent, high inflammability; 7 per cent or less, extreme inflammability.

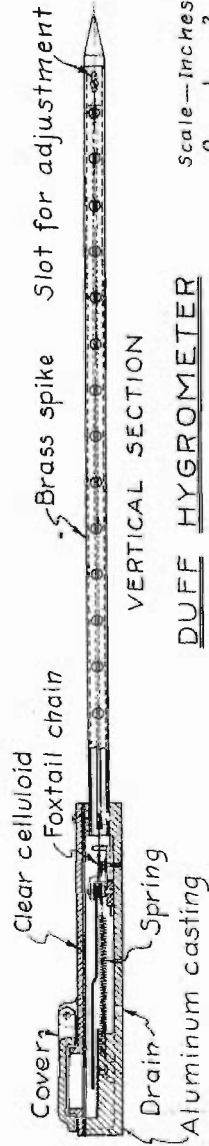
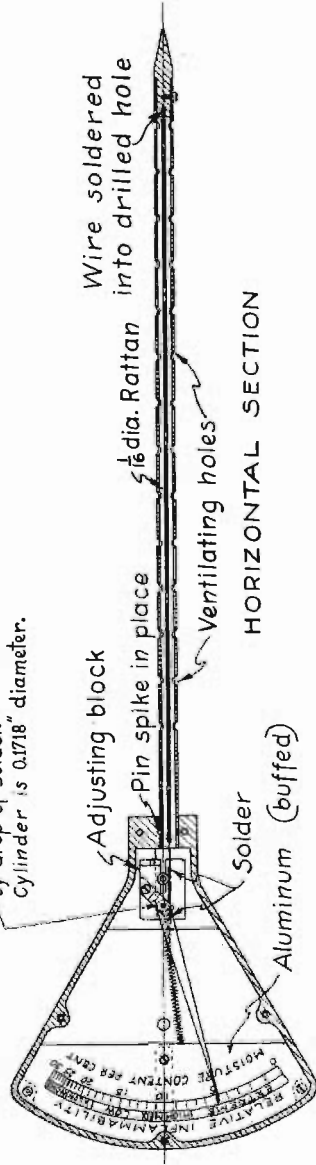
with changes in moisture content. One end of a strip of rattan 1/16 inch in diameter is fastened inside the end of a perforated pointed brass tube as shown in the accompanying diagram. The other end of the rattan is attached to a section of fox-tail chain, which passes around a metal cylinder in the head of the instrument and is secured to a small spring which keeps the whole system in tension. The chain is kept from slipping on the cylinder with a small drop of solder.

The cylinder on which the chain turns carries the pointer or indicator "hand" of the instrument. The rattan practically ceases to elongate when the moisture content of the fuels in which it rests goes above 35 per cent. At any rate readings obtainable above this point are not of very great accuracy. Adjustments of the pointer can be made without altering the spring tension by shifting a block on which the cylinder bearing the pointer is mounted or by adjustment at the tip of the tube.

In laying out a moisture-percentage scale for the duff hygrometer, the instrument is exposed in duff samples in an increasing series of moisture contents. Movement of the pointer decreases as high moisture contents are approached. Galvanized iron or zinc tubes with friction covers, of sufficient size to hold about 100 grams of oven-dry duff, are used in the calibration. The duff in one tube is held at about 2 per cent moisture content, in another at about 10, in others at 20, 30, and possibly higher percentages of moisture, respectively. The hygrometer is inserted in a tube and left for 6 to 12 hours, until the indicator shows that the rattan has reached a state of equilibrium with the moisture content of the surrounding duff. The instrument is then removed, and the duff contents of the tubes accurately weighed, dried in an oven, again weighed, and the exact duff moisture content computed. Several hygrometers can be calibrated at one time and several runs can be made on the same samples before oven drying if weights of the tubes and contents are kept for each set



Note: Foxtail chain held to cylinder by drop of solder.
Cylinder is 0.1718" diameter.



Scale — Inches
0 1 2

DUFF HYGROMETER

of hygrometers. The running of sufficient samples will make it possible to interpolate any desired number of moisture-content points on the instrument scale.

The whole scale should be checked at the beginning and end of each fire season.

More detailed instructions for the calibration and use of the duff hygrometer can be found in U. S. Department of Agriculture Miscellaneous Publication No. 29, "Measuring Forest-Fire Danger in Northern Idaho," by H. T. Gisborne. This publication is obtainable from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 20¢ a copy.