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TECHNICAL NOTE

THERMISTORS FOR SURFACE TEMPERATURE

By J. Harry G. Smith¹

Since the war thermally sensitive resistors, thermistors, have proved exceedingly useful in industry and in research. Thermistors are made of metallic oxides whose resistances vary greatly and almost linearly with changes in temperature. Measurements of thermistor resistance provide a means of evaluating temperature quickly and accurately. Most thermistors are shaped as small discs or rods which are available in several sizes to provide the desired temperature-resistance characteristics. They are electrically and chemically stable and are mechanically rugged. Although thermistors have many industrial applications foresters will be most interested in their use as thermometers and anemometers. Their small size, durability, cheapness, accuracy, and ease of use make thermistors valuable for measurement of soil and surface temperatures.

Thermistors have been used since 1946 to improve the accuracy of moisture determinations with Colman's electrical soil moisture instrument. Thermistors of the type provided with his fiberglas moisture units may also be used to measure surface temperature. Although these Western Electric Co. 7A thermistors were designed, and are recommended, only for mounting between spring-loaded contacts, they may be soldered to fine wire leads and insulated for use as thermometers. While it would be preferable to use type 17A thermistors with leads attached, the writer has secured good results with modified 7A thermistors. These were used to measure surface temperatures of seedbeds in spruce-fir forests for the Research Division of the British Columbia Forest Service.

To make the surface-temperature units, plastic-coated, two-wire, lead wire was cut in six-foot lengths. Then a thermistor was cool-soldered between the split ends of this double, 16-gauge, stranded copper wire. Each unit was coated twice with "Form-var" insulator and heated at 200° F. until set. Colman prevented electrical leakage similarly by using three coats of Bakelite Corp. varnish, formula XV-1657.

Two dozen thermistors were attached to a 24-point "Shallcross" switchbox for calibration in water. Colman's calibration chart for 0 to 110° F. was extended to 193° F. Individual thermistor corrections, ranging from .944 to 1.053, removed 90 per cent of the variation in thermistor resistances at 9

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temperature levels. The standard error of estimate of temperature by individual thermistors averaged .88° F. within a range from .36 to 1.54° F.

For field use the switch box was housed in a 4" x 6" x 6" plywood box. A small wooden peg was taped in the split end of each lead to aid in positioning the thermistors at the surface. To facilitate handling, the switch box was mounted on a board 10" x 30" in which a row of 24 one-quarter-inch holes was drilled for the pegs. A handle of 1" x 2" lumber was set on the board to support the lead wires and facilitate carrying the apparatus. With the thermistors in place, resistances indicating 24 surface temperatures may be measured in one minute.

The cost of 24 thermistors, switch box, leads, and labor, including that of calibration, amounted to approximately \$65 when the apparatus was assembled in March, 1953. Such equipment may be used easily with Colman soil moisture instruments and other ammeters with a range of 0 to 200 microamps. It will give good results providing that calibration is checked occasionally to ensure that insulation of thermistors and leads has not been damaged by field use.

REFERENCES

- COLMAN, E. A., 1947. Manual of instructions for use of the fiberglas soil-moisture instrument. California Forest and Range Experiment Station, reprinted by Berkeley Scientific Co., 20 pp. mimeo.
- DOWELL, K. P., 1948. Thermistors as components open products design horizons. Western Electric Bul. T2559E reprinted from *Electrical Manufacturing*.

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WESTERN FOREST INSECT WORK CONFERENCE

FOREST INSECT AND DISEASE RESEARCH REVIEWED AT WESTERN CONFERENCES

Specialists in forest entomology and forest pathology from western United States, Canada and Alaska met in Berkeley, California, December 2 - 4, 1954, to review progress in their battle against insects and diseases that attack forest trees.

Seventy men were present for meetings of two groups: 45 men at the Sixth Annual Western Forest Insect Work Conference, and 25 at the Second Annual Western Forest Disease Work Conference. This was the first time that joint sessions were held.

The Insect Conference devoted most of its attention to a review of current developments in forest insect research, particularly studies of host resistance, progress in biological control through use of insect diseases and problems in rearing insects for experimental purposes. Also considered was the current status of major insect pests in western North America as determined by recent surveys.

The programme of the Disease Conference included a review of new studies at western research centres, disease research methods and methods in forest disease surveys. A start was made on standardizing cull studies to produce