

A Versatile Instrument for the Measurement of Reflectance and Transmittance



The Welch Densichron is an electronic densitometer of good sensitivity and unusually high stability. It can be employed either for quantitative measurement of optical density, or as a sensing device for automatic control of various industrial processes in which constancy of transmitted or reflected light is a criterion of the quality or uniformity of the product.

It consists essentially of a probe unit containing a photoelectric tube for detecting light energy and an amplifier to which it is connected by a flexible cable. The amplifier incorporates a milliammeter calibrated to indicate either optical density on a "log" scale or percent transmission on a "linear" scale, depending upon the model.

The logarithmic optical-density scale extends from 0 to 1.5 and density is readable to 0.01. A three-step range switch increases the range to a maximum density of 4.5 with no loss in sensitivity or precision of readings. This range represents a linear response of the receiver to variations in light intensity of over 30,000 to 1.

The meter movement used in the log-scale model of the amplifier is designed in such a manner that the deflections are very nearly proportional to the logarithm of the reciprocal of the activating photoelectric current. This is advantageous in both densitometry and photometry inasmuch as optical density in both cases is this same function of photoelectric current and the scale can therefore be calibrated in essentially uniform increments of optical density. A lower scale on this meter is used for determining photographic exposure times.

The meter in the percent-transmission model uses a standard meter movement and indicates percent transmission on a linear scale. This may also be considered as percent reflectance or percent incident light upon the phototube. The full range of the scale for the first position of the range switch is from 0 to 100% transmission. Other positions of the switch provide ranges of 0 to 10%, 0 to 1% and 0 to 0.1%, respectively. The lower scale on this meter is calibrated to read directly the optical density corresponding to the percent transmission indicated on the upper scale.

The amplifier also produces an A.C. output signal, the voltage of which is a measure of the light intensity, and provision is made for utilizing the direct current of the ammeter circuit in an external circuit. The instrument therefore supplies a voltage which can be used to operate either a control mechanism or a standard ink recorder.

Principle of Operation

The outstanding feature of the Densichron is its patented system for magnetically modulating the space current in a phototube.* This is accomplished by applying a 60-cycle alternating magnetic field across the path of the electron beam, thereby deflecting the electrons from their path to the anode 120 times per second. The output current of the tube is thus changed from its normal steady value to a pulsating output with a frequency of 120 cycles per second. When the usual direct-current output of a phototube is amplified, the measuring instrument is subject to severe zero drift necessitating frequent recalibration, and its response is slow. The pulsating output from the Densichron phototube, however, is capable of stable, high-gain amplification with rapid response.

Although the Densichron can be used in a wide variety of ways it is a simple device to use and requires no special operator skill. It will perform satisfactorily in routine operations for long periods of time with little or no servicing, yet is readily adaptable to innumerable types of special measuring techniques.

* Henry P. Kalmus and George O. Striker, Rev. Sci. Inst., 19, 79 (1948).

3830A. DENSICHRON WITH BLUE PROBE. This consists of the amplifier with logarithmic-scale meter, blue-sensitive probe, metal probe support, five different measuring apertures, a cone with $\frac{1}{8}$ -inch aperture, and a set of instructions. The amplifier operates on 115 volts, 60-cycle A.C. only. except on special order. **Each, \$225.00**

3830B. DENSICHRON WITH RED PROBE. This is identical with No. 3830A except that a red-sensitive probe is furnished in place of the blue-sensitive probe. **Each, \$225.00**

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(Inquiries concerning these publications should be addressed, not to *Science*, but to the publisher or agency sponsoring the publication.)

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