

National Bureau of Standards Certificate

Standard Reference Material 2030

Glass Filter for Transmittance Measurement

R. Mavrodineanu and J. R. Baldwin

This Standard Reference Material is intended as a reference source for one-point verification of the transmittance and absorbance scales of spectrophotometers at the given wavelength and measured transmittance. It consists of one glass filter in its holder and one empty filter holder. The filter bears an identification number. For protection, the metal holder is provided with two shutters that should be removed during measurements.

The transmittance, T , at λ 465.0 nm and for a spectral bandpass of 2.7 nm is: _____ . The corresponding transmission density, $-\log_{10}T$, is: _____ .

Date of Certification: _____ .

The transmittance value (T) can be converted to percent transmittance ($\%T$) by multiplying by 100. The transmission density is calculated from the measured transmittance (T). This value should be indicated by the absorbance scale of the spectrophotometer if the filter is measured against air.

The transmittance value given was measured against air at an ambient temperature of 23.5 °C, and is estimated to be accurate to within ± 0.5 percent at the time of certification. This uncertainty includes the random and systematic errors of the calibration procedure, as well as transmittance changes of the filter during the period of calibration.

It is possible that aging of the glass may cause some filters to change transmittance by about ± 1 percent over a period of approximately 1 year from the date of calibration. Improper storage or handling of the filter may also cause changes [5]. In cases where verification is desirable, the filter should be returned to the National Bureau of Standards for cleaning and recalibration.

It is recommended that the filter in the holder be handled only by the edges and with soft plastic (polyethylene) gloves and optical lens tissue. When not in use, it should be stored in its holder, with the shutters on, and in the box provided for this purpose. Extended exposure to laboratory atmosphere and dusty surroundings should be avoided.

This Standard Reference Material was issued with the assistance and advice of K. D. Mielenz and J. R. DeVoe.

The technical and support aspect involved in the preparation, certification, and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. W. Seward.

Washington, D.C. 20234
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J. Paul Cali, Chief
Office of Standard Reference Materials

(over)

The transmittance measurements were made using the high-accuracy spectrophotometer designed and built at the Institute for Materials Research, National Bureau of Standards [1]. This instrument represents the primary transmittance standard; its transmittance accuracy was established using the double-aperture method of linearity testing [1,3,5,6]. The reproducibility (relative standard deviation obtained from a set of 20 measurements) of this high-accuracy spectrometer for transmittance measurements on glass filters similar to the one used to produce this SRM, is approximately 0.02 percent.

The combined uncorrected systematic error of the instrument is estimated to be not more than $\pm 10^{-4}$ transmittance units.

As indicated on the face of this certificate, SRM 2030 is intended to be used as a one-point verification of the transmittance (absorbance) scales of spectrophotometers. If these scales require verification at other wavelengths and transmittances, "Glass Filters for Spectrophotometry," SRM 930c or subsequent issues, should be used.

The neutral glass for the filter was provided by Schott of Mainz, Germany, and is designated as "Jena Color and Filter Glass" [2,5].

The exposed surface of the glass is approximately 29×8 mm, measuring from a point 1.5 mm above the base of the filter holder (see figure). The empty filter holder is provided to be used in the reference beam of the spectrophotometer so that approximately equivalent conditions of stray radiations are achieved for both beams.

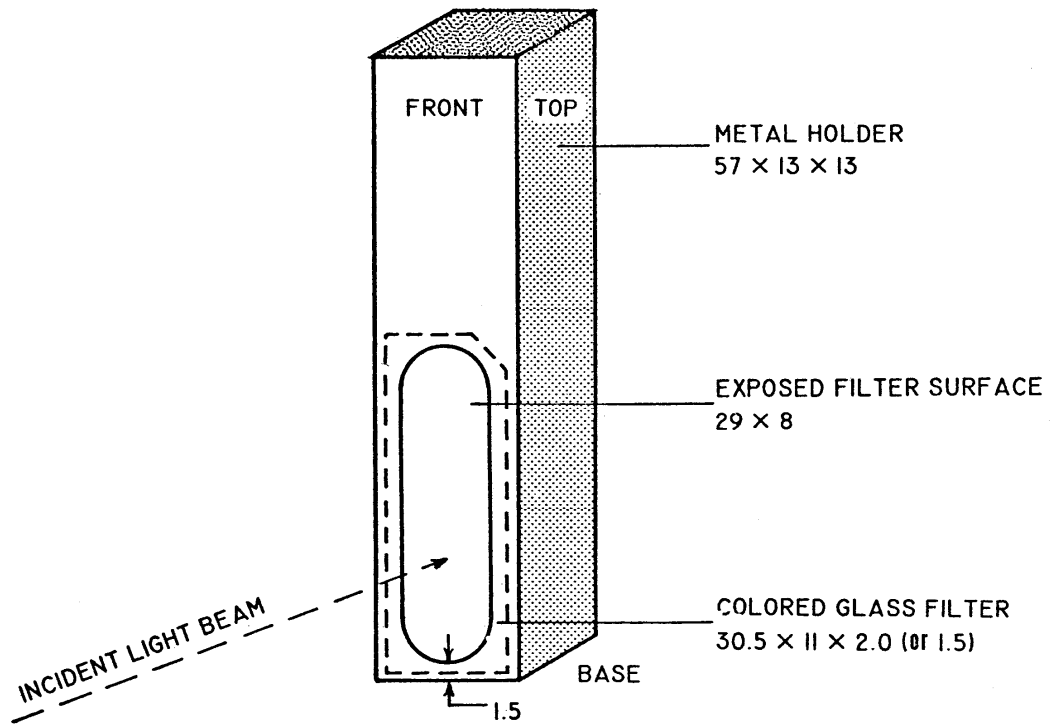
The transmittance of the filter depends upon the intrinsic properties of the material, spectral bandpass, wavelength, geometry of the optical beam, temperature, and positioning of the filter. A change of ambient temperature of 1 or 2 °C from 23.5 °C will not significantly affect the calibration [5]. Changes in the transmittance may be caused by surface conditions, aging of the glass, exposure to a harmful atmosphere, or careless handling as indicated on the face of this certificate [2,3,4,5]. The effective spectral bandpass used to determine the certified value is given on the face of the certificate and the transmittance measurements are made by producing the vertical image of the slit (about 8 mm by 0.5 mm), using a convergent beam geometry with an aperture ratio f:10, in the middle of the entrance face of the glass filter. The filter was measured in the spectrophotometer in a position perpendicular to the incident light beam as shown in the attached figure.

Prior to certification measurements, the filter was examined for surface defects and thoroughly cleaned [5]. Should the surface of the glass filter become contaminated, no attempt should be made to clean it unless the user has the facilities to demonstrate that the cleaning treatment has not altered the glass surface or degraded the accuracy of the certified value. Because the Standard Reference Material is a transfer standard, the only means available to verify its integrity is remeasuring its transmittance with a primary standard instrument similar to that used in this certification [1,4,5]. In most cases where verification, or recertification, of the transmittance value is desirable, it will be most expeditious to return the filter to the National Bureau of Standards for measurement. Prior to shipment the NBS Office of Standard Reference Materials should be contacted regarding the conditions and cost of verification and/or recertification.

REFERENCES

- [1] R. Mavrodineanu, An Accurate Spectrophotometer for Measuring the Transmittance of Solid and Liquid Materials, NBS Journal of Research 76A, No. 5, 405-425 (1972).
- [2] R. Mavrodineanu, Solid Materials to Check the Photometric Scale of Spectrophotometers, NBS Tech. Note 544, O. Menis and J. I. Shultz, ed., pp 6-17, U.S. Government Printing Office, Washington, D.C. 20402 (Sept. 1970), *ibid* NBS Tech. Note 584, pp 2-21 (December 1971).
- [3] K. S. Gibson, Spectrophotometry, NBS Circ. 484 (Sept. 1949).
- [4] Collected Papers from NBS Conference on Accuracy in Spectrophotometry and Luminescence Measurements, NBS Journal of Research 76A, No. 5, 375-510 (1972).
- [5] R. Mavrodineanu and J. R. Baldwin, Glass Filters as a Standard Reference Material for Spectrophotometry-Selection, Preparation, Certification, Use SRM 930, NBS Special Publication 260-51, U.S. Government Printing Office, Washington, D.C. 20402, (1975).
- [6] K. D. Mielenz and K. L. Eckerle, Spectrophotometric Linearity Testing Using Double-Beam-Aperture Method, *Appl. Optics*, 11, 2294-2303 (1972).

METAL HOLDER FOR THE COLORED GLASS FILTERS



DIMENSIONS IN mm