

National Bureau of Standards Certificate

Standard Reference Material 930b

Glass Filters for Spectrophotometry

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This Standard Reference Material is intended as a reference source for the calibration of the photometric scale of spectrophotometers. It consists of three individual filters and one empty filter holder. Each filter bears an identification number, and the upper left corner has been removed to indicate correct placing in the metal holder.

Filter & Set Ident. Number	ABSORBANCE (A)					TRANSMITTANCE (%T)				
	Wavelength and (Bandpass) nm					Wavelength and (Bandpass) nm				
	440.0 (2.2)	465.0 (2.7)	546.1 (6.5)	590.0 (5.4)	635.0 (6.0)	440.0 (2.2)	465.0 (2.7)	546.1 (6.5)	590.0 (5.4)	635.0 (6.0)

The transmittance values given are certified with a relative uncertainty of ± 0.5 percent (example: a nominal value of absorbance of 0.500 ± 0.0022). This uncertainty is the sum of the random error of ± 0.1 percent (2SD limit) and of estimated biases which are ± 0.4 percent. These biases are due to possible systematic errors. Measurements were made at 25 °C. Room temperature variations within several degrees Celsius of this temperature will not significantly affect the calibration of these filters.

It is recommended that the filters be handled only by the edges and with soft plastic (polyethylene) gloves and optical lens tissue. When not in use they should be stored in their holders and in the box provided for this purpose. Extended exposure to laboratory atmosphere and dusty surroundings should be avoided.

The overall direction and coordination of the technical measurements leading to certification were performed under the chairmanship of O. Menis and J. I. Shultz.

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

Washington, D. C. 20234
 February 24, 1975

J. Paul Cali, Chief
 Office of Standard Reference Materials

(over)

The transmittance measurements were made with the high-accuracy spectrophotometer designed and constructed at the National Bureau of Standards [1]. The accuracy of this instrument was established by light-addition measurements.

The neutral NG-4 and NG-5 glasses for the filters were provided by Schott of Mainz, Germany, and are designated as "Jena Colored and Filter Glass." Nominal transmittance for a filter 1.5 mm thick is 20 percent at 400.0 nm wavelength and 32 percent at 700.0 nm wavelength. Between these limits the transmittance varies in a monotonic manner [2].

The filter holder is black anodized aluminum alloy and has the following nominal dimensions: height: 57 mm, width: 13 mm, depth: 13 mm. This holder and the size and shape of the filters were selected to conform to the dimensions of the sample compartment of most conventional spectrophotometers. The filters are approximately 30.5 mm long, 11 mm wide, and 2.0 mm and 1.5 mm thick for the NG-4 glass and 1.5 mm thick for the NG-5 glass. Corresponding to these thicknesses are nominal transmittances of 10, 20, and 30 percent, respectively. These thicknesses were selected to provide a means for calibrating the photometric scale at three different levels. The exposed surface of the glass filter is approximately 29 mm by 8 mm, starting from a distance of 1.5 mm from the filter holder base (see figure).

The transmittance of filters depends on the intrinsic properties of the material. Spectral bandpass, wavelength [2,3,5], geometry of the optical beam, surface conditions, and positioning of the filter also affect the transmittance values, and can lead to further biases. The certified data will be reproduced when transmittance measurements are made under similar conditions. The effective spectral bandpasses used to determine the certified values are 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 opening of $f:10$, in the middle of the entrance face of the glass filter. (The filter should be positioned in the spectrophotometer as shown in the figure, to obtain correct values.)

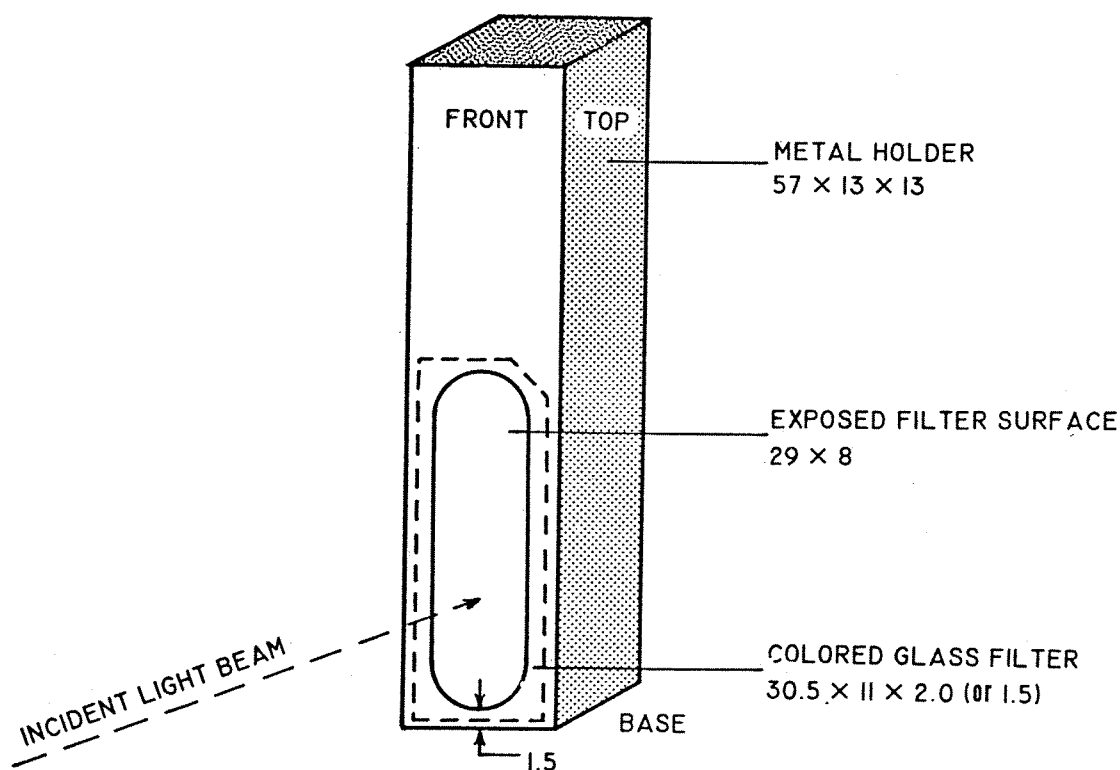
Prior to the certification measurements, each filter was examined for surface defects and then thoroughly cleaned. If, through handling, the surface of the filter becomes contaminated with dust, it may be cleaned with a small soft brush attached to a rubber tube connected to a vacuum source [2,4]. If the surface becomes contaminated with fingerprints, they must be eliminated before making measurements. This may be accomplished by removing the filter from its holder, breathing lightly on it, and rubbing the surface gently with optical lens tissue. The clean filter is then replaced in its proper position in its holder. To remove and replace the filter in the metal holder, the spring-loaded plate should be removed with care to prevent damage to the filter. As little handling as possible is recommended.

NOTE: The check of the calibration of photometric scales defines only one of the parameters required for obtaining accurate transmittance values and molar absorptivities. Other factors that also must be established are wavelength accuracy, stray light, cell parameters, fluorescence, polarization, reflection, and temperature coefficient. Some of these variables are discussed in NBS publications [1,2,5]. It is planned to summarize various aspects of accurate spectrophotometric measurements in an NBS-260 Special Publication that would provide additional data on specific Standard Reference Materials. In the interim, SRM 930b, should be used as described in the certificate. Consult the manufacturer of the instrument if differences are obtained that exceed those specified by the manufacturer.

We wish to acknowledge the cooperation of George N. Bowers, Jr., M.D., of Hartford Hospital, Hartford, Connecticut; Royden N. Rand, Ph.D., of the Hospital of the University of Pennsylvania, Philadelphia, Pennsylvania; and Donald S. Young, M.B., Ph.D., of the National Institutes of Health, Bethesda, Maryland.

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. J. R. Edisbury, Practical Hints on Absorption Spectrophotometry, Plenum Press, New York (1967).
5. Collected Papers from NBS Conference on Accuracy in Spectrophotometry and Luminescence Measurements, NBS Journal of Research 76A, No. 5, 375-510 (1972).

METAL HOLDER FOR THE COLORED GLASS FILTERS



DIMENSIONS IN mm

IMPORTANT NOTICE

Additional Suggestions for Handling Glass Filters for Spectrophotometry, SRM 930a

The preparation and certification of glass filters for spectrophotometry, SRM 930a, has required an appreciable amount of careful work. This material should be handled with particular attention to insure production of accurate measurements and long life. The following suggestions are made to that intent.

-Use the filters only when needed. Carefully unpack the filters one at a time, check the surface conditions by visual inspection in grazing incident light, and, only if needed, eliminate any visible dust particles following the directions given on the certificate. Place the filter directly in the spectrophotometer.

-After the measurements have been completed, wrap each filter in lens paper (lint free) and return it in its box.

-Use only lens paper.

-Do not expose the unprotected filters unnecessarily to laboratory atmosphere, sunlight, or heat.

-When handling the filter, hold it by the side at the upper end. To avoid fingerprints, do not apply fingers on the face of the filter. When it is possible, clean the filter in its holder. Only as a last resorts, remove the filter from its holder.

-If it becomes necessary to take the glass filter out of its metal holder, proceed with great care to avoid damaging this delicate and costly unit.

-In the event that an individual filter is broken, a replacement may be ordered from the Office of Standard Reference Materials for the price of \$85.

-Two types of metal holders are used for holding the glass filters.

1. a spring-loader holder made of brass and steel;
2. an all aluminum (black anodized) holder with black nylon screws.

In the first case this glass filter can be taken out by carefully lifting the spring-loaded plate all the way up until it stops in a vertical position. When the

filter is replaced in the holder, this spring-loaded plate should be held firmly with one finger while lowering it into place to prevent it from snapping and thus damaging the filter.

-When the glass filter should be taken out from the aluminum holder, carefully unscrew one of the nylon screws. Nylon is a slippery material; hence great care should be taken when using a screwdriver, to avoid slipping from the slotted screw head and hitting the glass filter. When the glass filter must be returned to the holder, use a fine tweezers to hold the nylon screw over the corresponding threaded opening in the aluminum holder. If necessary, use a new black nylon screw (3/48, 1/8" long)

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