Reference Wavelength Positions of Transmittance Minima of a Solution of 40 g/L Holmium Oxide in 10% (Volume Fraction) Perchloric Acid at Large Spectral Bandwidths

Standard Reference Material (SRM) 2034, holmium oxide solution wavelength standard, was produced in several batches (or series) from 1985 through 2004. For most of this time, the certified wavelength positions of transmittance minima of 14 absorption bands were retained from the original 1985 measurements based on the reproducibility of the band positions from one preparation to the next. For the latest series of SRM 2034, minor adjustments were made to the uncertainties and then to the central values of the certified bands based upon two international multi-laboratory comparison studies.[1,2] Reference 1 also introduced a model to predict the behavior of the solution band positions at large spectral bandwidths.

The production of SRM 2034 was discontinued after the 2004 series in recognition of the declaration[1] of the band positions of 40 g/L holmium oxide in 10 % (volume fraction) perchloric acid as constants of nature, or intrinsic standards. End users are encouraged to produce their own artifact standards or rely upon commercially produced reference materials conforming to the instructions for producing the solution.

The certified values of the transmittance band minima for 14 bands of the solution are given for six spectral bandwidths from 0.1 nm to 3.0 nm in the certificate for SRM 2034, Series 04b.[3] These and additional certified values within the same spectral bandwidth range are given in Table 4 of Reference 1.

In order to support traceability for instruments of SBW from 4 to 10 nm, the information values published in Table 4 of Reference 1 may be used as reference values for establishing traceability if used with an expanded uncertainty of ±1 nm. These reference values are reproduced for convenience in the Table below:

Band	Reference Values of Band Positions (nm) for indicated Spectral Bandwidths (SBW)						
	4 nm SBW	5 nm SBW	6 nm SBW	7 nm SBW	8 nm SBW	9 nm SBW	10 nm SBW
1	241.0 ± 1	241.0 ± 1	240.9 ± 1	240.9 ± 1	240.8 ± 1	240.8 ± 1	240.8 ± 1
2	250.1 ± 1	250.2 ± 1	250.1 ± 1	250.0 ± 1			
3	278.0 ± 1	277.9 ± 1	277.9 ± 1	277.9 ± 1	277.9 ± 1	278.6 ± 1	
4	287.6 ± 1	287.8 ± 1	288.0 ± 1	288.2 ± 1	288.3 ± 1	288.1 ± 1	287.3 ± 1
5	333.5 ± 1	333.5 ± 1	333.5 ± 1	333.5 ± 1	333.5 ± 1	333.5 ± 1	333.6 ± 1
6	345.6 ± 1	345.6 ± 1	345.6 ± 1	345.6 ± 1	345.6 ± 1	345.7 ± 1	345.7 ± 1
7	361.1 ± 1	361.1 ± 1	361.1 ± 1	361.1 ± 1	361.1 ± 1	361.0 ± 1	361.0 ± 1
8	386.3 ± 1	386.4 ± 1	386.6 ± 1	386.8 ± 1	387.1 ± 1	387.3 ± 1	387.5 ± 1
9	417.1 ± 1	417.3 ± 1	417.4 ± 1	417.4 ± 1	417.4 ± 1	417.4 ± 1	417.3 ± 1
10b	451.4 ± 1	451.4 ± 1	451.4 ± 1	451.4 ± 1	451.4 ± 1	451.4 ± 1	451.3 ± 1
q	473.5 ± 1	473.3 ± 1	472.8 ± 1	472.9 ± 1	473.2 ± 1	473.5 ± 1	
12	485.3 ± 1	485.3 ± 1	485.2 ± 1	485.1 ± 1	485.0 ± 1	484.9 ± 1	484.6 ± 1
13	537.6 ± 1	537.9 ± 1	538.3 ± 1	538.5 ± 1	538.6 ± 1	538.7 ± 1	538.8 ± 1
14	641.4 ± 1	641.7 ± 1	641.9 ± 1	642.1 ± 1	642.3 ± 1	642.6 ± 1	642.9 ± 1

The model used in Reference 1 for SBW values beyond the range of experimental data convolves the ideal triangular slit function characteristic of grating spectrophotometers through the "native" spectrum of the holmium oxide solution to produce the spectrum expected from an instrument with the SBW represented by the full width at half maximum (FWHM) of the slit function used. (The native spectrum is that acquired at an SBW of 0.1 nm, so that the instrument contribution to the observed widths of the experimental bands is negligible.) The same band location algorithms are then used as were used for the certified values. The model has been verified experimentally over the range of certification, and is considered to be the best approach to traceability for instruments whose SBW exceeds the limit of the certified values.

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[1] J.C. Travis et al., "Intrinsic Wavelength Standard Absorption Bands in Holmium Oxide Solution for UV/visible Molecular Absorption Spectrophotometry," J. Phys. Chem. Ref. Data, **34**, No. 1, 2005

[2] J.C. Travis et al., "An International Evaluation of Holmium Oxide Solution Reference Materials for Wavelength Calibration in Molecular Absorption Spectrometry", Anal. Chem., **74**, 3408-3415 (2002).

[3] https://www-s.nist.gov/srmors/certificates/view_certGIF.cfm?certificate=2034