



**Certified Reference
Materials
for
UV, Visible, NIR and IR
Molecular Spectroscopy**

TEC
INSTRUMENTAL

RM-06HLKCTX/USP/MT

Set Serial 25002

Customer Details:

TEC Instrumental S.A,
Blas Parera 1007,
Florida, Buenos Aires,
Argentina

**The customer information stated on this
page number 1, applies to all certificates.**

Original Starna references are manufactured under ISO 17034:2016 accreditation.

All calibration measurements are performed under ISO/IEC 17025:2017 accreditation.





Reference Material Certificate of Calibration and Traceability



0659

Starna Scientific Ltd
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Page Number 2 of 3

Potassium Dichromate in Perchloric acid sealed in Far UV quartz cells for use as a linearity and photometric accuracy reference in the UV.

Certificate Number: **9116209**
Certificate Date: **06 November 2023**
Expiration Date: **06 November 2025**
Analysis Number: **MT06112301**
Set Serial Number: **25002**
Cell Serial Number: **66166**
Blank Serial Number: **68591**

Description of Reference Material:

Potassium Dichromate crystals, SRM 935a, are purchased from NIST and solutions are prepared according to the procedure supplied with the crystals. The solutions are sealed by heat fusion in high quality Far UV quartz cells. The sealed solutions are then analyzed and certified for use in assessing the performance of spectrophotometers in the Ultraviolet region in accordance with the instructions that are issued with NIST SRM 935a.

Certified Values of Reference Material:

The Potassium Dichromate filled cells are measured against an air reference. The net absorbance values are listed in the table below. Under the analytical procedures used, as outlined by NIST in the Appendix NIST Special Publications 260-54. The combined analytical and instrumental uncertainties at the 95% confidence level ($k=2$) is 0.0037 A at 20 mg/l, 0.0045 A at 40 mg/l, 0.0049 A at 60 mg/l, 0.0058 A at 80 mg/l, and 0.0068 A at 100 mg/l.

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Nominal Concentration:

	Wavelength:	Absorbance	Normal Cert.
Potassium Dichromate Blank	350 nm	0.0318	
Cell Serial No: 68591	313 nm	0.0329	
	257 nm	0.0403	
	235 nm	0.0442	
Potassium Dichromate 60 mg/l	350 nm	0.6619	0.6301
Cell Serial No: 66166	313 nm	0.3193	0.2864
	257 nm	0.8891	0.8489
	235 nm	0.7798	0.7356



Set Serial Number: 25002
 Certificate Number: 9116209
 Calibration Date: 06 November 2023
 Analysis Date: 06 November 2023

UKAS Accredited Calibration Laboratory No.
 0659

Certifying Instrument Qualification:

All calibration is performed on one of a series of reference spectrophotometers. The instrument is tested and confirmed to perform to the manufacturers written specification over the analytical range used for the reference material certification.

The following references and procedures are used in the quality performance procedures relating to the qualification of the spectrophotometer performance:

Absorbance: NIST SRM 930e & 1930, Double Aperture method.
 Wavelength: NIST SRM 2034, Emission lines of mercury & deuterium.
 Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate.
 Resolution: Benzene vapour, half width of deuterium 656.1 nm line.

Calibration Method:

The conditions of analysis used to generate the certified values on this certificate are as listed in the chart below:

Material: Sealed Potassium Dichromate cell
 Reference: 68591
 Scale: Absorbance
 Range: 235 nm to 350 nm
 Slit width: 1.0 nm
 Temperature: 23.5 +/- 0.5 °C

Instructions for Use:

Determine the Absorbance of each cell against the supplied blank at each of the four listed wavelengths. Repeat several times. To assess photometric accuracy, compare the net Absorbance reading at each concentration and wavelength to the published value on the certificate. The absolute difference between the mean measured value and the certified value will not exceed the sum of the certified uncertainty and the specified accuracy of the instrument, if the instrument is performing correctly.

Instrument Dependencies:

The instrument must be designed to be used in the ultraviolet region down to 230 nm and have a spectral bandpass of 1.6 nm or less. Consult your instrument owners manual for this information.

This certificate is issued in accordance with the laboratory accreditation requirements of the United Kingdom Accreditation Service. It provides traceability of measurement to the SI system of units and/or to units of measurement realised at NIST, the National Physical Laboratory or other recognised National Metrology Laboratories. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

Duration of Certificate:

This certification is valid for a maximum period of two years from the date of issue or sooner if specified by the user's own protocols.

Re-certification Procedure:

All reference materials are originally certified and supplied in a useable condition. There is no warranty for fitness beyond initial receipt by the customer. When references need to be re-certified or inspected for any reason, customers should return them to the Sarna ISO/IEC 17025 & 17034 accredited calibration laboratory, where all previous data are collated. On receipt by Sarna Scientific the references are measured "As Received" before cleaning under the re-certification procedure. "As received" data are available on request.

Storage and Care:

Reference (s) should always be stored in the box provided and handled with extreme care. References are fragile and should be inserted and removed from the instrument taking care not to twist or apply leverage against the cell holder, as this may crack the reference. Damage in the form of scratches or contamination may alter the certified values significantly such that they need re-certifying or even complete replacement. For cleaning see the guidance notes at the back of this booklet.

Calibration performed by:

S. P. Beaird
 Calibration Technician

Approved Signatory:

A. Wakelin CSci CChem MRSC
 Calibration Manager



Reference Material Certificate of Calibration and Traceability



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Holmium oxide in perchloric acid sealed in a quartz cell for use as a wavelength accuracy reference in the UV and visible spectrum.

0659

Email: sales@starna.com

Set Serial Number: 25002
Cell Serial Number: 66696
Certificate Number: 9116210
Certificate Date: 06 November 2023
Expiration Date: 06 November 2025
Analysis number: MT06112301

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Description of Reference Material:

This reference material consists of an aqueous solution of 4% holmium oxide in 10% perchloric acid which is permanently sealed by heat fusion in a high quality far UV quartz cell. The reference material is designed for the verification and calibration of the wavelength scales of visible and ultraviolet spectrophotometers having nominal spectral bandwidths of 3 nm or less.

Certified Values of Reference Material:

The holmium oxide filled cell is measured in the absorbance mode against an air blank, over the wavelength range of 660 to 230 nm. For each spectral bandwidth, a baseline correction is performed with an empty cell holder. The 14 maximum absorption peaks are identified and certified to be within the expected wavelength range tolerance for each spectral bandwidth (SBW), as specified by the NIST reference control.

The combined analytical and instrument uncertainties at the 95% confidence level is 0.11 nm.

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

SBW Wavelengths in nanometers of peak maxima as referenced to air, +/- 0.11 nm

0.10	640.41	536.42	485.20	467.78	452.02	416.02	385.36	361.27	345.46	333.48	287.03	278.15	249.78	240.97
0.25	640.41	536.43	485.21	467.79	451.98	416.04	385.39	361.27	345.45	333.47	287.04	278.15	249.79	240.98
0.50	640.43	536.45	485.21	467.80	451.91	416.07	385.45	361.27	345.43	333.47	287.08	278.15	249.81	241.02
1.00	640.50	536.56	485.23	467.82	451.45	416.25	385.61	361.25	345.38	333.48	287.22	278.13	249.89	241.12
1.50	640.62	536.71	485.26	467.86	451.33	416.42	385.70	361.18	345.38	333.49	287.40	278.11	249.98	241.13
2.00	640.79	536.86	485.25	467.90	451.32	416.57	385.80	361.12	345.42	333.47	287.52	278.10	250.03	241.12
3.00	641.15	537.21	485.21	468.11	451.36	416.89	386.00	361.11	345.53	333.47	287.57	278.05	250.07	241.04

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Cell Serial Number: 66696
 Certificate Number: 9116210
 Calibration Date: 06 November 2023
 Analysis number: MT06112301

UKAS Accredited Calibration Laboratory No.
 0659

Certifying Instrument Qualification:

All calibration is performed on one of a series of reference spectrophotometers. The instrument is tested and confirmed to perform to the manufacturers written specification over the analytical range used for the reference material certification.

The following references and procedures are used in the quality performance procedures relating to the qualification of the spectrophotometer performance:

Absorbance: NIST SRM 930e & 1930, Double Aperture method.
 Wavelength: NIST SRM 2034, Emission lines of mercury & deuterium.
 Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate.
 Resolution: Benzene vapour, half width of deuterium 656.1 nm line.

Calibration Method:

The conditions of analysis used to generate the certified values on this certificate are as listed in the chart below:

Cell Pathlength: 10 +/- 0.01 mm
 Cell Material: Spectrosil Quartz
 Reference: Air

Scale: Absorbance
 Range: 660 nm to 230 nm
 Slit width: Multiple
 Temperature: 23.5 +/- 0.5 °C

Instructions for Use:

Carefully insert the holmium filled cell into the cell holder of your instrument, touching only the frosted sides or by holding the top of the cell. The cell is fragile and should always be handled with care. Leave the reference cell holder empty as all measurements are to be made against air. In the Absorbance mode, scan to find the peak maxima and then compare them to the certified wavelengths on this certificate as indicated for the spectral bandwidth (SBW) used by your instrument. If you find any significant differences, it is recommended that an approved manufacturer's representative inspects the instrument to determine the source of the difference.

Instrument Dependencies:

The instrument to be tested should have a SBW not exceeding 3 nanometers. Consult the instrument owners handbook for this information.

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Duration of Certificate:

This certification is valid for a maximum period of two years from the date of issue or sooner if specified by the user's own protocols.

Re-certification Procedure:

All reference materials are originally certified and supplied in a useable condition. There is no warranty for fitness beyond initial receipt by the customer. When references need to be re-certified or inspected for any reason, customers should return them to the Sarna ISO/IEC 17025 & 17034 accredited calibration laboratory, where all previous data are collated. On receipt by Sarna Scientific the references are measured "As Received" before cleaning under the re-certification procedure. "As received" data are available on request.

Storage and Care:

Reference (s) should always be stored in the box provided and handled with extreme care. Filters are fragile and should be inserted and removed from the instrument taking care not to twist or apply leverage against the cell holder, as this may crack the filter. Damage in the form of scratches or contamination may alter the certified values significantly such that they need re-certifying or even complete replacement. For cleaning see the guidance notes at the back of this booklet.

Calibration performed by:

S. P. Beaird
 Calibration Technician

Approved Signatory:

A. Wakelin CSci CChem MRSC
 Calibration Manager



Reference Material Certificate of Analysis



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Page Number 2 of 3

Potassium chloride aqueous solutions, sealed in far UV quartz cells, for use as a stray light reference in the ultraviolet spectrum.

Certificate Number: 9116211
Certificate Date: 06 November 2023
Expiration Date: 06 November 2025
Analysis Number: MT06112301
Set Serial Number: 25002
'10 mm Cell' Serial Number: 65145
'5 mm Cell' Serial Number: 65133

Description of Reference Material:

This reference consists of two high quality far UV quartz cells. Both cells contain a 12 g/l aqueous solution of potassium chloride, where the 'Sample' cell is 10 mm, and the 'Reference' cell is 5 mm path length. Both cells are permanently sealed by heat fusion. Used in this format, the essential spectral characteristic of the solution is that it produces a peak of known Absorbance value. * The measured wavelength positions this peak at the maximum Absorbance value. The reference material is designed for the detection of stray light at wavelengths below the measured value. ASTM E387-04(2014) gives this wavelength range as 175 to 200 nm. A commonly used wavelength by instrument manufacturers, etc. for this reference is 198 nm. All procedures are implemented in accordance with ISO/IEC 17025 and ISO Guide 34. Additional information can be found on the Starna web site at www.starna.com.

Measured Values of Reference Material:

The potassium chloride filled cell is scanned in Absorbance mode over the range 210 to 190 nm, using the '5 mm' blank as the reference. The Absorbance peak is verified and certified to be correct, in validating the purity of potassium chloride and its use as an indicator of instrumental stray light.

The combined analytical and instrumental uncertainties at the 95% confidence level is 0.11 nm.

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Peak Wavelength (nm)* +/- 0.11 nm	Measured Peak Absorbance value (A)	Stray Light Absorbance value (S)	Stray Light Transmission (T/%)
199.8	greater than 0.70 A	greater than 2.00 A	less than 1.0 T/%

IMPORTANT

- * *The Peak Wavelength (nm) and the Absorbance value (A) will vary significantly from one instrument to another.*
- * *The measurement details and information shown above simply indicates the purity and suitability for use of the stray light reference, permanently heat-fused sealed into the cuvette.*
- * *The value assignments shown above must NOT be used to verify either the wavelength and/or the Transmittance/Absorbance scale of the spectrophotometer under test.*
- * *Irrespective of the actual wavelength observed, the Absorbance value measured at the peak will give an estimate of the instrumental stray light in this area of the spectrum - see "Suggested Instructions for Use" on page 3.*
- * *If this resultant peak within the measured range indicates an Absorbance of greater than 0.7 A then the instrument is deemed to be compliant with General Chapter "Ultraviolet-Visible Spectroscopy" <857>, of the United States*



'10 mm Cell' Serial Number: 65145
'5 mm Cell' Serial Number: 65133
Certificate Number: 9116211
Calibration Date: 06 November 2023

Certifying Instrument Qualification:

All calibration is performed on one of a series of high performance reference spectrophotometers. The instruments are tested and qualified to the manufacturers' published specification over the analytical range used for the reference material certification. The following primary references fundamental procedures, are used in the qualification of the reference spectrophotometers:

Absorbance: NIST SRM 930e & 1930, Double Aperture method.
Wavelength: NIST SRM 2034, Emission lines of mercury & deuterium.
Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate.
Resolution: Benzene vapour, half width of deuterium 656.1 nm line.

Measurement Method:

The conditions of analysis used to generate the measured values on this certificate are as listed in the chart below:

Cell Path length: 10 +/- 0.01 mm
Cell Material: Spectrosil Quartz
Reference: 1.2 % KCl in a 5 mm path length cell
Scale: Absorbance
Range: 210 nm to 190 nm
Band width: 1.0 nm +/- 0.04 nm
Temperature: 23.5 +/- 1.0 °C
Peak read at: 199.8 +/- 0.11 nm

Suggested Instructions for Use:

Scan over the required wavelength range in Absorbance in either 'Double Beam' or 'Single Beam' mode as follows:

Single Beam Mode:

- * With an empty sample holder, baseline/zero the instrument against air.
- * Sequentially scan both the '5 mm' and '10 mm' references, and save the data values.
- * Mathematically subtract the '5 mm' data, from the corresponding '10 mm' data.

Double Beam Mode:

- * Place the '5 mm' in the Reference Beam, and the '10 mm' in the sample beam.

In either mode, the resultant spectrum should contain a clearly defined peak, at an associated maximum Absorbance value. This measured peak maximum Absorbance value will be related to the stray light value (S) by the following equation:

$$S = 0.25 * 10^{-2A}$$

Where A is the measured peak maximum Absorbance value.

Duration of Certificate:

This certificate is valid for a maximum period of two years from the date of issue or sooner if specified by the user's own protocols. Although the references are covered by a Lifetime Guarantee, this is subject to certain conditions, see Guidance Notes.

Re-certification Procedure:

All reference materials are certified and supplied in a useable condition. There is no warranty for fitness beyond initial receipt by the customer.

When references need to be re-certified or inspected for any reason, customers should return them to the Starna ISO/IEC 17025 & 17034 accredited calibration laboratory, where all original data is collated.

On receipt by Starna Scientific the references are measured 'As Received', before cleaning under the recertification procedure. 'As Received' data is available on request.

Storage and Care:

References should always be stored in the box provided & handled with extreme care. Quartz cells are fragile & should be inserted and removed from the instrument by holding the cell cap, taking care not to twist or apply leverage against the cell holder, as this may crack the cells. Damage in the form of scratches may alter the certified values significantly such that they need re-certifying and may, as with cracks, require complete replacement. For cleaning see Guidance Notes.

Calibration performed by:

S. P. Baird
Calibration Technician

Approved Signatory:

A. Wakelin CSci CChem MRSC
Calibration Manager



Reference Material Certificate of Calibration



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Toluene in hexane and hexane blank sealed in a quartz cell for use as a spectral resolution reference in the ultraviolet spectrum.

Email: sales@starna.com

Page Number 2 of 3

Certificate Number: 9116212
Certificate Date: 06 November 2023
Expiration Date: 06 November 2025
Analysis No: MT06112301
Set Serial Number: 25002
Cell Serial Number: 65690
Blank Serial Number: 65675

Description of Reference Material:

This reference material consists of two Far UV quartz cells, both of which have been permanently sealed. One cell is filled with a 0.02% v/v solution of toluene in hexane. The other cell is a blank, filled with hexane only. The reference material is designed for the verification of spectral resolution.

Certified Values of Reference Material:

The toluene in hexane filled cell is measured against the hexane blank at the maximum absorbance closest to 268.7 nm and the minimum absorbance closest to 267.0 nm. Using the results from the analysis, a ratio of absorbance maximum divided by absorbance minimum is calculated for each bandwidth.

The combined analytical and instrumental uncertainties at the 95% confidence level (k=2) is 0.0049 A.

The reported expanded uncertainty is based on the standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

Nominal Concentration 0.02 % v/v

Blank Serial No: 65675

Cell Serial No: 65690

Wavelength:	Absorbance	SBW
268.60	0.7691	1.00
267.00	0.3314	
Ratio	2.32	

Spectral Resolution:

The chart below, for cells with a ratio of 2.0, shows the estimated variation of ratio values, based on the slit width and the temperature of measurement.

PLEASE NOTE: THE CHART IS PROVIDED FOR INFORMATION PURPOSES ONLY.

Temperature of measurement	Spectral Bandwidth				
	0.5 nm +/- 0.1 nm	1.0 nm +/- 0.1 nm	1.5 nm +/- 0.1 nm	2.0 nm +/- 0.1 nm	3.0 nm +/- 0.1 nm
20 +/- 1 °C	2.4 - 2.5	2.0 - 2.1	1.6 - 1.7	1.3 - 1.4	1.0 - 1.1
25 +/- 1 °C	2.3 - 2.4	1.9 - 2.0	1.6 - 1.7	1.3 - 1.4	1.0 - 1.1
30 +/- 1 °C	2.1 - 2.2	1.8 - 1.9	1.5 - 1.6	1.3 - 1.4	1.0 - 1.1

FOR FURTHER CLARIFICATION:

USP Chapter <857> states: 'The ratio of the absorbance at the maximum to the absorbance at the minimum will typically fall in the 1.0-2.6 range'

For most compendial quantitative purposes a SBW of 2nm or less is sufficient, and the acceptance criteria for the ratio is NO LESS THAN 1.3'

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Set Serial Number: 25002
 Certificate Number: 9116212
 Calibration Date: 06 November 2023
 Analysis Date: 06 November 2023

UKAS Accredited Calibration Laboratory No.
 0659

Certifying Instrument Qualification:

All calibration is performed on one of a series of reference spectrophotometers. The instrument is tested and confirmed to perform to the manufacturers written specification over the analytical range used for the reference material certification. The following references and procedures are used in the quality performance procedures relating to the qualification of the spectrophotometer performance:

Absorbance: NIST SRM 930e & 1930, Double Aperture method.
 Wavelength: NIST SRM 2034, Emission lines of mercury & deuterium.
 Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate.
 Resolution: Benzene vapour, half width of deuterium 656.1 nm line.

Validation Method:

The conditions of analysis used to establish the range values on this certificate are as listed in the chart below:

Cell Pathlength: 10 +/- 0.01 mm
 Cell Material: Spectrosil Quartz
 Reference: Hexane
 Scale: Absorbance
 Range: 265 nm to 270 nm
 Slit width: 1.0 nm
 Temperature: 23.5 +/- 1.0 °C

Instructions for Use:

Carefully insert the toluene in hexane filled cell and hexane blank into the cell holder of your instrument touching only the frosted sides, or by holding the top of the cell. Cells are fragile and should always be handled with care. Determine the absorbance of the toluene in hexane cell against the hexane blank at each of the wavelengths. Calculate the ratio as on page two of this certificate.

Instrument Dependencies:

The instrument to be tested should have a spectral bandwidth not exceeding 2 nm. Consult your instrument's user manual for this information.

Duration of Certificate:

This certification is valid for a maximum period of two years from the date of issue or sooner if specified by the user's own protocols. Although the references are covered by a lifetime guarantee this is subject to certain conditions, see guidance notes.

Re-certification Procedure:

All reference materials are originally certified and supplied in a useable condition. There is no warranty for fitness beyond initial receipt by the customer. When references need to be re-certified or inspected for any reason, customers should return them to the Starna ISO/IEC 17025 & 17034 accredited calibration laboratory, where all previous data are collated.

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Storage and Care:

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Calibration performed by:

S. P. Baird
 Calibration Technician
 Approved Signatory:

A. Wakelin CSci CChem MRSC
 Calibration Manager

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