



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

**RM-02061060HLKCTX/5/R**

**Set Serial 30728**

**Customer Details:**

Total Laboratory Services Ltd  
Unit 14C Sunrise Business Park  
Blandford Forum  
Dorset  
DT11 8ST

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.





**Calibration Lab.**  
**Starna Scientific Ltd**  
**52/54 Fowler Rd**  
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**Tel. +44 (0) 20 8501 5550**

Email: sales@starna.com

## Reference Material Certificate of Calibration and Traceability

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: **118565**  
 Certificate Date: **25 January 2024**  
 Expiration Date: **25 January 2026**  
 Analysis Number: **40527**  
 Set Serial Number: **30728**  
 Blank Serial Number: **101557**



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### Description of Reference Material:

NIST SRM 935a Potassium Dichromate is used to prepare the reference solutions. These are sealed by heat fusion in high quality Far UV quartz cells. Certification is performed in accordance with the instructions that are issued with NIST SRM 935a. All procedures are implemented in accordance with ISO/IEC 17025 and ISO 17034. Additional information can be found on the Starna web site at [www.starna.com](http://www.starna.com)

### Certified Values of Reference Material:

The Potassium Dichromate filled cells are measured against a Perchloric acid blank. The net absorbance values are listed in the table below. Under the analytical procedures used, as outlined by NIST in the Appendix NIST Special Publication 260-54.

The combined analytical and instrument uncertainties at a coverage probability of 95 % 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, 0.0068 A at 100 mg/l, 0.0084 A at 120 mg/l, 0.0091 A at 140 mg/l, 0.0098 A at 160 mg/l, 0.011 A at 180 mg/l, 0.012 A at 200 mg/l, 0.013 A at 220 mg/l, 0.013 A at 240 mg/l and 0.0043 at 600 mg/l.

*The reported expanded uncertainty is based on a 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.*

*The weight shown below is the mean calculated weight of potassium dichromate in this solution using the specific absorbance values quoted on the NIST SRM 935a certificate, together with the certified absorbance values.*

Nominal Concentration:	Wavelength:	Absorbance:	Calculated Weight:
Potassium Dichromate 20 mg/l	350 nm	0.2077	mg/l ± 0.5 mg/l (k=2)
	313 nm	0.0958	
	257 nm	0.2832	
	235 nm	0.2490	
Cell Serial No: 99360			19.94
Potassium Dichromate 60 mg/l	350 nm	0.6396	mg/l ± 0.5 mg/l (k=2)
	313 nm	0.2892	
	257 nm	0.8642	
	235 nm	0.7460	
Cell Serial No: 86220			60.25
Potassium Dichromate 100 mg/l	350 nm	1.0651	mg/l ± 0.5 mg/l (k=2)
	313 nm	0.4803	
	257 nm	1.4488	
	235 nm	1.2529	
Cell Serial No: 82412			100.18

Set Serial Number: **30728**  
Starna Certificate No: **118565**  
Certificate Date: **25 January 2024**  
Analysis Date: **24 January 2024**

**UKAS Accredited Calibration Laboratory No. 0659**

## 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 manufacturer's published specification over the analytical range used for the reference material certification.

The following primary references and fundamental procedures are used in the qualification of the reference spectrophotometers:

Absorbance: NIST SRM 2031, 1930 & 930e, Double aperture method  
Wavelength: NIST SRM 2034, Emission lines of Hg & deuterium  
Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate  
Resolution: Benzene vapor, half width of D2 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 mm +/- 0.01mm  
Cell Material: Spectrosil Quartz  
Blank Solution: 0.001M Perchloric acid  
Scale: Absorbance  
Range: 350 to 235 nm  
Band width: 1.0 nm +/- 0.2nm  
Temperature: 23.5 +/- 1.0 °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 test instrument linearity, plot the results on a graph of absorbance vs concentration. The graph should produce straight lines if your instrument is linear in the region. To assess photometric accuracy, compare the net absorbance reading at each concentration and wavelength to the published values on this 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:

To achieve accurate results, the instrument must be designed to be used in the ultraviolet region down to 230nm, and have a spectral band width less than or equal to the spectral band width used for the certification. (see 'Calibration Method')

## 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 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 & ISO 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 re-certification procedure. "As received" data is available on request.

## Storage and Care:

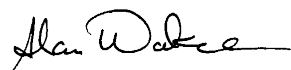
References should always be stored in the box provided and handled with extreme care. Quartz cells are fragile and should be inserted and removed from the instrument by holding the cell cap, taking care not to twist or apply leverage against the cell holder, as this may crack the cells. Damage in the 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:



**Calibration Technician - P. Wakelin RSci MRSC MISCT**

Approved Signatory:



**Calibration Manager - A. Wakelin CSci CChem MRSC**

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## Reference Material Certificate of Calibration and Traceability

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: **118565**  
 Certificate Date: **25 January 2024**  
 Expiration Date: **25 January 2026**  
 Analysis Number: **40527**  
 Set Serial Number: **30728**  
 Blank Serial Number: **101557**



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### Description of Reference Material:

NIST SRM 935a Potassium Dichromate is used to prepare the reference solutions. These are sealed by heat fusion in high quality Far UV quartz cells. Certification is performed in accordance with the instructions that are issued with NIST SRM 935a. All procedures are implemented in accordance with ISO/IEC 17025 and ISO 17034. Additional information can be found on the Starna web site at [www.starna.com](http://www.starna.com)

### Certified Values of Reference Material:

The Potassium Dichromate filled cells are measured against a Perchloric acid blank. The net absorbance values are listed in the table below. Under the analytical procedures used, as outlined by NIST in the Appendix NIST Special Publication 260-54.

The combined analytical and instrument uncertainties at a coverage probability of 95 % 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, 0.0068 A at 100 mg/l, 0.0084 A at 120 mg/l, 0.0091 A at 140 mg/l, 0.0098 A at 160 mg/l, 0.011 A at 180 mg/l, 0.012 A at 200 mg/l, 0.013 A at 220 mg/l, 0.013 A at 240 mg/l and 0.0043 at 600 mg/l.

*The reported expanded uncertainty is based on a 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*

Nominal Concentration:	Wavelength:	Absorbance:	Calculated Weight:
Potassium Dichromate 600 mg/l			
Cell Serial No: 86577	430 nm	0.9566	601.62 mg/l $\pm$ 2.7 mg/l (k=2)

Set Serial Number: **30728**  
Starna Certificate Number: **118565**  
Certificate Date: **25 January 2024**  
Analysis Date: **24 January 2024**

**UKAS Accredited Calibration Laboratory No. 0659**

## 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 manufacturer's published specification over the analytical range used for the reference material certification.

The following primary references and fundamental procedures are used in the qualification of the reference spectrophotometers:

Absorbance: NIST SRM 2031, 1930 & 930e, Double aperture method  
Wavelength: NIST SRM 2034, Emission lines of Hg & deuterium  
Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate  
Resolution: Benzene vapor, half width of D2 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 mm +/- 0.01mm  
Cell Material: Spectrosil Quartz  
Blank Solution: 0.001M Perchloric acid  
Scale: Absorbance  
Range: 430 nm  
Band width: 1.0 nm +/- 0.2nm  
Temperature: 23.5 +/- 1.0 °C

## Instructions for Use:

Determine the absorbance of the reference against the supplied blank at the listed wavelength. Repeat several times. To assess photometric accuracy, compare the net absorbance reading at each concentration and wavelength to the published values on this 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:

To achieve accurate results, the instrument must be designed to be used in the ultraviolet region down to 230nm, and have a spectral band width less than or equal to the spectral band width used for the certification. (see 'Calibration Method')

## 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 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 & ISO 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 re-certification procedure. "As received" data is available on request.

## Storage and Care:

References should always be stored in the box provided and handled with extreme care. Quartz cells are fragile and 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: 

**Calibration Technician - P. Wakelin RSci MRSC MIScT**

Approved Signatory: 

**Calibration Manager - A. Wakelin CSci CChem MRSC**

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## Reference Material Certificate of Calibration and Traceability

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

Certificate Number: **118566**  
 Certificate Date: **25 January 2024**  
 Expiration Date: **25 January 2026**  
 Analysis Number: **HL421101**  
 Set Serial Number: **30728**  
 Cell Serial Number: **86158**



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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 5 nm or less. All procedures are implemented in accordance with ISO/IEC 17025 and ISO 17034. Additional information can be found on the Starna web site at [www.starna.com](http://www.starna.com)

### 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 230nm. 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 a coverage probability of 95 % is 0.11 nm.

*The reported expanded uncertainty is based on a 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*

SBW	Wavelengths in nanometers of peak maxima as referenced to air, +/- 0.11nm													
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
4.00	641.42	537.58	485.26	473.53	451.41	417.07	386.31	361.14	345.57	333.47	287.64	277.98	250.11	241.00
5.00	641.66	537.91	485.25	473.35	451.40	417.32	386.44	361.13	345.58	333.47	287.78	277.93	250.15	240.97

Starna Cell Serial Number: **86158**  
Certificate Number: **118566**  
Certificate Date: **25 January 2024**  
Verification Date: **25 January 2024**

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**UKAS Accredited Calibration Laboratory No. 0659**

## 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 manufacturer's published specification over the analytical range used for the reference material certification.

The following primary references and fundamental procedures are used in the qualification of the reference spectrophotometers:

Absorbance: NIST SRM 2031, 1930 & 930e, Double aperture method  
Wavelength: NIST SRM 2034, Emission lines of Hg & deuterium  
Stray Light: NIST SRM 2032, KCl, KI & lithium carbonate  
Resolution: Benzene vapor, half width of D2 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 +/- 0.01mm  
Cell Material: Spectrosil Quartz  
Reference: Air  
Scale: Absorbance  
Range: 660 to 230 nm  
Band width: Multiple  
Temperature: 23.5° C +/- 1.0 °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. Measurements should be made within the temperature range of 20° to 30° C. In the absorbance mode scan the cell over the required range. Find the absorbance maxima and 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 a service technician inspect your instrument to determine the source of the discrepancy.

## Instrument Dependencies:

The instrument to be tested should be set at a SBW not exceeding 5 nm. Consult the instrument owners handbook for this information.

## 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 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 & ISO 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 re-certification procedure. "As received" data is available on request.

## Storage and Care:

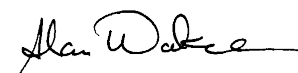
References should always be stored in the box provided and handled with extreme care. Quartz cells are fragile and should be inserted and removed from the instrument by holding the cell cap, taking care not to twist or apply leverage against the cell holder, as this may crack the cells. Damage in the 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:



**Calibration Technician - P. Wakelin RSci MRSC MIScT**

Approved Signatory:



**Calibration Manager - A. Wakelin CSci CChem MRSC**

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# Certificate of Analysis



0659

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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: **9116910**  
Certificate Date: **25 January 2024**  
Expiration Date: **25 January 2026**  
Analysis Number: **9192954**  
Set Serial Number: **30728**  
'10 mm Cell' Serial Number: **85563**  
'5 mm Cell' Serial Number: **84929**

## Description of Reference Material:

This reference consists of two high quality far UV quartz cell. 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 17034. 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/%)
198.6	greater than 0.70 A	greater than 2.00 A	less than 1.0 T/%

## IMPORTANT

- \* *The Peak Wavelength (nm) and the absorption value 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 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 in compliant with General Chapter "Ultraviolet-Visible Spectroscopy" <857>, of the United States Pharmacopeia.*

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 the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.





'10 mm Cell' Serial Number: **85563**  
'5 mm Cell' Serial Number: **84929**  
Certificate Number: **9116910**  
Calibration Date: **25 January 2024**

**UKAS Accredited Calibration Laboratory No. 0659**

## 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: 1.5 nm +/- 0.04 nm  
Temperature: 23.5 +/- 1.0 °C  
Peak read at: 198.6233 +/- 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.

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 the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full except with the prior written approval of the issuing laboratory.

## 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 and 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:

**P. Wakelin RSci MRSC MIScT**  
Calibration Technician

**Approved Signatory:**

**A. Wakelin CSci CChem MRSC**  
Calibration Manager



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## Reference Material Certificate of Calibration and Traceability

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

Certificate Number: **118567**  
Certificate Date: **25 January 2024**  
Expiration Date: **25 January 2026**  
Analysis Number: **11914**  
Set Serial Number: **30728**  
Cell Serial Number: **85239**  
Blank Serial Number: **85148**



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### Description of Reference Material:

This reference consists of two far UV quartz cells, both of which have been permanently sealed. One cell is filled with a 0.020 % 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 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 instrument uncertainties at a coverage probability of 95 % is 0.0049 A.

*The reported expanded uncertainty is based on a 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.*

Nominal Concentration 0.02 % v/v	Wavelength	Absorbance	SBW
<b>Peak</b>	268.69	0.3979	1.50
<b>Trough</b>	266.74	0.2500	
	<b>Ratio</b>	<b>1.59</b>	

The chart below, for cells with a ratio of 1.65, 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**

Spectral Resolution: Temperature of Measurement	Spectral slit width				
	0.5 nm +/- 0.1 nm	1.0 nm +/- 0.1 nm	1.5 nm +/- 0.2 nm	2.0 nm +/- 0.2 nm	3.0 nm +/- 0.2 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'.

## 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 manufacturer's published specification over the analytical range used for the reference material certification.

The following primary references and fundamental procedures are used in the qualification of the reference spectrophotometers:

Absorbance:	NIST SRM 2031, 1930 & 930e, Double aperture method
Wavelength:	NIST SRM 2034, Emission lines of Hg & deuterium
Stray Light:	NIST SRM 2032, KCl, KI & lithium carbonate
Resolution:	Benzene vapor, half width of D2 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 +/- 0.01mm
Cell Material:	Spectrosil Quartz
Reference:	Hexane
Scale:	Absorbance
Range:	265.0 to 270.0 nm
Band width:	0.5 to 3.0 nm
Temperature:	23.5° C +/- 1 °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 owner's manual for this information.

## 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 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 & ISO 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 re-certification procedure. "As received" data is available on request.

## Storage and Care:

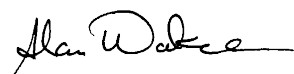
References should always be stored in the box provided and handled with extreme care. Quartz cells are fragile and should be inserted and removed from the instrument by holding the cell cap, taking care not to twist or apply leverage against the cell holder, as this may crack the cells. Damage in the 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.

Validation performed by:



**Calibration Technician - P. Wakelin RSci MRSC MIScT**

Approved Signatory:



**Calibration Manager - A. Wakelin CSci CChem MRSC**