

# TECHNICAL NOTE

## DEMYSTIFYING YOUR CALIBRATION CERTIFICATE



THE CALIBRATION CERTIFICATE IS AN OFFICIAL DOCUMENT CONTAINING VERY IMPORTANT INFORMATION ON THE PRODUCT TO WHICH IT IS RELATED. FOR EACH CALIBRATED PRODUCT, THERE IS ONLY ONE VALID CALIBRATION CERTIFICATE AT ANY TIME.

A complete Gentec-EO Calibration Certificate is composed of six different parts, each with its own purpose and type of information.

### 1 IDENTIFICATION

This first part contains different identification elements. The Gentec-EO official logo is displayed in the top left corner and clearly identifies the source of the certificate. In the top right corner, the words "Calibration Certificate" state the nature of the document.

Then, the first box contains the following elements:

A B C D	<b>Certificate #:</b>	<b>217509-140430</b>	E F G H	<b>Customer Name:</b>	
	<b>Model:</b>	<b>QE50LP-S-MB-QED-DO</b>		<b>V6</b>	
	<b>Head Serial Number:</b>	<b>217509</b>		<b>Instrument ID:</b>	
	<b>Attenuator Serial Number:</b>	<b>n/a</b>		<b>Date of Calibration:</b>	<b>Apr. 30, 2014</b>
	<b>Cal. Procedure:</b>	<b>420- 190076</b>		<b>Calibration Due Date:</b>	<b>*</b>

**A Certificate #:** A combination of the product's serial number and the emission date, this number identifies the certificate and relates it to a unique product.

**B Model number:** This is the official Gentec-EO model denomination of the product.

**C Serial number:** This is the unique serial number attributed to the calibrated product.

**D Cal. Procedure:** The procedure used for the calibration is identified by its Gentec-EO number. Since Gentec-EO is the manufacturer of the product, the calibration procedure has been established by Gentec-EO product development and calibration specialists.

**E Customer Name:** Some customers ask for their name to be written on the certificate. *This is optional.*

**F Instrument ID:** *Also optional,* this is the customer's identification of the product. Some customers rename or identify the product within their own nomenclature and ask that it is written on the certificate for their reference.

**G Date of calibration:** The actual day the calibration was performed. It may be different from the certificate emission date.

**H Calibration due date:** For new units, this is left blank, since the first recalibration interval is to the customer's discretion. For recalibrated instruments, the standard practice is to set this date to one year following the recalibration of the unit, although it is up to the user to decide. *Some may choose to calibrate at a different frequency than yearly.*

# TECHNICAL NOTE

## 2 CALIBRATION DATA

### Calibration Data

Calibration										
λ	Sensitivity (95% level of confidence)		Into Load	Energy			Ambient Temp.	Relative Humidity	Beam Ø	
				Energy	Pulse Duration @ base	Rep.Rate				
μm	V/J	%	Ω	mJ	μs	Hz	°C	%	mm	
<sup>P</sup> 1,064	2,692	± 3,0	>1M	90,4	150	10	23	20	37	
0,532	2,669	± 3,0	>1M	50,9	0,007	10	23	20	25	

<sup>S</sup> Value Corrected According To Spectral Absorption Curve

<sup>P</sup> Sensitivity programmed in detector head

<sup>A</sup> For the QED, QEA and QEAS attenuated QE joulemeters, this represents the sensitivity with the attenuator removed.

<sup>B</sup> For the QED, QEA and QEAS attenuated QE joulemeters, this represents the sensitivity with the attenuator installed.

**Note:** V6 and Higher version detectors contain additional data that allow Gentec-EO monitors to apply a Personal wavelength correction <sup>TM</sup>. Refer to the monitor's manual for more information. For other wavelengths, adjust the energy with the equation that follows. To use the QED, QEA and QEAS attenuated QE joulemeters at wavelengths other than 1.064μm refer to the "Attenuator Calibration Procedure, 420-190068" :

$$E(\lambda_2) \text{ Joules} = E(\lambda_1) \text{ Joules} \times \frac{S(\lambda_1)}{S(\lambda_2)}$$

λ<sub>1</sub>: Wavelength listed above

λ<sub>2</sub>: The new wavelength

E(λ<sub>1</sub>): Measured Energy

E(λ<sub>2</sub>): Energy adjusted for new wavelength

S(λ<sub>1</sub>): Sensitivity listed above

S(λ<sub>2</sub>): Sensitivity at new wavelength. Infer from absorption table and plot.

The second part is the main part of the Calibration Certificate. This is where the measurement results and conditions are reported. The displayed sensitivity was obtained under the displayed conditions and the significant departure from these conditions may have an impact on the calibrated product's performance.

Since the behavior of the product is known under a set of different operational conditions for wavelength and power or energy, the product's programming enables the customer to use the product within the normal operating conditions defined in the User Manual. The product's programming does not compensate for the beam diameter, since it mainly affects damage threshold. This very important aspect of the product's utilization is also documented in the User Manual.

Also in this part are additional information for the user and, in the case of a power measurement head, definitions of the parameters to calculate a wavelength correction factor when the product is used without a Gentec-EO monitor.

# TECHNICAL NOTE

## ③ TEST EQUIPMENT AND STANDARDS USED

### Test Equipment and Standards Used

ID#	Description	Serial#	Last Cal.	By	Certificate #
EOC-1204	Quantaray, INDI HGRS, Pulsed ND:YAG Laser, beam profile: Semi-Gaussian	115H	n/a	n/a	n/a
EOCE-708	National Instrument, NI 4351 for PCI	13645D5	Apr. 28, 2014	Gentec-EO	13645D5-140428
EOCE-907	Gentec-EO, XLP12, wattmeter	206000	Aug. 6, 2013	NIST	686087, 283899-13
EOCE-261	National Instrument, NI 5911 for PCI	D189FB	Nov. 15, 2013	Gentec-EO	D189FB-131115

This third part of the Calibration Certificate lists the controlled equipment used to perform the calibration of the product, including the Standards. *This is where the traceability of the calibration to international Standards is established.* Each equipment used is identified by its ID# and Serial Number and its calibration status is stated by the last calibration date, the name of the calibration service supplier and the Standard's Certificate Number.

With a few exceptions to some particular Standards, the last calibration date shall be less than one year before the actual unit calibration date.

## ④ DECLARATION OF CONFORMITY

### Declaration of Conformity

Gentec Electro-Optics certifies that, at the time of calibration, the above listed instrument meets or exceeds all of the specifications defined in the calibration procedure(s) or customer specification(s). The above listed instrument has been calibrated using standards traceable to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC).

\_\_\_\_\_  
Technician

\_\_\_\_\_  
Quality Assurance

\_\_\_\_\_  
Date

This part is a statement from Gentec-EO on the state of the equipment used and its traceability to NIST or NRC. This statement is signed by the calibration technician who performed the calibration of the unit and by a QA representative, and is dated.

The signatures qualify the Calibration Certificate as an original and official document.

# TECHNICAL NOTE

## 5 VARIANCE REPORT

The variance report is critical to maintain the historic traceability of the unit and to validate the results of the measurements that were performed with the unit since its last calibration.

### For Detectors

The "Change (%)" value in the "As Received" column on a calibration certificate for a detector head is the important parameter to consider. This value should be lower than the uncertainty value specified in the "Calibration Data" section of the certificate, meaning that the detector measures within the specified tolerance.

**Variance Report**

	Last Calibration	As Received	New Calibration
Date	Oct. 25, 2012	Apr. 14, 2014	Apr. 14, 2014
Sensitivity (mV/W)	223,4	220,2	220,2
Difference (from last calibration)	-----	-3,15	-3,15
Change (%)	-----	-1,4	-1,4

Remark : When no repair is made to the detector, the "As received" and "New Calibration" values are the same.

### For Monitors

#### Before

Scale	Applied	Target Value	As Found	Comment
Wattmeter				
W	V	W	W	
100,0	0,1000	100,0 ± 1,0	99,9	Within Tolerances
Photodiode				
W	A	W	W	
100 nW	1,00E-07	1,00E-07 ± 1E-09	1,00E-07	Within Tolerances
10 µW	1,00E-05	1,00E-05 ± 1E-07	9,99E-06	Within Tolerances
15 mW	1,50E-02	1,50E-02 ± 1,5E-04	1,50E-02	Within Tolerances

#### After

Scale	Applied	Target Value	As Found	Comment
Wattmeter				
W	V	W	W	
100,0	0,1000	100,0 ± 1,0	100,0	Within Tolerances
Photodiode				
W	A	W	W	
100 nW	1,00E-07	1,00E-07 ± 1E-09	1,00E-07	Within Tolerances
10 µW	1,00E-05	1,00E-05 ± 1E-07	1,00E-05	Within Tolerances
15 mW	1,50E-02	1,50E-02 ± 1,5E-04	1,50E-02	Within Tolerances

For the monitors, the variance report looks somewhat different, but the purpose is the same. In that case, the measured "Before" and "After" values are displayed for each scale of the monitor. Due to the nature and to the typical use of a monitor, adjustments and repairs are not often required.

When Gentec-EO receives a product for recalibration, the first step following the receiving inspection is to perform an "As Received" calibration. If any adjustments or repairs are necessary, they will be performed only after this first recalibration step. The only occurrence when the "As Received" calibration is not performed is when the received unit is not functional.

After an adjustment or repair, a "New Calibration" is made to take into account the possible effects on the product's behavior. If no adjustment or repair are required, the "As Received" and "New Calibration" data will be identical, since only one calibration will be made.

Finally, a remark might be added just below the variance report table, when it is needed, to explain a particular result. As an example, the sensitivity may change significantly when the sensor disk is replaced in a power measurement head.

## 6 GENTEC-EO INFORMATION

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445, St-Jean-Baptiste, Suite 160, Québec, QC, G2E 5N7, Canada T) 418.651.8003 F) 418.651.1174 1.888.5Gentec (543.6832) E) info@gentec-eo.com W) gentec-eo.com

The last part of the Calibration Certificate contains control information regarding the edition and revision of the certificate template and limitation on the reproduction of the document.

It also contains Gentec-EO contact information (address, phone and fax numbers, e-mail and web site).

# TECHNICAL NOTE

Below is an example of a complete Calibration Certificate for a new detector (without a variance report):



## CERTIFICATE OF CALIBRATION

<b>Certificate #:</b> 217509-140430 <b>Model:</b> QE50LP-S-MB-QED-D0 <b>Head Serial Number:</b> 217509 <b>Attenuator Serial Number:</b> n/a <b>Cal. Procedure:</b> 420- 190076	<b>Customer Name:</b> V6 <b>Instrument ID:</b> <b>Date of Calibration:</b> Apr. 30, 2014 <b>Calibration Due Date:</b> *
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Calibration									
λ	Sensitivity (95% level of confidence)		Into Load	Energy			Ambient Temp.	Relative Humidity	Beam Ø
				Energy	Pulse Duration @ base	Rep.Rate			
μm	V/J	%	Ω	mJ	μs	Hz	°C	%	mm
<sup>P</sup> 1,064	2,692	± 3,0	>1M	90,4	150	10	23	20	37
0,532	2,669	± 3,0	>1M	50,9	0,007	10	23	20	25

<sup>S</sup> Value Corrected According To Spectral Absorption Curve  
<sup>P</sup> Sensitivity programmed in detector head  
<sup>A</sup> For the QED, QEA and QEAS attenuated QE joulemeters, this represents the sensitivity with the attenuator removed.  
<sup>B</sup> For the QED, QEA and QEAS attenuated QE joulemeters, this represents the sensitivity with the attenuator installed.

**Note:** V6 and Higher version detectors contain additional data that allow Gentec-EO monitors to apply a Personal wavelength correction <sup>TM</sup>. Refer to the monitor's manual for more information. For other wavelengths, adjust the energy with the equation that follows. To use the QED, QEA and QEAS attenuated QE joulemeters at wavelengths other than 1.064μm refer to the "Attenuator Calibration Procedure, 420-190068" :

$$E(\lambda_2)_{Joules} = E(\lambda_1)_{Joules} \times \frac{S(\lambda_1)}{S(\lambda_2)}$$

λ<sub>1</sub>: Wavelength listed above  
 λ<sub>2</sub>: The new wavelength  
 E(λ<sub>2</sub>): Energy adjusted for new wavelength  
 S(λ<sub>2</sub>): Sensitivity at new wavelength. Infer from absorption table and plot.

E(λ<sub>1</sub>): Measured Energy  
 S(λ<sub>1</sub>): Sensitivity listed above

Test Equipment and Standards Used					
ID#	Description	Serial#	Last Cal.	By	Certificate #
EOC-1204	Quantaray, INDI HGRS, Pulsed ND:YAG Laser, beam profile: Semi-Gaussian	115H	n/a	n/a	n/a
EOCE-708	National Instrument, NI 4351 for PCI	13645D5	Apr. 28, 2014	Gentec-EO	13645D5-140428
EOCE-907	Gentec-EO, XLP12, wattmeter	206000	Aug. 6, 2013	NIST	686087, 283899-13
EOCE-261	National Instrument, NI 5911 for PCI	D189FB	Nov. 15, 2013	Gentec-EO	D189FB-131115

**Declaration of Conformity**

Gentec Electro-Optics certifies that, at the time of calibration, the above listed instrument meets or exceeds all of the specifications defined in the calibration procedure(s) or customer specification(s). The above listed instrument has been calibrated using standards traceable to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC).

\_\_\_\_\_  
Technician

\_\_\_\_\_  
Quality Assurance

\_\_\_\_\_  
Date

**• For Customer Use Only**

The calibration interval of this instrument begins on the date of receipt by the customer. The recommended calibration interval is 12 months. Please fill in appropriate dates as indicated.

Date Instrument Received: \_\_\_\_\_ Calibration Due Date: \_\_\_\_\_

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# TECHNICAL NOTE

Below is an example of a complete Calibration Certificate for a recalibrated monitor (with a Before/After report):



## CERTIFICATE OF CALIBRATION

<b>Certificate #:</b> 212734-140318	<b>Customer Name:</b>	
<b>Model:</b> UNO		
<b>Serial Number:</b> 212734	<b>Instrument ID:</b> C103647	
<b>Firmware Version:</b>	<b>Date of Calibration:</b> Mar. 18, 2014	
<b>Cal. Procedure:</b> 420-190263	<b>Calibration Due Date:</b> Mar. 18, 2015	

  

**Calibration Data**

Calibration uncertainty	Ambient Temperature	Relative Humidity
% (95% level of confidence)	°C	%
±1% ±5µV	23	20

  

**Test Equipment and Standards Used**

ID#	Description	Serial#	Last Cal.	By	Certificate #
EOCE-366	HP, 34401A, Multimeter (6)	MY45037042	Jun. 13, 2013	Pylon	G95846
EOCE-287	Keithley 220, programmable current source	445793	Oct. 11, 2013	Pylon	G99618

  

**Before**

Scale	Applied	Target Value	As Found	Comment
Wattmeter				
W	V	W	W	
100,0	0,1000	100,0 ± 1,0	99,9	Within Tolerances
Photodiode				
W	A	W	W	
100 nW	1,00E-07	1,00E-07 ± 1E-09	1,00E-07	Within Tolerances
10 µW	1,00E-05	1,00E-05 ± 1E-07	9,99E-06	Within Tolerances
15 mW	1,50E-02	1,50E-02 ± 1,5E-04	1,50E-02	Within Tolerances

  

**After**

Scale	Applied	Target Value	As Found	Comment
Wattmeter				
W	V	W	W	
100,0	0,1000	100,0 ± 1,0	100,0	Within Tolerances
Photodiode				
W	A	W	W	
100 nW	1,00E-07	1,00E-07 ± 1E-09	1,00E-07	Within Tolerances
10 µW	1,00E-05	1,00E-05 ± 1E-07	1,00E-05	Within Tolerances
15 mW	1,50E-02	1,50E-02 ± 1,5E-04	1,50E-02	Within Tolerances

**Declaration of Conformity**

Gentec Electro-Optics certifies that, at the time of calibration, the above listed instrument meets or exceeds all of the specifications defined in the calibration procedure(s) or customer specification(s). The above listed instrument has been calibrated using standards traceable to the National Institute of Standards and Technology (NIST) or the National Research Council of Canada (NRC).

\_\_\_\_\_  
Technician

\_\_\_\_\_  
Quality Assurance

\_\_\_\_\_  
Date

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