

CALIBRATION CERTIFICATE

Certificate Number

43795191121036

Model: R2014
Serial Number: 191121036
Sensor ID: 191121-034
Calibration Location: 1221 Disk Drive, Medford, OR 97501
Date of Calibration November 26, 2019

Next calibration on this instrument is due: November 26, 2020

Calibration Method Calibration of this instrument has been accomplished as defined in ISO 21501-4 2018: Light scattering airborne particle counter for clean spaces. All work performed is in accordance with Lighthouse Worldwide Solutions. Quality Manual P/N 714252800-1. Reproduction of this certificate and accompanying documentation is prohibited without the expressed written permission of Lighthouse Worldwide Solutions. All records of work performed are maintained by Lighthouse Worldwide Solutions.

Traceability The Standards of the Compliant Calibration Laboratory are traceable to the International System of Units (SI) through the National Institute of Standards and Technology, and are part of a comprehensive measurement assurance program for ensuring continued accuracy and measurement traceability within the level of uncertainty reported by this laboratory. The unique laboratory calibration number identified above shall be used in referencing metrological traceability for artifacts identified only in this certificate.

Uncertainty The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor of $k = 2$, which provides a confidence level of approximately 95%. The values and test criteria are applied using Simple Acceptance; Shared Risk approach.

Results This certifies the above named instrument conforms to the original specifications in effect at date of manufacture and test.

Environmental Conditions Ambient temperature 74.0 °F Relative humidity 32.0 %

Test Equipment

<u>Standards</u>	<u>Model</u>	<u>Mfg</u>	<u>Serial#</u>	<u>Cal Date</u>	<u>Cal Due</u>
Flow meter	4143	TSI	41431807001	10/22/2019	4/22/2020
DMM	Fluke 179	FLUKE	23430687	6/7/2019	6/7/2020
MCA	8000D	AMPTEK	786	1/24/2019	1/24/2020
Test Standard	R1104	LIGHTHOUSE	190506003	11/19/2020	5/19/2020

Particle Size Standards

<u>Nominal Size</u>	<u>Particle Size</u>	<u>Tolerance (nm)</u>	<u>Lot No.</u>	<u>Manufacturer</u>	<u>Expiration Date</u>
0.20µm	0.203µm	+/-2.5	205131	Thermo Scientific	11/30/2021
0.30µm	0.303µm	+/-3	204665	Thermo Scientific	11/30/2021
0.50µm	0.510µm	+/-3.5	210349	Thermo Scientific	4/30/2022
1.00µm	1.030µm	+/-5.5	202223	Thermo Scientific	9/30/2021



CALIBRATION RESULTS AS LEFT

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Size Calibrations as Left

Channel	Chnl Size	Threshold	Particle Size	Particle Size Voltage	Expanded Uncertainty	As Left Size Error
1	0.20µm	51mV	0.203µm	52.0mV	0.008 µm	0%
2	0.30µm	483mV	0.303µm	514.0mV	0.009 µm	0%
3	0.50µm	2243mV	0.510µm	2300.0mV	0.01 µm	0%
4	1.00µm	4042mV	1.030µm	4126.0mV	0.013 µm	0%

Measurements as Left

Nominal Flow Rate:	Measured Flow:	(limit ±5% of nominal)	Expanded Uncertainty	Result
2.83 LPM	2.81 LPM		0.1L/min	Pass

False Count Rate:

JIS B 9921 Zero Count	Observed Cts:	0	(≤ 1 ct max / 5 min.)	Pass
ISO21501-4 False Count Rate	Observed Cts:	0	Upper confidence level	18 Particles/m3

Counting Efficiency 50%:	Size	0.203 µm	47.1% (limit 30% - 70%)	Expanded Uncertainty	3.4 %	Result	Pass
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Counting Efficiency 100%:	Size	0.303 µm	98.4% (limit 90% - 110%)	Expanded Uncertainty	4.9 %	Result	Pass
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Size Resolution:	Size	0.240 µm	3.48% (limit 15%)	Expanded Uncertainty	2.6 %	Result	Pass
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CALIBRATION RESULTS AS FOUND

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Size Calibrations as Found

Channel	Size(μm)	As Rec'd Threshold Settings mV	As measured Threshold Settings mV	As Rec'd size (μm)	Percent size error (%)	Percent size error tolerance	Expanded Uncertainty	Pass/Fail
1	0.2	51	51	0.202	1.2%	+/- 10%	0.008 μm	Pass
2	0.3	483	483	0.299	-0.5%	+/- 10%	0.009 μm	Pass
3	0.5	2243	2243	0.499	-0.1%	+/-10%	0.01 μm	Pass
4	1	4042	4042	1.000	0.0%	+/-10%	0.013 μm	Pass

Measurements as Found

Nominal Flow Rate:	Measured Flow:	(limit ±5% of nominal)	Expanded Uncertainty	Result
2.83 LPM	2.81 LPM		0.1L/min	Pass

False Count Rate:

JIS B 9921 Zero Count	Observed Cts:	0	(≤ 1 ct max / 5 min.)	Pass
ISO21501-4 False Count Rate	Observed Cts:	0	Upper confidence level	18 Particles/m3

**Counting Efficiency
50%:**

Size	0.203 μm	47.1% (limit 30% - 70%)	Expanded Uncertainty	Result
			3.4 %	Pass

**Counting Efficiency
100%:**

Size	0.303 μm	98.4% (limit 90% - 110%)	Expanded Uncertainty	Result
			4.9 %	Pass

Size Resolution:

Size	0.240 μm	3.48% (limit 15%)	Expanded Uncertainty	Result
			2.6 %	Pass

Signature:

Head of Calibration:

D. Spranger

Head of calibration acknowledges that the calibration has been carried out in accordance with ISO 17025:2017 and Lighthouse Worldwide Solutions ISO 17025 Quality Management system to comply to ISO 21501-4:2018 calibration requirements.

Signature:

Calibration Tech/Engineer:

J. Klein