

C103

**CALIBRATION CERTIFICATE**

Certificate Number

43945200404033

Model: S3100
 Serial Number: 200404033
 Sensor ID: 200404-036
 Calibration Location: 1221 Disk Drive, Medford, OR 97501
 Date of Calibration: April 24, 2020

Next calibration on this
 instrument is due: April 24, 2021

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 72.0 °F Relative humidity 40.0 %

Test Equipment

<u>Standards</u>	<u>Model</u>	<u>Mfg</u>	<u>Serial#</u>	<u>Cal Date</u>	<u>Cal Due</u>
Flow meter	4043	TSI	40431722011	12/27/2019	9/27/2020
DMM	Fluke 179	Fluke	91110178	5/20/2019	5/20/2020
MCA	8000D	Amptek	994	3/10/2020	3/10/2021
Test Standard	Solair	LWS	100539006	2/20/2020	8/21/2020

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>
0.30µm	0.30µm	+/-3	219211	Thermo Scientific	11/30/2022
0.40µm	0.40µm	+/-3	211099	Thermo Scientific	4/30/2022
0.50µm	0.51µm	+/-3.5	218477	Thermo Scientific	10/1/2022
1.00µm	1.04µm	+/-6	215612	Thermo Scientific	8/31/2022
3.00µm	2.92µm	+/-15	199811	Thermo Scientific	8/1/2022
5.00µm	5.02µm	+/-20	214744	Thermo Scientific	7/1/2022
10.00µm	9.99µm	+/-60	213987	Thermo Scientific	10/31/2021

Counting Efficiency 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>
0.30µm	0.30µm	+/-3	219211	Thermo Scientific	11/30/2022
0.50µm	0.51µm	+/-3.5	218477	Thermo Scientific	10/1/2022

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	0.30µm	54mV	0.303µm	55.0mV	0.009 µm	0%
2	0.50µm	507mV	0.510µm	531.0mV	0.01 µm	0%
3	1.00µm	1152mV	1.036µm	1195.0mV	0.014 µm	0%
4	3.00µm	3292mV	2.920µm	3269.0mV	0.031 µm	0%
5	5.00µm	3738mV	5.020µm	3743.0mV	0.04 µm	0%
6	10.00µm	4463mV	9.990µm	4463.0mV	0.12 µm	0%

Measurements as Left

Nominal Flow Rate:	Measured Flow:	(limit $\pm 5\%$ of nominal)	Expanded Uncertainty	Result
28.30 LPM	28.66 LPM		0.8L/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	2 Particles/m3

Counting Efficiency 50%:	Size	0.303 µm	48.8% (limit 30% - 70%)	Expanded Uncertainty	3.4 %	Result
						Pass

Counting Efficiency 100%:	Size	0.51 µm	99.7% (limit 90% - 110%)	Expanded Uncertainty	4.9 %	Result
						Pass

Size Resolution:	Size	0.401 µm	9.32% (limit 15%)	Expanded Uncertainty	1.6 %	Result
						Pass

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	0.3	54	54	0.300	0.0%	+/- 10%	0.009 μm	Pass
2	0.5	507	507	0.499	-0.2%	+/- 10%	0.01 μm	Pass
3	1	1152	1152	0.998	-0.2%	+/-10%	0.014 μm	Pass
4	3	3292	3292	2.984	-0.5%	+/-10%	0.031 μm	Pass
5	5	3738	3738	4.991	-0.2%	+/-10%	0.04 μm	Pass
6	10	4463	4463	9.989	-0.1%	+/-10%	0.12 μm	Pass

Measurements as Found

Nominal Flow Rate:	Measured Flow:	(limit ±5% of nominal)	Expanded Uncertainty	Result
28.30 LPM	28.66 LPM		0.8L/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	2 Particles/m3

Counting Efficiency 50%:	Expanded Uncertainty	Result
Size 0.303 μm 48.8% (limit 30% - 70%)	3.4 %	Pass
Counting Efficiency 100%:	Expanded Uncertainty	Result
Size 0.51 μm 99.7% (limit 90% - 110%)	4.9 %	Pass

Size Resolution:	Expanded Uncertainty	Result
Size 0.401 μm 9.32% (limit 15%)	1.6 %	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: T Kish