CLEANROOM CERTIFICATION SERVICE

For

EXAMPLE COMPANY

CLEANROOM 1

123 Fake Street / St. Paul, MN

Testing Date: **January 23, 2017**

NEBB Certification #: 3031

1198 Cliff Road E / Burnsville, MN 55337 / 952-960-4400

Gerbig Cleanrooms is a NEBB-Certified Cleanroom Performance Testing Contractor

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NEBB Cleanroom Performance Test and Certification

Section

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NEBB CLEANROOM PERFORMANCE TEST AND CERTIFICATION

Certification Date: January 23, 2017
Previous Certification: January 23, 2016

Example Company
123 Fake Street
St. Paul, MN 55102

CLEANROOM DESCRIPTION	ROOM STATUS	CLASS
Cleanroom 1	Operational	ISO 7/Class 10,000

The data presented in this report is a record of cleanroom and system performance and was obtained in accordance with the current edition of the NEBB Procedural Standards for the Certified Testing of Cleanrooms. Any variances from design, specified, or agreed to criteria are noted in the cleanroom report project summary.

The results shown and information given in this report are certified to be accurate and complete to the extent possible by equipment and procedures used on this date.

Gerbig Cleanrooms warrants that the equipment or system listed above and / or identified In this report is operating at the specified levels in accordance with ISO 14644-1:2015, ISO 14644-3:2005, IEST-RP-CC006:2004, IEST-RP-CC034:3:2010, and/or the National Environmental Balancing Bureau Procedural Standards for Certified Testing of Cleanrooms at and only at this time, and makes no other warranties, stated or implied, concerning the continued performance, operation, or safety in use of this equipment past this time.

Submitted by:

_____ _____
John Smith Date
Cleanroom Certifiaction

Reviewed and Certified by:

_____ _____
James Butler Date
President

1198 Cliff Road E / Burnsville, MN 55337 t 952-960-4400 / f 952-960-4410 / email info@gerbig.com

Summary of Test Results

Section

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SUMMARY OF TEST RESULTS

Example Company Inc.

Cleanroom Certification Testing

January 23, 2017

On January 23, 2017 Gerbig Cleanrooms performed certification testing for the ISO 14644-1 class 7 Cleanroom 1 located at Example Company Inc. in St. Paul, MN. Testing included **room particle counting, HEPA filter leak testing, HEPA filter airflow velocity measurements, and room pressure differential measurements.**

Particle Counts and Locations

The Cleanroom met the requirements for certification as ISO 14644-1 class 7 (209E class 10,000). The room was certified in the operational mode and sampled at 42 inches above the floor. See the attached sample location drawing and calculation sheets for particle count locations, data, and analysis.

HEPA Filter Integrity (leak) Testing

All HEPA filters were checked for leakage through the filter and bypass leakage around the edges using a Tec Services aerosol photometer. All filters tested free of leaks, either initially or following repair or replacement. See the attached drawing for HEPA filter locations and leak status.

HEPA Filter Velocity Measurements

HEPA filter velocities were measured using a Shortridge ADM 870 airdata multimeter with Velgrid attachment. See the attached data sheets and drawing for filter velocity data and filter locations.

Relative standard deviation was calculated for each room, IEST RP-CC-006.3 recommends a relative standard deviation of less than 15%, or as agreed upon between customer and testing agency. Cleanroom 1 met this recommendation at the time of testing.

Room Pressure Differentials and Airflows

Room pressure differential measurements, using a Shortridge ADM 870 airdata multimeter, determined that airflows were of the desired strength and direction. Air flowed from the Cleanroom to the corridor. The attached drawing describes room pressure differentials and airflow directions.

Equipment Calibration

All applicable test instrumentation is calibrated to NIST-traceable standards. Calibration certificates are included at the end of this report.

Particle Count Results

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Example Compnay Inc.
123 Fake Street
St. Paul, MN 55102

ISO 14644-1 CALCULATION FOR CLEANLINESS LEVEL

CLEAN ZONE TESTED: Cleanroom 1

Airflow Type:		(Unidirectional)	Test mode was:	Operational
	X	(Non-unidirectional)	Sample Locations:	4
Room Size square feet:		40	Particle Size:	≥0.5
Cleanliness Class:		7		

Clean Zone Cleanroom 1 Meets ISO 14644-1 Class 7 Requirements (Federal Standard 209E Class 10,000) At ≥0.5 Micron For Data Collected on January 23, 2017

Statistical Classification Criteria

	per ft^3	per m^3
Mean of the Averages:	109	3,831
Standard Deviation:	11	398
Standard Error:	6	199

Acceptance Criteria

	per ft^3	per m^3
Highest Average at a Location:	124	4,378
Highest Average Allowed:	10,000	352,000

Optional Information

Average Temperature (°F):	N/A
Average Humidity (RH):	N/A

GERBIG CLEANROOMS

Technician(s): John Smith
Instrument(s): GEC-095

Example Compnay Inc.
123 Fake Street
St. Paul, MN 55102

RAW DATA AND AVERAGES FOR ISO 14644-1 CALCULATION

Clean Zone Tested:	Cleanroom 1	Sample Locations:	4
Test Mode:	Operational	Particle Size:	≥0.5 µm

Particle Counts Sampled On January 23, 2017

Location	Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Total	Average per ft^3		Average per m^3	Optional Data
1	125	93	N/A	N/A	N/A	218	**109**		**3848.8**	**N/A**
2	75	131	N/A	N/A	N/A	206	**103**		**3636.9**	**N/A**
3	144	104	N/A	N/A	N/A	248	**124**		**4378.4**	**N/A**
4	94	102	N/A	N/A	N/A	196	**98**		**3460.4**	**N/A**

HEPA Filter Velocity and Uniformity Results

Section

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Example Company Inc.
123 Fake Street
St. Paul, MN 55102

HEPA Filter Velocity and Volume Report

CLEAN ZONE TESTED: **Cleanroom 1** **TEST DATE:** **January 23, 2017**

Air System Number:	N/A	
Specified Air Flow to Room:	N/A	
Suggested Allowable Bound:	10%	(of customer identified specification)
Number of Filters:	2	

SUMMARY OF COLLECTED DATA

Uniformity Test Based on Collected Data and Resulting Averages

Average Air Velocity:	64.5 LFM
Number of Filters:	2
Standard Deviation of Average Velocity:	2.8 LFM
Relative Standard Deviation (Std.Dev./Avg.Velocity):	4.4%

Comparison To Specified Data

Specified Airflow:		N/A
Total Measured Airflow from Raw Data:		937 CFM
Percent of Specified Airflow:		N/A
Number of Filters	Below Limit:	0
	Within Limit:	2
	Above Limit:	0
Percent within Allowable Bound:		100 %

Room Air Changes Per Hour

Volume of Room (ft^3):	400
Volume of Air into Room per Minute (CFM):	937
Air Changes Per Hour:	141

GERBIG CLEANROOMS

Technician(s): John Smith
Instrument(s): GEC-012

Example Company Inc.
123 Fake Street
St. Paul, MN 55102

HEPA FILTER VELOCITY DATA, UNIFORMITY, AND RESULTING AVERAGES

Specified Airflow to Room:	N/A		
Specified Lin Velocity:	N/A	Average Volume:	469 CFM
Mean of Average Measured Velocity:	64.5 LFM	No. of Filters:	2
Lower Velocity Bound:	N/A	High Counts:	0
Upper Velocity Bound:	N/A	Low Counts:	0
Blank Space Data Points:	0	% Within Range:	100.0%
Standard Deviation of Average Measured Velocities:	2.8	Name of Zone:	**Cleanroom 1**
Relative Standard Deviation:	4.4%	Date of Test:	**23-Jan-17**

Filter No.	Reading 1	Reading 2	Reading 3	Reading 4	Reading 5	Reading 6	Reading 7	Reading 8	Filter Avg LFM	Filter CFM
1	45	80	N/A	N/A	N/A	N/A	N/A	N/A	63	454
2	65	68	N/A	N/A	N/A	N/A	N/A	N/A	67	483

Drawings

(Particle Count Location Guide, HEPA Integrity and Location Guide, and Room Pressure Differentials)

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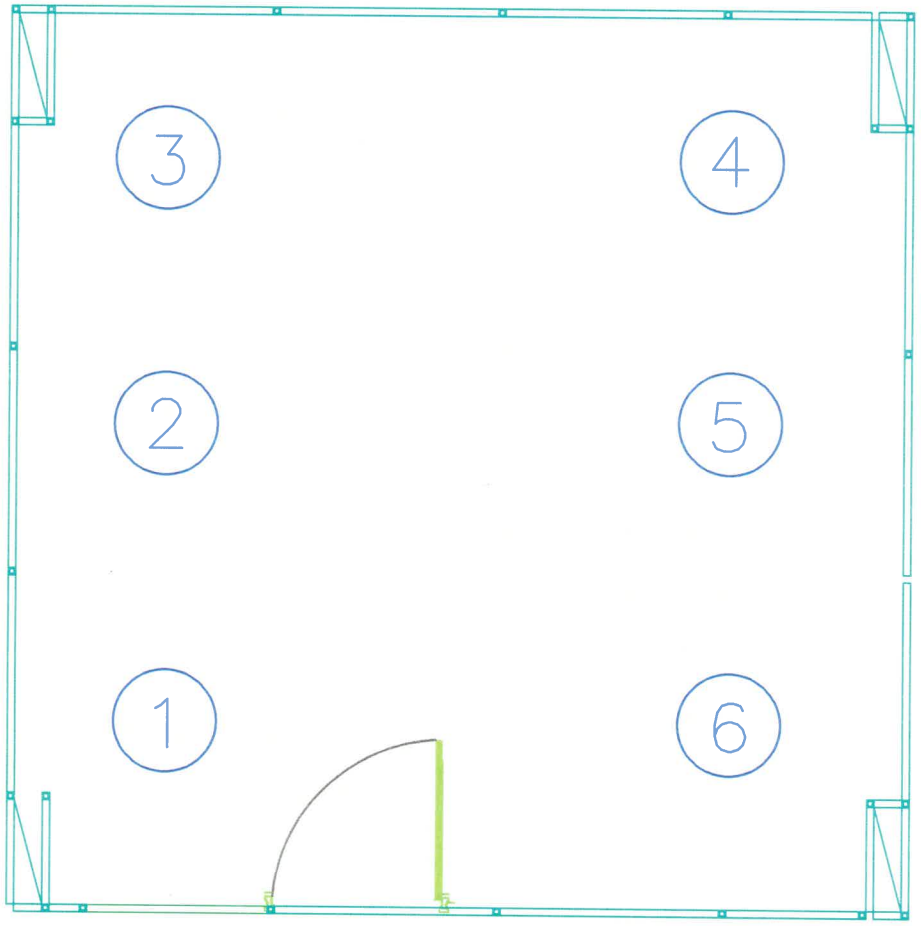
PARTICLE COUNT LOCATION GUIDE



GERBIG CLEANROOMS

DATE TESTED: JANUARY 23, 2017
TECHNICIAN(S): JOHN SMITH
INSTRUMENT(S): GEC-095

LEGEND

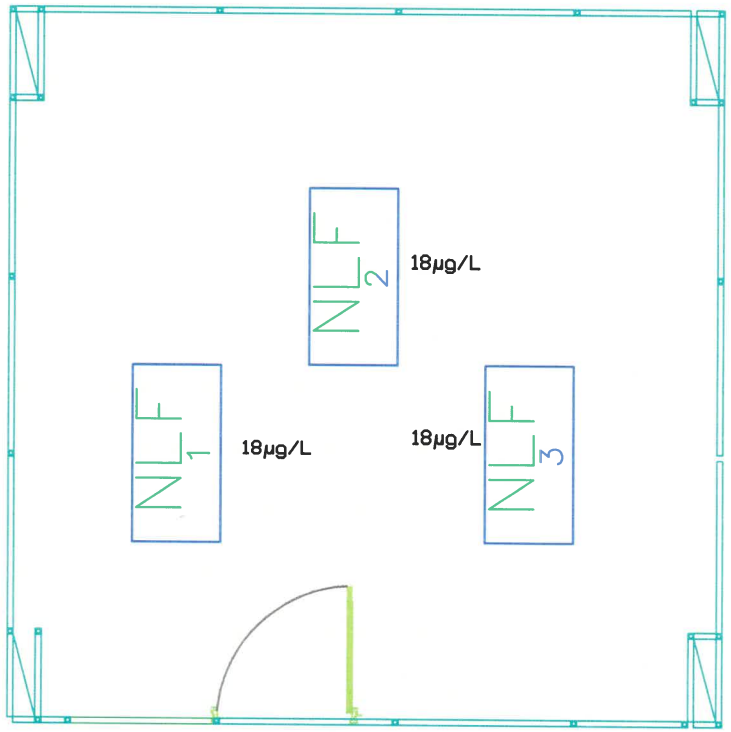
⑦ =LOCATION NUMBER OF PARTICLE COUNT

NOTE:

SEE SPREADSHEET FOR COUNT VALUES
SAMPLES TAKEN AT 42" ABOVE THE FLOOR UNLESS OTHERWISE INDICATED.
DRAWING NOT TO SCALE
SAMPLE VOLUME = 1 CU. FT.

EXAMPLE COMPANY INC.
CLEANROOM 1
123 FAKE STREET
ST. PAUL, MN 55102

HEPA INTEGRITY (LEAK) TEST AND LOCATION GUIDE



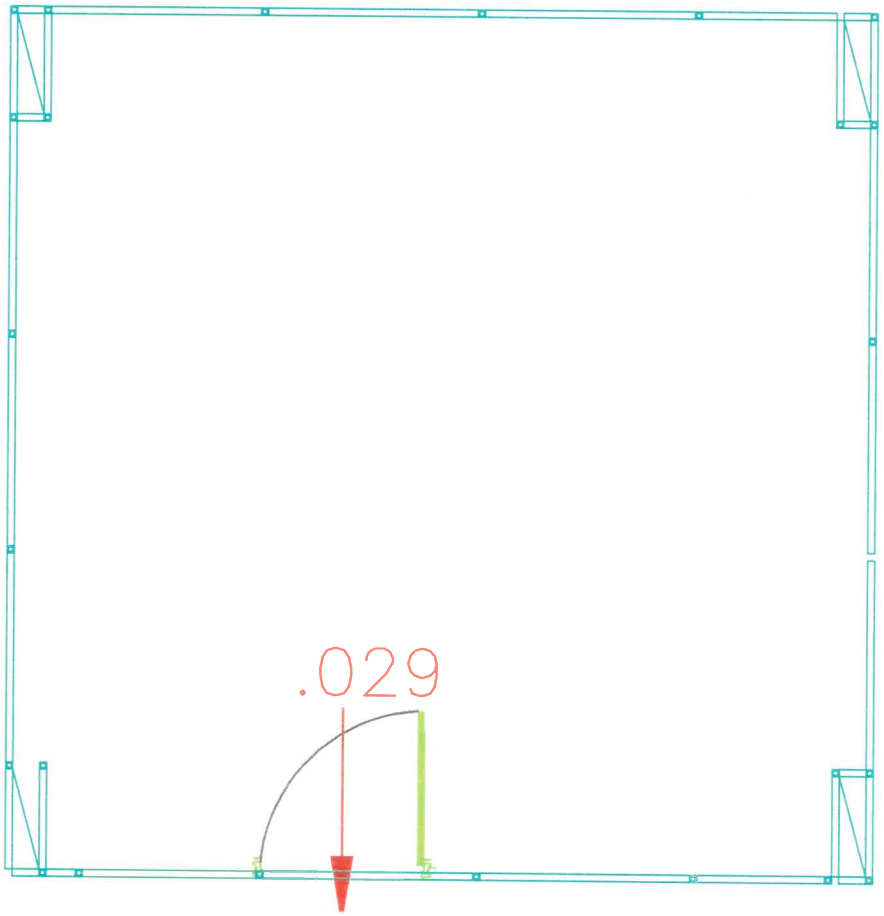
LEGEND

- ▭ =HEPA FILTER
- 2 =FILTER NUMBER
- NLF =NO LEAKS FOUND
- NLFAR =NO LEAKS FOUND AFTER REPAIR
- 20µg/L =CHALLENGE CONCENTRATION
- X =LEAK
- (X) =REPAIRED LEAK
- FAIL =FILTER FAILED
- NLFAR* =NO LEAKS FOUND AFTER REPLACEMENT

GERBIG CLEANROOMS

EXAMPLE COMPANY INC.
CLEANROOM 1
123 FAKE STREET
ST. PAUL, MN 55102

ROOM PRESSURE DIFFERENTIALS AND AIRFLOWS



GERBIG CLEANROOMS

LEGEND

.03 =PRESSURE DIFFERENTIAL " W.C.

=DIRECTION OF AIRFLOW

DATE TESTED: JANUARY 23, 2017

TECHNICIAN(S): JOHN SMITH

INSTRUMENT(S): GEC-012

EXAMPLE COMPANY INC.

CLEANROOM 1

123 FAKE STREET

ST. PAUL, MN 55102

Test Equipment Calibration Documents

Section

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Example Company Inc.
123 Fake Street
St. Paul, MN 55102

Calibration Information for Equipment Used
January 23, 2017

ZONE TESTED: **Cleanroom 1**

Instrument ID	Serial Number	Equipment Description	Calibration Date	Calibration Due
GEC-095	150605006	Lighthouse Particle Counter	14-Jun-2017	14-Jun-2018
GEC-012	M96938	Shortride Airdata Multimeter	09-Jan-2017	09-Jan-2018
GEC-081	1518	TEC Aerosol Photometer	26-Sep-2017	26-Sep-2018

ADDITIONAL INFORMATION:

All applicable test instrumentation is calibrated to NIST-traceable standards. Calibration certificate(s) are included with this certification report.

GERBIG
CLEANROOMS

LIGHTHOUSE
WORLDWIDE SOLUTIONS

Manufacturer's Calibration Certificate
ISO 21501-4

REPORT OF CALIBRATION

Model:	S1100LD
Serial Number:	150605006
Sensor ID:	150605-006

LWS Location: 1221 Disk Dr, Medford, OR 97501

Size calibration of the instrument has been accomplished by the method defined in ISO 21501-4 for channel threshold voltages listed 2-8. The first channel threshold voltage has been calibrated using a proprietary method defined by Lighthouse Worldwide Solutions. The counting efficiency has been verified using the method defined in ISO 21501-4.

The accuracy of the standards and equipment used in the calibration are traceable to the National Institute of Standards and Technology or have been derived from acceptable values of natural and physical constants. All record of work performed is maintained by Lighthouse Worldwide Solutions.

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.

Test Equipment:

Flow Meter	1705011	Calibration Due:	2/28/2018
DMM	85610018	Calibration Due:	5/19/2018
MCA	445	Calibration Due:	10/25/2017
CPC	154004	Calibration Due:	1/11/2018

Calibration was performed under the following controlled conditions:

Reference Temp: 72.0 °F Reference RH: 34.0 %

Threshold Voltage Settings:

Size:	0.10 um			Channel 1 Threshold Voltage:	28 mv
Particle Size:	0.15 um	Lot#	44893	Channel 2 Threshold Voltage:	1052 mv
Particle Size:	0.20 um	Lot#	166310	Channel 3 Threshold Voltage:	2540 mv
Particle Size:	0.25 um	Lot#	179881	Channel 4 Threshold Voltage:	3442 mv
Particle Size:	0.30 um	Lot#	174664	Channel 5 Threshold Voltage:	4292 mv
Particle Size:	0.50 um	Lot#	177807	Channel 6 Threshold Voltage:	5237 mv
Particle Size:	1.00 um	Lot#	174235	Channel 7 Threshold Voltage:	5959 mv
Particle Size:	5.00 um	Lot#	164510	Channel 8 Threshold Voltage:	7296 mv

Flow Rate:	Observed Flow:	1.02 CFM	(limit ±5% of nominal)	
False Count Rate:	Observed Cts:	0 /M^3		
Counting Efficiency:	Size 0.107 um:	47.7%	(limit 30% - 70%)	Lot# B1261
Counting Efficiency:	Size 0.200 um:	101.9%	(limit 90% - 110%)	Lot# 166310
Size Resolution:	0.20um Channel	6.30%	(limit 15%)	

Alex Skrove
Cal Tech

Certification Date: June 14, 2017

Cal Due Date: June 14, 2018

422348911-1 RB4

ACCREDITED CALIBRATION LABORATORY

Martin Calibration

"Your Partner in Quality"

Certificate of Calibration

Certificate #: 1889965

Calibration Performed By:
MARTIN CALIBRATION, INC.
11965 12TH AVENUE SOUTH
BURNSVILLE, MN 55337

For:
GERBIG ENGINEERING CO.
1198 E. CLIFF ROAD
BURNSVILLE, MN 55337

Serial Number:	M96938
Description:	AIRDATA MULTIMETER
Manufacturer:	SHORTRIDGE INSTRUMENTS
Model:	ADM-870
Range:	MULTIPLE RANGES
Temp./RH:	70 F / 22 %

Gage I.D.:	GEC-012
Performed By:	PAUL ROBERTSON
Procedure:	SCP-130-0004 & 170-0004
Cal Date:	09 Jan 2018
Due Date:	09 Jan 2019

Actual Measured Values Found to Be:
WITHIN NOMINAL TOLERANCE

Comments: Air Velocity is not Accredited.
Differential Pressure performed at 20.0° C reference temperature.

Test Points

Description	Nominal	Tolerance -	Tolerance +	As Found	Final	Unit
Air Velocity - Airfoil	50	41	59	52	52	ft/min
	100	90	110	101	101	ft/min
	200	187	213	202	202	ft/min
	500	478	522	508	508	ft/min
	1000	963	1037	1025	1025	ft/min
	2000	1933	2067	2015	2015	ft/min
	4000	3873	4127	4079	4079	ft/min
	5000	4843	5157	5088	5088	ft/min
Temperature	35.0	34.5	35.5	35.30	35.30	°F
	95.0	94.5	95.5	95.20	95.20	°F
	155.0	154.5	155.5	155.20	155.20	°F
Differential Pressure	0.100	0.097	0.103	0.0979	0.0979	inH2O
	0.500	0.489	0.511	0.5049	0.5049	inH2O
	1.000	0.979	1.021	0.990	0.990	inH2O
	5.000	4.899	5.101	4.987	4.987	inH2O
	10.000	9.799	10.201	9.97	9.97	inH2O
	50.000	48.999	51.001	50.11	50.11	inH2O

Standards Used To Calibrate Equipment:

Serial Number	Gage ID	Manufacturer	Model	Last Calibration	Due for Calibration
214	MI-170-013	TSI	8390	01 Aug 2017	01 Feb 2018
69930	MI-130-051	FLUKE	7250LP	10 Dec 2017	10 Dec 2018
970430	MI-120-301	BURNS ENGINEERING	5618B	22 Dec 2017	22 Dec 2018
A61429	MI-120-094	HART SCIENTIFIC	1521	24 Oct 2017	24 Oct 2018

11965 12th Avenue South, Burnsville, MN 55337 • 952-882-1528 • Fax 952-882-4086

Certificate of Calibration

Certificate #: 1889965

Uncertainty in Pressure measurement:

(-14.7 to 300) psi: 65µpsi/psi + 6e-4 in H2O

(300 to 1000) psi: 65 µpsi/psi

(1000 to 10000) psi: 0.12% of reading

Uncertainty in Temperature measurement:

(-200 to -20) °C: 0.0062 °C

(-20 to 120) °C: 0.0017 °C

(120 to 200) °C: 0.023 °C

(200 to 300) °C: 0.023 °C

(300 to 600) °C: 0.024 °C

The above instrument was calibrated by standards traceable to the National Institute of Standards & Technology (NIST) per the guidelines specified in the latest revisions of ANSI/NCSL Z540-1. All measurement uncertainties calculated at a 95% Confidence Level (k=2). The results indicated on this certificate relate only to the items calibrated. This certificate shall not be reproduced, except in full, without the written approval of Martin Calibration. Martin Calibration's responsibility shall in no event, nor for any cause whatsoever, exceed the purchase price of this certificate.

Quality Assurance Representative:

ilac-MRA

ANAB ACCREDITED CALIBRATION LABORATORY AC-1265

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TEC Services, Inc.
25 Little Avenue
New Oxford, PA 17350
Phone: 717-624-3191
Fax: 717-624-3549
www.tecservicesinc.com

Controlled Environment Products
Calibration & Services

EQUIPMENT CALIBRATION REPORT

Date Received:	9/22/17	Date Shipped:	9/26/17
Customer:	Gerbig Engineering	Contact:	Jamie
Address:	1198 E. Cliff RD	Phone #:	612-720-6135
	Burnsville MN 55337	Customer PO #:	Verbal
Manufacturer:	TEC Services	Model #:	PH-4
Instrument Type:	Aerosol Photometer	Serial #:	1518

INSTRUMENT DATA

		As Found	Final	Mfg. Tolerances
Straylight	(N/A)	1.15%	.801%	Not Applicable
Sample Flow	(1)	29.0	29.0	28.3 ± 2.8 SLPM
V1	(1)	5.15	5.15	5.15V +.05V / -.00V
V2	(1)	12.27	12.27	12.0V ± 1V
V3	(1)	-12.07	-12.07	-12.0V ± .5V
V4	(1)	24.12	24.12	24.0V ± .5V
U5	(1)	5.001	5.001	5.000 ± .010V
U12	(1)	5.000	5.000	5.000 ± .010V

(1) In Tolerance (2) Out of Tolerance (3) No effect on instrument operation (N/A) Not Applicable

Received in Tolerance: ☒ **Yes** ☐ **No** ☐ **Not Operable**

☐ **Not Applicable – NEW INSTRUMENT**

Calibrated for: ☒ PAO Temperature: 21.0 ° C Relative Humidity: 37.0 %

MAINTENANCE PERFORMED

☒ Clean / Rebuild Chamber ☒ Realign Optics ☒ Flush Hoses
☒ Check Wiring & Hardware ☐ Replace Gaskets ☐ Update Software Version _____
☐ Not Applicable - NEW INSTRUMENT

Notes: _____

FINAL VERIFICATION PERFORMED

☒ Leak Test Sampling System ☒ Test Scanning Probe ☒ Perform Voltage Check
☒ Verify Max Gain Stability ☒ Performance Test

NIST TRACEABLE EQUIPMENT USED

Description	Model	Serial #	Certificate #	Cal Date	Due Date
Digital Multimeter	Fluke 87-V	89910058	1237019	25 AUG 17	25 AUG 18
Thermohygrometer	Oakton 35700-00	CP69900	1237017	25 AUG 17	25 AUG 18
Flowmeter	DWYER VFB-69-BV	22400	1237016	28 AUG 17	28 AUG 18

Calibrated per Procedure: ☒ TEC001 ☐ TEC002 ☒ TEC003 ☐ TEC004 ☒ TEC005
☐ TEC006 ☒ TEC007 ☒ TEC008 ☒ TEC009 ☐ TEC010

CALIBRATION BY: _____ DATE: 9/26/17 DUE DATE: 9/26/18