



100X Automated Filter Tester

Customer:	NANO FILTER, INC.
Part Number:	100X-SM-SF-S-100-120-S-S-U
Unit Serial Number:	36249
Verification Date:	Monday, February 15, 2021
Unit Type:	Manual
Aerosol:	Salt

Calibration Equipment Used

Description	Serial #	Calibration Date	Calibration Due Date
Digital Multi Meter	16460040	11/12/2020	11/12/2021
Manometer 0-100PSI	00AU91	8/20/2020	8/20/2021
Manometer 0-10PSI	00AU92	8/20/2020	8/20/2021
Pressure Calibrator	1052442	10/29/2020	10/29/2021
Hi Pot Device	26540	4/21/2020	4/21/2021
Humidity/Temperature Meter	180702753	9/23/2020	9/23/2021
Aerosol Electrometer	70824060	10/22/2018	10/22/2023
Digital Scale	6A7604582	11/12/2020	11/12/2021
SMPS			
DMA	3082001816002	4/10/2020	4/10/2022
CPC	3750181501	4/16/2020	4/16/2022

Boards Configuration

Part Number	Description	Serial #	Revision	Software Revision
0800195	Relay Ctrl Brd	KEI00490	A	1.1
0800197	Diff Press Sensor Brd	KEI00720	F	1.2
0800198	Flow Ctrl Brd	KEI00487	A	1.2
0800199	Thermocouple Brd	4620-0001	E	1.3
0800200	LSC Brd	KEI00695	J	1.05
0800201	Level Sensor Brd	4720-0006	C	N/A
0800205	I2C Hub Brd	KEI00339	C	N/A
0800206	Power Control Brd	KEI00717	G	N/A
0800207	Pressure Sensor Brd	4720-0025	C	1.1
0800207	Pressure Sensor Brd	4720-0024	C	1.1
0800208	Misc I/O Brd	KEI00533	E	1.06
40-00800-003	Main Control Brd	4620-0029	B	2.1.B

		Serial #	Calibration Date	Calibration Due
5300162	Mass Flow Controller	231647	2/17/2021	2/17/2022

HiPot Testing

AC Dielectric Test	Pass	
AC Test Result	12.68	mA

Ground Bond Test	Pass	
Ground Bond Resistance	66.5	mΩ

Voltages Checks

		Nominal (VAC)	Tolerance (VAC)
Line Voltage		120	115.0 23.0
		Nominal (VDC)	Tolerance (VDC)
Power Board	TP1 to GND (TP3)	24.0	24.0 1.2
	TP2 to GND (TP3)	24.001	24.00 0.24
	TP4 to GND (TP3)	5.00	5.00 0.05
LSC Board	TP8 to GND (TP13)	15.118	15.00 0.75
	TP11 to GND (TP13)	-14.653	-15.00 0.75

Valve Manifold Setup

Valve Name	Description	Value	Nominal Value	Tolerance	Unit
SV2	Generator Nozzle Air	51.9	51	2	PSI
SV6	Generator Dilution Air	21.3	20	2	PSI
SV8	Vacuum Pump	77.1	70	10	PSI
SV5	Chuck Pressure	34.6	30	10	PSI
SV7	High Pressure Clamp	56	55	2	PSI
SV9	Stack Dilution Air	15.1	14	5	PSI
NV1	Purge Air	100.4	100	5	dB
FM1	Generator Dilution Air	35	35	5	LPM
NV4	Stack Dilution Air	56.1	55	5	LPM

Aerosol Conditioning

	Measured	Nominal	Tolerance	Units
Temperature	20.1	25.0	5.0	°C
Humidity	25.1	30.0	10.0	%RH

Performance Validation

Settings

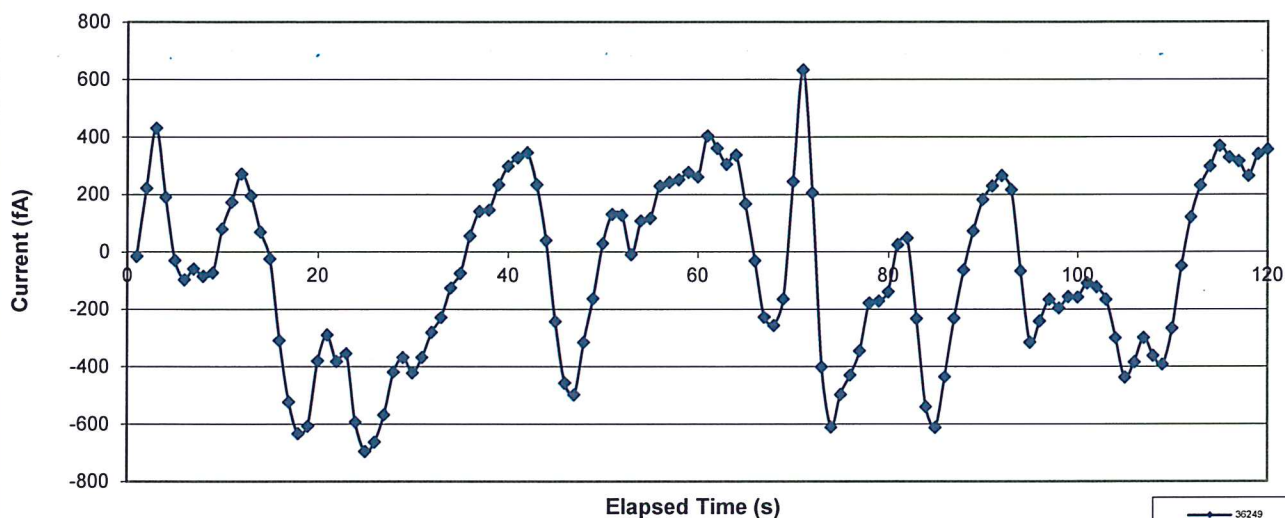
Load Time	8s
Sample Time	2s
Flow Rate	85lpm

# of Filter sheets	Test	Lot Number	% Penetration	Resistance	Flow
2	Test #1	511483	1.2386	52.5	85
	Test #2	511483	1.168	52.6	84.9
	Average		1.2033	52.6	85.0
3	Test #1	511483	0.2294	77.8	85.2
	Test #2	511483	0.2112	78.1	85.2
	Average		0.2203	77.95	85.2
4	Test #1	511483	0.0406	103.4	85.4
	Test #2	511483	0.0363	103.7	84.9
	Average		0.0385	103.55	85.2

Ionizer Balance

	fA	#/cm ³
Mean	-70.64	19788.6
Min	-694.24	625
Max	633.8	52078.4
Std. Dev. (RMS)	301.203	12144.5

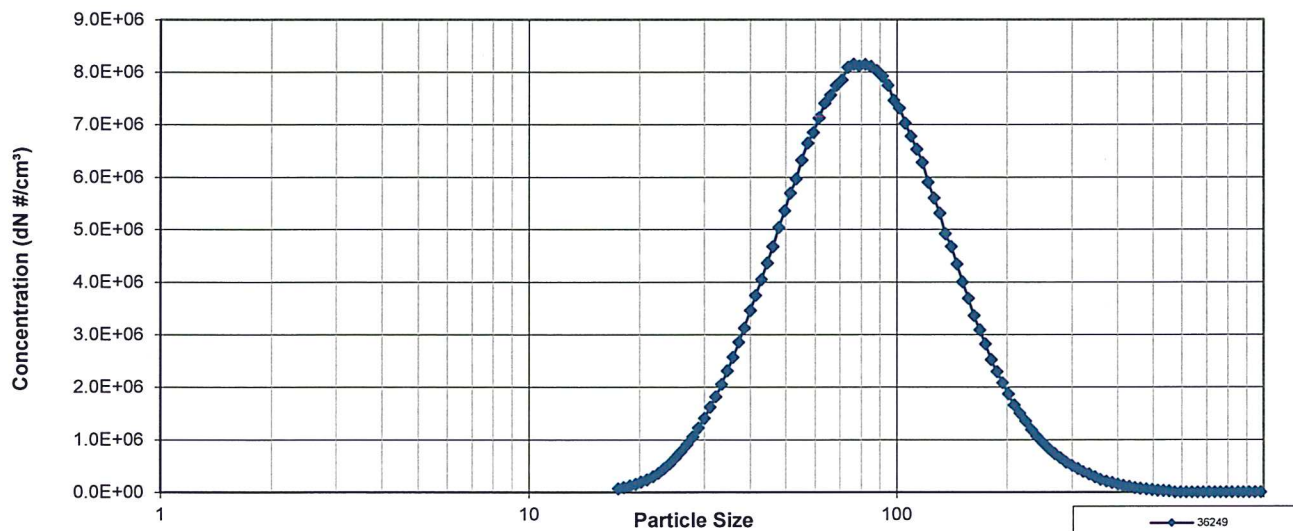
Aerosol Charge Measurement



SMPS Data Summary

	Number Particle Size	Diameter Particle Size	Surface Particle Size	Volume Particle Size	Mass Particle Size
median (nm)	81.1	108.4	147.6	203.1	203.1
mean (nm)	94.5	127.4	172.0	226.3	226.3
geo. mean (nm)	81.8	109.5	148.3	198.6	198.6
mode (nm)	76.4	101.8	140.7	224.7	224.7
geo. st. dev.	1.70	1.73	1.73	1.69	1.69
total conc.	4.70e+06(#/cm ³)	443.8(mm/cm ³)	1.78e+11(nm ² /cm ³)	5.09e+12(nm ³ /cm ³)	1.10e+04(Åμg/m ³)

Particle Size Distribution



System Variables

Salt Variables List

2/17/2021

7:31:29 AM

ATI - 36249

Reagent: Salt

Operating Hours: 5

Software Revision

Console	PCM. 2.1B
DP Sensor	DPB. 1.2
Flow Control Ifc	FCI. 1.2
LSC Interface	LSC. 1.05
Misc I/O	MIO. 1.06
Pressure Sensor 1	APB. 1.1
Pressure Sensor 2	APB. 1.1
Temp Monitor	TMB. 1.3
Valve Control	VCB. 1.1

Pressure Settings

Air Dryer Pressure:	76.7 PSI
Main Air Pressure:	88.5 PSI
Vacuum Pump Pressure:	77.9 PSI
Stack Dilution:	15.5 PSI
Generator Nozzle:	50.3 PSI
Dilution Air:	0.9 PSI
Dilution Flow:	58 lpm

Chuck Differential:	0 mmH2O
Cylinder Clamp:	55.5 PSI
Cylinder Up/Down:	36.8 PSI
Generator Dilution:	21.5 PSI

Flow Settings

Maximum Flow:	120
Measurement Mode:	SLPM

Alarms Settings

Penetration High Limit:	0.0200	Enabled
Penetration Low Limit:	0.0005	Disabled
Resistance High Limit:	25.0	Enabled
Resistance Low Limit:	15.0	Disabled
Flow Tolerance:	2.0	Disabled

Test Setup

Test Flow:	85.0
Load Time:	8.0
Extended Load Time:	8.0
Sample Time:	2.0
Open Time:	1.0
Cycles till Calibration:	1000

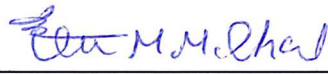
Generator and LSC

Gravimetric Test:	21.9
LSC Offset:	0
LSC Sensitivity:	88
LSC Zero(volts):	0.0116

42CFR Part 84 Aerosol Requirements

	Unit	NIOSH
	36249	42CFR Part 84
Count Median Diameter	81.1	75nm ± 20nm
Standard Geometric Deviation	1.70	≤1.86
Aerosol Temperature	20.1	25±5 °C
Relative Humidity	25.1	30% ± 10%

Approvals

ATI Production	ATI QA or Engineering
	
Print Name Peter Scolaro	Print Name MED CHAL

**AIR TECHNIQUES INTERNATIONAL**

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<http://www.atitest.com>**CALIBRATION AND TEST REPORT
DIFFERENTIAL PRESSURE SENSOR BOARD 0800197**

Report Number	0800197-021621-KEI00720
Procedure	IAT-190-WI
Part Number	0800197
Revision	F
PCBA Serial Number	KEI00720
Firmware Revision	1.2

CALIBRATION EQUIPMENT USED	SERIAL NUMBER	CALIBRATION DATE	CALIBRATION DUE DATE
Digital Multi Meter	16460040	11/12/2020	11/12/2021
Pressure Calibrator	00AU92	8/20/2020	8/20/2021
Digital Manometer	1052442	10/29/2020	10/29/2021

ITEM	AS FOUND ^{*1}	AS LEFT	TOLERANCE
ELECTRICAL CHECK			
TP8 to GND (TP7)	C	2.495	2.500 V ± 0.125 V
Upper Calibration Point	C	100.0	100.0 mmH2O ± 0.5 mmH2O
Verification Point	C	35.1	35.0 mmH2O ± 0.5 mmH2O
Verification Point	C	2.9	3.0 mmH2O ± 0.5 mmH2O
CHANNEL 1			
Upper Calibration Point	C	3.5	3.5 PSI ± 0.1 PSI
Verification Point	C	1.5	1.5 PSI ± 0.1 PSI

^{*1} (A) In Tolerance When Received (B) Out of Tolerance When Received (C) New Instrument, N/A**Condition of Unit as Found**☐ In Tolerance☐ Out of Tolerance☐ Inoperable☒ N/A

The instrument listed on this certification has been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally recognized consensus standards. A test uncertainty ratio of 4:1 was maintained unless otherwise stated. Any number of factors may cause the calibration item to drift out of calibration before the calibration interval has expired. The quality management system of Air Techniques International (ATI) is registered to ISO 9001:2015. The calibration of the above instrument manufactured by ATI was calibrated in compliance with applicable ATI procedures. All results contained within this certification relate only to item calibrated. This certificate shall not be reproduced except in full and with the consent of Air Techniques International.

Temperature: 20.7 RH: 36.6%

Test Technician	Calibration Date	Calibration Due
 PETER SCOLARO	16-Feb-2021	16-Feb-2022

IAT-189-FM Rev A 1/22/19

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<http://www.atitest.com>**CALIBRATION AND TEST REPORT
PRESSURE SENSOR BOARD 0800207**

Report Number	0800207-021621-4720-0025
Calibration Procedure / Rev #	IAT-192-WI / Rev A
Part Number	0800207
Revision	C
PCBA Serial Number	4720-0025
Firmware Revision	1.1

CALIBRATION EQUIPMENT USED	SERIAL NUMBER	CALIBRATION DATE	CALIBRATION DUE DATE
Digital Multi Meter	16460040	12-Nov-2020	12-Nov-2021
Digital Pressure Gauge	00AU91	20-Aug-2020	20-Aug-2021

ITEM	AS FOUND	*1	AS LEFT	ACTUAL	TOLERANCE
ELECTRICAL CHECK					
TP8 to GND (TP7)	C		4.092	4.096 V $\pm$ 0.205 V	
TP17 to GND (TP7)	C		4.092	4.096 V $\pm$ 0.205 V	
CHANNEL 0					
Upper Calibration Point	C		90	90 PSI $\pm$ 1 PSI	
Verification Point	C		50	50 PSI $\pm$ 1 PSI	
CHANNEL 1					
Upper Calibration Point	C		90	90 PSI $\pm$ 1 PSI	
Verification Point	C		50	50 PSI $\pm$ 1 PSI	
CHANNEL 2					
Upper Calibration Point	C		90	90 PSI $\pm$ 1 PSI	
Verification Point	C		50	50 PSI $\pm$ 1 PSI	
CHANNEL 3					
Upper Calibration Point	C		90	90 PSI $\pm$ 1 PSI	
Verification Point	C		50	50 PSI $\pm$ 1 PSI	

*1 (A) In Tolerance When Received (B) Out of Tolerance When Received (C) New Instrument, N/A

Condition of Unit as Found☐ In Tolerance☐ Out of Tolerance☐ Inoperable☒ N/A

The instrument listed on this certification has been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally recognized consensus standards. A test uncertainty ratio of 4:1 was maintained unless otherwise stated. Any number of factors may cause the calibration item to drift out of calibration before the calibration interval has expired. The quality management system of Air Techniques International (ATI) is registered to ISO 9001:2015. The calibration of the above instrument manufactured by ATI was calibrated in compliance with applicable ATI procedures. All results contained within this certification relate only to item calibrated. This certificate shall not be reproduced except in full and with the consent of Air Techniques International.

Temperature: RH:

Test Technician	Calibration Date	Calibration Due
 PETER SCOLARO	16-Feb-2021	16-Feb-2022

IAT-191-FM Rev A 1/22/19

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<http://www.atitest.com>**CALIBRATION AND TEST REPORT
PRESSURE SENSOR BOARD 0800207**

Report Number	0800207-021621-4720-0024
Calibration Procedure / Rev #	IAT-192-W1 / Rev A
Part Number	0800207
Revision	C
PCBA Serial Number	4720-0024
Firmware Revision	1.1

CALIBRATION EQUIPMENT USED	SERIAL NUMBER	CALIBRATION DATE	CALIBRATION DUE DATE
Digital Multi Meter	16460040	12-Nov-2020	12-Nov-2021
Digital Pressure Gauge	00AU91	20-Aug-2020	20-Aug-2021

ITEM	AS FOUND	*1	AS LEFT	ACTUAL	TOLERANCE
ELECTRICAL CHECK					
TP8 to GND (TP7)	C		4.092	4.096 V	± 0.205 V
TP17 to GND (TP7)	C		4.091	4.096 V	± 0.205 V
CHANNEL 0					
Upper Calibration Point	C		90	90 PSI	± 1 PSI
Verification Point	C		50	50 PSI	± 1 PSI
CHANNEL 1					
Upper Calibration Point	C		90	90 PSI	± 1 PSI
Verification Point	C		50	50 PSI	± 1 PSI
CHANNEL 2					
Upper Calibration Point	C		90	90 PSI	± 1 PSI
Verification Point	C		50	50 PSI	± 1 PSI
CHANNEL 3					
Upper Calibration Point	C		90	90 PSI	± 1 PSI
Verification Point	C		50	50 PSI	± 1 PSI

*1 (A) In Tolerance When Received (B) Out of Tolerance When Received (C) New Instrument, N/A

Condition of Unit as Found☐ In Tolerance☐ Out of Tolerance☐ Inoperable☒ N/A

The instrument listed on this certification has been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally recognized consensus standards. A test uncertainty ratio of 4:1 was maintained unless otherwise stated. Any number of factors may cause the calibration item to drift out of calibration before the calibration interval has expired. The quality management system of Air Techniques International (ATI) is registered to ISO 9001:2015. The calibration of the above instrument manufactured by ATI was calibrated in compliance with applicable ATI procedures. All results contained within this certification relate only to item calibrated. This certificate shall not be reproduced except in full and with the consent of Air Techniques International.

Temperature: 20.4 RH: 37%

Test Technician	Calibration Date	Calibration Due
 PETER SCOLARO	16-Feb-2021	16-Feb-2022



7641 N. Business Park Dr., Tucson, AZ 85743 U.S.A., 1.888.290.6060

Certificate of Calibration

Serial No. 231647 - 30-Mar-2020

Device Under Test

Customer:	Hamilton Associates, Inc.	Calibration Procedure/Rev. #:	DOC-AUTOCAL-GASFLOW/Rev. 94
Sales Order Number:	SO358054	Calibrated By:	Benny Lopez
Serial Number:	231647	Calibration Date:	30-Mar-2020
Model Number:	MCR-250SLPM-D	Certification Number:	264892
Customer Part Number:	5300162	Full Scale Pressure:	160.00 PSIA
Software Version:	8v20.0-R23	Pressure Accuracy:	+/-0.5% of Full Scale
P/D/I Values:	95 / 6656 / 0	Temperature Accuracy:	+/-1.5°C
Adder Codes:	5M, 5IN, GAS: Air, RANGE (120 SLPM), P1: 2 PSIG, P2: VAC, STP: 21.1°C & 760 torr, HC, DS	Standard Temp. & Pressure:	21.10°C, 14.69595 PSIA
		Normal Temp. & Pressure:	0.00°C, 14.69595 PSIA
		Calibration due 1 yr. after receipt:	17 Feb 2021
Process Gas:	Selectable		Pete Swolan
Calibration Gas:	Air		
Range:	120.00 SLPM		
Gas Temperature:	27.44°C		
Ambient Humidity:	28.12%		

Equipment Used

Flow:	TOOL-MOLBOX3	Voltage:	TOOL-CMTR43	Pressure:	TOOL-PRESSURE21-
Tool Due Date:	04-Nov-2021	Tool Due Date:	11-Nov-2020		145PSIG
Manufacturer/Model:	DH Instruments / Molbox1-A	Manufacturer/Model:	Fluke / 87 V	Tool Due Date:	11-Dec-2020
Device Uncertainty:	NA \ Determined by Molbloc	Device Uncertainty:	+/- (0.1% + 1 digit)	Manufacturer/Model:	Alicat / P-100PSIG-D
		Temperature:	TOOL-TEMP15	Device Uncertainty:	0.1% of Reading of full scale
Flow:	TOOL-MOLBLOC6	Tool Due Date:	13-Nov-2020		
Tool Due Date:	05-Dec-2020	Manufacturer/Model:	ASL / F200-A-2+Probe		
Manufacturer/Model:	DH Instruments / 2E3-S	Device Uncertainty:	+/- 0.02°C		
Device Uncertainty:	+/- 0.2% of reading				

All test equipment used for calibration is NIST traceable.

Calibration

Uncertainty: +/- (0.4% of Reading + 0.2% of Full Scale)
Units of measure: SLPM

Calibration Pressure: Inlet: 2 PSIG
Outlet: VAC

Output 1 Configuration
mini-DIN Pin #6

Output 2 Configuration
mini-DIN Pin #2

D.U.T.	Actual	In Tolerance	Output 1	Output 2
0.00	0.00	Yes	0.000 Vdc	5.12 Vdc
29.98	29.98	Yes	1.249 Vdc	5.12 Vdc
60.00	60.00	Yes	2.500 Vdc	5.12 Vdc
90.06	90.06	Yes	3.750 Vdc	5.12 Vdc
120.00	120.06	Yes	5.00 Vdc	5.12 Vdc

Notes: 0-5V set-point.

Calibrated By:
QC Signature:

Benny Lopez

3/30/2020 12:59:00 PM

Alicat Scientific, Inc. is an ISO 9001 certified company.

CS1 Rev 17 Last Modified 15-May-2017

