



Controlled Environment Management

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UNIVERSITY OF ARIZONA

Micro/Nano Fabrication Center Cleanroom Testing Tour

CEM Project: UAZ121127

November 2012



Jeff Raposa – NEBB CPT Professional

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University of Arizona - Bay 1

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

PARTICLE COUNT TEST RESULTS

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean =	3.00 ft ³	105.95 m ³
Sampling Mode	Static (At-Rest)	
Sample Size	≥ 0.3 μm	
Sample Volume	1.0 ft ³	28.3 liters
Sample Rate	1.0 cfm	28.3 lpm
Class Limit	300 ft ³	10200 m ³
Area Meets Class 5	Pass	

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5
Sample 1	26	9	1	0	1
Sample 2	6	21	0	0	6
Average	0	15	1	0	4

PC Location	PC6	PC7	PC8	PC9	PC10
Sample 1	2	4	2	0	3
Sample 2	3	2	1	0	10
Average	0	3	2	0	7

Temperature = 73° F
 Relative Humidity = 25%
 PC = Particle Count Sample Location

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSl	8386	2050182	September-13

Comments: _____
 (1) Temperature and Relative Humidity measured in center of room.
 (2) Statistical calculations not required for > 9 sample locations.

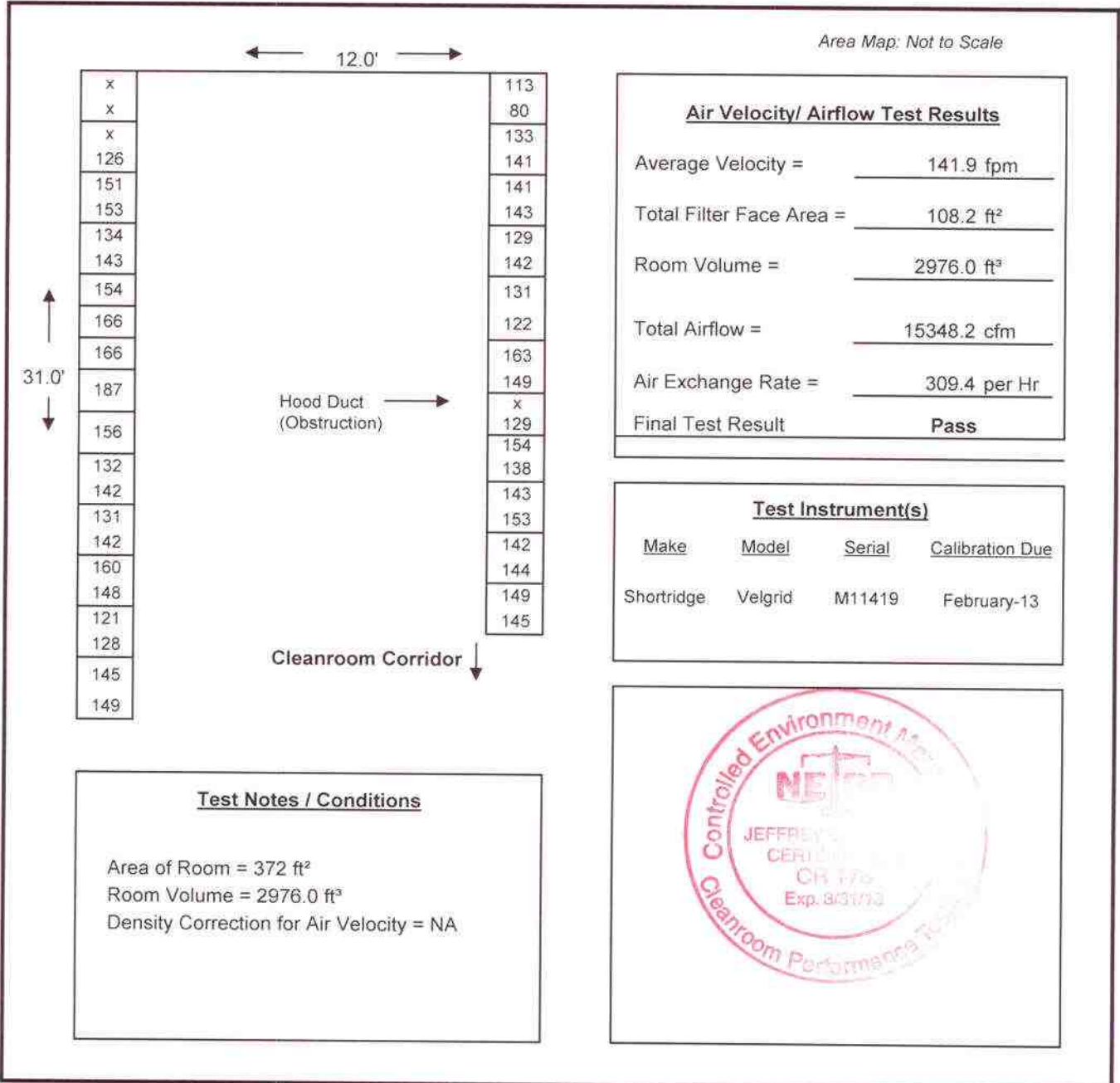


University of Arizona - Bay 1

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

AIR VELOCITY / AIRFLOW TEST RESULTS



Comments:

- (1) Area for Filters = Left Side: 56.83 ft² (31.0' x 22"), Right Side: 51.33 ft² (28.0' x 22").
- (2) Shortridge Velgrid used to measure air velocities. No density correction factor applied to readings.
- (3) x represents a fume hood blocking access to the HEPA filters.



University of Arizona - Bay 2

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

PARTICLE COUNT TEST RESULTS

← 12.0' →

↑ 26.5' ↓

← Cleanroom Corridor →

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean =	16.70 ft ³	589.76 m ³
Sampling Mode	Static (At-Rest)	
Sample Size	≥ 0.3 μm	
Sample Volume	1.0 ft ³	28.3 liters
Sample Rate	1.0 cfm	28.3 lpm
Class Limit	300 ft ³	10200 m ³
Area Meets Class 5	Pass	

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5
Sample 1	0	30	3	35	13
Sample 2	1	23	0	19	15
Average	0	27	2	27	14

PC Location	PC6	PC7	PC8	PC9	PC10
Sample 1	13	7	5	59	44
Sample 2	11	0	4	49	28
Average	0	4	5	54	36

Temperature = 73° F
 Relative Humidity = 25%
 PC = Particle Count Sample Location

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

Comments: _____
 (1) Temperature and Relative Humidity measured in center of room.
 (2) Statistical calculations not required for > 9 sample locations.

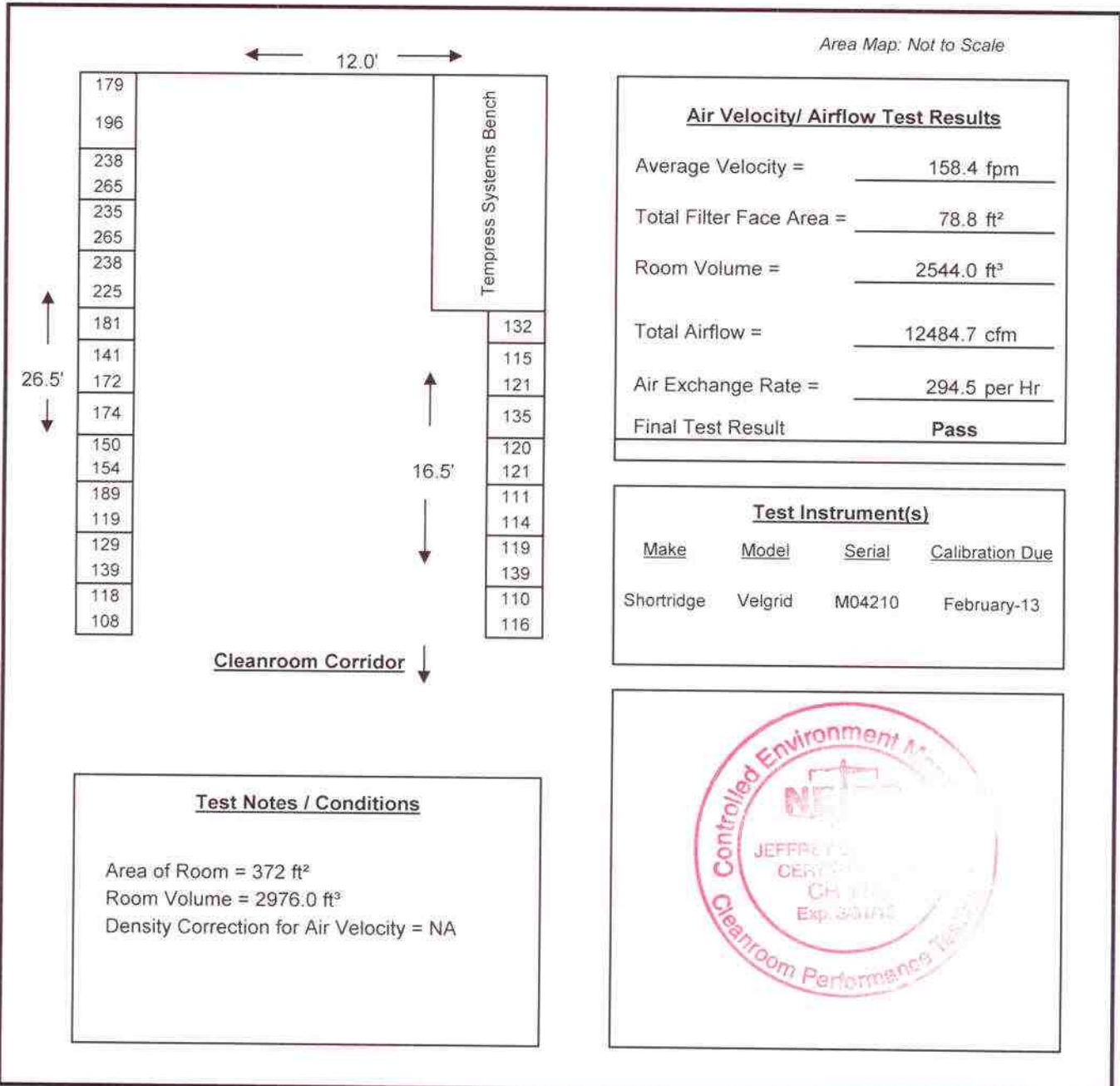


University of Arizona - Bay 2

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 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

AIR VELOCITY / AIRFLOW TEST RESULTS



Comments:

(1) Area for Filters = Left Side: 48.58 ft² (26.5' x 22"), Right Side: 30.25 ft² (16.5' x 22").

(2) Shortridge Velgrid used to measure air velocities. No density correction factor applied to readings.



University of Arizona - Bay 3

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/27/12

PARTICLE COUNT TEST RESULTS

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean = 0.03 ft³ 1.18 m³

Sampling Mode Static (At-Rest)

Sample Size ≥ 0.3 μm

Sample Volume 1.0 ft³ 28.3 liters

Sample Rate 1.0 cfm 28.3 lpm

Class Limit 300 ft³ 10200 m³

Area Meets Class 5 Pass

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Sample 1	0	0	0	0	0	0	0
Sample 2	0	0	0	0	0	1	0
Average	0.0	0.0	0.0	0.0	0.0	0.5	0.0

	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15
	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0
	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

PC = Particle Count Sample Location
 Temperature = 70° F
 Relative Humidity = 20%

Comments:

(1) Temperature and Relative Humidity measured in center of room.

(2) Statistical calculations not required for > 9 sample locations.

(3) Particle counter sampling probe staged around equipment in area.



University of Arizona - Bay 3

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

AIR VELOCITY / AIRFLOW TEST RESULTS

← 12' →				
A	B	A	B	A
106	104	101	120	118
112	116	105	110	108
118	112	116	101	121
114	116	115	115	122
C	D	C	D	C
113	101	89	97	85
80	96	99	100	82
80	94	98	104	83
A	B	A	B	A
116	108	116	104	115
110	96	106	111	111
124	116	107	97	112
104	95	109	95	96
C	D	C	D	C
96	143	128	144	145
121	132	145	125	121
135	131	128	122	112
A	B	A	B	A
151	135	122	118	117
145	127	111	128	125
153	113	124	125	122
127	124	115	132	120

Area Map: Not to Scale

Air Velocity/ Airflow Test Results

Average Velocity = 114.0 fpm

Total Area = 324.0 ft²

Room Volume = 2647.1 ft³


Total Airflow = 36939.6 cfm

Air Exchange Rate = 837.3 per Hr

Final Test Result Pass

Test Instrument(s)

Make	Model	Serial	Calibration Due
Shortridge	Velgrid	M04210	February-13



← Cleanroom Corridor →

Comments

(1) Velocities measured with Shortridge Velgrid.

(2) Room has 25 quantity HEPA filters.

(A) Filter Area = 22.5"x70.5" (11.02 ft²)
 (B) Filter Area = 28.5"x70.5" (13.95 ft²)
 (C) Filter Area = 22.5"x46.5" (7.27 ft²)
 (D) Filter Area = 28.5"x46.5" (9.20 ft²)



University of Arizona - Bay 4A

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127

Technician(s): Chris Calendo

Date(s): 11/27/12

PARTICLE COUNT TEST RESULTS

ISO 14644 Test Results

Sample Mean =	0.00 ft ³ 0.00 m ³
Sampling Mode	Static (At-Rest)
Sample Size	≥ 0.3 μm
Sample Volume	1.0 ft ³ 28.3 liters
Sample Rate	1.0 cfm 28.3 lpm
Class Limit	300 ft ³ 10200 m ³
Area Meets Class 5	Pass

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5	PC6
Sample 1	0	0	0	0	0	0
Sample 2	0	0	0	0	0	0
Average	0	0	0	0	0	0

PC Location	PC7	PC8	PC9	PC10	PC11	PC12
Sample 1	0	0	0	0	0	0
Sample 2	0	0	0	0	0	0
Average	0	0	0	0	0	0

PC = Particle Count Sample Location
 Area of Room = 201 ft²
 Room Volume = 1674.3 ft³

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

PC = Particle Count Sample Location
 Temperature = 72° F
 Relative Humidity = 19%

Controlled Environment Metrics

Comments:

- (1) Temperature and Relative Humidity measured in center of room.
- (2) Statistical calculations not required for > 9 sample locations.
- (3) Particle counter sampling probe staged around equipment in area.



University of Arizona - Bay 4A

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 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): James Rawls
 Date(s): 11/27/12

AIR VELOCITY / AIRFLOW TEST RESULTS

← 12.0' →

99	117	106	92	101
108	115	106	99	96
110	110	107	101	100
101	99	106	109	117
111	149	120	118	128
117	108	121	105	128
99	98	123	102	103
106	126	121	107	107
114	133	112	95	110
119	117	117	107	95
109	107	110	105	102

Cleanroom Corridor

↑ 16.75' ↓

Area Map: Not to Scale

Air Velocity/ Airflow Test Results

Average Velocity = 110.0 fpm

Total Area = 201.0 ft²

Room Volume = 1674.3 ft³

Total Airflow = 22102.7 cfm

Air Exchange Rate = 792.1 per Hr

Final Test Result Pass


Test Instrument(s)

Make	Model	Serial	Calibration Due
Shortridge	Velgrid	M04210	February-13

(A) Filter Area = 22.5"x70.5" (11.02 ft²)
 (B) Filter Area = 28.5"x70.5" (13.95 ft²)
 (C) Filter Area = 22.5"x46.5" (7.27 ft²)
 (D) Filter Area = 28.5"x46.5" (9.20 ft²)

A	B	A	B	A
D	C	D	C	D
A	B	A	B	A

Filter Grid



Comments:

(1) Air velocities measured with Shortridge Velgrid device.

(2) Ceiling equipped with 4 different sizes of HEPA filters as listed above as A,B,C and D.



University of Arizona - Bay 4B

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/27/12

PARTICLE COUNT TEST RESULTS

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean =	0.17 ft ³ 5.89 m ³
Sampling Mode	Static (At-Rest)
Sample Size	≥ 0.3 μm
Sample Volume	1.0 ft ³ 28.3 liters
Sample Rate	1.0 cfm 28.3 lpm
Class Limit	300 ft ³ 10200 m ³
Area Meets Class 5	Pass

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5	PC6
Sample 1	0	0	4	0	0	0
Sample 2	0	0	0	0	0	0
Average	0	0	2	0	0	0

PC Location	PC7	PC8	PC9	PC10	PC11	PC12
Sample 1	0	0	0	0	0	0
Sample 2	0	0	0	0	0	0
Average	0	0	0	0	0	0

PC = Particle Count Sample Location
 Area of Room = 143 ft²
 Room Volume = 1156.0 ft³

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

PC = Particle Count Sample Location
 Temperature = 72° F
 Relative Humidity = 19%

Comments: _____
 (1) Temperature and Relative Humidity measured in center of room.
 (2) Statistical calculations not required for > 9 sample locations.
 (3) Particle counter sampling probe staged around equipment in area.

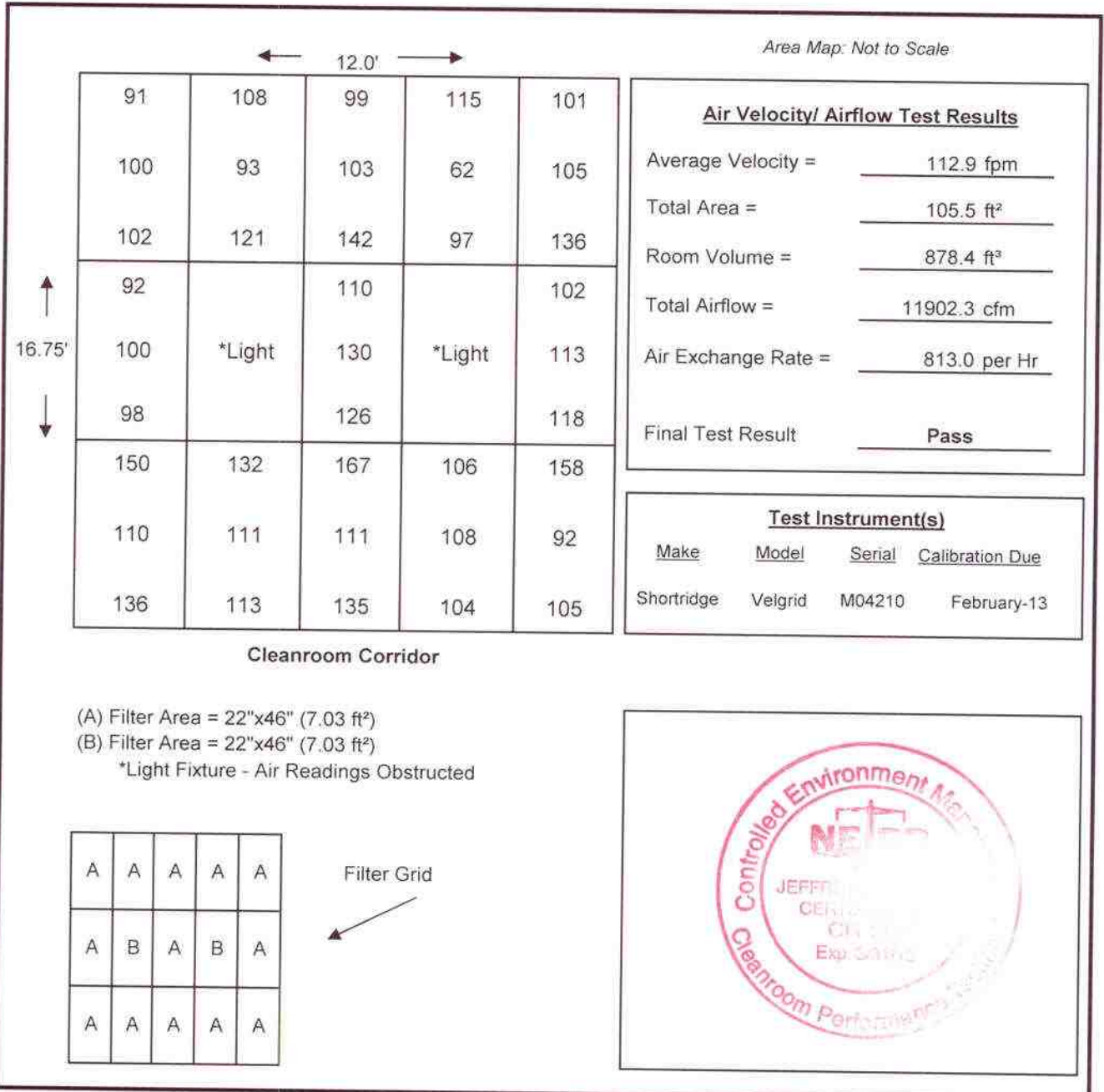


University of Arizona - Bay 4B

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): James Rawls
 Date(s): 11/27/12

AIR VELOCITY / AIRFLOW TEST RESULTS



Comments:

(1) Air velocities measured with Shortridge Velgrid device.

(2) Ceiling equipped with 2 different sizes of HEPA filters as listed above as A and B.



University of Arizona - Bay 5

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

PARTICLE COUNT TEST RESULTS

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean =	0.07 ft ³	2.35 m ³
Sampling Mode	Static (At-Rest)	
Sample Size	≥ 0.3 μm	
Sample Volume	1.0 ft ³	28.3 liters
Sample Rate	1.0 cfm	28.3 lpm
Class Limit	300 ft ³	10200 m ³
Area Meets Class 5	Pass	

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Sample 1	0	0	0	1	0	0	0
Sample 2	0	0	0	0	0	0	0
Average	0.0	0.0	0.0	0.5	0.0	0.0	0.0

	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15
	0	0	0	0	0	0	0	0
	1	0	0	0	0	0	0	0
Average	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

PC = Particle Count Sample Location
 Temperature = 73° F
 Relative Humidity = 22%

Comments:

(1) Temperature and Relative Humidity measured in center of room.

(2) Statistical calculations not required for > 9 sample locations.

(3) Particle counter sampling probe staged around equipment in area.



University of Arizona - Bay 5

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): James Rawls
 Date(s): 11/27/12

AIR VELOCITY / AIRFLOW TEST RESULTS

← 12' →

Area Map: Not to Scale

	A	B	A	B	A
	92	101	86	101	100
	89	129	90	95	101
	86	105	97	105	92
	84	93	90	108	88
	C	D	C	D	C
	86	90	111	93	103
	95	83	110	116	121
	84	83	110	107	112
↑ 27' ↓	A	B	A	B	A
	125	120	120	107	122
	125	113	123	113	120
	123	129	123	113	118
	120	115	100	110	120
	C	D	C	D	C
	101	98	95	118	95
	92	92	95	106	90
	99	101	85	96	99
	A	B	A	B	A
	111	121	110	115	99
	118	125	112	125	100
	115	109	107	109	97
	113	120	107	115	93

← Cleanroom Corridor →

<u>Air Velocity/ Airflow Test Results</u>	
Average Velocity =	<u>105.3 fpm</u>
Total Area =	<u>324.0 ft²</u>
Room Volume =	<u>2647.1 ft³</u>
Total Airflow =	<u>34120.8 cfm</u>
Air Exchange Rate =	<u>773.4 per Hr</u>
Final Test Result	<u>Pass</u>

<u>Test Instrument(s)</u>			
<u>Make</u>	<u>Model</u>	<u>Serial</u>	<u>Calibration Due</u>
Shortridge	Velgrid	M04210	February-13

Comments

(1) Velocities measured with Shortridge Velgrid.

(2) Room has 25 quantity HEPA filters.

(A) Filter Area = 22.5"x70.5" (11.02 ft²)
 (B) Filter Area = 28.5"x70.5" (13.95 ft²)
 (C) Filter Area = 22.5"x46.5" (7.27 ft²)
 (D) Filter Area = 28.5"x46.5" (9.20 ft²)

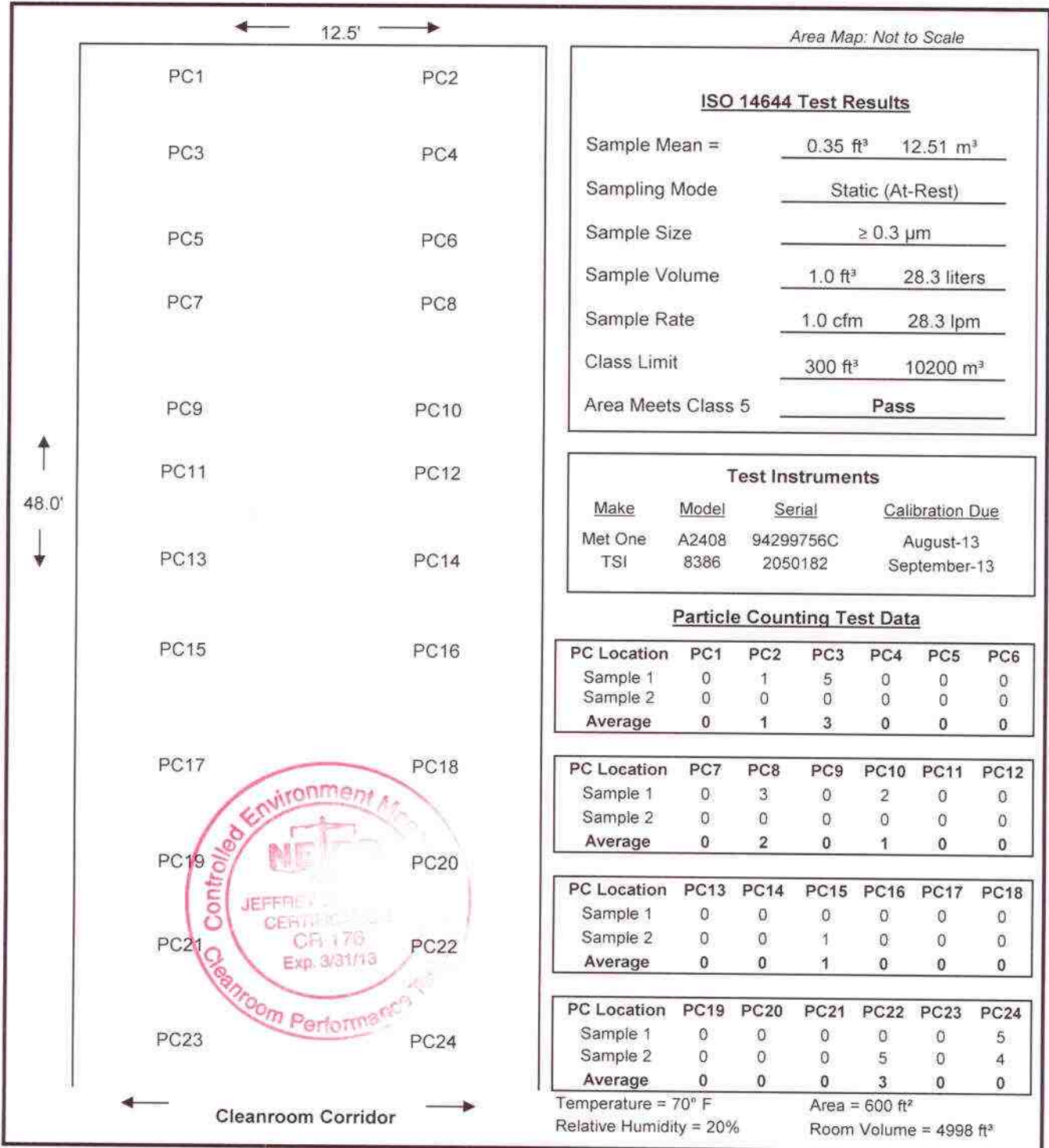


University of Arizona - Bay 6

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/27/12

PARTICLE COUNT TEST RESULTS



CEM - UAZ Nano Fab CER Bay 6 PC DCF

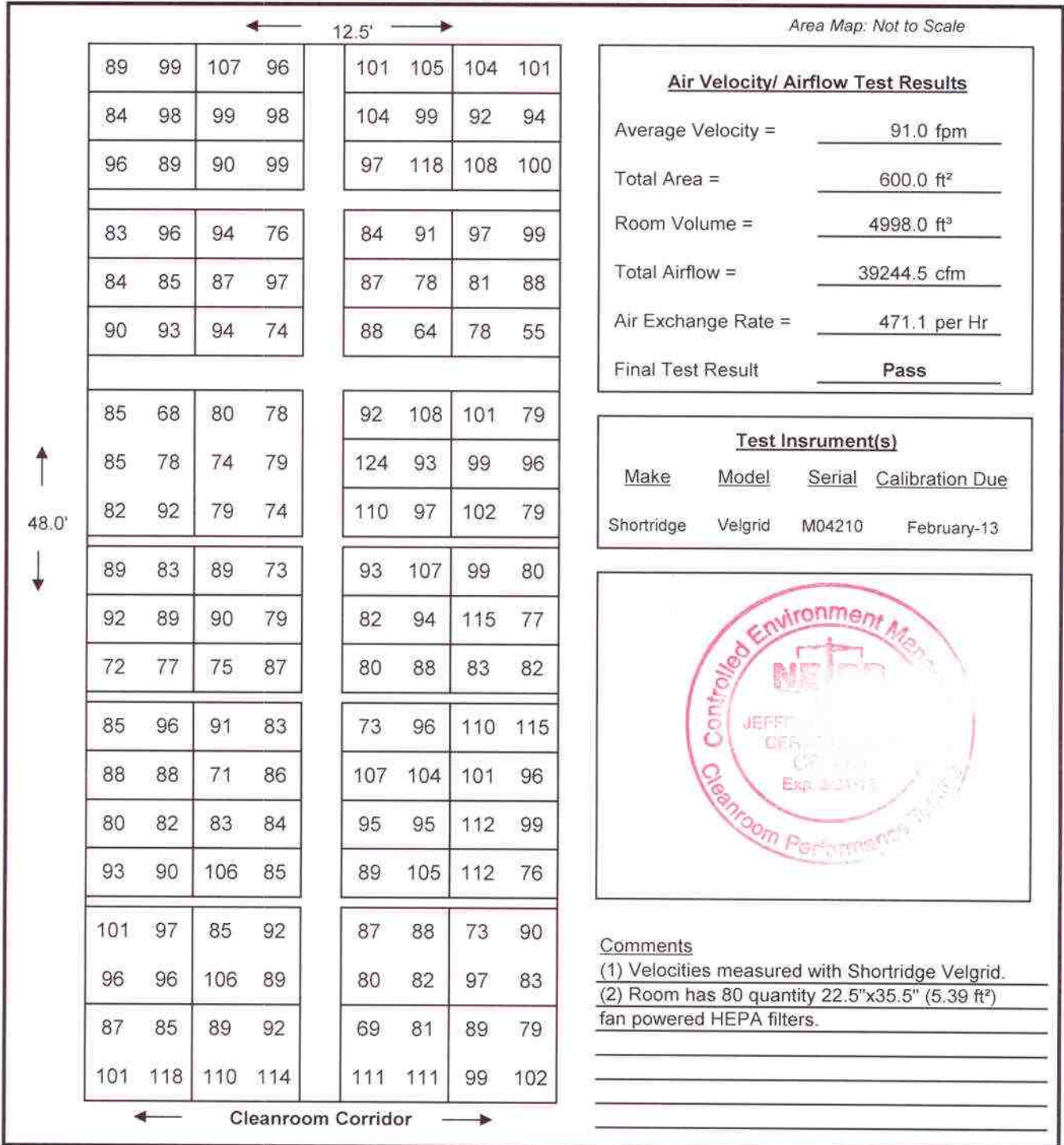


University of Arizona - Bay 6

Micro/Nano Fabrication Center
College of Engineering
Tucson, AZ 85721

Project ID: UAZ121127
Technician(s): Chris Calendo / James Rawls
Date(s): 11/27/12, 11/28/12

AIR VELOCITY / AIRFLOW TEST RESULTS



University of Arizona - Bay 7

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 12/03/12

PARTICLE COUNT TEST RESULTS

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean =	0.23 ft ³ 8.24 m ³
Sampling Mode	Static (At-Rest)
Sample Size	≥ 0.3 μm
Sample Volume	2.0 ft ³ 56.6 liters
Sample Rate	1.0 cfm 28.3 lpm
Class Limit	30 ft ³ 1020 m ³
Area Meets Class 4	Pass

Particle Counting Test Data

PC Location	PC1	PC2	PC3	PC4	PC5	PC6	PC7
Sample 1	2	0	0	0	0	0	0
Sample 2	0	0	0	0	1	0	0
Average	0.0	0.0	0.0	0.0	0.5	0.0	0.0

	PC8	PC9	PC10	PC11	PC12	PC13	PC14	PC15
	0	0	4	0	0	0	0	4
	0	0	0	0	0	0	2	0
	0.0	0.0	0.0	0.0	0.0	0.0	1.0	2.0

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

PC = Particle Count Sample Location
 Temperature = 72° F
 Relative Humidity = 22%

Comments:

- (1) Temperature and Relative Humidity measured in center of room.
- (2) Statistical calculations not required for > 9 sample locations.
- (3) Particle counter sampling probe staged around equipment in area.



University of Arizona - Bay 7

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 12/03/12

AIR VELOCITY / AIRFLOW TEST RESULTS

↑ 24' ↓	← 12' →					
	125	106	129	134	118	133 149
	137	141	134	128	111	118 119
	131	122	126	112	101	113 118
	158	107	129	112	101	113 118
	85	91	87	124	137	116 127
	83	87	77	124	137	116 127
	80	61	79	165	127	124 117
	80	62	72	137	114	118 137
	119	134	118	129	103	152 113
	126	117	125	129	103	152 113
	118	124	125	132	132	119 132
	132	115	133	139	124	149 118
	121	143	140	130	124	115 123
	108	130	134	130	124	115 123
	120	95	120	111	121	127 122
108	102	112	126	147	141 162	
Entrance Door						
Gowning Room / Ante Area						

Air Velocity/ Airflow Test Results

Average Velocity = 119.8 fpm

Total Area = 288.0 ft²

Room Volume = 2016.0 ft³

Total Airflow = 34488.0 cfm

Air Exchange Rate = 1026.4 per Hr

Final Test Result Pass

Test Instrument(s)

Make	Model	Serial	Calibration Due
Shortridge	Velgrid	M04210	February-13

Comments

(1) Velocities measured with Shortridge Velgrid.

(2) Room has 24 quantity HEPA filters.

Area Map: Not to Scale



University of Arizona - Bay 8

Micro/Nano Fabrication Center
 College of Engineering
 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 12/03/12

PARTICLE COUNT TEST RESULTS

Area Map: Not to Scale

ISO 14644 Test Results

Sample Mean =	0.83 ft ³	29.43 m ³
Standard Deviation	2.04 ft ³	72.09 m ³
95% UCL	2.50 ft³	88.29 m³
Sampling Mode	Static (At-Rest)	
Sample Size	≥ 0.3 μm	
Sample Volume	1.0 ft ³	28.3 liters
Sample Rate	1.0 cfm	28.3 lpm
Class Limit	300 ft ³	10200 m ³
Area Meets Class 5	Pass	

PC Location	PC1	PC2	PC3	PC4	PC5	PC6
Sample 1	0	0	0	0	0	10
Sample 2	0	0	0	0	0	0
Average	0	0	0	0	0	5

Test Instrument(s)

Make	Model	Serial	Calibration Due
Met One	A2408	94299756C	August-13
TSI	8386	2050182	September-13

PC = Particle Count Sample Location
 Area of Room = 81 ft²
 Room Volume = 646 ft³

Temperature = 70° F
 Relative Humidity = 27%

Comments: _____
 (1) Temperature and Relative Humidity measured in center of room.



University of Arizona - Bay 8

Micro/Nano Fabrication Center
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 Tucson, AZ 85721

Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 12/03/12

AIR VELOCITY / AIRFLOW TEST RESULTS

← 9.5' →

↑ 8.5' ↓

Area Map: Not to Scale

Air Velocity/ Airflow Test Results

Average Velocity =	95.7 fpm
Total Area =	42.2 ft ²
Room Volume =	646.0 ft ³
Total Airflow =	4037.6 cfm
Air Exchange Rate =	375.0 per Hr
Final Test Result	Pass

Test Instrument(s)

<u>Make</u>	<u>Model</u>	<u>Serial</u>	<u>Calibration Due</u>
Shortridge	Velgrid	M04210	February-13

Comments:

- (1) Air velocities measured with Shortridge Velgrid device.
- (2) Ceiling equipped with 6 HEPA filters as represented in diagram.

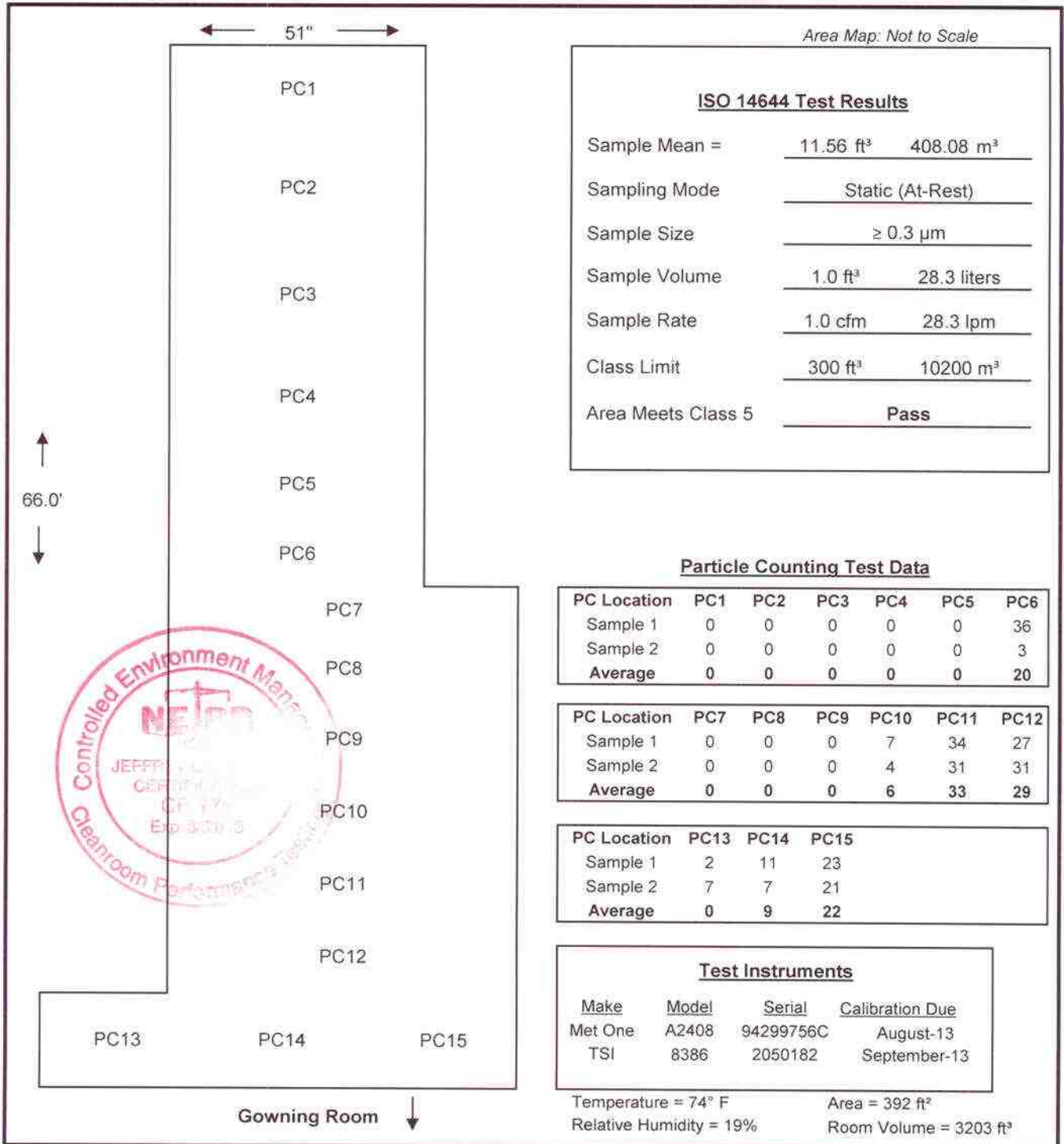


University of Arizona - Corridor

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Project ID: UAZ121127
 Technician(s): Chris Calendo, James Rawls
 Date(s): 11/27/12

PARTICLE COUNT TEST RESULTS

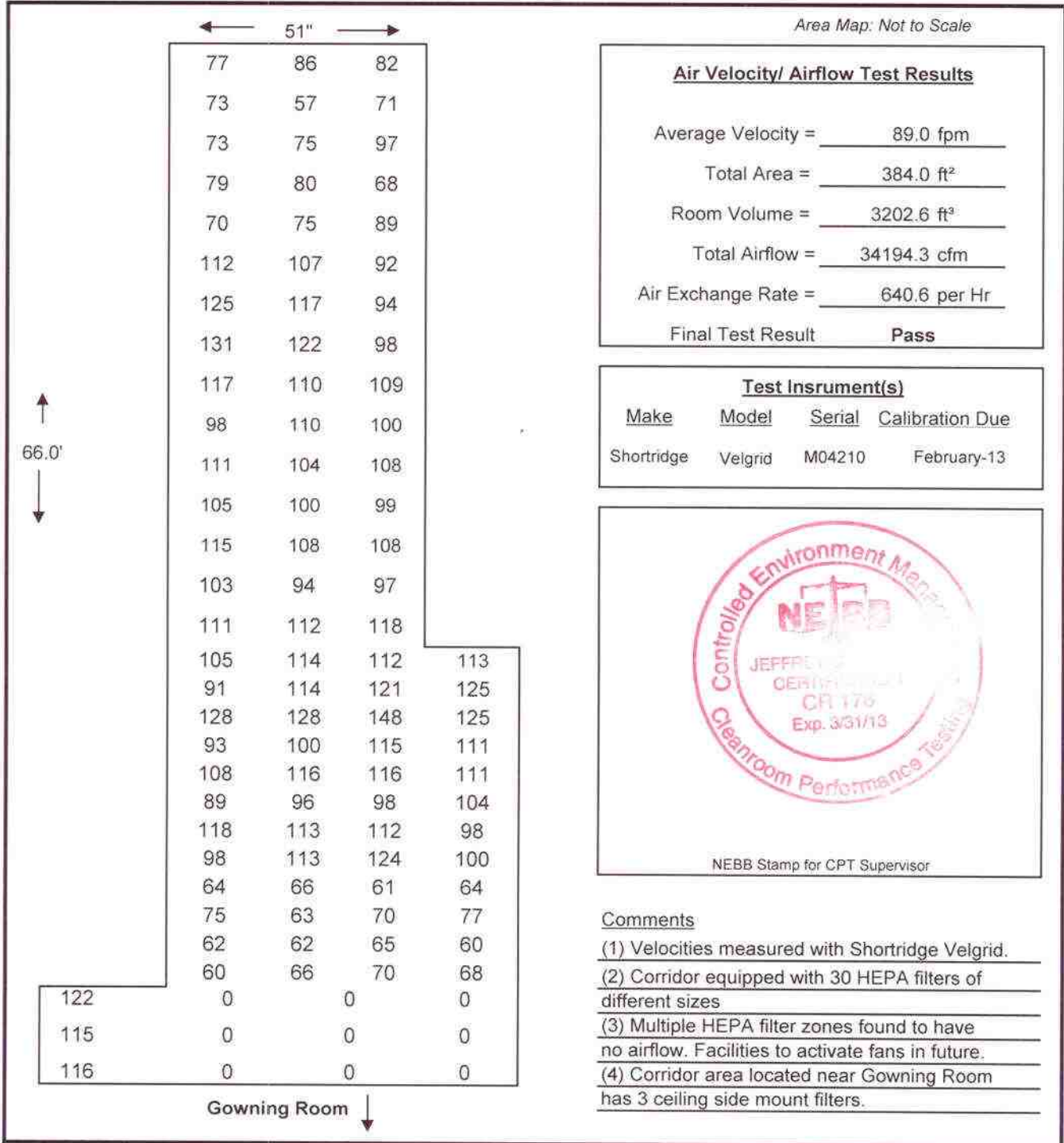


University of Arizona - Corridor

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Project ID: UAZ121127
 Technician(s): Chris Calendo
 Date(s): 11/28/12

AIR VELOCITY / AIRFLOW TEST RESULTS



PARTICLE SERVICE, INC.

P.O. Box 1647
Campbell, CA 95009

Telephone: 408-378-0100
Toll Free: 888-378-4858
www.particleservice.com

CERTIFICATE OF CALIBRATION

Number 7880A

Calibration Date 14 Aug 2012

Recalibration Date 31 Aug 2013

Calibration Interval 12 Months

COPY

Company Controlled Environment Management

Location

Unit Received In Tolerance

Unit Returned In Tolerance

Manufacturer	Met One	Asset #	N/A
Model #	A2408	Cal #	N/A
Serial #	94299756C	I.D. #	N/A

Particle Service, Inc. certifies that the above listed instrument meets or exceeds all published specifications and has been calibrated using standards and instruments whose accuracy is traceable to the National Institute of Standards and Technology (NIST). The procedures of Particle Service, Inc. comply with ISO 17025 and ANSI Z540. Supporting documentation relative to traceability is available for review by appointment. This document shall not be reproduced, except in full, without the written approval of Particle Service, Inc.

Standards

Standard ID	Type	Description	Expiration Date	Test Methodology
0127	Oscilloscope	TDS3012B	3/31/2013	ISO 21501-4 IEST-RP-CC014.2 Factory Procedure Flow test uncertainty ratio - 2.5:1 Size test uncertainty - 7.8 % TUR 4:1 (where applicable) Reference particle traceability NIST SRM - 1690, 1691, 1692, 1960, 1961, 1963
0142	Digital Multimeter	34401A	10/31/2012	
0139	Temperature / RH	M170 / HMP75	4/30/2013	
0120	Pulse Analyser	MCA-8000A	12/31/2012	
0141	Flowmeter	4043	9/30/2012	
0121	Flowmeter	4043	9/30/2012	
0152	Stowatch	V 1 03	4/30/2014	
0126	Barometric Pressure	DPI 740	4/30/2014	
2023	Particle Size Standard	296 nm ± 6 nm	5/31/2014	
2024	Particle Size Standard	498 nm ± 9 nm	5/31/2014	
2021	Particle Size Standard	1034 nm ± 15 nm	10/31/2013	
2018	Particle Size Standard	5003 nm ± 40 nm	2/28/2013	

Test Results

Parameter	Tolerance	Units	Received	Returned	Delta %	Comments
Flow Rate	28.3 ± 5.0 %	slpm	28.3	28.3	0.0%	obsolete system - advise phase out unit detecting but not resolving 0.3um particles optimize - channel # 2
Time Base	60.00 ± 1.0 %	sec	60.03	60.03	0.0%	
Sensor Noise	< Channel 1	mV peak	16.4	16.4	0.0%	
Reference Voltage	N/A	Vdc	1.02	1.02	0.0%	
Laser Current	Reference Value	mVdc	133.5	133.5	0.0%	
False Count Rate	< 5 / 10 min	counts	0	0	0.0%	
300 nm	± 10.0 %	mVdc	21.1	21.1	0.0%	
500 nm	± 10.0 %	mVdc	43.2	39.8	8.5%	
1000 nm	± 10.0 %	mVdc	15	15	0.0%	
5000 nm	± 10.0 %	mVdc	1835.1	1835.1	0.0%	

Environmental Conditions

Temperature 22.4 °C - Acceptable range 12 - 29 °C
Relative Humidity 41.8 % - Acceptable range 10 - 75 %
Barometric Pressure 100.34 kPa - Acceptable range 96.0 - 106.0 kPa

Affirmation

The undersigned certifies that the information contained in this document is true and correct.

Engineer

Bradley Bini
Bradley Bini

AIRDATA FLOWMETER CERTIFICATE OF RECALIBRATION

Customer ID: 016123

S/N: M04210

Customer: CONTROLLED ENVIRONMENT MANAGEMENT

City: GILBERT

State: AZ

As-Received Model #: ADM-860C

Converted to Model #: _____

Order #: R122482

COPY

This instrument has been calibrated using Calibration Standards which are traceable to NIST (National Institute of Standards and Technology). Quality Assurance Program and calibration procedures meet the requirements for ANSI/NC SL Z540-1-1994, ISO 17025, MIL-STD 45662A and manufacturers specifications.

Calibration accuracy is certified when meters are used with properly functioning accessories only. Test Accuracy Ratio is 2:1 for air flow calibration. All specified uncertainties are expressed in expanded terms (twice the calculated uncertainty).

This report shall not be reproduced, except in full, without the written approval of Shortridge Instruments, Inc. Results relate only to the item calibrated.

Procedure used for air flow: Procedure for Recalibration of AirData Multimeters on a FlowHood SIP-CP06 Revision: 12 Dated: 06/20/05

Limitations on use: See Shortridge Instruments, Inc. Instruction Manuals for the use of AirData Multimeters and FlowMeters

AIR FLOW TEST (cfm)
TEST METER TOLERANCE: $\pm 3.0\%$ of reading ± 7 cfm

Calibration Equipment: FlowHood Stand Calibration Transfer Standard AirData Multimeter Model ADM-870, Serial Number M99083 or M98543 and FlowHood Calibration Stand S/N 7401 calibrated as a system. Manufactured by Shortridge Instruments, Inc. System Calibration Date: 06/22/12-06/27/12 System Calibration Due Date: 06/2013

Rated accuracy of system is $\pm 1.5\%$ of reading ± 3.5 cfm. Resolution: 0.1 Uncertainty of system is as stated at each Set Point.

All readings are compensated for the density effects of barometric pressure and temperature.

AS-RECEIVED TEST CONDITIONS

Transfer Standard: M99083 M98543 _____
Relative Humidity: _____ 52 %
Ambient Temperature: _____ 74 °F
Barometric Pressure: _____ 28.44 in Hg

Calibrated By: R. Cichanowicz
Calibration Date: 08/02/2012

Within Spec: Yes No NA See Notes

FINAL TEST CONDITIONS

Transfer Standard: M99083 _____ M98543
Relative Humidity: _____ 51 %
Ambient Temperature: _____ 74 °F
Barometric Pressure: _____ 28.38 in Hg

Calibrated By: R. Cichanowicz
Calibration Date: 08/08/2012

Flow Testing performed using: Customer's FlowHood

Shortridge Instruments, Inc. In-House FlowHood

Calibration Approved by: A. Hernandez

Title: QA Mgr

Date: 08/08/2012

Approximate Set Point	Set Point Uncertainty	AS-RECEIVED TEST			FINAL TEST		
		Standard CFM	Test Meter CFM	Difference	Standard CFM	Test Meter CFM	Difference
100	< 5.0 %	101	103	2	101	102	1
500	< 1.5 %	500	498	-2	501	500	-1
1000	< 1.5 %	1006	1007	1	1001	996	-5
1500	< 1.25 %	1505	1513	8	1507	1511	4
2000	< 1.25 %	2004	2029	25	2002	2026	24

Notes: _____

