



Airflow Testing Report

Prepared for

Portland Public Schools

February 2022





9700 SW Capitol Hwy, Suite 110
Portland, OR 97219
ameresco.com

PROJECT OVERVIEW

As part of the continuing process to ensure a safe return to in-person learning, Portland Public Schools has contracted with Ameresco to test the airflow and ventilation of all educational and office spaces in each school. The data is reviewed by both Ameresco and PPS personnel to identify any potential shortcomings in the airflow from the HVAC systems. To accomplish this task, Ameresco has partnered with a local NEBB certified Test-Adjust-Balance (TAB) firm, Neudorfer Engineers, who will measure the airflow to each zone with calibrated measurement equipment in accordance with current testing standards and procedures. As part of this effort, HVAC professionals will review the operation of the HVAC equipment serving every educational and office space in each school.

Ameresco is pleased to have partnered with PPS over the last decade as the district's Energy Services Company (ESCO) on six energy efficiency construction projects, four service projects, and numerous energy audits. Our partnership has resulted in reducing over 3,000 tons of CO₂ and other GHG emissions and over \$1,000,000 in utility cost savings per year. Ameresco appreciates this opportunity to play a small role in the safe reopening of schools.

About Ameresco, Inc.

Founded in 2000, Ameresco, Inc. (NYSE:AMRC) is a leading cleantech integrator and renewable energy asset developer, owner and operator. Our comprehensive portfolio includes energy efficiency, infrastructure upgrades, asset sustainability and renewable energy solutions delivered to clients throughout North America and the United Kingdom. Ameresco's sustainability services in support of clients' pursuit of Net Zero include upgrades to a facility's energy infrastructure and the development, construction, and operation of distributed energy resources. Ameresco has successfully completed energy saving, environmentally responsible projects with Federal, state and local governments, healthcare and educational institutions, housing authorities, and commercial and industrial customers. With its corporate headquarters in Framingham, MA, Ameresco has more than 1,000 employees providing local expertise in the United States, Canada, and the United Kingdom. For more information, visit www.ameresco.com.

Explanation of ASHRAE Total Effective Air Changes per Hour (ACH_e) Calculation

ASHRAE has been updating their Building Readiness document to reflect the most current understanding in the engineering community for how to operate and maintain buildings during the pandemic. Their update on 4/27/2021 provided an explanation of the impact air filters and air cleaning devices have on the air in buildings. They provided the methodology, formulas, and an Excel-based tool for determining the equivalent outside air a space is receiving by having a mix of outside air, filtered recirculated air, and additional air filtration or cleaning devices in the room. Here is the explanation from ASHRAE:

Epidemic Conditions in Place



Equivalent Outdoor Air:

The equivalent outdoor air calculation indicates that the outdoor air can be calculated by using the combination of the actual outdoor air, impact of filtration or air cleaning technologies on recirculated air, and the impact of air cleaning technologies in the space.

This is using the principal of filters in series and the effectiveness at reducing particles. For items in series, the initial item would see the recirculated airflow to clean. The second item in the series would see the “cleaned” air from Item 1 and so the impact of Item 1 must be accounted for in Item 2.

As part of the airflow testing project that Portland Public Schools has partnered with Ameresco to complete, we are including the calculation of the Total Effective Air Changes per Hour (ACH_e) to show the impact of the air filtration that is active in nearly all spaces in the PPS schools. The formula for doing so is:

$$ACH_e = (ACH_{oa} + ACH_f) * E_z + ACH_{ir}$$

where:

- ACH_{oa} = air changes per hour of outside air = outside airflow in cubic feet per minute * 60 minutes per hour / room volume in cubic feet
- ACH_f = air changes per hour of clean air from filtered recirculated air with filters of the specified MERV rating as determined by ASHRAE
- E_z = Zone Air Distribution Effectiveness = how effective the HVAC system is at circulating and mixing the air to distribute the clean air throughout the room
- ACH_{ir} = the air changes per hour of clean air from portable air filters in the room = number of filters * CADR * 60 minutes per hour / room volume in cubic feet
 - CADR = Clear Air Delivery Rate = the CFM of clean air as specified by the manufacturer of the air filter

In order to include these calculations in the airflow testing reports, Ameresco and PPS have made the following assumptions as not all the variables are known:

1. PPS is in process of upgrading the air filters in their HVAC systems to MERV 13 and plans to be complete with that project for the start of the '21-'22 school year. In this report and for the sake of the ACH_e calculation, we are using the filters that are in place at the time of the measurements, so some of them are still MERV 8.
2. ASHRAE has guidelines for what should be used for the Zone Air Distribution Effectiveness (E_z) based on the HVAC system configuration, but they do not provide a value for every HVAC system and room configuration. For the majority of PPS rooms, an E_z of 0.8 – 1.0 would be most appropriate, so we have made the conservative assumption of using 0.8 for every space as that yields the lower ACH_e.
3. The CADR for a given air filter is from manufacturer ratings and is based on certain conditions (fan speed, particulate size, filter cleanliness, etc.) that change with operating conditions.



NEUDORFER ENGINEERS INC.

**TEST REPORT TYPE:
SURVEY REPORT**

Portland Public Schools Airflow Testing BESC Facility

Job Number: 2021-0297

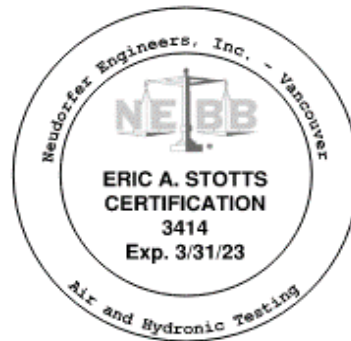
Project Completion Date: February 2022

Revision Date:

-

Revision Number:

-



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Neudorfer Engineers, Inc.

Consulting Engineers Seattle, Washington - Portland, Oregon



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**Portland Public Schools Airflow Testing
BESC Facility**

TABLE OF CONTENTS

Title Sheet	3
Report Certification	4
Terms	5
Instrument Calibration	6
Report Summary	7
Airflow Survey Report	8
TAB Notes	19
Floor Layout	20



Neudorfer Engineers, Inc.

Consulting Engineers Seattle, Washington - Portland, Oregon



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REPORT TITLE

CERTIFIED TEST: SURVEY REPORT

Project: Portland Public Schools Airflow Testing
BESC Facility

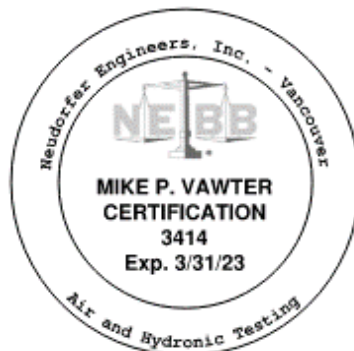
NEI Job#: 2021-0297

Mechanical Engineer: NA

Architect: NA

HVAC Contractor: NA

TAB Firm: Neudorfer Engineers Inc
Test Engineer: Justin Davis



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CERTIFICATION

Portland Public Schools Airflow Testing

The data presented in this report is a record of system measurements and final adjustments that have been obtained in accordance with the current edition of the NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems. Any variances from design quantities, which exceed NEBB tolerances, are noted in the Test-Adjust-Balance Report Project Summary.

Significant / Noteworthy Remarks are noted on the General Remarks and General Field Notes pages. Other remarks are noted on individual test sheets.

Noted deficiencies are not the TAB firms responsibility to repair. Prior to issuance of this report, Deficiency Reports are forwarded to our contracted agent.

Warranty is limited to one year from date of this report. Within that time, any discrepancies, ambiguities, or omissions found in this report will be retested, adjusted, or balanced as needed. A written notification will be required.

Submitted and Certified by:

NEBB TAB Firm: **Neudorfer Engineers Inc**

Certification No: **3414**

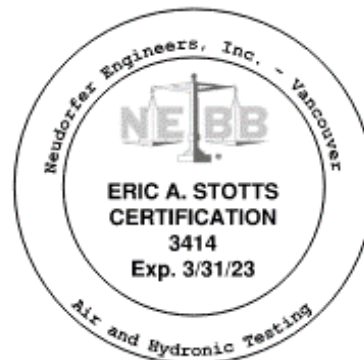
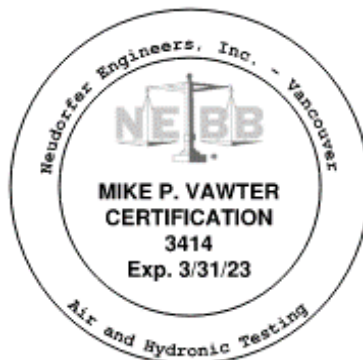
Expiration Date: **March 31, 2023**

Certification Date: **March 31, 2021**

(Date completed) **Signed and Sealed by:**

NEBB Supervisor: **Mike Vawter P.E.**

NEBB Supervisor: **Eric Stotts**





Neudorfer Engineers, Inc.

Consulting Engineers Seattle, Washington - Portland, Oregon



www.NeudorferEngineers.com

TERMS AND ABBREVIATIONS

Project: **Portland Public Schools Airflow Testing**

AC or ACU Air Conditioner or Air Conditioning Unit

AH or AHU Air Handler or Air Handling Unit

ACH Air Changes per Hour

AVG Average

BHP Brake Horsepower

CAV Constant Air Volume

CBV Calibrated Balancing Valve
(Circuit Setter)

CC Cooling Coil

CD Ceiling Diffuser

CFM Cubic Feet per Minute

CH Chiller

CHWS Chilled Water Supply

CHWR Chilled Water Return

CP Circulating Pump

CR Ceiling Register

CRAC Computer Room Air Conditioner

CRU Computer Room Unit

CT Cooling Tower

CU Condenser Unit

CUH Cabinet Unit Heater

CWS Condenser Water Supply

CWR Condenser Water Return

DAT Discharge Air Temperature

DB Dry Bulb

DD Direct Drive

DDC Direct Digital Controls: EMS Control
System for the HVAC

Des. Design

Dia. Diameter

Disch. Discharge

EA Exhaust Air

EAT Entering Air Temperature

Economizer Controls and components that allow an
air handler to logically utilize outdoor air
for cooling as opposed to the use of
mechanical cooling.

EF Exhaust Fan

EG Exhaust Grille

EMCS Energy Management Control System

ERU Energy Recovery Unit

E.S.P. External Static Pressure

HRC Heat Recovery Coil

EWT Entering Water Temperature

FCU Fan Coil Unit

FD Fire Damper

FSD Fire Smoke Damper

FLA Full Load Amperage: Maximum
amperage a motor can draw.

Flow Hood Instrument that captures air and
converts the reading to CFM.

FHT Fume Hood Test

FPB Fan Powered Box

FPM Feet per Minute

FR Field Report

FT Foot, Feet

FTU Fan Terminal Unit

GPM Gallons per Minute

HC Heating Coil

TDH Pressure Difference across the entering
and leaving side of a pump.

HEPA High Efficiency Particulate Absorbing

HP Horsepower

HVAC Heating Ventilation and Air Conditioning

HWS Heating Water Supply

HWR Heating Water Return

HX Heat Exchanger

HZ Hertz, cycle per second

in. inches

in.w.g. inches of water gauge

Kfactor Correction factor to the free area need to
calculate CFM.

KW Kilowatts

LAT Leaving Air Temperature

LBWG Low Wall Grille

LWR Low Wall Register

LWT Leaving Water Temperature

MAU Make-up Air Handling Unit

MBH 1,000 BTUH

N/A Not Applicable

OSA Outside Air

OBD Opposed Blade Damper

ΔP Pressure Drop.

PH Phase

PSI Pounds per Square Inch

RA Return Air

RAT Return Air Temperature

RF Return Fan

RH Relative Humidity

RHC Reheat Coil

RPM Revolutions per Minute

RTU Roof Top Unit

SA Supply Air

SAT Supply Air Temperature

S.F. Service Factor

SF Supply Fan

SFD Smoke/Fire Damper

SP Static Pressure

sq.ft. square feet

Suct. Suction

SWG Sidewall Grille

SWR Sidewall Register

TAB Test; Adjust; and Balance

TSP Total Static Pressure: Difference
between the entering and leaving
static pressure of a fan.

UH Unit Heater

VAV Variable Air Volume; box that
contains a motorized damper that
modulates airflow.

VD Volume Damper

VFD Variable Frequency Drive

Velgrid Instrument that reads used to read
velocity in feet per minute.

VVT Variable Volume Terminal

WC Water Column

W.G. Water Gauge

WB Wet Bulb

INSTRUMENT CALIBRATIONS

Portland Public Schools Airflow Testing

BESC Facility

Instrument Type	Air Data Meter with Flowhood	Instrument Serial #	M97410
Instrument Manufacturer	Shortridge	Calibration Date	10/4/2021
Instrument Model Number	ADM 860	Calibration Due	10/4/2022
Instrument Type	Differential Pressure Water Meter	Instrument Serial #	W12178
Instrument Manufacturer	Shortridge	Calibration Date	10/4/2021
Instrument Model Number	HDM-250	Calibration Due	10/4/2022
Instrument Type	Psychrometer	Instrument Serial #	181128924
Instrument Manufacturer	Extech	Calibration Date	10/1/2021
Instrument Model Number	RH390	Calibration Due	10/1/2022
Instrument Type	Tachometer	Instrument Serial #	B185B5022P
Instrument Manufacturer	Nidec	Calibration Date	10/1/2021
Instrument Model Number	MT-200	Calibration Due	10/1/2022
Instrument Type	Amp Probe	Instrument Serial #	33380179WS
Instrument Manufacturer	Fluke	Calibration Date	10/1/2021
Instrument Model Number	323 Clamp Meter	Calibration Due	10/1/2022
Instrument Type	Digital Thermometer	Instrument Serial #	45400509WS
Instrument Manufacturer	Fluke	Calibration Date	10/1/2021
Instrument Model Number	52 II	Calibration Due	10/1/2022
Instrument Type	Manometer	Instrument Serial #	M97410
Instrument Manufacturer	Shortridge	Calibration Date	10/4/2021
Instrument Model Number	ADM 860	Calibration Due	10/4/2022
Instrument Type	Thermal Anemometer	Instrument Serial #	AVM440808002
Instrument Manufacturer	Alnor Instruments	Calibration Date	9/22/2021
Instrument Model Number	AVM 440	Calibration Due	9/22/2022
Instrument Type	Ultrasonic Flow Meter	Instrument Serial #	N1F1823T
Instrument Manufacturer	Fuji	Calibration Date	9/20/2021
Instrument Model Number	Portaflow-C	Calibration Due	9/20/2022



PROJECT	Portland Public Schools Airflow Testing
LOCATION	BESC Facility; 501 N Dixon St, Portland, OR 97227

REPORT SUMMARY

This project has been surveyed per plans and specifications using the National Environmental Balancing Bureau (NEBB) standards and procedures.

The scope of work for this project was to assess the current airflows for each classroom, office, and special purpose space. Air changes per hour were calculated along with the % of OSA for the spaces and any deficiencies found for each piece of equipment has been noted in the following report.

All ventilation equipment was commanded to run by the BMS system. Ventilation units were measured with a flowhood on the supply outlets. Outside air was recorded with a flowhood on the OSA louvre where accessible. AK factors were calculated from flowhood readings. The remaining OSA values were recorded with a velgrid. AHU supply air was recorded by a summation of the outlets as recorded by flowhood or velgrid when appropriate. Outside air was recorded with a velgrid or airfoil and calculated by the free area method.

The measured airflows in this report represent the performance of the equipment at the time of measurement, which vary over time based on operating conditions. There are factors outside the control of Neudorfer that impact airflow, and variance in those factors is expected and normal. One significant factor is the MERV rating and condition of the air filters on the equipment. During the summer of 2021, PPS began upgrading the filters on all their fan systems to MERV 13. Those upgraded filters are more effective at capturing particles but also impact the amount of airflow from the equipment. These filter changes were occurring while the airflow measurement project was happening, so some schools had the new filters, and some had the old filters at the time of measurement. On the data page included this report, there is a line stating whether or not the upgraded filters were in place at the time of measurement.



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
Lower Level 2																
Rm. L201	SF-1 & 2	AHU	-	-	874	7.9	6,905	600	96	16%	5.2	0.8	1	6.1	3.8	Non-rectangular room.
Rm. L201A	SF-1 & 2	AHU	-	-	3,180	7.9	25,122	2,930	469	16%	7.0	1.1	1	5.7	5.1	Non-rectangular room.
Rm. L201B	SF-1 & 2	AHU	14.6	12.5	183	7.9	1,442	185	30	16%	7.7	1.2	1	16.5	5.6	
Rm. L202	SF-1 & 2	AHU	-	-	631	7.9	4,985	215	34	16%	2.6	0.4	1	5.0	1.9	Non-rectangular room.
Rm. L203	SF-3	AHU	-	-	2,687	7.9	21,227	1,120	179	16%	3.2	0.5	6	6.7	2.3	Non-rectangular room.
Rm. L203A	SF-1 & 2	AHU	59.4	19.5	1,158	7.9	9,151	255	41	16%	1.7	0.3	3	6.3	1.2	
Rm. L203A-1	SF-3	AHU	10.7	9.5	102	7.9	803	68	11	16%	5.1	0.8	1	23.1	3.7	
Rm. L203A-2	SF-1 & 2	AHU	10.7	9.5	102	7.9	803	65	10	16%	4.9	0.8	1	23.0	3.6	
Rm. L203A-3	SF-1 & 2	AHU	10.7	9.6	103	7.9	811	60	10	16%	4.4	0.7	1	22.5	3.2	
Library	SF-1 & 2	AHU	34.3	39.4	1,351	8.4	11,352	490	78	16%	2.6	0.4	1	3.3	1.9	
Rm. L212	SF-1 & 2	AHU	24.2	14.9	361	8.5	3,065	110	18	16%	2.2	0.3	1	6.7	1.6	
Faculty	SF-1 & 2	AHU	17.0	14.9	253	8.5	2,153	150	24	16%	4.2	0.7	1	10.3	3.1	
Rm. L213	SF-3	AHU	69.0	29.5	2,036	8.4	17,098	1,175	188	16%	4.1	0.7	3	5.8	3.0	
Rm. L213E	SF-3	AHU	14.9	9.5	142	8.5	1,203	72	12	16%	3.6	0.6	1	15.6	2.6	
Rm. L213D	SF-3	AHU	19.4	9.6	186	8.5	1,583	80	13	16%	3.0	0.5	1	12.1	2.2	
Rm. L213C	SF-3	AHU	14.0	9.7	136	8.5	1,154	68	11	16%	3.5	0.6	1	16.1	2.6	
Rm. L213F	SF-3	AHU	15.2	9.6	146	8.5	1,240	50	8	16%	2.4	0.4	1	14.3	1.8	
Rm. L213A	SF-1 & 2	AHU	49.2	17.1	841	8.1	6,815	870	139	16%	7.7	1.2	1	7.9	5.6	
Rm. L213B	SF-1 & 2	AHU	110.8	25.1	2,781	8.1	22,527	2,390	382	16%	6.4	1.0	3	6.7	4.7	
Rm. L213B2	SF-3	AHU	14.0	9.7	136	8.0	1,154	74	13	16%	3.8	0.7	1	16.3	2.8	
Rm. L213B3	SF-1 & 2	AHU	14.9	14.6	218	8.1	1,762	2,665	426	16%	90.7	14.5	1	75.3	66.5	
Rm. L216	SF-1 & 2	AHU	147.2	58.7	8,641	21.2	183,182	6,040	966	16%	2.0	0.3	1	1.5	1.4	
Rm. L 214	SF-1 & 2	AHU	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This space is an archive safe, unable to access space.
Rm. L215A	SF-1 & 2	AHU	16.5	6.9	114	7.9	899	55	9	16%	3.7	0.6	1	20.0	2.7	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
Lower Level 2																
Rm. L215	SF-1 & 2	AHU	26.9	24.1	648	8.0	5,186	680	109	16%	7.9	1.3	1	8.8	5.8	
Rm. L209C	SF-1 & 2	AHU	15.4	10.0	154	8.0	1,232	145	23	16%	7.1	1.1	1	17.8	5.2	
Rm. 209A	SF-3	AHU	17.3	8.5	147	8.0	1,176	85	14	16%	4.3	0.7	1	16.4	3.2	
Rm. L211	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This space is a locker room.
Breakroom	MZU-2	AHU	26.4	19.8	523	8.0	4,182	490	490	100%	7.0	7.0	1	9.4	5.6	
Kitchen	MZU-1	AHU	-	-	-	-	152,123	16,245	816	5%	6.4	0.3	1	4.7	4.6	Non-rectangular room.
Rm. L209H1	MZU-2	AHU	9.5	7.7	73	8.0	585	150	150	100%	15.4	15.4	1	39.0	12.3	
Rm. L209H	-	-	27.0	17.6	475	9.7	4,609	-	-	-	0.0	0.0	1	3.4	0.0	Ventillation is provided by adjacent space.
Rm. L209G	MZU-2	AHU	11.0	9.7	107	8.0	854	90	90	100%	6.3	6.3	1	23.3	5.1	
Rm. L209E	MZU-2	AHU	10.3	19.6	202	8.0	1,615	300	300	100%	11.1	11.1	1	18.6	8.9	
Lower Level 1																
Office L101	SF-1 & 2	AHU	-	-	7,735	7.9	61,107	3,760	602	16%	3.7	0.6	6	4.2	2.7	
Office L100A	SF-1 & 2	AHU	9.6	9.5	91	7.9	720	130	21	16%	10.8	1.7	1	29.6	7.9	
Office L100B	SF-1 & 2	AHU	19.5	9.5	185	7.9	1,463	120	19	16%	4.9	0.8	1	14.3	3.6	
Office L100C	SF-1 & 2	AHU	14.5	9.5	138	7.9	1,088	335	54	16%	18.5	3.0	1	27.9	13.5	
Office L100D	SF-1 & 2	AHU	13.7	13.7	188	7.9	1,483	250	40	16%	10.1	1.6	1	17.9	7.4	
Office L100E	SF-1 & 2	AHU	14.0	9.7	136	7.9	1,073	190	30	16%	10.6	1.7	1	22.3	7.8	
Office L100F	SF-1 & 2	AHU	19.2	9.5	182	7.9	1,441	30	5	16%	1.2	0.2	1	11.7	0.9	
Office L100G	SF-1 & 2	AHU	11.9	9.6	114	7.9	902	40	6	16%	2.7	0.4	1	19.2	1.9	
Kitchen	SF-1 & 2	AHU	13.9	9.0	125	7.9	988	385	62	16%	23.4	3.7	1	32.9	17.1	
Faculty	SF-1 & 2	AHU	12.3	19.5	240	7.9	1,895	70	11	16%	2.2	0.4	1	9.9	1.6	
Rm. L120A	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This is a server room.
Office L109	SF-1 & 2	AHU	-	-	2,727	7.9	21,543	4,175	668	16%	11.6	1.9	1	9.2	8.5	Non-rectangular room.
Office L109A	SF-1 & 2	AHU	13.6	17.6	239	7.9	1,891	240	38	16%	7.6	1.2	1	13.8	5.6	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

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Filter Status: Upgraded

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Lower Level 1																
Office L109B	SF-1 & 2	AHU	14.5	9.6	139	7.9	1,100	85	14	16%	4.6	0.7	1	17.6	3.4	
Office L109C	SF-1 & 2	AHU	14.5	9.6	139	7.9	1,100	75	12	16%	4.1	0.7	1	17.2	3.0	
Office L120	SF-1 & 2	AHU	49.4	28.9	1,428	7.9	11,279	485	78	16%	2.6	0.4	2	4.7	1.9	
Office L121	SF-1 & 2	AHU	29.6	14.5	429	7.9	3,391	200	32	16%	3.5	0.6	1	7.2	2.6	
Office L140	SF-3	AHU	-	-	5,819	7.9	45,970	2,905	465	16%	3.8	0.6	3	3.8	2.8	Non-rectangular room.
Office L140A	SF-3	AHU	15.2	9.5	144	7.9	1,141	90	14	16%	4.7	0.8	1	17.1	3.5	
Office L140B	SF-3	AHU	14.5	9.5	138	7.9	1,088	125	20	16%	6.9	1.1	1	19.4	5.0	
Office L140C	SF-3	AHU	19.6	17.0	333	7.9	2,632	305	49	16%	7.0	1.1	1	11.0	5.1	
Office L140D	SF-3	AHU	20.1	9.5	191	7.9	1,509	120	19	16%	4.8	0.8	1	13.8	3.5	
Office L140E	SF-3	AHU	20.1	9.3	187	7.9	1,477	100	16	16%	4.1	0.7	1	13.5	3.0	
Office L140F	SF-3	AHU	19.4	20.0	388	7.9	3,065	340	54	16%	6.7	1.1	1	10.0	4.9	
Rm. L142	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	This is a server equipment room.
Rm. L144	SF-3	AHU	-	-	994	8.8	8,747	490	78	16%	3.4	0.5	1	4.2	2.5	Non-rectangular room.
Rm. 148	SF-3	AHU	-	-	711	7.6	5,404	250	40	16%	2.8	0.4	2	7.8	2.0	Non-rectangular room.
Rm. 148A	SF-3	AHU	22.9	11.0	252	7.6	1,914	30	5	16%	0.9	0.2	1	8.8	0.7	
Rm. 148B	SF-3	AHU	14.0	10.8	151	7.6	1,149	210	34	16%	11.0	1.8	1	21.6	8.0	
Rm. L106	MZU-2	AHU	-	-	978	8.4	8,215	835	835	100%	6.1	6.1	1	6.8	4.9	
Rm. L106A	MZU-2	AHU	13.9	9.6	133	8.4	1,121	185	185	100%	9.9	9.9	1	21.8	7.9	GRD has been taped mostly closed.
Rm. L106B	MZU-2	AHU	14.4	12.8	184	8.4	1,548	300	300	100%	11.6	11.6	1	19.4	9.3	
Office L110	MZU-2	AHU	-	-	564	8.4	4,738	650	650	100%	8.2	8.2	1	9.9	6.6	
Rm L102A	-	-	12.5	9.0	113	7.9	889	-	-	-	0.0	0.0	1	17.6	0.0	Ventilation is provided by adjacent space.
Rm. L102	SF-3	AHU	-	-	375	7.7	2,888	205	33	16%	4.3	0.7	1	8.5	3.1	
First Floor																
Rm. 100A	SF-1 & 2	AHU	15.0	9.3	140	9.0	1,256	90	14	16%	4.3	0.7	1	15.6	3.1	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
First Floor																
Rm. 100B	SF-1 & 2	AHU	9.8	9.3	91	9.0	820	81	13	16%	5.9	0.9	1	23.4	4.3	
Rm. 100C	SF-1 & 2	AHU	9.8	9.3	91	9.0	820	78	12	16%	5.7	0.9	1	23.2	4.2	
Rm. 100D	SF-1 & 2	AHU	9.8	9.3	91	9.0	820	80	13	16%	5.9	0.9	1	23.3	4.3	
Rm. 100E	SF-1 & 2	AHU	19.3	13.8	266	9.0	2,397	70	11	16%	1.8	0.3	1	7.8	1.3	
Rm. 100F	SF-1 & 2	AHU	14.9	10.9	162	9.0	1,462	200	32	16%	8.2	1.3	1	16.7	6.0	
Rm. 100G	-	-	10.3	10.8	111	9.0	1,001	-	-	-	0.0	0.0	1	15.6	0.0	Ventillation is provided by adjacent space.
Rm. 100H	SF-1 & 2	AHU	11.0	9.0	99	9.0	891	100	16	16%	6.7	1.1	1	22.4	4.9	
Rm. 100J	SF-1 & 2	AHU	12.2	9.8	120	9.0	1,076	165	26	16%	9.2	1.5	1	21.2	6.7	
Rm. 100K	SF-1 & 2	AHU	16.9	11.0	186	9.0	1,673	80	13	16%	2.9	0.5	1	11.4	2.1	
Rm. 100L	-	-	-	-	-	-	-	-	-	-	0.0	0.0	0	N/A	0.0	Copy room open to adjacent space w/ no supply.
Rm. 100M	SF-1 & 2	AHU	9.7	9.6	93	9.0	838	45	7	16%	3.2	0.5	1	21.0	2.4	
Rm. 100N	SF-1 & 2	AHU	9.8	9.6	94	9.0	847	70	11	16%	5.0	0.8	1	22.1	3.6	
Rm. 100P	SF-1 & 2	AHU	9.8	9.7	95	9.0	856	80	13	16%	5.6	0.9	1	22.3	4.1	
Office 100	SF-1 & 2	AHU	-	-	3,980	9.0	35,820	1,805	289	16%	3.0	0.5	3	3.5	2.2	Non-rectangular room.
Board Room 101	SF-1 & 2	AHU	-	-	1,606	10.6	17,024	5,200	832	16%	18.3	2.9	2	15.3	13.4	Non-rectangular room.
Lighting room	SF-1 & 2	AHU	-	-	56	9.0	504	45	7	16%	5.4	0.9	0	N/A	3.9	Non-rectangular room.
Rm. 101B1	SF-1 & 2	AHU	10.0	9.2	92	9.0	828	80	13	16%	5.8	0.9	1	23.1	4.2	
Rm. 102	SF-1 & 2	AHU	-	-	1,022	9.5	9,709	450	72	16%	2.8	0.4	1	3.6	2.0	Non-rectangular room.
Rm. 102A	-	-	19.9	12.4	247	12.8	3,159	-	-	-	0.0	0.0	1	4.9	0.0	Ventillation is provided by adjacent space.
Rm. 102B	SF-1 & 2	AHU	12.7	9.4	119	9.6	1,146	40	6	16%	2.1	0.3	1	15.1	1.5	
RR ADA F	SF-1 & 2	AHU	26.0	8.9	231	9.5	2,198	210	34	16%	5.7	0.9	1	11.3	4.2	
Rm. 104	SF-1 & 2	AHU	-	-	571	9.5	5,425	640	102	16%	7.1	1.1	1	8.1	5.2	Non-rectangular room.
Rm. 105	SF-1 & 2	AHU	-	-	1,266	9.5	12,027	825	132	16%	4.1	0.7	1	4.3	3.0	Non-rectangular room.
Rm. 105A	SF-1 & 2	AHU	9.6	14.7	141	9.5	1,341	175	28	16%	7.8	1.3	1	17.4	5.7	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
First Floor																
Rm. 105B	SF-1 & 2	AHU	13.9	9.6	133	9.5	1,268	210	34	16%	9.9	1.6	1	19.6	7.3	
Rm. 106	SF-1 & 2	AHU	14.5	9.5	138	9.5	1,309	115	18	16%	5.3	0.8	1	15.8	3.9	
Office 107	HP-1, 2 & 3	Heat Pump	29.6	26.7	790	9.5	7,508	740	740	100%	5.9	5.9	2	8.9	4.7	
Rm. 107A	HP-1	Heat Pump	14.0	9.6	134	9.5	1,277	125	125	100%	5.9	5.9	1	16.9	4.7	
Rm. 107B	HP-1	Heat Pump	14.0	11.6	162	9.5	1,543	85	85	100%	3.3	3.3	1	12.8	2.6	
Rm. 107C	HP-1	Heat Pump	8.9	8.0	71	9.5	676	40	40	100%	3.5	3.5	1	25.9	2.8	
Rm. 107D	HP-2	Heat Pump	10.4	10.0	104	8.0	832	40	40	100%	2.9	2.9	1	21.1	2.3	
Rm. 107E	HP-1 & 2	Heat Pump	9.5	9.7	92	9.5	875	50	50	100%	3.4	3.4	1	20.6	2.7	
Rm. 108	HP-1 & 2	Heat Pump	19.5	12.0	234	9.5	2,223	70	70	100%	1.9	1.9	1	8.5	1.5	
Rm. 121	SF-3	AHU	-	-	4,398	9.5	41,781	1,525	244	16%	2.2	0.4	1	2.0	1.6	Non-rectangular room.
Rm. 121A	SF-3	AHU	14.0	10.4	146	9.5	1,383	15	2	16%	0.7	0.1	1	11.8	0.5	
Rm. 121B	SF-3	AHU	14.0	9.3	130	9.5	1,237	15	2	16%	0.7	0.1	1	13.1	0.5	
Rm. 121C	SF-3	AHU	17.8	14.0	249	9.5	2,367	10	2	16%	0.3	0.0	1	6.8	0.2	
Rm. 121D	SF-3	AHU	15.3	12.9	197	9.5	1,875	85	14	16%	2.7	0.4	1	10.3	2.0	
Rm. 121E	SF-3	AHU	15.3	15.9	243	9.5	2,311	80	13	16%	2.1	0.3	1	8.3	1.5	
Rm. 121F	SF-3	AHU	15.3	9.2	141	9.5	1,337	85	14	16%	3.8	0.6	1	14.5	2.8	
Rm. 121G	SF-3	AHU	29.0	20.0	580	9.5	5,510	430	69	16%	4.7	0.7	1	6.3	3.4	
Office 114	HVU 10	AHU	19.8	45.9	909	13.4	12,178	1,815	91	5%	8.9	0.4	1	7.8	6.5	
Office 114A	-	-	19.8	10.5	208	9.6	1,996	-	-	-	0.0	0.0	1	7.8	0.0	Ventillation is provided by adjacent space.
Maint. Rm. A	HVU 10	AHU	-	-	11,850	-	229,840	11,790	590	5%	3.1	0.2	1	2.3	2.2	
Maint. Rm. B	HVU-11	AHU	-	-	5,624	18.0	101,232	3,265	359	11%	1.9	0.2	1	1.6	1.4	
Office 130	HVU-11	AHU	-	-	3,169	12.0	38,028	1,105	122	11%	1.7	0.2	1	1.7	1.3	
Rm. 130A	HVU-11	AHU	10.7	9.7	104	12.0	1,245	130	14	11%	6.3	0.7	1	17.1	4.6	
Rm. 130B	HVU-11	AHU	10.9	13.8	150	12.0	1,805	190	21	11%	6.3	0.7	1	13.2	4.6	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
First Floor																
Maint. Rm. C	HVU-4	AHU	-	-	2,975	18.0	53,550	2,545	255	10%	2.9	0.3	1	2.4	2.1	Non-rectangular room.
Corridor	HVU-12&9&4	AHU	-	-	2,180	18.0	39,240	5,575	2,453	44%	8.5	3.8	0	N/A	6.4	Non-rectangular room.
Rm. 128B	AHU-2 & 4	Fan Coil	24.0	18.2	437	9.9	4,324	630	0	0%	8.7	0.0	1	9.9	6.3	Note #1
Rm. 128C	HVU-9 & 8	AHU	73.4	29.4	2,158	18.0	38,843	12,628	1,137	9%	19.5	1.8	1	14.6	14.2	Note #3
Rm. 128C-5	HVU-9	AHU	23.1	9.1	210	10.0	2,102	675	68	10%	19.3	1.9	1	21.4	14.0	
Rm. 128C-2	HVU-9	AHU	23.1	19.9	460	18.0	8,274	1,290	129	10%	9.4	0.9	1	8.7	6.8	
Breakroom	AHU-2	Fan Coil	11.1	16.5	183	10.0	1,832	230	0	0%	7.5	0.0	1	13.9	5.4	Note #1
Rm. 128A	AHU-2	Fan Coil	14.6	28.6	418	10.0	4,176	535	0	0%	7.7	0.0	1	9.3	5.5	Note #1
Carpenters Office	HVU-7	AHU	19.5	17.0	332	18.0	5,967	830	50	6%	8.3	0.5	1	8.7	6.0	
Rm. 128E	HVU-8	AHU	20.7	22.7	470	17.8	8,364	5,045	2,422	48%	36.2	17.4	1	29.3	27.4	
Rm. 128E-1	HVU-8	AHU	8.5	22.5	191	10.0	1,913	85	41	48%	2.7	1.3	1	10.2	2.0	Note #4
Rm. 128C-1	HVU-6	AHU	19.2	15.8	303	18.0	5,460	710	36	5%	7.8	0.4	1	8.5	5.6	
Locksmith	HVU-6	AHU	19.9	20.5	408	18.0	7,343	790	40	5%	6.5	0.3	1	6.8	4.7	
Rm. 128A-1	AHU-3	Fan Coil	10.6	15.0	159	10.4	1,654	210	0	0%	7.6	0.0	1	14.9	5.5	Note #1
Rm. 128A-2	AHU-3	Fan Coil	10.6	9.0	95	10.4	992	205	0	0%	12.4	0.0	1	24.6	8.9	Note #1
Rm. 128F-1	AHU-3	Fan Coil	12.4	9.0	112	10.0	1,116	300	0	0%	16.1	0.0	1	25.6	11.6	Note #1
Rm. 128F-2	AHU-3	Fan Coil	12.4	98.9	1,226	10.0	12,264	195	0	0%	1.0	0.0	1	2.0	0.7	Note #1
Rm. 128F	AHU-3	Fan Coil	12.4	9.0	112	10.0	1,116	295	0	0%	15.9	0.0	1	25.4	11.4	Note #1
Rm. 133B	FR-1	Furnace	10.1	8.6	87	8.0	695	35	3	9%	3.0	0.3	1	24.6	2.2	
Rm. 133B-1	FR-1	Furnace	10.0	8.7	87	8.0	696	50	5	9%	4.3	0.4	1	25.5	3.1	
Rm. 133B-2	FR-1	Furnace	10.0	8.7	87	8.0	696	40	4	9%	3.4	0.3	1	24.9	2.5	
Rm. 133B-3	FR-1	Furnace	12.4	10.3	128	8.0	1,022	105	9	9%	6.2	0.6	1	19.7	4.5	
Rm. 133A	FR-1	Furnace	11.8	13.2	156	8.0	1,246	155	14	9%	7.5	0.7	1	17.9	5.4	
Rm. 133	FR-1	Furnace	28.7	37.7	1,082	8.0	8,656	745	67	9%	5.2	0.5	1	5.6	3.8	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
First Floor																
Rm. 134A	FR-1	Furnace	15.2	10.3	157	8.0	1,252	195	18	9%	9.3	0.8	1	19.2	6.8	
Rm. 134B	FR-1	Furnace	7.6	10.2	78	8.0	620	90	8	9%	8.7	0.8	1	31.5	6.3	
Rm. 134C	FR-1	Furnace	15.2	19.5	296	8.0	2,371	190	17	9%	4.8	0.4	2	16.7	3.5	
Rm. 134D	-	-	7.0	10.2	71	8.0	571	-	-	-	0.0	0.0	1	27.3	0.0	Ventillation is provided by adjacent space.
Glass Shop	HVU-5	AHU	66.2	39.2	2,595	18.1	46,970	3,370	34	1%	4.3	0.0	1	3.4	3.1	
Rm. 135A	-	-	7.4	7.4	55	11.0	602	-	-	-	0.0	0.0	1	25.9	0.0	Ventillation is provided by adjacent space.
Wood Shop	HVU-3 & 4	AHU	155.8	65.3	10,177	18.0	183,183	12,310	616	5%	4.0	0.2	1	3.0	2.9	
Rm. 126	HVU-4	AHU	9.6	6.0	58	8.0	461	25	1	5%	3.3	0.2	1	36.2	2.4	
Men's RR 126	HVU-4	AHU	22.8	12.0	274	8.0	2,189	210	11	5%	5.8	0.3	0	N/A	4.2	
Woman's RR 126	HVU-4	AHU	16.5	9.7	160	8.0	1,280	185	9	5%	8.7	0.4	0	N/A	6.3	
Corridor 126	HVU-4	AHU	20.8	5.1	106	8.0	849	85	4	5%	6.0	0.3	0	N/A	4.3	
Corridor A	HVU-16 & 17	FCU	15.6	101.0	1,576	19.0	29,936	3,020	91	3%	6.1	0.2	0	N/A	4.4	
Corridor B	HVU-13 & 14	FCU	201.7	9.4	1,896	19.0	36,024	3,300	165	5%	5.5	0.3	0	N/A	4.0	
Maint. Shop D	HVU-1 & 2	AHU	-	-	14,305	19.0	271,795	15,215	1,369	9%	3.4	0.3	1	2.5	2.4	Non-rectangular room.
Storage 132H North	-	-	18.5	27.0	500	17.9	8,941	-	-	-	0.0	0.0	0	N/A	0.0	Ventillation is provided by adjacent space.
Shade Shop	HVU-2	AHU	-	-	1,821	17.9	32,596	775	178	23%	1.4	0.3	1	1.5	1.1	Non-rectangular room.
Rm. 132C	Office HP	Heat Pump	14.9	12.1	180	7.5	1,352	275	0	0%	12.2	0.0	1	20.3	8.8	Note #6
Rm. 132B	Office HP	Heat Pump	17.3	11.4	197	9.4	1,854	250	0	0%	8.1	0.0	1	14.2	5.8	Note #6
Rm. 132E	Office HP	Heat Pump	16.3	9.9	161	7.3	1,178	250	0	0%	12.7	0.0	1	22.4	9.2	Note #6
Rm. 132D	Office HP	Heat Pump	-	-	370	7.4	2,738	630	0	0%	13.8	0.0	1	15.6	9.9	Note #6
Rm. 132 G	-	-	16.5	12.8	211	9.4	1,985	-	-	-	0.0	0.0	0	N/A	0.0	Room is a return plenum for the Office HP.
Upper Office	Office HP	Heat Pump	43.5	16.2	705	7.6	5,356	1,150	0	0%	12.9	0.0	1	12.2	9.3	Note #6
Storage 132H South	-	-	44.8	28.4	1,272	19.1	24,301	-	-	-	0.0	0.0	2	1.3	0.0	Ventillation is provided by adjacent space.
Rm. 119	SF-3	AHU	-	-	1,210	9.3	11,253	540	86	16%	2.9	0.5	1	3.5	2.1	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESS Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
First Floor																
Rm. 119A	-	-	8.9	9.6	85	9.3	795	-	-	-	0.0	0.0	1	19.6	0.0	Ventillation from adjacent space.
Rm. 119B	SF-3	AHU	-	-	141	9.6	1,354	40	6	16%	1.8	0.3	1	12.8	1.3	Non-rectangular room.
Rm. 115	SF-3	AHU	25.0	132.3	3,308	9.4	31,091	100	16	16%	0.2	0.0	1	0.6	0.1	
Rm. 115B	SF-3	AHU	12.0	7.3	88	9.4	823	40	6	16%	2.9	0.5	1	21.1	2.1	
Rm. 115A	SF-3	AHU	-	-	351	9.4	3,299	20	3	16%	0.4	0.1	1	5.0	0.3	Space also includes Rm.124. Non-rectangular room.
Rm. 115C	SF-3	AHU	10.0	10.2	102	9.4	959	20	3	16%	1.3	0.2	1	17.2	0.9	
Maint. Rm E	SF-3	AHU	30.6	34.8	1,065	9.4	10,010	450	72	16%	2.7	0.4	1	3.5	2.0	
Maint. Rm. E1	SF-3	AHU	-	-	196	9.4	1,842	110	18	16%	3.6	0.6	1	11.1	2.6	Non-rectangular room.
Maint. Rm. E Office	SF-3	AHU	8.9	7.4	66	9.4	619	75	12	16%	7.3	1.2	1	30.5	5.3	
Second Floor																
Cafe/kitchen	SF-3	AHU	78.8	25.6	2,017	9.0	18,156	2,050	328	16%	6.8	1.1	2	6.7	5.0	
Café	SF-1 & 2	AHU	36.4	29.3	1,067	9.0	9,599	1,140	182	16%	6.0	1.1	2	7.7	4.4	
Rm. 200	SF-1 & 2	AHU	80.0	79.9	6,392	9.0	57,528	2,895	463	16%	3.0	0.5	1	2.5	2.2	
Rm. 200A	SF-1 & 2	AHU	10.7	14.0	150	9.0	1,348	230	37	16%	10.2	1.6	1	19.1	7.5	Office area was calculated by subtracting the offices.
Rm. 200B	SF-1 & 2	AHU	10.7	14.0	150	9.0	1,348	210	34	16%	9.3	1.5	1	18.4	6.8	
Rm. 200C	SF-1 & 2	AHU	14.0	14.6	204	9.0	1,840	205	33	16%	6.7	1.1	1	13.4	4.9	
Rm. 200D	SF-1 & 2	AHU	14.0	14.6	204	9.0	1,840	295	47	16%	9.6	1.5	1	15.5	7.0	
Rm. 200E	SF-1 & 2	AHU	14.0	14.0	196	9.0	1,764	375	60	16%	12.8	2.0	1	18.2	9.3	
Rm. 200F	SF-1 & 2	AHU	14.6	10.6	155	9.0	1,393	105	17	16%	4.5	0.7	1	14.5	3.3	
Rm. 200G	SF-1 & 2	AHU	14.6	9.9	145	9.0	1,301	98	16	16%	4.5	0.7	1	15.3	3.3	
Rm. 200H	SF-1 & 2	AHU	19.0	14.7	279	9.0	2,514	200	32	16%	4.8	0.8	1	9.7	3.5	
Rm. 200J	SF-1 & 2	AHU	19.0	14.7	279	9.0	2,514	430	69	16%	10.3	1.6	2	19.9	7.5	
Rm. 200L	SF-1 & 2	AHU	9.6	8.6	83	9.0	743	66	11	16%	5.3	0.9	1	24.9	3.9	
Rm. 200M	SF-1 & 2	AHU	9.6	5.7	55	9.0	492	71	11	16%	8.7	1.4	1	38.0	6.3	

Date: 2/4/2022

Readings By: Justin Davis



AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
Second Floor																
Rm. 200N	SF-1 & 2	AHU	9.9	9.5	94	9.0	846	130	21	16%	9.2	1.5	1	25.2	6.7	
Rm. 200N1	SF-1 & 2	AHU	9.9	9.6	95	9.0	855	150	24	16%	10.5	1.7	1	25.9	7.7	
Rm. 200Q	SF-1 & 2	AHU	14.6	9.5	139	9.0	1,248	45	7	16%	2.2	0.3	1	14.1	1.6	
Rm. 200S	SF-1 & 2	AHU	14.6	9.5	139	9.0	1,248	145	23	16%	7.0	1.1	1	17.6	5.1	
Rm. 200T	SF-1 & 2	AHU	16.1	9.6	155	9.0	1,391	45	7	16%	1.9	0.3	1	12.6	1.4	
Rm. 201	SF-1 & 2	AHU	21.3	8.8	187	8.8	1,646	185	30	16%	6.7	1.1	1	14.4	4.9	
Rm. 202	-	-	10.2	9.7	99	9.0	890	-	-	-	0.0	0.0	1	17.5	0.0	Ventilation is provided by adjacent space.
Rm. 203	SF-1 & 2	AHU	19.3	9.8	189	9.0	1,702	75	12	16%	2.6	0.4	1	11.1	1.9	
Rm. 205	SF-1 & 2	AHU	19.6	13.0	255	9.0	2,293	280	45	16%	7.3	1.2	1	12.2	5.4	
Rm. 200P	SF-1 & 2	AHU	14.4	14.0	202	9.0	1,814	185	30	16%	6.1	1.0	1	13.1	4.5	
Rm. 200R	SF-1 & 2	AHU	14.6	9.4	137	9.0	1,235	130	21	16%	6.3	1.0	1	17.3	4.6	
Rm. 206	SF-1 & 2	AHU	24.6	15.9	391	9.0	3,520	485	78	16%	8.3	1.3	1	10.5	6.1	
Rm. 200U	SF-1 & 2	AHU	14.6	9.7	142	9.0	1,275	165	26	16%	7.8	1.2	1	17.9	5.7	
Rm. 200V	SF-1 & 2	AHU	14.6	9.7	142	9.0	1,275	175	28	16%	8.2	1.3	1	18.3	6.0	
Rm. 200 M1	SF-1 & 2	AHU	14.6	9.6	140	9.0	1,261	205	33	16%	9.8	1.6	1	19.5	7.1	
Rm. 207	SF-1 & 2	AHU	17.5	14.5	254	9.0	2,284	395	63	16%	10.4	1.7	1	14.4	7.6	
Rm. 208	SF-1 & 2	AHU	19.3	14.6	282	9.0	2,536	175	28	16%	4.1	0.7	1	9.2	3.0	
Rm. 209	SF-1 & 2	AHU	9.8	13.9	136	9.0	1,226	70	11	16%	3.4	0.5	1	15.2	2.5	
Rm. 210	SF-1 & 2	AHU	13.0	9.7	126	9.0	1,135	65	10	16%	3.4	0.5	1	16.3	2.5	
Rm. 211	SF-1 & 2	AHU	14.7	9.7	143	9.0	1,283	135	22	16%	6.3	1.0	1	16.8	4.6	
Rm. 212	SF-1 & 2	AHU	21.0	9.7	204	9.0	1,833	390	62	16%	12.8	2.0	1	17.9	9.3	
Rm. 214	SF-1 & 2	AHU	14.0	9.6	134	9.0	1,210	160	26	16%	7.9	1.3	1	18.7	5.8	
Rm. 215	SF-1 & 2	AHU	14.0	9.6	134	9.0	1,210	175	28	16%	8.7	1.4	1	19.3	6.4	
Rm. 216	SF-1 & 2	AHU	14.0	9.1	127	9.0	1,147	235	38	16%	12.3	2.0	1	22.6	9.0	

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AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESC Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
Second Floor																
Rm. 217	SF-1 & 2	AHU	14.6	14.0	204	9.0	1,840	160	26	16%	5.2	0.8	1	12.3	3.8	
Rm. 218	SF-1 & 2	AHU	14.0	9.6	134	9.0	1,210	120	19	16%	6.0	1.0	1	17.3	4.4	
Rm. 219	SF-1 & 2	AHU	14.0	10.0	140	9.0	1,260	110	18	16%	5.2	0.8	1	16.2	3.8	
Rm. 220	SF-1 & 2	AHU	14.0	14.6	204	9.0	1,840	180	29	16%	5.9	0.9	0	N/A	4.3	
Rm. 221	SF-1 & 2	AHU	14.0	14.0	196	9.0	1,764	175	28	16%	6.0	1.0	1	13.2	4.4	
Rm. 225A	SF-1 & 2	AHU	17.0	10.0	170	9.0	1,530	145	23	16%	5.7	0.9	1	14.4	4.2	
Rm. 222	SF-1 & 2	AHU	18.8	15.6	293	9.0	2,640	305	49	16%	6.9	1.1	1	11.0	5.1	
Rm. 224	SF-1 & 2	AHU	15.8	8.8	139	9.0	1,251	55	9	16%	2.6	0.4	1	14.4	1.9	
Rm. 226	SF-1 & 2	AHU	9.6	8.7	84	9.0	752	95	15	16%	7.6	1.2	1	26.3	5.6	
Rm. 227	SF-1 & 2	AHU	9.6	14.0	134	9.0	1,210	105	17	16%	5.2	0.8	1	16.7	3.8	
Rm. 228	SF-1 & 2	AHU	14.0	9.9	139	9.0	1,247	120	19	16%	5.8	0.9	1	16.7	4.2	
Rm. 229	SF-1 & 2	AHU	14.3	9.8	140	9.0	1,261	50	8	16%	2.4	0.4	1	14.1	1.7	
Rm. 230	SF-1 & 2	AHU	7.3	9.8	72	9.0	644	35	6	16%	3.3	0.5	1	26.6	2.4	
Rm. 231	SF-3	AHU	14.0	7.6	106	9.0	958	90	14	16%	5.6	0.9	1	20.4	4.1	
Rm. 232	SF-3	AHU	24.6	9.4	231	9.0	2,081	145	23	16%	4.2	0.7	1	10.6	3.1	
Rm. 234	SF-3	AHU	14.7	14.7	216	9.0	1,945	140	22	16%	4.3	0.7	1	11.2	3.2	
Rm. 235	SF-3	AHU	14.0	9.5	133	9.0	1,197	95	15	16%	4.8	0.8	1	16.5	3.5	
Rm. 237	SF-3	AHU	14.0	14.0	196	9.0	1,764	120	19	16%	4.1	0.7	1	11.8	3.0	
Rm. 238	SF-3	AHU	19.7	8.1	160	9.0	1,436	335	54	16%	14.0	2.2	1	21.1	10.3	
Rm. 240	-	-	29.5	15.3	451	12.6	5,687	-	-	-	0.0	0.0	1	2.7	0.0	Ventillation is provided by adjacent space.
Rm. 239	SF-3	AHU	13.9	14.0	195	9.0	1,751	80	13	16%	2.7	0.4	1	10.9	2.0	
Rm. 243	SF-3	AHU	19.6	17.9	351	9.0	3,158	205	33	16%	3.9	0.6	1	7.8	2.9	
Rm. 244	SF-3	AHU	16.9	8.9	150	9.0	1,354	100	16	16%	4.4	0.7	1	14.8	3.2	
Rm. 246	SF-3	AHU	9.9	7.1	70	9.0	633	65	10	16%	6.2	1.0	1	29.2	4.5	

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AIRFLOW SURVEY REPORT

Project: Portland Public Schools Airflow Testing
Location: BESS Facility; 501 N Dixon St, Portland, OR 97227
Filter Status: Upgraded

Room	Equipment Info		Room Dimensions					Airflow Measurements			Calculated ACH					Notes
	Served By	Equipment Type	Room Length	Room Width	Room Area	Room Height	Room Volume	Total CFM Supply	OA CFM Supply	OA %	Air Changes per Hour (supply)	Air Changes per Hour (OA)	# of Portable Filters	Total Effective Air Changes per Hour (ACH_e) with Portable Filter	Total Effective Air Changes per Hour (ACH_e) without Portable Filter	
Second Floor																
Rm. 251	SF-3	AHU	16.0	9.6	154	9.0	1,382	65	10	16%	2.8	0.5	1	13.4	2.1	
Rm. 252	SF-3	AHU	11.0	9.5	105	9.0	941	100	16	16%	6.4	1.0	1	21.3	4.7	
Rm. 253	-	-	16.0	9.5	152	9.0	1,368	-	-	-	0.0	0.0	1	11.4	0.0	Ventilation is provided by adjacent space.
Rm. 248	SF-3	AHU	20.6	12.8	264	9.0	2,373	180	29	16%	4.6	0.7	1	9.9	3.3	
Rm. 236	SF-3	AHU	-	-	245	9.0	2,205	115	18	16%	3.1	0.5	1	9.4	2.3	Non-rectangular room.
Rm. 250	SF-3	AHU	19.5	14.5	283	9.0	2,545	165	26	16%	3.9	0.6	1	9.0	2.8	
Rm. 249	SF-3	AHU	14.6	9.6	140	9.0	1,261	100	16	16%	4.8	0.8	1	15.9	3.5	
Rm. 258E	SF-3	AHU	23.9	21.0	502	9.0	4,517	545	87	16%	7.2	1.2	1	8.8	5.3	
Rm. 258D	SF-3	AHU	-	-	2,911	9.0	26,199	855	137	16%	2.0	0.3	1	2.0	1.4	Non-rectangular room.
CA210	SF-1 & 2	AHU	74.5	44.8	3,338	9.0	30,038	1,480	237	16%	3.0	0.5	1	2.7	2.2	
CA240	SF-3	AHU	-	-	3,921	9.0	35,289	2,025	324	16%	3.4	0.6	3	3.8	2.5	Non-rectangular room.
Office CA235	SF-3	AHU	24.0	25.3	607	9.0	5,465	410	66	16%	4.5	0.7	1	6.2	3.3	
Office CA243	SF-3	AHU	-	-	2,473	9.0	22,257	1,700	272	16%	4.6	0.7	2	4.8	3.4	Non-rectangular room.
Office CA246	SF-3	AHU	31.2	26.4	824	9.0	7,413	760	122	16%	6.2	1.0	1	6.6	4.5	
CA255	SF-3	AHU	-	-	2,215	9.0	19,935	905	145	16%	2.7	0.4	1	2.8	2.0	
CA230	SF-3	AHU	39.1	28.7	1,122	9.0	10,100	345	55	16%	2.0	0.3	1	3.0	1.5	
CA225	SF-1 & 2	AHU	-	-	2,189	9.0	19,701	1,135	182	16%	3.5	0.6	1	3.3	2.5	Non-rectangular room.
CA205	SF-1 & 2	AHU	-	-	2,150	9.0	19,350	1,790	286	16%	5.6	0.9	1	4.9	4.1	Non-rectangular room.
Open Air Lobby	SF-3	AHU	78.7	28.7	2,259	31.4	70,923	6,665	1,066	16%	5.6	0.9	0	N/A	4.1	
Stair Vestibule L2	SF-1 & 2	AHU	-	-	559	9.0	5,031	420	67	16%	5.0	0.8	0	N/A	3.7	Non-rectangular room.

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NOTE #	NOTE DESCRIPTION
1	Fan Coil is 100% return.
2	N/A
3	OSA supplied from HVU-8; the OSA for HVU-9 was fully closed at time of test.
4	HVU-8 rooms get very hot, occupants requested it off.
5	N/A
6	Not ducted for OSA.

