



IAQ Verification Report

Science and Technology Magnet High School of Southeastern Connecticut

New London, CT

SES Project No. 24-461

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Table of Contents

Executive Summary	1
IAQ Verification Process.....	1
<i>Filter Evaluation</i>	1
<i>Ventilation Evaluation</i>	1
<i>Demand Control Ventilation</i>	2
Project Approach.....	2
Participants.....	4
Facility Description	5
<i>Building</i>	5
<i>Occupancy</i>	5
<i>Building Automation System Description</i>	5
<i>HVAC Systems Description</i>	5
<i>Air Handling Units</i>	5
Recommendations.....	6
<i>Initial Recommendations</i>	6
<i>Recommendation #1: Repair/Replace Damper Actuators For AHU-2 & 3</i>	7
<i>Recommendation #2: Set New Fixed Minimum Outside Air Damper Positions For AHU-1, 2, 3, 4 & 5</i>	7
<i>Recommendation #3: Replace Lecture Hall Space CO2 Sensor</i>	8
<i>Recommendation #4: Rebalance Spaces Associated With AHU-4 & 5</i>	8
<i>Recommendation #5: Filter Improvements</i>	9
Next Steps	9
<i>Review Recommendations</i>	9

Appendix A IAQ Evaluation Sheet

Appendix B International Mechanical Code Minimum Ventilation Rates (2021) per ASHRAE 62.1



Executive Summary

Sustainable Engineering Solutions, LLC (SES) and Trueflow Testing and Balancing were retained by the Town of New London to provide professional engineering and test and balancing (TAB) services to meet the indoor air quality (IAQ) verification requirements of the state legislation Public Act No. 23-167 at the Science and Technology Magnet High School of Southeastern Connecticut. This combined effort successfully completed the required verification as outlined in the legislation. With a focus on validating and improving indoor air quality, SES and Trueflow systematically assessed each air handling system to measure current ventilation rates, filtration rates and distribution levels compared to current ventilation standards. Overall, the HVAC air handling systems were found to be in good condition and have been well maintained.

Currently, the majority of spaces within the building do not meet minimum ventilation requirements due to the minimum outside air damper position for each of the five air handling units being at 0%. However, we believe that with simple building control system modifications, rebalancing and minor repairs, the building will satisfy all minimum ventilation requirements. Recommendations associated with the buildings air handling units have been included in this report for the Client to review. Note that throughout this report the term “ventilation” air and “outside” are used interchangeably and are one in the same.

IAQ Verification Process

Filter Evaluation

As required by the law, the team reviewed the current level of filtration installed on each air handling system and analyzed the feasibility of increasing the filter ratings to MERV 13. A filter’s minimum efficiency reporting value, or MERV, is a rating system that measures how efficient a filter is at trapping harmful particulate matter, dust, and debris in the air. This rating system categorizes filters into a ranking from 2 to 20, with a MERV 8 being the standard. A higher MERV rating means that a filter is more efficient and MERV 13 is recommended for many commercial and industrial buildings and by state code. At its minimum, a MERV 13 filter traps less than 75% of air particles that are 0.3 to 1.0 microns in size and is at least 90% effective when the particles increase to 3 to 10 microns in size. Along with assessing the filter efficiencies, the condition of unit’s filters and proper sealing of the filter banks to eliminate bypass air was also evaluated.

Ventilation Evaluation

The amount of ventilation air delivered into interior occupied spaces is governed by the 2022 Connecticut State Building Code, which references ASHRAE Standard 62.1. This code prescribes the flow rate of ventilation air that must be supplied mechanically, or otherwise, to occupied areas based on occupancy classifications. Depending on the type of use of a space and total space area, outdoor air flow rates in cubic feet per minute (CFM) per person and square foot are defined when the parameters are known. When total occupants per space are unknown, the code defines occupant density for each



classification type in number of occupants per space floor area. The final flow rate in CFM for every occupied space can thus be calculated.

As an alternative to providing outside air mechanically to occupied spaces, the building code also allows for outside air to enter occupied areas naturally through operable windows. If the area of operable windows for an occupied space is at least 4% of the space's floor area, mechanical ventilation for that space is not required by code. However, although spaces with sufficient operable window area may satisfy code requirements, this is not a realistic way of providing adequate ventilation during periods of cold or hot weather.

The amount of outside air supplied to occupied spaces is important for occupant comfort and health because contaminants generated by people and materials in the space must be removed or they will build up to unhealthy levels. Diluting interior air with outside air reduces the concentration of carbon dioxide, volatile organic compounds (VOCs) along with various airborne viral and bacterial contaminants.

Demand Control Ventilation

In certain applications, the amount of outside air delivered to a space can be reduced if occupancy and indoor air quality can be safely monitored and controlled. This is most typically accomplished through monitoring carbon dioxide (CO₂) and occupancy sensors in the space, otherwise known as "Demand Control Ventilation" or DCV. As occupancy rises in a space, so does the amount of CO₂ as a result of the occupant's natural respiration and exhalation of CO₂. By monitoring CO₂ and occupancy status, an HVAC system can reduce the amount of outside air to a zone when levels and occupancy are low. If CO₂ levels rise above a certain threshold or occupancy is detected, the HVAC system can then increase the amount of fresh air until the levels fall back below an acceptable level. Having an operational demand control ventilation strategy in place will help reduce energy consumption of a facility while simultaneously ensuring all spaces are achieving the required fresh air requirements.

Project Approach

During the review of the school, SES took the following steps to complete the study:

- Develop an IAQ evaluation plan and conduct a kickoff meeting with the client and Trueflow to review the plan, project schedule, access, etc.
- Perform a walkthrough of the building to review the HVAC systems providing ventilation air for a condition assessment of the systems and understand any maintenance issues that may be related.
- Review available documentation for the HVAC systems that includes:
 - As-built drawings or original design drawings
 - O&M documentation for systems performance data
 - Review any previous testing adjusting and balancing reports from the HVAC systems

- Review documentation describing the chronology of known problems, system failures, complaints, and alterations.
- Develop IAQ evaluation documentation for field evaluation of equipment.
- Perform field evaluation of equipment for ventilation sequence of operation and verify calibration of CO₂ sensors where used (+/- 50 PPM).
- Review Trueflow's completed ventilation rate verification sheets for each space for compliance with ASHRAE 62.1
- Review the Trueflow's completed unit data sheets for each system providing ventilation air for ventilation airflows, filter condition and efficiency, damper conditions and maintenance adequacy.
- Prepare a report that summarizes the verification process, identifies any deficiencies that require correction and any recommendations to address the deficiencies found and next steps.



Participants

The participants in the IAQ verification process for this project are identified below.

Owner

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TAB Provider

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Facility Description

Building

Building:	Science and Technology Magnet High School
Location:	490 Jefferson Ave, New London, CT 06320
Building Size (gross):	70,000 ft ²
Year Constructed:	2006
Building Use (current):	Education



The three-story, 70,000 square foot Science and Technology Magnet School was constructed in 2006. The space was built with the intention of providing the Southeastern part of Connecticut with a school with a heightened focus on science and technology based curriculum. The school consists of various classrooms, labs, offices and a lecture hall.

Occupancy

The building is occupied Monday through Friday between 7 a.m. and 4 p.m. Special events are held on the weekends and after hours as needed for school extracurricular activities. In addition, the school hosts summer school activities during the summer break.

Building Automation System Description

The HVAC system is controlled by a building automation system. This system has graphics for all the HVAC equipment and is capable of trending and performing custom control algorithms.

HVAC Systems Description

Air Handling Units

In total, there are five (5) air handling units (AHUs) in the school. Four units are multizone variable-air-volume (VAV) units that serve multiple VAV box zones. AHU-2 is a single-zone constant volume air handling unit. The air handling units appear original to the building and remain in good condition. All five air handling units and terminal units are connected to the building automation system.



For the four multizone AHUs, supply airflow provided to the space is controlled by the VAV boxes. As downstream VAV boxes modulate the units supply fan speeds modulate via variable frequency drive to meet the static pressure setpoint. As the heating, cooling and ventilation (CO2) requirements of the space change, the VAVs modulate their dampers accordingly. The AHUs mix return air from the building with fresh outside air, filters the airstream and then conditions it by heating or cooling as necessary. As the airflow requirements of the spaces change, the supply fan of the unit will increase and decrease speed accordingly.

For the single zone air handling unit, the spaces are conditioned and ventilated by the associated unit. The unit mixes return air from the space with fresh outside air, filters the airstream and then conditions it by heating or cooling as necessary at a constant airflow.

All AHUs maintain a fixed minimum outside air damper setpoint but are equipped with return air carbon dioxide (CO2) sensors for demand control ventilation. As the CO2 in the building rises above the AHU RA CO2 setpoint, the outside air damper will modulate from minimum setpoint to 100% open. Once CO2 levels fall below setpoint, the outside air damper will modulate back towards minimum position.

Unit Tag	Serves	Type	Min OA Damper Setpoint	CO2 Setpoint
AHU 1	Admin	Multi-Zone Variable Volume	0%	800 PPM
AHU 2	Lecture Hall	Single Zone Constant Volume	0%	1200 PPM
AHU 3	Level 1 & 2 North Classrooms	Multi-Zone Variable Volume	0%	800 PPM
AHU 4	Level 1 & 2 South East Classrooms	Multi-Zone Variable Volume	0%	800 PPM
AHU 5	Level 3	Multi-Zone Variable Volume	0%	1200 PPM

Recommendations

The following recommendations were made based on the review of TAB report, ventilation comparisons to the IMC Minimum Ventilation Rates (2021) and industry best practices. Additional supporting information can be found in the Appendices of the report.

Due to the limited area of focus of the required IAQ verification and this review, SES strongly recommends verifying the condition of all related HVAC equipment components and control functionality outside of the scope of this verification, prior to implementing any modifications to the HVAC systems.

Initial Recommendations

- Recommendation #1: Repair/Replace Damper Actuators For AHU-2 & 3
- Recommendation #2: Set New Fixed Minimum Outside Air Damper Positions For AHU-1, 2, 3, 4 & 5
- Recommendation #3: Replace Lecture Hall Space CO2 Sensor



- Recommendation #4: Rebalance Spaces Associated With AHU-4 & 5
- Recommendation #5: Filter Improvements

Recommendation #1: Repair/Replace Damper Actuators For AHU-2 & 3

During testing, adjusting, and balancing it was found that damper actuators for AHU-2 & 3 were not operating per design. Because of this, the quantity of outside air being supplied into the space did not meet the minimum ventilation requirements of the space. For AHU-2, the outside air damper did not modulate open on a call for demand control ventilation. In addition, when the damper position was overridden to 100% outside air, the damper did not modulate open. For AHU-3, the outside air damper appeared to be stuck 15% open and return air damper appeared to be stuck 100% open.

SES recommends New London Facilities or Contractor review the operation of the outside air dampers for AHU-2 & 3 and return air damper for AHU-3. If the actuators are found to be inoperable, they should be replaced to ensure the proper amount of outside air is supplied to the space.

Recommendation #2: Set New Fixed Minimum Outside Air Damper Positions For AHU-1, 2, 3, 4 & 5

During a review of the building management system, it revealed that the minimum outside air damper positions for AHUs 1 through 5 were set to 0%. As a result, when there are no active calls for economizer mode or demand control ventilation, the required minimum outside air levels is not achieved in any of the building's spaces.

SES recommends that the outside air airflow for the following air handling units is re-balanced to the values shown in the table below and a new minimum outside air damper position established for use in the programming for the AHU.

SES recommends the following actions:

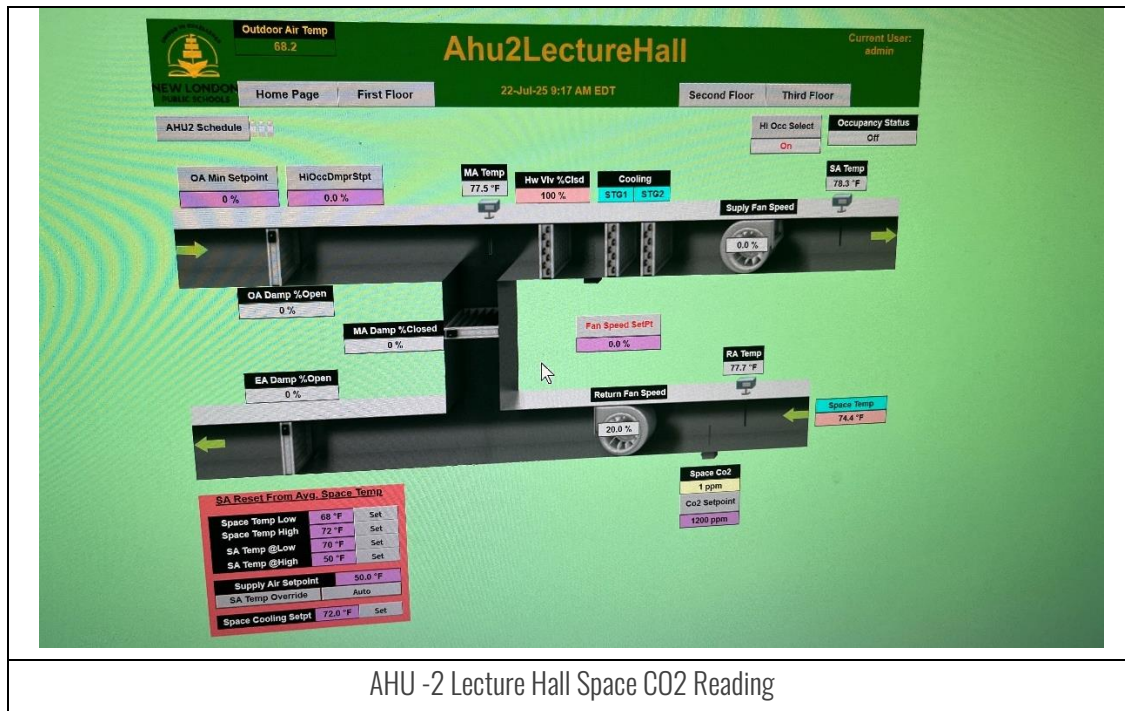
- A TAB contractor should determine new MIN-OAD damper percentages that correspond to the airflows listed in the table above.
- The updated setpoints should be incorporated into the BAS sequence.

Unit Tag	Served	Measured Outside Airflow at Minimum Damper Position (CFM)	Calculated Required Minimum Outside Airflow (CFM)
AHU 1	Admin	0	150
AHU 2	Lecture Hall	0	190
AHU 3	Level 1 & 2 North Classrooms	0	1,840
AHU 4	Level 1 & 2 South East Classrooms	0	1,410
AHU 5	Level 3	0	1,450

Recommendation #3: Replace Lecture Hall Space CO2 Sensor

During review of the building management system, the space CO2 reading for the lecture hall, which is served by AHU-2, was 1 ppm.

SES recommends this sensor is replaced to ensure demand control ventilation programming operates to satisfy actual space requirements.



Recommendation #4: Rebalance Spaces Associated With AHU-4 & 5

During testing, adjusting and balancing, several classrooms were found by TAB to not supply enough air to the space to meet the minimum ventilation requirements for the space. Each space below is served by their own dedicated VAV.

SES recommends the following spaces are re-balanced to supply the following supply air CFM provided in the table below.

Associated AHU	Space	TAB Airflow (CFM)	Required Airflow (CFM)
AHU-4	Classroom 209	297	425
AHU-4	Classroom 211	271	400
AHU-4	Classroom 224	282	405
AHU-5	Classroom 311	228	350



Recommendation #5: Filter Improvements

Currently, all air handling units were found to utilize MERV 8 or 10 filters.

SES recommends replacing and upgrading all final filters to at least MERV 13 for increased filtration efficiency.

Next Steps

Review Recommendations

It is recommended that the client review this report and the proposed recommendations for further clarification, if needed and decide a course of action. SES can provide additional assistance if needed, to further analyze and develop these recommendations for future implementation, and if desired, provide commissioning of the implemented measures.



Appendix A: IAQ Evaluation Sheet

			Filters (1 - clean, 2 - partially loaded, 3 - dirty)					TAB Measured						
Tag	AREA SERVED	Type	Pre-Filter Condition	Final Filter Conditon	Unit Condition	Outside Air Control Method	CO2 Control?	Supply Airflow2	Min. Outside Airflow3	% OA	Summated OA Airflow	Calculated Min. Outside Airflow2	% OA of TAB	Comments
AHU 1	Admin	Multi-Zone Variable Volume	2	2	GOOD	Fixed Minimum	Yes	1,897	1897	14%	266	270	14%	
AHU 2	Lecture Hall	Single Zone Constant Volume	2	2	GOOD	Fixed Minimum	Yes	7,534	-	7%	556	560	7%	
AHU 3	Level 1 & 2 North Classrooms	Multi-Zone Variable Volume	2	2	GOOD	Fixed Minimum	Yes	7,585	2,799	62%	4,680	4,690	62%	
AHU 4	Level 1 & 2 South East Classrooms	Multi-Zone Variable Volume	2	2	GOOD	Fixed Minimum	Yes	9,480	9,480	33%	3,159	3,160	33%	
AHU 5	Level 3	Multi-Zone Variable Volume	2	2	GOOD	Fixed Minimum	Yes	7,204	7,204	43%	3,078	3,080	43%	

IMC 2021 Ventilation Assessment																	
Unit Tag	Room #	Category	Infiltration	ZoneArea, Az, per space (SF)	Zone Population, Pz, per space	People OA Rate in Breathing Zone, Rp (CFM/person)	Area OA Rate in Breathing Zone, Ra (CFM/SF)	Default Occupant Density	Breathing Zone OA (CFM) Vbz=RpPz+RaAz	Table 6-2 Zone Air Distribution Effectiveness	Zone OA Flow, Voz	Min. Ventilation Airflow (CFM)	Actual Supply Airflow (CFM)	RTU % OA	Actual Ventilation Airflow (CFM)	Ventilation Difference (CFM)	Code Satisfied?
AHU 1	Corridor 114N	Corridors	No	431.25	15	0	0.06	0	26	1	26	26	272	100%	272	246	Yes
AHU 1	Corridor 104	Corridors	No	622.5	15	0	0.06	0	37	1	37	37	236	100%	236	199	Yes
AHU 1	Office 105	Office spaces	No	536	6	5	0.06	5	62	1	62	62	125	100%	125	63	Yes
AHU 1	Workroom 107	Conference rooms	No	120.75	4	5	0.06	50	27	1	27	27	32	100%	32	5	Yes
AHU 1	Office 108	Office spaces	No	266.5	9	5	0.06	5	61	1	61	61	97	100%	97	36	Yes
AHU 1	Office 109	Office spaces	No	208	3	5	0.06	5	27	1	27	27	42	100%	42	15	Yes
AHU 1	Office 110	Office spaces	No	162.75	3	5	0.06	5	25	1	25	25	30	100%	30	5	Yes
AHU 2	Auditorium	Auditoriums	No	3024	75	5	0.06	150	556	1	556	556	7,534	0%	-	(556)	No
AHU 3	Classroom 116	Computer Lab	No	1424	24	10	0.12	25	411	1	411	411	298	37%	110	(301)	No
AHU 3	Classroom 119	Classrooms (ages 9 plus)	No	845.25	24	10	0.12	35	341	1	341	341	312	37%	115	(226)	No
AHU 3	Classroom 123	Wood/metal shop	No	1181.25	22	10	0.18	20	433	1	433	433	783	37%	289	(144)	No
AHU 3	Office 121	Office spaces	No	148.5	6	5	0.06	5	39	1	39	39	0	37%	-	(39)	No
AHU 3	Corridor 101N	Corridors	No	1717.5	35	0	0.06	0	103	1	103	103	299	37%	110	7	Yes
AHU 3	Corridor 101S	Corridors	No	1717.5	35	0	0.06	0	103	1	103	103	589	37%	217	114	Yes
AHU 3	Corridor 217N	Media Center	Yes	2793	60	10	0.12	25	935	1	935	935	422	37%	156	(779)	No
AHU 3	Corridor 217S	Media Center	Yes	2793	60	10	0.12	25	935	1	935	935	1780	37%	657	(278)	No
AHU 3	Classroom 204	Classrooms (ages 9 plus)	No	1083	27	10	0.12	35	400	1	400	400	312	37%	115	(285)	No
AHU 3	Classroom 216	Classrooms (ages 9 plus)	No	1794.5	37	10	0.12	35	585	1	585	585	426	37%	157	(428)	No
AHU 3	Classroom 218	Classrooms (ages 9 plus)	No	855	25	10	0.12	35	353	1	353	353	339	37%	125	(228)	No
AHU 3	Office 213	Office spaces	No	199.5	6	5	0.06	5	42	1	42	42	91	37%	34	(8)	No
AHU 4	Corridor 115	Corridors	No	782	25	0	0.06	0	47	1	47	47	230	100%	230	183	Yes
AHU 4	Office 134	Office spaces	No	218.5	3	5	0.06	5	28	1	28	28	121	100%	121	93	Yes
AHU 4	Classroom 132	Science laboratories	No	2090	25	10	0.18	25	626	1	626	626	692	100%	692	66	Yes
AHU 4	Office 133	Office spaces	No	138	4	5	0.06	5	28	1	28	28	38	100%	38	10	Yes
AHU 4	Classroom 127	Science laboratories	No	1161	24	10	0.18	25	449	1	449	449	1226	100%	1,226	777	Yes
AHU 4	Corridor 135N	Corridors	No	468	20	0	0.06	0	28	1	28	28	981	100%	981	953	Yes
AHU 4	Corridor 135S	Corridors	No	468	20	0	0.06	0	28	1	28	28	586	100%	586	558	Yes
AHU 4	Corridor 212	Classrooms (ages 9 plus)	No	1092	23	10	0.12	35	361	1	361	361	556	100%	556	195	Yes
AHU 4	Classroom 209	Classrooms (ages 9 plus)	No	1260	27	10	0.12	35	421	1	421	421	297	100%	297	(124)	No
AHU 4	Office 210	Office spaces	No	141.75	3	5	0.06	5	24	1	24	24	32	100%	32	8	Yes
AHU 4	Classroom 211	Classrooms (ages 9 plus)	No	871	29	10	0.12	35	395	1	395	395	271	100%	271	(124)	No
AHU 4	Classroom 224	Classrooms (ages 9 plus)	No	1007.5	28	10	0.12	35	401	1	401	401	282	100%	282	(119)	No
AHU 4	Corridor 208	Corridors	Yes	467.5	15	0	0.06	0	28	1	28	28	275	100%	275	247	Yes
AHU 4	Corridor 226N	Corridors	Yes	468	20	0	0.06	0	28	1	28	28	329	100%	329	301	Yes
AHU 4	Corridor 226S	Corridors	Yes	468	20	0	0.06	0	28	1	28	28	533	100%	533	505	Yes
AHU 4	Corridor 227S	Corridors	Yes	614.25	15	0	0.06	0	37	1	37	37	357	100%	357	320	Yes
AHU 4	Classroom 222	Media Center	No	360.75	13	10	0.12	25	173	1	173	173	429	100%	429	256	Yes
AHU 4	Office 223	Office spaces	No	228	3	5	0.06	5	29	1	29	29	105	100%	105	76	Yes
AHU 5	Corridor 301N	Corridors	Yes	848.25	20	0	0.06	0	51	1	51	51	324	100%	324	273	Yes
AHU 5	Corridor 301S	Corridors	Yes	848.25	20	0	0.06	0	51	1	51	51	0	100%	-	(51)	No
AHU 5	Office 302	Office spaces	No	161	5	5	0.06	5	35	1	35	35	138	100%	138	103	Yes
AHU 5	Office 304	Office spaces	No	210	8	5	0.06	5	53	1	53	53	323	100%	323	270	Yes
AHU 5	Office 305	Office spaces	No	210	4	5	0.06	5	33	1	33	33	159	100%	159	126	Yes
AHU 5	Classroom 313	Science laboratories	No	1387.75	24	10	0.18	25	490	1	490	490	756	100%	756	266	Yes
AHU 5	Classroom 317	Classrooms (ages 9 plus)	No	1462.5	24	10	0.12	35	416	1	416	416	526	100%	526	111	Yes
AHU 5	Corridor 312	Classrooms (ages 9 plus)	No	1,445	24	10	0.12	35	413	1	413	413	337	100%	337	(76)	No
AHU 5	Office 310	Office spaces	No	200	6	5	0.06	5	42	1	42	42	89	100%	89	47	Yes
AHU 5	Classroom 311	Classrooms (ages 9 plus)	No	866	24	10	0.12	35	344	1	344	344	228	100%	228	(116)	No
AHU 5	Classroom 320	Science laboratories	No	1,223	26	10	0.18	25	480	1	480	480	800	100%	800	320	Yes
AHU 5	Classroom 319	Science laboratories	No	1,298	28	10	0.18	25	514	1	514	514	525	100%	525	11	Yes
AHU 5	Corridor 325	Corridors	Yes	660	20	0	0.06	0	40	1	40	40	195	100%	195	155	Yes
AHU 5	Corridor 309	Corridors	Yes	495	20	0	0.06	0	30	1	30	30	282	100%	282	252	Yes
AHU 5	Corridor 322N	Corridors	Yes	468	20	0	0.06	0	28	1	28	28	306	100%	306	278	Yes
AHU 5	Corridor 322S	Corridors	Yes	468	20	0	0.06	0	28	1	28	28	361	100%	361	333	Yes
AHU 5	Office 321	Office spaces	No	209	4	5	0.06	5	33	1	33	33	122	100%	122	89	Yes

Unit Tag	Room #	Category	ZoneArea, Az, per space (SF)	TAB Exhaust CFM	# of Toilets	Calc'd Exhaust CFM	Ventilation Difference (CFM)	Code Satisfied?	Comments
	Girls BR 111	Toilet rooms - private	254	95	3	75	20	Yes	
	Unisex BR 137	Toilet rooms - private	64	34	1	25	9	Yes	
	Boys BR 112	Toilet rooms - private	173	75	3	75	-	Yes	
	Boys BR 206	Toilet rooms - private	173	77	3	75	2	Yes	
	Men's BR 229	Toilet rooms - private	64	38	1	25	13	Yes	
	Grils BR 205	Toilet rooms - private	234	94	3	75	19	Yes	
	Girls BR 306	Toilet rooms - private	234	98	3	75	23	Yes	
	Women's BR 328	Toilet rooms - private	64	50	1	25	25	Yes	
	Boys BR 307	Toilet rooms - private	173	80	3	75	5	Yes	

Notes

No fresh air requirements for public bathrooms, only exhaust. Exhaust is 50 CFM or 70 CFM per water closet or urinal. If exhaust fan is intermittent than the higher value is used.

No fresh air requirements for private bathrooms, only exhaust. Exhaust is 25 CFM or 50 CFM per water closet or urinal. If exhaust fan is intermittent than the higher value is used.

No fresh air requirements for shower rooms, only exhaust. Exhaust is 20 CFM or 50 CFM per shower head. If exhaust fan is intermittent than the higher value is used.

Corridors are .06 CFM/sf only

Locker rooms are exhasut only at 0.5 CFM/sf

Corridors are .06 CFM/sf only



Appendix B: International Mechanical Code Minimum Ventilation Rates (2021) per ASHRAE 62.1

Minimum Ventilation Rates in Breathing Zone		People Outdoor Air Rate <i>R_p</i>	Area Outdoor Air Rate <i>R_a</i>	Default Values (Occupant Density)	Air Class	OS (6.2.6.1.4)	Comments
Occupancy Classification	Category	cfm/person	cfm/sf	#/1000sf			
Educational Facilities	Art Classroom	10	0.18	20	2	No	
Educational Facilities	Classrooms (ages 5 to 8)	10	0.12	25	1	No	
Educational Facilities	Classrooms (ages 9 plus)	10	0.12	35	1	No	
Educational Facilities	Computer Lab	10	0.12	25	1	No	
Educational Facilities	Daycare Sickroom	10	0.18	25	3	No	
Educational Facilities	Daycare (through age 4)	10	0.18	25	2	No	
Educational Facilities	Auditoriums	5	0.06	150	0		
Educational Facilities	Lecture Classroom	7.5	0.06	65	1	Yes	Per ASHRAE, lecture classrooms are spaces with low space generated emissions and hard surfaces. Little off gassing so reduced levels. Most standard classrooms will be lecture classroom type.
Educational Facilities	Lecture hall (fixed seats)	7.5	0.06	150	1	Yes	University style (see occupant density)
Educational Facilities	Libraries	5	0.12	10	n/a	No	
Educational Facilities	Media Center	10	0.12	25	1	No	
Educational Facilities	Multiuse assembly	7.5	0.06	100	1	Yes	
Educational Facilities	Music/theater/dance	10	0.06	35	1	Yes	
Educational Facilities	Science laboratories	10	0.18	25	2	No	
Educational Facilities	University/college laboratories	10	0.18	25	2	No	
Educational Facilities	Sports locker rooms	0	-0.7	0	0	No	
Educational Facilities	Wood/metal shop	10	0.18	20	2	No	
Food and Beverage	Bars, cocktail lounges	7.5	0.18	100	2	No	
Food and Beverage	Cafeteria/fast-food dining	7.5	0.18	100	2	No	
Food and Beverage	Kitchen (cooking)	7.5	0.18	20	2	No	
Food and Beverage	Restaurant dining rooms	7.5	0.18	70	2	No	
Private Dwellings	Toilet rooms - private	0	0	0	0		
Offices	Conference rooms	5	0.06	50	1	Yes	
Offices	Main entry lobbies	5	0.06	10	1	Yes	
Offices	Office spaces	5	0.06	5	1	Yes	
Offices	Reception areas	5	0.06	30	1	Yes	
Offices	Telephone/data entry	5	0.06	60	1	Yes	
Public spaces	Corridors	0	0.06	0			
Public spaces	Shower room	0	0	0			
Public spaces	Toilet rooms - public	0	0	0			
Public Assembly Spaces	Auditorium seating area	5	0.06	150	1	Yes	
Public Assembly Spaces	Libraries	5	0.12	10	1	No	
Public Assembly Spaces	Toilet rooms - public	0	0	0			
Sports and Entertainment	Bowling alley (seating)	10	0.12	40	1	No	
Sports and Entertainment	Disco/dance floors	20	0.06	100	2	Yes	
Sports and Entertainment	Gambling casinos	7.5	0.18	120	1	No	
Sports and Entertainment	Game arcades	7.5	0.18	20	1	No	
Sports and Entertainment	Gym, sports arena (play area)	20	0.18	7	2	No	
Sports and Entertainment	Health club/aerobics room	20	0.06	40	2	No	
Sports and Entertainment	Health club/weight room	20	0.06	10	2	No	
Sports and Entertainment	Spectator areas	7.5	0.06	150	1	Yes	
Sports and Entertainment	Stages, studios	10	0.06	70	1	Yes	
Sports and Entertainment	Swimming (pool and deck)	0	0.48	0	2	No	

Minimum Exhaust Rates				
Occupancy Classification	Category	CFM/fixture	CFM/SF	Comments
Educational Facilities	Toilet rooms - public	50	0	20
Educational Facilities	Toilet rooms - private	25	0	
Educational Facilities	Shower rooms	20	0	
Educational Facilities	Sports locker rooms	0	0.5	