

# **Building Ventilation Performance Levels Disclosure**

*Provide the following information to your organization*

**Date:**

**Submitted by Name / Organization:**

**Submitted To:**

**Email:**

**Phone:**

---

## **BACKGROUND**

In 2020 the US was hit with the COVID-19 pandemic and to deal with the disaster the CDC guidance has been to get vaccinated and ensure proper ventilation in our buildings. Everyone is focused on vaccinations but little education has been offered on ventilation performance levels and the need for disclosure.

When considering airborne contagions in buildings, ventilation performance levels are provided in terms of Air Changes per Hour (ACH). The CDC recommends 12 ACH for hospital rooms with airborne contagions [1]. The Philadelphia restaurant program set a requirement of 15 ACH for restaurants that could then increase their capacity as an incentive [2.1 to 2.4]. Hawaiian Airlines discloses their ventilation performance levels on their entertainment screens.

This facility may not have voluntarily disclosed the ventilation performance levels in various parts of the building or buildings. If it has disclosed ventilation performance levels then please let us know so that we can add you to the online Clean Air Buildings Database at:

<https://www.cassbeth.com/cleanairbuildings/index.html>.

## **FACTS BEARING ON THE ISSUE**

We know that people will get infected with airborne contagions when the ventilation is off; the ACH=0. We also know from empirical data that people get infected with COVID-19 when the ACH=1 [3.1 to 3.3]. As the ACH level increases, the risk of infection decreases. As one walks through many buildings it is obvious that some areas have poor ventilation performance levels; the air is stale and stagnant.

Public building maintenance is a challenge. Even the best facility management teams have issues like blocked vents, partially closed dampers because of complaints of hot or cold air, timers are not working properly, and sensors, fans, and dampers stop working properly [3.3].

## **RECOMMENDATIONS**

Following the lead of others, the recommendation are to follow what the Philadelphia Restaurant program established as a road map [2.1 to 2.4]:

1. Gather design data from the HVAC vendor(s) for each area serviced (sq-ft and cu-ft) and the expected ventilation rate (fan cubic feet per minute - CFM). Using the data calculate, the design ACH levels.  $ACH = \text{Fan Cubic-feet per Hour} / \text{Room Cubic-feet}$ .
2. Using anemometers, measure the air flow from each vent for each serviced area. Calculate the measured ACH levels and compare the measured data with the design data.
3. Disclose the ACH levels for each area via email and on the website.
4. Post certificates in each area showing the measured ACH levels.
5. Update the certificates every 3 months.

It is expected that some areas will have great ventilation with 12+ ACH, some areas will have good ventilation and, some areas will have poor ventilation with 0-1 ACH.

Periodic inspections with documented evidence using certificates that are posted for public viewing will ensure effective maintenance. The goal is to not pass judgement on the ACH level, the goal is to just disclose the level. Determining appropriate ACH levels is part of a next phase effort and may be part of a national long term Ventilation Evaluation Program.

Since the HVAC system must be maintained and follow the appropriate building codes [4.1 to 4.3], the financial costs are minimal. It is expected that the HVAC vendor(s) must produce balance reports as part of normal system maintenance. The balance reports should have the area serviced (fan CFM) and space (sq-ft and cu-ft) data. Adding a column to a spreadsheet to calculate the ACH levels is trivial and can be performed by anyone. The HVAC(s) vendors do not need to perform the calculation.

The Philadelphia School district used 5 vendors to produce balance reports for 230+ schools with 13,000+ rooms and they posted the spreadsheets online [5]. Adding the ACH column was simple. This is an example of what can be done to understand complex building portfolio ventilation performance levels. This analysis can be furnished upon request.

### **ANTICIPATED BENEFITS**

Lowering the airborne contagion level in your building will reduce healthcare costs. There are multiple studies showing the financial benefits of reducing Flu infections. [6.1 to 6.3]

Posting Ventilation Performance Level Certificates will show the public that the building operators care about the system ventilation. This will help to add to the public confidence that management is doing the right thing and not hiding problems. Instead management is actively solving problems, this is a great workforce and customer motivator.

Analysis clearly shows that if this effort were to be adopted across the US, there would be a significant drop in COVID-19 infections and deaths. [7.1 to 7.3]

## **ANTICIPATED IMPACTS**

It is possible that your HVAC vendor is treating the ventilation data as proprietary and that the contract vehicle must change. Their only responsibility might be to just sign a statement that they are complying with the appropriate codes. If that is the case, the contracts must change moving forward to allow for new oversight, which now must include disclosing the ventilation performance levels and HVAC sizing so that ACH levels can be determined.

In the mean time you can perform your own building ventilation performance level assessment. The process is simple and requires an anemometer for \$19 and a tape measure. A 1 to 2 person team can quickly do the measurements. [2.1 to 2.4]

If you perform this simple work it can be used as an example for the rest of the community, country, and world to follow. This is not the first time that the those at the ground level have led to solve significant problems.

COVID-19 is endemic, it is like tuberculosis, measles, and other airborne contagions from the previous century. It has been a leading cause of death for 2 years. To eventually eliminate tuberculosis and other airborne contagions, it took vaccines and modern forced air heat and cooling systems. Our building ventilation systems have been ignored during the time of great health when our parents and grandparents understood building ventilation.

From Time Magazine February 1, 2022: If We're Going to Live With COVID-19, It's Time to Clean Our Indoor Air Properly, Edward A. Nardell is Professor of Global Health and Social Medicine, Harvard Medical School.

*COVID-variants may be with us for years to come, and this will certainly not be the last respiratory virus pandemic. We have long suffered from annual contagious respiratory infections, but exceptionally low rates of influenza and common colds during COVID-precautions have demonstrated that not all of this suffering need happen. So, we need to think clearly and scientifically about how better we can reduce the spread of viruses indoors especially when and where masks will no longer be in common use.*

*Are there effective engineering controls that can help make indoor environments truly safer?*

In May of 2021, 39 scientists published "A Paradigm Shift to Combat Indoor Respiratory Infection"

*There is great disparity in the way we think about and address different sources of environmental infection. Governments have for decades promulgated a large amount of legislation and invested heavily in food safety, sanitation, and drinking water for public health purposes. By contrast, airborne pathogens and respiratory infections, whether seasonal influenza or COVID-19, are addressed weakly, if at all, in terms of regulations, standards, and building design and operation, pertaining to the air we breathe.*

There are always unintended consequences but it is difficult to see negative impacts at this point. The anticipated positive impacts are huge and can save lives in the years to come now that we have airborne contagions that cause serious illness and death.

**Example Building Areas Ventilation Performance Disclosure Spreadsheet**

No	Building 300 Areas	AHU ID	Sq-Ft	Cu-Ft	CFM	CFH	No of Vents	ACH	Date
1.	2d Floor Lab 03		1380	17940	4830	289800	23	16.1	4/27/2022
2.	2d Floor Lab 11		760	9880	919.2	55152	4	5.5	4/27/2022
3.	2d Floor Lab 12		720	9360	2071.3	124278	14	13.2	4/27/2022
4.	2d Floor Lab 19		456	5928	1032	61920	5	10.4	4/27/2022
5.	3d Floor Office 300K21								
6.	1st Floor Auditorium								
7.	1st Floor Atrium								
8.	1st Floor Day Care								
9.	1st Floor Credit Union								
10.	1st Floor Cafeteria								
11.	1st Floor Men’s Room 1								
12.	1st Floor Women’s Room 1								

Notes

1. AHU: Air Handling Unit
2. Site survey data gather rate estimated to be 10 min per 1000 sq-ft or 167 hours per 1 million sq-ft.
3. Data gather approaches are (1) dedicated team or (2) provide instructions and let space occupant organization gather the data and self report, similar to Philadelphia Restaurant program.

**Example Buildings Ventilation Performance Disclosure Spreadsheet**

No	Area	ACH min	ACH max	ACH Avg	Date
1.	Building 300 Office Area				
2.	Building 300 Labs				
3.	Building 316 Office Area				
4.	Building 316 Labs				
5.	Hanger				
6.					

---

## Room Ventilation Performance Disclosure Certificate

---

**Room / Zone Name:**

**Square feet:**

**Cubic feet:**

**CFM:**

**ACH Level:**

**Vents Unblocked: yes/no**

**Dampers Open: yes/no**

**Timers Working: yes/no**

**Inspection Authority and Date:**

**Comments:**

---

**Authority**

**Date**

Clean Air Buildings Database: <https://www.cassbeth.com/cleanairbuildings/index.html>

---

# Building Ventilation Performance Disclosure Certificate

---

**Building Name & Address:**

**Square feet:**

**Cubic feet:**

**CFM:**

**Min ACH Level:**

**Max ACH Level:**

**Average ACH Level:**

**Comments:**

---

**Authority**

**Date**

Clean Air Buildings Database: <https://www.cassbeth.com/cleanairbuildings/index.html>

## **REFERENCES**

### CDC ACH Guidelines

[1] CDC Appendix B. Air Guidelines for Environmental Infection Control in Health-Care Facilities (2003)

<https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html>

[1.2] CDC Guidelines for Environmental Infection Control in Health-Care Facilities, July 2019.

<https://www.cdc.gov/infectioncontrol/pdf/guidelines/environmental-guidelines-P.pdf>

### Philadelphia Restaurant Program

[2.1] Enhanced Ventilation Standards for Indoor Dining and Application Form for Increased Dining Capacity, City of Philadelphia, February 14, 2021. webpage

[https://www.phila.gov/media/20210216105327/Enhanced-Ventilation-Standards-for-Indoor-Dining\\_2\\_16\\_21.pdf](https://www.phila.gov/media/20210216105327/Enhanced-Ventilation-Standards-for-Indoor-Dining_2_16_21.pdf)

[2.2] Food Establishments That Have Met Enhanced Ventilation Standards to Allow for Increased Indoor Dining Capacity, City of Philadelphia, March 09, 2021. webpage

[https://www.phila.gov/media/20210311122403/50CapacityRestaurants\\_030921.pdf](https://www.phila.gov/media/20210311122403/50CapacityRestaurants_030921.pdf)

[2.3] EHS Enhanced Ventilation Standards for Indoor Dining, February 16, 2021. webpage

<https://www.youtube.com/watch?v=HlneLDi9r54>

[2.4] EHS TIPS Enhanced Ventilation Standards for Indoor Dining, February 16, 2021. webpage

<https://www.youtube.com/watch?v=58uRfAxh6Cw>

### School Case History

[3.1] 8 Classmates, 2 Fully Vaccinated Family Members, Test Positive for COVID in Lower Merion, NBC 10 Philadelphia, April 25, 2021. webpage

<https://www.nbcphiladelphia.com/news/coronavirus/8-classmates-2-fully-vaccinated-family-members-test-positive-for-covid-in-lower-merion/2791754>

[3.2] Lower Merion School District says a ventilation flaw could have fueled a COVID-19 outbreak in second-grade classroom, The Philadelphia Inquirer, April 26, 2021. webpage

<https://www.inquirer.com/education/lower-merion-school-district-penn-valley-covid-outbreak-hvac-20210426.html>

[3.3] Drexel Faculty Meeting. The Lower Merion School District staff evaluated the classroom HVAC system and found that a part within the ductwork above the ceiling was mostly closed allowing only about 30% of the maximum amount of fresh air into the room where the 2d grade children were infected. The design requirement for the school HVAC system is 375 CFM and the measured rate was 120 CFM for the affected classroom.

## Building Codes and Standards

[4.1] International Building Code (IBC), webpage, [https://codes.iccsafe.org/content/IBC2018P3/chapter-12-interior-environment#IBC2018P3\\_Ch12\\_Sec1202](https://codes.iccsafe.org/content/IBC2018P3/chapter-12-interior-environment#IBC2018P3_Ch12_Sec1202), <https://codes.iccsafe.org/content/IBC2021P2/index>

[4.2] International Mechanical Code (IMC), webpage <https://codes.iccsafe.org/content/IMC2015/chapter-4-ventilation>

[4.3] American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), webpage <https://www.ashrae.org>

## Philadelphia Schools Site Survey Balance Reports

[5] Philadelphia School District, Ventilation and Air Balance Reports, City of Philadelphia. March 22, 2021. webpage <https://docs.google.com/spreadsheets/d/18Kn2h5zS6ivX27-msM2Pdy10HUUWaUAomAaXJJ2FK7w/edit#gid=999445241>

## Flu Season Costs

[6.1] Flu Season to Cost Business \$17B in Lost Productivity, New Jersey Business & Industry Association NJBIA, January 17, 2019. webpage <https://njbia.org/flu-season-to-cost-business-17b-in-lost-productivity>

[6.2] Past Seasons Estimated Influenza Disease Burden, Centers for Disease Control and Prevention, October 01, 2020, webpage <https://www.cdc.gov/flu/about/burden/past-seasons.html>

[6.3] Inpatient Hospital Stays and Emergency Department Visits Involving Influenza, 2006-2016, Agency for Healthcare Research and Quality, October 2019. webpage <https://www.hcup-us.ahrq.gov/reports/statbriefs/sb253-Influenza-Hospitalizations-ED-Visits-2006-2016.jsp>

## COVID-19 Research From a Systems Perspective

[7.1] COVID-19 A Systems Perspective, Walter Sobkiw, February 15, 2021, Cassbeth, 650 pages. ISBN 978-0983253044.

[7.2] Clean Air Buildings Database. <https://www.cassbeth.com/cleanairbuildings/index.html>

[7.3] COVID-19 Research From A Systems Perspective. <https://www.cassbeth.com/covid-19/index.html>



## ACH LEVELS

<https://www.cdc.gov/infectioncontrol/guidelines/environmental/appendix/air.html>

	<b>Area</b>	<b>ACH min</b>	<b>ACH max</b>	<b>ACH Avg</b>	<b>Source</b>
274	Hospital Operating/surgical cystoscopic rooms	15			CDC
275	Hospital Delivery room	15			CDC
276	Hospital Recovery room	6			CDC
277	Hospital Critical and intensive care	6			CDC
278	Hospital Newborn intensive care	6			CDC
279	Hospital Treatment room	6			CDC
280	Hospital Trauma room	15			CDC
281	Hospital Anesthesia gas storage	8			CDC
282	Hospital Endoscopy	6			CDC
283	Hospital Bronchoscopy	12			CDC
284	Hospital ER waiting rooms	12			CDC
285	Hospital Triage	12			CDC
286	Hospital Radiology waiting rooms	12			CDC
287	Hospital Procedure room	15			CDC
288	Hospital Patient room	6			CDC
289	Hospital Toilet room	10			CDC
290	Hospital Newborn nursery suite	6			CDC
291	Hospital Protective environment room	12			CDC
292	Hospital Airborne infection isolation room	12			CDC
293	Hospital Isolation alcove or anteroom	10			CDC
294	Hospital Labor/delivery/recovery	6			CDC
295	Hospital Labor/delivery/recovery/ postpartum	6			CDC
296	Hospital Patient corridor	2			CDC
297	Hospital X-ray (surgical/critical care and catheterization)	15			CDC
298	Hospital X-ray (diagnostic & treatment)	6			CDC
299	Hospital Darkroom	10			CDC
300	Hospital General	6			CDC
301	Hospital Biochemistry	6			CDC
302	Hospital Cytology	6			CDC
303	Hospital Glass washing	10			CDC
304	Hospital Histology	6			CDC
305	Hospital Microbiology	6			CDC
306	Hospital Nuclear medicine	6			CDC
307	Hospital Pathology	6			CDC
308	Hospital Serology	6			CDC
309	Hospital Sterilizing	10			CDC
310	Hospital Autopsy room	12			CDC
311	Hospital Nonrefrigerated body-holding room	10			CDC
312	Hospital Pharmacy	4			CDC
313	Hospital Examination room	6			CDC

	<b>Area</b>	<b>ACH min</b>	<b>ACH max</b>	<b>ACH Avg</b>	<b>Source</b>
314	Hospital Medication room	4			CDC
315	Hospital Treatment room	6			CDC
316	Hospital Physical therapy and hydrotherapy	6			CDC
317	Hospital Soiled workroom or soiled holding	10			CDC
318	Hospital Clean workroom or clean holding	4			CDC
319	Hospital ETO-sterilizer room	10			CDC
320	Hospital Sterilizer equipment room	10			CDC
321	Hospital Soiled or decontamination room	6			CDC
322	Hospital Clean workroom	4			CDC
323	Hospital Sterile storage	4			CDC
324	Hospital Food preparation center	10			CDC
325	Hospital Ware washing	10			CDC
326	Hospital Dietary day storage	2			CDC
327	Hospital Laundry general	10			CDC
328	Hospital Soiled linen (sorting and storage)	10			CDC
329	Hospital Clean linen storage	2			CDC
330	Hospital Soiled linen and trash chute room	10			CDC
331	Hospital Bedpan room	10			CDC
332	Hospital Bathroom	10			CDC
333	Hospital Janitor's closet	10			CDC
	<b>Max</b>	15			CDC
	<b>Min</b>	2			CDC
	<b>Avg</b>	8			CDC

	<b>Area</b>	<b>ACH min</b>	<b>ACH max</b>	<b>ACH Avg</b>	<b>Source</b>
101	All spaces in general	5		5	EPA / Various
102	Arcades	12	16	12	EPA / Various
103	Assembly halls	6	8	6	EPA / Various
104	Attic spaces for cooling	12	15	12	EPA / Various
105	Auditoriums	8	15	8	EPA / Various
106	Bakeries	20	30	20	EPA / Various
107	Banks	5	10	5	EPA / Various
108	Bank Vaults	6		6	EPA / Various
109	Barber Shops	10	14	10	EPA / Various
110	Bars	20	30	20	EPA / Various
111	Beauty Shops	18	24	18	EPA / Various
112	Bedrooms	4	8	4	EPA / Various
113	Boiler Rooms	15	20	15	EPA / Various
114	Bowling Alleys	14	20	14	EPA / Various
115	Cafeterias	12	15	12	EPA / Various
116	Casino (nonsmoking)	14	18	14	EPA / Various
117	Casino (Smoking)	20	30	20	EPA / Various
118	Classrooms (ART)	16	20	16	EPA / Various
119	Classrooms (ages 5 and up)	12	16	12	EPA / Various
120	Classrooms (science lab)	16	20	16	EPA / Various
121	Classrooms (shop classes)	16	20	16	EPA / Various
122	Churches	8	15	8	EPA / Various
123	Cigar Lounges	20	30	20	EPA / Various
124	Club rooms	12		12	EPA / Various
125	Clubhouses	20	30	20	EPA / Various
126	Coin operated dry cleaner	24	20	24	EPA / Various
127	Coin operated laundries	11	13	11	EPA / Various
128	Cocktail Lounges	20	30	20	EPA / Various
129	Computer Rooms	8	12	8	EPA / Various
130	Commercial dry cleaner	24	30	24	EPA / Various
131	Commercial Laundry	22	26	22	EPA / Various
132	Conference Rooms	5	8	5	EPA / Various
133	Court Houses	4	10	4	EPA / Various
134	Day Care (ages up to 4)	14	18	14	EPA / Various
135	Dance halls	16	20	16	EPA / Various
136	Dental Centers	8	12	8	EPA / Various
137	Department Stores	6	10	6	EPA / Various
138	Dining Halls	12	15	12	EPA / Various
139	Dining rooms (restaurants)	12		12	EPA / Various

	<b>Area</b>	<b>ACH min</b>	<b>ACH max</b>	<b>ACH Avg</b>	<b>Source</b>
140	Dress Shops	6	10	6	EPA / Various
141	Drug Shops	6	10	6	EPA / Various
142	Dry Cleaners	6	20	6	EPA / Various
143	Engine rooms	4	6	4	EPA / Various
144	Factory buildings, ordinary	2	4	2	EPA / Various
145	Factory buildings, with fumes or moisture	10	15	10	EPA / Various
146	Fast Food	12	14	12	EPA / Various
147	Fire Stations	4	10	4	EPA / Various
148	Food Processing	10	25	10	EPA / Various
149	Foundries	15	20	15	EPA / Various
150	Galvanizing plants	20	30	20	EPA / Various
151	Garages repair	20	30	20	EPA / Various
152	Garages storage	4	6	4	EPA / Various
153	Health Club	20	26	20	EPA / Various
154	Homes, night cooling	10	18	10	EPA / Various
155	Hookah	20	30	20	EPA / Various
156	Hospital rooms	6	10	6	EPA / Various
157	Kitchens (commercial)	15	30	15	EPA / Various
158	Kitchens (residential)	8	14	8	EPA / Various
159	Laundries	10	15	10	EPA / Various
160	Libraries, public	5		5	EPA / Various
161	Lunchrooms	12	15	12	EPA / Various
162	Luncheonettes	12	15	12	EPA / Various
163	Nightclubs	20	30	20	EPA / Various
164	Machine shops	6	12	6	EPA / Various
165	Malls	6	10	6	EPA / Various
166	Meat Processing	20	26	20	EPA / Various
167	Medical Centers	8	12	8	EPA / Various
168	Medical Clinics	8	12	8	EPA / Various
169	Medical Offices	8	12	8	EPA / Various
170	Mills, paper	15	20	15	EPA / Various
171	Mills, textile general buildings	5		5	EPA / Various
172	Mills, textile dye houses	15	20	15	EPA / Various
173	Money Counting room	8	15	8	EPA / Various
174	Municipal Buildings	5	10	5	EPA / Various
175	Museums (Children's)	12	15	12	EPA / Various
176	Museums / Galleries	10	14	10	EPA / Various
177	Nail Salons	18	24	18	EPA / Various
178	Offices, public	5		5	EPA / Various
179	Offices, private	5		5	EPA / Various

	<b>Area</b>	<b>ACH min</b>	<b>ACH max</b>	<b>ACH Avg</b>	<b>Source</b>
180	Photo dark rooms	10	15	10	EPA / Various
181	Pharmacy Prep	8	10	8	EPA / Various
182	Pig houses	6	10	6	EPA / Various
183	Pet Shops	12	14	12	EPA / Various
184	Photo Studios	6	8	6	EPA / Various
185	Police Stations	5	10	5	EPA / Various
186	Post Offices	5	10	5	EPA / Various
187	Poultry houses	6	10	6	EPA / Various
188	Precision Manufacturing	10	50	10	EPA / Various
189	Public Retail Stores	6	10	6	EPA / Various
190	Pump rooms	5		5	EPA / Various
191	Residences	4	6	4	EPA / Various
192	Restaurants	8	12	8	EPA / Various
193	Retail	6	10	6	EPA / Various
194	School Classrooms	4	12	4	EPA / Various
195	Shoe Shops	6	10	6	EPA / Various
196	Shopping Centers	6	10	6	EPA / Various
197	Shops, machine	5		5	EPA / Various
198	Shops, paint	15	20	15	EPA / Various
199	Shops, woodworking	5		5	EPA / Various
200	Smoking Lounges	20	30	20	EPA / Various
201	Substation, electric	5	10	5	EPA / Various
202	Supermarkets	8	10	8	EPA / Various
203	Swimming pools	20	30	20	EPA / Various
204	Town Halls	5	10	5	EPA / Various
205	Taverns (nonsmoking)	14	18	14	EPA / Various
206	Taverns (Smoking)	20	30	20	EPA / Various
207	Theaters	8	15	8	EPA / Various
208	Transformer rooms	10	20	10	EPA / Various
209	Turbine rooms, electric	5	10	5	EPA / Various
210	Vape Shop	20	30	20	EPA / Various
211	Warehouses	6	30	6	EPA / Various
212	Waiting rooms, public	5		5	EPA / Various
213	Welding Areas	12	16	12	EPA / Various
	<b>Max</b>	24	50	24	EPA / Various
	<b>Min</b>	2	4	2	EPA / Various
	<b>Avg</b>	11	17	11	EPA / Various

	Area	ACH min	ACH max	ACH Avg	Source
219	Auditorium	8	15	8	Others
220	Bakeries	20	30	20	Others
221	Beauty Shops	6	10	6	Others
222	Boiler Rooms	15	20	15	Others
223	Classrooms	6	20	6	Others
224	Computer Rooms	15	20	15	Others
225	Dental Centers	8	12	8	Others
226	Garages -Repair	20	30	20	Others
227	Hospital Rooms	4	6	4	Others
228	Kitchens	15	60	15	Others
229	Machine Shops	6	12	6	Others
230	Malls	6	10	6	Others
231	Municipal Buildings	4	10	4	Others
232	Police Stations	4	10	4	Others
233	Precision Manufacturing	10	50	10	Others
234	Shops, Paint	15	20	15	Others
235	Wood Shops	5		5	Others
236	Theatres	8	15	8	Others
237	Warehouses	6	30	6	Others
238	Waiting Rooms, Public	4		4	Others
	<b>Max</b>	20	60	20	
	<b>Min</b>	4	6	4	
	<b>Avg</b>	9	21	9	

[https://en.wikipedia.org/wiki/Air\\_changes\\_per\\_hour](https://en.wikipedia.org/wiki/Air_changes_per_hour)

	Area	ACH min	ACH max	ACH Avg	Source
244	Basement Parking	15	30	15	wiki
245	Residential Basement	3	4	3	wiki
246	Bedroom	5	6	5	wiki
247	Residential Bathroom	6	7	6	wiki
248	Residential Living Rooms	6	8	6	wiki
249	Residential Kitchen	7	8	7	wiki
250	Residential Laundry	8	9	8	wiki
251	Business Offices	6	8	6	wiki
252	Business Lunch Break Rooms	7	8	7	wiki
253	Business Conference Rooms	8	12	8	wiki
254	Business Copy Rooms	10	12	10	wiki
255	Computer Rooms	10	14	10	wiki
256	Restaurant Dining Area	8	10	8	wiki
257	Restaurant Food Staging Area	10	12	10	wiki

	Area	ACH min	ACH max	ACH Avg	Source
258	Restaurant Bar	15	20	15	wiki
259	Public Hallway	6	8	6	wiki
260	Public Retail Store	6	10	6	wiki
261	Public Foyer	8	10	8	wiki
262	Church	8	12	8	wiki
263	Public Auditorium	12	14	12	wiki
264	Commercial kitchens & Restrooms	15	30	15	wiki
265	Smoking rooms	15	20	15	wiki
266	Laboratories	6	12	6	wiki
267	Classrooms	3	4	3	wiki
268	Warehousing	3	10	3	wiki
	<b>Max</b>	15	30	15	wiki
	<b>Min</b>	3	4	3	wiki
	<b>Avg</b>	8	12	8	wiki

	Area	ACH min	ACH max	ACH Avg	Source
45	Basements	3	4	3	Others
46	Bedrooms	5	6	5	Others
47	Bathrooms	6	7	6	Others
48	Family Living Rooms	6	8	6	Others
49	Kitchen	7	8	7	Others
50	Laundry	8	9	8	Others
51	Business Offices	6	8	6	Others
52	Lunch Break Rooms	7	8	7	Others
53	Conference Rooms	8	12	8	Others
54	Medical Procedure Offices	9	10	9	Others
55	Copy Rooms	10	12	10	Others
56	Main Computer Rooms	10	14	10	Others
57	Smoking Area	13	15	13	Others
58	Restaurant	8	20	8	Others
59	Dining Area	8	10	8	Others
60	Food Staging	10	12	10	Others
61	Kitchen	14	18	14	Others
62	Bar	15	20	15	Others
63	Public Buildings	6	20	6	Others
64	Hallways	6	8	6	Others
65	Retail Stores	6	10	6	Others
66	Foyers	8	10	8	Others
67	Churches	8	12	8	Others
68	Restrooms	10	12	10	Others
69	Auditorium	12	14	12	Others
70	Smoking Rooms	15	20	15	Others

	Area	ACH min	ACH max	ACH Avg	Source
	<b>Max</b>	15	20	15	
	<b>Min</b>	3	4	3	
	<b>Avg</b>	9	12	9	

	Area	ACH min	ACH max	ACH Avg	Source
76	Attic Ventilation	10		10	Others
77	Auditoriums	4	15	4	Others
78	Banks	4	10	4	Others
79	Battery Charge Room	4		4	Others
80	Boiler Room	15	30	15	Others
81	Computer Room	15	20	15	Others
82	Electrical Room	10	10	10	Others
83	Fire Station	4	10	4	Others
84	Garage (Parking)	5	15	5	Others
85	Garage (Repair)	6	30	6	Others
86	Gymnasium	6	30	6	Others
87	Kitchen (General Ventilation)	12	15	12	Others
88	Locker Room	12	30	12	Others
89	Manufacturing (Light)	5	10	5	Others
90	Manufacturing (Heavy)	10	20	10	Others
91	Medical / Dental Office	8	12	8	Others
92	Municipal Buildings	4	10	4	Others
93	Police Station	4	10	4	Others
94	Toilet Room (Residential)	8		8	Others
95	Warehouse Ventilation	6	15	6	Others
	<b>Max</b>	15	30	15	
	<b>Min</b>	4	10	4	
	<b>Avg</b>	8	17	8	

	Area	ACH min	ACH max	ACH Avg	Source
3	Assembly Hall	6	20	6	Others
4	Attic	15	30	15	Others
5	Auditorium	6	20	6	Others
6	Bakery	20	30	20	Others
7	Bar	15	30	15	Others
8	Barn	3	5	3	Others
9	Boiler Room	20	60	20	Others
10	Bowling Alley	9	20	9	Others
11	Cafeteria	12	20	12	Others
12	Church	6	15	6	Others
13	Classroom	10	15	10	Others
14	Club Room 1	9	20	9	Others
15	Dance Hall	9	20	9	Others



	<b>Area</b>	<b>ACH min</b>	<b>ACH max</b>	<b>ACH Avg</b>	<b>Source</b>
16	Dining Room	8	15	8	Others
17	Dry Cleaner	12	30	12	Others
18	Engine Room	20	60	20	Others
19	Factory	9	30	9	Others
20	Foundry	12	60	12	Others
21	Garage	6	30	6	Others
22	Generator Room	12	30	12	Others
23	Gymnasium	8	20	8	Others
24	Kitchen	12	60	12	Others
25	Laboratory	12	30	12	Others
26	Laundry	15	30	15	Others
27	Machine Shop	10	20	10	Others
28	Mill	8	20	8	Others
29	Office	8	30	8	Others
30	Packing House	12	30	12	Others
31	Projection Room	30	60	30	Others
32	Recreation Room	8	30	8	Others
33	Residence	10	30	10	Others
34	Restaurant	6	12	6	Others
35	Rest Room	9	12	9	Others
36	Store	9	20	9	Others
37	Transfer Room	12	60	12	Others
38	Warehouse	6	20	6	Others
	<b>Max</b>	30	60	30	
	<b>Min</b>	3	5	3	
	<b>Avg</b>	11	29	11	