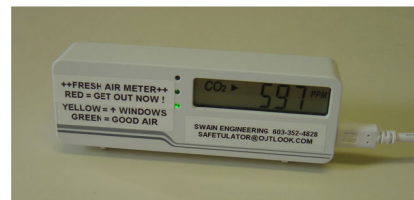


Improving COVID-19 Safety within Buildings
A Do-It-Yourself Guide for Building Operators
Sept. 23, 2021, Revised Oct. 8, 2021, by Roy Swain, P.E.

Ventilation and Air Purification Recommendations

1. For all types of residential and commercial buildings: In each room, maintain as a minimum the fresh air ventilation standard of 21 cubic feet per minute (cfm) per person as recommended by the World Health Organization (WHO). See Appendix 1.
 - 1.1 This level of fresh air can be conveniently measured, with a modest safety factor, as a carbon dioxide (CO₂) reading of 800 parts per million (ppm) or less. (The 800 ppm standard is the same as that established in 2020 for Vermont Schools).
 - 1.2 In each room where you want to display the fresh air status to the occupants, install a large wall-mounted CO₂ meter, which will show “green” at a CO₂ level of 800 ppm or less. (An appropriate and correctly-adjusted meter is available from the author for a current price of \$259.)



- 1.3 In each room where you want only one person to monitor the fresh air status, provide a smaller CO₂ meter with the same color-coded setpoints. (A small, correctly-adjusted meter also is available from the author, for a current price of \$159.)
- 1.4 Open windows, install window fans, or adjust and operate your ventilation system to “keep it in the green”.
- 1.5 If you have a mechanical ventilation system that measures CO₂ and automatically adjusts the amount of fresh air, adjust the CO₂ setpoint to 750 ppm (which includes an extra 50 ppm safety factor because mechanical ventilation control is not always perfect).
- 1.6 If you do not have an adequate ventilation system, consider engineering and constructing a new or improved system, which can keep your building warm and eliminate the need to manually open windows.
- 1.7 NEVER use a CO₂ meter with “automatic background calibration” turned on (even though many meters come from the factory this way). Doing so will ruin the calibration and make the meter worthless.

2. If needed, supplement actual fresh air with virus-free, filtered air from in-room air purifiers.
 - 2.1 See Appendix 2 for selection criteria and recommended air purifiers. Of the three models listed, my current favorite is the Blueair Classic 205 (available from Blueair, or search for “ASIN : B01L7VZX52” on Amazon, where it is currently \$228.)
 - 2.2 Do not run the air purifiers on high speed, or any speed where the noise level exceeds 45 dBA at three feet (which can be measured with any sound level meter). Too much noise exceeds acoustic standards for buildings and is psychologically detrimental.
 - 2.3 Provide enough air purifiers to provide airflow of 10 cfm per person. You don’t need to measure the cfm – just use the manufacturer’s cfm airflow number for the fan speed you choose. One Blueair Classic 205 suffices for up to 14 people.
 - 2.4 Continue to open windows or run your ventilation system in addition to running the air purifiers.
 - 2.5 If you are running air purifiers, then your CO2 meter only needs to be “green” or “yellow” (with the “yellow” indicating a CO2 level of 1000 ppm or less.) Running in the “yellow” provides less actual fresh air and saves energy when the fresh air needs to be heated or air conditioned, and is an adequate level that meets current building code requirements.

Roy’s Personal Practices

3. Require everyone in the building to be fully vaccinated within the last eight months.
 - 3.1 An alternative can be a negative COVID-19 PCR test with the sampling within 48 hours.
 - 3.2 Another alternative can be the BinaxNOW “instant” antigen test which delivers results in 15 minutes. The directions call for doing the test twice, a couple of days apart. But for this instant screening use, only a single test per person needs to be administered. Also note that these test kits (\$12 per test) currently are in very short supply, sell out quickly, and are hard to come by. See Appendix 3.
4. Pay attention to Covid-19 community spread, especially numbers of cases and deaths.
 - 4.1 Best overall information source for your state and county: <https://covidactnow.org/>
 - 4.2 For the odds of having COVID-positive people in your building: <https://covid19risk.biosci.gatech.edu/>
5. When entering a building with unknown fresh air, wear a real N95 mask.
 - 5.1 Cloth face coverings or surgical masks are an inferior choice. I consider their effectiveness to be somewhere between 10% and 68%, based on many studies.
 - 5.2 Instead, wear disposable NIOSH-labeled N95 masks, which I consider to be 90% effective, and are available to the non-medical public. Try different models to find your personal favorite.
 - 5.3 The paper masks can be easily sterilized for reuse by putting the used mask in a small box in a crock pot on low setting. (There is actually a published scientific page on this.)
 - 5.4 Careful adjustment of the fit is critical. If any mask fogs up your glasses, or leaks around the edges, or does not move in and out when you breathe, then it is not adjusted properly.
 - 5.5 Take a CO2 meter into the building with you, and leave promptly if the meter is not “green.” Provide a 5V cell phone battery pack to make the meter portable.