

CLEAN AIR FOR SCHOOLS- Indoor Air Quality Guidelines

Hernandez Aerobiology & Disinfection Laboratory

<https://www.colorado.edu/faculty/hernandez/>

Measurement	Description	Sources & Controls
Temperature	Temperature relates to human comfort; if too cold or too warm, productivity levels will be reduced.	Temperature levels are largely governed by local climactic condition, occupancy and HVAC performance.
Relative Humidity	Humidity is an index of how much water vapor is present in room air. This relates to human comfort as well as building materials (mold growth).	Humidity levels are largely set by local climactic conditions and air conditioner performance.
Carbon Dioxide	Is exhaled by building occupants and removed by building ventilation systems.	CO ₂ levels under occupied conditions are indicative of HVAC ventilation performance.
Particulate Matter (PM) PM₁₀ PM_{2.5}	Airborne microscopic particles that building occupants inhale indoors; the PM _{subscript} denoted the aerodynamic diameter of the particles in fractions of millimeters. PM₁₀ :Size of respirable particles retained in nose, mouth and sinuses PM_{2.5} :Size of respirable particles that can penetrate lungs	Indoor particulate matter levels are largely governed by local pollution, wind patterns, routine cleaning practices, occupants and their activities. Can be controlled by systemic HVAC filtration and/or supplementary portable air cleaners.
Volatile Organic Carbon (VOC)	Broad class of chemicals used for cleaning and esthetics, including soaps, detergents, disinfectants and perfumes.	Indoor VOC levels are largely controlled by cleaning practices and the personal care products (and perfumes) from occupants.

This project is part of the Colorado Department of Public Health and Environment (CDPHE) Disease Control and Public Health Response Division's Indoor Air Quality Program, and is supported by the Centers for Disease Control and Prevention (CDC) of the U.S. Department of Health and Human Services (HHS) as part of an award totaling \$173,450,305 with 0% percentage financed with non-governmental sources. The contents are those of the author(s) and do not necessarily represent the official views of, nor an endorsement, by CDC, HHS, or the U.S. Government. Questions about the project can be addressed to media_info@state.co.us.

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Measurement	Guidelines and Sources
Temperature	68-75°F in winter 75-80°F in summer (ASHRAE standard 55-2017)
Relative Humidity	30-60% (USEPA)
Carbon Dioxide (CO ₂)	CO ₂ is used to estimate ventilation rate in occupied classrooms with air exchange recommended at no less than 5 air changes per hour. See CDC guidelines for how to estimate ventilation from CO ₂ measurements (CDC - https://www.cdc.gov/coronavirus/2019-ncov/community/ventilation.html#how-much-ventilation) CO ₂ levels in ambient (outdoor) air are typically near 400 ppm _v . Indoor levels are recommended to remain between 800-1350 ppm _v above local outdoor background. (Healthvent European Union https://doi.org/10.1186/s12940-016-0101-8) (ASHRAE Standard 62.1-2016)
Particulate Matter (PM) PM ₁₀ PM _{2.5}	No indoor PM standards currently exist, and in their absence, outdoor standards are listed. US standards for outdoor air quality state that PM _{2.5} should not exceed 35 ug/m ₃ on average over a 24 hr period; PM ₁₀ should not exceed 150 ug/m ³ . While the World Health Organization recommends that 24 hr PM exposures should be limited to the following: PM _{2.5} 15 ug/m ³ and PM ₁₀ below 45 ug/m ³ . (USEPA; WHO)
Volatile Organic Carbon (VOC)	Can be used to monitor cleaning /custodial activities under unoccupied conditions; other activities that may elevate local VOC levels include personal care products (perfumes), vaping, smoking, spray paint use, etc.

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