



Environmental Health Committee (EHC) Emerging Issue Brief

Increased Awareness of Health Impacts of Indoor PM_{2.5} and Need for Particulate Matter Control in Occupied Spaces

1. What is the issue?

The impact of exposure to airborne particles on human health has been recognized for millennia.¹ As we spend more of our time indoors (up to 90% of lifetime for some populations²), exposure to and control of airborne particles indoors becomes increasingly important. The aggregate harm done to the population in the indoor environment, measured in Disability Adjusted Life Years (DALY) is dominated by exposure to particulate matter (PM); no other contaminant comes within a factor of five.³ Fine particles 2.5µm or less in diameter (PM_{2.5}) have increased short- and long-term adverse health effects because they penetrate more deeply into the respiratory system. Research continues into the health effects of ultrafine particles and nanoparticles.^{4 5} Airborne pathogens such as SARS-CoV-2 are transmitted by respiratory aerosols that are predominantly fine particles.^{6 7 8 9 10}

People are exposed to harmful concentrations of particles both outdoors¹¹ and indoors.¹² There are issues of wildfires in several locations^{13 14} and crop burning in some countries.¹⁵ Although outdoor pollution migrates indoors¹⁶, particles from indoor sources¹⁷ dominate personal exposure for many people. World Health Organization (WHO) air quality guideline levels for PM₁₀ (45 µg/m³ 24-hour, 15 µg/m³ annual) and PM_{2.5} (15 µg/m³ 24-hour, 5 µg/m³ annual) are more stringent than US EPA and States' requirements for PM^{18 19}.

Despite the increased awareness of negative health impacts, indoor PM_{2.5} sources and levels have remained largely unaddressed in standards and codes, with the exception of health care facilities. For media filters of the type usually installed in building HVAC equipment, current model codes only regulate smoke generation from filters if ignited.^{20 21 22} ASHRAE standards for non-healthcare buildings contain requirements for filters to protect some HVAC equipment; only when outdoor PM levels exceed national limits is outdoor air filtration required to protect occupant health in non-residential occupancies. Some building types often lack effective filtering, notably senior living facilities that are not governed by more stringent healthcare facility requirements. Certain recirculation HVAC systems that are becoming more popular²³ (e.g., selected VRF cassettes) cannot easily accommodate filters that are effective in removing small particles²⁴ and are being applied where they influence more vulnerable populations.

2. What does this mean for ASHRAE?

ASHRAE Standards define acceptable indoor air quality (62.1, 62.2)^{25 26} and particle filter performance (52.2)²⁷. However, they do not provide comprehensive guidance for when and where filtration should be used to achieve acceptable indoor air quality and what level is required, unless outdoor PM₁₀ or PM_{2.5} exceed national standards. For more than four decades, ASHRAE ventilation standards for non-healthcare facilities adopted a definition of *acceptable indoor air quality* that requires that there be *no known contaminants at harmful concentrations*.²⁸ Because we now know more about the health harms of PM_{2.5}, target concentrations for indoor air should be included in ASHRAE Standards.

Cost-benefit analyses that consider the impact on human health of PM_{2.5} control find air cleaning to be highly cost-effective.^{29 30} The convergence of higher health benefits of small particle filtration combined with the decreasing costs of filtering small particles makes this an opportune time to establish health-based requirements for PM_{2.5} in occupied spaces.

The ASHRAE Epidemic Task Force's widely adopted recommendation to achieve MERV-13 or better levels of filtration for infectious aerosol exposure reduction³¹ highlights a significant leadership opportunity for ASHRAE to improve indoor air quality at all times of building and its HVAC system operation. California's Title 24-2019 had already increased filtration requirements (MERV-13 for outdoor and return air in all building types).³² Other organizations requiring or recommending improved filtration as a new baseline include the General Services Administration for all US federal buildings³³, the White House National COVID-19 Preparedness Plan³⁴ and *Clean Air in Buildings Challenge*³⁵, and UK building regulations.³⁶ These new requirements differ in their levels of prescribed filtration performance, type of air to be filtered (outdoor, recirculation), applicable systems, and operation conditions (normal, pandemic, wildfire). A comprehensive, consistent, and flexible approach is needed, and ASHRAE is best positioned to create the framework for reducing indoor environmental exposures to PM_{2.5}.

3. What Actions Should ASHRAE Consider?

ASHRAE consensus standards committees should consider the following actions:

- Require control of indoor particle concentrations to 24-hour and annual levels, in standards for acceptable indoor air quality (62.1, 62.2), for all building types and across all climatic conditions.
- Require commissioning of filtration and air cleaning systems in the commissioning section of applicable standards.

ASHRAE should consider the following actions:

- Propose changes to the model building codes to require capacities for minimum filtration of particles, particularly in spaces where occupants are more vulnerable, like long term care facilities, schools, and prisons. These capacities may be required for both outdoor air filtration and indoor air recirculation and infiltration.
- Incorporate cost-benefit analysis in development of standards and guidance that takes into consideration the health impacts of PM_{2.5} exposure
- Establish global outdoor air quality design data, analogous to climatic design data, to provide a standardized starting point for design professionals.
- Formulate recommendations to building owners and policy makers regarding retrofits of existing buildings to meet new particle concentration guidance.

- Provide information about the benefits of operating filtration systems in buildings to our allies who operate and maintain buildings and to the public for their dwellings.

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