Shaping Tomorrow's Built Environment Today

ASHRAE Position Document on

Filtration and Air Cleaning

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ASHRAE is a global professional society of over 55,000 members, committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration and their allied fields (HVAC&R). ASHRAE position documents are approved by the Board of Directors and express the views of the Society on specific issues. These documents provide objective, authoritative background information to persons interested in issues within ASHRAE's expertise, particularly in areas where such information will be helpful in drafting sound public policy. The documents also clarify ASHRAE's position for its members and building professionals.

Filtration and Air Cleaning is a Public Interest Issue

Airborne contaminants, i.e., gases, vapors, and particles (including bioaerosols, i.e., bacteria, molds, fungi, and viruses), can originate from indoor sources, such as building materials, common cleaning agents and occupant activities, or the outdoor environment. Outdoor contaminants, such as pollen or combustion products, occur naturally in plant life and vegetation; human activities generate pollutants, such as exhaust from factories and the internal combustion engines of motor vehicles. Combustion processes create by-products such as nitrous oxide and ultrafine particles. Filtration and air cleaning can improve indoor air quality by physically removing airborne contaminants, inactivating viable biological particles, or transforming gaseous contaminants through chemical reactions.

The effectiveness of various filtration and air-cleaning technologies, both in-duct and in-room, depends on the nature of airborne contaminants, the airflow rates and patterns in the space induced by the HVAC layout and air cleaners, the operation principles of the filtration and air-cleaning technology, and their proper application. Experimental data in the peer-reviewed literature show that some filtration and air-cleaning technologies can effectively remove or inactivate airborne contaminants. However, there is considerable variation in the research documenting the direct effects of various filtration and air-cleaning devices on human health regarding both short-term and long-term effects, generally suggesting insufficient research to make firm conclusions. Further, filtration and air cleaning can have positive and negative secondary consequences, including changing energy use, impacting work performance, learning and absenteeism, emitting by-products of air cleaning, and changing building occupants' perceptions of the indoor environment. Similar to health impacts, there is generally limited evidence on some of these consequences to make firm conclusions.

Filtration and air cleaning offer a cost-effective, energy-efficient alternative or supplement to other exposure-reduction methods, such as pollutant source control or dilution by ventilation with outdoor air or using the local exhaust. As a result of using filtration and air cleaning, the effect of ventilation with outdoor air can be enhanced thanks to the improved quality of the supplied air and/or increased

air volume used for diluting the contaminants. This benefit is particularly relevant in many urban places that do not fulfill ambient air quality standards and recommendations specified by the World Health Organization (WHO) or the US Environmental Protection Agency (EPA).

Filtration and air-cleaning technologies can help reduce the energy used and the carbon impact of air conditioning, especially when outdoor air is hot and humid. Hence, they offer the opportunity to lower operational costs thanks to energy savings because less outdoor air needs to be conditioned without compromising indoor air quality. Examples of such applications are the Indoor Air Quality Procedure (IAQP) design method in ASHRAE Standard 62.1 for commercial buildings or the adoption of air filtration according to ASHRAE Standard 62.2 for residential buildings.

The HVAC industry, government, and public should be informed of the potential benefits and challenges of filtration and air-cleaning technologies. Limitations related to specific applications, long-term performance, and potential operational risks should be considered, along with the benefits. The purpose of this position document is to provide a basis for a comprehensive consideration of filtration and air cleaning.

Why ASHRAE Takes Positions on Filtration and Air Cleaning

ASHRAE is committed to addressing the impact of HVAC-related technologies on human exposure to airborne contaminants. As part of its core mission, ASHRAE actively sets standards and guidelines to evaluate the effectiveness of HVAC technologies, including filtration, air cleaning, and disinfection, to reduce exposure to contaminants and safeguard the health and comfort of building occupants. This evaluation is crucial in guiding ASHRAE members and the public to select and use filtration and air cleaning technologies. Additionally, the evaluation is necessary as these technologies are included in standards prepared by ASHRAE, such as ASHRAE Standards 61.1, 62.2, and 170.

The Indoor Air Quality Procedure outlined in ASHRAE Standard 62.1, *Ventilation for Acceptable Indoor Air Quality*, determines the amount of outdoor air appropriate for indoor space(s). When correctly applied, this procedure allows the deployment of filtration and air-cleaning technologies and other strategies to enhance indoor air quality, lower outdoor air requirements, and reduce energy consumption by air-handling systems. The Indoor Air Quality Procedure requires the deployed filtration and air-cleaning technologies to undergo efficiency assessments using recognized standard test methods (e.g., ASHRAE Standards 52.2 and 145.2, among others). Emerging standard test methods allow for determining the efficiency of filtration and air-cleaning technologies applied in a chamber, duct, or combination thereof. In addition, ASHRAE Standard 241 introduced comprehensive requirements for infection risk management, which are outlined in terms of equivalent clean airflow rate per occupant in a given space use type (ECAi). This approach expands the traditional scope of ventilation strategies beyond simply increasing outdoor air intake. It acknowledges the potential of filtering, cleaning, and disinfecting the air by various technologies to contribute to meeting the equivalent clean airflow requirements. This flexibility allows for compliance through customized control combinations, optimizing costs and energy usage.

Positions and Recommendations

ASHRAE Takes the Positions that:

- Filtration and air cleaning effectively improve air quality when used properly.
- Caution should be exercised when using filtration and air-cleaning technologies and strategies that may be ineffective or unsafe.
- Filtration and air-cleaning devices that produce compounds to remove or inactivate target pollutant(s) either at the device, in a duct, or in space should only be used if proven safe.
- Filtration and air cleaning performance should be based on nationally or internationally recognized and published standardized tests from ASHRAE and other independent organizations or agencies. A detailed explanation of alternative tests and their correspondence to standardized tests should accompany performance testing results when such tests do not exist.
- In-situ effectiveness and safety of filtration and air-cleaning technologies are a strong function of air distribution, maintenance, aging, degradation impacts, component face air velocities, system airflow rates, installation, space volume, and other application and contextual factors. Accordingly, filtration and air-cleaning effectiveness and safety in a specific application should not be assumed equivalent to performance determined using controlled laboratory tests under specific conditions.
- All electrically powered filtration and air-cleaning devices should only be used when tested and labeled for ozone emission in accordance with Underwriters Laboratory (UL) 2998 or an equivalent international standardized test to avoid hazards associated with ozone.
- Secondary consequences over the lifetime of filtration and air cleaning devices and under all conditions of use should be considered, including, among others, maintenance implications, harmful by-products or other compounds added to the air, energy implications, odors, noise, material degradation, and other aging issues, including reduced air-cleaning performance.
- Efficiency tests, reduction of target contaminant concentrations, or other performance data of filtration and air-cleaning devices alone should not be used to make claims of direct health impacts.

ASHRAE Recommends that:

- Research to quantify the benefits of filtration and air cleaning should be supported.
- Research that predicts by-products generated by filtration and air cleaning during the whole service life and their potential risks to human health should be conducted.
- Identification of application-relevant conditions for laboratory testing for filtration and air cleaning should be pursued so that the test results can predict the behavior of filtration and air-cleaning technologies more closely in as many real-world applications as possible.
- The assessment of all filtration and air-cleaning devices should be expanded to include the whole service life and not only initial conditions to determine whether effectiveness and safety change over the lifetime of a device. Contaminants with properties similar to those of typical outdoor and indoor environments shall be used for this assessment.
- Actions related to the laboratory to field scaling of filtration and air cleaning devices should be defined.

- Additional standards and guidelines for filtration and air cleaning should be developed covering a wide variety of technologies and challenge contaminants, especially for the technologies for which no current standards are available.
- Review and revision of existing standards and guidelines for filtration and air cleaning should be supported to address new technologies, knowledge, contaminants, and applications.
- User guidelines for filtration and air cleaning should be developed and applied to pollutant load calculations, design, selection, installation, operation, maintenance, aging, and energy use where needed.
- In-situ tests should be developed to evaluate filtration and air-cleaning device performance in specific settings, ideally utilizing low-cost instrumentation to minimize barriers to application.
- A standard protocol should be developed for estimating the reduction of health risks using the documented laboratory performance of filtration and air cleaning in removing specific air pollutants, either through direct assessment of health effects (e.g., using human subjects or animal models) or by modeling.
- The methodology should be developed to estimate the potential health benefits of removing pollutants by filtration and air cleaning compared with other methods, such as ventilation with outdoor air, as well as energy cost and carbon impacts.
- Research should be conducted to assess the impact of filtration and air cleaning in a space on air distribution, including studying airflow patterns and their effect on the performance of filtration and air cleaning and ventilation effectiveness.
- Research should be conducted on integrating air cleaning technologies with building ventilation and HVAC systems to optimize air distribution and indoor air quality.
- Research on the impact of air cleaning technologies on decarbonization, building energy consumption, and overall environmental sustainability should be conducted.

History and Terminology

ASHRAE's Board of Directors approved the first version of the Position Document on Filtration and Air Cleaning in 2015. The present document is a revised version with updated positions and recommendations. It uses specific terms whose definitions are as follows:

- **Technology**: Application of advanced scientific knowledge, engineering principles, and innovative methodologies to develop and implement devices, systems, and processes to reduce contaminants from the air.
- **Strategy:** A planned approach or set of actions designed to achieve specific goals related to improving indoor air quality by effectively using filtration and air cleaning technologies.
- **Safe:** Safe refers to filtration and air cleaning technologies and strategies to reduce indoor air contaminants without causing health risks and other risks such as reduced comfort or work performance to occupants and/or damage to the indoor/outdoor environments.
- **Unsafe:** Unsafe filtration and air cleaning devices are those that do not meet safety standards or pose risks to occupants or the environment. Unsafe devices are also those that may be ineffective or unproven.

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Additional ASHRAE Resources

ASHRAE Handbook

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ASHRAE. 2024. Chapter 17, “Ultraviolet Lamp Systems.” In *ASHRAE Handbook—HVAC Systems and Equipment*. Peachtree Corners, GA: ASHRAE.

ASHRAE. 2024. Chapter 29, “Air Cleaners for Particulate Contaminants.” In *ASHRAE Handbook—HVAC Systems and Equipment*. Peachtree Corners, GA: ASHRAE.

ASHRAE Standards, Guidelines, and User’s Manuals

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ASHRAE Cognizant Committees

Guideline Project Committee

GPC 35P (Proposed Guideline), Method for Determining the Energy Consumption Caused by Air-Cleaning and Filtration Devices

Standard Project Committees and Standard Standing Project Committees

ASHRAE SPC 180, Standard Practice for Inspection and Maintenance of Commercial-Building HVAC Systems
ASHRAE SPC 185.5P, Method of Testing HVAC-duct mounted Devices and Systems and In-Room devices for Particle and Microorganism Removal or Inactivation in a Chamber with a Recirculating Duct System
ASHRAE SSPC 52.2, Method of Testing General Ventilation
Air-Cleaning Devices for Removal Efficiency by Particle Size
ASHRAE SSPC 62.1, Ventilation for Acceptable Indoor Air Quality
ASHRAE SSPC 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
ASHRAE SSPC 145, Test Method for Assessing the Performance of Gas Phase Air Cleaning Equipment
ASHRAE SSPC 170, Ventilation of Health Care Facilities
ASHRAE SSPC 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings
ASHRAE SSPC 185, Method of Testing Ultraviolet Sources for Use in HVAC&R Units or Air Ducts on Irradiated Surfaces (Includes Subcommittees 185.1, 185.2, 185.3, and 185.4)
ASHRAE SSPC 241, Control of Infectious Aerosols
Technical Committees
ASHRAE TC 2.3, Gaseous Air Contaminants and Gas Contaminant Removal Equipment
ASHRAE TC 2.4, Particulate Air Contaminants and Particulate Contaminant Removal Equipment
ASHRAE TC 2.9, Ultraviolet Air and Surface Treatment

Technical Resource Group

ASHRAE TRG2.RAST, Reactive Air and Surface Treatment

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Other Resources

UL. 2020. ULE 2998, *Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners*. Northbrook, IL: UL.

DOCUMENT REVISION COMMITTEE ROSTER

The ASHRAE Position Document on Filtration and Air Cleaning was developed by the Society's Position Document Revision Committee, formed on February 2, 2021, with Pawel Wargocki as its chair.

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DOCUMENT HISTORY

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