

Institute of Environmental Sciences and Technology

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Contamination Control Division
Guideline CC035.1

Design Considerations for Airborne Molecular Contamination Filtration Systems in Cleanrooms and Other Controlled Environments



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1 SCOPE AND LIMITATIONS

1.1 Scope

This Guideline describes areas of concern when considering filtration systems that will be effective in eliminating trace amounts of airborne molecular contamination (AMC), here defined as less than 1 part per million by volume (ppmv), from the air supplied to cleanrooms and other controlled environments. This document discusses various applications, potential points of use, filtration methods, materials of construction, performance comparison, and follow-up assessment, secondary impacts of the filters on the rest of the heating, ventilating and air-conditioning (HVAC) system, and exterior impacts on the filtration system (including environmental conditions, upsets, and spills). The Guideline establishes the types of information required to design and implement an effective AMC filtration system. While this document is targeted at cleanroom facilities, it could also provide a framework for other applications such as, but not limited to, laminar flow stations, minienvironments, isolators, and glove boxes.

1.2 Limitations

Because of the large number of combinations of variables, this document does not attempt to recommend specific filtration systems or filtration media for each application. This Guideline does not establish a test standard, although several applicable standards are referenced. This Guideline is not intended to address microbiological issues, radioactive issues, pollution control issues, or emergency response and safety systems. Nor does this Guideline deal with respirators, as accepted test methods and standards exist for these devices.

2 REFERENCES

2.1 Reference documents

The following documents are incorporated into this Guideline to the extent specified herein. Users should apply the most recent editions of the references.

IEST-RP-CC007: Testing ULPA Filters

IEST-RP-CC031: Method for Characterizing Out-gassed Organic Compounds from Cleanroom Materials and Components

2.2 Sources and addresses

IEST

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3 TERMS AND DEFINITIONS

Some terms are defined here for the purposes of this Guideline. If definitions are not provided, common usage shall apply.

absorption

The attraction of a contaminant to a sorbent surface and the incorporation of the contaminant into the structure of the sorbent (e.g., water absorbing into a superabsorbent powder).

acid

A corrosive material that reacts chemically as an electron pair acceptor.

activated

Describing an adsorbent whose surface area has been extended through the creation of pores or other internal openings.

adsorption

The attraction of a contaminant to a surface, including inner pore surfaces, of a medium by physical forces (e.g., van der Waals forces), where the contaminant remains on the surface of the sorbent.

airborne molecular contamination (AMC)

Contamination present in the air in a gaseous state, as opposed to a liquid-droplet or solid-particle aerosol. **NOTE:** This definition is specific to this Guideline, which deals with systems designed to remove gaseous contaminants and control odor for the comfort of occupants.

ambient air

Air that is common to the particular environment of interest. For this Guideline, ambient air may be air at atmospheric pressure, uncontrolled, or conditioned and controlled for temperature and humidity.

base

A corrosive material that reacts chemically as an electron pair donor.

breakthrough (see also penetration)

The measurable concentration of a specific contaminant downstream of a filter system, usually expressed in absolute concentration units. The ability to detect breakthrough depends on the detection limit of the measurement technique. A breakthrough curve is a continuous plot of contaminant breakthrough vs. time.

bypass

The deliberate or unintentional diversion of air around the filter medium in a filtration system.

capacity

The cumulative amount of contaminant that is removed by a filter system within a specified time period or at a specified efficiency level.

catalyst

Any substance of which a small proportion notably affects the rate of a chemical reaction without itself being consumed or undergoing a chemical change. **NOTE:** Most catalysts accelerate reactions, but a few retard them (inhibitors).

challenge

The AMC or mixture of AMCs upstream or at the inlet of a filtration system, either introduced intentionally for a test, or present in the actual application.

channeling

The disproportionately greater flow of gas through passages of lower resistance that can occur in fixed beds or columns of granular media due to nonuniform packing, granule segregation, irregular sizes and shapes of the media, gas pockets, wall effects, and other causes.

chemisorption (chemical adsorption)

Chemical bonding of a molecular contaminant to a solid surface or to a chemical on that surface.

cleanroom

A room in which the concentration of airborne particles, molecular contaminants, or both, are controlled to specified limits.

concentration

The quantity of one substance dispersed in a defined amount of another. For AMCs, two common conventions are defined as weight per volume (e.g., $\mu\text{g}/\text{m}^3$) or volume per volume (e.g., ppbv).

condensable

A substance (other than water), typically having a boiling point above room temperature at atmospheric pressure, capable of condensation on a clean surface.

contaminant

Any unwanted substance present in or on a material or any surface within a clean zone.

desorption

The process by which adsorbed materials leave the substrates on which they are adsorbed and reenter the airflow.

diffusion, molecular

A process of spontaneous intermixing of different substances attributable to molecular motion (Brownian motion) and tending to produce uniformity of concentration.

efficiency

The fraction of a specific contaminant that is removed by the filter system, usually expressed as a percentage.

efficiency curve

A continuous plot of contaminant removal efficiency against time.

end point

The occurrence of the maximum permissible concentration of a specific contaminant in the air downstream of a filter system. Also, the time when a predetermined contaminant penetration or efficiency is reached.