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ANSI/ASHRAE Standard 185.3-2024
Method of Testing Commercial and Industrial In-Room Air-Cleaning Devices and Systems for Microorganism Bioaerosol Removal or Inactivation in a Test Chamber

NOTE

Approved addenda, errata, or interpretations for this standard can be downloaded free of charge from the ASHRAE website at www.ashrae.org/technology.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

The COVID-19 pandemic made it clear that enhancements to standard ventilation practices are required to protect building occupants from diseases spread via infectious aerosols. The use of in-room air cleaners (IRACs) is one quick, simple, and cost-effective method to reduce the concentration of infectious aerosols in indoor spaces. The number of commercially available IRACs continues to increase, as does the number of technologies (or combinations of technologies) used to remove infectious aerosols from the air. Though many IRACs claim to inactivate or remove microorganisms from the air, there are often limited to no scientific data to support those claims.

To assist building owners and operators in making informed decisions, consensus methods of tests are necessary to gather the scientific evidence on which claims of effectiveness can be based. Robust test standards form the foundation for air-cleaner selection and end-user confidence in the ventilation industry. Both ASHRAE and the Association of Home Appliance Manufacturers (AHAM) have developed test standards focused on IRAC removal of airborne microorganisms in a room. AHAM Standard AC-5, Method for Assessing the Reduction Rate of Key Bioaerosols by Portable Air Cleaners Using a Aerobiology Test Chamber*, was published in 2022 and results in a clean air delivery rate for microbes (mCADR) for residential IRACs. However, AHAM AC-5 does not cover larger commercial and industrial IRACs.*

ANSI/ASHRAE Standard 185.3 contains test procedures that may be applied to any brand or model IRAC used in commercial or industrial applications. This standard should not replace AHAM AC-5 for residential IRACs. The laboratory test chamber, required equipment, prescribed microorganisms, analytical techniques, and result calculations are designed to limit variability and error between individual tests. Calculated outcomes include the percent reduction, net percent reduction, and CADR for each of four organisms. Test reporting includes requirements for descriptions of the device, test setup, and results.

The results of tests performed under this standard may be publicly stated for commercial use.

Considerable capital may be required to establish a laboratory with the required test chamber and analytical capabilities. However, compliance with the test standard cannot be met with an alternative test chamber or procedures. Modified testing (e.g., using different microorganisms or a chamber with different dimensions) under this standard is possible, but this would be considered a nonstandard test. Nonstandard testing results under this standard should be clearly labeled as such, because they should not be compared to testing results obtained under a standard test. Properly interpreting the results of a nonstandard test requires a level of understanding and expertise that is not necessary when the standard is followed as written.

This test method covers the efficacy of the IRAC for removal of bioaerosols from the air, along with associated output measurements. It does not cover the safety aspects of the tested IRACs or conformance with energy regulations. Regarding safety, ASHRAE recommends that products manufactured or marketed in the United States be submitted to an appropriate independent nationally recognized testing laboratory for inspection and listing in conformance with the safety standards and procedures followed by such laboratories. Specific to ozone emissions from IRACs, UL Standard 2998, Environmental Claim Validation Procedure (ECVP) for Zero Ozone Emissions from Air Cleaners*, should be used where required. This standard method does not replace UL 2998 certification.*

Regarding energy use, the IRAC manufacturer must follow all state, provincial, and federal requirements for such equipment. It is recommended that products be submitted to an appropriate independent nationally recognized testing laboratory for inspection and listing in conformance with the energy regulations.

This test method will be incorporated into ANSI/ASHRAE Standard 241, Control of Infectious Aerosols*, by reference. The effectiveness of commercial and industrial IRACs under the requirements of Standard 241 can be determined using this method if bacteriophage MS2 is used as the challenge organism. For the purposes of Standard 241, only testing with MS2 is required. Testing with only MS2 will result in a nonstandard test under this method, as testing against one Gram-negative bacterium, one Gram-positive bacterium, one bacteriophage, and one fungus is required for a standard test.*

1. PURPOSE

The standard establishes a test method for evaluating commercial and industrial in-room air-cleaning devices and systems for microorganism bioaerosol removal or inactivation in a test chamber.

2. SCOPE

2.1 This standard specifies selected indicator microorganisms in the test chamber and defines procedures for generating the bioaerosols required for the method of test.

2.2 This standard provides a method for counting the number of viable microorganisms in the chamber to calculate the elimination efficiency for each microorganism.

2.3 This standard establishes minimum performance specifications for the equipment required to conduct the tests, defines methods of calculating and reporting results obtained from the test data, and establishes a reporting system to be applied to in-room devices and systems covered herein.

2.4 This standard does not address the health and safety effects of operating devices and systems in an occupied room.

2.5 This standard applies to commercial and industrial in-room air-cleaning devices and systems. This standard is not intended to conflict with or replace ANSI/AHAM Standard AC-5 [1] for testing portable residential air cleaners.

3. DEFINITIONS AND ACRONYMS

3.1 Definitions

aerosol: small particles (solid or liquid) suspended in air.

air changes per hour (ach): the clean air delivery rate divided by chamber volume expressed in compatible units.

***baseline*:** the concentration of analytes (microorganisms, ions, chemicals, particles) in the chamber air before injection of the test aerosol.

bioaerosol: an aerosol containing viable or culturable bacteria, spores, viruses, toxins, and other similar material.

equivalent air changes for hour: air changes per hour of air that is free of infectious aerosols.

***in-room air cleaner*:** a device that is placed in a room to clean the air. This may include standalone, portable, and wall-mounted units.

L_{eq}* or *L_{avg}: best described as the average sound level over the period of the measurement. Usually measured with A-weighting, the L_{eq} has no time constant applied, but the L_{avg} is usually slow time weighted. As it is an average, it will settle to a steady value, making it much easier to read accurately than a simple instantaneous sound level. Being an average, it also shows the total energy of the noise being measured, so it is a better indicator of potential hearing damage or the likelihood that the noise will generate complaints.

limit of blank (LOB): the highest apparent analyte concentration expected to be found when replicates of a blank sample containing no analyte are tested.

$$\text{LOB} = \text{mean}_{blank} + 1.645(\text{SD}_{blank})$$

limit of detection (LOD): the lowest analyte concentration likely to be reliably distinguished from the LOB and at which detection is feasible. LOD is determined by utilizing both the measured LOB and test replicates of a sample known to contain a low concentration of the analyte.

$$\text{LOD} = \text{LOB} + 1.645(\text{SD}_{low\ concentration\ sample})$$

limit of quantification (LOQ): the lowest concentration at which the analyte can not only be reliably detected but at which some predefined goals for bias and imprecision are met. The LOQ may be equivalent to the LOD or it could be at a much higher concentration. LOQ equals 10 times the standard error of the calibration graph divided by the slope of the calibration curve.

net percent removal/inactivation: percentage removal/inactivation in contaminant over time accounting for percentage removal/inactivation due to natural decay.

percent removal/inactivation: percentage reduction in contaminant over time.

real-time analyzer: device used to measure an environmental parameter in real time or near-real time, which is typically based on sensor technologies.

reflectance: the ratio of the light reflected by a surface to the light incident upon it.

statistically valid CFU/PFU count: generally considered 25 to 250 per nominal 100 mm Petri plate. This can also be described as 1 to 13 CFU/cm^2 or 1 to 13 PFU/cm^2 for plates, regardless of diameter.

total reflectance: the ratio to the incident flux of the radiant flux reflected at all angles within the hemisphere bounded by the plane of measurement.