**ANSI/ASHRAE Standard 52.2-2007**
**(Supersedes ANSI/ASHRAE Standard 52.2-1999)**
**Includes the ANSI/ASHRAE addendum listed in Appendix H**

# ASHRAE STANDARD

# Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

See Appendix H for approval dates by the ASHRAE Standards Committee, the ASHRAE Board of Directors, and the American National Standards Institute.

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**NOTE**

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## FOREWORD

*ANSI/ASHRAE Standard 52.2-2007, the most recent edition of this standard, incorporates Addendum a into the standard's previous edition, Standard 52.2-1999. Addendum a changed the procedure for evaluating the results of the reference filter test in order to make the reference filter test more practical and to allow a wider selection of filters to fulfill the test requirements.*

*Standard 52.2 was developed so that both users and specifiers can compare products, predict a uniform level of known performance under operating conditions with reasonable certainty, and determine appropriate air-cleaner efficiencies for specific situations.*

*Historically, standards for testing air cleaners have been developed in response to the needs of the times. Protection of machinery and coils came first, then reduction of soiling. Now concerns about indoor air quality and respirable particles, protection of products during manufacturing, and protection of HVAC equipment have prompted development of this test standard based on particle size.*

*Standards Project Committee (SPC) 52.2 was first organized in 1987 to develop a particle size test procedure but was disbanded in 1990 after it became evident that basic research was needed. In 1991, a research contract (ASHRAE 671-RP, Appendix Reference A1) was awarded to review test methodology and recommend approaches for obtaining particle size efficiency data. After the research project was completed and accepted in 1993, SPC 52.2 was reactivated with members representing a broad range of interests. The result of their work is this standard.*

*SPC 52.2 debated many questions in writing this standard. Comments on some of the more important of these questions, which are included in Informative Appendix A, are the bend in the test duct; the use of a particle's physical size, its aerodynamic size, or its light-scattering size; dust loading and minimum efficiency reporting; the particle size range covered by the standard; and the selection of the test aerosol.*

### Description of Standard

*This standard addresses two air-cleaner performance characteristics of importance to users: the ability of the device to remove particles from the airstream and its resistance to airflow. Air-cleaner testing is conducted at airflow rates not less than 0.22 $m^3/s$ (472 cfm) nor greater than 1.4 $m^3/s$ (3000 cfm).*

*A sample of air from a general ventilation system contains particles with a broad range of sizes having varied effects, sometimes dependent on particle size. Coarse particles, for example, cause energy waste when they cover heat transfer surfaces. Fine particles cause soiling and discoloration of interior surfaces and furnishings as well as possible health effects when inhaled by occupants of the space. When air cleaners are tested and reported for efficiency in accordance with this standard, there is a basis for comparison and selection for specific tasks.*

*The test procedure uses laboratory-generated potassium chloride particles dispersed into the airstream as the test aerosol. A particle counter measures and counts the particles in 12 size ranges, both upstream and downstream, for the efficiency determinations.*

*This standard also delineates a method of loading the air cleaner with synthetic dust to simulate field conditions. A set of particle-size removal-efficiency (PSE) performance curves at incremental dust loading is developed and, together with an initial clean performance curve, is the basis of a composite curve representing the minimum performance in each size range. Points on the composite curve are averaged, and the averages are then used to determine the minimum efficiency reporting value (MERV) of the air cleaner.*

*Coarse air cleaners may be tested for particle size removal efficiency when they are clean with results reported in the prescribed format. (An example of a coarse air cleaner is the so-called "furnace" filter, a flat panel with a cardboard frame and spun glass fiber media.) However, testing of coarse air cleaners in accordance with Section 10 of this standard, using loading dust for reporting purposes, typically will not produce meaningful results. These air cleaners are reported on after first being tested by the arrestance method outlined in* ANSI/ASHRAE Standard 52.1–1992, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

### Electronic Air Cleaners

*Some air cleaners, such as externally powered electrostatic precipitators (also known as electronic air cleaners), may not be compatible with the loading dust used in this test method. The dust contains very conductive carbon that may cause electrical shorting, thus reducing or eliminating the effectiveness of these devices and negatively affecting their MERV. In actual applications, the efficiency of these devices may decline over time, and their service life is dependent on the conductivity and the amount of dust collected.*

### Passive Electrostatic Fibrous Media Air Filters

*Some fibrous media air filters have electrostatic charges that may be either natural or imposed upon the media during manufacturing. Such filters may demonstrate high efficiency when clean and a drop in efficiency during their actual use cycle. The initial conditioning step of the dust-loading procedure described in this standard may affect the efficiency of the filter but not as much as would be observed in actual service. Therefore, the minimum efficiency observed during testing may be higher than that achieved during actual use.*

### Not an Application Standard

*Users should not misinterpret the intent of this standard. This is a test method standard, and its results are to be used to directly compare air cleaners on a standardized basis irrespective of their applications. Results are also used to give the* *design engineer an easy-to-use basis for specifying an air cleaner. It is entirely possible that an industry organization may use this test method as the basis for an application standard with, for example, different final resistances.*

***Note:*** *Footnotes are used throughout this standard to provide nonmandatory guidance for the user in addition to the nonmandatory guidance found in the informative appendices. Footnotes are for information only and are not part of the standard.*


## Acknowledgments

*SSPC 52.2 wishes to acknowledge with thanks the contributions of many people outside the voting membership, including European filtration authorities who made suggestions through the committee's international member. Also, some of the background information in this foreword was taken or paraphrased from an* ASHRAE Journal *article, "Changing Requirements for Air Filtration Standards," by David S. Ensor, Brian C. Krafthefer, and Thomas C. Ottney, published in June 1994.*


## 1. PURPOSE

This standard establishes a test procedure for evaluating the performance of air-cleaning devices as a function of particle size.

## 2. SCOPE

**2.1** This standard describes a method of laboratory testing to measure the performance of general ventilation air-cleaning devices.

**2.2** The method of testing measures the performance of air-cleaning devices in removing particles of specific diameters as the devices become loaded by standardized loading dust fed at intervals to simulate accumulation of particles during service life. The standard defines procedures for generating the aerosols required for conducting the test. The standard also provides a method for counting airborne particles of 0.30 to 10 µm in diameter upstream and downstream of the air-cleaning device in order to calculate removal efficiency by particle size.

**2.3** This standard also establishes performance specifications for the equipment required to conduct the tests, defines methods of calculating and reporting the results obtained from the test data, and establishes a minimum efficiency reporting system that can be applied to air-cleaning devices covered by this standard.

## 3. DEFINITIONS AND ACRONYMS

**3.1 Definitions.** Some terms are defined below for the purposes of this standard. When definitions are not provided, common usage shall apply (see Reference 3, Informative Appendix G).

***airflow rate:*** the actual volume of test air passing through the device per unit of time, expressed in $m^3/s$ ($ft^3/min$ [cfm]), to three significant figures.

***charge neutralizer:*** a device that brings the charge distribution of the aerosol to a Boltzman charge distribution. This represents the charge distribution of the ambient aerosol.

***coefficient of variation (CV):*** standard deviation of a group of measurements divided by the mean.

***correlation ratio data acceptance criteria:*** criteria used to determine the adequacy of the correlation data, further defined in Section 10.6.2.

***correlation ratio (R):*** the ratio of downstream to upstream particle counts without the test service installed in the test duct; is determined from the average of at least three samples. This ratio is used to correct for any bias between upstream and downstream sampling and counting systems, and its calculation is described in Section 10.3.

***device:*** throughout this standard the word *device* refers to air-cleaning equipment used in general ventilation for the removal of particles, specifically, the air cleaner being tested.

***disposable air filters:*** filters that are designed to operate through a specified performance range and then be discarded and replaced.

***dust increment:*** the amount of dust fed during a definite part of the loading procedure.

***face area:*** the gross area of the device exposed to airflow. This area is measured in a plane perpendicular to the axis of the test duct or the specified direction of airflow approaching the device. All internal flanges are a part of this area, but items such as mounting hardware and electrical raceways normally mounted out of the airstream are not included. Face area is measured in $m^2$ ($ft^2$) to three significant figures.

***face velocity:*** the rate of air movement at the face of the device (airflow rate divided by face area), expressed in m/s (fpm) to three significant figures.

***final filter:*** a filter used to collect the loading dust that has passed through a device during the test procedure.

***final resistance:*** the resistance to airflow of the air-cleaning device at which the test is terminated and results calculated, expressed in Pa (in. of water).

***general ventilation:*** the process of moving air into or about a space or removing it from the space. The source of ventilation air is either air from outside the space, recirculated air, or a combination of these.

***initial resistance:*** the pressure loss of the device operating at a specified airflow rate with no dust load, expressed in Pa (in. of water).

***isokinetic sampling:*** sampling in which the flow in the sampler inlet is moving at the same velocity and direction as the flow being sampled.

***loading dust:*** a compounded synthetic dust used for air-cleaner loading. Specifications for this dust are given in Section 6.2.

***media:*** for a fibrous-type air cleaner, media is that part of the device that is the actual dust-removing agent. Webs of spun fiberglass and papers are examples of air filter media.