ANSI/ASHRAE Addendum b to
ANSI/ASHRAE Standard 52.2-2007

ASHRAE ADDENDA

2008 Supplement

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

Approved by the ASHRAE Standards Committee on June 21, 2008; by the ASHRAE Board of Directors on June 25, 2008; and by the American National Standards Institute on July 24, 2008.

This standard is under continuous maintenance by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form, instructions, and deadlines may be obtained in electronic form from the ASHRAE Web site, http://www.ashrae.org, or in paper form from the Manager of Standards. The latest edition of an ASHRAE Standard may be purchased from ASHRAE Customer Service, 1791 Tullie Circle, NE, Atlanta, GA 30329-2305. E-mail: orders@ashrae.org. Fax: 404-321-5478. Telephone: 404-636-8400 (worldwide), or toll free 1-800-527-4723 (for orders in US and Canada).

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SPECIAL NOTE

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The Assistant Director of Technology for Standards and Special Projects of ASHRAE should be contacted for:

a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

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ANSI/ASHRAE Standard 52.2-2007
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NOTE

When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org.

(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 first part of this addendum is part of a larger plan to combine Standards 52.1 and 52.2 into a single standard on air filter testing. It incorporates the 52.1 sections on arrestance and dust-holding capacity into Standard 52.2 and deletes some references to Standard 52.1 that occur in Standard 52.2. Future addenda will complete the process of making Standard 52.2 self-sufficient and comprehensive, and at this time SPC 52.1 will be able to withdraw Standard 52.1. While similar to previous definitions, the terms arrestance *and* dust holding capacity *are procedurally different and should not be directly compared to prior definitions in previous versions of Standard 52.*

Part 2 of this addendum adds a new informative appendix to Standard 52.2, Appendix J. Appendix J provides an optional method of conditioning a filter using fine KCl particles to demonstrate efficiency loss that might be realized in field applications. When Standard 52.2-1999 was published, the project committee recognized that the conditioning step, also called the first dust-loading step, was not fully adequate for revealing the drop in efficiency that some filters undergo during actual use. This is pointed out in the standard's foreword: "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." This is further discussed in Appendix A of the standard (A2.2 and A2.3) where it is stated that "ASHRAE Technical Committee 2.4 has funded a research project to develop a loading dust for a new loading test method that will more nearly represent the minimum efficiency points in actual real-world use." This procedure is an outcome of that research project (ASHRAE RP-1190, "Develop a New Loading Dust and Dust Loading Procedures for the ASHRAE Filter Test Standards 52.1 and 52.2") and ASHRAE RP-1189, "Investigation of Mechanisms and Operating Environments that Impact the Filtration Efficiency of Charged Air Filtration Media," and subsequent committee action.

The procedure described in Informative Appendix J is the result of project committee revisions in response to comments received during two public reviews of the procedure. Since these revisions, however, the procedure has not been issued for another public review, and Appendix J is not ANSI approved.

Addendum b to Standard 52.2-2007

Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

[Revise the last paragraph of the current Foreword, Description of Standard, as indicated.]

…However, testing of coarse air cleaners in accordance with the full Section 10 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 Section 10.7.2 ~~ANSI/ASHRAE Standard 52.1–1992, Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter *(Reference 2*~~.

[Add the following three definitions to Section 3.1, Definitions, and place them in the correct alphabetical positions.]

arrestance, A: a measure of the ability of an air-cleaning device with efficiencies less than 20% in the size range of 3.0–10.0 µm to remove loading dust from test air. Measurements are made of the weight of loading dust fed and the weight of dust passing the device during each loading step. The difference between the weight of dust fed and the weight of dust passing the device is calculated as the dust captured by the device. Arrestance is then calculated as the percentage of the dust fed that was captured by the device.

average arrestance, A_{avg}: for an air-cleaning device with efficiencies less than 20% in the size range of 3.0–10.0 µm, the average value of the arrestances made on the device during the loading test, weighted by the amounts of dust fed to the device during each incremental dust loading step.

dust holding capacity, DHC: the total weight of the synthetic loading dust captured by the air-cleaning device over all of the incremental dust loading steps.

[Add the following new acronym in Section 3.2, Acronyms, between CV and HEPA.]

DHC dust holding capacity

[Revise Section 8.1.3, as indicated.]

8.1.3 Test to a final resistance of 350 Pa (1.4 in. of water) if a final resistance has not been specified (otherwise test to the specified final resistance) or until the arrestance drops below 85% of the peak value, whichever comes first.

[Revise Section 10.7.2, Dust-Loading Procedure, as indicated.]

10.7.2 Dust-Loading Procedure

10.7.2.1 Weigh the final filter to the nearest 0.1 gram.

10.7.2.~~1~~2 The test duct shall be in the dust-loading configuration with the final filter installed. The dust feeder shall be positioned so that the feeder nozzle is centered in the inlet mixing orifice and the nozzle tip is in the same plane as the orifice. All airflow in the particle sampling lines shall be turned off and their inlets sealed to prevent the entry of loading dust.

10.7.2.~~2~~3 Weigh the quantity of dust to ±0.1 g for one increment of loading.

10.7.2.~~3~~4 Distribute the dust uniformly in the dust feeder tray. Dust shall be distributed with a depth that will provide a dust concentration in the test of 70 ± 7 mg/m^3 (2.0 ± 0.2 g/1000 ft^3).[44]

10.7.2.~~4~~5 Start the test duct blower and adjust to the test airflow rate for the test device.

10.7.2.~~5~~6 Turn on the dust feeder heater lamp. Adjust the air pressure regulator on the dust feeder to give the required dust feeder venturi airflow rate, 0.0068 ± 0.0002 m^3/s (14.5 ± 0.5 cfm). This condition shall be maintained throughout the feed period. Start the dust feeder tray drive.

10.7.2.~~6~~7 Maintain the test duct airflow rate at the test flow ±2%. After the feeder tray motion is complete, brush dust remaining in the feeder tray into the aspirator. Vibrate or rap the dust feeder tube for 30 seconds.

10.7.2.~~7~~8 Turn off the feeder tray drive and the airflow to the aspirator venturi. With the test duct airflow on, reentrain any test dust in the duct upstream of the test device by use of a compressed air jet directed obliquely away from the device. Record the airflow resistance of the test device.

10.7.2.~~8~~9 If several dust increments are required to achieve one quarter of the required flow resistance increase of the device, repeat the steps of 10.7.2.~~2~~3 through 10.7.2.~~7~~8. A complete dust increment shall be fed before running the next PSE test.

10.7.2.~~9~~10 Stop the test duct airflow and remove the final filter from the test duct, taking care to avoid spilling dust from the final filter. Weigh the final filter to the nearest 0.1 g. ~~Remove any test dust deposited in the test duct between the test filter device and the final filter.~~

10.7.2.11 Collect any test dust deposited in the test duct between the test filter device and the final filter. Weigh the collected dust to the nearest 0.1 g.

10.7.2.12 Add the weight of dust collected in the procedure of 10.7.11 to the weight increase of the final filter to establish the amount of synthetic dust passing the device during the feed period.

10.7.2.13 For air cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 µm, calculate arrestance (A_i) for dust loading increment i as:

$$A_i = 100[1 - W_d / W_u] \qquad (10\text{-}27)$$

where

A_i = Arrestance for dust loading increment i,

W_d = weight of synthetic loading dust passing the device, and

W_u = weight of dust fed.

10.7.2.14 For all devices, calculate dust holding capacity (DHC) for dust loading increment *i* increment as:

$$DHC_i = W_u - W_d \qquad (10\text{-}28)$$

where

DHC_i = dust holding capacity for dust loading increment *i*,

W_d = weight of synthetic loading dust passing the device, and

W_u = weight of dust fed.

[Renumber Equation 10-27 in Section 10.7.3.2 as 10-29 due to the addition of the two new equations in Section 10.7.2.]

[Add two new Sections 10.8.4 and 10.8.5 and renumber the current Section 10.8.4 as Section 10.8.6 accordingly.]

10.8.4 For air-cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 µm, calculate the average arrestance (A_{avg}) as

$$A_{avg} = [1/W] \sum_{i=1}^{f} [W_i A_i](\text{percent}) , \qquad (10\text{-}30)$$

where

W = total weight of dust fed, g;

W_i = weight of dust fed during loading increment *i*, g;

A_i = arrestance measured during loading increment *i*, %; and

f = final loading increment.

10.8.5 For all devices, calculate DHC as

$$\text{DHC} = \sum_{i=1}^{f} DHC_i \ (\text{grams}) , \qquad (10\text{-}31)$$

where

DHC_i = dust holding capacity for loading increment *i*, and

f = final loading increment.

[Add new items m and n to the list of reporting information in Section 11.2.]

m. Average ASHRAE dust arrestance (for air-cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 µm)

n. Dust Holding Capacity (DHC)

[Add a new item 4 under item k in the list of reporting information in Section 11.2.]

4. Resistance vs. synthetic loading dust fed (for air-cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 µm)

[Revise Section 12.3 as follows to remove the reference to Standard 52.1 and replace it with a reference to the procedure added to Standard 52.2 by this addendum.]

12.3 The minimum efficiency reporting value in the specified size ranges and final resistance for reporting purposes shall be in accordance with Table 12-1. Air cleaners with MERV1 to MERV4 (i.e., devices with efficiencies less than 20% in the size range of 3.0–10.0 µm) shall also be tested in accordance with the ~~arrestance method~~ Dust-Loading Procedure outlined in ~~ANSI/ASHRAE Standard 52.1-1992 (Reference 2)~~ Section 10.7.2 of this standard before using this system for reporting.

[Remove the Minimum Final Resistance columns in Table 12-1 and the reference to Standard 52.1 in one of the headings in Table 12-1.]

TABLE 12-1 Minimum Efficiency Reporting Value (MERV) Parameters

Standard 52.2 Minimum Efficiency Reporting Value (MERV)	Composite Average Particle Size Efficiency,% in Size Range, μm			Average Arrestance,%, ~~by Standard 52.1 Method~~	~~Minimum Final Resistance~~	
	Range 1 0.30–1.0	Range 2 1.0–3.0	Range 3 3.0–10.0		~~Pa~~	~~in. of water~~
1	n/a	n/a	$E_3 < 20$	$A_{avg} < 65$	~~75~~	~~0.3~~
2	n/a	n/a	$E_3 < 20$	$65 \le A_{avg} < 70$	~~75~~	~~0.3~~
3	n/a	n/a	$E_3 < 20$	$70 \le A_{avg} < 75$	~~75~~	~~0.3~~
4	n/a	n/a	$E_3 < 20$	$75 \le A_{avg}$	~~75~~	~~0.3~~
5	n/a	n/a	$20 \le E_3 < 35$	n/a	~~150~~	~~0.6~~
6	n/a	n/a	$35 \le E_3 < 50$	n/a	~~150~~	~~0.6~~
7	n/a	n/a	$50 \le E_3 < 70$	n/a	~~150~~	~~0.6~~
8	n/a	n/a	$70 \le E_3$	n/a	~~150~~	~~0.6~~
9	n/a	$E_2 < 50$	$85 \le E_3$	n/a	~~250~~	~~1.0~~
10	n/a	$50 \le E_2 < 65$	$85 \le E_3$	n/a	~~250~~	~~1.0~~
11	n/a	$65 \le E_2 < 80$	$85 \le E_3$	n/a	~~250~~	~~1.0~~
12	n/a	$80 \le E_2$	$90 \le E_3$	n/a	~~250~~	~~1.0~~
13	$E_1 < 75$	$90 \le E_2$	$90 \le E_3$	n/a	~~350~~	~~1.4~~
14	$75 \le E_1 < 85$	$90 \le E_2$	$90 \le E_3$	n/a	~~350~~	~~1.4~~
15	$85 \le E_1 < 95$	$90 \le E_2$	$90 \le E_3$	n/a	~~350~~	~~1.4~~
16	$95 \le E_1$	$95 \le E_2$	$95 \le E_3$	n/a	~~350~~	~~1.4~~

Note: The minimum final resistance shall be at least twice the initial resistance, or as specified above, whichever is greater. Refer to Section 10.7.1.1.[45]

[Delete normative Reference 2 and renumber the remaining references accordingly.]

~~2. *ANSI/ASHRAE Standard 52.1-1992, Gravimetric and Dust-spot Methods for Testing Air-cleaning Devices Used in General Ventilation for Removing Particulate Matter.*~~

[Revise of Section A2.3 in Appendix A as follows.]

A2.3 ASHRAE Technical Committee 2.4 funded a research project (ASHRAE 1190-RP) to develop a new loading test method that would more nearly represent the minimum efficiency points in actual real-world use. ~~This method is currently in public review.~~ <u>The results of this research were used to develop a method of conditioning that has been demonstrated in limited cases to more closely predict filter performance in field use. This method of conditioning is now included in this standard as Informative Appendix J with an optional step to help predict the efficiency loss the filter may realize in field applications.</u>

[Remove the last sentence of Section A3.2 in Appendix A since reference to Standard 52.1 is now unnecessary.]

A3.2 The upper size limit of 10 μm was chosen to address the ability of air cleaners to remove potentially irritating and nuisance particles that adversely affect human health and air-handling equipment. Particles of this size may be trapped in the nose and cause irritation and/or allergic reactions. These particles can also soil surfaces and equipment. Such contamination can provide nutrients for biological growth in ductwork or cause duct corrosion, both of which contribute to indoor air quality (IAQ) degradation. Filtration of large particles is needed to protect air-handling systems and equipment from contamination, according to ASHRAE SSPC 62, the standing committee maintaining ASHRAE Standard 62, Ventilation for Acceptable Indoor Air Quality. ~~Some air cleaners that remove 10 μm size particles may be tested by the proposed Standard 52.2 method, but others will require testing in accordance with the arrestance method of ASHRAE Standard 52.1-1992.~~

[Replace the sample report in Figure C-1 with the following revised report.]

Page 1 of 3

ASHRAE Std. 52.2 Air Cleaner Performance Report Summary

1 (This report applies to the tested device only)

Laboratory Data 3

Report No. 99-392 Test No. 99-1798 Date DEC. 12, 1999

Test laboratory INDEPENDENT TEST LAB, INC.

Operator T. SMITH Supervisor G. SUPER

Particle counter(s): Brand COUNTALL Model 226/80

4 **Device Manufacturer's Data** 2 3

Manufacturer FILTERMAKER, INC.

Product name FLO-RITE Model 12

Test requested by FILTER SALES CO.

Sample obtained from OPEN MARKET 5

Catalog rating: Airflow rate 1.18 m^3/s Initial press. drop 53 Pa

Specified test conditions: Airflow rate 1.18 m^3/s 6

Final pressure drop 250 Pa 7 Face velocity 3.2 m/s

Device Description 8

Dimensions: height 590 mm width 590 mm depth 560 mm

Generic name BAG FILTER Media type SYN. NONWOVEN POLYESTER

Effective media area 3.5 m^2 9 Media color YELLOW

Amount and type of adhesive NONE

Other attributes 5 POCKETS

Test Conditions

Airflow rate 1.18 m^3/s Temperature 22°C RH 50%

Test aerosol type KCl

Final pressure drop 250 Pa Face velocity 3.2 m/s

Remarks NONE

Resistance Test Results

Initial resistance 57 Pa 10 Final resistance 250 Pa

Minimum Efficiency Reporting Data 11

Composite average efficiencies E_1 13% E_2 60% E_3 87%

Air cleaner average Arrestance N/A 17

Minimum efficiency reporting value (MERV) for the device:

MERV 10 @ 1.18 12

Dust Holding Capacity (g) 693 16

Figure C-1 Sample summary air-cleaner performance report, Page 1.

[Add the following new Figure C-4 after Figure C-3.]

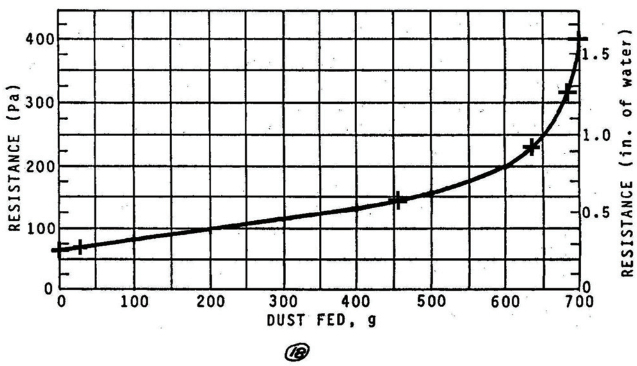

Figure C-4 Sample air-cleaner report summary, Page 3 (continued with Resistance vs. Synthetic Loading Dust Fed graph ONLY for air-cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 μm).

[Add the following numbered descriptions (items 16 through 18) after item 15 in Section C2.1.]

16. The dust-holding capacity presents the total weight of synthetic loading dust captured by the air-cleaning device over all of the incremental dust loading steps. This value should not be used to calculate the expected life of the device in use.
17. The average dust arrestance presents the ability of the filter to remove loading dust from test air. This is measured and reported only for air-cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 µm.
18. This curve shows the resistance vs. synthetic loading dust fed (for air-cleaning devices with efficiencies less than 20% in the size range of 3.0–10.0 µm).

[Revise the third paragraph in Section D2.5 as follows to remove the reference to Standard 52.1 and replace it with a reference to a procedure added to the standard by this addendum.]

The filter is classified as MERV Group 1-4 and must be tested in accordance with the arrestance method outlined in ~~ANSI/ ASHRAE Standard 52.1-1992~~ Section 10.7 of this standard. The air cleaner can then be reported in accordance with Table 12-1 using the average arrestance value.

[Add new Appendix J.]

(This appendix 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 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.)

INFORMATIVE APPENDIX J OPTIONAL METHOD OF CONDITIONING A FILTER USING FINE KCL PARTICLES TO DEMONSTRATE EFFICIENCY LOSS THAT MIGHT BE REALIZED IN FIELD APPLICATIONS

J1. PURPOSE OF OPTIONAL TEST

This conditioning procedure is a separate test from Section 10.7.1.2, item b, of the standard to determine the magnitude of the efficiency loss a filter may realize in field applications. For any particular type or model of filter, the test described in the body of the standard must be used. If desired, both tests may be used; however, the same test filter may not be tested with both methods. When the test in Appendix J is used, the data output obtained from the efficiency test procedure after the KCl conditioning step is referred to as MERV-A, as defined in Section J2.2 below. The data output value is thus differentiated from the MERV value that is the data output of the test without the KCl conditioning

The conditioning step described herein is representative of the best available knowledge of real life filter efficiency degradation at the time of the publication of this procedure. Changes in filtration performance are environment-dependent and, therefore, filters may or may not degrade to the conditioned efficiencies described in this document. For this reason, the results from this appendix may be used to compare filters as described in the Foreword to Standard 52.2 (see section titled, “Not an Application Standard”).

The goal of this appendix is to provide an optional conditioning method of test, gather data using this method, and validate this method to achieve consensus for possible future incorporation into the body of the standard. This procedure is being included as an option to the test method so that those concerned about a possible drop in filtration efficiency have a recognized test method to predict the magnitude of the efficiency loss. This standard is under continuous maintenance, and the committee welcomes continuous maintenance proposals addressing means to improve the method.

J2. DEFINITIONS AND ACRONYMS

J2.1 Definitions to be used in addition to those listed in Section 3 of the standard are as follows:

condensation particle counter (CPC): an instrument used to measure the concentration of submicrometer aerosol particles. Also called a *condensation nucleus counter (CNC)*.

conditioning aerosol: a submicrometer solid-phase potassium chloride aerosol used to reproduce the falloff in efficiency that electret filters may experience in real-life applications.

CT: for the conditioning aerosol, the product of the in-duct aerosol concentration (C) measured with the CPC and the exposure time (T).

Laskin generator: A nozzle that uses a source of compressed air as part of a system to generate a polydispersed aerosol from a liquid. ***Note:*** A Laskin generator is shown in *NSF Standard 49: Class II (Laminar Flow) Biosafety Cabinetry.*

J2.2 Acronyms to be used in addition to those listed in Section 3 of the standard are as follows:

A_{avg}-A = average value of the arrestances made on the device during loading test when Appendix J conditioning is used.

DHC-A = the total weight of the synthetic loading dust captured when Appendix J conditioning is used.

MERV-A #-A = minimum efficiency reporting value according to Appendix J, where # represents the numeric value from Table J-2.

J3. TEST APPARATUS FOR CONDITIONING AEROSOL IN ADDITION TO THE TEST APPARATUS REQUIRED IN SECTION 4 OF THE STANDARD

J3.1 Condensation Particle Counter. The in-duct concentration of the conditioning aerosol shall be measured with a CPC having a minimum 50% counting efficiency at 0.02 µm. The CPC shall have a concentration limit of $\geq 500{,}000\ cm^{-3}$. The CPC shall not be operated above its concentration limit.

J3.2 Laskin Generator. The conditioning aerosol shall be generated using one or more Laskin generators. The aerosol output of the Laskin generator(s) is not required to be passed through a charge neutralizer. The nozzles shall be operated at air pressures of 20 to 60 psig. The Laskin generator(s) shall be operated with an aqueous solution of KCl in water prepared to a ratio of 1.00 g of reagent grade KCl for each 1.00 L of distilled or filtered deionized water. The compressed air line supplying the Laskin generator shall be equipped with devices for the removal of oil and water and have a high-efficiency particle filter (99.97% @ 0.3 µm or better) installed near the Laskin generator(s). The conditioning aerosol shall be injected between the inlet filter bank (item 3 of Figure 4-1) and the upstream mixing orifice (item 9 of Figure 4-1).

J3.3 Separate Duct for Conditioning Step. The use of a separate duct for the conditioning portion of the test is acceptable as long as the conditioning duct meets the following criteria:

- The cross-sectional dimensions of the duct are 610 × 610 mm (24 × 24 in.).
- The HEPA filter bank, transition, aerosol injection tube, mixing orifice, perforated diffusion plate, upstream sampling probe, and main flow measurement nozzle are designed and installed according to Section 4.2.
- The test filter does not extend beyond the length of the duct.
- Test environmental conditions meet Section 4.2.3.

The conditioning duct can be operated in a positive or a negative pressure mode.

J4. SUBSECTION TO BE USED WITH SECTION 5.1 OF THE STANDARD

J4.1 If a separate duct is used for the conditioning step (see Section J3.3), then velocity uniformity (see Section 5.2) shall be performed on that duct.

J5. SUBSECTION TO BE USED WITH SECTION 5 OF THE STANDARD

J5.1 Uniformity of the Conditioning Aerosol Concentration

J5.1.1 The uniformity of the conditioning aerosol concentration across the duct cross section shall be determined by a nine-point traverse in the 610 × 610 mm (24 × 24 in.) duct immediately upstream of the device section (i.e., at the location of the upstream sample probe), using the grid points shown in Figure 5-1. The traverse shall be made by either (a) installing nine sample probes of identical curvature, diameter, and inlet nozzle diameter but of variable vertical length or (b) repositioning a single probe.

J5.1.2 The conditioning aerosol generation system shall be operated in the same manner as intended for conditioning of test filters.

J5.1.3 The aerosol concentration measurements shall be made with a CPC meeting the specifications of Section J3.1. A one-minute average concentration shall be recorded at each grid point. The average shall be based on at least ten readings taken at equal intervals during the one-minute period. After sampling all nine points, the traverse shall then be repeated four more times to provide a total of five samples from each point. These five values for each point shall then be averaged. The traverse measurements shall be performed at airflow rates of 0.22, 0.93, and 1.4 m^3/s (472, 1970, and 2990 cfm).

J5.1.4 The CV of the corresponding nine grid point particle concentrations shall be less than 15% for each airflow rate.

J5.1.5 Ratio of Small to Large Particles in the Conditioning Aerosol. With the conditioning aerosol generator operating as it would for conditioning operation during a standard test, the in-duct aerosol concentration shall be measured with the CPC and with the particle counter used for PSE testing. The CPC sample inlet shall be located within 100 mm (4 in.) of the OPS inlet, and they can share the same inlet. The ratio of the CPC concentration to the concentration of particles > 0.3 µm (measured by the PSE particle counter and consisting of all particles measured between 0.3 and 10 ° m) shall be >20,000.

Note: The units of concentration will need to be the same to calculate the correct ratio. Typically the particle counter output will be in units of particles/m^3 and the CPC output will be in units of particles/cm^3.

J6. SUBSECTION TO BE USED WITH TABLE 5-1, SYSTEM QUALIFICATION MEASUREMENT REQUIREMENTS OF THE STANDARD

Parameter	Requirement
Ratio of the CPC concentration to the concentration of particles >0.3 μm (measured by the PSE particle counter)	Ratio > 20,000
Conditioning Aerosol Uniformity: Based on traverse measurements made over a 9-point equal-area grid at each test airflow rate.	CV <15%
Conditioning aerosol in-duct aerosol concentration	$< 1 \times 10^6$ cm^{-3} or less than the concentration limit of the CPC, whichever is smaller

J7. SUBSECTION TO BE USED WITH TABLE 5-2, APPARATUS MAINTENANCE SCHEDULE OF THE STANDARD

Maintenance Item	Incorporated into Each Test	Monthly	Bi-Annually	After a Change that May Alter Performance	Comment
Drain, rinse, and refill the Laskin generator with fresh 0.1% KCl solution					Daily
Ratio of the CPC concentration to the concentration of particles >0.3 μm	X				
Conditioning Aerosol Uniformity			X	X	
Conditioning Aerosol Concentration	X				

J8. SUBSECTION TO BE USED WITH SECTION 6, TEST MATERIALS, OF THE STANDARD

J8.1 Conditioning Aerosol. The conditioning aerosol shall be solid-phase potassium chloride (KCl) particles generated from an aqueous solution. The solution shall be prepared by dissolving reagent grade KCl in distilled or filtered deionized water at a proportion of 1.00 g of KCl per 1.00 L of water.

J9. SUBSECTION TO BE USED WITH SECTION 8.2, TEST PROCEDURES, OF THE STANDARD

J9.1 Test Sequence. The sequence of tests on the device shall be as follows:

a. Resistance vs. airflow rate of the clean device at various airflow rates as prescribed in Section 9 of the standard

b. PSE prescribed in Section 10 of the standard of the clean device per the standard.

c. PSE prescribed in Section 10 of the standard of the device after conditioning per this appendix.

d. PSE prescribed in Section 10 of the standard of the device when incrementally loaded with synthetic dust as prescribed in the standard with the exception of the 30 gram conditioning load (see Section 10.7.1.2.b).

J10. CONDITIONING PROCEDURE (USE THIS PROCEDURE INSTEAD OF SECTION 10.7.1.2.B OF THE STANDARD)

J10.1 After the initial efficiency test is completed, the filter shall be exposed to the conditioning aerosol. The duct airflow rate used during the conditioning step will be the same as is used during the dust-loading and particle size efficiency testing. Note that all filters tested according to this standard must be exposed to the same conditioning aerosol procedure, regardless of the specific materials, construction details, or other variables.

J10.2 Prior to conditioning, all internal surfaces of the Laskin generator shall be rinsed with distilled or filtered deionized water and then filled with KCl solution, as specified in Section J8.1.

J10.3 Record the background concentration using the CPC upstream of the test device with the duct airflow rate set to the same value used during testing.

J10.4 The measured in-duct conditioning aerosol concentration shall not exceed 1.0×10^6 cm^{-3}.

J10.5 Conditioning shall be performed in incremental steps with a PSE taken after each increment. The minimum incremental conditioning step shall be a CT of 6.4×10^7 particles cm^{-3} min. Conditioning is stopped when either (a) the current measurement shows no further significant drop in efficiency or (b) the cumulative CT exposure of the filter reaches a CT of 1.2×10^9 particles cm^{-3} min. A “significant drop” is a drop in efficiency of at least two percentage points in two or more adjacent particle size ranges relative to the minimum efficiencies in those ranges measured in any of the previous steps.

Note: Filters with large media area (typical of 300 mm or 12 in. filters and bag filters) may require cumulative conditioning CTs up to the maximum level of 1.2×10^9 particles cm^{-3}min. The test laboratory should select an incremental conditioning step size consistent with this expectation and avoid relatively small conditioning increments that may underchallenge the filter.

J10.6 Periodically during conditioning, the in-duct concentration of the conditioning aerosol shall be measured and recorded. The measurement interval shall be such that a minimum of three measurements are obtained during each conditioning interval.

J10.7 Whenever the determined correlation ratio is (see Section 10.3), it is recommended that the ratio of the concentration of small to large particles be measured. This ratio must be evaluated a minimum of two times during the conditioning procedure—once at the beginning of the conditioning and once at the end of the conditioning. The small particle concentration is that obtained from the CPC. The large particle concentration is that obtained from the PSE particle counter and is the concentration of all particles >0.3 µm. The ratio of the concentrations must be >20,000.

J10.8 To prevent deliquescence of the KCl during conditioning, relative humidity must be maintained below 65% in the test duct at all times during the test. If the filter is removed from the test duct for any reason during the test, it must be stored in an environment with RH less than 65%.

J11. SUBSECTION TO BE USED WITH SECTION 11.2 OF THE STANDARD

J11.1 Conditioning

1. The background concentration (particles cm^{-3})
2. The average conditioning aerosol concentration (particles cm^{-3})
3. The cumulative conditioning duration (minutes)
4. The cumulative conditioning CT (particles cm^{-3} min)
5. The PSE following each conditioning increment.
6. Dust holding capacity DHC-A (grams)

J11.2 Minimum Efficiency Reporting Value (MERV-A) according to Appendix J

1. The average of the minimum PSE of the four size ranges from 0.30 to 1.0 µm (E_1-A)
2. The average of the minimum PSE of the four size ranges from 1.0 to 3.0 µm (E_2-A)
3. The average of the minimum PSE of the four size ranges from 3.0 to 10.0 µm (E_3-A)
4. MERV-A for the device

J11.3 Minimum Efficiency Reporting Value (MERV-A) According to Appendix J for Air Cleaners

J11.3.1 The minimum efficiency reporting value (MERV-A) for an air cleaner shall be based on three composite average PSE points developed from a test at a manufacturer's specified airflow rate selected in accordance with Section 8-1. Dust loading shall follow the procedure outlined in Section 10.7 except substituting Section J10 of this appendix for Section 10.7.1.2 b of the standard. The results of the tests shall be reported in accordance with Sections 10.8.1 and 10.8.2. The four data points from the Section 10.8.2 composite curve in each of the three size range groups from Table J-1 shall be averaged, and the resultant three average minimum PSEs (E_1-A, E_2-A, and E_3-A) shall be reported.

J11.3.2 With this appendix, the minimum final resistance for an air cleaner shall always be the same as or greater than twice the initial resistance.

J11.3.3 With this appendix, the minimum efficiency reporting value in the specified size ranges and final resistance for reporting purposes shall be in accordance with Table J-2.

J11.3.4 The reporting designator shall be a combination of the air cleaner's MERV-A and the test airflow rate (e.g., MERV-A 10-A at 0.93 indicates that the air cleaner has a MERV-A 10-A when tested at 0.93 m^3/s [1970 cfm]).

TABLE J-1 Size Range Groups

Average Minimum PSE Designator	Corresponding Size Range Group, µm
E_1-A	0.30 to 1.0
E_2-A	1.0 to 3.0
E_3-A	3.0 to 10

TABLE J-2 KCl Conditioned Per Appendix J Minimum Efficiency Reporting Value (MERV-A) Parameters

Standard 52.2 Appendix J Minimum Efficiency Reporting Value (MERV-A)	Composite Average Particle Size Efficiency in Size Range, %			Average Arrestance, %
	Range 1 (0.3–1.0μm)	Range 2 (1.0–3.0μm)	Range 3 (3.0–10.0μm)	
1–A	n/a	n/a	E_3–A < 20	$A_{avg} < 65$
2–A	n/a	n/a	E_3–A < 20	$65 \leq A_{avg} < 70$
3–A	n/a	n/a	E_3–A < 20	$70 \leq A_{avg} < 75$
4–A	n/a	n/a	E_3–A < 20	$75 \leq A_{avg}$
5–A	n/a	n/a	20 ≤ E_3–A < 35	n/a
6–A	n/a	n/a	35 ≤ E_3–A < 50	n/a
7–A	n/a	n/a	50 ≤ E_3–A < 70	n/a
8–A	n/a	n/a	70 ≤ E_3–A	n/a
9–A	n/a	E_2–A < 50	85 ≤ E_3–A	n/a
10–A	n/a	50 ≤ E_2–A < 65	85 ≤ E_3–A	n/a
11–A	n/a	65 ≤ E_2–A < 80	85 ≤ E_3–A	n/a
12–A	n/a	80 ≤ E_2–A	90 ≤ E_3–A	n/a
13–A	E_1–A < 75	90 ≤ E_2–A	90 ≤ E_3–A	n/a
14–A	75 ≤ E_1–A < 85	90 ≤ E_2–A	90 ≤ E_3–A	n/a
15–A	85 ≤ E_1–A < 95	90 ≤ E_2–A	90 ≤ E_3–A	n/a
16–A	95 ≤ E_1–A	95 ≤ E_2–A	95 ≤ E_3–A	n/a

ASHRAE Standard 52.2 Air Cleaner Performance Report Summary with Optional Conditioning Procedure According to Appendix J

(This report applies to the tested device only)

Laboratory Data

Report number__________Test number______________ Date______________

Test laboratory____

Operator_______________________Supervisor________________________

Particle counter(s): Brand___________________Model__________________

Device Manufacturer's Data

Manufacturer________________________Product name_________________

Model______________________Test requested by______________________

Sample obtained from____

Catalog rating: Airflow rate_________________Initial pressure drop_____________

Specified test conditions: Airflow_____________Final pressure drop____________

Face velocity____

Device Description

Dimensions: Height_____________Width______________Depth__________________

Generic name_______________________Media type_______________________

Effective media area____________________Media color___________________

Amount and type of adhesive (Tackifier)___________________________________

Other attributes____

Test Conditions

Airflow rate_________________Temperature______________RH______________

Test aerosol type___________Final pressure drop___________Face velocity_______

Duct configuration (one or two ducts used):

Remarks____

Conditioning Parameters

Background concentration (particles cm^{-3})

Avgerage cond aerosol concentration (particles cm^{-3})___________________________

Cumulative conditioning duration (minutes)______________________________

Is filter continuously conditioned in the same duct? ________________________

Cumulative conditioning CT (particles cm^{-3} min)__________________________

PSE following each conditioning increment______________________________

Resistance Test Results

Initial resistance______________________Final resistance_________________

KCl Conditioned Minimum Efficiency Reporting Data (According to Appendix J)

Composite average efficiencies: E_1-A__________ E_2-A__________ E_3-A__________

Air cleaner average arrestance: A_{avg}-A_________

Dust holding capacity: DHC-A_________

Minimum efficiency reporting value: MERV-A_________

(This appendix 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.)

APPENDIX
18-MONTH SUPPLEMENT
ADDENDA TO ANSI/ASHRAE STANDARD 52.2-2007

This supplement includes Addendum b to ANSI/ASHRAE Standard 52.2-2007. The following table lists each addendum and describes the way in which the standard is affected by the change. It also lists the ASHRAE and ANSI approval dates for each addendum.

Addendum	Section(s) Affected	Description of Changes*	ASHRAE Standards Committee Approval	ASHRAE BOD Approval	ANSI Approval
b	Sections 3.1, 3.2, 8.1.3, 10.7.2, 10.8.4, 10.8.5, 11.2, 12.3, A2.3 and A3.2 in Appendix A, Appendix C, Appendix J, and Table 12-1	The first part of this addendum is part of a larger plan to combine Standards 52.1 and 52.2 into a single standard on air filter testing. It incorporates the 52.1 sections on arrestance and dust-holding capacity into Standard 52.2 and deletes some references to Standard 52.1 that occur in Standard 52.2. Future addenda will complete the process of making Standard 52.2 self sufficient and comprehensive, and at this time SPC 52.1 will be able to withdraw Standard 52.1. While similar to previous definitions, the terms arrestance and dust holding capacity are procedurally different and should not be directly compared to prior definitions in previous versions of standard 52. Part 2 of this addendum adds a new informative appendix to Standard 52.2, Appendix J. Appendix J provides an optional method of conditioning a filter using fine KCl particles to demonstrate efficiency loss that might be realized in field applications. Appendix J is not ANSI approved.	6/21/08	6/25/08	7/24/08

* These descriptions may not be complete and are provided for information only.

NOTE

When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at http://www.ashrae.org.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.