Introduction

This ASHRAE Standard 52.2 User Guide was created by the National Air Filtration Association (NAFA), a group of over 200 air filter distributors, manufacturers and engineers. This Guide, and the application of a particle-based contaminant removal standard prescribed by ASHRAE Standard 52.2 "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size," are intended to assist end-users and specifiers in their selection of appropriate air filtration products. NAFA suggests the integrated use of standards 52.1 and 52.2 to indicate anticipated performance throughout the useful life of the filter.

The ASHRAE Standard 52.2

ASHRAE Standard 52.2 features many improvements over the 52.1 standard. Data such as average efficiency, arrestance and dust holding capacity which are provided by 52.1 will remain important performance characteristics (see Table 1 for Application Guidelines for the two standards).

Some of the improvements found in the ASHRAE 52.2 standard include:

- The use of mandatory (code) language, which enables the standard to be referenced by other codes that are developed.
- Where 52.1 expressed efficiency as an overall percentage, 52.2 expresses efficiency as a function of specific particle sizes.
- The 52.2 method of test will create results that are reliable and verifiable.
- Seventy-two (72) data points are reduced into a single curve that typifies the minimum efficiency of a filter.

Table 1: Application Guidelines

MERV Std 52.2	Average ASHRAE Dust Spot Efficiency Std 52.1	Average ASHRAE Arrestance Std 52.1	Particle Size Ranges	Typical Applications	Typical Filter Type
1—4	< 20%	60 to 80%	> 10.0 µm	Residential / Minimum Light / Commercial Minimum / Equipment Protection	Permanent / Self Charging (passive) Washable / Metal, Foam / Synthetics Disposable Panels Fiberglass / Synthetics
5—8	< 20 to 35%	80 to 95%	3.0—10.0 µm	Industrial Workplaces Commercial Better / Residential Paint Booth / Finishing	Pleated Filters Extended Surface Filters Media Panel Filters
9—12	40 to 75%	> 95 to 98%	1.0—3.0 µm	Superior / Residential Better / Industrial Workplaces Better / Commercial Buildings	Non-Supported / Bag Rigid Box Rigid Cell / Cartridge
13—16	80—95% +	> 98 to 99%	0.30—1.0 µm	Smoke Removal General Surgery Hospitals & Health Care Superior / Commercial Buildings	Rigid Cell / Cartridge Rigid Box Non-Supported / Bag
17—20[1]	99.97[2] 99.99[2] 99.999[2]	N/A	≤ 0.30 µm	Clean Rooms High Risk Surgery Hazardous Materials	HEPA ULPA

Note: This table is intended to be a general guide to filter use and does not address specific applications or individual filter performance in a given application. Refer to manufacturer test results for additional information

(1) Reserved for future classifications

(2) DOP Efficiency

Standard 52.2 Test Procedure: How Data is Obtained

An air filter's performance is determined by measuring the particle counts upstream and downstream of the air-cleaning device being tested.

Particle counts are taken over the range of particle sizes six times, beginning with a clean filter and then after the addition of standard synthetic ASHRAE dust loadings for five additional measurement cycles.

A laboratory aerosol generator, which operates much like a paint sprayer, is used to create a challenge aerosol of known particle size in the air stream. This will generate particles covering the 12 required particle size ranges for the test (See Table 2).

The challenge aerosol is injected into the test duct and particle counts are taken for each of the size data points.

The filter's performance, on each of the twelve particle sizes, during the six test cycles (a total of 72 measurements) is determined. For each measurement, the filtration efficiency is stated as a ratio of the downstream-to-upstream particle count. The lowest values over the six test cycles are then used to determine the Composite Minimum Efficiency Curve (Note: in many cases, this will be the initial reading before the five dust loads). Using the lowest measured efficiency avoids the fiction of averaging and provides a "worst case" experience over the entire test.

The twelve size ranges are placed in three larger groups according to the following schedule:

Table 2: ASHRAE 52.2 Particle Size Ranges

Range	Size	Group
1	0.30 to 0.40	E1
2	0.40 to 0.55	
3	0.55 to 0.70	
4	0.70 to 1.00	
5	1.00 to 1.30	E2
6	1.30 to 1.60	
7	1.60 to 2.20	
8	2.20 to 3.00	
9	3.00 to 4.00	E3
10	4.00 to 5.50	
11	5.50 to 7.00	
12	7.00 to 10.00	

ranges 1—4 (or E1, which is 0.3 to 1.0 µm), ranges 5—8 (or E2, which is 1.0 to 3.0 µm), and ranges 9—12 (or E3, which is 3.0 to 10.0 µm). Averaging the Composite Minimum Efficiency for each of these groups will calculate the average Particle Size Efficiency (PSE), and the resulting three percentages (E1, E2, E3) are then used to determine the MERV.

Minimum Efficiency Reporting Value (MERV)

An "overall" reporting value of a 52.2-evaluated air filter is the expression of the Minimum Efficiency Reporting Value (MERV). The MERV is a single number that is used, along with the air velocity at which the test was performed; to simplify the extensive data generated by the method of testing. MERV is expressed on a 16 point scale and is derived from the PSE for each of the three groups. (See Table 3: MERV Parameters.)

The average PSE for each of the three groups (E1, E2 and E3) is referenced against the Minimum Efficiency Reporting Value Parameters (see Table 3: MERV Parameters). Move up the appropriate Range Group (E1, E2 and E3) on Table 3 and record the MERV to the left of the first true statement. Do this for all three groups.

The final MERV will be the lowest value of the three (e.g. E1=MERV 13, E2=MERV 11, E3=MERV 12 would mean that the final MERVE is 11).

Standard Test Airflow Rates

The Minimum Efficiency Reporting Value (MERV) must be stated with the air velocity at which the filter was tested. For example, if the filter was tested with an air velocity of 492 FPM and was found to be MERV 10, the filter's Minimum Efficiency Reporting Value would be MERV 10 @ 492 FPM. ASHRAE Standard 52.2 tests are to be conducted at one of seven airflow rates:

118 FPM (0.60 m/s)
246 FPM (1.25 m/s)
295 FPM (1.50 m/s)
374 FPM (1.90 m/s)
492 FPM (2.50 m/s)
630 FPM (3.20 m/s)
748 FPM (3.80 m/s)

Minimum Final Resistance

Final resistance must be at least twice the initial resistance at the test airflow rate, or the values in Table 3, whichever is greater.

Average Arrestance by Standard 52.1

Filters with an efficiency of less than 20% in E3 (MERV 1 through MERV 4) must be tested per the arrestance test of ASHRAE Standard 52.1

Conclusion

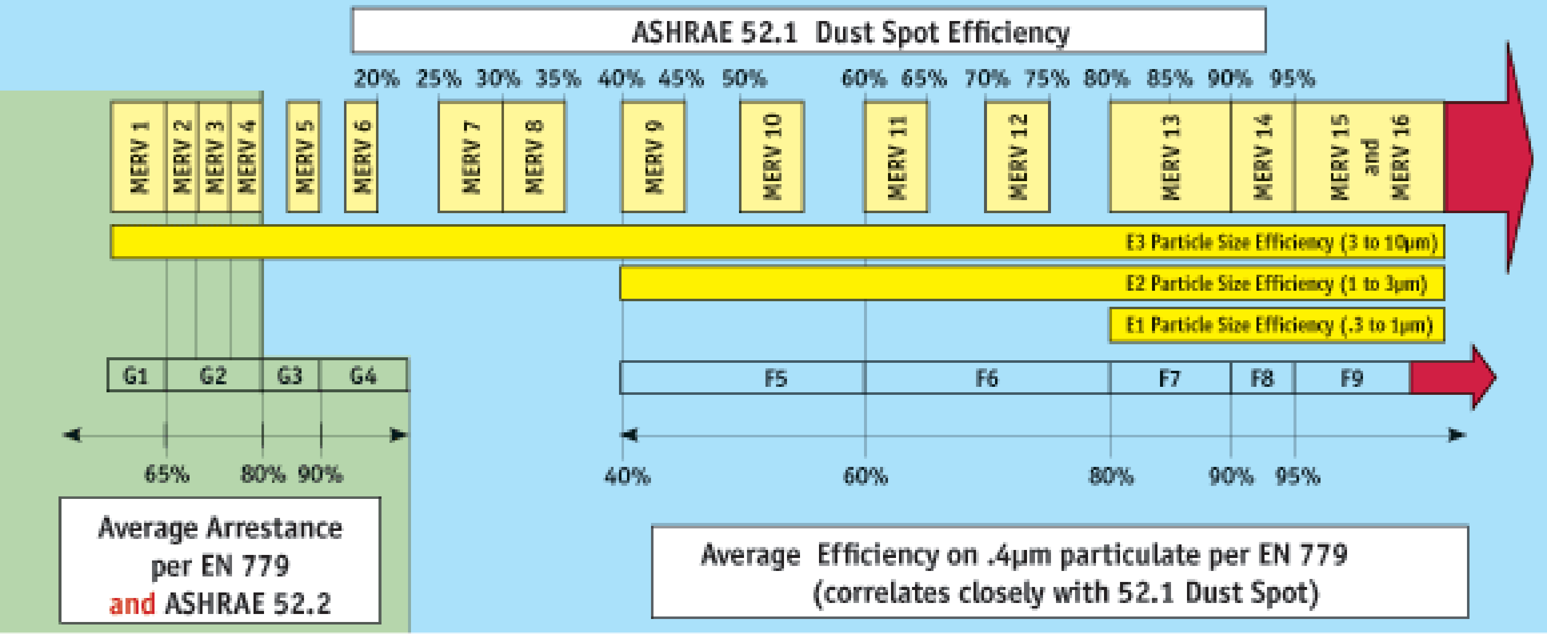
Consider contacting your local National Air Filtration Association (NAFA) member company. Most NAFA members are staffed by NAFA Certified Air Filtration Specialists (CAFS) to assist in the proper selection of filters for your applications.

Table 3: MERV Parameters

Standard 52.2 Minimum Efficiency Reporting Value (MERV)	Composite Average Particle Size Efficiency, % in Size Range, µm			Average ASHRAE Arrestance, %, by Standard 52.1 Method	Minimum Final Resistance	
	Range 1 (0.3 - 1.0)	Range 2 (1.0 - 3.0)	Range 3 (3.0 - 10.0)		PA	Inches of Water
1	n/a	n/a	E3 < 20	Aavg < 65	75	.3
2	n/a	n/a	E3 < 20	65 ≤ Aavg < 70	75	.3
3	n/a	n/a	E3 < 20	70 ≤ Aavg < 75	75	.3
4	n/a	n/a	E3 < 20	75 ≤ Aavg	75	.3
5	n/a	n/a	20 ≤ E3 < 35	n/a	150	.6
6	n/a	n/a	35 ≤ E3 < 50	n/a	150	.6
7	n/a	n/a	50 ≤ E3 < 70	n/a	150	.6
8	n/a	n/a	70 ≤ E3	n/a	150	.6
9	n/a	E2 < 50	85 ≤ E3	n/a	250	1.0
10	n/a	50 ≤ E2 < 65	85 ≤ E3	n/a	250	1.0
11	n/a	65 ≤ E2 < 80	85 ≤ E3	n/a	250	1.0
12	n/a	80 ≤ E2	90 ≤ E3	n/a	250	1.0
13	E1 < 75	90 ≤ E2	90 ≤ E3	n/a	350	1.4
14	75 ≤ E1 < 85	90 ≤ E2	90 ≤ E3	n/a	350	1.4
15	85 ≤ E1 < 95	90 ≤ E2	90 ≤ E3	n/a	350	1.4
16	95 ≤ E1	95 ≤ E2	95 ≤ E3	n/a	350	1.4

Test Standard Comparison Chart

The chart below is useful in understanding the relationship between ASHRAE Test Standard 52.1-1999, ASHRAE Test Standard 52.2-2007, E1, E2, E3 and European Test Standard EN 779.



Source: Mr. Robert Burkhead, President of Blue Heaven Technologies, Louisville, Kentucky.