V-8 Testing Comments

V8 Performance: MERV and MERV-NC Testing

Air Cleaning versus Air Filtration

This is an important distinction, especially when it comes to performance testing. Air filters use passive mechanical means to capture particulates and are essentially sieves: the smaller the holes in the sieve the more efficient the filter is, but also the more resistant it is to airflow. Air filters range from 1" fiberglass furnace filters to 24" deep HEPA and ULPA filters.

Air cleaners, on the other hand, utilize a variety of physical and electrical phenomena to remove particulates from the air. Dynamics Air Cleaners, for example, use mechanical means as well as polarization and agglomeration.

Meaningful short-term comparisons of air filters and air cleaners have been problematic. To quote The AHR News in a 1998 article about the, then pending, ASHRAE 52.2 test procedure:

> "Still unanswered is whether the test method can be adequately applied to electronic air cleaners- a long-standing bone of contention, since eac's and air filters are two different animals when it comes to the way they clean the air."

ASHRAE Air Filter Testing

ASHRAE testing was developed largely to compare clean passive filters. The two traditional tests were the 52.1 Dust Spot Test and the 52-76 Arrestance Test. The new 52.2 Test is a better test, but it is still only geared towards comparisons of clean passive filters.

In brief, the Dust Spot Test put a standardized dust through a filter and a device was used to compare staining of standardized medias before and after the test filter; from the color difference, the efficiency was inferred and the ASHRAE rating (30%, 65%, etc.) was derived. However, an ASHRAE rating of, for example, 65% does *not* mean that the filter is 65% effective at a given particle size. The 52.1 method was developed before there were accurate means of measuring particle size and distribution. Further, the test dust contained very high levels of carbon black, something generally not found in typical atmospheric dust. Carbon black made for easy-to-read color changes, but unfortunately, it is highly conductive and quickly discharged the field in our Panels, dramatically decreasing performance. To quote ASHRAE:

> "Standard 52.1 test dust contains carbon black and is not suitable for testing electronic air cleaners because it causes them to short out".

ASHRAE 52-76 uses a fairly coarse standardized test dust and weighs the filter before and after. This is a useful indicator of the filter's ability to protect coils from the larger particulates that can clog them, but says little about the filter's ability to catch the smaller particulates (below 1.0μm) that are of concern to occupants. Technically, 52-76 test dust does contain particulates that below 1.0μm, and some air filter manufacturers use their 52-76 results to imply good performance on small particulates. However, this can be misleading since the test measures the *weight* of the dust collected. By weight, sub-micron particulates account for less than 3% of what is in the air. By *number*, just the opposite is true, sub-micron particulates account for close to 98% of the total particulates.

52.2 uses what is called fractional testing. This uses particle counters to measure actual particle counts before and after the filter. The counters measure the particles in 12 "bins": bin #1 is particles 0.3-0.4μm, bin #2 0.4-0.55μm, bin #3 0.55-0.7μm, etc. The results are then grouped and averaged into three sub-categories (E1: .35-.84μm, E2: 1.14-2.57μm, and E3: 3.46-8.37μm). Six efficiency tests are run as the filter is loaded to 1.4" of resistance. The minimum efficiency in each category is then used to yield the MERV (minimum efficiency rating value) rating. The MERV test uses two aerosols: a challenge aerosol of potassium chloride and a loading dust that is a mix of things and contains, like the 52.1 test, about 20% carbon black. According to 52.2 committee, its presence in the 52.2 test dust is based on its historical use in the 52.1 test dust. 52.2 is a much better test than 52.1 and it is an excellent means of comparing clean passive filters. The results are the MERV numbers that are starting to be used. However, 52.2 is still not a good test for measuring the actual performance of various air cleaners. ASHRAE recognizes this shortcoming and footnote 43 of the test protocol states the following:

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> "Electrostatic phenomena considerations: the test dust and loading procedure specified herein may not be representative of real-world particulate loading, and may favor or disfavor certain types of air cleaning devices that rely on electrostatic phenomena to enhance their performance. These electrostatic phenomena may be natural, imposed on the media during manufacture or imposed on the media by applying a voltage across the media while the device is in use."

Despite this shortcoming, the MERV test is becoming the standard for measuring filter efficiency. In the absence of a universal standard, the MERC-NC test has been developed. This test uses the same protocol as the MERV test, with the exception that SAE fine dust without carbon black is substituted as the loading dust. It should be noted that while this protocol is not yet an ASHARE Standard, it is more indicative of real world conditions and has been used by us and others whose devices use electrostatics.

V8 Performance

As discussed above the MERV rating is based on the Minimum E1, E2, E3 values. The efficiencies themselves are found on page 3 of a typical report. The required values for MERV 13-16 are as follows:

Rating	E1	E2	E3
13	less than 75%	greater than 90%	greater than 90%
14	between 75% and 85%	greater than 90%	greater than 90%
15	between 85% and 90%	greater than 90%	greater than 90%
16	greater than 95%	greater than 95%	greater than 95%

(It is interesting to note that a MERV 13 filter does not need to remove any sub-micron particles.)

In the standard MERV test, the V8 starts as a MERV 16, drops to a MERV 13 when it shorts out and winds up a MERV 14. Therefore, it is a MERV 13.

In the MERV-NC test, the V8 is a MERV 16 with over 3,700 grams of dust on it. This is 5-12 times the amount a passive filter can hold. While the E1 efficiency stays above 95% throughout, however, there is a slight drop in the efficiency in the larger range the V8 finishes with 4,582 grams of dust and a MERV-NC rating of 15. As a point of reference, a HEPA filter is a MERV 17.

Lastly, it is important to note in all cases the MERV results will understate the impact of the V8 on the space as it does not take into account agglomeration or removal of particles smaller than .3 micron –at which the V8 excels- nor reduction of VOC's and odors.

Summary from Report # 3097239-02 Dated May 19, 2006 from Intertek which follows.

	E1. E2, E3 Values For REPORT NO. 3097239-002 dated May 19,2006 By Intertek											
Range Number	1	2	3	4	5	6	7	8	9	10	11	12
Composite Minimum	91	94.4	96.6	98.1	98.9	99.1	96.7	96.1	95.1	94.1	93.1	92.2

E1 = 95.0 **E2 = 97.7** **E3 = 93.6**

Dynamic Air Quality Solutions
Tel: 800-578-7873
P.O. Box 1258
Princeton, NJ 08542