

# Fractional Efficiency Gains Through the Use of Binks Receptor Booth Filter

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**Abstract:** This disclosure attempts to clarify the procedural issues of the new ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers) standard as it pertains to defining the minimum efficiency reporting value of a spray booth filter. It will attempt to define the difference between the Binks Receptor filter and the leading filters used in spray booth applications. In addition, data will be presented which will show that the Binks filter outperformed competitive filters when independent testing was performed.

## I. Introduction

Standard 52.1-1992 provided three important evaluation criteria for filters: dust spot efficiency, arrestance, and dust holding capacity. The new ASHRAE standard, 52.2-2007 provides a filter's initial efficiency as a function of particle size as well as a numeric value that allows a user or engineer to specify a product minimum efficiency reporting value or MERV. Both Standards also provide a filter's initial resistance to airflow which is an important denominator regardless of the Standard that is applied.

An important criterion in developing the new Standard was the goal of providing a 'low point' of filter efficiency or in most cases initial filter efficiency. Most filters incorporating mechanical principles of particle capture become more efficient as they load with dirt. Rather than provide an average efficiency, the new Standard attempts to provide a methodology in which the lowest point efficiency value is determined. In this manner, the user would know how efficient the filter is at its lowest point, which in most cases is as soon as it is installed in the booth. Other test procedures provide an average efficiency, which may require extensive time to reach in actual operation.

The independent test reports provide the user with a chart that shows the filter's initial particle size versus efficiency through the twelve ranges of

particle capture. Three ranges are defined in the test range that will define the fractional efficiency of the filter:

E1 (%) Initial Efficiency 0.30-1.0 um

E2 (%) Initial Efficiency 1.0-3.0 um

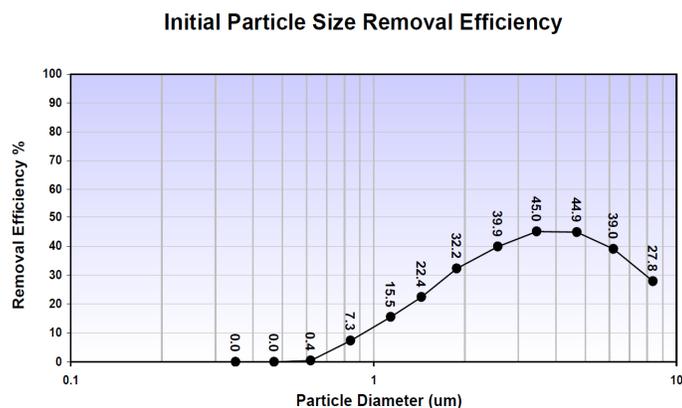
E3 (%) Initial Efficiency 3.0-10.0 um

The values of E1, E2 and E3 are then referenced on the ASHRAE table to determine the respective minimum efficiency reporting value or MERV. ***In short, the higher the MERV rating, the more efficient the filter will be in capturing smaller particles.*** In the case of paint booth filtration, we would be especially concerned with the micron filtration in the 3.0-10.0 micron particle range. Small particle capture in this range will prevent most airborne contaminants in a spray application from passing through the filter media.

## II. Analysis

Independent testing was performed by Blue Heaven Technologies using ASHRAE Standard 52.2-2007 protocol.

The **Binks Green Receptor** filter media was tested using a 20"x20"x2" media. The fractional efficiency curve for the 1.0-10.0 micron range is shown in the figure, below.



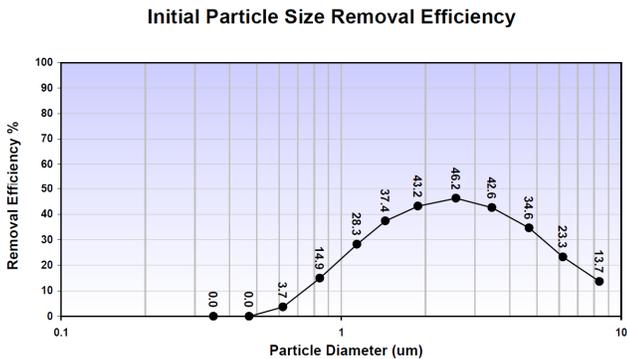
*Binks Receptor Fractional Efficiency*

The test results for the Binks Receptor filter can be summarized as:

Airflow Rate (CFM)	819
Nominal Face Velocity (fpm)	295
Initial Resistance (in WG)	0.19
E1 (%) Initial Efficiency 0.30-1.0um	2
E2 (%) Initial Efficiency 1.0-3.0um	28
E3 (%) Initial Efficiency 3.0-10.0um	39

Estimated Minimum Efficiency Reporting Value (MERV) **MERV 6 @ 819CFM**

Similarly, the same independent testing was performed on **Paint Pockets Diamond** paint arrester using a 20"x20"x2" media. The fractional efficiency curve for the same particle range is displayed in the following figure:



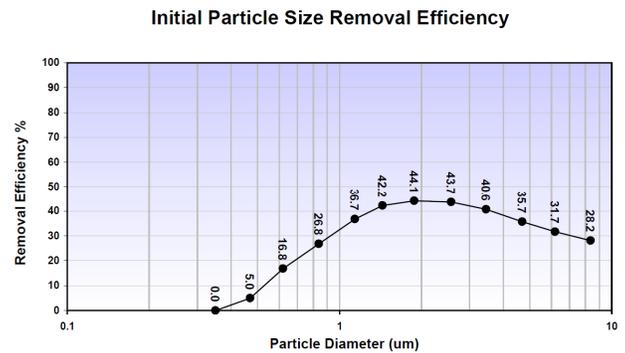
*Paint Pockets Diamond Fractional Efficiency*

The test results for the Paint Pockets filter can be summarized as:

Airflow Rate (CFM)	819
Nominal Face Velocity (fpm)	295
Initial Resistance (in WG)	0.24
E1 (%) Initial Efficiency 0.30-1.0um	5
E2 (%) Initial Efficiency 1.0-3.0um	39
E3 (%) Initial Efficiency 3.0-10.0um	29

Estimated Minimum Efficiency Reporting Value (MERV) **MERV 5 @ 819CFM**

In the same manner, independent testing was also performed on the GFS Wave Filter. Because the Wave Filter is cut longitudinally into two halves from the same pad, a separate test for each half section was made. In essence, the two halves become a matched set. The tests indicate that the two halves produced distinctly different results.



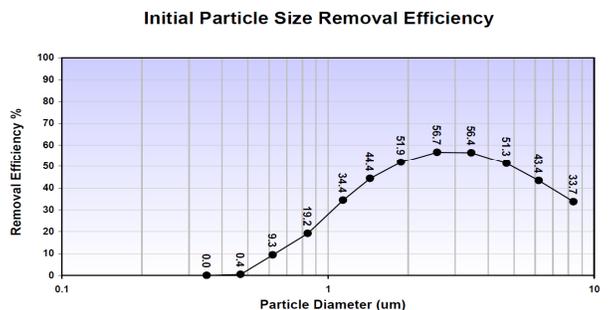
*GFS Wave Filter Fractional Efficiency Results – First Half Section*

The test results for the **GFS Wave filter first half section** can be summarized as:

Airflow Rate (CFM)	819
Nominal Face Velocity (fpm)	295
Initial Resistance (in WG)	0.35
E1 (%) Initial Efficiency 0.30-1.0um	12
E2 (%) Initial Efficiency 1.0-3.0um	42
E3 (%) Initial Efficiency 3.0-10.0um	34

Estimated Minimum Efficiency Reporting Value (MERV) **MERV 5 @ 819CFM**

The results for the second half section are displayed below:



*GFS Wave Filter Fractional Efficiency Results - Second Half Section*

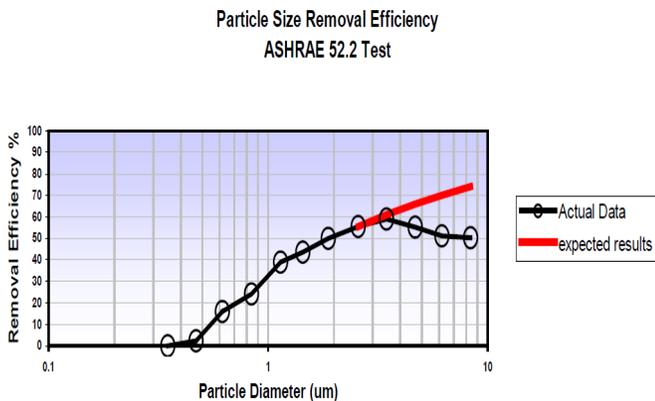
The test results for the **GFS Wave filter second half section** can be summarized as:

Airflow Rate (CFM)	819
Nominal Face Velocity (fpm)	295
Initial Resistance (in WG)	0.44
E1 (%) Initial Efficiency 0.30-1.0um	7
E2 (%) Initial Efficiency 1.0-3.0um	47
E3 (%) Initial Efficiency 3.0-10.0um	46

Estimated Minimum Efficiency Reporting Value (MERV) **MERV 6 @ 819CFM**

The two halves show a distinct difference in the fractional efficiency results. While the first half had a MERV rating of 5, the second half displayed a MERV rating of 6. The inconsistency could be explained by the manner in which the filter is produced.

Any questions pertaining to the shapes of the curves in the 3.0-10.0 um particle range can be explained by the following graphic



The ASHRAE 52.2 tests show that the particle removal efficiency drops off in this range and can be explained by the phenomenon of ‘particle bounce’. When it occurs, particle bounce generally happens in filters that are MERV 8 and below. The lower the MERV value the larger the filter fibers, as a rule of thumb. The bounce phenomenon requires a combination of large particles and large fibers.

#### IV. Conclusions

The ASHRAE 52.2 tests can be summarized as follows:

1) ***The Binks Receptor filter displayed the highest MERV rating of 6 from the independent tests.***  
This rating was consistent with previous tests conducted on the Binks filter.

2) ***Competitor’s filters displayed lower MERV ratings and inconsistent results.***  
The MERV rating on the Paint Pockets filter had a value of 5 compared to the Binks value of 6. The Wave filter halves had MERV ratings of 5 and 6 indicating a significant inconsistency in the manner in which the two halves are produced.

3) ***The fractional efficiency results of the Binks Receptor filter were better and more consistent than competitors.***  
The improved fractional efficiency results point to the manner in which the Binks Receptor filter will effectively remove small paint particulates in spray booth environments.

4) ***The Binks Receptor filter had the lowest initial filter resistance than the competition.***  
The filter resistance (WG) of each can be summarized;

Binks Receptor:	0.19
Paint Pockets:	0.24
GFS Wave – one half:	0.35
GFS Wave – second half:	0.44

#### V. Future Research

Industrial Finishing is uniquely situated to continue to make improvements to its atomization products and consumable products such as the Binks Receptor booth filter. We will continue to provide products that are environmentally friendly within the framework of our Green Works campaign. Contact your Industrial Finishing Specialist for further details.

## VI. References

[1] Blue Heaven Technologies, *ASHRAE Standard 52.2-2007 Test Report No. 10-100, Paint Pockets Diamond, 2010*

[2] Blue Heaven Technologies, *ASHRAE Standard 52.2-2007 Test Report No. 10-101, Binks Green Receptor, 2010*

[3] Blue Heaven Technologies, *ASHRAE Standard 52.2-2007 Test Report No. 10-231, Wave Filter, 2010*

[4] Blue Heaven Technologies, *ASHRAE Standard 52.2-2007 Test Report No. 10-232, Wave Filter, 2010*

[5] Industrial Finishing, *Enhanced Paint Holding Capacity and Run-Off Characteristics Realized in New Booth Filter, Micheli, 2009*

[6] Camfil Farr, *ASHRAE Testing for HVAC Air Filtration a Review of Standards 52.1-1992 & 52.2-1999, Technical Service Bulletin, 2002*

[7] RTI International, *Air Filter and Air Cleaner Testing Services*

[8] Blue Heaven Technologies, *FAQ – Efficiency Curve Shape, Rose, 2006*