LMS Single Pass Efficiency Test – Executive Summary

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Test Summary

The purpose of this test is to measure the single pass efficiency of the Genesis Air CU-S and CU-R. This test is preformed based on ASHRAE 52.2-2017 Appendix L, which allows single pass efficiency to be determined based on the reduction of viable MS2, rather than particle capture.

In this test, a 24” x 24” cross section stainless steel duct was used to convey 2000 CFM of air through the Genesis Air Photocatalyst. Half of the trials tested the 2424 CU-S and the other half of the trials tested the 2424 CU-R. The pre-filter used in the CU-R is a MERV 13. The biological contaminants used are MS2, Staph Epidermis, E. Coil, and Aspergillus Niger. The table below shows the average removal efficiency. The trials using MS2 will be used as an equivalent ASHRAE 52.2 single pass efficiency.

Contaminant Species	Average Removal Efficiency		
	Natural Decay	Genesis Air CU-S (without Pre-filter)	Genesis Air CU-R (with MERV 13)
Staph. Epidermis	2.74 %	47.93 %	89.02 %
E. Coli	15.54 %	76.90 %	92.96 %
MS2	5.60 %	73.58 %	90.73 %
Aspergillus Niger	9.10 %	38.02 %	88.18 %

Table 1: Contaminant Removal Efficiency.

MERV Filter Efficiency			
MERV Rating	Particle Range 1: 0.3 – 1.0 µm	Particle Range 2: 1.0 – 3.0 µm	Particle Range 3: 3.0 – 10.0 µm
8		≥20 %	≥70 %
9		≥35 %	≥75 %
10		≥50 %	≥80 %
11	≥20 %	≥65 %	≥85 %
12	≥35%	≥80 %	≥90 %
13	≥50 %	≥90 %	≥90 %
14	≥75 %	≥90 %	≥95 %
15	≥85 %	≥90 %	≥95 %
16	≥95 %	≥95 %	≥95 %

From ASHRAE Standard 52.2 - 2017

Table 2: MERV Filter Efficiency

ASHRAE Standard 241-2023 Review

ASHRAE Standard 241-2023 Appendix A states that most electronic air cleaning devices must not produce excessive amounts of ozone or formaldehyde as byproducts. The standard sets UL 2889 as the criteria for zero ozone emissions. The standard also sets 50 µg/h as the maximum allowable emission of formaldehyde. These devices should also be tested to ensure they do not increase the level of large particulate through clumping of smaller particulate caused by electrostatic charge. The cleanliness class of the test duct, as described in ISO 14644-14, shall not increase more than one level when the electronic air cleaner is in use.

The Genesis Air PCO Device does not use electrostatic charge to clump particles, so there should not be an increase in particulate matter. The PCP compound has been tested by UL as being UL 2998 compliant for zero ozone emissions.

ASHRAE Standard 241 gives guidelines on how to calculate the combined efficiency when multiple air cleaning devices are placed together in series. Equation (7-2b) can be used to find the combined filter efficiency of using a PCP with any given MERV final filter.

$$\varepsilon_{total} = \{1-[1-(\varepsilon_1/100)] \times [1-(\varepsilon_2/100)]\} \times 100 \qquad (7\text{-}2b)$$

Equation (7-2c) can be used to find the combined filter efficiency of using a PCP with any given pre-filter and final filter.

$$\varepsilon_{total} = \{1-[1-(\varepsilon_1/100)] \times [1-(\varepsilon_2/100)] \times [1-(\varepsilon_3/100)]\} \times 100 \qquad (7\text{-}2c)$$

Using these equations, the table below was created to show the combined efficiencies of a prefilter and final filter in an air handling system.

Combined Filter Efficiency with Prefilter and Final filter								
Prefilter	Final Filter							
	None	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
None		MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 6	MERV 6	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 7	MERV 7	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 8	MERV 8	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 9	MERV 9	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 10	MERV 10	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 11	MERV 11		MERV 12	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
MERV 12	MERV 12			MERV 13	MERV 13	MERV 14	MERV 15	MERV 16
MERV 13	MERV 13				MERV 14	MERV 15	MERV 15	MERV 16

Table 3: Combined Filter Efficiency without Genesis Air equipment

Another table can be created based on the single pass efficiency of the Genesis Air equipment when used with a prefilter and final filter. The table below shows this combined filter efficiency.

Combined Filter Efficiency with Prefilter, Final filter, and Genesis Air								
Pre-filter	Final Filter							
	None	MERV 10	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 16
None	MERV 8	MERV 12	MERV 13	MERV 13	MERV 15	MERV 15	MERV 16	MERV 16
MERV 6	MERV 10	MERV 12	MERV 14	MERV 14	MERV 15	MERV 15	MERV 16	MERV 16
MERV 7	MERV 11	MERV 12	MERV 13	MERV 14	MERV 15	MERV 15	MERV 16	MERV 16
MERV 8	MERV 11	MERV 12	MERV 14	MERV 14	MERV 15	MERV 15	MERV 16	MERV 16
MERV 9	MERV 12	MERV 13	MERV 14	MERV 14	MERV 15	MERV 15	MERV 16	MERV 16
MERV 10	MERV 12	MERV 13	MERV 14	MERV 14	MERV 15	MERV 15	MERV 16	MERV 16
MERV 11	MERV 14		MERV 14	MERV 15	MERV 15	MERV 15	MERV 16	MERV 16
MERV 12	MERV 14			MERV 15	MERV 15	MERV 16	MERV 16	MERV 16
MERV 13	MERV 15				MERV 15	MERV 16	MERV 16	MERV 16

Table 4: Combined filter efficiency with Genesis Air equipment