Third Party Air Purifier Study Using EN1822-5 Test Standard: A Competitive Analysis

Test Report of Full Device Efficiency

Introduction

Blue Heaven Technologies performed an EN-1822-5 study on nine commercially-available air purifiers to determine the most penetrating particle size (MPPS) at a defined fan setting. For each device the particle removal efficiency was determined for the highest fan speed setting and a low speed (note: traditional CADR tests are generally performed at the highest speed setting for air purifiers). This study found that for most (excluding the Celios G200) of the tested air purifiers, the efficiency at the highest speed was significantly worse than that of a lower fan speed. The test results also showed that no air purifier (excluding the Celios G200) was able to meet the HEPA standard that many of them claim.

Materials and Methods

The EN-1822-5 test method is used to determine the total system filtration efficiency of a filter assembly. In this case it is determining how well a device filters when it is fully assembled and operating as intended. This test method provides a more accurate assessment of the *quality of the air leaving a device*, as compared to filtration performance measurements of only the filter *material* used by a device.

The test described below exposes design flaws in air purifiers including poor sealing (leaks) around filters and over-reliance on technologies such as electrical filter material charging, which degrades over use time. The particles used for challenging air purifiers in an EN1822-5 tests are formed from the oily substance Di-Ethyl-Hexyl-Sebacate (DEHS). When DEHS comes in contact with heavily charged filter media the result is that the charge on the filter media is neutralized (removed) and the filtration performance therefore depends mainly on the mechanical properties of the filter alone instead of temporary charging effects.

Once the testing is complete, the samples' efficiency results are scored based on values from the chart below. E10 (85% or higher at MPPS) is the lowest observed filter class on the filtration standard and U17 (99.999995 or higher at MPPS) is the highest filter class achievable. This test setup was only able to generate enough DEHS particles to measure up to H14 (99.995% or better at MPPS) which means that the highest achievable test result for the test was H14. This means that even if we measured no penetrating particles for the entire test duration (which the Celios G200 achieved for several particle sizes) the maximum score that could be reliably reported was H14.

Filter Class	Integral Value		Local Value	
	Efficiency (%)	Penetration (%)	Efficiency (%)	Penetration (%)
E10	≥ 85	≤ 15		
E11	≥ 95	≤ 5		
E12	≥ 99.5	≤ 0.5		
H13	≥ 99.95	≤ 0.05	≥ 99.75	≤ 0.25
H14	≥ 99.995	≤ 0.005	≥ 99.975	≤ 0.025
U15	≥ 99.9995	≤ 0.0005	≥ 99.9975	≤ 0.0025
U16	≥ 99.99995	≤ 0.00005	≥ 99.99975	≤ 0.00025
U17	≥ 99.999995	≤ 0.000005	≥ 99.9999	≤ 0.0001

Source: https://airfiltration.mann-hummel.com/air-knowledge/filtration-standards/en1822/

Test Setup

The images above show the testing equipment used to count and size the generated DEHS particles used to challenge the air purifiers for determining the MPPS of the units during operation:

Particle Counter - TSI 3772 CPC Counter

Particle Classifier - TSI 3080 Classifier

Summary of Results

The charts below are a summary of the test results of all devices compared to the G200. The G200 greatly outperformed all competition. The columns labeled *Remaining Particles…* and *Multiples of Particles…* are provided to help understand performance differences vs. the Celios G200.

Device	Efficiency Result at MPPS	Remaining Particles After Cleaning 1 million particles to the Efficiency Rating	Multiple of particles remaining compared to G200 in Single Pass
G200 Low Fan Speed	99.9943%	57	1
G200 High Fan Speed	99.9923%	77	1
Competitor 1 Low Fan Speed	98.4094%	15906	279
Competitor 1 High Fan Speed	89.5401%	104599	1358
Competitor 2 Low Fan Speed	97.5568%	24432	429
Competitor 2 High Fan Speed	98.3961%	16039	208
Competitor 3 Low Fan Speed	94.9366%	50634	888
Competitor 3 High Fan Speed	79.7201%	202799	2634
Competitor 4 Low Fan Speed	98.0996%	19004	333
Competitor 4 High Fan Speed	49.2881%	507119	6586
Competitor 5 Low Fan Speed	94.6460%	53540	939
Competitor 5 High Fan Speed	39.3711%	606289	7874
Competitor 6 Low Fan Speed	68.8457%	311543	5466
Competitor 6 High Fan Speed	71.7502%	282498	3669
Competitor 7 Low Fan Speed	67.1748%	328252	5759
Competitor 7 High Fan Speed	84.6685%	153315	1991
Competitor 8 Low Fan Speed	51.1527%	488473	8570
Competitor 8 High Fan Speed	13.8603%	861397	11187

Summary of Comparison (High and Low Speeds)
Competitor 1 leaves over 270 times more particles when compared to G200 on Low
Competitor 1 leaves over 1350 times more particles on High Speed when compared to G200 on High
Competitor 2 leaves over 420 times more particles when compared to G200 on Low
Competitor 2 leaves over 200 times more particles on High Speed when compared to G200 on High
Competitor 3 leaves over 880 times more particles when compared to G200 on Low
Competitor 3 leaves over 2630 times more particles on High Speed when compared to G200 on High
Competitor 4 leaves over 330 times more particles when compared to G200 on Low
Competitor 4 leaves over 6580 times more particles on High Speed when compared to G200 on High
Competitor 5 leaves over 930 times more particles when compared to G200 on Low
Competitor 5 leaves over 7870 times more particles on High Speed when compared to G200 on High
Competitor 6 leaves over 5460 times more particles when compared to G200 on Low
Competitor 6 leaves over 3660 times more particles on High Speed when compared to G200 on High
Competitor 7 leaves over 5750 times more particles when compared to G200 on Low
Competitor 7 leaves over 1990 times more particles on High Speed when compared to G200 on High
Competitor 8 leaves 8570 times more particles when compared to G200 on Low
Competitor 8 leaves over 11180 times more particles on High Speed when compared to G200 on High

Conclusions

The results shown in this document from the third party EN1822-5 testing support that the Celios G200 is far superior in terms of first pass filtration efficiency to any of the tested leading competitors. When it comes to single pass particulate air efficiency – which is a measure of how clean the air is coming out of the air purifier, the G200 is truly in a class of its own at both high and low air speed levels. The G200 was not only the best outright performer from an efficiency standpoint, but was also the most consistent in terms of the level of clean air as a function of speed setting. The G200 maintained its superior filtration performance at both high and low fan speed settings which was not the case for the majority of competitors (most dropped off significantly at the higher fan speeds when compared to their performance at low speed). Also, other than the G200, there were only a few units that even achieved any classification on the EN1822-5 chart and only 2 (other than the G200) that achieved a score at both high and low speeds. None reached H13 or H14 (the highest levels of this test) other than the Celios G200. In contrast, the G200 did not receive a rank below H13 in any test configuration.