



## Independent Lab Comparison of Electronic Air Cleaners

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### **Clearing the Performance Confusion of Electronic Air Cleaners**

#### **A Technical White Paper**

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## 1.0 Conclusion:

The independent testing by LMS Technologies has concluded that when considering all the important factors regarding an air cleaner purchase decision; air cleaning performance, airflow resistance and maintenance, the York Affinity Hybrid EAC provides the best value.

- **Particle Removal Efficiency:** The York Affinity Hybrid EAC offers the best air-cleaning performance. Though the Trane CleanEffects model has higher performance right out of the box, the CleanEffects quickly loads with particulate and after two months has lower performance than all other models. The Affinity EAC provides the best cleaning performance over time.
- **Airflow Resistance:** The York Affinity Hybrid EAC has the lowest resistance to airflow – saving the homeowner energy and minimizing the impact of the air cleaner on the HVAC equipment.
- **Serviceability:** The York Affinity Hybrid EAC has the longest service life, requiring less maintenance than other models.
- **Dust Holding Capacity:** Construction of the media used in this type of air cleaner can significantly affect the amount of dust it can hold. The Carrier air cleaners tested during this project was able to hold only 80% of the amount of dust required to reach the same final pressure of 0.3” w.c. as the York Affinity Hybrid EAC. At final pressures above 0.3” w.c., the same air cleaner was able to hold only 68% of the amount the York Affinity Hybrid EAC was able to hold even though each air cleaner had the same amount of media.

|                           | <u>Initial</u> Particle Removal Efficiency at Various Particle Size Ranges |                         |                 | <u>6-Month</u> Particle Removal Efficiency in Various Particle Size Ranges |                         |                 | Airflow Resistance at 450 fpm ("w.c) | Service Life (months) |
|---------------------------|--|-------------------------|-----------------|--|-------------------------|-----------------|--------------------------------------|-----------------------|
|                           | Smoke & small bacteria   | Bacteria & small spores | Pollen & spores | Smoke & small bacteria   | Bacteria & small spores | Pollen & spores |                                      |                       |
| <b>York Affinity</b>      | 92.00%   | 95.70%                  | 97.80%          | <b>94.60%</b>  | <b>98.10%</b>           | <b>99.90%</b>   | <b>0.13</b>                          | <b>12</b>             |
| <b>Carrier Infinity</b>   | 87.60%   | 94.50%                  | 97.70%          | 90.90%   | 96.00%                  | 98.80%          | 0.16                                 | 8                     |
| <b>Trane CleanEffects</b> | <b>95.20%</b>  | <b>99.10%</b>           | <b>99.80%</b>   | 67.70%   | 59.70%                  | 45.50%          | 0.25                                 | 6                     |
| <b>Honeywell F300</b>     | 84.40%   | 94.40%                  | 97.80%          | 84.30%   | 93.20%                  | 96.60%          | 0.18                                 | 6                     |

**Green = Best in Class**

**Red = Worst in Class**

## 2.0 Introduction

**The increased need for indoor air quality:** According to the EPA, the lack of air movement through today's newer, more air-tight homes can lead to a buildup of toxic pollutants that can have concentrations up to a hundred times greater inside a home than outside.

**The increased awareness of whole-home air cleaners:** More allergy sufferers are seeking remedies and many doctors are recommending whole-home air cleaners as a solution. More homeowners are looking for ways to help keep their house cleaner and protect expensive HVAC equipment. The HVAC industry is actively promoting the benefits of whole-home filtration.

**Types of whole-home air cleaners:** There are two primary types of whole-home air cleaners; electronic and media air cleaners. Media air cleaners capture particles as the air flows through a woven media. Electronic air cleaners (EACs) utilize electricity to charge particles as they pass through the air cleaner. The charged particles are then trapped on collector plates. EACs by design are more capable of capturing smaller particles like smoke and small bacteria than media air cleaners. People with acute medical needs that call for an air cleaner will typically realize greater health benefits with an EAC. Some EACs also include a media filter to help increase their performance.

**The confusing claims of manufacturers:** The increased demand for EACs has brought about an increase in the number of models available for the homeowner to choose from. Many manufacturers have created new ways to test and report air cleaner performance to best suit their own results, allowing each to claim they have the best performing air cleaner on the market. All this activity has created a great deal of confusion for the homeowner seeking the best air cleaner available.

## 3.0 Independent Laboratory Testing

In order to clarify the performance and value of today's EACs, LMS Technologies, a leading independent test laboratory, has completed a comprehensive and entirely unbiased test of the leading EACs in the industry.

### 3.1 Testing Lab:

LMS Technologies Inc. of Bloomington MN is an independent laboratory and global leader of particulate air filtration testing. LMS also performs contamination testing for the food, drug and semiconductor industry.

### 3.2 Test Methodology:

LMS independently obtained samples of 4 leading EACs from the open market to ensure a random selection. LMS also selected sizes of each that provided the most consistent comparison:

- **Trane CleanEffects**
- **York Affinity**
- **Honeywell F300**
- **Carrier Infinity**

### 3.3 Tests and Test Standards:

All tests were conducted following strict ASHRAE test standards. ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) is the governing body for standards in the HVAC industry. Listed below are the specific tests and test standards.

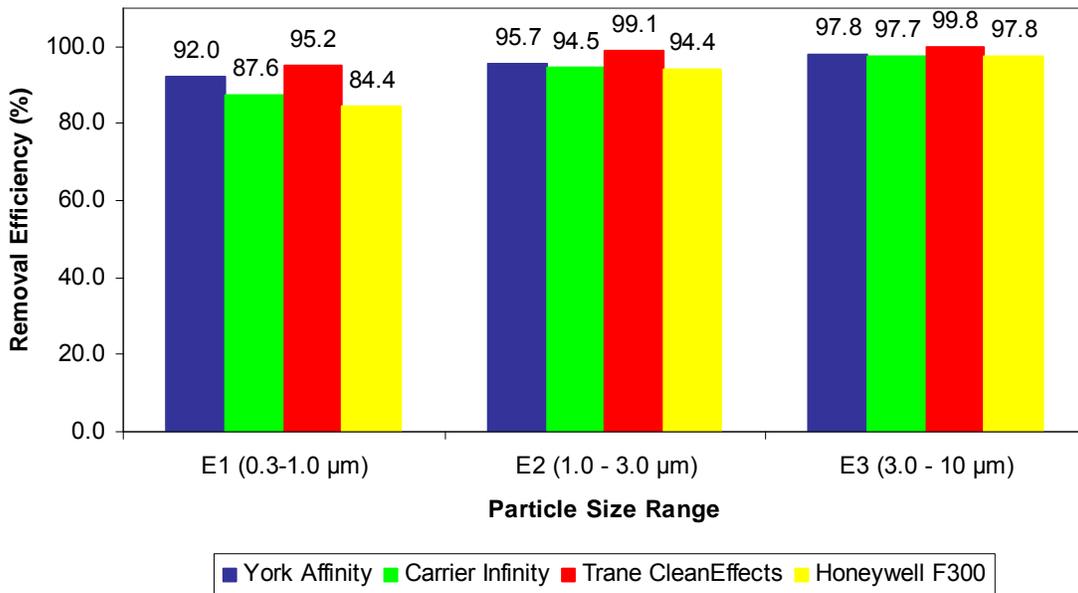
| Performance Characteristic  | Value of Test Results   | How Tested                                      |
|-----------------------------|---|---|
| Initial (as new) Efficiency | This test measures the efficiency with which particles are removed by the air cleaner “right out of the box”.                             | ASHRAE1 Standard 52.2-2007                      |
| 20 gram Efficiency          | This test measures the particle removal efficiency after loading 20 grams of a synthetic laboratory dust at the filter.                   | ASHRAE Standard 52.2-2007                       |
| 60 gram Efficiency          | This test measures the particle removal efficiency after loading 60 grams of a synthetic laboratory dust at the filter.                   | ASHRAE Standard 52.2-2007                       |
| Dust Holding Capacity       | This test quantifies the amount of loading dust required to increase the airflow resistance of an air cleaner to a specified final point. | ASHRAE Standard 52.1-1992                       |
| Service Interval            | This defines the service interval or life of the air cleaner.   | ASHRAE Standard 52.1-1992 & Mfr Recommendations |
| Airflow Resistance          | This test measures the amount of air flow resistance caused by the air cleaner at various air velocities.                                 | ASHRAE Standard 52.2-2007                       |

### Independent Lab Test Results - Performance

#### 3.4 Initial Test Results:

The below graph illustrates the performance of the 4 leading air cleaners across a range of particle sizes when the air cleaners are brand new. These test results show how many particles that enter the air cleaner are removed “right out of the box”. This measurement is less important for EACs than other types of filters that rely on electrostatic attraction to remove particles.

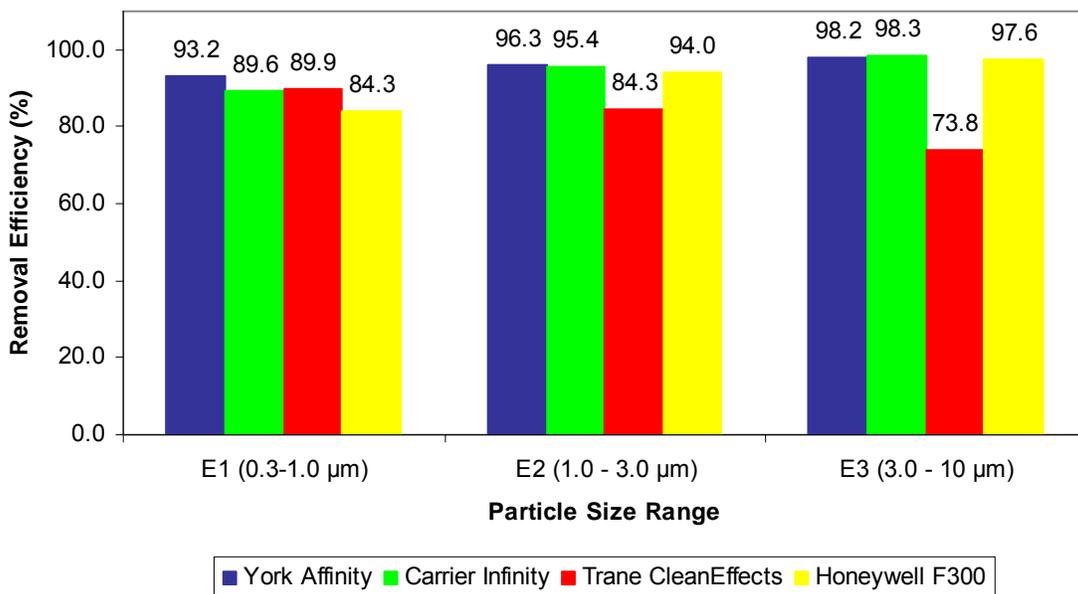
### Particle Removal Efficiency WHEN NEW



### 3.5 Two Month Test Results:

The below graph illustrates the impact on performance as the air cleaner loads with particulate over time. Several models actually see an improvement in performance over, while the Trane CleanEffects model has a dramatic decrease in performance after two months.

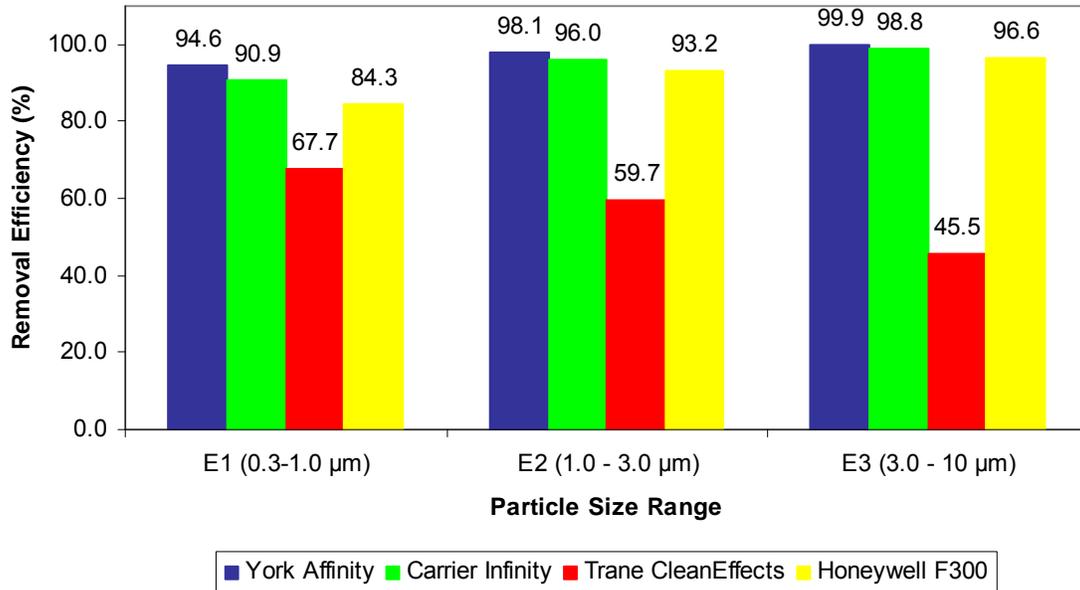
### Particle Removal Efficiency AFTER 2 MONTHS



### 3.6 Six and Ten Month Test Results:

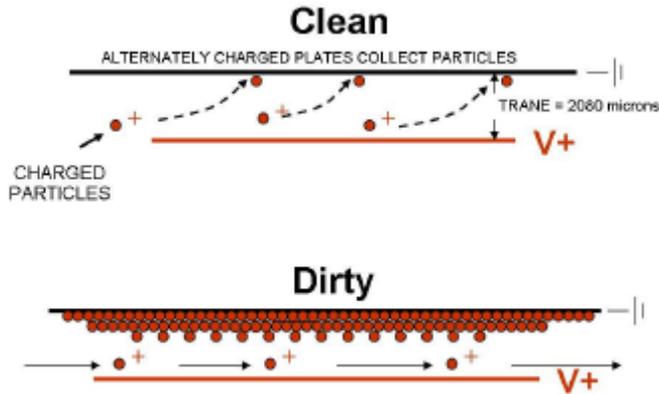
The below graphs are most representative of performance over the typical service life of many air cleaners. The Trane CleanEffects air cleaner continues a steep decline in performance while the three other air cleaners continue to improve in performance over time. The York Affinity EAC offers the best performance, capturing up to 99.9% of particulate between 3 and 10 microns, up to 54% better than the competition.

#### Particle Removal Efficiency AFTER 6 MONTHS



#### Performance by Design:

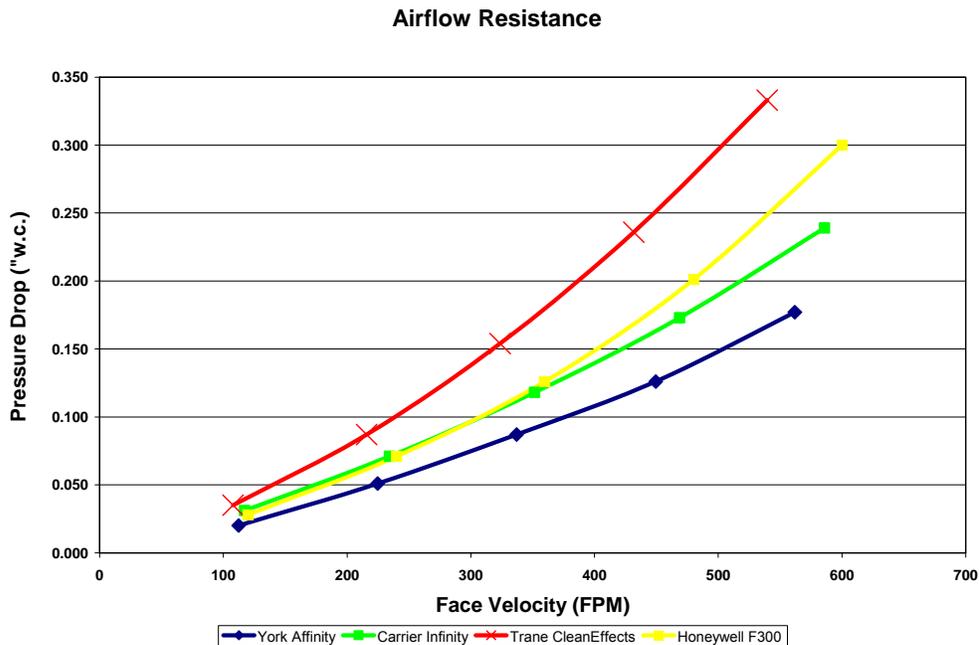
The degradation in performance of the Trane CleanEffects model can be traced to its design. The CleanEffects captures particulate entirely by electrostatic attraction across a honeycomb collector plate. As particles build on the surface of the collector plate, the ability to attract new particles gets weaker until it becomes ineffective. This design provides a high level of performance when brand new, but inferior performance after the filter begins to load with particulate.



The York Affinity and Carrier Infinity are hybrid electronic air cleaners that utilize both electrostatic attraction and the mechanical mechanisms of filtration across a media element. This combination allows for a more consistent and higher level of filtration performance across the life of the air cleaner.

#### 4.0 Independent Lab Test Results – Airflow Resistance

It is critically important that air cleaners minimize the airflow restriction while cleaning the air within the HVAC system. Restricting the flow can cause the system to operate inefficiently and waste energy, costing the homeowner money. Restricting the airflow can also damage the expensive components within the HVAC equipment by causing the equipment to work harder than designed. Air cleaners need to offer maximum filtration performance with minimal air flow resistance.

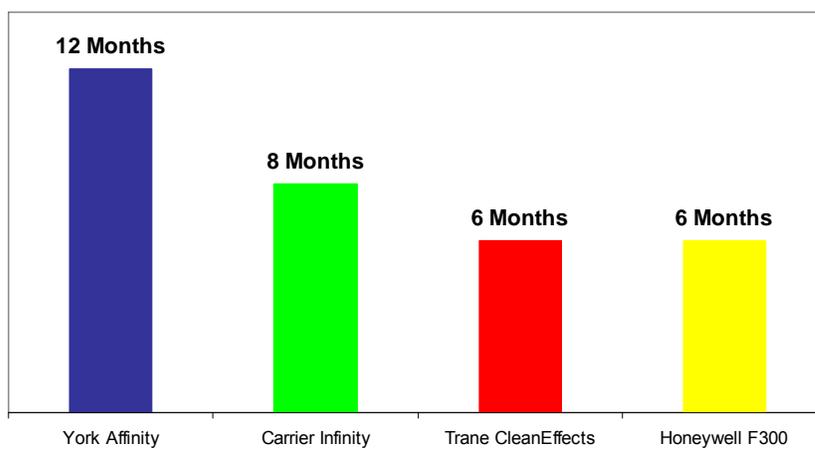


The above chart illustrates the airflow resistance of the subject air cleaners. Less airflow resistance indicates superior performance. The York Affinity model offers consistently less airflow resistance than competitive models.

## 5.0 Maintenance

All EACs require some maintenance in order to retain performance. All four air cleaners tested by LMS require periodic cleaning of the internal components. The Trane CleanEffects and Honeywell F300 models are recommended by the manufacturer to be cleaned every six months. The York Affinity Hybrid EAC needs to be cleaned every 12 months of use.

**Time Between Cleanings (Months)**



## 6.0 Independent Lab Test Results - Dust Holding Capacity

**6.1 Test Method:** Dust-holding capacity tests were performed in accordance with ASHRAE Standard 52.1-1992 and were performed only on the York Affinity Hybrid EAC and Carrier Infinity. Collector cell type air cleaners, like the Trane and Honeywell units, will reduce in efficiency as dust is loaded, therefore, a comparable end point cannot be achieved. This test involves loading the air cleaner with a synthetic dust until the final pressure drop across the loaded air cleaner reaches a predefined limit. The amount of dust collected by the air cleaner is measured and reported as the dust-holding capacity of the device. The efficiency with which the air cleaner captures the loaded dust is also measured and is reported as an arrestance value. Both the York Affinity Hybrid EAC unit and the Carrier unit had arrestance values in excess of 99.8%, so virtually all of the dust that was fed was captured by the air cleaner. The dust used for this test is the standard loading dust. The intent of this test is not to quantify the efficiency of the unit, but only to quantify the amount of dust it can hold, so the testing was performed with the power off.

## 6.2 Test Result

