Life's Resources, Inc.
Lowering Risks by Innovation™

Effect of the Electro Breeze Air Filter on Airborne Particles in a Recirculating Air Duct

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Prepared for

Electro Breeze Air Cleaner Ltd.
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by

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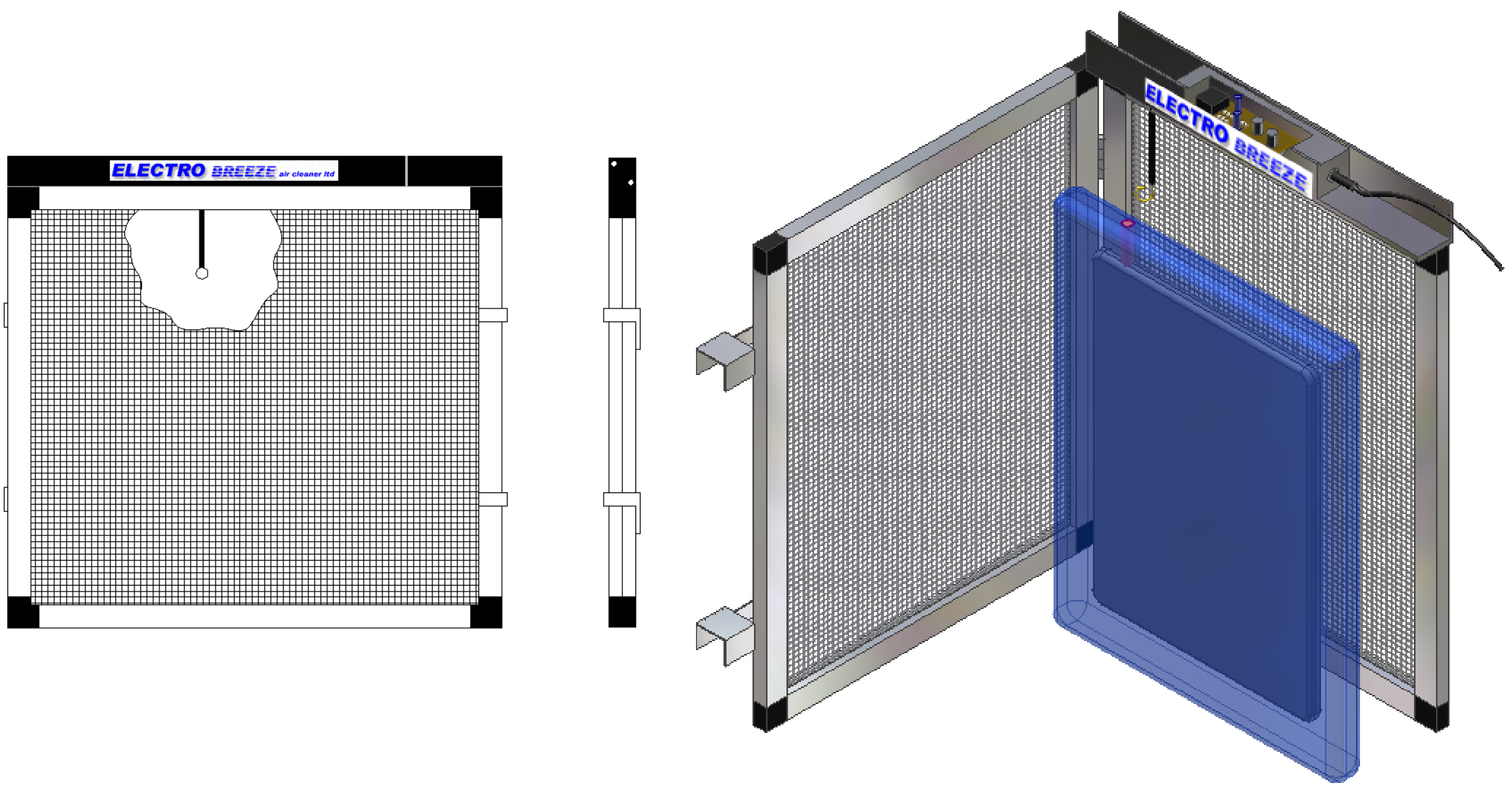
1” PANEL FILTER



1.0 Introduction

1.1 Purpose

The purpose of these tests was to determine the effect of the Electro Breeze Electronic Air Filter on airborne particles contained within a recirculating air duct.

1.2 Background

Air is an important vehicle for transmitting particles of respiratory significance from sources to humans. Such particles may contain irritating materials, hazardous chemicals, or infectious and allergenic microorganisms. Reducing the levels of airborne particles in occupied spaces can lower exposure of susceptible persons to such airborne contaminants. Levels of airborne particles can be reduced by either eliminating air-contaminating sources or reduce the densities of the particles in the air. The use of air filters that capture particles of respiratory significance can be an important method of removing particles that are introduced into the air from existing sources.

Numerous devices have been developed and marketed for the purpose of removing particles from the air in indoor environments. These units operate on principles that include electrically neutral and electrically charged media filtration, electronic precipitation onto collecting plates, electrostatic precipitation, ozone generation, particle ionization, and others. Existing air cleaning devices operate with varying levels of effectiveness. Standard methods have been developed for evaluating conventional air cleaning devices, included electrically neutral filters.[1] [2] The standard methods for evaluating air-cleaning devices typically employ evaluation under once-through conditions. Consequently, these methods are especially useful for evaluating mechanical air filtration devices using a single pass-through of air containing contaminating particles.

Some air cleaning devices, such as those using electronically charged fibrous media, impart polar ionic charges to particles that pass through the charged media. This particle polarization, under certain conditions, enhances particle agglomeration and subsequent mechanical removal during multiple passes through the device. Consequently, the effectiveness of the devices that operate by agglomeration increases as particles are re-circulated in the air stream. Therefore, standard tests that are based on one-pass rather than on multiple-pass

[1] ASHRAE Standard 52.1-1992, Gravimetric and Dust-spot Methods for Testing Air-cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved) American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta.
[2] *Standard 52.2-1999 -- Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI approved),* American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., Atlanta.

performance are likely to significantly underestimate the effectiveness of such devices under real-world conditions. Under most real-world conditions, air is recirculated through central heating, air conditioning, and ventilation systems.

1.3 Specific Objectives

The specific objective of the tests described herein was to determine the effect of the Electro Breeze Electronic Air Filter on the densities of contaminating particles introduced into a recirculating air stream compared to the control condition, without the test filter in place.

2.0 Test Equipment and Methods

2.1 Test Air Filter

The test filter was an electronic air filter manufactured by Electro Breeze, St-Sauveur-Des-Monts, Quebec, Canada. The unit had dimensions of approximately 12 in. x 24 in. x 3/4 in. and operated by applying a high-voltage charge to a disposable fibrous electronic filter media. The unit was operated using a 24-volt AC transformer and with a high voltage probe that was in contact with a center screen. The frame attached to outside screens was in contact with an electrically grounded surface during operation.

2.2 Test Duct

The test duct consisted of an electrically grounded steel ventilation duct of 1 x 2 ft attached via duct transitional adapters to an approximately 21 ft x 10 in diameter galvanized steel recirculation duct. Air was circulated through the test duct using two backward curved impellers. Air was recirculated through the test portion of the air duct at an average face velocity of approximately 270 fpm. Ambient relative humidity of 70 percent and temperature of 77° F were determined using a wet and dry bulb psychrometer.

2.3 Smoke Introduction

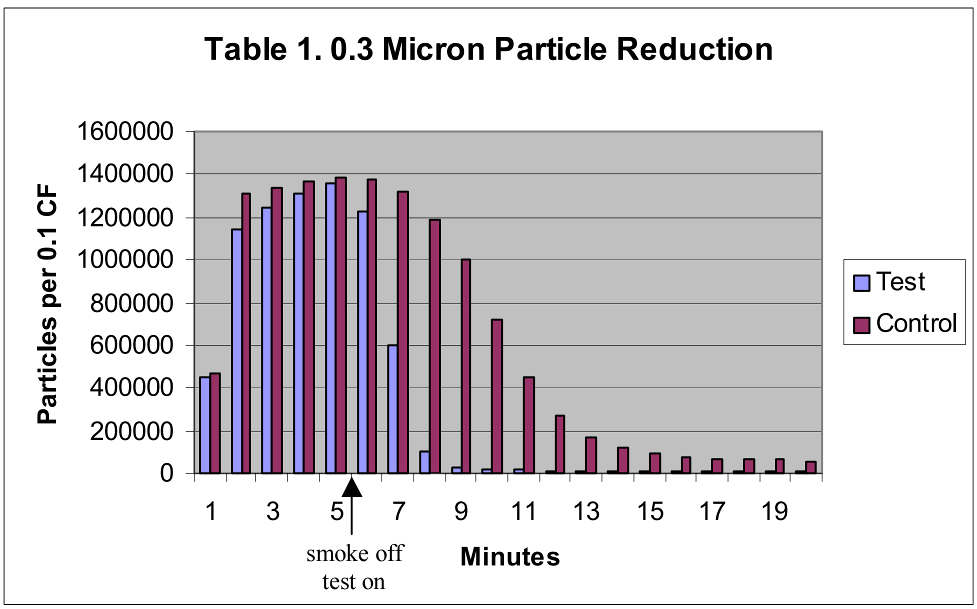
Cigarette smoke (Pall Mall, Brown & Williamson Tobacco Corporation, Louisville, KY) was introduced into the test duct by placing the one end of a cigarette in a specially designed holder located on an outside wall of the duct approximately 2 ft upstream from the test filter location. After air recirculation was started, the cigarette was lit and “smoked” into the air stream for five minutes. The cigarette smoke remaining outside the test chamber was collected and ducted to a high efficiency HEPA air cleaner. After five minutes of cigarette smoke introduction into the test chamber, the cigarette was removed and extinguished and the hole was sealed.

2.4 Air Sampling

Airborne particles were monitored for micron and submicron particles using a Met-One Model 227B-EL laser particle counter (Met- One, Grants Pass, OR). Particles in two different size ranges, 0.3 µm and 1 µm, were simultaneously monitored. Particle measurements were made at an air sampling rate of 0.1 cfm and recorded at 1-min intervals, allowing for a 5-sec response time. Samples were taken approximately 2-in downstream from the test filter.

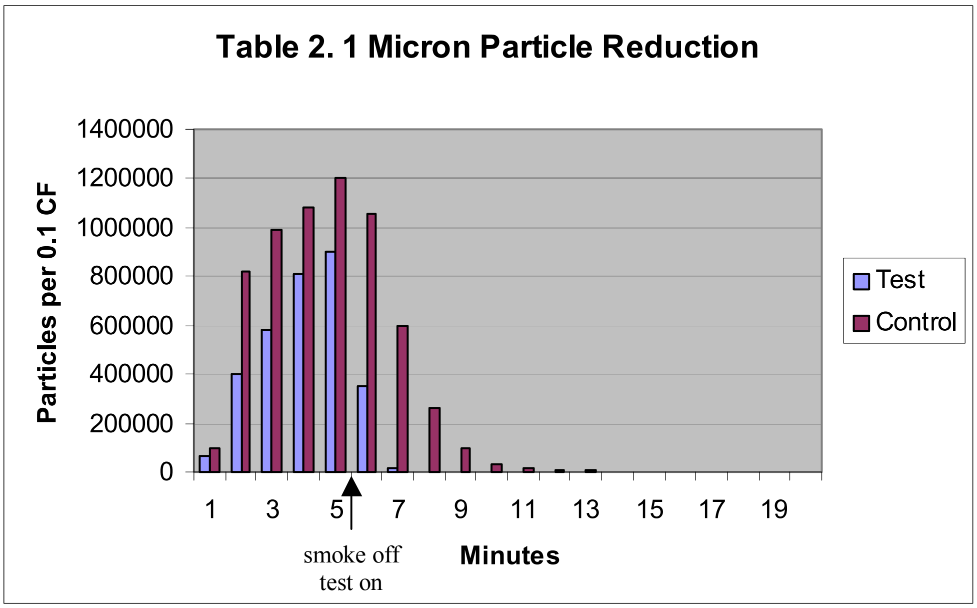
3.0 Results

The density of 0.3 µm airborne particles with the test air filter in place was compared with that without the air filter in place. The initial comparison was made during the first 5 min of operation during smoke introduction into the chamber. During this initial 5-min period, the test experiment shows the particle densities with the



filter in place but without electronic activation. The control experiment shows the same conditions, except without the filter in place. While the particle densities are slightly lower with the unactivated filter in place, the differences are negligible. After 5 min of operation, the particle density with the unactivated filter in place was only about 2.1 percent lower than without the filter in place. Within 5 min after the electronic activation of the test filter and cessation of smoke introduction, the particle density decreased by approximately 97.8 percent compared to the control.

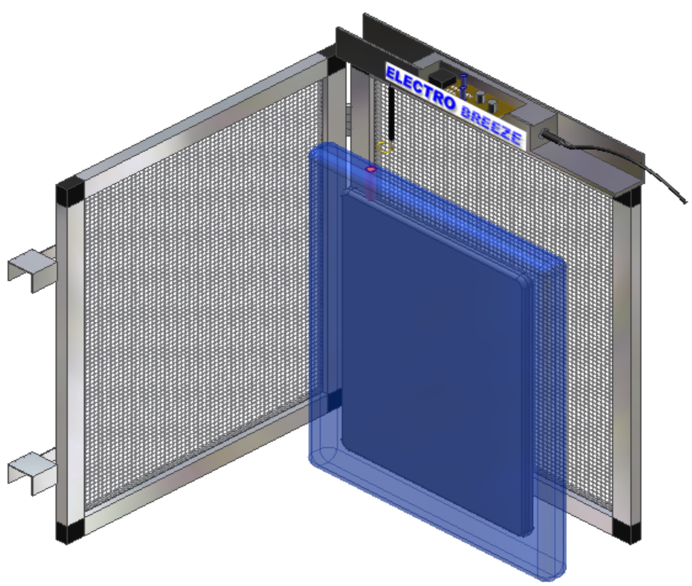
The density of 1 µm airborne particles with the test air filter in place was compared with that without the air filter in place. The initial comparison was made during the first 5 min of operation during smoke introduction into the chamber. During this initial 5-min period, the test experiment shows the particle densities with the filter in place but without electronic activation. The control experiment shows the same conditions, except without the filter in place.



The differences in the initial air densities were much greater for the 1 µm than for the 0.3 µm particles. After 5 min of operation, the particle density with the unactivated filter in place was about 25.3 percent lower than without the filter in place. This suggests greater physical removal of the larger sized particles by filtration through the filter media. Within 4 min after the electronic activation of the test filter, the particle density decreased by approximately 99.7 percent compared to the control.

4.0 Conclusions

Tests performed on the Electro Breeze electronic air filter in an air duct under recirculating conditions demonstrated effective removal of small airborne particles when compared to a nonfilter control. Activating the electronic air filter significantly increased the reduction of 0.3 and 1 µm particles generated from tobacco smoke when compared to the control. After a 5-min period of introducing smoke into the test duct, operation of the electronic filter for 5-min showed a 0.3 µm particle reduction by 97.8 percent compared to the control. After a 5-min period of introducing smoke into the test duct, operation of the electronic filter for 4-min showed a 1 µm particle reduction by 99.7 percent compared to the control.



Lifes Resources Inc. Lab Test Results For Electro Breeze Air Cleaner

Here are the key highlights of the test.

- The air cleaner without electronic activation removes some particles.

- However, when the air cleaner is electronically activated, there is a significant reduction of particles, 99.7% reduction, after 4 minutes of air flow through the chambers.

- The difference between an air cleaner non activated and electronically activated is extraordinary.

- Extrapolating from the lab test chambers, we can conclude that any environment can effectively be cleaned of polluting particles of micron and sub-micron sizes using our multi-pass electronic air cleaner.

- In a home of 2,000 SF with a 9' ceiling (18,000 cubic feet), a furnace or air conditioner working on 1200 cfm (cubic feet per minute), (18,000/1200cfm). There are four complete passes or air changes in an hour. We can conclude that the air has been cleaned similar to the test chamber results. Continuous air flow assures the continuous removal of polluting particles.

- The same principle of air cleaning applies to all environments.

- Offices, businesses, buildings, plants can all be air cleaned with proper air handling and using Electro Breeze electronic air cleaners.

- **The labs of Lifes Resources** have proven the superior performance of electronic cleaners. It is a known fact that particles smaller than 1 micron are much more numerous and more harmful to our health than larger particles. The tests, run by **the labs of Lifes resources**, prove that our electronic air cleaner cleans the air to over 97% of 0.3 micron.