# Infinity™ Air Purifier

Carrier®

Turn to the Experts℠


## Technology Overview

# INTRODUCTION

Homeowners are becoming increasingly health conscious and they want healthier indoor air. Carrier has a solution for healthier indoor air that no one else can offer – the Infinity™ Air Purifier.

The Infinity Air Purifier delivers industry leading, state-of-the-art technology that is so effective it delivers filtration efficiency equivalent to MERV 15 and germicidal technology powerful enough to **capture and kill a wide variety of airborne pathogens in treated air including human influenza virus, human cold virus, tuberculosis bacteria, measles virus, and various spores.** In fact, it's the same air purification technology used to protect some secure government facilities and hospitals and now it's available to homeowners. Here's how it works:

## TECHNICAL OPERATION

The "capture and kill" technology that the Infinity Air Purifier uses is a three-step process. In step **1**, as particles pass through the air purifier, they're electrically charged by the precision-point ionization array, which uses 22,000 volts DC to create dense "clouds" of ions that attach themselves to the particles.

In step **2**, a specially designed media cartridge is sandwiched between 11,000 volts DC and electrical ground. As a result, a strong electrical field is created across the filter, which causes the negative and positive charges within each filter fiber to separate and migrate to opposite sides of the fiber (polarization). Particles entering the filter are electrically attracted to the oppositely charged part of a fiber resulting in extremely high collection efficiency.

In step **3**, the intense electric field established across the filter results in a charge separation across the captured pathogen's cell membrane and a stretching of the cell wall. The pathogen is also bombarded by negative ions from the ionization section, which further pushes the membrane towards rupture. The net result on captured pathogens is the rupturing of the cell membrane causing inactivation or death.


*Gas Furnace Model*


*Fan Coil Model*

## GERMICIDAL TESTING

Airborne pathogens that can enter a home's HVAC system share one of the three basic physiologies: 1) bacteria; 2) fungi; or 3) viruses. Within the bacteria group there are three different subtypes: 1) spore forming; 2) gram positive; and 3) gram negative. The Infinity Air Purifier has been independently tested in labs of the Center for Disease Control (CDC), the University of Colorado, the Southwest Foundation for Biomedical Research and LMS Technologies against representative agents from each of the physiological types and has demonstrated outstanding kill performance against each one. The tests are summarized in the table below.

| Physiology | | Organism | Kill Rate* |
|---|---|---|---|
| Bacteria | Spore Forming | *Bacillus subtilis* (Anthrax surrogate) | 97%[7] |
| | Gram Positive | *Mycobacterium Parafortuitum* (Tuberculosis surrogate) | 99.9%[7] |
| | | *Staphlococcus aureaus* | 97.5%[4]<br>100%[5] |
| | Gram Negative | *Serratia marcescens* | 96.6%[1]<br>100%[4] |
| | | *Pseudomonas aeruginosa* | 99.9%[7] |
| Virus | | *Morbillivirus* (Measles) | 99.9%[1] |
| | | *Vaccinia* (Smallpox surrogate) | 99.9%[6] |
| | | *Coronavirus* (SARS) | 99.9%[2] |
| | | *Influenza Wild Type A* | 99%[1] |
| | | *Human Influenza* | 99%[2] |
| | | *Avian Influenza* | 99.9%[3] |
| | | *Encephalomyocarditis picomaviridae* (Human cold virus surrogate) | 99.99%[4] |
| Fungi | | *Aspergillus versicolor* | 99%[7] |

* Kill rate claim is percentage of pathogens captured on the media that were killed or inactivated after continuous exposure to an energized system for the stated time period.

[1] After one hour exposure
[2] After two hour exposure
[3] After five hour exposure
[4] After six hour exposure
[5] After 12 hour exposure
[6] After 18 hour exposure
[7] After 24 hour exposure

## OZONE

Unlike some portable home air purification devices that intentionally generate high levels of ozone, the Infinity Air Purifier creates only incidental trace amounts of ozone – levels far below the safe exposure limit of 50 PPB established by the FDA.

## OTHER TECHNOLOGIES

The Infinity Air Purifier's technology and design differs from other types of electronic and electronic/media hybrids in several key ways that offer higher efficiency, lower maintenance, and more quiet operation.

First, the Infinity Air Purifier's precision point ionization array uses an ionization array with metal points to charge the particles as they enter the air purifier. Unlike ionization wires used in traditional electronic air cleaners (EACs) and some hybrids, the points do not need to be replaced and require virtually no maintenance.

Second, the Infinity Air Purifier uses an actively charged media to capture airborne particles with very high initial efficiency. The intense electric field established across the filter causes charges collected on the filter's fibers to "migrate" along the surface of the fibers to the downstream electrode and off to ground. This keeps the collection sites on the fibers active to attract new incoming particles throughout the life of the air purifier. In contrast, the cells used in traditional EACs and some hybrids can decrease in filtration efficiency as captured particles blanket their collection surfaces.

Third, the Infinity Air Purifier's patented technology is the only product in the industry that claims to capture and kill airborne pathogens such as human and avian influenza virus, rhinovirus (common cold), tuberculosis bacteria, measles virus, and mold spores by using a highly effective and unique combination of intense media polarization and negative ion bombardment. In contrast, traditional EACs and hybrids lack this unique combination and thus the germicidal efficiency attributed to their combination.

Finally, unlike many traditional EACs, the Infinity Air Purifier is very quiet, creates no arcing noise, and ozone production is significantly lower, even at the very low airflow rates characteristic of today's variable speed systems.

## INFINITY AIR PURIFIER TECHNOLOGY Q&A

**Q: What is the Infinity Air Purifier technology?**

**A:** The Infinity Air Purifier is a hybrid between an electronic air cleaner and media filter that offers the benefits of a high-voltage electrostatic precipitator and the ease of maintenance of a media filter. In addition, it is very effective at killing captured viruses, bacteria, and mold spores.

**Q: How does the technology work?**

**A:** In step 1, particles entering the air purifier are electrically charged by the precision point ionization array which uses 22,000 volts DC to create dense "clouds" of ions that attach themselves to the particles. In step 2, a specially designed media cartridge is sandwiched between 11,000 volts DC and electrical ground. As a result, a strong electrical field is created across the filter, which causes the negative and positive charges within each filter fiber to separate and migrate to opposite sides of the fiber (polarization). Particles entering the filter are electrically attracted to the oppositely charged part of a fiber resulting in extremely high collection efficiency. In step 3, the intense

electric field established across the filter results in a charge separation across the captured pathogen's cell membrane and a stretching of the cell wall. The pathogen is also bombarded by negative ions from the ionization section which further pushes the membrane towards rupture. Additionally, in the ionization section, hydroxyl radicals are produced which create “oxidative stress” on the organism. The net result on captured pathogens is the rupturing of the cell membrane causing inactivation or death.

**Q: Why is germicidal capability important?**

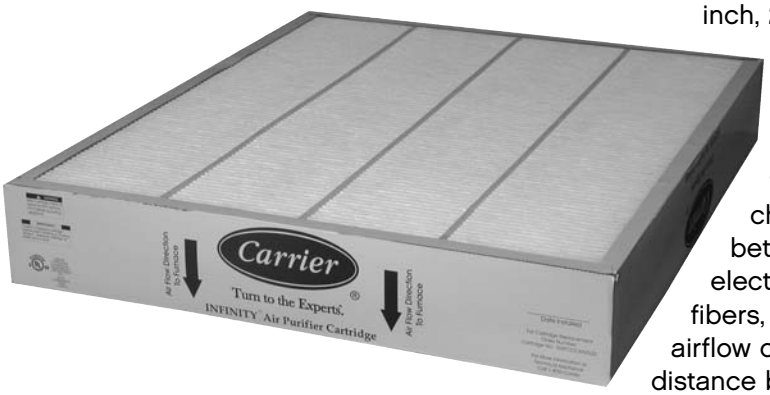
**A:** Just capturing pathogens on the filter (like typical systems) doesn't eliminate all the risks associated with poor air quality. Dust, dead skin cells, and other matter collected on the filter provide nutrients on which trapped organisms can grow and, as a result, produce waste products which can then be carried downstream into the living space without a germicidal effect. Certain bacteria captured on an ordinary filter can release endotoxins to which many people are highly allergic. These endotoxins can irritate the skin, induce respiratory problems, fever, and even shock. In humid environments, mold can multiply and actually grow through a filter and live spores can be distributed throughout the home.

**Q: Why is Infinity Air Purifier technology important?**

**A:** There is a growing need for whole-home high-efficiency air filtration devices that are easy to maintain while preventing the growth of captured airborne pathogens. Mechanical filters typically fail to provide the particle capture efficiencies necessary to effectively remove airborne viruses and bacteria. Electronic air cleaners provide an increase in efficiency compared to media; however, their performance can rapidly deteriorate over time and they also can be very difficult to maintain. The Infinity Air Purifier provides a complete solution with a very high filtration efficiency and germicidal effect while being extremely easy to maintain.

**Q: What is the difference between the Infinity Air Purifier and traditional types of electrostatic air cleaners?**

**A:** Pre-charged electrostatic filters receive a charge when the filter's fibers are manufactured. In use, oppositely charged particles are attracted to these sites of fiber charge and, by combining, neutralize the charge (positive + negative = 0) and thus in time, new particles entering the filter are no longer electrostatically attracted to the fibers. The filter's efficiency can deteriorate to its mechanical efficiency only. In contrast, the Infinity Air Purifier system's electrostatic field established across the filter causes charges collected on the filter's fibers to “migrate” along the surface of the fibers to the downstream electrode and off to ground. This keeps the collection sites on the fibers active to attract new incoming particles. Electronic air cleaners depend upon very close spacing between parallel




spaced charged plates and grounded collector plates. As particles collect on the ground collector plates, the attraction of new particles can diminish, resulting in a dramatic loss of collection efficiency. One-inch, 24-volt electrostatic filters place two pieces of flat filter media on either side of a charged screen and then sandwich them between two grounded metal screens. This is designed to set up an electrostatic field across the two pieces of filter media. However, the voltage between the grounded screens and the charged screen must be kept low to avoid arcing between these screens. This limits the intensity of the electric field produced and its ability to polarize the filter's fibers, thus minimizing particle collection efficiency. Also, as airflow compresses the upstream filter media, it reduces the distance between the grounded screen and the charged center screen sometimes allowing the voltage to arc between the two. In addition, as conductive particles collect in the filter media they can build a pathway across the filter media, again allowing the charge to arc between the various screens and diminishing filtration efficiency.

**Q: How efficient is this unit's filtration?**

**A:** The Infinity Air Purifier is equivalent to a MERV 15. The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) has established a rating standard designated as 52.2, which created the Minimum Efficiency Reporting Value (MERV) so that various filters can be evaluated properly. MERV ratings are designated with numbers from 1 to 16. The higher the MERV rating, the better the filter's performance (percent efficiency) for smaller particles. A MERV rating of 15 requires 85-95% efficiency for the smallest particles tested.

**Q: How long will the filter last?**

**A:** Filter life varies from home to home, and is based on several factors. Most homeowners find that the filter lasts for 8 to 12 months.

**Q: How do I know when to change my filter?**

**A:** If your purifier is used in conjunction with the Carrier Infinity™ Control, the control will notify you when it is time to change the filter. Other thermostats may have a timer or reminder built in. Check with your Carrier dealer to find out if your particular thermostat has a filter change reminder. If not, ask the dealer about a semi-annual or annual maintenance service.

**Q: Can I use another brand of filter in the purifier?**

**A:** No. The filter used in the Infinity Air Purifier is patented, and uses a design that carries an electrical charge through the filter to kill the captured organisms. Other filters are not capable of operating with this process.

**Q: What can happen if someone changes an ordinary filter containing live pathogens?**

**A:** The person changing the filter can be exposed to live bacteria and viruses. Movement of the dirty filter can shake loose dust and living pathogens into the air which could then be inhaled.

**Q: Are there any odor control benefits to the Infinity Air Purifier?**

**A:** The Infinity Air Purifier is capable of capturing very small particles, down to 0.1 micron. Only odors associated with the presence of particulates will be reduced. If odor control is a concern, Carrier recommends installing a ventilator to bring in fresh air.

**Q: Does this unit produce ozone? If so, how much?**

**A:** Yes, it does, however, in much lower levels than typical Electronic Air Cleaners. The Infinity Air Purifier produces around 5PPB (parts per billion) ozone. The EPA recommends no more than 50PPB for a healthy living space. In most cases, the ozone output will be below the levels detectable by most individuals. The output varies according to airflow, humidity, ambient ozone levels and the duct system.

**Q: What is the power consumption of the purifier?**

**A:** Approximately 18 watts.

**Q: How do you know if the unit is operating?**

**A:** The purifier has a light that indicates the unit is on when the external switch is in the on position.

**Q: Does the Infinity Air Purifier make any sounds while operating?**

**A:** No. Unlike traditional electronic air cleaners, the purifier creates no zapping noises.

**Q: Is there a benefit to using ultraviolet lights in conjunction with the purifier?**

**A:** Yes. Carrier UV lights installed at the coil and drain pan will help prevent the build-up of contaminants on your air coil.

**Q: How does the Infinity Air Purifier compare to a HEPA filter?**

**A:** True HEPA (High-Efficiency Particulate Air) filters are slightly more efficient at capturing the tiniest particles. However, HEPA filters do not have the germicidal capability of the Infinity Air Purifier. In addition, HEPA filters have a very high resistance for airflow (pressure drop), and therefore, generally incorporate an additional fan.

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