

# Compare Air Purification Technologies

## 1. Compare Air Purification Technologies Side-by-Side

CONTAMINANT	SCOPE OF CLEANING	DOMESTIC AIR PURIFIER TECHNOLOGIES						Airora
		HEPA	Electrostatic (Electronic)	UV-C	Ionising	TSS (Airfree)	PCO / PECO	
<b>Plant and Mould Allergens</b> such as pollen, mould & spores	Within the Device	✓	✓	✓ <sup>5</sup>	✓	✓	✓	✓
	The Whole Room						4	✓
<b>Proteinaceous Allergens</b> such as cat/dog dander, house mite excretions & cat saliva	Within the Device	✓ <sup>1</sup>	✓ <sup>1</sup>	✓ <sup>5</sup>	✓ <sup>1</sup>	✓ <sup>2</sup>	✓	✓
	The Whole Room						4	✓
<b>Chemical Allergens, Pollution &amp; Irritants</b> such as cigarette smoke, VOCs, ozone, ammonia, NO <sub>2</sub> and formaldehyde	Within the Device						✓	✓
	The Whole Room						4	✓
<b>Odours</b> from food, cooking, laundry, toilets & waste	Within the Device					✓	✓	✓
	The Whole Room						4	✓
<b>Bacteria and Viruses</b> such as MRSA, <u>C. difficile</u> , Colds & Flu	Within the Device	3	3	✓ <sup>5</sup>	✓	✓	✓	✓
	The Whole Room						4	✓

### Notes:

1. These types of filter collect the particulates in cigarette smoke, but not the equally important gaseous content.
2. TSS technology removes some gaseous pollutants and irritants, such as ozone, but not others, such as volatile organic compounds (VOCs).
3. HEPA and electrostatic filters remove bacteria and viruses from the air but do not kill them. Untreated, those bacteria and viruses colonise the filter / plates making cleaning and replacement potentially hazardous.
4. While PCO / PECO devices share the wider scope of action of Airora, they lack our patented technology, which means that they cannot reliably cascade hydroxyls throughout a whole room and onto surfaces.
5. While UV-C is thought to achieve these outcomes, unlike Hydroxyls UV-C takes some time to work, and there is much scientific debate about 'how long' and thus how fast the air can flow until they become ineffective. The EPA says: "typical UVGI cleaners used in homes have limited effectiveness in killing bacteria and molds"

## 2. Understanding Air Purification Technologies

### 2.1 HEPA

HEPA Filters capture over 99% of all pollen and spores from the air that passes through them and before the advent of Airora they were often considered the 'Gold Standard' for allergen removal from the air in a room. Because they have traditionally been considered 'the best' among traditional ant-allergen air cleaning technologies, people have learned to live with their many drawbacks, including:

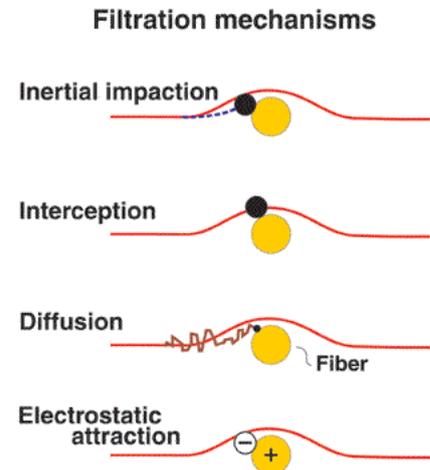
- HEPA filters clean pollen and spores from the air that passes through them but not, by any means, from all of the air in a room. This is because constant air changes, stratification, re-contamination, re-circulation and eddy formation means that there are always significant airborne pollutants in a room which have not been drawn into the device.
- Typical HEPA-based air purifiers can remove particles down to 0.3 microns, but 90% of the particles in the air, including many harmful ones, are smaller than that. Most HEPA air purifiers only catch a fraction of these harmful particles. Airora air purifiers use hydroxyls, not filters, to effectively remove particles all the way down to 0.007 microns.
- To shift sufficient air through the device so as to achieve a positive effect overall, HEPA based air purifiers need powerful fans which are relatively noisy.

Many have a 'feature' which turns the fan down at night so that you can sleep - even though that then reduces their effectiveness further!

- In capturing pollen and spores, HEPA filters also capture (but not kill) bacteria and viruses, which remain live and colonise the filter making the necessary regular replacement potentially hazardous.
- HEPA filters only collect particulates, not gasses. Consequently many lung irritants, pollutants and asthma triggers are not cleaned from the air, including volatile organic compounds (VOCs), ozone, formaldehyde, ammonia, carbon monoxide and more.

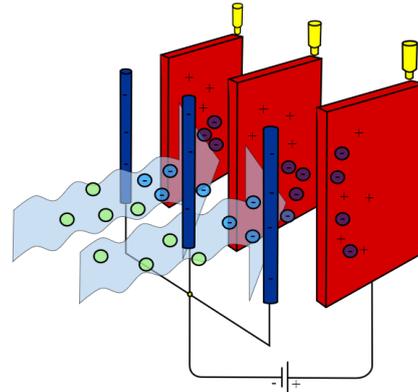
Some manufacturers have tried to reduce the downsides, for example by coating the filter with anti-microbials (itself a potential irritant) but unfortunately the fundamentals remain unchanged.

### 2.2 Electrostatic (sometimes termed Electronic)



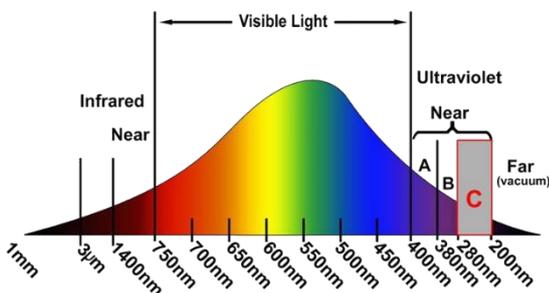
Electrostatic (sometimes termed Electronic) filters consists of a series of charged metal collection plates that, like a magnet, attract oppositely charged particulates, such as pollen and spores. Developed as an alternative to HEPA filters, and to remove the need for regular filter changes, these devices retain some drawbacks in common with HEPA filters while introduce some new ones of their own:

- As with HEPA filters they have the drawback that they only clean the air that passes through them (and at a lower efficiency), they only collect particulates, not gasses, and they also become infested with live captured bacteria and viruses.
- As the surface of the collection plates become covered by the captured particulates, their ability to attract further particulates decreases, from perhaps 80% down to as low as 30%. Weekly (or even daily) cleaning is required to keep them operating at optimum efficiency.
- This type of air purifier often increases the level of ozone, itself a lung irritant, in a room.



There is a second type of electronic air purifier that uses a media charged filter rather than plates. The inclusion of a physical filter allows them to better maintain their ability to filter out the larger particulates, but you will still have all the other drawbacks above, coupled with a significant decrease in the efficiency to collect smaller particulates over time.

## 2.3 Ultraviolet Light (UV-C)



After prolonged exposure to UV-C light mould, mildew, and in some cases even bacteria and viruses are killed or left incapacitated.

The key word above is 'prolonged' and that means that UV-C sterilisers are primarily used in health care facilities to bathe a contaminated item in intense UV-C light in a sealed environment. In that situation they are a valuable and effective sanitising technology.

In the domestic setting UV-C has been employed in air filters that claim to destroy mould, mildew, and in some cases even bacteria and viruses. Sadly however, as with every other sort of filter, they have the fundamental drawback that they only clean the air that passes through them but not, by any means, all of the air in a room.

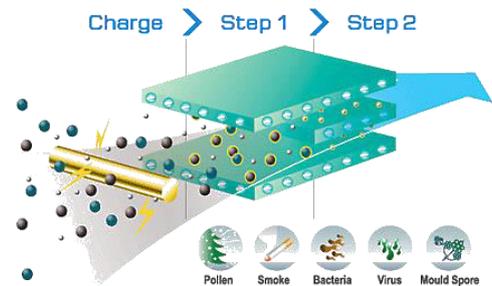
Indeed, with UV-C air cleaners this lack of effectiveness is exacerbated by the fact that to be effective the air flow must be slow and consequently the reach and effectiveness in terms of cleaning all the air in a room is very low.

Sadly, there are grossly misleading claims being made for this technology. Such claims mislead by focusing on the rate of pathogen kill in the air passing slowly through the device, and not the rate of pathogen kill in the air in the room itself, which will inevitably be far, far lower.

**The EPA says: "typical UVGI cleaners used in homes have limited effectiveness in killing bacteria and molds"**

## 2.3 Ionising

An ioniser air purifier releases ions (that is charged particles) into the air. Inside or near to the device these ions collide with airborne particles such as dust or smoke thereby give them a charge. The now charged particles are either attracted to a filter within the air purifier or surfaces, such as walls and curtains outside, or sink to the floor, taking them out of the air.

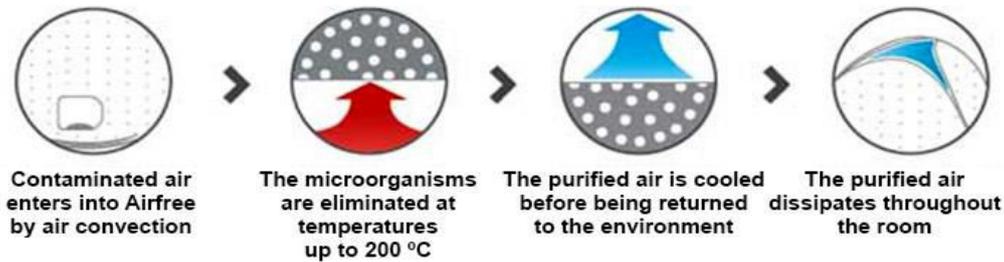


- As with HEPA filters they have the drawback that they only effect particulates, not gasses.
- Some (for example from Sharp, LifeAir and FitAir) claim that making contact with ions kills viruses and bacteria and also neutralises allergens. However, the effect is only local to the device and does not propagate throughout the room as with a hydroxyl cascade. Indeed, LifeAir's own published data shows that only around 1% of ions remain active just three feet (1m) away from the device.
- As they only re-distribute particulates from the air to surfaces in the room then, as the particles gradually lose their charge, they will likely be re-adsorbed back into the air.
- If an ionised particle is inhaled, it is more likely to stick to the walls of your respiratory system thus increasing the chance of an allergic reaction.
- This type of air purifier often increases the level of ozone, itself a lung irritant, in a room.

Sadly, there are grossly misleading claims being made for this type of air cleaner. Such claims mislead by focusing on their effectiveness on the air passing through the device, not the overall effectiveness across a whole room.

**It is of note that Asthma UK recommends that ionising air purifiers not be used.**

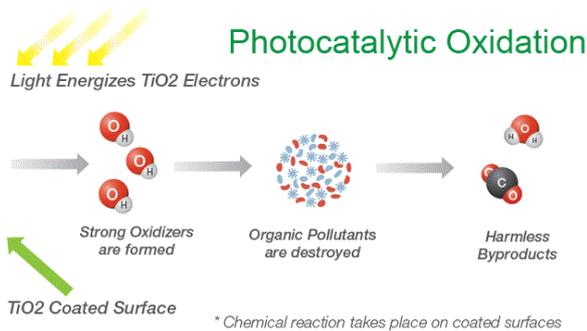
## 2.4 TSS (Airfree)



A TSS Steriliser works by incinerating those particles that pass through it by heating them up to circa 200 degrees C. It is effective at removing airborne particles of size 1 micron and smaller, including: bacteria, viruses, moulds, pet dander, smoke, and house dust mite allergens.

While its effects are wider in scope than other traditional filter technologies it unfortunately amplifies their shortcomings:

- As with all other filter-based devices they have the drawback that they only clean the air that passes through them, and this is exacerbated by the fact that Airfree relies on convection currents and contain no fan - so silent yes, but effective in drawing in and neutralising contaminants from across an entire room, absolutely not.



- Airfree is designed to work gradually over a period of weeks, but the majority of air in a room changes every hour or even more quickly!

Airfree destroys some gaseous lung irritants and ashma triggers, such as ozone, but not others, such as volatile organic compounds (VOCs).

## 2.5 Photocatalytic Oxidation, PCO and Photo-Electrochemical Oxidation, PECO

Others have produced rudimentary air purifiers based on Hydroxyl Radical cleaning.

While PCO / PECO air cleaners share the wider scope of action of Airora, without Airora's advanced patented 'Hydroxyl Cascade' technology they are unable to reliably cascade hydroxyls throughout a whole room and onto surfaces.

Consequently, PCO / PECO air cleaners rely mostly on exposing pollution to hydroxyl radicals within the device. As such they share the same shortcomings as traditional filter-based air cleaners.

Sadly, there are grossly misleading claims being made for this basic technology. Such claims mislead by focusing on their effectiveness in cleaning the air passing through the device, not their overall effectiveness across a whole room and its contents.

### **3. Combinations**

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Air purifiers based on HEPA, Electrostatic and Ionising filter technology are sometimes paired with other technologies to broaden their scope of cleaning action, for example to reduce odours or remove certain gasses.

Electrostatic and Ionising filters often produce material amounts of ozone as a by-product. The ozone may reduce smells, bacteria and viruses to a degree, but ozone is also well known as a lung irritant and unlike Airora's technology they increase the ozone present in a room, not reduce it.

More generally, some manufacturers include 'activated carbon' or similar additional filters to capture and neutralise odours. Unfortunately, such additional activated carbon filters add to the cost, are rather heavy and usually require at least annual replacement to remain effective.

To widen the cleaning action to killing bacteria and viruses, some manufacturers also subject air flowing through the device to ultra violet (UV) light, which if strong enough can kill both bacteria and viruses, but only if they are exposed to it for sufficient time. However, all traditional filter devices also require a fast air stream driven by a powerful fan if they are to draw air from across an entire room. The speed of the air passing through them is then generally far too fast for the UV to act as an effective sanitiser.

### **4. Why in-room, filter-only air cleaning devices can never be very effective**

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While each traditional filter technology has its own strengths and weaknesses, they all share the common failing that they only clean the air that passes directly through them (or is immediately adjacent in the case of ion emitters), and then only of some types of contaminant. In the real world, that failing means that filter only devices can never be very effective.

Where test results do exist for such filtration devices, they are usually based on either an 'idealised sealed test room' or simply just measure the percentage removal of target pollutant from the air passing through the device, not from the room itself.

Even in an 'idealised sealed test room', air emitted from the device immediately mixes with the existing air, continually redistributing contaminants around the room, and that combined with stratification and eddy formation limit the effectiveness of even the best devices.

Such devices will typically only reach their maximum level of contaminant reduction in hours, not minutes or seconds, and the faster the device, the larger it is, the more power it consumes and the more noise it typically makes.

In your own home however, conditions are 'real' not 'idealised':

- The air in a typical home changes (that is replaced by new air from outside) at least once an hour. While this may seem surprising, in many older homes it is even more frequent!
- However powerful, filter only devices can never keep up with these changes nor with re-contamination, such as brushing past furniture and causing settled pollen to rise into the air again.
- To keep ahead of the air changes, re-contamination, re-circulation, and eddy formation, a truly effective air purifier needs to act quickly across all classes or contaminant, preferably within seconds, and to reach and clean all of the air in a room, not just the air which passes through the device.

## 5. Then along came Airora ...

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Airora 4-in-1 achieves its superior performance by employing patented next-generation air cleaning technology which directly cleans the air throughout the room, not just the air that passes through the device.



Nevertheless, the Airora 4-in-1 also takes every opportunity to clean the air passing through it of allergens and irritants by using UV light and intense exposure to Hydroxyl Radicals. Together these clean the air passing through the device of the widest possible range of contaminants, without the cost and inconvenience of a HEPA filter or the cleaning requirements of a traditional electrostatic filter.

As the Airora 4-in-1 doesn't rely on cleaning the air that passes through the device, air flows can be lower and the fan whisper quiet.

And there's more, because the air passing through the device soon becomes sterilised by the hydroxyl radical cascade throughout the room, there will be no build up of live bacteria and viruses within the device, unlike typical electrostatic or HEPA filters which can become rapidly infected.

But that is just the start, the real strength of the Airora 4-in-1 lies in its ability to clean all of the air on the room by generating an entirely safe, self sustaining and natural hydroxyl cascade ('Nature's Detergent') which reaches and starts cleaning the air and smooth surfaces in every corner of the room in seconds, without having to rely on air movement, by what scientists call 'molecular diffusion'.

The hydroxyl cascade produced by Airora acts throughout all the air in the room and on exposed surfaces to:

- Neutralise airborne allergens such as pollen, spores, pet dander, cat saliva and house dust mite excretions.



- Eliminate all common lung irritants and other pollutants such as ozone, volatile organic compounds (VOCs), formaldehyde and carbon monoxide.
- Remove odours from the air, leaving it 'crisp and fresh'.
- Kill all the types of bacteria and viruses that are harmful to people, such as Colds, Flu, MRSA, C-difficile and Norovirus