



NAEM

National Association of  
Environmental Medicine

## INDOOR AIR FILTRATION

Indoor air can be up to 10 times more toxic than outdoor air! Airborne toxins come from dust, VOCs, fragrances, mold/mycotoxins, wildfire smoke, home renovation materials, cleaning products, gas stoves, and more. Indoor air filtration is essential to improve and maintain health. For those with health issues, the quality of the air filter system makes a difference. With so many different air filter options available, and at a wide range of prices, it is hard to decide which air filter is best for you and your household. You need to do your research to identify the best solution for YOUR HEALTH.

Importantly, if your home needs mold remediation, an air filtration system will not be enough. Please work with your provider to identify a skilled Indoor Environmental Professional or Building Biologist. A good resource to find skilled IEPs and remediators who specialize in mold is at [ISEAI.org](http://ISEAI.org).

### IMPORTANT THINGS TO CONSIDER WITH AIR PURIFIERS

#### #1: MOST PEOPLE NEED AN AIR FILTER/PURIFIER WITH BOTH TYPES OF FILTERS

Indoor pollutants include BOTH particulates and VOCs/gases. Both types of pollutants can be absorbed through lung tissue and can negatively impact your health. Particulate pollution is filtered by HEPA filters that capture even ultrafine particles. VOC pollution is adsorbed or trapped by carbon filters.

HEPA FILTER	ACTIVATED CARBON FILTER
<p><b>REMOVES PARTICULATE AIR POLLUTION.</b></p> <ul style="list-style-type: none"><li>● Most important for clearing wildfire smoke, mold/mycotoxins, pollen, bacteria and viruses.</li><li>● HEPA filters are all essentially the same and will remove 99.97% of all particles sized 0.3 microns - which is the most difficult size particulate to capture.</li><li>● Importantly, the filters are even <b>better</b> at removing particulates sized larger or <b>smaller</b> than 0.3 microns. While counter- intuitive, all HEPA filters will remove up to 99.99% of 0.1 micron particulates. (<a href="http://EPA.gov">EPA.gov</a>)</li><li>● Ultrafine particles (&lt;0.1 microns) make up about 90% of airborne particles, including viruses, bacteria AND VOCs and solvents.</li></ul>	<p><b>REMOVES CHEMICALS, VOCs &amp; ODORS</b></p> <ul style="list-style-type: none"><li>● Most important for those with chemical sensitivity, MCAS and chronic health issues. Also important for those with high solvent/ VOC exposures (see list below)</li><li>● These filters have activated carbon and zeolites that trap or adsorb airborne chemicals, VOCs, gases, and odors.</li><li>● The more carbon it includes (3 pounds+ preferred), the better it is in purifying the air.</li><li>● Importantly, once a carbon filter is 'saturated' it can't work anymore. This is why it is important to replace your filters regularly, especially for the less expensive units that have less carbon.</li></ul>

## #2: DETERMINE THE SQUARE FOOTAGE OF THE AREA YOU WANT TO PURIFY

Determining the correct area of the space you want to purify is essential. The air only gets cleaned IF IT CAN FLOW THROUGH THE MACHINE! For a typical bedroom, you can calculate the square footage by multiplying the length times width (12 ft by 12 ft = 144 sf). For other areas of the home, you will likely need to make adjustments to your size calculations.

- If your ceilings are higher than 8 feet, you need to adjust your area estimate higher. You will likely need a more powerful machine to pull the air from all corners of the room.
- If your home has an open-concept floor plan where the living area opens into the kitchen or other rooms, you will need a more powerful machine and/or multiple machines to move all the air.
- Each primary room needs an air purifier unit - the air must flow to a machine to be cleaned!

## #3: DETERMINE THE CORRECT MACHINE SIZE AND TYPE FOR YOUR NEEDS AND BUDGET

There are two measures often listed on air purifiers that indicate its quality and strength in purifying your air. For areas with high ceiling and open floor plans you will need a higher rated machine.

AIR CHANGES PER HOUR (ACH)	CLEAN AIR DELIVERY RATE (CADR)
This is how many times the air goes through the cleaner per hour. Research suggests 5-6 ACH drives a 50% reduction in particles and 8-10 ACH results in an 80% reduction. With each hour it runs it will further reduce airborne particles.	The Association of Home Appliance Manufacturers (AHAM) created a standard for measuring an air cleaner's efficiency. CADR indicates the volume of filtered air an air cleaner delivers, with separate ratings for tobacco, smoke, pollen and dust. A higher CADR means the unit cleans the air faster than a lower rated unit.

When shopping for an air filter, you can often look at that product's ACH and CADR ratings. Not all brands have CADR ratings, especially many of the high-end medical grade air filters. On the IQAir website, it states that the CADR rating is limited as it only tests the filters for 20 minutes and their higher quality machines are more effective over the long term even with a similar CADR score.

**Importantly, CADR does NOT measure the removal of VOCs and other chemicals which require a carbon filter - in addition to the HEPA filter. So the amount of carbon needs to be considered too.**

## DETERMINING YOUR INDIVIDUAL AIR FILTRATION NEEDS

Your air filtration needs can vary by type of exposure (mold, wildfire smoke, VOCs, etc.), your room type/size and your physical health needs. While it is best to work with your provider to identify the best air filtration plan for your health and house, here are some guidelines to consider.

- Understand your personal exposure risk to BOTH particulates and solvents/VOCs. Many of the items we use in and around our home are made with chemicals and can off-gas into the air. As newer houses are made more energy efficient (i.e. less drafty), these gases and particulates can't escape and they recirculate in our homes and the air we breathe.
- If you have exposure or potential exposure to wildfire smoke, it is important to know that in addition to small (PM<sub>2.5</sub>) particulate matter, the smoke also tends to carry VOCs and other

chemicals, including formaldehyde, that also need to be cleaned from the air.

- If your exposure is at a work location, ask for air filtration solutions - for everyone's health.
- Importantly, you can purchase or borrow an **indoor air quality monitor** to determine your risk of exposure to particulates, VOCs, solvents and gases by room to help you determine your needs.
  - Better: AirKnight 9-in-1 Indoor Air Quality Monitor (model AK1000 - about \$150)
  - Best: IQAir AirVisual Pro Air-Quality Indoor Monitor (model 360 - about \$299)

	Particulate Exposure Sources	Solvents & VOCs Exposure Sources
At home	<ul style="list-style-type: none"> <li>● Moldy or water-damaged areas</li> <li>● Wildfire smoke</li> <li>● Tobacco smoke</li> <li>● Dust</li> <li>● Pollen and other outdoor pollutants</li> <li>● Pet fur/hair</li> <li>● Wood-burning fireplace/stove</li> </ul>	<ul style="list-style-type: none"> <li>● Recent renovation/construction</li> <li>● Vinyl flooring, new carpeting</li> <li>● Spray foam insulation in walls</li> <li>● Gas powered tools/mowers</li> <li>● Gas stove, oven and/or furnace</li> <li>● Gas or wood stove/fireplace</li> <li>● Memory foam mattress or pillow</li> <li>● Tobacco or cannabis (smoke/vape)</li> <li>● Air fresheners/candles</li> <li>● Furniture paint or refinishing</li> <li>● Standard/scented cleaning products</li> </ul>
At work	<ul style="list-style-type: none"> <li>● Moldy or water-damaged areas</li> <li>● Wildfire smoke</li> </ul>	<ul style="list-style-type: none"> <li>● Auto shops/gas stations</li> <li>● Hair/nail salons</li> <li>● Airports/airlines</li> <li>● Furniture and bedding stores</li> <li>● Construction sites</li> <li>● Dry cleaners</li> <li>● Use disinfectants (hospital/dental)</li> </ul>
Do you live or work near	<ul style="list-style-type: none"> <li>● Open fields, golf course or agriculture</li> <li>● Busy streets, especially with truck traffic</li> </ul>	<ul style="list-style-type: none"> <li>● Heavy traffic, especially trucks</li> <li>● Dry cleaners</li> <li>● Chemical plants, industry or airports</li> </ul>

## DESIGNING YOUR AIR FILTRATION PLAN

1. **DETERMINE THE FILTRATION EFFICIENCY YOU NEED FOR YOUR HEALTH & EXPOSURE**
  - Particulate matter exposure - dust, pollen, mold, wildfire smoke, bacteria and viruses
    - ALL NEED: HEPA filtration with a CADR rating of 250 or higher
  - Solvent/VOCs exposure - new construction, gas stoves/fireplaces, cigarette smoke, etc.
    - Minimal risk/no sensitivity: activated carbon filters standard in entry/mid-level units (but must replace carbon filter regularly, typically every 6 months or sooner)
    - Higher risk/some sensitivity: activated carbon filters with 3-12 pounds of carbon
    - High risk/strong sensitivity: activated carbon filters with 12-30 pounds of carbon
    - Note: if you have a higher risk of solvent/VOC exposure, you will likely need to invest in a more expensive medical or industrial grade purifier to make your indoor air safe. You should also consider purchasing an indoor air quality monitor.
  - If you have potential exposure to formaldehyde (nail salons, dental offices, wildfire smoke) you should find a carbon filter that also includes zeolite or potassium permanganate.
  - A few of our members have reacted to the off-gassing of some air filtration units and filters due to foam components and or glues. If you are highly sensitive to off-gassing, it is

best to check the reviews to see if the unit you are considering has had any issues.

## 2. **DETERMINE THE NUMBER OF UNITS YOU NEED FOR YOUR HOME/WORK ENVIRONMENT**

- Bedroom - get a high quality air HEPA filter. Increase level of carbon filtration if you use a memory foam mattress or pillow, have vinyl flooring or new carpeting
- Living room - get a high quality HEPA filter. Increase level of carbon filtration if you smoke, use air fresheners, have a gas fireplace, have vinyl flooring or new carpeting. Also important if you live near a busy street or industry and keep doors and windows open.
- Kitchen - get a high quality HEPA filter. Increase level of carbon filtration if you have a gas stove/oven, use air fresheners/candles, smoke or completed renovations.
- Work locations - if your location has high VOC, chemical exposures (see above), get a high quality HEPA and carbon filtration unit, ideally medical or industrial grade.

## 3. **OPERATING SUGGESTIONS FOR AIR FILTER UNITS**

- Place air purifiers at least 18 inches from a wall and any furniture. Once working, check to make sure there is strong air flow around your unit to make sure all the air circulates.
- Keep windows and outside doors closed, except for in-and-out traffic.
- You should typically run your air filters 24/7 on their highest 'quiet' setting, which is usually medium high. Turn on high as needed during higher pollution events like wildfire smoke.
- Clean pre-filters monthly to remove pet hair and dust that can impede efficiency.
- Some of the higher end brands have air quality sensors built in that will turn the machine on when air quality changes and will also alert you when the filters need to be replaced.

## 4. **MARK YOUR CALENDARS FOR FILTER REPLACEMENTS**

- Plan for your filter replacement to maximize effectiveness.
  - On low/mid-range air filters, you typically need to replace the filters every 6-12 months. You need to replace them sooner after renovation or a wildfire smoke event.
  - Higher end/medical grade machines are typically larger units with larger filters that only need to be replaced every 2-5 years, however they are more expensive.
- As filter replacement can get expensive, factor that in when purchasing an air filtration unit as the more expensive machines need new filters less often.

## AIR FILTER/PURIFIER BRAND RECOMMENDATIONS

As noted above, your decision on which model to buy needs to factor in your health needs, budget, and house requirements (# of units, square footage, layout). The following is only our suggestion.

### **MEDICAL GRADE MACHINES: Good for removal of particulates AND VOCs, and solvents**

**Based on clinical experience, the two brands recommended most by our clinicians are Austin Air and IQ Air.** Both of these brands are superior in clearing VOCs, solvents and other gases not cleaned by a HEPA filter. The primary difference between the units are cost - and the amount of activated carbon (for VOCs, chemicals). Some of the carbon filters add zeolite or potassium iodide or permanganate to better capture chemicals, including formaldehyde. AllerAir AirMedic Pro 5 is similar to the Austin Air with 14 pounds of carbon. The high levels of carbon are excellent at removing VOCs and solvents from the air. There is little statistical difference in the performance of these HEPA filters.

For those without high levels of VOCs/solvent exposure, Air Doctor 3500 is another unit commonly used. It has 1.5 pounds of carbon in its filter - which is recommended to be replaced every 6 months.

So annual carbon filtration is 3 pounds. For comparison, the Austin Air has 15 pounds of carbon which lasts for 5 years, which assumes it saturates up to 3 pounds of carbon per year. The Air Doctor 5500 has 3.7 pounds of carbon so it is a good choice for larger rooms. Carbon binds or adsorbs toxins so it becomes saturated over time, so regular filter replacement is important and impacts overall operating cost.

Note: Information below reflects current website or Amazon standard pricing and product specifications. These products often go on sale so their initial costs and overall operating costs could be lower.

	AUSTIN AIR	AUSTIN AIR	IQ AIR	ALLERAIR	AIR DOCTOR	INTELLIPURE
Model	Healthmate	Healthmate PLUS	HealthPro Plus	AirMedic Pro 5	3500	Ultrafine 468
Max. Sq Ft	1500 sf	1500 sf	1125 sf	1274 sf	1274 sf	1125 sf
HEPA filter	Medical grade HEPA	Medical grade HEPA	HyperHEPA	Medical Grade HEPA	UltraHEPA	UltraHEPA
#s of Carbon in standard filter	15 lbs	15 lbs + potassium iodide	5 lbs + potassium permanganate	14 lbs Exec or VOCARB blends	1.5 lbs + potassium permanganate	1.4 lbs est.
Carbon filter life	5 years	5 years	2 years	2-3 years	6 months	6 months
#s of Carbon used per year based on filter life	3 lbs	3 lbs	2.5 lbs	5-7 lbs	3 lbs	2.8 lbs
CADR (smoke)	250	250	300	NA	340	NA
Air Quality & Replace Filter Indicators	No	No	Yes	No	Yes	Yes
Unit Retail Price	\$715	\$855	\$899	\$700-\$750	\$519	\$999
Filter Cost	\$285	\$420	HEPA: \$199 V5/Carbon: \$99 Pre-Filters: \$79	\$153 set: 1 HEPA & 2 Carbon	\$153 set: 1 HEPA & 2 Carbon	\$275 Set: 1 HEPA, 2 each pre & post VOC
Filter Cost/year	\$57/year - based on 5 year life	\$84/year - based on 5 year life	HEPA (4 yrs), V5/Carbon (2yrs), Pre-Filter (1.5 yrs), \$159/year	Prefilter (1yr), HEPA & Carbon Filter (2-3 yrs): \$100-\$150/year	\$153/year: HEPA (1 yr), Carbon (2 per yr)	HEPA (1 yrs), Pre/post VOC Filters (6 mo) , \$275/year
5 Year Cost (unit+filters)	\$1000	\$1275	\$1454	\$1100-\$1300	\$1131	\$2100

### **MORE AFFORDABLE AIR FILTRATION UNITS: For areas you use less and have less toxin exposure**

As all HEPA filters are essentially the same, these units will all be strong on removing particulate pollution, even ultra-fine particles. While these recommended machines have a carbon filter and remove some chemicals and gases, the amount of carbon (typically <1 pound) in these filters is significantly less than the higher end machines meaning they are not as good at removing chemicals, VOCs and odors. It is also why you need to replace these filters every 6-12 months as they do get saturated and less efficient.

The Wirecutter does comprehensive annual reviews on air purifiers and their effectiveness on HEPA/particulate filtration - especially for allergens (pollen and mold spores), bacteria, viruses and smoke. While it is a good source of information, it does not test for VOC filtration.

Note: Information below reflects current website or Amazon standard pricing and product specifications. These products often go on sale so their initial costs and overall operating costs could be lower. No specific information was found on the actual amount of carbon/filter so used the standard estimate of less than 1 pound per filter.

	BLUEAIR	BLUEAIR	COWAY	CONWAY	WINIX
Model	Blue Pure 311iMax	Blue Pure 211iMax	AirMega AP-1512HH Mighty	AirMega 400	5500-2
Max. Sq Ft	929 sf	1524 sf	361 sf	1560sf	360 sf
HEPA filter	HEPA	HEPA	HEPA	True HEPA	HEPA
#s of Carbon in standard filter - estimated	<1 lb	<1 lb std or 2x carbon in SmokeBlock filter	<1 lb	@1 lb	<1 lb
Filter life	6-9 months	6-9 months	6 months	6 months	6 months
#s of Carbon used per year based on filter life - estimated	about 1 lb	about 1 lb standard or 2 lbs SmokeBlock	about 1 lb	about 2 lbs	about 1 lb
CADR (smoke)	250	410	233	NA	232
Air Quality & Replace Filter Indicators	Yes	Yes	Yes	Yes	Yes
Unit Retail Price without sale pricing	\$230	\$350	\$230	\$430	\$250
Filter Cost	\$45	\$70 standard or \$85 smokeblock	\$57 set: 1 HEPA + 2 Carbons	\$129 HEPA and Act. Carbon	\$80 set
Filter Cost/year	\$67-\$90	\$105-140 std, or \$127-170 Smokeblk	\$57	\$258/yr	\$80
5 Year Cost (unit+filters)	\$500-\$590	\$770-910 Std or \$858-\$1030 Smokeblock	\$458	\$1462	\$570

## OTHER AIR FILTRATION TECHNOLOGIES

In addition to HEPA and activated carbon filtration, some brands offer additional technologies they claim to increase their effectiveness. Currently, we have not seen sufficient information to support these claims and the research suggests they could produce dangerous levels of ozone or chemicals, directly or as a by-product. We do not currently recommend ionizers or UV light filtration.

## SUMMARY

Indoor air pollution is a mix of both particulate matter and VOC/solvent gases. As most of our patients have (or had) significant health issues and/or chemical sensitivities, it is NAEM's recommendation that the primary bedroom and living areas need to use a filter with both a HEPA filter for particulates AND an activated carbon filter with at least 3 pounds of carbon per year of use. This guideline is based on current information. As technology changes and our learning advances, we will update this recommendation.