# USEPA
# The Wildfire Smoke Guide for Public Health Officials
**https://www.epa.gov/wildfires/wildfire-smoke-guide-public-health-officials**

### 3.5 Use Air Filters and Air Cleaners

Using high-efficiency HVAC filters, PACs, and do-it-yourself (DIY) air cleaners, alone or in combination, can reduce PM2.5 concentrations in indoor environments. PACs and DIY air cleaners are intended to deliver cleaner air to a single room, while HVAC filters can deliver cleaner air to the whole home. However, two or more well-placed PACs and/or DIY air cleaners can be equally effective, and their cost may still be less than operating a central air system continuously with a high-efficiency filter. The Wildfire Guide fact sheet on Indoor Air Filtration summarizes the information in this section for the general public.

In general, upgrading the HVAC filter is expected to be most effective in tighter (typically newer) homes when the HVAC fan is run continuously and the filter is installed correctly and changed frequently (Alavy and Siegel 2019; Zhang et al., 2020). One study during an extreme wildfire event (PM2.5 > 200 µg/m3 for several days) observed a 45% decrease in PM2.5 concentrations relative to outdoors using a MERV 13 filter with intermittent HVAC operation as needed for air conditioning (Antonopolous et al., 2024). Modeling indicates that even with a typical low-efficiency (MERV 4) filter, running the system continuously may reduce PM2.5 concentrations by about 24% compared to intermittent operation (Fisk and Chan 2017).

Portable air cleaners alone can effectively reduce PM2.5 concentrations, even in homes that do not have central air conditioning and are most effective if windows and doors remain closed and excessive heat is not a concern. During a wildfire smoke event, PACs may reduce indoor PM2.5 concentrations by 50-80%, averaging around 65% (Barn et al 2008, Xiang et al. 2021). Properly constructed DIY air cleaners can perform similarly to commercial air cleaners (Holder et al., 2022; Eykelbosh 2023; May et al., 2021).

PACs can be used in combination with HVAC filter upgrades to maximize the reduction of indoor PM2.5. In one study during an intense smoke event lasting nearly two weeks, using both a PAC and an HVAC system with a MERV 13 filter reduced indoor PM2.5 concentrations by about 80% relative to the outdoors, compared to about 45% using the HVAC system with a MERV 13 filter alone (Antonopolous et al., 2024).

### 3.5A Choose Air Cleaners and Filters that Do Not Produce Ozone

Use only CARB-certified air cleaners. Ozone is a lung irritant that poses serious health risks for humans and animals. The California Air Resources Board (CARB) certifies air cleaners that produce little or no 55 ozone, and only CARB-certified air cleaners may be sold in California. See the List of CARB-Certified Air Cleaning Devices.

For more information about ozone and air cleaners, see:

- EPA: Ozone Generators that are Sold as Air Cleaners
- CARB: Hazardous Ozone-Generating Air Purifiers

A single air cleaning product may use one or more air cleaning technologies. These technologies typically use one or both of the following mechanisms for particle removal:

- Mechanical mechanisms that capture particles in a fibrous and/or fabric filter. For example, HEPA filters and other pleated filters are mechanical filters. Mechanical air cleaners and filters, especially higher-efficiency filters, can effectively remove PM2.5 from smoke and do not produce ozone. Some filters use electrostatically charged fibers to increase their efficiency, which also does not produce ozone.
- Electronic mechanisms that use electric fields to remove particles from the air. This category includes ionizers, electrostatic precipitators, and other electronic air cleaning technologies. Electronic air cleaners have the potential to produce ozone. There is some evidence that these air cleaners can produce other harmful byproducts as well (Collins and Farmer 2021; NASEM 2022). There is limited evidence that electronic air cleaners can effectively remove PM2.5 from smoke in the air and they are not recommended for smoke removal (Zeng et al., 2022a; Zeng et al., 2022b; Stinson et al., 2024; NASEM 2024). Ionizers, in particular, can cause particles to stick to materials (e.g., carpet, walls) near the device which can be resuspended into the indoor air if disturbed.

Other air cleaning technologies, such as photocatalytic oxidation (PCO) technology, hydroxyl generators, and devices with UV light components, are not designed to remove particles from the air. There is limited evidence that these technologies are effective for smoke or odor removal (Stinson et al., 2024.; Zeng et al., 2022; NASEM 2024). (Note that some technologies that can effectively inactivate pathogens, such as ultraviolet germicidal irradiation (UVGI), do not remove smoke.) Similar to electronic air cleaners, they also have the potential to produce ozone or other harmful byproducts (Collins and Farmer 2021; NASEM 2022).

Given that electronic air cleaning technologies are not recommended for smoke removal, **the following sections focus on mechanical air cleaners and filters**.

**3.5B Use Air Filters in Air Systems**

**Choose an Appropriate Filter for the System**

Forced air heating and air conditioning systems contain filters that remove some airborne particles with different degrees of efficiency. These filters only work to reduce PM while running



the forced air system for cooling or heating or running the fan only. Most systems are equipped with a flat panel, low-efficiency filter primarily designed to protect the equipment from clogging with large debris like hair and dust. If possible, a pleated medium- or high-efficiency particle filter should be installed in the central heating and/or cooling system. Higher-efficiency filters (e.g., filters rated at MERV 13 or higher, see below) are preferred because they can capture more of the PM2.5 associated with smoke and reduce the amount of outdoor air pollution that gets indoors. However, caution must be taken to ensure that the system is able to handle the increased airflow resistance from a higher-efficiency filter. Consultation with an HVAC technician may be necessary to confirm if or which high-efficiency filters will work with an individual system.

**Filter Rating Systems**

Furnace and HVAC filters are rated based on how well they remove particles from the air, most often reported as a Minimum Efficiency Reporting Value (MERV) rating based on the average removal efficiency across three particle size ranges (Table 1). For more information, see the EPA webpage What is a MERV rating?.

Other commercially common proprietary rating systems for in-duct air filters include the Microparticle Performance Rating (MPR) and Filter Performance Rating (FPR). In general, the higher the filter rating, the higher the filter's removal efficiency for at least one particle size range.

**Table 3.1** Particle size efficiency for select MERV ratings*

| **MERV Rating** | **Average Particle Size Removal Efficiency (%)** | | |
|---|---|---|---|
| | **Particle Size (µm)** | | |
| | **0.3–1.0** | **1.0–3.0** | **3.0–10.0** |
| MERV 1-7 | Not tested | Not tested | <20 to ≥50 |
| MERV 8-10 | Not tested | 20 to ≥50 | 70 to ≥80 |
| MERV 11-12 | 20 to ≥35 | 65 to ≥80 | 85 to ≥90 |
| MERV 13-16 | 50 to ≥95 | 85 to ≥95 | 90 to ≥95 |
| HEPA | | ≥99.97 | |