

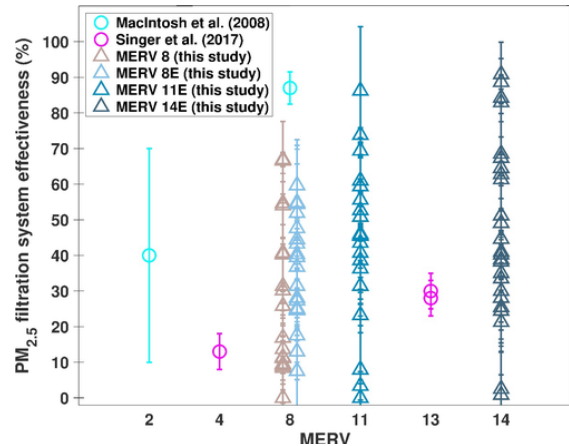
Alavy M, Siegel JA. 2020. In-situ effectiveness of residential HVAC filters. *Indoor Air*, **30**(1), 156-166. DOI: [10.1111/ina.12617](https://doi.org/10.1111/ina.12617)

### Abstract

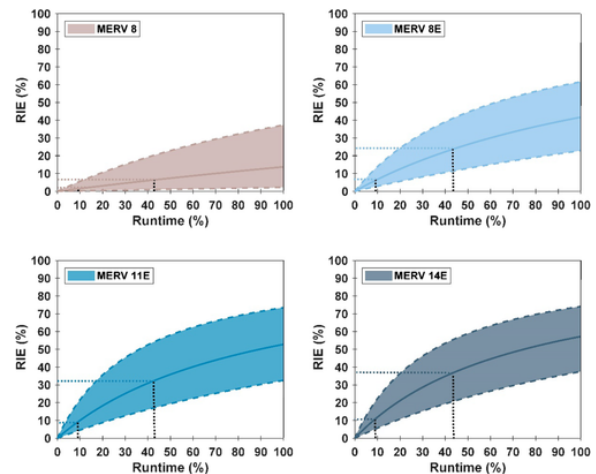
In this study, we explore different filter and contextual characteristics that influence effectiveness of high-efficiency filters in 21 residences in Toronto, Canada. The in situ effectiveness was assessed with decay tests at the beginning and the end of filter life with four different filters (MERV 8-14 from ASHRAE Standard 52.2) installed in operational HVAC systems, compared with either the system off or with no filter installed. There was considerable difference between median  $PM_{2.5}$  effectiveness of the non-electret filters when compared to electret filters (16% vs. 36%) of the same nominal efficiency (MERV 8). However, median  $PM_{2.5}$  effectiveness of electret filters only slightly improved (between 5% and 9% absolute increase) as MERV increased from 8 to 14. There was more variation in filter effectiveness between the same filter in different homes than there was between different filters in the same home. Variations in filter performance arose because home-specific particle loss rates (eg, ventilation rate) vary greatly in different buildings. The higher the loss rates due to non-filter factors, the lower the effectiveness of a filter. Given the relatively large variation in effectiveness for a given filter over time and in different homes, increasing system runtime may be a productive way to improve filter performance in many homes.

### Practical Implications

- Filter performance in homes is **weakly linked** to the **nominal** efficiency of the filter.
- Filter performance is strongly linked to **home- and system-specific parameters**.
- The same filter will have a **large range** of effectiveness when installed in different homes.
- Parameters that are important to filter performance include **ventilation rate** and **system runtime**



**Figure 4.** Comparison between measured  $PM_{2.5}$  filtration system effectiveness from this study and other related measurement studies in the literature. The circles and their associated error bars represent  $PM_{2.5}$  effectiveness and its uncertainty as reported in each of those measurement studies for each MERV. The triangles and their associated error bars represent  $PM_{2.5}$  effectiveness in this study for each MERV. MERV = minimum efficiency reporting value.



**Figure 4.** Range of runtime influence effectiveness (RIE) from Equation 4. for the MERV 8 (top left), MERV 8E (top right), MERV 11E (bottom left), and MERV 14E (bottom right) filters in this study. The black vertical lines represent the median (9.6%) and the 90th percentile (43%) runtime results from this study, and the horizontal dotted lines represent their corresponding RIE

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