Li T, Siegel JA. 2020. Laboratory performance of new and used residential HVAC filters: Comparison to field results (RP-1649). *Science and Technology for the Built Environment*, **26(6)**, 844-855.
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Abstract

Particle filters are used in heating, ventilating, and air-conditioning (HVAC) systems to protect equipment and reduce exposure to airborne particles. Filtration standards such as ANSI/ASHRAE Standard 52.2 are used to evaluate filter performance in a laboratory setting. In this work, we examined the lab-tested performance of new filters with different nominal efficiencies as determined by ASHRAE Standard 52.2 and compared these results to the lab-tested and in-situ performance of filters deployed in 21 occupied residential environments. The lab-tested results comparison shows that the dust loading and conditioning procedure in ASHRAE Standard 52.2 provides a reasonable range of efficiencies for the used filters, but the target final pressure drop of 250 Pa is an overestimation of the realistic pressure drops. Moreover, the specified test dust was not a good representation of the dust in this sample of residential environments. The lab-tested and in-situ results comparison suggests that even for the same filter, its lab-tested performance could differ greatly from its in-situ performance because of variations in system and loading conditions, which are not captured in the laboratory setting. Overall, the lab-tested results are an overestimation of the in-situ efficiency and an underestimation of the in-situ pressure drop for both new and used filters.

Main findings

1. ASHRAE Standard 52.2 testing procedure with Appendix J provides reasonable bracketing of the in-situ performance for our sample of filters.
2. No strong correlation between filter nominal efficiency and filter pressure drop, in-situ or in a lab.
3. The target final drop (250 Pa) from ASHRAE Standard 52.2 is an overestimation of the in-situ filter pressure drop in our sample of homes.
4. The test dust from the dust loading procedure did not appropriately reflect the impact of dust loading on naturally loaded filters due to the difference in composition and morphology.
5. We observed large variations in both in-situ efficiency and pressure drop within a filter type, suggesting that the system and environment a filter is installed in is as important as filter nominal efficiency.

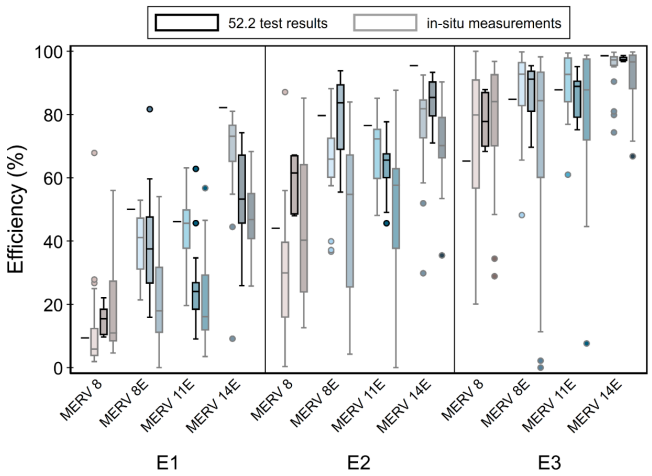

Figure 5 Lab-tested (black) and in-situ (grey) efficiency for new (lighter color) and used (darker color) filters for E1 (0.3-1 µm), E2 (1-3 µm), and E3 (3-10 µm) ranges. MERV = minimum efficiency reporting value.

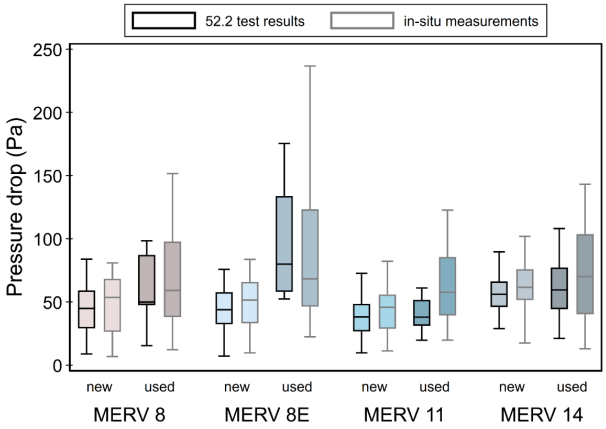

Figure 6 Calculated lab-tested (black outline) and in-situ (grey outline) pressure drop at in-situ face velocity for new (lighter color) and used (darker color) filters.

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