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## **HVAC System Filter Requirements**

*Additional submitted attachment is included below.*

# Comments on HVAC System Filter Requirements in 2019 Title 24, Part 6 45-Day Language

California Statewide Utility Codes and Standards Team

February 20, 2018

## 1. Introduction

The Statewide CASE Team appreciates the opportunity to participate in the rulemaking and the thoughtful feedback we have received from the California Energy Commission on the Codes and Standards Enhancement (CASE) proposals.

The CASE initiative presents recommendations to support the Energy Commission's efforts to update California's Building Energy Efficiency Standards (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities – Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison and SoCalGas® – and two publicly Owned Utilities – Los Angeles Department of Water and Power, and Sacramento Municipal Utility District – sponsored this effort.

The California Statewide Utility Codes and Standards Team (Statewide CASE Team) actively supports the Energy Commission in developing revisions to Title 24, Part 6 by developing code change proposals that will result in feasible, enforceable, and cost-effective enhancements to the building energy efficiency standards. In developing these proposals, the Statewide CASE Team conducts research and market surveys, holds stakeholder meetings, and evaluates the energy savings and cost-effectiveness of considered measures. The CASE Reports, which present pertinent information that supports the code change proposals, are posted within each measure topic page on [title24stakeholders.com](http://title24stakeholders.com).

The Statewide CASE Team encourages the Energy Commission to consider the following changes to HVAC system filter requirements.

## 2. Summary

The 45-Day Language includes the mandatory requirement of MERV 13 filters. Stakeholders have expressed concerns about the pressure drop (resistance to air flow) of higher MERV filters. Tests were performed on a set of 24 inch by 24-inch filters to provide third-party verification data on the performance of filters with various MERV ratings in one and two-inch depths over a range of velocities for use by the Statewide CASE Team, the Energy Commission and stakeholders. The results show that acceptable pressure drops of less than 0.20 inch w.c. can be achieved by either one- or two-inch deep MERV 13 filters. No correlation was found between filter MERV ratings and pressure drop. One-inch and two-inch deep filters can have the same pressure drop at the same MERV rating, allowing either to be used. All filters have increasing pressure drop with increasing airflow. The full test report and results can be found in Appendix D to the Residential Indoor Air Quality CASE Report, dated February 2018, which is available here: [http://title24stakeholders.com/wp-content/uploads/2018/02/2019-T24-CASE-Report\\_Res-IAQ\\_Final\\_February-2018.pdf](http://title24stakeholders.com/wp-content/uploads/2018/02/2019-T24-CASE-Report_Res-IAQ_Final_February-2018.pdf).

### 3. Recommendations

The following modifications to the 45-Day Language are proposed:

1. Eliminate all mandatory requirements related to filter pressure drop and size, and rely on the verification of fan efficacy to ensure that all system components, not just filters, are properly designed and installed.
2. In Section 150.0(m)12Bii, prescribe a design maximum filter pressure drop of 0.15 inch w.c. and a maximum velocity of 225 feet per minute (fpm) instead of 150 fpm.
3. Reference the CALGreen mandatory measure for ACCA Manual D sizing in Part 6 Section 150(m)12 to reinforce the requirement.

### 4. Background

#### 4.1 Updates to Filter Requirements in 2019 Title 24, Part 6

To summarize the proposed 45-Day Language requirements: MERV 13 or equivalent filters must be used, and systems must include either:

- Two-inch deep filters per 150.0(m)12Biia
- One-inch deep filters with a verified face velocity of 150 fpm or less and a pressure drop less than 0.10 inch w.c. per 150.0(m)12Biib
- One-inch deep filters with a verified face velocity of not more than 151-176 fpm (depending on system size) and a pressure drop less than or equal to 0.10 inch w.c., and return ducts sized per Tables 150.0-B/C (resulting in 376 to 439 fpm duct velocity)

#### 4.2 Other Relevant Standards

Section 1607(d)(12) of the 2016 California Appliance Efficiency Regulations (Title 20) requires air filters to be labeled using the format below. The original effective date of July 1, 2016 was delayed until July 2019.

|         |                   |          |         |         |                             |         |         |         |         |         |                          |
|---------|-------------------|----------|---------|---------|-----------------------------|---------|---------|---------|---------|---------|--------------------------|
| MERV    | ( $\mu$ m)<br>PSE | 0.30-1.0 | 1.0-3.0 | 3.0-10  | Airflow Rate (CFM)          | [val 1] | [val 2] | [val 3] | [val 4] | [val 5] | *Max<br>Rated<br>Airflow |
| [value] | (%)               | [value]  | [value] | [value] | Initial Resistance<br>(IWC) | [value] | [value] | [value] | [value] | [value] |                          |

**Figure 1. Example of filter label in Title 20<sup>1</sup>**

The mandatory measures in the California Green Building Standards (Title 24, Part 11 or CALGreen) require that systems be sized in accordance with ACCA Manual D or equivalent methods (Division 4.5, 4.507.2). The Manual D process involves adding up the pressure losses from the cooling coil, filter, supply and return grilles, and other components, subtracting this sum from the manufacturer’s listed external static pressure at the required airflow to obtain the available static pressure, and sizing the ducts so they do not exceed this available pressure. Unfortunately, this requirement is enforced by only a few building departments. A reasonably well-designed system might have the pressure drops shown in Table 1 below. As in this example, the total external pressure drop for the furnace or air handler is equal to the sum of the component pressure drops at the design airflow rate.

<sup>1</sup> 2016 Appliance Efficiency Regulations. California Energy Commission. January 2017. <http://www.energy.ca.gov/2017publications/CEC-400-2017-002/CEC-400-2017-002.pdf>

**Table 1: Typical Residential System Pressure Losses**

| <b>Component</b>   | <b>Pressure Drop<br/>(inch w.c.)</b> |
|--------------------|--------------------------------------|
| Cooling Coil       | 0.25                                 |
| Filter             | 0.15                                 |
| Supply Grilles     | 0.03                                 |
| Return Grilles     | 0.03                                 |
| Ducts              | 0.24                                 |
| Total PD           | <b>0.70</b>                          |
| Design Furnace ESP | <b>0.70</b>                          |

### 4.3 Stakeholder Issues

Through pre-rulemaking workshops and docket postings, stakeholders have expressed the following concerns:

- The ability of systems with MERV 13 filters to meet proposed lower efficacy requirements.<sup>2</sup>
- The challenges of installing larger filter grilles needed for MERV 13 filters due to space limitations and higher cost.<sup>3</sup>
- Filter size limitations with ceiling-mounted air handlers designed for multifamily systems, including the inability of air handlers to accommodate two-inch filters and filters with sufficient face area to meet the velocity limits.<sup>4</sup>

The CASE Team has also found that while there is an ample selection of one-inch MERV 13 filters available in retail stores, no walk-in stores currently offer two-inch filters and they must be ordered through the store, or purchased online, typically in full box quantities.

### 4.4 Goals of Testing

The Title 20 requirement for filter labeling will not become effective until July 2019. There is limited data available on filter pressure drop characteristics. The CASE Team identified only one manufacturer, 3M Filtrete, that provides labels that meet the forthcoming requirement. Testing was initiated to develop pressure drop data on un-labeled filters, and as a verification of data provided in filter labels. The results can be used to determine whether the difference in pressure drop between one and two-inch deep filters is significant enough to justify making two-inch deep filters mandatory, to verify manufacturer ratings, and to assess whether stakeholder concerns about filter pressure drop requirements are supported by test data.

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<sup>2</sup> Meeting notes. 2019 Title 24 Part 6 Code Development Cycle Utility-Sponsored Stakeholder Meeting for Residential HVAC, Residential Indoor Air Quality (IAQ) and Nonresidential IAQ Measures. September 27, 2016. [http://title24stakeholders.com/wp-content/uploads/2016/12/2019T24-Utility-Stkhldr-Mtg-Notes\\_Res-HVAC-and-All-IAQ-final.pdf](http://title24stakeholders.com/wp-content/uploads/2016/12/2019T24-Utility-Stkhldr-Mtg-Notes_Res-HVAC-and-All-IAQ-final.pdf)

<sup>3</sup> Meeting notes. 2019 Title 24 Part 6 Code Development Cycle Utility-Sponsored Stakeholder Meeting for Residential and Nonresidential Indoor Air Quality. March 16, 2017. [http://title24stakeholders.com/wp-content/uploads/2017/07/2019-Utility-Sponsored-Stakeholder-Notes\\_IAQ\\_7.12.17.pdf](http://title24stakeholders.com/wp-content/uploads/2017/07/2019-Utility-Sponsored-Stakeholder-Notes_IAQ_7.12.17.pdf)

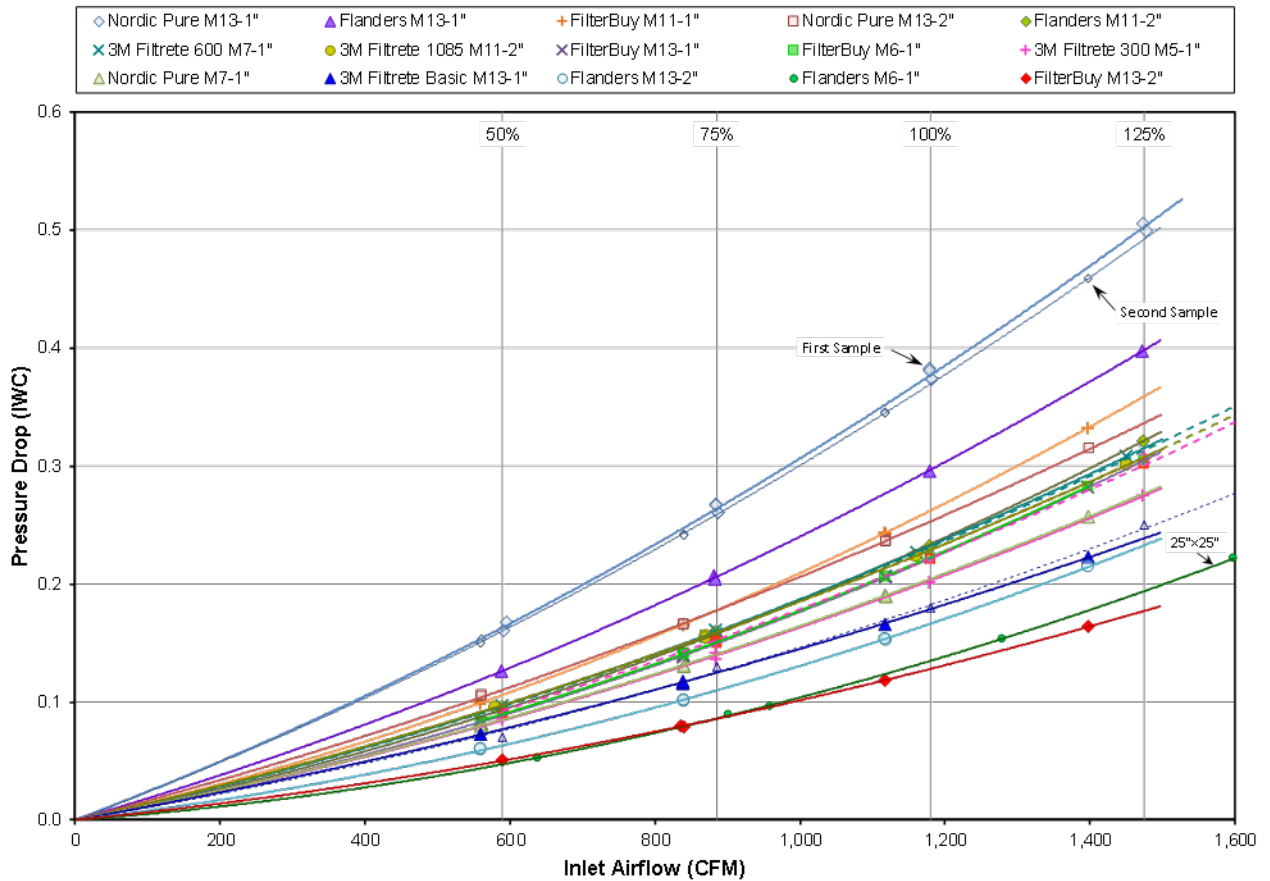
<sup>4</sup> California Building Industry Association Comments on Draft 2019 Building Energy Efficiency Standards. Docket number: 17-BSTD-01. October 13, 2017. [http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221506\\_20171013T163502\\_Robert\\_Raymer\\_PE\\_Comments\\_Draft\\_2019\\_Building\\_Energy\\_Efficiency.pdf](http://docketpublic.energy.ca.gov/PublicDocuments/17-BSTD-01/TN221506_20171013T163502_Robert_Raymer_PE_Comments_Draft_2019_Building_Energy_Efficiency.pdf)

## 5. Test Results

### 5.1 Pressure Drop vs. Airflow & Velocity

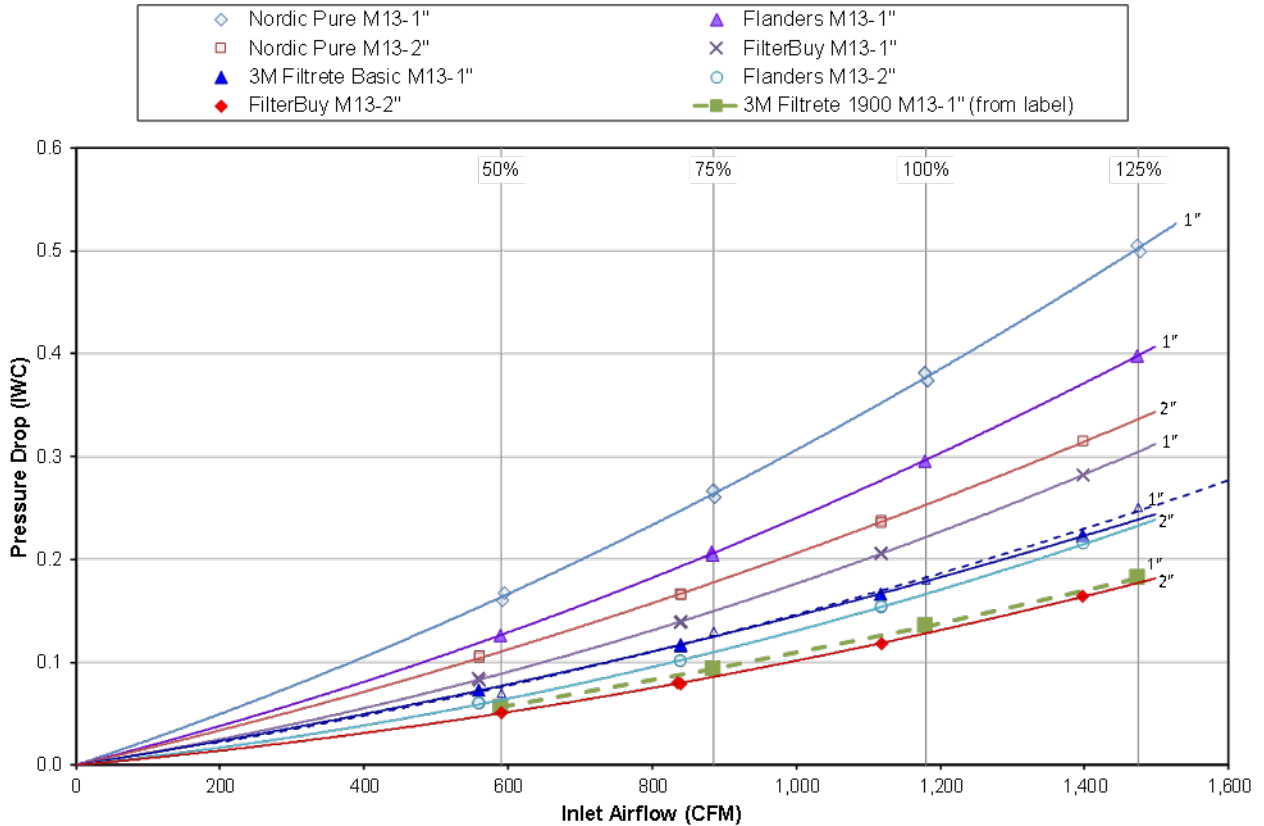
Figure 4 graphs the performance of all filters tested. The legend indicates the MERV rating and the filter depth (e.g., M13-2" is a two-inch deep MERV 13 filter).

The dotted lines are plots of manufacturer performance data and show reasonably good alignment with ATS lab test results. Tests of two Nordic Pure MERV 13 filters were completed with similar results. As with Table 2, the plot shows there is no direct correlation of MERV rating to pressure drop performance. For example, the MERV 7 Filtrete 700 curve is above the MERV 13 Filtrete Basic.



**Figure 2: Pressure drop versus airflow for all filters tested**

Figure 5 shows only the curves for MERV 13 filters. The MERV 13 Filtrete Basic filter tested is not one that is commonly available in retail stores, but can be ordered and has a lower price than the commonly available Filtrete 1900. For comparison, a curve fit of the label data from a Filtrete 1900 was included in the Figure 5 plot, which appears as the green dotted line. The curves in Figure 5 are also labeled to indicate the filter depth.



**Figure 3: Pressure drop versus airflow for only the MERV 13 rated filters**

## 5.2 Relevance of Test Results to Proposed Title 24, Part 6 Standards

In response to stakeholder concerns regarding the difficulty complying with lower efficacy requirements, referring to Table 1, if filter pressure drop is kept at or below 0.15 inch w.c., then a total external static pressure of 0.7 inch w.c. should be easily achieved. Referring to Figure 3, five of the eight MERV 13 filters tested are at or below 0.15 inch w.c. at a velocity of about 225 fpm. From prior ATS testing of furnaces and heat pumps, it was learned that they can comply with a 0.45 W/cfm standard at or below external static pressures of 0.7 inches w.c.<sup>5</sup> Thus, if designers and contractors comply with the CALGreen mandatory requirement for system sizing using Manual D or other methods, then this concern can be dismissed.

Regarding the perception that larger filter grilles will be needed for MERV 13 filters, Figure 2 clearly shows that filter pressure drop does not correlate to MERV rating, and that if filters are selected carefully using labelled pressure drop data, implementers should not encounter this problem.

The 45-Day Language proposed requirements for either providing a two-inch deep filter or maintaining a filter velocity of 150 fpm or less is not necessary and could be a hardship on the HVAC industry,

<sup>5</sup> See Appendix D of the Residential Quality HVAC Measures – Final CASE Report. CASE Revised December 2017, which is available here: [http://title24stakeholders.com/wp-content/uploads/2017/12/2019-T24-CASE-Report\\_Res-Quality-HVAC\\_Final\\_December-2017.pdf](http://title24stakeholders.com/wp-content/uploads/2017/12/2019-T24-CASE-Report_Res-Quality-HVAC_Final_December-2017.pdf).

especially for ceiling-mounted air handlers used in multifamily installations. Filter slots for many of these ceiling units are not designed for filters deeper than one inch and many, to conserve space, incorporate return air grilles in the air handler box rather than using ducted returns. Again, referring to Figure 3, all but three of the MERV 13 filters would meet the requirement for a pressure drop not to exceed 0.15 inch w.c. at a velocity of 225 fpm (or 900 cfm for the 24-inch by 24-inch filter size), so if they can meet the velocity limits then they could also meet the 0.15 inch w.c. pressure drop requirement in 150.0(m)12Biib.

Of the five filters shown in Figure 5 that fall at or below 0.15 inch w.c. static pressure at 225 fpm, three are one inch deep. This result does not support the requirement for two-inch filters, or the more rigorous requirements proposed for one-inch deep filters.