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FINAL STAFF REPORT

Update to Testing and Marking for Air Filters

2021 Appliance Efficiency Rulemaking for Air Filters

Docket Number 20-AAER-02

Gavin Newsom, Governor

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California Energy Commission

Alejandro Galdámez, P.E.
Primary Author

Alejandro Galdámez, P.E.
Project Manager

Ryan Radford
Supervisor
STANDARDS AND TOOLS UNIT

Pierre du Vair, Ph.D.
Manager
APPLIANCES OFFICE

Michael J. Sokol
Deputy Director
EFFICIENCY DIVISION

Drew Bohan
Executive Director

PREFACE

On March 14, 2012, the California Energy Commission (CEC) issued an order instituting rulemaking to begin considering standards, test procedures, labeling requirements, and other efficiency measures to amend the *Appliance Efficiency Regulations* (California Code of Regulations, Title 20, Sections 1601 through Section 1609). In this order, the CEC identified appliances with the potential to save energy, water or both. The goal of the rulemaking was to develop proposed appliance efficiency standards and measures to realize these savings opportunities.

On March 25, 2013, the CEC released an invitation to participate to provide interested parties the opportunity to inform the CEC about the products, markets, and industry characteristics of the appliances identified. The CEC reviewed the information and data received and hosted workshops May 28 through 31, 2013, to publicly vet this information.

On June 13, 2013, the CEC released an "invitation to submit proposals" to seek proposals for standards, test procedures, labeling requirements, and other measures to improve the efficiency and reduce the energy or water consumption of the identified appliances.

On May 13, 2015, the CEC adopted testing, marking, and certification requirements for air filters used in residential heating, ventilation, and air-conditioning systems.

On March 8, 2017, the CEC adopted emergency regulations to delay the effective date of labeling requirements for residential air filters after discovering that the testing protocol could not be implemented. On July 18, 2017, the CEC published a draft staff report discussing the proposed updates to the testing, certification, and marking requirements for air filters.

On August 3, 2017, the CEC held a staff workshop to review the staff report with interested parties and gather public comment.

The CEC adopted the emergency regulations on August 9, 2017. However, because the CEC did not complete a rulemaking to rectify the problems within one year, per the Emergency Rulemaking, the regulation officially reverted to the 2015 Title 20 California Code of Regulations, for air filters.

The CEC published a regulatory advisory stating that the certification and marking requirements contained in the regulation cannot be implemented and the problems identified will be addressed through a rulemaking process.

The CEC has reviewed all the information received. This report contains updates and adds information to rectify the regulations for air filters based, in part, on that information.

ABSTRACT

This report updates the testing and marking requirements to the air filter standards in the *Appliance Efficiency Regulations* (California Code of Regulations, Title 20, Section 1601 through Section 1609). The proposed updates are part of the 2020 Appliance Efficiency Rulemaking (Docket #20-AAER-02) and reflect the same conclusions for the cost-effectiveness and technical feasibility analysis. The updates to the regulatory language in this report assure an accurate and reliable certification and marking of residential air filters by manufacturers. It became clear to the California Energy Commission that manufacturers could not test and comply with the existing regulation because of the lack of clarity in the regulatory language. The regulations required testing small, medium, and large air filters without a clear definition making it hard for manufacturers to test and certify.

Staff proposes to amend the testing requirements for residential air filters, to update to the newest versions of the test procedures: American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers Standard 52.2-2017; and the Air-Conditioning, Heating, and Refrigeration Institute Standard 680 (I-P) — 2017 test procedure. The update will allow manufacturers to choose one size filter as a basic model for new certification requirements in Table X of Section 1606 of the California Code of Regulations, Title 20. Without these updates on testing, certification, and marking to the 2015 Title 20 California Code of Regulations for air filters, manufacturers are unable to certify because of the lack of clarity in the regulatory language. Additionally, the new regulations yield a product availability with the same baseline as the one discussed in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages* staff report.

Keywords: Appliance Efficiency Regulations, appliance regulations, energy efficiency, air filters.

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EXECUTIVE SUMMARY

This report presents updates to the existing 2015 regulations for air filters discussed in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages.* The updates clarify the certification requirements in Title 20 of the California Code of Regulations for air filters used in residential ducted forced-air heating and air-conditioning systems. These updates include the use of updated test procedures, certification, and labeling requirements. California Energy Commission staff understands that the lack of clarity on the sizing requirements in California Code of Regulations, Title 20, Section 1606 for air filters, prohibit manufacturers from certifying air filters. The updates presented in this staff report assure that manufacturers can certify air filters in a cost-effective and technically feasible manner.

Staff proposes to update the testing, certification, and marking requirements for air filters. Staff has modified the existing scope for air filters to clarify that only air filters for ducted systems are covered by the regulation. Staff also proposes to update the test procedures to the most recent iterations of the American National Standards Institute/American Society of Heating, Refrigerating and Air-Conditioning Engineers Standard 52.2-2017 and the Air-Conditioning, Heating, and Refrigeration Institute Standard 680 (I-P)-2017 test methods. Staff allows the size of the filter used for testing to be chosen by the manufacturer as the basic model for the filter family. The certification and marking requirements have been updated to specify requirements based on the test procedure used for testing. The testing, marking, and certification requirements were technically feasible and cost-effective when originally adopted in 2015, and these updates do not change the analyses discussed in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages* document.

CHAPTER 1:
Legislative Criteria

Section 25402(c)(1) of the Public Resources Code requires that the California Energy Commission (CEC) reduce the inefficient consumption of energy and water on a statewide basis by prescribing efficiency standards and other cost-effective measures[1] for appliances that require a significant amount of energy and water to operate. Such standards must be feasible and attainable and must not result in any added total cost to the consumer over the designed life of the appliance.

In determining cost-effectiveness, the CEC considers the value of the water or energy saved, the effect on product efficacy for the consumer, and the life-cycle cost of complying with the standard to the consumer. The CEC also considers other relevant factors including the effect on housing costs, the statewide costs and benefits of the standard over the lifetime of the standard, the economic impact on California businesses, and alternative approaches and the associated costs.

This report uses the same cost-effectiveness and technical feasibility assumptions originally presented in the 2015 report *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages*.[2] After the current regulations were circulated in 2015, the CEC discovered that it could not be implemented or enforced without modifications. This rulemaking addresses those concerns and proposed modifications to air filter testing, marking, and certification. Consequently, the appropriate baseline for both the cost-effectiveness and technical feasibility analysis is the same as the assessed one in the 2015 CEC staff analysis. The updated information in this report includes revised estimates of monetary savings and number of households in California. Rather than using 2015 nominal dollars, the updated information uses electricity and natural gas rates for 2019 to estimate savings in 2019 nominal dollars.

1 These include energy and water consumption labeling, fleet averaging, incentive programs, and consumer education programs.

2 Singh, Harinder, et al.; Staff Analysis of HVAC Air Filters, Dimming Flouorescent Ballasts, and Heat Pump Water Chilling Packages 2015, Page 1, https://efiling.energy.ca.gov/GetDocument.aspx?tn=203717&DocumentContentId=11534

CHAPTER 2:
Efficiency Policy

The Warren-Alquist Act[3] establishes the CEC as California's primary energy policy and planning agency. The act requires that the CEC reduce the wasteful and inefficient consumption of energy and water in the state by prescribing statewide standards for minimum levels of operating efficiency for appliances that consume a significant amount of energy or water.

For nearly four decades, California has regularly increased the energy efficiency requirements for new appliances sold and new buildings constructed in the state. Through the Appliance Efficiency Program, appliance standards have shifted the marketplace toward more efficient products and practices, reaping significant benefits for California's consumers. The state's Title 20 Appliance Efficiency Regulations, along with federal appliance standards encompassing a variety of appliance types, saved an estimated 34,707 gigawatt-hours (GWh) of electricity and 1,775 million therms in 2017 alone, resulting in about $8.26 billion in savings[4] to California consumers.[5] In the 1990s, the California Public Utilities Commission (CPUC) decoupled the utilities' financial results from direct energy sales, promoting utility support for efficiency programs. These efforts have reduced peak load needs by more than 8,645 megawatts (MW) and continue to save about 32,594 GWh per year of electricity.[6] The potential for additional savings remains by increasing the energy efficiency and availability of efficient appliances.

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3 The Warren-Alquist State Energy Resources Conservation and Development Act, Division 15 of the Public Resources Code, § 25000 et seq., https://ww2.energy.ca.gov/2020publications/CEC-140-2020-001/CEC-140-2020-001.pdf

4 Using current average electric power and natural gas rates of residential electric rate of $0.182 per kilowatt-hour, commercial electric rate of $0.159 per kilowatt-hour, residential natural gas rate of $1.206 per therm, and commercial natural gas rate of $0.846 per therm. This estimate does not incorporate any costs associated with developing or complying with appliance standards.

5 California Energy Commission. 2017 IEPR Workshops, Notices and Documents, Docket # 17-IEPR-01, https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2017-integrated-energy-policy-report/2017-iepr

6 California Energy Commission, *California Energy Demand 2016-2026 Revised Electricity Forecast,* January 2016, available at http://docketpublic.energy.ca.gov/PublicDocuments/15-IEPR-03/TN207439_20160115T152221_California_Energy_Demand_20162026_Revised_Electricity_Forecast.pdf

Although this regulation is not one which introduces an efficiency standard, it provides the necessary information, through database certification and labeling, for consumers to acquire an efficient air filter for heating, ventilation, and air conditioning (HVAC) systems. Since air filter accounts for 1 percent of the total efficiency of the HVAC system, CEC staff calculate a total energy savings of approximately 30 GWh/year of electricity and 5.5 million therms of natural gas.

CHAPTER 3:
Product Description

This report contains the following description presented in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages,* as no updates to this aspect of the rulemaking are necessary.[7]

Air filters remove particulates from the air stream in ducted forced-air heating or cooling systems in homes and businesses. The removal of particulates, such as dust, from the air stream protects HVAC systems from degradation. Air filters ensure the proper operation of HVAC systems by keeping internal components clean and free of particulate build up that lowers system efficiency, reduces reliability, and diminishes heat transfer.

Air Filters are typically placed in the return duct or adjacent to the air handler in an HVAC system, which promotes easy installation and maintenance. The air handler pulls air through the return duct and, consequently, through the filter. Air filters are made in a range of styles, materials, and sizes. They are generally one to four inches thick, made of polyester or fiberglass, and styled in a flat or pleated pattern.

Air filters use either mechanical filtration or electrostatic filtration to remove particulates from the air. Mechanical or surface media filtration is the capture of particulates through a dense fiber medium. Typically, the air filter media is pleated, allowing more surface area to capture debris. Electrostatic filtration uses electrostatic precipitation to remove particulates. Electrostatic precipitators charge particles and pull them out of the air stream. This can be done in a one- or two-stage system. In a one-stage system, a plate or other surface charges and attracts the particles. In a two-stage system, the particles are charged in the first stage as the particles flow past a set of charged wires or corona fields. The charged particles are then attracted to an oppositely charged plate or grounded media filter as the particles flow through Stage 2. Some air filter models in the market combine mechanical and electrostatic filtration.

There are two elements of air filter performance: (1) the effectiveness of particulate removal from the air, and (2) resistance to airflow (or pressure drop) across the filter. One measurement of the effectiveness of an air filter at removing particles from the air is particle size efficiency (PSE), which is the fraction or percentage of particles captured

7 Singh, et al. 2015 Staff Analysis, Page 1,
https://efiling.energy.ca.gov/GetDocument.aspx?tn=203717&DocumentContentId=11534

on an air filter. Particle size efficiency is measured across three particle-size bins: 0.3 to 1.0 micrometer (μm[8]), 1.0 to 3.0 μm, and 3.0 to 10.0 μm, as directed by either the test method in the American National Standards Institute (ANSI)/American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) 52.2 2017 Standard or the test method in Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 680 2017. When ANSI/ASHRAE 52.2 2017 is used to determine PSE, the measured values of PSE in each particle-size bin are then used to determine the Minimum Efficiency Reporting Value (MERV). MERV corresponds to a level of filtration performance ranging from 1 to 16, with higher numbers indicating an air filter that is more effective at capturing particles. Consumers need air filters with particulate removal performance to protect the efficiency of their HVAC systems.

Pressure drop across the air filter or resistance to airflow is the other aspect of air filter performance. As the air stream passes through the air filter, the static pressure decreases because of the resistance of the air filter. This static pressure difference is measured in inches of water column (IWC) at either a specific face velocity or a specific airflow rate. The pressure drops due to resistance to airflow through a new air filter is called the "initial resistance," and the resistance when the air filter is fully loaded with particulates is called the "final resistance." HVAC system designers need to know the initial pressure drop of an air filter to take that into account when sizing HVAC equipment and related ductwork. Air filters typically account for 20 to 50 percent of total HVAC system pressure drop, depending on the system configuration, filter efficiency, and loading condition.

When an HVAC system with a brushless permanent magnet blower motor is subjected to high static pressure, the motor controls increase motor speed to maintain system airflow. The increased motor speed causes a corresponding increase in power draw, resulting in an increase in energy consumption. When an HVAC system with a permanent split capacitor blower motor is subjected to high static pressure, the motor speed slows, and system airflow cannot be maintained. Although the reduced motor speed leads to lower power draw, the failure to maintain system airflow results in a drop in the cooling efficiency and cooling capacity of the system, which may result in a longer run time to cool or heat the ambient air to the set-point temperature of the thermostat. The overall effect can be an increase in energy use. Over time, excessive pressure drop can result in damage to furnaces from overheating, frozen condensing coils in air-conditioning units, and early failure of blower motors. Consumers need the ability to purchase replacement air filters with pressure drop performance that matches

[8] A (μm) micrometer is a unit of measure for length equal to 0.001mm, or about 0.000039 inch.

HVAC system specifications to run the system efficiently and prevent equipment damage.

CHAPTER 4:
Regulatory Approaches

Federal Regulations

There are no U.S. Department of Energy (DOE) standards or test procedures for air filters. There are no Federal Trade Commission labeling requirements for air filters.

California Regulations

Effective July 1, 2014, the 2013 Building Energy Efficiency Standards (Energy Code) in Title 24, Part 6 of the California Code of Regulations began requiring the installation of air filters in newly constructed homes and certain alterations to residential HVAC systems, which were marked by the manufacturer to indicate particulate filtration efficiency and pressure drop. On or after July 1, 2016, air filters sold or offered for sale in California must be certified to the CEC and marked by the manufacturer to indicate particulate filtration efficiency and pressure drop. These Title 20 regulations were intended to harmonize with, and complement, the Energy Code in Title 24.

In fall 2016, the CEC learned that manufacturers of air filters were concerned about the testing requirements. The regulations were meant to provide manufacturers flexibility when conducting required tests; however, manufacturers lacked information on how to identify and select which air filters sizes were required to be tested. Further, manufacturers were unclear how to apply the test results from the small, medium, and large air filters to the rest of the manufacturers' air filters in the same product family. The lack of an industry standard or accurate method to scale test results to different filter sizes made it impossible for manufacturers to consistently comply with the testing, marking, and certification requirements for air filters. These concerns were not raised during the original rulemaking and became evident after the regulations were adopted. The regulations need to be more specific with respect to different air filter sizes needed for testing and certification

On August 9, 2017, the CEC adopted emergency regulations to change the effective date by which air filters sold or offered for sale in California must comply with testing, marking, and certification requirements. The effective date was delayed from July 1, 2016, to the new effective date of April 1, 2019. This compliance delay provided the CEC time to collaborate with stakeholders to study, address, and resolve manufacturers' concerns with the existing testing requirements, while allowing manufacturers to continue to supply air filters to the California market. The rulemaking clarifying the test, certification, and labeling requirements was not completed within the allotted time frame of one-year, and as a result, the standard reverted back to the original regulation. This report clarifies test, certification, and labeling requirements that are the basis for a new rulemaking.

Staff has determined that it is necessary to develop modifications to the regulations to address manufacturers concerns about the current air filter requirements. This report discusses proposed updates to the testing, certification, and marking requirements to allow manufacturers flexibility when conducting the required tests for certification. Although this report adds more reporting fields for certification and marking, it does not add complexity that will increase the calculated costs previously asserted in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages.*[9]

Test Methods

Two test procedures are allowed under the existing air filter regulations — AHRI 680-2009 and ASHRAE 52.2-2012. There are numerous similarities between the two test procedures; however, a value for MERV can be determined only when using ASHRAE 52.2. Electronic air filters must use AHRI 680 because those filters are incompatible with the conductive loading dust used in ASHRAE 52.2. Updated versions of both test procedures have been published, and staff proposes to amend existing regulations to allow use of the most current versions of the test procedures. This report updates the versions of the test procedures to AHRI Standard 680 (I-P) 2017 Standard for Performance Rating of Residential Air Filter Equipment and ANSI/ASHRAE Standard 52.2-2017 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

9 Singh, et al. 2015 Staff Analysis, Page 1, https://efiling.energy.ca.gov/GetDocument.aspx?tn=203717&DocumentContentId=11534

CHAPTER 5:
Proposal and Alternative

Staff analyzed the available information on air filters from the initial rulemaking record that established the air filter requirements. This information was supplemented with stakeholders' comments and communications made after the initial rulemaking. The proposal is focused on addressing concerns raised by stakeholders because of vague language on different sizes of air filters needed for testing to comply with existing regulations. Stakeholders did not offer any alternatives beyond an update to the test procedures. Staff was not able to identify alternatives to the proposal, other than delay adoption of proposed regulatory amendments.

Existing regulation for air filters contains ambiguous language which creates the inability of manufacturers to implement testing, certification, and marking requirements for air filters. The primary concern raised by manufacturers is that the "air filter size tested" specified in Title 20, California Code of Regulations, Section 1606, Table X is too vague. This ambiguity complicates not only manufacturers' ability to comply, but the CEC's ability to enforce the requirements. This in turn negatively impacts consumers' access to legally certified residential air filters for home systems. Although manufacturers are still producing and selling air filters in California, the CEC and the public lack access to important information.[10] In addition, since the tested air filter size is not clear, it allows manufacturers to randomly choose a size, making it difficult to compare filters from different manufacturers. This is counter to the intent of Appliance Efficiency Regulations presented in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages*.[11]

Proposed Regulation:

Staff is proposing regulatory amendments to address the concerns expressed by manufacturers regarding the testing, certification, and marking requirements for air filters. This report and the proposed updates to the regulations will clarify the testing, certification, and marking requirements for air filters. The proposed regulations provide

10 Thomson Reuters Westlaw, California Code of Regulations, Title 20, §1606 Filing by Manufacturers; Listing of Appliances in the MAEDbS, https://govt.westlaw.com/calregs/Document/I92986F7849F94E5FBB7CC8BC8A72F338?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)

11 Singh, et al. 2015 Staff Analysis, Page 1, https://efiling.energy.ca.gov/GetDocument.aspx?tn=203717&DocumentContentId=11534

consumers with information regarding replacement air filter pressure drop performance. This information allows the consumer to better match a replacement air filter with an HVAC system specification to run the system efficiently and prevent equipment damage.

Alternative 1: Further Delay of the Compliance Date

Staff considered further delay of compliance and enforcement with the existing regulations.[12] However, this alternative would not address the concerns expressed by manufacturers regarding ambiguity of the testing, certification, and marking requirements for air filters. Therefore, staff rejected this alternative as a viable solution to remedy concerns with the existing regulations.

12 Notice of Approval of Emergency Regulatory Action, https://efiling.energy.ca.gov/GetDocument.aspx?tn=216719&DocumentContentId=26622

CHAPTER 6:
Proposed Regulations Updates for Air Filters

Staff has determined it is necessary to develop amendments to the air filters regulations to properly address testing, certification, and labeling requirements. Staff recommends modifications to clarify air filter testing, certification, and labeling, and the rationale for those modifications is below.

Scope and Definitions

The scope of the air filter requirements in the Energy Code is limited to ducted systems, but the scope of the requirement in the Appliance Efficiency Regulations is not limited to ducted systems. Because the requirements are meant to be complementary, staff proposes to align the scope of the Appliance Efficiency Regulations with that of the Energy Code by defining air filters as those that are "designed for installation in residential ducted forced-air heating or cooling systems."

Staff recommends adding a definition for the basic model air filter to simplify manufacturer identification of air filters that are required to be tested. The definition for basic model of an air filter is based on air filters with the same filter media type, pleat characteristics (pleat depth and spacing), and construction (pleat support and frame pattern), and will have the same pressure drop when operating at the same face velocity, even when the filters have different face areas.

Test Methods

To be consistent with industry practices and the Energy Code, staff recommends updating the allowable test methods to the current version, specifically:

> AHRI Standard 680 (I-P) 2017 Standard for Performance Rating of Residential Air Filter Equipment (AHRI 680-2017)
>
> ANSI/ASHRAE Standard 52.2-2017 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (ANSI/ASHRAE 52.2-2017)

Staff recommends testing be required only for the basic model of air filter instead of small, medium, and large filters for each grade as required in the current regulations. For filters that are represented by the basic model, meaning those with the same depth and construction but different face areas, the pressure drop should be identical when the filters are operated at identical face velocity. The air flow rate is the product of the face velocity multiplied by the face area. It is possible to develop a scaling method that allows manufacturers to mark an air filter based on the test results of the basic model. Use of this method would reduce a manufacturer's testing requirements without degrading the quality of the information marked on the air filter. As a result, staff

recommends that manufacturers only be required to test one of each basic model air filter. In the draft staff report, staff proposed that the tested air filter shall be as close as possible to 24 inches wide by 24 inches long. Although staff recommends that manufacturers follow this guidance, the proposed regulatory language clarifies that the choice of air filter size to test is at the discretion of the manufacturer. Manufacturers can also voluntarily test additional filters with other dimensions to gather more accurate data.

Certification

The Appliance Efficiency Regulations require air filter certification to the CEC for tested products. Because staff recommends requiring manufacturers to test one basic model of air filter, only the basic model air filter is required for the certification of the entire air filter family. Staff recommends minor modifications to the required certification data for air filters identified in Section 1606 Table X, including a required calculation for the air flowrate at 0.1 inches of water column calculated by using the least squares method using test procedure data. These modifications are consistent with the use of the basic model of an air filter and with the AHRI 680-2017 and ANSI/ASHRAE 52.2-2017 test methods.

The method of least squares is a standard approach in regression analysis to approximate the solution of overdetermined systems by minimizing the sum of the squares of the residuals made in the results of every single equation.[13] It is used to predict the behavior of dependent variables. The most important application is in data fitting. It is a method that creates a representative mathematical equation that best fits the results of the data at hand and as such, it can be used to predict a result from conditions not tested but that lie within the data set.

Marking of Appliances and Effective Date

The Appliance Efficiency Regulations will be updated to require each unit of air filter, manufactured on or after the designated effective date that are sold or offered for sale in California, be marked with specific information as described in Chapter 10, Table X, of this report. The marking on the air filter must be either visible through the packaging or the packaging must be marked with the same information. Manufacturers may include additional information on the air filter, packaging, or associated equipment, as long as it does not conflict with the required marking on the air filter. The marking

13 The Method of Least Squares, Steven J. Miller, Mathematics Department Brown University, https://web.williams.edu/Mathematics/sjmiller/public_html/BrownClasses/54/handouts/MethodLeastSquares.pdf

requirements apply to air filters sold at retail stores, as well as air filters sold in distributor packs for end use in California.

For air filters that are the basic model and are tested, the resulting test data shall be used as the information required for marking the air filter. For air filters that are not tested, but instead use the scaling method discussed below, the marking information shall be based on the test data for an air filter of the same basic model that has been tested in accordance with Table X (Chapter 10). The scaling method was previously discussed in the "Test Methods" portion of this chapter.

For non-tested air filters, or calculated from basic model, the marking is based on the scaling of a tested basic model using:

- ANSI/ASHRAE 52.2-2017. Staff proposes that the airflow rate values correspond to the airflow rate values from a tested air filter of the same basic model, multiplied by the face area of the non-tested filter and divided by the face area of the tested air filter. The face velocity, particle size efficiency, initial resistance values, and MERV are the same for the tested and non-tested air filter models.
- AHRI 680-2017. Staff proposes that the non-tested airflow rate values correspond to the airflow rate values from a tested air filter of the same basic model, multiplied by the face area of the non-tested filter being marked, and divided by the face area of the tested air filter. The face velocity, particle size efficiency, and initial resistance values are the same for the tested and non-tested air filter models.

CHAPTER 7:
Technical Feasibility

The technical feasibility analysis presented in the 2015 report *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages* continues to apply and is referenced herein.[14] This staff report does not propose any modifications that negatively impact the technological feasibility of the testing, certification, and marking requirements. This staff report proposes to reduce the number of air filters required to be tested by allowing scaling of tested data from one air filter to air filters of different face area but with the same depth and construction. The staff report also proposes a scaling method to ensure a consistent approach to scaling is used by manufacturers. The reduced testing requirements and standardized scaling method serve to increase the technological feasibility of the air filter requirements in the Appliance Efficiency Regulations.

14 Singh, et al. 2015 Staff Analysis, Page 1,
https://efiling.energy.ca.gov/GetDocument.aspx?tn=203717&DocumentContentId=11534

CHAPTER 8:
Savings and Cost Analysis

Economic Impacts

This report used the same assumptions presented in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages* (2015 Staff Analysis).[15] The CEC updated the number of total households in California with data from the Department of Finance using the same breakdown percent of type of households presented in the 2015 Staff Analysis. Staff understands that the ambiguity of the current regulations makes it difficult for manufacturers to certify and the CEC to enforce. Because existing regulations could not be implemented, there has been no enforcement of the current regulation. Air filters continue to be sold or offered for sale in California as they were manufactured before the existing regulations were adopted. For this reason, the baseline assumptions remain unchanged.

Using the same assumptions as the 2015 Staff Analysis in combination with new 2020 total number of households it was calculated to provide an annual energy savings of nearly 38 GWh and 6.1 million therms after full stock turnover, **Table 8-1,** of air filters in residential ducted forced-air heating and cooling systems.[16] The analysis determined the annual state monetary savings to be approximately $13.7 million with annual costs or approximately $3.2 million. Annual net statewide benefits were determined to be approximately $10.5 million.

15 Singh, et al. 2015 Staff Analysis, Page 1,
https://efiling.energy.ca.gov/GetDocument.aspx?tn=203717&DocumentContentId=11534

16 Ibid

Table 8-1: Baseline Monetary Savings

	Electric kWh/yr	**Gas** Therms/yr
Total Energy Consumption	7,603,047,301	1,218,792,750
Noncompliance %	50%	50%
Energy Savings %	1%	1%
Total Energy Savings	38,015,237	6,093,964
$/kWh	0.1497	
$/Therm		1.31
Annual Total	$5,690,880.90	$7,983,092.51

Annual Total Monetary Savings: $13,673,973.42

Source: CEC from Table A-1 of Appendix A

The *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages* shows the cost of implementing an air filter label requirement includes initial design, printing plates, production line adjustments, ink, and adhesive labels. Spreading these costs across the large number of air filters manufactured and sold each year, the manufacturer 3M characterized the incremental cost of air filter labeling as zero or near zero in its proposal.[17] The California investor-owned utilities (IOU) characterized the incremental cost as $0.02 per filter in its proposal with the use of manufacturer information.[18] Assuming a 50 percent markup for a commoditized label, the CEC used $0.03 as the incremental cost per filter.

Household costs presented in this report used the same determination presented in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages* which determined a cost of $0.075 per year based on two filter

17 3M response to Invitation to Submit Proposal, July 29, 2013, https://efiling.energy.ca.gov/GetDocument.aspx?tn=71785&DocumentContentId=8242

18 Air Filter Testing, Listing, and Labeling CASE initiative, Analysis of Standards Proposal for Air Filter Testing, Listing, and Labeling, https://efiling.energy.ca.gov/GetDocument.aspx?tn=71764&DocumentContentId=8239

changes per year, an average of 1.25 filters per residential HVAC system, and an incremental cost per filter of $0.03.[19] Household monetary savings per household were determined to be $1.49 per year and a monetary cost per household of $0.19 per year resulting in an annual net benefit $1.30 per household.

CEC staff recalculated the net benefit using 2020 electricity and natural gas rates to reflect current savings. The updated analysis does not deviate from the assumptions used in the *Staff Analysis of HVAC Air Filters, Dimming Fluorescent Ballasts, and Heat Pump Water Chilling Packages*.[20] For example, staff used the same assumption that 50 percent of HVAC systems in California are using filters with excessive pressure drop, reducing the associated efficiency, and therefore increasing the electric energy being used. Taking in consideration the increase in the total number of households in California, the updated energy savings are approximately 38 GWh and 6.1 million therms after full stock turnover. Staff updated estimates of monetary savings using 2020 rates for electricity and natural gas, which increased the annual savings to approximately $13.7 million. The total cost is estimated to be $3.2 million a year.[21]

Household costs remained at approximately $0.08 per year based on two filter changes per year, an average of 1.25 filter per residential HVAC system, and an incremental cost per filter of $0.03. Household net benefits were calculated to approximately $0.63 per household, resulting in a statewide annual net benefit of $10.5 million, **Table 8-2**.

Table 8-2 Annual Benefit

	Per Household	State
HVAC Systems with Filters		16,828,753
Annual kWh Savings	2.26	38,015,237
Annual Therm Savings	0.36	6,093,964
Monetary Savings	$0.81	$13,673,973.42
Monetary Costs	$0.19	$3,155,391.12
Annual Net Benefit	$0.63	$10,518,582.30

Source: CEC Staff

19 Ibid

20 Ibid

21 Ibid

Fiscal Impact

State:

Using the average cost from the procurement data collected from Cal-eProcure for 2020, it is estimated that the proposed regulation may have a state fiscal impact, **Table 8-3,** of $1,748.07.[22] Please note that the data used for this estimate is only reflective of that State of California and not local governments, however, while CEC was unable to determine the fiscal costs to local agencies, the CEC assumes similar fiscal impacts.

Table 8-3: CA State Fiscal Impact

Units	Total Cost	Average price per unit ($)	Incremental Cost	State Fiscal Impact
58,269	$554,700.18	$9.52	$0.03	**$1,748.07**

Source: CEC Staff

Local Government:

To calculate the fiscal impact for local governments, CEC used data from the California State Controller's Office to calculate the number of employees per local government since HVAC systems are design based on occupancy.[23] The total number of local government employees is of 2,016,3334, which is 7.78 times more than the number of people employed by the State of California (259,255). Using this percentage to calculate the fiscal impact for all local government offices will be around $13,600.

22 Fi$Cal SCPRS Search, Description=PLEATED FILTER, from 01/01/2020 to 12/31/2020.
23 Government Compensation in California, California State Controller Betty T. Yee, https://publicpay.ca.gov/

CHAPTER 9:
Environmental Impacts

No Adverse Environmental Impacts

The proposed modification to the current air filters efficiency standards and marking requirements would apply only to air filters manufactured on or after the effective date of the proposed standard. The updated standards would not cause additional waste, as it does not require replacement earlier than the normal product life cycle of the air filter. The updated standards do not require the use of any specific materials to improve the efficiency and do not require any redesign of the air filter at all. Savings are derived from improving air filter markings and selection by consumers. Therefore, CEC staff could not identify any adverse environmental impacts associated with the proposed update to the current air filters efficiency standards.

Benefits

The proposed modification to the existing standards will allow manufacturers to certify all sizes of air filters to the CEC. The modification will also enable consumers to purchase the correct air filter that is compatible with ducted forced-air heating or cooling systems.

The proposed modification to the current air filter standards will lead to improved efficiency of HVAC systems for California residents, as well as energy and energy bill savings. This energy savings translates to fewer power plants built and less pressure on the limited energy resources, land, and water use associated with energy production. In addition, lower electricity consumption results in reduced greenhouse gas and criteria pollutant emissions, primarily from lower generation in hydrocarbon-burning power plants, such as natural gas power plants.

CHAPTER 10:
Proposed Regulatory Language

Proposed language appears as underline and deletions appear as ~~strikeout.~~ Existing language appears as plain text. Three dots or "…" represent the substance of the regulations that exists between the proposed language and current language.

§ 1601. Scope

This Article applies to the following types of new appliances, if sold or offered for sale in California, except those sold wholesale in California for final retail sale outside the state and those designed and sold exclusively for use in recreational vehicles, or other mobile equipment. Unless otherwise specified, each provision applies only to units manufactured on or after the effective date of the provision.

NOTE: For the applicability of these regulations to appliances installed in new building construction, see sections 110.0 and 110.1 of part 6 of Title 24 of the California Code of Regulations.

…[skipping (a) and (b)]

(c) Central air conditioners, which are electrically powered unitary air conditioners and electrically powered unitary heat pumps, except those designed to operate without a fan; and gas-fired air conditioners and gas-fired heat pumps, air filters ~~for residential buildings for use in forced-air heating or forced-air cooling equipment~~, and heat pump water-heating packages.

…[skipping "(d) Portable air conditioners, evaporative coolers…", through end of section]

Note Authority cited: Section 25213, 25218(e), 25402(a)-25402(c), and 25960, Public Resources Code; and sections 16, 26, and 30, Governor's Exec. Order No. B-29-15 (April 1, 2015).

Reference: Section 25216.5(d), 25402(a)-25402(c), 25402.5.4, and 25960, Public Resources Code; and section 16, Governor's Exec. Order No. B-29-15 (April 1, 2015).

§ 1602. Definitions

…[skipping (a) and (b)]

(c) Air Conditioners, Air Filters, and Heat Pump Water-Heating Packages.

…[skipping "Air Conditioner" and "Air-cooled air conditioner"]

"Air filter" means an air-cleaning device ~~installed in forced-air heating or cooling equipment and~~ used for removing particulate matter from the air and designed for installation in residential ducted forced-air heating or cooling systems.

…[skipping "Air filter depth" to "Air-source heat pump"]

"Basic model" of an air filter means all units of a given type of air filter with the same depth and the same construction, including type and grade of air filter media, pleat spacing, pleat height, pleat support, and filter frame pattern. The "basic model" of an air filter includes air filters with different filter face areas.

…[skipping "Basic model" of a federally regulated central air… to "Maximum rated airflow rate"]

"Minimum efficiency reporting value (MERV)" of an air filter means the composite particle efficiency metric defined in ANSI/ASHRAE Standard 52.2-~~2012~~2017.

…[skipping "Multi-head mini-split system" to "Particle size"]

"Particle size efficiency" of an air filter also known as "particle size removal efficiency" means the fraction (percentage) of particles that are captured on the air filter. Particle size efficiency is measured in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (µm). Particle size efficiency is abbreviated as "PSE" in the required ~~labels~~marking for air filters.

…[skipping "Premium motor"]

"Pressure drop" of an air filter means the drop in static pressure versus air flow rate across air filter media in the forced-air heating or cooling ~~equipment~~system.

…[skipping "Room air conditioner" through (x)"Landscape Irrigation Equipment"]

The following documents are incorporated by reference in Section 1602.

…[skipping FEDERAL STATUTES AND REGULATIONS to ADOBY SYSTEMS INCORPORATED]

Number	*Title*

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASHRAE Standard 52.2-2017

Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

…[skipping ANSI C78.1-1991 (R1996) to end of section]

Note: Sections 25213, 25128(e), 25402(a)-25402(c) and 25960, Public Resources Code; and sections 16, 26 and 30, Governor's Exc. Order No. B-29-15 (April 1, 2015). Reference: Sections 25216.5(d), 25402(a)-25402(c), 25402.5.4 and 25960, Public Resources Code; and section 16, Governor's Exec. Order No. B-29-15 (April 1, 2015).

§ 1604. Test Methods for Specific Appliances.

…[skipping (a) and (b)]

(c) Central Air Conditioners, Air Filters, and Heat Pump Water-Heating Packages.

...[skipping (1) and (2)]

(3) Air Filters.

(A) The test methods for air filters are shown in Table C-2. Manufacturers shall test each basic model of air filter at dimensions determined by the manufacturer.

Table C-2: Air Filter Test Methods

Appliance Performance Criteria	**Test Method**
Air Filter Pressure Drop	~~AHRI 680-2009*~~ AHRI Standard 680 (I-P)-2017* or ~~ANSI/ASHRAE Standard 52.2-2012~~ ANSI/ASHRAE Standard 52.2-2017
Minimum Efficiency Reporting Value (MERV)	~~ANSI/ASHRAE Standard 52.2-2012~~ANSI/ASHRAE Standard 52.2-2017
Air Filter Particle Size Efficiency	~~AHRI 680-2009*~~ AHRI Standard 680 (I-P)-2017* or ANSI/ASHRAE Standard 52.2-2017 ~~ANSI/ASHRAE Standard 52.2-2012~~
Dust Holding Capacity	~~AHRI 680-2009*~~AHRI Standard 680 (I-P)-2017* or ANSI/ASHRAE Standard 52.2-2017 ~~ANSI/ASHRAE Standard 52.2-2012~~
* MERV not reportable for models being tested to AHRI Standard 680 (I-P)-2017 ~~AHRI 680-2009~~ only.	

(B) The following procedure shall be used to calculate the airflow rate value in cubic feet per minute at an initial resistance pressure difference of 0.1 inches water column:

1. The value or airflow rate at an initial resistance of 0.1 inches water column shall be determined from a least-squares fit to airflow rate in cfm, as a function of initial resistance static pressure difference in inches water column, using:

$Q = C \times dP^n$, where Q=airflow rate in cfm, dP=initial resistance pressure difference in inches water column, and C and n are the coefficients determined in the least squares fit.

2. The data used for this fit shall be the following ordered pairs: (0,0), (initial resistance value 1, airflow rate value 1), (initial resistance value 2, airflow rate value 2), (initial resistance value 3, airflow rate value 3), (initial resistance value 4, airflow rate value 4), (initial resistance value 5, airflow rate value 5 (only applicable when using the ANSI/ASHRAE Standard 52.2-2017 test procedure))

3. The value for airflow rate at an initial resistance of 0.1-inch water column shall be calculated as: $Q = C \times 0.1^n$

~~Manufacturers shall test small, medium, and large size filters for each grade.~~

…[skipping (c)(4) through (x)]

The following documents are incorporated by reference in Section 1604.

Number	*Title*

…[skipping FEDERAL TEST METHODS and UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (EPA)]

AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE (AHRI)

AHRI ~~680-20092009~~Standard 680 (I-P)-2017

~~2009~~2017 Standard for Performance Rating of Residential Air Filter Equipment

…[skipping the rest of AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE (AHRI)]

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASHRAE Standard 52.2-2017

Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

...[skipping the rest of AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI) through AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)]

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

~~ASHRAE 52.2-2012~~

~~Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size~~

…[skipping ANSI/ASHRAE 118.2-1993 to end of section]

Note: Authority cited: Section cited: Sections 25213, 25218(e), 25402(a)-25402(c) and 25960, Public Resources Code; and section 16, 26 and 30, Governor's Exec. Order No. B-29-15 (April 1, 2015. Reference: Sections 25216.5(d), 25402(a)-25402(c) and 25960, Public Resources Code; and section 16, Governor's Exec. Order No. B-29-15 (April 1, 2015).

§ 1606. Filing by Manufacturers; Listing of Appliances in Database.

(a) Filing of Statements.

Each manufacturer shall electronically file with the Executive Director through the MAEDbS a statement for each appliance that is sold or offered for sale in California. The statement shall contain all the information described in paragraphs (2) through (4) of this subsection and shall meet all of the requirements of paragraph (1) of this subsection and all other applicable requirements in this Article.

The effective dates of this section shall be the same as the effective dates shown in section 1605.1, 1605.2 or 1605.3 of this Article for appliances for which there is an energy efficiency, energy consumption, energy design, water efficiency, water consumption, or water design standard in section 1605.1, 1605.2, or 1605.3 of this Article. For appliances with no energy efficiency, energy consumption, energy design, water efficiency, water consumption, or water design standard in section 1605.1, 1605.2, or 1605.3 of this Article, the effective date of this section shall be one year after they are added to section 1601 of this Article, unless a different effective date is specified.

EXCEPTIONS to Section 1606(a) of this Article: Section 1606(a) of this Article is not applicable to:

1. external power supplies,

2. small electric motors,

3. á la carte chargers meeting the EXCEPTON noted in section 1605.3(w)(2) of this Article, or

4. general service lamps

(1) General Rules.

…[skipping (A) to (H)]

(I) Air Filters. The statement for air filters shall be for each basic model of air filter tested under section 1604(c)(4) of this Article.

...[skipping (a)(2) through (a)(3)(D)]

Table X: Data Submittal Requirements

…[skipping "All Appliances" to B "Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps"]

C	Air Filters manufactured on or after ~~April 1, 2019~~December 1, 2022	~~Air filter sizes tested~~	~~Small, medium, and large~~
		~~Minimum Efficiency Reporting Value (MERV) (reportable for models tested to ASHRAE 52.2-2012 only)~~	~~1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, N/A~~
		~~Particle Size Efficiency for 0.3 to 1.0 µm particle size~~	
		~~Particle Size Efficiency for 1.0 to 3.0 µm particle size~~	
		~~Particle Size Efficiency for 3.0 to 10.0 µm particle size~~	
		~~Test Procedure used to determine air filter efficiency performance~~	~~AHRI 680-2009, or ASHRAE 52.2-2012~~
		~~Air Filter Length~~	
		~~Air Filter Width~~	

		~~Air Filter Depth~~	
		~~Air Filter Face Area~~	
		~~Face Velocity Utilized for the test procedure~~	~~Value in feet per minute or N/A~~
		~~Airflow Rate value 1~~	
		~~Airflow Rate value 2~~	
		~~Airflow Rate value 3~~	
		~~Airflow Rate value 4~~	
		~~Airflow Rate value 5 Maximum Rated Airflow Rate~~	
		~~Initial Resistance at air flow rate value 1~~	~~Test results to one-hundredths of an Inch of Water Column~~
		~~Initial Resistance at airflow rate value 2~~	~~Test results to one-hundredths of an Inch of Water Column~~
		~~Initial Resistance at airflow rate value 3~~	~~Test results to one-hundredths of an Inch of Water Column~~
		~~Initial Resistance at airflow rate value 4~~	~~Test results to one-hundredths of an Inch of Water Column~~
		~~Initial Resistance at airflow rate value 5~~	~~Test results to one-hundredths of an Inch of Water Column~~
		~~Final Resistance at the point where test is terminated, and results determined~~	~~Test results to one-hundredths of~~

			~~an Inch of Water Column~~
		~~Dust Holding Capacity at the maximum rated airflow rate as published by the manufacturer~~	~~Test results in multiples of one gram.~~
		~~Airflow Rate value determined at an Initial Resistance of 0.1 Inch of Water Column~~	
		Length of tested air filter (inches)	
		Width of tested air filter (inches)	
		Depth of tested air filter (inches)	
		Face Area of tested air filter (square inches)	
		Test Procedure used	AHRI Standard 680 (I-P)-2017, ANSI/ASHRAE Standard 52.2-2017
		Face Velocity Utilized for the test procedure (feet per minute)	
		Minimum Efficiency Reporting Value (MERV) (if ANSI/ASHRAE Standard 52.2-2017 was used)	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16
		Particle Size Efficiency for 0.3 to 1.0 µm particle size (percentage)	
		Particle Size Efficiency for 1.0 to 3.0 µm particle size (percentage)	
		Particle Size Efficiency for 3.0 to 10.0 µm particle size (percentage)	
		Airflow Rate value 1 (cubic feet per minute)	
		Airflow Rate value 2 (cubic feet per minute)	

		Airflow Rate value 3 (cubic feet per minute)	
		Airflow Rate value 4 (cubic feet per minute)	
		Airflow Rate value 5 (cubic feet per minute) (Maximum Airflow Rate if ANSI/ASHRAE Standard 52.2-2017 was used)	
		Calculated Airflow Rate value at an Initial Resistance of 0.1 inches water column (cubic feet per minute)[7]	
		Initial Resistance at air flow rate value 1 (inches water column)	
		Initial Resistance at airflow rate value 2 (inches water column)	
		Initial Resistance at airflow rate value 3 (inches water column)	
		Initial Resistance at airflow rate value 4 (inches water column)	
		Initial Resistance at airflow rate value 5 (inches water column) (if ANSI/ASHRAE Standard 52.2-2017 was used)	
		Final Resistance at the point where test is terminated, and results determined (inches water column)	
		Dust Holding Capacity at the maximum rated airflow rate as published by the manufacturer (grams)	

…[skipping C All Central Air Conditioners… through end of Table X...]

The following documents are incorporated by reference in Section 1606.

…[skipping CALIFORNIA ENERGY COMMISSION through FEDERAL STATUTES AND REGULATIONS]

Number *Title*

AIR-CONDITIONING, HEATING, AND REFRIGERATION INSTITUTE (AHRI)

AHRI Standard 680 (I-P)-2017

2017 Standard for Performance Rating of Residential Air Filter Equipment

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/ASHRAE Standard 52.2-2017

Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size

…[skipping NATIONAL ELECRTICAL MANUFACTURER'S ASSOCIATION (NEMA) through the end of section]

Note: Authority cited: Sections 25213, 25218(e), 25402(a)-25402(c) and 25960, Public Resources Code; and sections 16, 26 and 30, Governor's Exec. Order No. B-29-15 (April 1, 2015). Reference: Sections 25216.5(d), 25402(a)-25402(c), 25402.5.4 and 25960, Public Resources Code: and section 16, Governor's Exec. Order No. B-29-15 (April 1, 2015).

§ 1607. Marking of Appliances.

…[skipping (a) through (c)]

(d) Energy Performance Information.

...[skipping (1) through (10)]

~~(11) Air Filters. Each unit of air filters manufactured on or after April 1, 2019 shall be marked, permanently and legibly, on an accessible and conspicuous place on the edge of the filter itself or on the pleats, in characters of font size 12, with the information specified in either section (A) or (B) below as applicable to the air filter model:~~

~~(A) Air filters for which the reported information is determined in accordance with the AHRI standard 680-2009 shall be marked with the following information:~~

~~1. Particle size efficiency (PSE) of the unit in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (µm).~~

~~2. Initial resistance for the range of airflow rates as published by the manufacturer, including the maximum rated airflow rate. The selected airflow rates shall be in multiples of 400 cfm. If the maximum rated airflow rate is not a multiple of 400 cfm, then report initial resistance~~

~~at multiples of 400 cfm, and any fraction thereof, to include the maximum rated airflow rate as described in subsections a, b, c, d, e below.~~

a. ~~Airflow Rate Value 1 (val 1) = 400 cubic feet per minute (cfm). If 400 cfm is not within the manufacturer's published range of airflow rates for the filter, value = N/A.~~

~~b. Airflow Rate Value 2 (val 2) = 800 cubic feet per minute (cfm). If 800 cfm is not within the manufacturer's published range of airflow rates for the filter, value = N/A.~~

~~c. Airflow Rate Value 3 (val 3) = 1200 cubic feet per minute (cfm). If 1200 cfm is not within the manufacturer's published range of airflow rates for the filter, value = N/A.~~

~~d. Airflow Rate Value 4 (val 4) = 1600 cubic feet per minute (cfm). If 1600 cfm is not within the manufacturer's published range of airflow rates for the filter, value = N/A~~

~~e. Airflow Rate Value 5 (val 5) = Maximum Rated Airflow Rate (cfm).~~

~~3. Mark the non-reported MERV information field as "N/A."~~

~~(B) Air filters for which reported information is determined in accordance with ASHRAE Standard 52.2-2012 shall be marked with the following information:~~

~~1. Particle size efficiency (PSE) of the unit in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (µm).~~

~~2. Initial resistance for the range of airflow rates as published by the manufacturer, including the maximum rated airflow rate. The airflow rate values shall be the maximum rated airflow rate, and the values for 50%, 75%, 100% and 125% of the test airflow rate value determined in accordance with ASHRAE 52.2-2012. as described in subsections a, b, c, d, e below.~~

~~a. Airflow Rate Value 1 (val 1) = 50% of the test airflow rate in cubic feet per minute (50% of airflow rate value 3).~~

~~b. Airflow Rate Value 2 (val 2) = 75% of the test airflow rate in cubic feet per minute (75% of airflow rate value 3).~~

~~c. Airflow Rate Value 3 (val 3) = 100% test airflow rate in cubic feet per minute; determined as equal to selected test face velocity (feet per minute) multiplied by the air filter face area (square feet).~~

~~d. Airflow Rate Value 4 (val 4) = 125% of the test airflow rate in cubic feet per minute (125% of airflow rate value 3.~~

~~e. Airflow Rate Value 5 (val 5) = Maximum Rated Airflow Rate (cfm).~~

~~3. Minimum Efficiency Reporting Value (MERV).~~

~~The information shall be disclosed in the format in Table Z.~~

~~**Table Z**~~

~~**Sample Air Filter Marking**~~

~~*MERV*~~	~~*(µm) 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 Rated Airflow~~
~~[value]~~		~~[value]~~	~~[value]~~	~~[value]~~	~~Initial Resistance (IWC)~~	~~[value]~~	~~[value]~~	~~[value]~~	~~[value]~~	~~[value]~~	

~~If the marking on the air filter is not legible through its retail packaging, then the packaging shall also be labeled with the same information and in the same format as Table Z. The requirements of this section shall not preclude manufacturers from providing additional information.~~

(11) Air Filters. Each unit of air filters manufactured on or after December 1, 2022, shall be marked, permanently and legibly, on an accessible and conspicuous place on the edge of the filter itself or on the pleats, in characters of font size 12, with the information specified in either section (A) or (B) below as applicable to the air filter unit. If the marking on the air filter is not legible through its retail packaging, then the packaging shall also be marked with the same information and in the same format. Sample air filter markings are shown in Tables Z-1 and Z-2.

(A) Air filters for which the basic model has been tested in accordance with AHRI Standard 680 (I-P)-2017.

1. Air filters that have been tested and for which the reported information is determined in accordance with the AHRI Standard 680 (I-P)-2017 shall be marked with the following information:

a. Particle size efficiency (PSE) of the unit in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (µm).

b. Initial resistance for the range of airflow rates as published by the manufacturer, including the maximum rated airflow rate. The airflow rate values shall be the values for 25%, 50%, 75%, and 100% of the maximum rated airflow rate determined in accordance with AHRI Standard 680 (I-P)-2017 as described in subsections (i), (ii), (iii), (iv) below.

(i) Airflow Rate Value 1 (val 1) = 25% of the maximum rated airflow rate in cfm (25% of airflow rate of value 4).

(ii) Airflow Rate Value 2 (val 2) =50% of the maximum rated airflow rate in cfm (50% of airflow rate of value 4).

(iii) Airflow Rate Value 3 (val 3) = 75% of the maximum rated airflow rate in cfm (75% of airflow rate of value 4).

(iv) Airflow Rate Value 4 (val 4) = 100% of the maximum rated airflow rate in cfm.

2. Air filters that have not been tested shall be marked with information that is based on the information for an air filter of the same basic model which has been tested per section 1604(c)(4) of this Article in accordance with the AHRI Standard 680 (I-P)-2017 and certified to the Energy Commission per section 1606(a)(1)(H) of this Article. Information for an air filter that has not been tested shall be determined at a face velocity that is identical to the face velocity used for the test procedure for the tested air filter of the same basic model. Air filters that have not been tested shall be marked with the following information:

a. Particle size efficiency (PSE) of the unit in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (μm). The PSE values for an air filter that has not been tested shall be identical to the PSE values determined for a tested air filter of the same basic model.

b. Initial resistance values for the range of airflow rate values 1 through 4. The initial resistance values for an air filter that has not been tested shall be identical to the initial resistance values 1 through 4 determined for a tested air filter of the same basic model.

c. Airflow rate values 1 through 4 for an air filter that has not been tested shall each be equal to the corresponding airflow rate values 1 through 4 from a tested air filter of the same basic model multiplied by the face area of the filter that has not been tested and divided by the face area of the tested air filter of the same basic model.

(B) Air filters for which the basic model has been tested in accordance with ANSI/ASHRAE Standard 52.2 2017.

1. Air filters that have been tested and for which the reported information is determined in accordance with ANSI/ASHRAE Standard 52.2-2017 shall be marked with the following information:

a. Particle size efficiency (PSE) of the unit in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (μm).

b. Initial resistance for the range of airflow rates as published by the manufacturer, including the maximum rated airflow rate. The airflow rate values shall be the maximum rated airflow rate, and the values for 50%, 75%, 100% and 125% of the test airflow rate value determined in accordance with ANSI/ASHRAE 52.2-2017 as described in subsections (i), (ii), (iii), (iv), (v) below.

(i) Airflow Rate Value 1 (val 1) = 50% of the test airflow rate in cfm (50% of airflow rate value 3).

(ii) Airflow Rate Value 2 (val 2) = 75% of the test airflow rate in cfm (75% of airflow rate value 3).

(iii) Airflow Rate Value 3 (val 3) = 100% of the test airflow rate in cfm; determined as equal to selected test face velocity (feet per minute) multiplied by the air filter face area (square feet).

(iv) Airflow Rate Value 4 (val 4) = 125% of the test airflow rate in cfm (125% of airflow rate value 3).

(v) Airflow Rate Value 5 (val 5) = Maximum Rated Airflow Rate in cfm as published by the manufacturer.

c. Minimum Efficiency Reporting Value (MERV). The value shall be a whole number between 1 and 16.

2. Air filters that have not been tested shall be marked with information that is based on the information for an air filter of the same basic model which has been tested per section 1604(c)(4) of this Article in accordance with the ANSI/ASHRAE Standard 52.2-2017 and certified to the Energy Commission per section 1606(a)(1)(H) of this Article. Information for an air filter that has not been tested shall be determined at a face velocity that is identical to the face velocity used for the test procedure for the tested air filter of the same basic model. Air filters that have not been tested shall be marked with the following information:

a. Particle size efficiency (PSE) of the unit in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 micrometers (μm). The PSE values for an air filter that has not been tested shall be identical to the PSE values determined for a tested air filter of the same basic model.

b. Initial resistance values for the range of airflow rate values 1 through 5. The initial resistance values for an air filter that has not been tested shall be identical to the initial resistance values 1 through 5 determined for a tested air filter of the same basic model.

c. Airflow rate values 1 through 5. Airflow rate values 1 through 5 for an air filter that has not been tested shall each be equal to the corresponding airflow rate values 1 through 5 from a tested air filter of the same basic model multiplied by the face area of the filter that has not been tested and divided by the face area of the tested air filter of the same basic model.

d. Minimum Efficiency Reporting Value (MERV). The MERV for an air filter that has not been tested shall be identical to the value determined for a tested air filter of the same basic model. The value shall be a whole number between 1 and 16.

Table Z-1: Sample Air Filter Marking (AHRI Standard 680 [I-P]-2017)

(µm) PSE (%)	0.30-1.0	1.0-3.0	3.0-10	Airflow Rate (CFM)	[val 1]	[val 2]	[val 3]	[val 4]*	*Max Rated Airflow
	[val]	[val]	[val]	Initial Resistance (IWC)	[val]	[val]	[val]	[val]	

Table Z-2: Sample Air Filter Marking (ANSI/ASHRAE Standard 52.2-2017)

MERV	(µm) PSE (%)	0.30-1.0	1.0-3.0	3.0-10	Airflow Rate (CFM)	[val1]	[val2]	[va3]	[val 4]	[val5]*	*Max Rated Airflow
[val]		[val]	[val]	[val]	Initial Resistance (IWC)	[val]	[val]	[val]	[val]	[val]	

...[skipping (12) through the end of the section]

Note: Authority cited: Sections 25213, 25218(e), 25402(a)-25402(c) and 25960, Public Resources Code. Reference: Sections 25216.5(d), 25402(a)-25402(c) and 25960, Public Resources Code.

Glossary/Acronyms

Definitions & Acronyms:

Acronym/Term	Description/Definition
AHRI	Air-Conditioning, Heating, and Refrigeration Institute
ANSI	American National Standards Institute
ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers
CASE Team CEC	Codes and Standards Enhancement Team California Energy Commission
CPUC	California Public Utilities Commission
DOE	U.S. Department of Energy
ENERGY CODE	Building Energy Efficiency Standards
GHG	Greenhouse gas; any gas that has the property of absorbing infrared radiation emitted from Earth's surface and reradiating it back to the Earth's surface, thus contributing to the greenhouse effect. Carbon dioxide, methane, and water vapor are the most important greenhouse gases.
GWh	Gigawatt-hour; A unit of energy representing one billion watts hours and is equivalent to one million kilowatt hours.
HVAC	Heating, ventilation, and air conditioning
IEPR	Integrated Energy Policy Report
IOU	Investor owned utility
IWC	Inches of water column; A non-SI unit for pressure. The units are conventionally used for measurement of certain pressure differentials such as small pressure differences across an orifice, or in a pipeline or shaft
	Kilowatt-hour; A unit of energy equal to 3600 kilojoules usually used as a billing unit of energy.
MAEDbS	Modernized Appliance Efficiency Database System
MERV	Minimum Efficiency Reporting Value
MW	Megawatt

PSE	Particle size efficiency
RASS	Residential Appliance Saturation Study
Therm	A unit of heat equivalent to 100,000 Btu or $1.055x10^8$ joules; It is approximately the energy equivalent of burning 100 cubic feet of natural gas.
µm	Micrometer; micrometer is a unit of measure for length equal to 0.001mm, or about 0.000039 inch.

APPENDIX A: Calculations

The CEC *2009 Residential Appliance Saturation Survey* (RASS) provided the average energy use and household saturation of central air conditioners, air-source heat pumps, furnace fans, and furnaces across the single-family, townhome, 2-4-unit apartment, 5+ unit apartment, and mobile homes housing types. The 2010 Census and *2010 American Community Survey* provided the total number of state households and the household breakdown for single-family, townhouse, 2-4-unit, 5+ unit, and mobile home households.

The CEC determined the annual statewide energy consumption of home HVAC systems using air filters. As the first step the annual energy consumption of each filter HVAC system type per household type was determined using the formula:

$$Total\ Annual\ Energy_{Household\ type} = N_{households} \times S_{HVAC\ per\ HH} \times E_{avg\ HVAC\ per\ HH}$$

N: number of households
S: household saturation of HVAC type per household type
E: average energy consumption per HVAC type per household type

The energy use across all HVAC system types per each household type is summed to determine total annual filtered HVAC energy use per household type. Then, the energy consumption of each household type is summed into a state total for home filtered HVAC systems.

Table A-1: Annual Statewide Energy Consumption Residential HVAC Systems With Filters

	No. of HHs	Central AC's		Heat Pumps		Furnace Fans		Furnaces		Total Energy Consumption	
Household type		kWh/yr	Saturation	kWh/yr	Saturation	kWh/yr	Saturation	Therms/yr	Saturation	kWh/yr	Therms/yr
Single Family	7,710,310	894	66%	994	3%	216	76%	183	76%	6,045,037,369	1,072,349,937
Townhouse	960,454	483	48%	320	7%	91	45%	58	45%	283,516,414	25,067,849
2 – 4 hh Apartment	1,093,850	494	48%	324	7%	80	45%	66	45%	323,560,943	32,487,356
5+ hh Apartment	3,001,418	324	48%	522	7%	64	45%	32	45%	662,893,223	43,220,422
Mobile Home	506,906	876	53%	504	1%	157	63%	143	63%	288,039,352	45,667,186
Total										**7,603,047,301**	**1,218,792,750**

Source: CEC Staff

Energy Savings

[24] *Table 5.6.A Average Price of Electricity to Ultimate Customers by End-Use Sector, by State, October 2019 and 2018*. The natural gas rate used for these calculations was obtained from the U.S Energy Information Administration for Natural Gas for December 2019.[25] The Natural Gas rate was converted from dollars per thousand cubic feet ($/ft^3$) to dollars per therm ($/therm).

The net average energy impact across California climate types, heating and cooling loads, blower motor types, duct leakage scenarios, and filter-loading scenarios is a savings of 1 percent.[26] The percentage of HVAC systems using air filters with excessive pressure drop is estimated as high as 85 percent, according to data in one study.[27]

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24 U.S. Energy Information Administration, Electric Power Monthly with Data for October 2019, December 2019, https://www.eia.gov/electricity/monthly/

25 U.S. Energy Information Administration, Natural Gas Prices, Residential Price, https://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_m.htm

26 Walker, Dickeroff, Faulkner and Turner (Lawrence Berkeley National Laboratory). *Energy Implications of In-Line Filtration in California*. LBNL-6143E. October 2012. https://www.osti.gov/servlets/purl/1167440

27 Proctor, John, Rick Chitwood, and Bruce A. Wilcox. 2011. *Efficiency Characteristics and Opportunities for New California Homes*. California Energy Commission. Publication Number:CEC-500-2012-062. http://www.energy.ca.gov/2012publications/CEC-500-2012-062/CEC-500-2012-062.pdf

However, given the degree of uncertainty, the CEC made the conservative assumption that 50 percent of HVAC systems are using filters with excessive pressure drop.

Total energy consumption for residential filtered HVAC systems (E_{total}) is multiplied by the percentage of households using air filters with excessive pressure drop (P_{non}) and percentage of energy savings per household ($P_{savings}$) to determine annual energy savings ($E_{savings}$), as demonstrated in the formula:

$$E_{savings} = E_{total} \times P_{non} \times P_{savings}$$

Annual energy savings ($E_{savings}$) are multiplied by the monetary rate per energy unit (R_{energy}) to determine monetary savings per energy type (M_{energy}):

$$M_{energy} = E_{savings} \times R_{energy}$$

The total annual state monetary savings (M_{total}) are the sum of the monetary savings per each energy type, electric ($M_{electric}$) and gas (M_{gas}):

$$M_{total} = M_{electric} + M_{gas}$$

Table A-2: Annual Statewide Savings

	Electric	**Gas**	**Total Monetary Savings**
	kWh/yr	Therms/yr	
Total Energy Consumption	7,603,047,301	1,218,792,750	
Non-Compliance %	50%	50%	
Energy Savings %	1%	1%	
Total Energy Savings	38,015,237	6,093,964	
$/kWh	0.1497		
$/Therm		1.31	
Annual Total	$5,690,880.90	$7,983,092.51	$13,673,973.42

Source: CEC Staff

Cost of Compliance

The 2009 RASS provided household saturation of central air conditioners, air-source heat pumps, furnace fans, and furnaces across the single-family, townhome, 2-4-unit apartment, 5+ unit apartment, and mobile home housing types. The 2010 Census and *2010 American Community Survey*[28] provided the state households and households breakdown for single-family, townhouse, 2-4, 5+ unit, and mobile home households.

The CEC projected the number of filtered HVAC systems in the residential sector. The number of households for each household type (N_{hh}) was multiplied by the saturation of each HVAC system type ($S_{cac\ per\ hh}$, $S_{hp\ per\ hh}$, $S_{f\ per\ hh}$) to determine the number of filtered HVAC systems per household type as demonstrated in the formula:

$$F_{hh} = (N_{hh} \times S_{cac\ per\ hh}) + (N_{hh} \times S_{hp\ per\ hh}) + (N_{hh} \times S_{f\ per\ hh})$$

The sum of all filtered HVAC systems per household type determined the total number of filtered HVAC systems in the residential sector (F_{total}).

The manufacturer 3M characterized the incremental cost of air filters labeling as zero or near zero when spread across all air filter shipments. The California IOUs characterized the incremental cost as $0.02 per filter in a proposal with the use of manufacturer information. Assuming a 50 percent markup for commoditized label, the CEC considers $0.03 as the incremental cost per filter. The CEC assumed two filter changes per year and an average of 1.25 filters per home HVAC system.[29] This results in an annual incremental cost (C_i) per air filter of $0.08 to the consumer for labeling. The total cost of labeling (C_{total}) is the number of filtered HVAC systems (F_{total}) multiplied by the average number of filters per HVAC system (NF_{ave}) multiplied by the number of replacement filters per year (YRF) multiplied by the annual incremental cost (C_i) to the consumer.

$$C_{total} = (F_{total}) \times (NF_{ave}) \times (YRF) \times (C_i)$$

28 2010 American Community Survey, https://www.census.gov/programs-surveys/acs/guidance/comparing-acs-data/2010.html

29 Proctor, John, Rick Chitwood, and Bruce A. Wilcox. 2011. *Efficiency Characteristics and Opportunities for New California Homes*. California Energy Commission. Publication Number: CEC-500-2012-062. http://www.energy.ca.gov/2012publications/CEC-500-2012-062/CEC-500-2012-062.pdf

Table A-3: Annual Statewide Costs

Household Type	No. of HHs	Central AC Saturation	Heat Pumps Saturation	Furnace Fan Heating Only	Total
Single Family	7,710,310	66%	3%	76%	11,179,950
Townhouse	960,454	48%	7%	45%	960,454
2 – 4 hh Apartment	1,093,850	48%	7%	45%	1,093,850
5+ hh Apartment	3,001,418	48%	7%	45%	3,001,418
Mobile Home	506,906	53%	1%	63%	593,080
Total Number of HVAC System with Filters					16,828,753
Filters per HVAC System					1.25
Filters replacements per year					2
Cost per Filter Label					$0.03
Annual Label Cost					$0.075
Annual Monetary Cost					$3,155,391.12

Source: CEC Staff

Net Benefit

The CEC determined the total net benefit (NB_{total}) to California by subtracting the annual state monetary cost (C_{total}) from the annual state monetary savings (M_{total}).

$$NB_{total} = M_{total} - C_{total}$$

The CEC determined net benefit per household (NB_{hh}) by dividing the annual state monetary savings (M_{total}) by the number of filtered HVAC systems (F_{total}).

$$NB_{hh} = M_{total} \div F_{total}$$

Table A-4: Annual Statewide Net Benefit

	Per Household	State
HVAC Systems with Filters	-	16,828,753
Annual kWh Savings	2.26	38,015,237
Annual Therm Savings	0.36	6,093,964
Monetary Savings	$0.81	$13,673,973.42
Monetary Costs	$0.19	$3,155,391.12
Annual Net Benefit	$0.63	$10,518,582.30

Source: CEC Staff