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AHRI Comments â€“ Title 20 Pre-Rulemaking â€“ Air Filter Labeling Docket No. 17-AAER-01

Additional submitted attachment is included below.

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September 1, 2017

California Energy Commission
Docket Unit, MS-4
Re: Docket No. 17-AAER-01
1516 Ninth Street
Sacramento, California 95814-5512

Re: AHRI Comments – Title 20 Pre-Rulemaking – Air Filter Labeling *[Docket No. 17-AAER-01]*

Dear CEC Staff:

These comments are submitted in response to the California Energy Commission (CEC) Staff Workshop on appliance efficiency regulations for pool pumps and motors, portable electric spas, commercial clothes dryers, and air filter labeling held on Thursday, August 3, 2017, and the July 2017 draft staff report regarding proposals to amend the Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601 through Section 1609).

AHRI is the trade association representing manufacturers of heating, cooling, water heating, and refrigeration equipment. More than 300 members strong, AHRI is an internationally recognized advocate for the industry, and develops standards for and certifies the performance of many of the products manufactured by our members. In North America, the annual output of the HVACR industry is worth more than $20 billion. In the United States alone, our members employ approximately 130,000 people, and support some 800,000 dealers, contractors, and technicians. In addition to its activities as a global standards developer, AHRI works closely with other global codes and standards developers as well as utilities to ensure their access to the latest technology and innovation from the HVACR and water heating industry.

AHRI Standard 680 Update

AHRI Standard 680 (I-P)-2015, *Performance Rating of Residential Air Filter Equipment*, is in the process of being amended to update the test procedure for establishing the initial resistance of the filter and to include calculations for extending ratings from tested products to filters of other sizes within the same family. The standard is slated to be approved by this fall. Where the 2015 edition of the standard calls for running tests, and reporting initial resistances at the maximum rated airflow rate and at airflow rates in

multiples of 400 cfm between 400 cfm and the maximum rated airflow rate, the revised standard proposes conducting the test and reporting the initial resistance of the filter at 25%, 50%, 75%, and 100% of the maximum rated airflow rate. Consensus on this approach was reached after careful deliberation of the 2015 edition and consideration of CEC's intent to require rating, listing and marking of filters of all sizes, designed for installation in residential ducted forced-air heating or cooling systems, and sold in California.

We understand that this approach is different than what was originally proposed by industry, but hope that CEC agrees that moving to four rating points, for products rated with AHRI 680, and reporting initial resistance at airflows as a percentage of the maximum rated airflow rate, makes even more sense to consumers and to the Commission. We also acknowledge that this is a deviation from the five points CEC is proposing for listing products in accordance with ASHRAE 52.2. For products rated in accordance with AHRI Standard 680, there is no need to list initial resistance above the maximum rated airflow rate, as the AHRI standard is not used to establish this value. The use of AHRI Standard 680 is only applicable once maximum rated airflow has been established, likely using ASHRAE 52.2, and operation past this maximum airflow is not supported by the manufacturer. Should a consumer need to purchase a product, it should only be used up to the maximum rated airflow rate. Due to the differences between the two standards, CEC should not be concerned with the listing of data at four points, rather than five points. A simple way to address this would be to list "N/A" for the fifth point. An example label is included in the draft of AHRI Standard 680, attached, requires noting that the highest value is maximum rated airflow rate. AHRI recommends CEC adopt similar language.

Additional Comments

AHRI supports CEC's recommendation for excluding air filters with adjustable dimensions. Indeed, it is not possible for the manufacturer to mark the filter with all of the required information when the final face area of the filter is not a knowable quantity.

AHRI also supports CEC's proposed definition for basic model of an air filter and that filters with the same filter media type, the same pleat characteristics (e.g., pleat depth and spacing), and the same construction (e.g., pleat support and frame pattern) will have the same pressure drop when operating at the same face velocity, even when the filters have different face areas. This definition aligns with that in AHRI Standard 680 and will facilitate manufacturer identification of the air filters that are required to be tested.

AHRI appreciates the clear note under Table Z in the staff report that, "The requirements of this section shall not preclude manufacturers from providing additional information" and stresses the importance that this note is duplicated in Title 20. This note will address the concerns raised that electronic air cleaners with removeable media be permitted to mark the removeable media with indication it should only be used in the

electronic air cleaner for which it was designed. Such filters are not interchangeable with other systems.

Conclusion

AHRI appreciates the opportunity to provide these comments. If you have any questions regarding this submission, please do not hesitate to contact me.

Sincerely,

Laura Petrillo-Groh, PE
Engineering Director, Regulatory Affairs
Direct: (703) 600-0335
Email: LPetrillo-Groh@ahrinet.org

Attachments

1. AHRI Draft Standard 680 (I-P)-2017 dated August 31, 2017

ANSI/AHRI Standard 680 (I-P)-2017

2017 Standard for

Performance Rating of Residential Air Filter Equipment

This is a draft standard prepared on 8/31/2017

Approved American National Standard ANSI

Approved by ANSI on July 8, 2016

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SAFETY DISCLAIMER

AHRI does not set safety standards and does not certify or guarantee the safety of any products, components or systems designed, tested, rated, installed or operated in accordance with this standard/guideline. It is strongly recommended that products be designed, constructed, assembled, installed and operated in accordance with nationally recognized safety standards and code requirements appropriate for products covered by this standard/guideline.

AHRI uses its best efforts to develop standards/guidelines employing state-of-the-art and accepted industry practices. AHRI does not certify or guarantee that any tests conducted under its standards/guidelines will be non-hazardous or free from risk.

Note:

This standard supersedes ANSI/AHRI Standard 680 (I-P)-2015.
For SI ratings, see AHRI Standard 681 (SI)-2017.

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APPENDICES

PERFORMANCE RATING OF RESIDENTIAL AIR FILTER EQUIPMENT

Section 1. Purpose

1.1 *Purpose*. The purpose of this standard is to establish for residential Air Filter Equipment: definitions; classifications; test requirements; rating requirements; minimum data requirements for Published Ratings; operating requirements; marking and nameplate data; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope*. This standard applies to factory-made Air Filter Equipment and Air Filter Media, as used in such equipment, for removing particulate matter, when used in environmental conditioning of inhabited spaces in residential facilities. The standard evaluates the "combined" performance of Air Filter Equipment in all aspects: Initial Resistance, Final Resistance, Particle Size Efficiency, and Dust Holding Capacity. This offers both the user and specifier a complete view of the Air Filter Equipment for comparison purposes.

2.2 *Exclusions*. This standard does not apply to the following:

2.2.1 Air Filter Equipment and Air Filter Media for removing particulate matter, when used in industrial or commercial processes not associated with environmental conditioning of inhabited space.

2.2.2 Air Filter Equipment when used in removing abnormally high concentrations of specific contaminants.

2.2.3 Portable appliances which include Air Filter Equipment in combination with fans, coils, dampers, etc., but can be applied to the Air Filter Equipment as used therein.

2.2.4 Commercial and industrial Air Filter Equipment covered by AHRI Standard 850 (I-P).

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the ASHRAE Wikipedia website (https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology) unless otherwise defined in this Section.

3.1 *Air Filter Equipment.* Air cleaning equipment used for removing particulate matter.

3.2 *Air Filter Media.* The part of the Air Filter Equipment, which is the actual particulate removing agent. In the case of Group RII equipment (Section 4), the terms charging section and/or collecting section shall be used.

3.3 *Dust Holding Capacity.* The amount of dust captured on the Air Filter Equipment. Dust Holding Capacity shall be established at the Maximum Rated Airflow Rate of the Air Filter Equipment as published by the manufacturer.

3.4 *Final Resistance.* The resistance of the Air Filter Equipment operating at its Maximum Rated Airflow Rate, at which the test is terminated and result calculated.

3.5 *Initial Resistance.* The resistance of the Air Filter Equipment operating at its range of airflow rates with no dust load per Section 5.4.1.

3.6 *Loading Dust.* A compound synthetic dust used for Air Filter Equipment loading. It is composed, by weight, of 93.5% ISO fine test dust (ISO Standard 12103-1, A2 Fine Test Dust) and 6.5% milled cotton linters (CAS# 9004-34-6).

3.7 *Maximum Rated Airflow Rate*. The highest airflow rate at which the Air Filter Equipment is operated as published by the manufacturer.

3.8 *Particle Size Efficiency*. The fraction (percentage) of particles that are captured on the Air Filter Equipment. Particle Size Efficiency shall be measured in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 microns. Particle Size Efficiency shall be established at the Maximum Rated Airflow Rate of the equipment as published by the manufacturer.

3.9 *Published Rating.* A statement of the assigned values of those performance characteristics, under stated Rating Conditions, by which a unit may be chosen to fit the application. These values apply to all units of like nominal capacity and type (identification) produced by the same manufacturer. As used herein, the term Published Rating includes the rating of all performance characteristics shown on the unit or published in specifications, advertising or other literature controlled by the manufacturer, at stated Rating Conditions.

3.9.1 *Application Rating*. A rating based on tests performed at application Rating Conditions (other than Standard Rating Conditions).

3.9.2 *Standard Rating*. A rating based on tests performed at Standard Rating Conditions.

3.10 *Rating Conditions*. Any set of operating conditions under which a single level of performance results and which causes only that level of performance to occur.

3.10.1 *Standard Rating Conditions*. Rating Conditions used as the basis of comparison for performance characteristics.

3.11 *Sealing Means*. Edge seals to prevent air bypass under rated operating conditions.

3.12 *"Shall" or "Should."* "Shall" or "should" shall be interpreted as follows:

3.12.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.12.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.13 *Standard Equipment.* The minimum assembly of components required to qualify equipment within one of the classification groups.

3.14 *Support*. The means necessary to place the Air Filter Media in the air stream and to prevent air bypass around the filter assembly under maximum rated operating conditions.

3.15 *Test Aerosol.* A polydisperse solid-phase (i.e., dry) potassium chloride (KCl) granules generated from aqueous solution, used in this standard to determine Particle Size Efficiency of the air cleaning equipment.

Section 4. Classifications

4.1 *Groups*. For the purpose of this standard, Air Filter Equipment and Air Filter Media are classified into groups:

4.1.1 Group RI - Panel or Pleated
4.1.2 Group RII - Electronic air cleaner
4.1.3 Group RIII - Air Filter Media (for Group RI)

4.2 *Descriptions.*

4.2.1 *Group RI.* This group of filters shall include panel or pleated type Air Filter Equipment. Panel type Air Filter Equipment is characterized by flat shallow assemblies in which the velocity of the air stream approaches the velocity through the Air Filter Media. Pleated type Air Filter Equipment is characterized by pleated or pocket configuration, wherein the approach velocity of the air stream is substantially greater than the velocity through the Air Filter Media. The equipment may be of the permanent cleanable type, or of the disposable non-renewable type, and may be dry or viscous-coated. Viscous impingement filters are included in this group.

4.2.2 *Group RII.* This group of Air Filter Equipment shall include electronic air cleaners. Equipment of this type uses high voltage electrostatic principles to collect particulate matter. These filters may be of single-stage or multiple-stage configuration. Part or all of the charging and/or collecting sections may be manually cleanable, automatically cleanable, or disposable. This group is only for products with active power supplies.

4.2.3 *Group RIII.* This group of filters shall include the filter media component used in Air Filter Equipment in Group RI. The filter shall be tested in, as used conditions.

4.3 *Standard Equipment*. Standard Equipment for Groups RI, RII and RIII is specified in this Section.

4.3.1 Equipment which is classified as Group RI and RIII Air Filter Equipment shall consist of:

4.3.1.1 Air Filter Media
4.3.1.2 Support
4.3.1.3 Sealing Means

4.3.2 Equipment which is classified as Group RII shall consist of:

4.3.2.1 High voltage power supply is a means of supplying high voltage for the Air Filter Equipment.
4.3.2.2 Support
4.3.2.3 Sealing Means, if applicable
4.3.2.4 Safety controls are a means of positively breaking line voltage power to the device.
4.3.2.5 Operating controls
4.3.2.6 Collecting section is a means of collecting particulate matter. Examples are:

4.3.2.6.1 Electrically charged surfaces which may be viscous coated and which may require periodic cleaning.
4.3.2.6.2 Electrically charged surfaces which hold the collected particles plus a secondary downstream filter which collects the re-entrained particles.
4.3.2.6.3 Air Filter Media and electrically charged active and/or passive grid(s).

4.3.2.7 Charging section (multi-stage equipment only) is the section of the equipment which imparts an electrical charge to the particulate matter.
4.3.2.8 Connectors are a means of transferring high voltage from the power source to the collecting and/or charging section.

4.3.3 *Optional Equipment.* Optional equipment may include: viscous coatings, frames, automatic control systems, wash accessories or washing systems, pre-filters or after-filters.

Section 5. Test Requirements

5.1 *Test Apparatus.* The test apparatus requirements and qualification shall be per ASHRAE Standard 52.2 or Appendix E

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5.2 *Test Materials.*

5.2.1 *Test Aerosol.* The Test Aerosol shall be solid-phase potassium chloride (KCl) per ASHRAE Standard 52.2.

5.2.2 *Loading Dust.* The Loading Dust for testing the Air Filter Equipment shall be composed, by weight, of 93.5% ISO fine test dust (ISO Standard 12103-1, A2 Fine Test Dust) and 6.5% milled cotton linters (CAS# 9004-34-6). The

Loading Dust shall contain no powdered carbon. Other details of the Loading Dust shall be per ASHRAE 52.2 Standard.

5.3 *Equipment Preparation*. The complete Air Filter Equipment shall be prepared in accordance with the manufacturer's recommendations. Preparation shall include:

5.3.1 Application (type, amount and method) of viscous coating
5.3.2 Proper mounting of the equipment to ensure the flow of air through the Air Filter Media
5.3.3 Sealing of test device with the test duct to avoid leakage or dust accumulation
5.3.4 Any other preparations that are recommended by the manufacturer in order to demonstrate the equipment's intended performance. Airflow across the equipment is not required during the run-in period.

5.4 *Test Procedure*. The Air Filter Equipment shall be tested for Initial Resistance, Particle Size Efficiency, Final Resistance, and Dust Holding Capacity.

5.4.1 *Initial Resistance*. The test shall be run and reported for the range of airflow rates as published by the manufacturer, including the Maximum Rated Airflow Rate. The selected airflow rates shall be 25%, 50%, 75%, and 100% of the Maximum Rated Airflow Rate.

For Air Filter Equipment with disposable media, the Initial Resistance shall be determined for new media. For Air Filter Equipment with cleanable media, the Initial Resistance shall be determined for an equipment that has been cleaned according to the manufacturer's instructions after it had been loaded per Section 5.4.3 of this standard.

5.4.2 *Particle Size Efficiency*. The test shall be run and reported at the Maximum Rated Airflow Rate as published by the manufacturer.

5.4.2.1 The Particle Size Efficiency measurements shall be made in twelve particle size ranges or bins between 0.30 µm and 10 µm as per ASHRAE Standard 52.2.

5.4.2.2 Particle Size Efficiency measurements shall be first conducted for clean Air Filter Equipment. For Air Filter Equipment with cleanable media, the clean Air Filter Equipment shall be one that has been cleaned according to the manufacturer's instructions after it has been loaded per Section 5.4.3 of this Standard.

5.4.2.3 Particle Size Efficiency measurements shall then be repeated after the dust loading steps are completed as per section 5.4.3.

5.4.2.4 The average of the two measurements (clean and loaded) at each of the twelve particle size ranges or bins shall be calculated.

5.4.2.5 The Particle Size Efficiency in the range of 0.3 µm to 1.0 µm is calculated as the average of the four size ranges from 0.3 µm to 1.0 µm in section 5.4.2.4.

5.4.2.6 The Particle Size Efficiency in the range of 1.0 µm to 3.0 µm is calculated as the average of the four size ranges from 1.0 µm to 3.0 µm in section 5.4.2.4.

5.4.2.7 The Particle Size Efficiency in the range of 3.0 µm to 10 µm is calculated as the average of the four size ranges from 3.0 µm to 10.0 µm in section 5.4.2.4.

5.4.3 *Dust Holding Capacity*. Dust Holding Capacity shall be tested and reported at the Maximum Rated Airflow Rate as published by the manufacturer. The Loading Dust is as specified in Section 5.2.2. Recommended dust feed rate is 70 ± 7 mg/m^3. Lower dust feed rate can be used but shall be reported in the results.

5.4.3.1 Weigh the clean Air Filter Equipment to the nearest 0.1 g.

5.4.3.2 Install the Air Filter Equipment in the test duct and feed the Loading Dust in one or multiple intervals until either of the following conditions occur, whichever comes first:

5.4.3.2.1 The resistance of the Air Filter Equipment reaches 0.5 in wc.

5.4.3.2.2 The Particle Size Efficiency falls below 75% of the clean Air Filter Equipment value in any of the particle size range that measures Particle Size Efficiency of 50% or more for a clean filter equipment. If more than one particle size ranges measure Particle Size Efficiency of 50% or more, the smaller particle size range shall be used for the 75% limit.

5.4.3.3 Weigh the dust loaded Air Filter Equipment to the nearest 0.1 g. The difference in weight from the clean Air Filter Equipment is the Dust Holding Capacity of the test device, measured to the nearest gram.

5.4.3.4 Dust Holding Capacity can be rated at conditions prior to reaching either of the prescribed end point limit conditions stated in section 5.4.3.2. The penalty would be lower Dust Holding Capacity.

5.4.4 *Final Resistance*. The test shall be run and reported at the Maximum Rated Airflow Rate as published by the manufacturer. The test shall be run on the dust loaded Air Filter Equipment after the completion of Dust Holding Capacity test per section 5.4.3.

5.5 *Method of Test for Ozone Concentration.* Group RII Air Filter Equipment shall be tested for ozone concentration at the Maximum Rated Airflow Rate as published by the manufacturer and in accordance with Appendix D of this standard.

Section 6. Rating Requirements

6.1 *Published Ratings*. All Published Ratings shall include Standard Ratings and Standard Rating Conditions, but may also include Application Ratings where a statement of conditions of temperature, humidity, and airflow rate, as well as input voltages (where applicable), are provided.

6.1.1 *Standard Ratings.* Standard rating shall be established at the rating conditions as defined in Section 5. The rating data that shall be published are shown below:

6.1.1.1 Initial Resistance
6.1.1.2 Final Resistance
6.1.1.3 Dust Holding Capacity
6.1.1.4 Particle Size Efficiency for three particle size ranges: 0.30 µm to 1.0 µm, 1.0 µm to 3.0 µm, and 3.0 µm to 10 µm.
6.1.1.5 Ozone concentration Compliance (for Group RII Air Filter Equipment).

6.1.2 *Reporting Results*. Test results shall be reported using the test report format as shown in Appendix C.

6.1.3 The standard rating shall be published in the sample format shown in Table 1:

6.1.4 *Values of Standard Ratings.* Standard Ratings shall be published only in the multiples and terms shown below:

6.1.4.1 Rated airflow rate (s) shall be stated at 25%, 50%, 75%, and 100% of the Maximum Airflow Rate. (rounded to the nearest 100 cfm).
6.1.4.2 Resistance (s) shall be stated multiples of 0.01 in wc
6.1.4.3 Particle Size Efficiency (s) shall be stated in multiples of 1%. When the Particle Size Efficiency is greater than 99% is shall be reported as "greater than 99%." When the Particle Size Efficiency is less than 20%, it shall be reported as “less than 20%”.
6.1.4.4 Dust Holding Capacity shall be stated in multiples of 1 g,
6.1.4.5 Input power shall be stated in multiples of 5 W,

6.1.5 *Standard Rating Conditions.* The conditions of tests for Standard Ratings shall be:

6.1.5.1 Temperature range of test air shall be stated in 50°F to 100°F.
6.1.5.2 Humidity range of test air shall be 35% to 55%.
6.1.5.3 Line voltage supply (where applicable) shall be nameplate rated voltage ± 1 V. For multiple voltage equipment, the manufacturer shall designate the test voltage and voltage control set point.
6.1.5.4 Rated airflow rate(s) shall be stated as defined in Section 3, cfm ± 2%.

6.1.6 *Application Rating Conditions.* Ratings at conditions other than those specified in Sections 6.1.1 and 6.1.5 may be published as Application Ratings.

6.1.7 *Rated Voltage.* Rated voltage for 50 and 60 Hz Air Filter Equipment shall be in accordance with the nameplate electrical characteristics (Section 9.1).

6.2 *Application Ratings.* Whenever Application Ratings are published or printed, the conditions at which these ratings apply shall be shown. Application Ratings shall include, or be accompanied by, the Standard Ratings clearly identified as such.

6.3 *Tolerances*. Published Ratings shall be such that any sample(s), not exceeding five samples, selected at random and tested in accordance with this standard, shall result in average tested values with an allowance for testing as follows:

6.3.1 The Initial Resistance shall not exceed the published resistance by more than 10% or 0.02 in H_20, whichever is greater.

6.3.2 Particle Size Efficiency(s) shall not fall below the published efficiency(s) by more than 2%.

6.3.3 The Dust Holding Capacity shall be not fall below the published capacity by more than 10%.

6.3.4 The input power shall not exceed the published input power by more than 5%.

6.3.5 The Rated Final Resistance shall not exceed the published resistance by more than 10% or 0.02 in H_20, whichever is greater.

Table 1. Example of Format for Published Rating

Airflow Rate, CFM	Initial Resistance, in H_20	Final Resistance[2], in H_20	Dust holding Capacity[2], g	Efficiency[2] (Particle Size 0.30-1.0 µm), %	Efficiency[2] (Particle Size 1.0-3.0 µm), %	Efficiency[2] (Particle Size 3.0-10 µm), %
500	0.10					
1000	0.17					
1500	0.25					
2000[1]	0.32	0.50	45	17	53	87
Is ozone Compliant?[3,4]						

1. Maximum Rated Airflow Rate as published by the manufacturer
2. Standard Rating requires that these shall be tested at Maximum Rated Airflow Rate as published by the manufacturer.
3. Only applies to Group RII
4. This is either Pass or Fail

Section 7. Minimum Data Requirements for Published Ratings

7.1 *Minimum Data Requirements for Published Ratings.* As a minimum, Published Ratings shall include all Standard Ratings. All claims to ratings within the scope of this standard shall include the statement "Rated in accordance with AHRI Standard 680 (I-P)." All claims to ratings outside the scope of this standard shall include the statement "Outside the scope of AHRI Standard 680 (I-P)." Wherever Application Ratings are published or printed, they shall include a statement of conditions at which the ratings apply and shall be accompanied by the Standard Ratings clearly identified as such.

Section 8. Operating Requirements

8.1 *Breaching Test (For Groups RI and RII)*. Following the standard rating test (or cleanability test, if performed), a breaching test shall be performed.

8.1.1 *Procedure.* The Air Filter Equipment shall be tested at a resistance of 1 in H_20. The resistance shall be increased by increasing the airflow rate. This increased resistance shall be applied for a period of five minutes.

8.1.2 *Requirements.* During the course of the test, there shall be no evidence of tearing, dislocation from its frame, or other damage to the Air Filter Equipment.

Section 9. Marking and Nameplate Data

9.1 *Marking and Nameplate Data*. As a minimum the nameplate on each residential air filter unit shall display the manufacturer's name, model designation, and electrical characteristics (for Group RII only).

Nameplate voltages for 60 Hertz systems shall include one or more of the equipment nameplate voltage ratings shown in Table 1 of ANSI/AHRI Standard 110. Nameplate voltages for 50 Hz systems shall include one or more of the utilization voltages shown in Table 1 of IEC Standard 60038.

Section 10. Conformance Conditions

10.1 *Conformance.* While conformance with this standard is voluntary, conformance shall not be claimed or implied for products or equipment within the standard's *Purpose* (Section 1) and *Scope* (Section 2) unless such claims meet all of the requirements of the standard and all of the testing and rating requirements are measured and reported in complete compliance with the standard. Any product that has not met all of the requirements of the standard cannot reference, state or acknowledge the standard in any written, oral, or electronic communication.

APPENDIX A. REFERENCES - NORMATIVE

A1 Listed here are all standards, handbooks and other publications essential to the formation and implementation of the standard. All references in this appendix are considered part of the standard.

A1.1 AHRI Standard 110-2012 , *Air-Conditioning, Heating, and Refrigerating Equipment Nameplate Voltages*, 2012, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Boulevard, Suite 500, Arlington, VA 22201, U.S.A.

A1.2 AHRI Standard 850 (I-P) 2013, *Commercial and Industrial Air Filter Equipment*, 2013, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Boulevard, Suite 500, Arlington, VA 22201, U.S.A.

A1.3 ANSI/ASHRAE Standard 52.2-2012, *Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size*, 2007, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle N.E. Atlanta, GA 30329, U.S.A.

A1.4 ASHRAE Terminology, https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology, 2014, American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc., 1791 Tullie Circle, N.E., Atlanta, GA 30329, U.S.A

A1.5 IEC Standard 60038, IEC Standard Voltages, 2002, International Electrotechnical Commission, 3, rue de Varembe, P.O. Box 131, 1211 Geneva 20, Switzerland.

A1.6 ISO 12103-1, *Road Vehicles – Test Dust for Filter Evaluation*, 1997, International Organization for Standardization (ISO), 1, ch. de la Voie-Creuse, Case postale 56 CH-1211 Geneva 20, Switzerland.

A1.7 Title 21, Code of Federal Regulations (CFR), Part 801, Subpart 801.415, U.S. Food and Drug Administration, 10903 New Hampshire Avenue, Silver Spring, MD 20993

A1.8 AHRI Standard 681 (SI)-2015, *Performance Rating of Residential Air Filter Equipment*, 2015, Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Boulevard, Suite 500, Arlington, VA 22201, U.S.A.

APPENDIX B. REFERENCES - INFORMATIVE

B1 Listed here are standards, handbooks and other publications which may provide useful information and background but are not considered essential. References in this appendix are not considered part of the standard.

None.

APPENDIX C. AHRI STANDARD 680 AIR FILTER EQUIPMENT REPORT SUMMARY – NORMATIVE

Laboratory Information

Report No._____ Test No._____ Date_____
Test laboratory_____
Operator_____ Supervisor_____

Air Filter Equipment Information

Manufacturer_____
Product name_____ Model_____
Test requested by_____
Air Filter Equipment group_____ Maximum Rated Airflow Rate_____
Dimensions:_____
Other attributes_____

Test Conditions

Temperature_____ (°F) Relative Humidity_____ (%)
Test Airflow rate (maximum rated)_____ (CFM) Loading Dust Feed Rate_____ (lb/ft^3)
($1\ lb/ft^3 = 16018.4634\ g/m^3$)

Remarks_____

Initial Resistance Test Results

Airflow Rate (CFM)	Resistance ("H_20)	Remarks
(25%)		
(50%)		
(75%)		
(100%)		

Particle Size Efficiency and Dust Holding Capacity Test Results

Test Airflow rate (maximum rated) (CFM)_____
Weight of clean Air Filter Equipment (g)_____
Weight of loaded Air Filter Equipment (g)_____
Final Resistance (" wc)_____
Average of Initial and Final Particle Size (0.30 – 1.0 µm) Efficiency (%)_____
Average of Initial and Final Particle Size (1.0 – 3.0 µm) Efficiency (%)_____
Average of Initial and Final Particle Size (3.0 - 10 µm) Efficiency (%)_____
Dust Holding Capacity (g)_____
Maximum Ozone Concentration (ppb) _____ at Flowrate (CFM) _____ (for Group RII Air Filter Equipment)

APPENDIX D. METHOD OF TEST FOR OZONE CONCENTRATION FOR GROUP RII AIR FILTER EQUIPMENT - NORMATIVE

Ozone Concentration Requirement (For Group RII Equipment). In conformance with Title 21 published by the U.S. Department of Health and Human Services, Food and Drug Administration in the *Code of Federal Regulations* Section 801.415, no Group RII equipment shall have a maximum ozone concentration in the effluent air exceeding 50 ppb.

D1 *Purpose.* The purpose of this appendix is to provide test procedures for establishing an ozone concentration level for Group RII Air Filter Equipment.

D2 *Scope.* The test procedures provided in this appendix are for use with Group RII Air Filter Equipment mounted in the ASHRAE duct system described in ASHRAE Standard 52.2.

D2.1 *Exclusions.* This appendix is not applicable to field tests or to tests conducted in enclosed space applications.

D3 *Ozone Monitoring Instrument.* An ozone monitor that is approved by the U.S. Environmental Protection Agency for ambient air monitoring shall be acceptable for determining the ozone level in the duct.

D3.1 *Calibration.* The calibration of the ozone monitor shall be done according to the procedures outlined in the instrument manufacturer's instruction manual

D3.2 *Reference Standard.* The reference standard for calibrating the ozone monitor shall be in accordance with the procedures outlined in the *Federal Register*.

D4 *Recording Instrument.* A recorder that is compatible with the recorder output of the ozone monitor shall be used.

D5 *Electrical Measurements*. Electrical measurements shall be taken with indicating instruments. Ionizer and collector voltages shall be recorded and shall be expressed to the nearest 100 V, DC.

D6 *ASHRAE Duct.* The ASHRAE duct system described in ASHRAE Standard 52.2 shall be used for this test.

D7 *Location of Ozone Monitor's Sampling Tube.* The ozone monitor sampling tube shall be located immediately adjacent to the downstream sampler and shall point directly into the air stream.

D8 *Performance Test.* The test shall be started only after a state of equilibrium has been reached. Prior to the start of this test, the ozone background level shall be measured with the Air Filter Equipment off.

D8.1 *Power Supply Voltage.* The voltage input shall be set at the nameplate voltage. The ionizer and collector voltage shall be set per the manufacturer's instructions. If adjustable without the use of tools, the ionizer voltage and collector voltage shall be adjusted to the maximum level.

D8.2 *Ozone Background Level.* Tests shall proceed only after the background level of ozone in the air passing through the duct has been established with the equipment off. The ozone measurement shall be recorded when the ozone reading reaches a steady state level.

D8.3 *Ozone Measurements.* The Air Filter Equipment shall be turned on and ozone measurements shall be recorded when the ozone reading reaches a steady state level. The concentration shall be recorded to the nearest 1 ppb.

D8.4 *Airflow Rate.* The Air Filter Equipment shall be tested at the minimum operational airflow rate designed for the air purifier.

D8.5 *Background Check.* After the ozone measurement has been recorded, the Air Filter Equipment shall be turned off and the resulting reading taken.

D8.6 *Recorded Ozone Concentration.* The two ozone background readings shall be averaged, and the result subtracted from the concentration measured in Section D8.3. This value shall be recorded as the ozone concentration.

D8.7 *Determination of Airflow Rate.* The airflow rate shall be calculated as provided in ASHRAE Standard 52.2, and recorded.

D9 *General Test Data*. The following data shall be recorded for each Air Filter Equipment tested for ozone concentration:

D9.1 Air filter manufacturer - name and address

D9.2 Location of test facility - company name and address

D9.3 Date of test runs

D9.4 Observers - responsible engineers and technicians

D9.5 Designation of unit

D9.5.1 Model number
D9.5.2 Manufacturer's serial number
D9.5.3 Ionizer and collector voltages - expressed to the nearest 100 V, DC
D9.5.4 Nameplate voltage

D9.6 Designation of ozone monitor

D9.6.1 Model number
D9.6.2 Manufacturer's serial number
D9.6.3 Calibration date

D9.7 Airflow rate, cfm

D9.8 Duct air temperature, dry-bulb reading, °F

D9.9 Duct air temperature, wet-bulb reading, °F

D9.10 Relative humidity, %

D9.11 Barometric pressure (Absolute), in Hg

D9.12 Air nozzle diameter, in

D9.13 Pressure drop across nozzle, in H_20

D9.14 Sampling point is the distance of the sampling tube from the Air Filter Equipment and is expressed to the nearest 0.50 ft

D9.15 Description of recorder (if used)

D9.15.1 Manufacturer's name

D9.15.2 Model number

D9.16 All ozone concentrations, ppb

Note: Other information helpful to the test, such as photographs, weather conditions at the time of the test, etc., may be included in the test report.

APPENDIX E. Method of Scaling Performance of Filters in the Same Filter Family - Normative

E1 *Purpose.* The purpose of this appendix is to provide a method for calculating ratings from a tested filter to a similar filter of a different size

E2 *Scope.* The calculation procedure provided in this appendix is for use with Air Filter Equipment mounted in the ASHRAE duct system described in ASHRAE Standard 52.2.

E2.1 *Exclusions.* This appendix is not applicable to field tests or to tests conducted in enclosed space applications.

E2.2 *Test Methodology*. A test conducted in accordance with AHRI 680 or ASHRAE 52.2 is applicable.

E2.3 *Performance Test.* The tested filter for performance shall be based on one of the closest filters in the family to a Nominal 24 in x 24 in.

E3 *Definitions.*

E3.1 *Filter Family.* Filters with the same construction including pleat spacing, pleat height, type of media, pleat support, and filter frame pattern, but with different filter face area are classified as part of a family.

E4 *Similarities within a Filter Family.* Performance of a filter media is governed by the face velocity. That is, that intensive properties of a filter media will be the same between individual filter models provided that they are from the same Filter Family and tested at the same face velocity. For any filter family, the following metrics will be the same if testing is done at the same face velocity:

E.5.1 Initial Resistance,
E.5.2 Final Resistance, and
E.5.3 Particle Efficiency,

E5 *Calculations.*

E5.1 The Face Area (A_{FA}), inches^2, shall be calculated as follows:

$$A_{FA} = Overall\ Filter\ Length \cdot Overall\ Filter\ Width \quad \text{(E1)}$$

E5.2 The Face Velocity, ft/min, shall be calculated as follows:

$$V_F = \frac{Q_{Tested}}{A_{FA,Tested}} \quad \text{(E2)}$$

E5.3 The Calculated Volumetric Flow Rate ($Q_{Calculated}$), cfm, shall be calculated as follows:

$$Q_{Calculated} = V_F \cdot A_{FA,Calculated} \quad \text{(E3)}$$

E5.4 The Calculated Dust Holding Capacity ($DHC_{Calculated}$), g, shall be calculated as follows:

$$DHC_{Calculated} = \frac{A_{FA,Calcualed}}{A_{FA,Tested}} \cdot DHC_{Tested} \quad \text{(E4)}$$

E6 *Symbols.*

V_F	=	Face velocity, ft/min
$Q_{Calculated}$	=	Volumetric flow rate, cfm
Q_{Tested}	=	Volumetric flow rate, cfm
$A_{FA,Calcualted}$	=	Face Area, ft^2
$A_{FA,Tested}$	=	Face Area, ft^2
$DHC_{Calculated}$	=	Dust holding Capacity, g
DHC_{Tested}	=	Dust holding Capacity, g

E7 *Example Calculations.*

Table E1. Example of Calculated Performance based on Tested Filter Performance

Filter Tested to method per E2.2			Airflow Rate, CFM	Face Velocity, ft/min	Initial Resistance, in H_20	Final Resistance, in H_20	Dust holding Capacity, g	Efficiency (Particle Size 0.30-1.0 µm), %	Efficiency (Particle Size 1.0-3.0 µm), %	Efficiency (Particle Size 3.0-10 µm), %
Model	1									
Overall Length, in	24.0		500	200	0.10					
Overall Width, in	24.0		1000	300	0.17					
Pleat Depth, in	5.0		1500	400	0.25					
Face Area, ft^2	4.0		2000	500	0.32	0.50	44	17	53	87
Calculated Filter Performance			Airflow Rate, CFM	Face Velocity, ft/min	Initial Resistance, in H_20	Final Resistance, in H_20	Dust holding Capacity, g	Efficiency (Particle Size 0.30-1.0 µm), %	Efficiency (Particle Size 1.0-3.0 µm), %	Efficiency (Particle Size 3.0-10 µm), %
Model	2									
Overall Length, in	18.0		250	200	0.10					
Overall Width, in	16.0		500	300	0.17					
Pleat Depth, in	5.0		750	400	0.25					
Face Area, ft^2	2.0		1000	500	0.32	0.50	22	17	53	87