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AHRI Comments â€“ Title 24-2019 Revised Express Terms

Additional submitted attachment is included below.

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May 7, 2017

California Energy Commission
Docket Unit, MS-4
1516 Ninth Street
Sacramento, California 95814-5512

Re: AHRI Comments – Title 24-2019 Revised Express Terms, 15-Day Language *[Docket No. 17-BSTD-02]*

Dear CEC Staff:

These comments are submitted in response to the California Energy Commission's (CEC) proposed changes to the Building Energy Efficiency Standards contained in the California Code of Regulations (CCR), Title 24, Part 6, and associated administrative regulations in Chapter 10 of Part 1 as published in the Revised Express Terms (15-Day Language) on April 20, 2018.

AHRI is the trade association representing manufacturers of heating, cooling, water heating, and commercial refrigeration equipment. More than 300 members strong, AHRI is an 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 and water heating industry is worth more than $44 billion. In the United States alone, the HVACR and water heating industry supports 1.3 million jobs and $256 billion in economic activity annually.

Several major and substantive changes were made to the 45-day language Express Terms to get to the Revised Express Terms; however, neither the Initial Statement of Reason (ISOR) nor the Negative Declaration were reissued to reflect these changes. Any measures ultimately adopted by the CEC in the 2019 edition of Title 24 need to be clearly and directly evaluated for their impact on each product affected. While we are pleased that several measures have been revised as a result of stakeholder concerns, unfortunately there are still important guidelines and procedures that remain unclear. For the benefit of both the public and industry – not to mention basic fairness – manufacturers must be able easily to determine if they are in compliance with applicable regulations. Release of the aforementioned documents, and appropriate time for stakeholder review, are critical to a transparent and fair regulatory process.

Mandatory Requirements for All Occupancies

Consolidating Demand Response, Section 110.12(a)

AHRI appreciate the work CEC has done to address comments received during the Express Terms 45-day language review period; however, some questions remain regarding new language that has been included in Section 110.12(a). While the consolidated demand response (DR) requirements now more clearly permit open source communication to a manufacturer's cloud some additional clarity is needed regarding the term "certified" in the Section. The 15-day language now requires a "certified" OpenADR 2.0a or 2.0b Virtual End Node (VEN); however, it is unclear from regulatory test what certification means in this context and how manufacturers would comply. Not only does there exist an OpenADR Alliance Certification Process, other avenues may exists in the near future, from both traditional and non-traditional certification bodies. For example, while an AHRI Certification Program does not yet exist, should one be created for AHRI Standard 1380P, *Demand Response through Variable Capacity HVAC Equipment in Residential and Small Commercial Applications*, would this qualify? Also, it is unclear if CEC considering requiring DR certified equipment in the the Modernized Appliance Efficiency Database (MAEDBS)? AHRI suggests this process be discussed with stakeholders.

Further, AHRI recommends CEC not limit DR equipment to the OpenADR protocol, but also include an option to permit equipment that responds to a CTA-2045 signals into Title 24. This would give California even more flexibility and options for implementing smart devices and building resiliency into the electric grid.

Low Rise Residential Proposals

Mandatory Requirements, Section 150.0

Change in Filter Efficiency Requirement

AHRI stands by previous comments and supports increasing filter efficacy, where necessary, but not over the entire state. The 15-day language did not address AHRI's concerns. While additional work has been conducted on this issue, CEC has not provided a response to the Commission's lack of action regarding stakeholder comments, particularly regarding an energy study. It has been extensively documented by the CASE team that the requirement for mechanically-driven supply air with MERV 13 filtration of outside air in high-rise multi-family units will increase costs by approximately $1,600 per unit. While it is certainly simpler to require statewide compliance, a more targeted approach, such as that recommended by the CASE team, would address the issue without penalizing homeowners in locations with acceptable outdoor air quality. The CASE team proposes delineating high ambient PM 2.5 areas by those locations within 500 feet of a "busy roadway," defined as a roadway with annual average daily traffic (AADT) equal to or greater than 100,000 vehicles per day. Those buildings within

proximity to such roadways would be required to have systems with MERV 13 filters, and all others would be required to have a minimum of MERV 8 filters. Studies are cited with the CASE report that roughly five percent of the population will be affected, based on such proximity to freeways in Southern California. Also, all attainment and unclassified zones published in the most recent edition of the Area Designations for State Ambient Air Quality Standard PM 2.5 map issued by the Air Quality Planning Branch should only be required to install MERV 8 filters[1]. This approach makes sense, and other than the small fraction of time where PM2.5 is associated with cooking, it seems that proposing a blanket MERV 13 filter requirement is completely unnecessary. Adequate data has been provided to support this approach, and the potential failure modes, safety and efficiency issues associated with higher static pressures, as discussed in greater detail below, are significant.

Further, a blanket MERV 13 filter requirement does not consider the successful efforts nonattainment zones are making to reach attainment. There are currently plans in place to improve the outdoor air quality, and once re-designated by the EPA, these areas will no longer require enhanced filtration.

The energy impact of requiring all new construction HVAC systems to include MERV 13 filtration has also not been investigated. While this may not be required, it should not be ignored that new construction projects will need to increase the size of and capacity of HVAC ducting and/or equipment to accommodate larger filters and/or higher filter pressure losses, and that if applied to existing construction without corresponding duct/equipment upgrades, a certain percentage of equipment failures and potential damage should be expected to occur from the reduced air flow rates, which are commonly known to increase the possibility of air-conditioning coil freeze-up as well as heat exchanger failures that could result in carbon monoxide hazards.

AHRI supports limiting the requirement for MERV 13 for outdoor air filtration only to areas that have high ambient PM2.5: near busy roadways. For the remainder of the state the existing requirement for MERV 6 filtration on outside air is sufficient.

Air Filtration, Section 150.0(m)12

AHRI is concerned with the change to Section 150.0(m)12.A.i in the Revised Express Terms which removes the exception for systems using less than 10 feet of ductwork and evaporative coolers. Indeed, evaporative coolers are exempt from similar such provision in the non-residential Section 120(b)1. All CASE team and CEC studies were conducted on traditional central air-conditioners and heat pumps. No research regarding the impact on other systems was presented to support the15-day language proposal requiring MERV 13 air filters on *all* mechanical space equipment regardless of it serving the purpose of introducing outside air to the space or not. Title 24 now proposes to require MERV 13 filters on all equipment supplying outside air to the indoors, so why also add such a stringent requirement on other space conditioning equipment? AHRI

[1] December 2015 ARB PM 2.5 Map https://www.arb.ca.gov/desig/adm/2015/state_pm25.pdf accessed October 18, 2017.

strongly suggest CEC reconsider deleting the 10 foot of ductwork exception from this section as the Commission does not have the proper justification to do so.

Fan Efficacy, Section 150.0(m)13

AHRI appreciates CEC responding to stakeholder concerns by including an exception for gas furnaces manufactured prior to July 3, 2019, complying with the increase in stringency of the fan efficacy requirements.

Unfortunately, industry is still concerned that CEC has not provided an exception for packaged or mobile home products. While ten furnace models were tested to provide additional data to justify the proposed 0.45 Watts/cfm fan efficacy requirement for furnaces, this data does not include any packaged or mobile home products. On September 15, 2017, AHRI suggested by e-mail that CEC test higher tonnage package equipment as the larger furnaces are expected to have the most difficult time complying with the federal furnace fan rule. The November 2017 CASE report fails to mention any testing of packaged or mobile home products being included in the testing. Requirements need to be vetted across all products affected by the proposed regulation. If packaged products are intended to be included, then additional studies need to be done on those products. Without any validation testing, AHRI strongly urges CEC to provide an exemption for packaged or mobile home products. AHRI supports product improvements that make advancements in efficiency; however, these should not be mandated across all product lines without an adequate body of corresponding test data in each category. Doing so will cause market disruption which will disproportionately affect some manufacturers more than others.

The test report also fails to address previously raised concerns (during the July 18th meeting and in previous AHRI comments) that for this particular measure, the field tests were not conducted with MERV 13 filters. AHRI suggests that CEC show through this testing that an increased MERV requirement would not adversely impact energy consumption. The increased filtration and Watts/cfm analyses have previously been conducted separately, which has led CEC to erroneously deduce that both the MERV 13 and 0.45 Watts/cfm measures are reasonable. There are many published studies (see Exhibit-1) which conclusively show a negative impact on energy efficiency as a result of increased filtration. These two proposals should not be considered in isolation as they both impact the same product. Again, maintaining current MERV 6 to MERV 8 requirements protect equipment from dust and particulates, and shifting the task of higher filtration rates to dedicated IAQ systems will avoid the colliding objectives of efficiency, health, safety liabilities and market disruption.

The purpose of the current 0.58 Watts/cfm requirement is to ensure that duct systems are properly sized. The intention of this fan efficacy measure is to maintain current standards for duct design as furnace fan efficiency improves. AHRI does appreciate that CEC is proposing that 0.45 Watts/cfm requirement will be applicable only to furnaces and that the existing 0.58 Watts/cfm requirement will remain in effect for air handling units that are not furnaces.

During the October 5, 2017, workshop a HERS rater noted that a majority of the furnace installations are struggling to meet the current 0.58 Watts/cfm requirement - even the condensing furnaces with ECMs. There are field data collection and analysis opportunities that would substantiate our position on fan watt draw: HERS providers such as CHEERS and CalCERTS maintain databases with measurements taken in field conditions. AHRI continues to urge CEC to review portions of the collected data to determine the fan efficacy values being recorded today rather than relying on measurements taken on duct work conducted in a laboratory setting. The fan efficacy metric is effectively an efficiency metric which is dependent on duct design, and if Manual D is not followed properly, furnaces with ECMs also end up getting penalized. The HERS registries provide access to field measured fan efficacy data for several homes, and would allow CEC to evaluate a large sample size representative of actual field performance. An uncertainty analysis should be performed on all field measurements, and compliance should be based on being within the field measurement, with allowances made to accommodate for uncertainty due to inaccuracy of field measurements as opposed to laboratory measurements. The bottom line is that while it is important to ensure proper duct construction, there is no way to verify that Manual D is being complied with during the construction process, and manufacturers of HVAC equipment should not be held responsible for duct design and construction.

Lastly, AHRI suggest CEC review formatting for exceptions in 150.0(m)13, as those paragraphs appear to be incorrectly aligned.

Prescriptive Requirements, Section 150.1

Heating Capacity at 17 °F, Section 150.1(b)3.B.iv and v

AHRI appreciates CEC's responding to industry concerns by making the inspection of minimum heating performance (HSPF) at 17 degrees Fahrenheit an option for performance compliance.

Water Heating Prescriptive Requirements, Sections 150.1(c)8.A.ii, iii and iv

The modifications made to this section in the 15-day language document appear to have attempted to address some of the concerns expressed in the comments we submitted on March 4, 2018. However, the current proposed revisions merely shift our concern to different categories of water heaters.

We agree with the basic concept of restoring the prescriptive compliance requirement for gas or propane storage type water heaters with an input of 75,000 Btu per hour or less and a rated volume less than or equal to 55 gallons (proposed Section 150.1(c)8.A.ii.); however, we do not agree with the inclusion of other design features as a condition for the installation of these water heaters. As we noted in our March 4, 2018 comments, adding prescriptive provisions applicable to the installation of federal compliance products violates EPCA's preemptions provisions. 42 U.S.C. 6297(c).

In proposed Section 150.1(c)8.A.iii, the additional prescriptive provisions of subsections a., b., and c., are proposed to be deleted. Consistent with our comments above regarding Federal preemption, we agree with that change. However, we do not agree with the change to limit this option to gas or propane storage type water heaters with an input of 75,000 Btu per hour or less and a rated volume of more than 55 gallons. The current input limit of 105,000 Btu per hour for models of this size should be retained. No information has been provided to justify this change to lower the input limit. The California Plumbing Code requires that water heaters in new residential dwellings be sized per the requirements of the code. There may be new residential buildings that require a large gas storage water heater with an input greater than 75,000 Btu/h. The building energy standards should not put an arbitrary restriction of the plumbing code sizing requirements. In addition, many gas storage water heater models in the range of 76,000 Btu/h to 105,000 Btu/h are condensing water heaters, the highest efficiency models available.

Proposed Section 150.1(c)8.A.iv, requires the installation of solar panels along with two other prescriptive provisions when a heat pump water heater is installed. Proposed Section 150.1(c)8.A.v allows the installation of a heat pump water heater meeting an advanced specifications and very limited other prescriptive provisions. The Initial Statement of Reasons claims that all the prescriptive options must be equivalent. This was demonstrated for the water heater options that were presented in the 45-day language document and has not been demonstrated for the current water heater options in the 15-day language document. Our March 4, 2018 comments pointed out that with certain exceptions, 42 U.S.C. § 6297(f) prohibits a regulation or other requirement contained in a State or local building code for new construction concerning the energy efficiency or energy use of a covered product. No information has been provided to even attempt to show that the exceptions which allow for an exemption from Federal preemption have been met by these proposed requirements. We continue to maintain that these proposed water heating prescriptive requirements conflict with federal efficiency minimums and, thus, are invalid.

We reaffirm our recommendation that the CEC decouple the requirements for the type of water heater that may be installed from any added prescriptive provisions that restrict the acceptability of such installations.

Fan Efficacy, Section 150.1(c)10

AHRI appreciates CEC also making changes to this section to acknowledge the appropriate exemption of gas furnaces manufactured prior to July 3, 2019 from complying with the increase in stringency of the fan efficacy requirements. AHRI suggests that all changes proposed in this letter for Section 150.0(m) should also be implemented in Section 150.1(c) for consistency in the standard.

Additions and Alterations, Section 150.2

Replacement Water Heater Requirements, Section 150.2(b)1.H

AHRI has the same concerns as discussed in Sections 150.1(c)8.A.iv and v above and urges CEC to decouple the water heater from the photovoltaic requirements.

Minimum Airflow Requirements

Current Title 24 requirements for verification of system performance are based on 350 cfm per nominal ton; however, these requirements should instead be based on rated capacity. The 350 cfm per nominal ton minimum airflow requirement is not an accurate representation of airflow rates at which systems operate. While most residential HVAC systems do operate in the 350-450 cfm per rated ton range, and most HVAC OEMs do design their systems to operate somewhere in that range, there are some outliers to this nominal range. The optimal airflow rate for an HVAC system depends on many factors, such as the option for several different indoor coils, which can change the rated airflow for the system. Certified capacity and airflow rates are publicly available on the AHRI Certification Directory. Just as CEC has proposed using the AHRI Certification Directory for heat pump capacity at 17 °F, inspectors are easily able to find rated capacity and airflow rates. CEC should allow airflow rates that are utilized to achieve federally mandated minimum efficiency performance.

Residential and Non-residential Appendices

Rated Heat Pump Capacity Verification, RA 3.4.4.2

AHRI appreciates CEC's responding to industry concerns by making the inspection of minimum heating performance (HSPF) at 17 degrees Fahrenheit an option for performance compliance and that changes were made to the Residential Appendices to confirm that, "if the product directory does not publish capacity ratings at 17°F, then compliance with capacity at 17°F is not required."

Thermal Storage Equipment

AHRI supports CEC's proposal to provide a limited compliance credit to battery energy storage systems that will provide energy design rating points of credit toward the energy efficiency target score. Providing a credit for energy storage is important because it has a critical role to play in helping California achieve its clean energy and greenhouse gas reduction goals in an affordable manner. A recently published ASHRAE research project (ASHRAE RP-1607) concluded *cool thermal energy storage systems can boost the utilization of renewable energy resources by as much as 50 percent and reduce owners' operating costs.*

We urge CEC to make a similar credit available to thermal storage systems, including grid-connected flexible electric heating and cooling (including ice thermal

storage), when they are controlled similarly to the control schemes prescribed for battery storage. Credit for energy storage should be technology neutral and performance-based.

Nonresidential, High Rise Residential, and Hotel/Motel Building Proposals

Requirements for Ventilation and IAQ, Section 120.1

AHRI strongly supports complete harmonizationwith *ANSI/ASHRAE Standard 62.1-2016 Ventilation for Acceptable Indoor Air Quality* (ASHRAE 62.1), rather than aligning with the concept and arbitrarily increasing the stringency of certain aspects, particularly the ventilation rate increase of 130-percent above the ASHRAE 62.1 levels. In the CASE report, it has been claimed that, "Without the 130 -percent multiplier on minimum ventilation rates, concentrations of CO_2 in the space for certain occupancy categories can exceed 2,000 parts per million (ppm), which can have adverse effects on human health in as little as a 3-hour exposure session." However, there are only five categories which exceed this limit and only by very small amounts (10-275 ppm). The five categories are also typically places one would spend less than three hours. It should also be noted that the CASE report does not justify the use of 2,000 ppm and the lowest CO_2 concentration limit cited in Appendix C of ASHRAE 62.1 is the non-regulatory level of 3,500 ppm, a recommended maximum long term exposure for Canadian residences developed in 1987 and reaffirmed in 1995 by a committee of provincial members convened by the federal government to establish consensus guideline-type levels. A revised version is being considered. Levels set by this Canadian agency are not intended to be enforced. CEC should reconsider divergence and instead completely harmonize with ASHRAE 62.1.

Air Filter Efficiency, Section 120.1(b)1.C

AHRI suggests CEC similarly address concerns raised to Section 150.0(m)12.A.i in the Revised Express Terms which also proposes removing the exception for systems using less than 10 feet of ductwork. As stated, above, no research regarding the impact on other systems was presented to support the15-day language proposal requiring MERV 13 air filters on *all* mechanical space equipment regardless of it serving the purpose of introducing outside air to the space or not. While AHRI does not agree a state-wide filter efficacy increase it warranted, logic stands that if the intent of the increase in filter efficacy is to address PM 2.5 from outside air, then limiting MERV 13 filters to those systems should be adequate to address the problem. Again, CEC has not conducted adequate research on expanding the MERV 13 requirement to all space conditioning equipment.

AHRI is extremely concerns with new language presented in Section 120.1(c)1 which expands increased filter efficacy requirements beyond outside air to also include return air.

AHRI reiterates the same concerns expressed regarding residential IAQ proposals on MERV 13 filters and applications as well as comments made on March 18. As

previously stated, one member company compared the performance of MERV 8 and MERV 13 filters over time. Clean air pressure drops for MERV 8 and 13 were 0.24 inches and 0.30 inches, respectively, at 500 fpm. Recommended final pressure drops are one inch for both filters, but MERV 13 was found to clog much faster, and necessitates frequent filter replacement, thereby increasing labor costs. There is also a significant energy penalty associated with running equipment with filters loaded to over one-inch pressure drop. Many nonresidential building customers also buy MERV 8 pre-filters to extend the life of the MERV 13 filter. Redundant filter air pressure drop penalty is greater but the replacement filter media cost is less. It is unclear from the CASE report if pre-filtering scenarios have been fully considered in staff's decision making proposals. Frequently there is pre-filtration in commercial buildings.

Like the concerns expressed on the residential equipment side, analysis performed for some nonresidential HVAC measures assumes a MERV 9 filter in the CEC technical analysis; however, this is not consistent with the CEC's indoor air quality proposal for areas exceeding the 2.5 micron (PM2.5) threshold, where MERV 13 filters are being proposed for nonresidential buildings. AHRI would also like CEC to provide additional information regarding the extent of these PM 2.5 nonattainment areas which would require enhanced filtration, perhaps by releasing zip codes of affected areas. Lastly, it is unclear what filtration level is being proposed for areas with better air quality. CEC should make this aspect of the proposal clearer. It should also be noted, that the proposal for MERV 13 filters seems to extend to those fans that bring in outdoor air, yet no rationale has been provided for requiring such mitigation for indoor air pollutants. Also, while the intent of the nonresidential HVAC proposals is cost-effective enhancements to improve energy efficiency and energy performance in California buildings, it is not possible for California to achieve these goals without considering the increased cost of California-specific equipment to consumers. Nor is it considered in the market impact analysis on the manufacturers. AHRI recommends making it clear, that any MERV 13 filter requirement is limited to (1) nonresidential structures with a close proximity to busy roadways; and (2) fans which bring in outdoor air in commercial applications (economizers).

It also appears that CEC has not reviewed the impact of the MERV 13 proposal on all equipment and building types. Package terminal air conditioners and heat pumps (PTAC/PTHP) and single package vertical units (SPVU) are frequently applied in hotels and motels, but due to the space-constrained nature of these products, neither are able to accommodate a two-inch deep MERV 13 filter. Even a one-inch deep MERV 13 filter would seriously reduce the airflow, which would adversely impact both energy efficiency and occupant comfort, as well as make equipment noisier. AHRI recommends exempting equipment which brings in outdoor air associated with any make-up air units with a maximum airflow threshold of 120 cfm in Section 120.1(c).

AHRI supports exempting existing mechanical equipment from the MERV 13 filter requirement in Section 7.2 of the California Green Building Standards Code, Part 11.

Labeling for Dwelling Unit Ventilation Systems, Section 120.1(c)1.A.viii

While AHRI understands that recent studies conducted to establish long-term compliance with ASHRAE Standard 62.2 may suggest that many homeowners disable, or rarely use home ventilation systems, the text proposed, “This switch controls the indoor air quality ventilation for the home. Leave it on unless the outdoor air quality is very poor,” may not be the best way to address the problem. Though many of these switches may be installed in less obvious places, California homeowners likely will not want such a label in their home, and would remove it, negating the intended effect. AHRI suggests CEC review this issue more carefully and propose an alternate solution.

Filter Depth, Section 120.1(c)1.B

AHRI appreciates CEC including the option for one-inch deep filters in this section.

Air Classification and Recirculation Limitations, Section 120.1(g)

AHRI appreciates CEC harmonizing with ASHRAE Standard 62.1 and including allowances for limited installation of energy recovery ventilation devices (ERV) consistent with Sections 5.16.3.2.5 and 5.16.3.3.2.

Pipe Insulation, Section 120.3(a)

AHRI appreciates CEC responding to the AHRI concerns submitted in previous comments by clarifying that the general requirements for pipe insulation in Section 120.3(a) are for normal operating conditions. The goal of insulating piping for space-conditioning and service water-heating systems is to save energy. This can be accomplished for a reasonable cost by sizing the insulation to be for normal operating conditions rather than the maximum expected operating conditions. After this point, there will be diminishing returns on the energy savings side, with significant increases in cost. Designing for normal operating conditions will capture full energy savings potential for the vast majority of system operation, and will provide impactful benefit during design day conditions.

AHRI also appreciates CEC retaining Exception 4 to Section 120.3, “Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.”

Proposal for Tables 120.6.B & 120.6.C: Use 95 °F Saturated Condensing Temperature (SCT), 95°F Outdoor Dry-bulb Temperature, 70 °F Outdoor Wet-bulb Temperature for thermal rating condition for adiabatic condensers

AHRI is concerned that CEC has not accepted the reasonable approach previously proposed and reiterated here. The proposed language in Table 120.6-C establishes a method of minimum sizing for adiabatic condensers based exclusively on the dry-bulb and the dry heat rejection efficiency. AHRI proposes establishing minimum sizing criteria

for the equipment based on adiabatic (wet) operating conditions, with the saturated condensing temperature at or below the ambient dry bulb temperature, for the following reasons:

- *Changing this approach (i.e. not using typical design conditions in Title 24 to rate equipment) will create confusion for those designing the system.* Adiabatic condensers are designed to operate in wet-mode during Design Day (i.e. summer, hot) conditions, and are sized this way by consulting engineers. As such, code requirements should follow based on wet (adiabatic) criteria. Efficiency criteria for air-cooled and evaporative condensers each have a summer-condition selected to match their respective *design* summer-operating mode.
- *The Code does not establish the criteria for the performance of the equipment operating in the manner in which the CASE study was performed.* All of the energy modeling that was performed in the CASE study to demonstrate the benefit of adiabatic condensers to the State was done assuming wet performance in warm weather.
- *By establishing criteria based solely on dry performance characteristics of adiabatic condensers, it could actually result in increased energy consumption in California.* Dry criteria could incentivize some of the industry to design such units with poor performance, or creatively modify or label air-cooled condensers into adiabatic hybrid units, potentially leading to the opposite outcome from the intent of this regulation.

By rating a unit by the proposed method, above, the energy results of the CASE study could be maintained, confusion in the industry would be minimized, and as air-cooled condensers would have no (0) capacity with this method, they could not be substituted.

In addition, the CEC has proposed acceptance testing in dry mode only using an air-cooled condenser test standard. As these units are designed for wet operation, which is where they save the maximum energy, we suggest that adiabatic condensers be tested in the wet (adiabatic) mode. Alternatively, if the CEC desires to not make this modification to the 45-day language, and call for adiabatic condensers to be tested in the dry mode, then the language should clearly state that the adiabatic pads should be removed during dry mode testing. This will place adiabatic designs more on par with air-cooled condensers.

Nonresidential Performance and Prescriptive Approaches, Section 140

AHRI supports California adopting *ANSI/ASHRAE/IES Standard 90.1-2016 -- Energy Standard for Buildings Except Low-Rise Residential Buildings* (ASHRAE 90.1) content in a consistent and harmonized manner. While it is understood that ASHRAE 90.1 was developed to suit the nation, reviewing the measures suitable for California, or adapting measures to better suit California's climate zones is logical and appropriate, but to propose significant deviations from proposals developed through ASHRAE's

consensus-building process under the umbrella of “ASHRAE 90.1-2016 proposals” is misleading. During the course of the development of Title 24-2019, several proposals have strayed far from the intent of the ASHRAE 90.1 measures and, if implemented, would negatively impact manufacturers of HVAC equipment by requiring multiple product design requirements to be implemented in different states.

Fan System Power, Section 140.4(c)

The recent CASE team report, posted to docket on April 12, 2018, show that moving to MERV 13 filters will negatively impact statewide energy saving, as AHRI has suggested in past comments. However, the report does not justify the 15-day language proposal to remove the credit for high efficiency filters in Table 140.4-B Fan Power Limitation Pressure Drop Adjustment. It is unclear where the 200 fans cited in the study were installed. Are these installed in equipment, if so, what kind? If so, where within the product? Rather than eliminate the pressure drop for filters, ARHI recommends lowering the filter efficacy, except where warranted by poor outdoor air quality, as outlined above and in previous AHRI comments.

AHRI does appreciate the retention of the pressure drop adjustments for replacement projects in Table 141.0-D.

Cooling Tower Efficiency, Mandatory Requirement, Section 140.4(h)5

While it would be preferable for CEC to harmonize completely with ASHRAE 90.1, AHRI does appreciate that the proposed language in the Express Terms is a significant improvement to the previous proposal by only increasing the minimum efficiency for axial fan, open-circuit cooling towers serving condenser water loops for chilled water plants with a total of 900 gpm or greater, from 42.1 gpm/hp to 60.0 gpm/hp, rather than the previous 80.0 gpm/hp, and exempting existing building-mounted systems. This modification will increase the models available for designers, while helping to minimize unintended adverse market consequences caused by switching to less efficient cooling systems.

Exhaust Air Heat Recovery, Pre-publication Draft Section 140.4 (o)

AHRI appreciates CEC’s reconsideration of previously proposed language related to exhaust air heat recovery which is now absent in the Express Terms. AHRI had previously commented that in the mild climate zones of California exhaust air heat recovery is not cost effective. In a similar study conducted by ASHRAE SSPC 90.1, it was shown that most applications are not cost effective at the 50-percent threshold and CEC’s 60-percent proposal will be even less so, with DOAS being a notable exception. Should CEC seek to reintroduce this measure in the future, AHRI suggests net sensible energy recovery ratio of at least 50-percent for both heating and cooling for DOAS only.

Waterside Economizers, Section 140.4

AHRI supports CEC's decision to harmonize the water-side approach with the levels in ASHRAE 90.1-2016. This is a significant improvement from the previous proposal.

In line with previous AHRI comments, Table 140.4-C applies to a limited subset of chilled water systems (i.e., chilled beams, radiant, etc. – systems without fans) and should be so noted in the title which is currently slightly misleading as it could easily be understood to apply to all chilled water systems. AHRI suggests CEC retitle Table 140.4-C to, "Table 140.4-C. Capacity requirements for chilled-water cooling systems without a fan or systems that use induced airflow." For reference, the analogous table in Standard 90.1 states, "Chilled-water cooling *systems* without a fan or that use induced airflow, where the total capacity of these *systems* is less than 1,000,000 Btu/h in Climate Zones 0, 1B, and 2 through 4; less than 1,400,000 Btu/h in Climate Zones 5 through 8; or any size in Climate Zone 1A."

Transfer Air for Exhaust Air Makeup, Section 140.4(o)

AHRI supports the proposal to use transfer air to supplement air to spaces that exhaust more than the amount of conditioned air required. AHRI appreciates CEC responding to previous AHRI comments and modifying this proposal to harmonize with ASHRAE Standard 62.1 regarding pressurization. However, one important point is necessary for complete harmonization. ASHRAE 62.1-2016 limits the recirculation of lower quality air into spaces that contain air of higher quality. AHRI urges CEC to include a similar provision to ensure the highest degree of indoor air quality possible while reducing the overall energy consumption of the building.

Service Water Heating Systems, Prescriptive Requirements, Section 140.5

AHRI remains concerned with the change in requirements for service water heating systems to comply with the solar fraction requirement of Section 150.1(c)8.B.iii. In the current edition of Title 24, buildings four stories and greater are not required to comply with the solar fraction requirement; however, CEC is now proposing to increase the exemption to buildings of eight stories or greater. During the February 6 public hearing, CEC staff was unable to provide a data-driven reason for this change, and no detailed proposal are contained in the CASE reports. In light of this lack of proof to substantiate the change, AHRI recommends retaining the current exemption of four stories or greater.

Conclusion

AHRI would alert CEC that our organization is moving in August, prior to the publication of Title 24-2019. As such, we request that you update all references to AHRI

standards and guidelines to the following address: 2311 Wilson Boulevard, Suite 400, Arlington VA, 22201.

As always, AHRI recommends CEC make changes to its proposal consistent with items highlighted in these comments in order to avoid significant violations of federal preemption provisions contained in the Energy Policy and Conservation Act. AHRI also urges CEC to harmonize its proposals completely with ASHRAE 90.1 and 62.1, for climate zones where it does not have a negative market impact.

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

Sincerely,

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Engineering Director, Regulatory Affairs
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Exhibit-1: Relevant Studies on the Energy Impact of High Efficiency Filters and Observations

1. Yang, Li, Braun, James E., Groll and Eckhard A. "The impact of evaporator fouling and filtration on the performance of packaged air conditioners." International Journal of Refrigeration Volume 30, Issue 3 (May 2007): 506-514. Accessed online: http://www.sciencedirect.com/science/article/pii/S0140700706001897

   "Equipment having low efficiency filters had higher EER after fouling than equipment with high efficiency filters, because high efficiency filters result in significantly higher pressure drops than low efficiency filters."

2. Stephens, Brent, Siegel, Jeffrey A., and Novoselac, Atila. "Energy Implications of Filtration in Residential and Light-Commercial Buildings." ASHRAE Transactions OR-10-038 (RP-1299) (2000): 346-357. Accessed online: http://www.ce.utexas.edu/prof/novoselac/Publications/Novoselac_ASHRAE_Transactions_2010.pdf

   Some observations:

   a. The decrease in airflow rate as a result of a higher MERV filter directly conflicts with the minimum 350 cfm/ton Title 24 airflow requirement. Here are the pertinent references within the research paper:
      i. Page 351 - "The results in Table 3 show that high-MERV filters introduced an approximately 45% greater pressure drop than low MERV filters. High-MERV filters caused median airflow rates to decrease by approximately 4% in the fan-only period and by 10% in the cooling mode, relative to low-MERV filters. High MERV filters decreased fan power draw by approximately 1% in the fan-only mode and 4% in the cooling mode relative to low-MERV filters. The net result of the changes in airflow and fan power is that high-MERV filters supplied approximately 4% less volumetric airflow per unit of power in the fan-only mode and 5% less in the cooling mode."
      ii. Page 351 - "The magnitude of flow reductions seen with higher-efficiency filters generally agrees with the flow reductions measured in Parker et al. (1997)."
      iii. Table 3 on page 352 – The variation in fan efficacy is not much while comparing the "High-MERV vs. Low-MERV" and "Mid-MERV vs. Low-MERV" scenarios, but there is a significant disparity in the airflow rate percentages in cooling mode for the two scenarios.
      iv. Page 353 – "According to the regressions, a doubling of the filter pressure drop (due either to loading or replacement with a higher efficiency filter) would likely result in an 6 to 8% decrease in system airflow during fan-only operation and 7 to 10% during cooling operation."

b. Increased energy consumption:
    i. Table 5 on page 354 – the positive change in daily energy consumption in the last column indicates higher energy consumption associated with high-MERV filters relative to lower MERV filters. There are 6 such instances within the table.
        1. The Title 24 CASE report does not thoroughly assess the impact of the proposed MERV 13 measure on energy consumption across the 16 climate zones.
    ii. Page 355 – "…five of seven residential systems showed an increase in energy consumption with high-MERV filters (positive values in Table 5)…"

3. Walker, Iain S., Dickerhoff, Darryl J., Faulkner, David, and Turner,W illiam J. N. "System Effect of High Efficiency Filters in Homes." LBNL. (March 2013) Accessed online: http://escholarship.org/uc/item/2nj5z1xm#page-10

   Some observations:

   a. Page 5 – Section titled "Field testing of filter impacts on HVAC system performance" illustrates potential issues for putting filters into existing systems that were not designed for high-MERV filters and their associated air flow resistance.
       i. CEC should consider that a majority of the installed based is still PSC-dependent, and will continue to be so for a few years even after the 1/1/2020 compliance date. Homeowners will not simply change out their systems upon the occurrence of the 7/3/2019 FER compliance date. Therefore, the mandatory MERV 13 requirement will end up reducing the airflow for installed-base systems with PSC motors (up to 10% per this LBNL study).
   b. Page 6 – "In a couple of cases even BPM driven blowers were unable to maintain airflow because the motors were operating at maximum output before the required airflow rate was met. Other complications for predicting the system performance were that, in one case, a BPM driven blower increased flow with a MERV 16 filter. This shows how the particulars of the BPM control algorithm can confound predictions of performance."
       i. The LBNL figures across pages 7 and 8 don't precisely show the data for MERV 13 filters, but this type of analysis should be included in the CASE report, when published. AHRI suggests a similar analysis for MERV 13 in cooling dominated California regions is warranted to assess the full impact of the proposed residential HVAC measures.
   c. Page 9 – "Filtration causes a higher energy penalty in cooling dominated climates than in heating dominated climates mostly due to higher airflow requirements for cooling systems." This is one of the conclusions within the LBNL study.

4. During the June 6, 2017 CEC Title 24-2019 Pre-rulemaking Staff Workshop, CEC indicated that the "incremental cost for 1-inch depth MERV 13 versus MERV 6 may

be less than $4." According to Factory Direct, the incremental cost is much higher. A real-world example for the increase in incremental cost for switching filters in an average home, while excluding the filter griller resizing cost or the cost to add a new filter grille is as follows:

a. Switching from a 14x14x1 MERV 6 to 14x14x2 MERV 13 – incremental cost is $9.20 for each filter.
b. Switching from a 10x20x1 MERV 6 to 10x20x2 MERV 13 – incremental cost is $9.9 for each filter.
c. Total incremental cost for two new filters while not accounting for any changes to the filter grilles – $ 19.10.