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Additional submitted attachment is included below.

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March 4, 2017

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

Re: AHRI Comments – Title 24-2019 Express Terms and February Public Hearings *[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 Express Terms (45-Day Language) on January 19, 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.

We believe that 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.

The last sentence of the Initial Statement of Reason (ISOR) incorrectly states, "Therefore, these proposed regulations do not duplicate or conflict with any federal regulations." In truth, there are several proposals which CEC must change because they are plainly preempted under the Energy Policy and Conservation Act of 1975 (EPCA), 42 U.S.C. § 6297. Moreover, failing to make these changes will jeopardizes not only the specific offending proposals but others as well, since it is not clear that pre-empted proposals can be severed from others.

Mandatory Requirements for All Occupancies

Consolidating Demand Response, Section 110.12(a)

AHRI supports consolidating demand response (DR) requirements into a single section. This consolidation improves the clarity of the requirements since they relate to all equipment. We do, however, have a handful of questions and concerns. During the February 5th Public Hearing, CEC indicated that OpenADR 2.0 is required, but that other communication protocols are also allowed; however, with the OpenADR requirement to the end node, it appears in practice that other communication protocols would not be permitted. There have been ongoing discussions within the manufacturing community, particularly during the development of proposed AHRI Standard 1380P, *Demand Response through Variable Capacity HVAC Equipment in Residential and Small Commercial Applications*, regarding the need for options to communicate via Open ADR to a manufacturer's cloud, which would then communicate directly with the end node devices. Arguments in favor of this strategy include reducing test burden by allowing demand response test tools to be located remotely from the unit under test (UUT),; and enhancing security. Open source communication to a manufacturer's cloud would not impede CEC's desire to implement simple approaches to scale DR. AHRI suggests that CEC include language clearly permitting open source communication to a manufacturer's cloud to ensure robust competition in the DR marketplace.

Low Rise Residential Proposals

Mandatory Requirements, Section 150.0

Change in Filter Efficiency Requirement

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.

Fan Efficacy, Section 150.0(m)

While CEC has tested ten furnace models to provide additional data to justify the proposed 0.45 Watts/cfm fan efficacy requirement for furnaces, this data does not completely address previous AHRI comments and concerns. 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. Unfortunately, the report released in November 2017 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.

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

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.

The proposal is also fatally flawed because of the stranded inventory it would create. The compliance date for the federal furnace fan rule is July 3, 2019, while the 2019 edition of Title 24 will go into effect shortly thereafter on January 1, 2020. This means new construction builders will have only five months to switch to gas furnaces with higher efficiency motors. Because the federal furnace fan standard is based on the date of manufacture, the fan efficacy requirement should be based on the date of manufacture as well. *A proposal ignoring the date of manufacture would not only be arbitrary and capricious but it would be pre-empted by federal law.* 42 U.S.C. § 6297; 42 U.S.C. § 6316(b)(2)(A). The proposal effectively requires use of higher efficiency products than federal standards allow and imposes a penalty on federally compliant products. The underlying policy of federal preemption is to maintain consistent efficiency regulations nation-wide, rather than creating a patchwork of differing requirements for the same product.[2] The proposed effective date undermines this purpose and is contrary to federal law. The Energy Policy and Conservation Act plainly states "effective on the effective date of an energy conservation standard established in or prescribed under section 6295 of this title for any covered product, **no State regulation concerning the energy efficiency, energy use, or water use of such covered product shall be effective**." 42 U.S.C 6297(c). This prohibition is broadly written to apply not only to efficiency minimums, but labeling requirements, effective dates, and installation penalties. CEC has not received a waiver from the Department of Energy for its proposal, and none of the other narrow preemption exemptions apply. It is important to note that building codes are expressly prohibited from requiring installation of products with efficiencies in excess of federal minimums in the absence of a waiver. 42 U.S.C. 6297(f)(4)(b). Further, no testing was performed on furnaces with PSC motors, and there is no indication that these existing, federally compliant products will be able to meet proposed requirements, further falling afoul of federal preemption. To alleviate these problems, CEC should maintain the existing 0.58 Watt/cfm requirement on all furnaces manufactured prior to July 3, 2019.

Prescriptive Requirements, Section 150.1

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

The proposal imposes verification requirements beyond federal requirements for heat pumps with greater than minimum heating performance (HSPF), specifically heating capacity values at 17 degrees Fahrenheit, as an option for performance compliance. With certain exceptions, which do not apply in this case, 42 U.S.C. § 6297 prohibits state regulations from requiring disclosure of information with respect to the energy use, energy efficiency, or water use of any covered product. And the proposal, which bans federally compliant products unless they comply with these excessive requirements is thus pre-

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[2] Air Conditioning Heating and Refrigeration Institute v. City of Albuquerque 835 F. Supp.2d 1133 (Dist. N.M. 2010) Elaborating on the purpose behind Section 6297's broad preemption provision, the Court stated: "The legislative history indicates that during the 1970s, some states began enacting appliance efficiency standards. S. Rep. No. 110-6 at 3 (January 20, 1987). Consequently, "appliance manufacturers were confronted with the problem of a growing patchwork of differing State regulations which would increasingly complicate their design, production and marketing plans." S. Rep. No. 110-6 at 3 (January 20, 1987). One purpose of National Appliance Energy Conservation Act is to "reduce the regulatory and economic burdens on the appliance manufacturing industry through the establishment of national energy conservation standards for major residential appliances." S. Rep. No. 110-6 at 1 (January 20, 1987); H. Rep. No. 1000-11 at 24 (March 3, 1987) (legislation "designed to protect the appliance industry from having to comply with a patchwork of numerous conflicting State requirements"). The prescriptive standards in Volume I of the City of Albuquerque's Code, which are more stringent than the federal standards, could complicate the design, production and marketing plans of appliance manufacturers, thus thwarting Congressional intent."

empted by federal law for this reason as well. CEC could make this an optional, but not a required field.

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

AHRI has serious concerns with deleting prescriptive compliance requirements for gas or propane storage type water heaters with an input of 105,000 Btu per hour or less, with a rated volume of more than 55 gallons as proposed for Section 150.1(c)8.A.ii. The ISOR explains that the option for storage water heaters less than or equal to 55 gallons is being deleted because Quality Insulation Installation (QII) is now a requirement for all new low-rise buildings.

The banning of gas or propane storage type water heaters with an input of 105,000 Btu per hour or less, rated volume of more than 55 gallons is clearly preempted under 42 U.S.C. § 6297. This proposal would also ban a federally compliant product which is clearly prohibited under EPCA. As stated above, building codes that conflict with federal efficiency minimums are invalid. Adding prescriptive provisions applicable to the installation of federal compliance products violates EPCA's preemptions provisions. 42 U.S.C. 6297(c).

Additionally, the ISOR also claims that all the prescriptive options must be equivalent; however this has not been demonstrated for the water heater options, particularly now that these products are rated based on the amount of hot water they can provide (i.e. usage bins). The efficiency of a 30 gallon medium usage model cannot be compared to that of a 50 gallon high usage model, nor can the efficiency of any model be translated to an estimated daily usage that is not within the bin at which the model was rated.

AHRI urges CEC to maintain parity with the performance path, as well as federal law, and allow an option for gas or propane storage type water heaters with an input of 105,000 Btu per hour or less, rated volume of more than 55 gallons to remain.

CEC's proposal in Sections 150.1(c)8.A.iii and iv, which requires the installation of solar panels when a heat pump water heater is installed, is also clearly preempted - regardless of the efficiency of the product. With certain exceptions, which do not apply in this case, 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. Linking the installation of heat pump water heaters and solar panels speaks directly to the energy use of the product. It would ban a federally compliant product by imposing a penalty through the code. To alleviate this situation, AHRI urges CEC to decouple the water heater from the photovoltaic requirements. We do not think that this should impact proposed limited compliance credit to battery energy storage systems that will provide several energy design rating points of credit towards the energy efficiency target score. Heat pump water heaters play an important role in energy storage that is critical to California's clean energy and greenhouse gas reduction goals.

Fan Efficacy, Section 150.1(c)10

AHRI suggests that 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.iii and iv above and urges CEC to decouple the water heater from the photovoltaic requirements.

Residential Appendices

Rated Heat Pump Capacity Verification, RA 3.4.4.2

Should CEC make the specified heating capacity values of heat pumps at 17 degrees Fahrenheit optional, rather than required, AHRI supports the use of the AHRI Certification Directory for the visual verification of heat pump capacity at 47°F and 17°F should inspectors need to confirm this information, as presented at the July 18th meeting.

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.

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.

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

Requirements for Ventilation and IAQ, Section 120.1

AHRI strongly supports the previous version of draft code language that harmonized completely and thoroughly with *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

The same concerns expressed regarding residential IAQ proposals on MERV 13 and the two-inch filter depth requirement apply to nonresidential applications. The two-inch filter depth requirement should be eliminated in favor of a pressure drop related measure. 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.

Filter Depth, Section 120.1(c)1.B

The ISOR clearly states that, "2-inch depth filters for improved filter airflow, otherwise allow for 1-inch depth filters if 0.1 inch w.c. pressure drop and 150 ft per minute face velocity for the filter is used for the design;" however, the one-inch option seems to have been inadvertently left out of Section 120.1(c)1B. AHRI recommends including the option for one-inch deep filters in this section.

Natural Ventilation Procedure, Section 120.1(c)2

AHRI would like the CEC to be aware of draft modifications to the Natural Ventilation Procedure of ASHRAE 62.1-2016, which are expected to be released for public review shortly. The 62.1 committee has already voted to issue the draft addendum for public review. This addendum provides specific requirements for the exception to the mechanical ventilation requirements by providing a clear compliance path. It also recognizes that there are inherent health issues with outdoor air in many locations in the world and updates the prescriptive requirements based on recent studies and airflow evaluations.

Outdoor Air requirements specified in 6.2.1 of 62.1-2016 have been applied to naturally ventilated buildings, essentially prohibiting purely naturally ventilated buildings in cities that don't meet national outdoor air standards. Although this is not the best solution, it prioritizes occupant health and follows national guidelines already applied to other 62.1 procedures until new methodology is developed.

The prescriptive path has been improved by removing the openable area requirement of 4% of net occupiable floor area, which to the committee's knowledge was a very rough rule of thumb that neglected to meet varying ventilation demands of different program types and did not differentiate between opening orientations or configurations that are well known and quantifiably demonstrated to improve natural ventilation flowrates. The source of the 4% is unknown to the working group, numerous members on 62.1, and senior leaders in the Chartered Institution of Building Services Engineers (CIBSE).

In its place, two tables are proposed that provide minimum openable area based on program type, opening geometry, and spacing of vertical openings. Calculations used to generate the tables do not consider wind, due to its unreliability, and rely solely on a buoyancy-driven flow resulting from a one degree Celsius temperature difference between the indoors and outdoors, a very conservative assumption. The calculation methodology follows equations provided by ASHRAE and CIBSE for the calculation of natural ventilation flowrates.

Natural ventilation systems driven by the wind or that rely on less conservative buoyancy-driven flow will need to be designed as Engineered Systems, given the complexities involved in such systems preclude them from following a simple prescriptive path.

A six-point definition of a naturally ventilated Engineered System has been developed to require designers to more fully document natural ventilation systems that do not meet prescriptive values. Designers will be required to document key environmental drivers, system components, and system flowrates. Driven by a tight schedule, the 62.1 committee decided to use the same flowrate requirements already specified in the standard, requiring Engineered Systems to provide the same amount of air as the VRP or IAQP. Designers will also be required to document their compliance with national outdoor air standards. Designers of hybrid mechanical and natural ventilation systems will be required to demonstrate effective moisture control to reduce the likelihood of mold.

AHRI suggests CEC review the draft addendum, upon publication, and consider adopting similar provisions into Title 24 upon incorporation in ASHRAE Standard 62.1.

Air Classification and Recirculation Limitations, Section 120.1(g)

The new proposed section for air classification and recirculation limitations is missing a crucial component from ASHRAE Standard 62.1 – allowances for energy recovery ventilation devices (ERV). Sections 5.16.3.2.5 and 5.16.3.3.2 each contain exceptions to permit the installation of ERVs.

> 5.16.3.2.5 Class 2 air shall not be recirculated or transferred to Class 1 spaces.
>
> Exception: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device is permitted. Recirculated Class 2 air shall not exceed 10% of the outdoor air intake flow.
>
> 5.16.3.3.2 Class 3 air shall not be recirculated or transferred to any other space.
>
> Exception: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device is permitted. Recirculated Class 3 air shall not exceed 5% of the outdoor air intake flow.

AHRI urges CEC to adopt the above exceptions at the same levels at ASHRAE Standard 62.1.

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

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.

<u>Fan System Power, Section 140.4(c)</u>

AHRI supports updating the fan allowances to be aligned with ASHRAE 90.1, with the only exception being modification for California climate conditions. It should be noted that, during the July workshop, CEC stated that the base case in the CEC technical document assumes a MERV 9 filter; 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. Despite AHRI's urging, CEC did not update the model to show the energy impact the fan system power with the proposed air-filter level of MERV 13.

<u>Exhaust Air Heat Recovery, Pre-publication Draft Section 140.4 (o)</u>

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.

<u>Waterside Economizers, Section 140.4</u>

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.

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.

Service Water Heating Systems, Prescriptive Requirements, Section 140.5

AHRI is 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 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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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.