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AHRI Comments â€“ Title 24-2019 Pre-Rulemaking October 4 and 5, 2017 Staff Workshop

Additional submitted attachment is included below.

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

Re: AHRI Comments – Title 24-2019 Pre-Rulemaking October 4 and 5, 2017 Staff Workshop *[Docket No. 17-BSTD-01]*

Dear CEC Staff:

These comments are submitted in response to the California Energy Commission (CEC) Staff Workshop on 2019 Draft 2019 Building Energy Efficiency Standards held on October 4 and 5, 2017, and the final Codes and Standards Enhancement (CASE) reports regarding proposals to update California's Building Energy Efficiency Standards (Title 24, Part 6).

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

There was an extremely short deadline to provide comments in response to detailed final CASE reports and to the staff workshop. AHRI suggests that CEC hold a separate meeting to discuss new and previously undiscussed HVAC-related measures in depth with industry. The October workshops did not go into great depth in CEC's decision-making on proposals, nor were final CASE reports published early enough for the public to ask informed questions at this meeting, indeed, these reports were only docketed on October 16. Final information has also not been published for all measures. While the Residential Quality HVAC Measures report is noted to be "Final" on the cover, the CASE team is in the process of conducting additional testing on furnaces to justify proposals.

Additional time would certainly be helpful for industry to supply information requested by the Commission.

Residential Proposals

Ventilation and Indoor Air Quality Updates, 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, this will perhaps be the first instance on record of CEC proposing a measure to simplify matters. 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. Certainly no information has been provided to support this approach.

Further, a blanket MERV 13 filter requirement does not consider the efforts nonattainment zones are taking, and achieving, to reach attainment. There are currently plans in place to improve the outdoor air quality, and once redesignated by the EPA, these areas 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.

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

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.

As acknowledged in the final CASE report, the proposed requirement for MERV 13 (or AHRI 680-2009 particle size efficiency of greater than 80 percent in the 1.0- 3.0 μm range) filters in ducted thermal conditioning systems will increase costs, will require larger return air grilles to minimize pressure drop, and may require more frequent replacement. In the same report, the CEC has proposed that these impacts can be minimized by using thicker pleated filters that have greater surface area. From a system product design standpoint, consumers moving to filters that are lower in pressure drop and/or have longer life cycles is a good thing. System pressure is critical to the correct operation of HVAC equipment. Unfortunately, in reality, many homeowners are not very stringent on changing out dirty filters in their system, some renters do not even have access to the units, and the dirtier the filter, the more strain on the system. It is presumptive for CEC to force a homeowner to install a two-inch deep filter at the unit return when perhaps installing a larger one-inch deep filter in a more accessible location (like a ceiling drop or floor return) would be preferred. Further, it is imperative that CEC consider the impact of adding resistance to the system as it looks to increase the level of air filtration efficiency. It is important to note that not all filtration media is designed the same. During recent testing of two filter providers conducted by a member company, they found a 0.08-inch difference in static pressure for the same size one-inch deep MERV 11 filters at an air velocity of 492 feet per minute. Establishing a minimum depth requirement of two inches in Section 150.0(m) does not guarantee a reduction in pressure drop over a shallower depth filter. Instead, the CEC should look to prescribe maximum pressure drop across the applied filter. This will encourage filter manufacturers to provide provisions for applying larger filters, deeper filters, or develop new media that can provide the right filtration at a lower applied pressure drop.

Fan Efficacy, Sections 150.0(m) and 150.1(c)10

While CEC has committed to testing of ten furnace models to provide additional data to justify the proposed 0.45 Watt/cfm fan efficacy requirement for furnaces, this data is not yet available. The Residential Quality HVAC Measures report should not be marked "Final" on the cover if the CASE team is indeed in the process of conducting additional testing on furnaces to justify the fan efficacy proposals. No additional information has been released on this testing, but AHRI did provide the suggestion to CEC staff via email on September 15 to test higher tonnage package equipment as the larger furnaces will have the most difficult time complying with the federal furnace fan rule.

The final CASE 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 w/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.

The purpose of the current 0.58 W/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 Watt/cfm requirement will be applicable only to furnaces and that the existing 0.58 Watt/cfm requirement will remain in effect for air handling units that are not furnaces. AHRI hopes that the CASE report will be updated after laboratory testing has concluded, and that a summary of the testing and all reports are made public. A comment period needs to be opened for this pre-rulemaking information as well.

Also, a HERS provider noted during the October 5 workshop that a majority of the furnace installations are struggling to meet the current 0.58 w/CFM requirement, even the condensing furnaces with ECMs. HERS providers such as CHEERS and CalCERTS maintain databases with measurements taken in field conditions. CEC should 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.

Concerns also remain for possible stranded inventory. The compliance date for the Federal furnace fan rule is July 3, 2019, while the 2019 edition Title 24 will go into effect on January 1, 2020. This means new construction builders will have only five months to switch over 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. Ignoring the date of manufacture will put this provision of the code in violation of federal preemption.

HERS Verification Protocols

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.

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 revised to 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 Measures

ASHRAE 90.1-2016 Proposals

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. Several proposals stray 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 140.0

AHRI supports updating the fan allowances to be consistent with 90.1, but the total static allowance and fan power calculations should be completely harmonized with ASHRAE 90.1, including the minimum BHP / CFM. CEC's proposal only allows 0.82 BHP/1000 CFM for constant air volume applications while 90.1 requirements are 0.95 BHP/1000 CFM. A similar variation exists on VAV applications. The 90.1 minimums are challenging for packaged rooftop systems requiring exhaust or return fans that operate at design conditions. If rooftop units are unable to meet the minimum horsepower per airflow proposal, then an external exhaust/relief fan would be required. CEC's study does not consider these consequential costs. This situation would problematic and costly on replacement applications. Further, the proposed increase in static allowance and fan power calculations above the carefully considered ASHRAE 90.1 measures presents a potential federal preemption issue, as the fan power in regulated equipment is accounted for in the product's efficiency metric.

Also, 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. AHRI urges CEC to update the model to show the energy impact the fan system power with the proposed air-filter level of MERV 13.

Exhaust Air Heat Recovery

In the mild climate zones of California energy recovery is not cost effective. AHRI urges CEC to conduct a full cost-effective analysis regarding this measure and reconsider the proposal. 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.

Equipment Efficiency

AHRI supports CEC adopting equipment efficiencies proposed in 90.1 into Tables 110.2A through 110.2K.

Waterside Economizers

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.

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

AHRI supports the proposal to use transfer air to supplement air to spaces that exhaust more than the amount of conditioned air required. While transfer air is usually the most energy efficient and least expensive makeup air source, AHRI urges CEC to focus on two caveats in order to harmonize with ASHRAE Standard 62.1: First, Section 5.9.2 of ASHRAE 62.1-2016 requires that a positive net pressure be maintained. If the rate of air exhausted from a space exceeds the outdoor air supplied to adjacent spaces, the outdoor air rate to the adjacent spaces will generally need to be increased to ensure the net building pressure is positive. Secondly, ASHRAE 62.1 limits the recirculation of lower quality air into spaces that contain air of higher quality.

Cooling Tower Efficiency

AHRI is concerned that this proposal goes too far by increasing the minimum efficiency for axial fan, open circuit cooling towers from 42.1 gpm/hp to 80.0 gpm/hp and thus is not harmonized with ASHRAE Standard 90.1-2016. While we are encouraged that the proposal keeps replacement of existing building-mounted systems at 42.1 gpm/hp, we are very concerned with the potential for a market shift to less efficient alternative cooling systems due to the additional first cost and unit size / weight. AHRI is doubtful that the CASE report adequately evaluates the potential financial and site impact. For instance, the structural survey shows a 30 to 40-percent increase in unit weight resulting from this proposal. Again, AHRI urges CEC to harmonize completely with ASHRAE Standard 90.1.

Indoor Air Quality

AHRI is strongly supportive of the draft code language being harmonize completely and thoroughly with ASHRAE standards, *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, as was previously proposed.

The same concerns expressed regarding residential IAQ proposals on MERV 13 and the two-inch filter depth requirement hold for nonresidential applications as well. 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 the PM 2.5 nonattainment areas which would require enhanced filtration, perhaps by releasing zip codes of affected areas. Lastly, is unclear what filtration level is being proposed for areas with better air quality. CEC should make this proposal clear. It should also be noted, that the proposal for MERV 13 filters seems to be beyond those fans which bring in outdoor air, yet no rationale has been provided for indoor air pollutants which require mitigation to such an extent. Also, while the intent of the nonresidential HVAC proposals is to result in cost-effective enhancements to improve energy efficiency and energy performance in California buildings, it is not possible for California to achieve these goals without including the increased cost of California-specific equipment to consumers or on the manufacturers in the market impact section of the analysis. 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.

It is also clear 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 occupant comfort with added noise. Equipment efficiency would be adversely affected as well. 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).

Pipe Insulation

AHRI suggests that CEC make clear 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 increase 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. This proposal can be accomplished simply by adding “For normal operating conditions,” in front of “The piping conditions listed below…” in Section 120.3(a).

Also of concern is the proposed removal of 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.” It is unclear why CEC has proposed to delete this exception. No detailed explanation was provided by CEC during the staff workshop on October 4. AHRI recommends retaining Exception 4.

Conclusion

We reiterate our request for a separate meeting to discuss proposals in depth, as two weeks was not sufficient for complete industry assessment of proposed measures. CEC should also extend the deadline for comments until at least 30 days after the CASE report on Residential HVAC Measures has been published.

Most importantly, AHRI continues to urge CEC to harmonize 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.