

October 30, 2011

California Energy Commission
Dockets Office, MS-4
Re: Docket No 10-BTSTD-01
1516 Ninth Street
Sacramento, CA, 95814-5512

Dear CEC Staff:

Carrier Corporation, a division of United Technologies has review the proposed language posted on the CEC web page as of Oct 24, 2011 and would like to file the following comments and proposed changes.

In section 100.1 – Definitions and Rules of Construction the following changes should be made. There may be some other reference changes that we would recommend that the CEC double check all references and requirements to see if all references have been included.

- For AHRI 210/240 standard there have been some revisions that should be included in the Title 24 Standard. Addendum 1 has already been published and is posted on the AHRInet.org website. Addendum 1 removed the IPLV which is no longer supported by the industry as a part load metric. Addendum 2 which will be released by the end of the years adds the new IEER efficiency part load metric. The changes are shown in green in the modified text below.

AHRI ARI 210/240 is the Air-conditioning, **Heating**, and Refrigeration Institute document entitled “Unitary Air- Conditioning and Air-Source Heat Pump Equipment,” 2003 (ARI 210/240-2003, **including Addendum 1 and 2**)

- AHRI 340/360 has been updated from the referenced 2000 standard. The referenced standard should be AHRI 210/240-2007 with addendum 1 and 2.

AHRI ARI 340/360 is the Air-**e**Conditioning, **Heating**, and Refrigeration Institute document entitled “Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment,” **2000 2007** (ARI 340/360-**2000, 2007, including addendum 1 and 2**).

- AHRI 365 has been updated and the current version is 2009. The reference should be revised as follows.

AHRI ARI 365 is the Air-**C**eonditioning, **Heating**, and Refrigeration Institute document entitled, "Commercial and Industrial Unitary Air-Conditioning Condensing Units," **2002 2009** (ARI 365-**2002, 2009**).

- AHRI 550/590 has just been updated to the 2011 version and Title 24 should reference this version of the standard.

AHRI ARI 550/590 is the Air-**c**Conditioning, **Heating**, and Refrigeration Institute document entitled “Standard for Water Chilling Packages Using the Vapor Compression Cycle,” **1998 2011** (ARI 550/590-**982011**).

- AHRI 1230-2010 with addendum 1 should be added as a reference using the following text.

[AHRI 1230-2010 with addendum 1 is the Air-Conditioning, Heating, and Refrigeration Institute document entitled Performance Rating of Variable Refrigerant Flow \(VRF\) Multi-Split Air-Conditioning and Heat Pump Equipment](#)

- The reference to ASHRAE 55-2004 is out of date and should be revised as noted.

ASHRAE STANDARD 55 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document entitled " Thermal Environmental Conditions for Human Occupancy," ~~2004~~ 2010(ASHRAE Standard 55-~~2004~~2010).

In section 110.2 (a) the following exception has been added;

EXCEPTION 2 to Section 110.2(a): Positive displacement (air- and water-cooled) chillers with a leaving evaporator fluid temperature higher than 32°F, shall show compliance with Table 110.2D when tested or certified with water at standard rating conditions, per the referenced test procedure.

This requirement appears to have been copied from the ASHRAE 90.1-2010. This is really not an exception to the ratings and should be shown as a requirement which defines the scope of the efficiency table 110.2D

In section 110.2 (c) 2 the following statement does not seem to make sense. Should the requirement be “shall include” instead of “shall not include”

2. Upgradeable Capabilities. USTs shall ~~not~~ include onboard communication devices and shall have at least one expansion port which will allow for the installation of a removable module to enable standards based communications (included but not limited to ZigBee, WiFi) and standards based messaging protocols (SmartEnergy Profile (SEP),.....

There are several issues with the proposed modifications to table 110.2-A which are listed below;

- There are no listed efficiencies for air cooled products less than 65K. They should be added to the table
- Efficiency increases have been added for 65K to 135K and 135K to 240K in 1/1/2015. These products are under federal control and this will violate federal preemption.
- Table is still showing IPLV's which are not longer supported by the AHRI 340/360 standard and the certification programs. The table needs to be revised to include the new IEER metric. The values can be obtained from the ASHRAE 90.1-2010 table. The latest version of this table has been modified by the ASHRAE 90.1 addendum j. We have included a copy of the approved addendum j.
- Several products are missing from the table and the requirements for water and evaporatively cooled and air cooled and water cooled condensing units have changed. Refer to the ASHRAE 90.1 addendum j.
- Note b is out of date and should be changed to IEER. We would recommend the ASHRAE 90.1 table format be used where the heating products are covered directly in the table and not in a footnote.

There are several issues with the proposed modifications to table 110.2-B

- There are no listed efficiencies for air cooled products less than 65K. They should be added to the table
- Requirements are shown for 2015 but they are the same as before 2015. If they were to be higher in 2015 this would be a violation of federal standards so the column should be removed.
- Table is still showing IPLV's which are not longer supported by the AHRI 340/360 standard and the certification programs. The table needs to be revised to include the new IEER metric. The values can be obtained from the ASHRAE 90.1-2010 table. The latest version of this table has been modified by the ASHRAE 90.1 addendum j. We have included a copy of the approved addendum h.

- Several product categories are missing from the table and we recommend you adopt the ASHRAE 90.1 table as shown in addendum h to the ASHRAE 90.1-2010 standard.

There are also some errors in table 110.D. The issues are listed below.

- Only the IPLV is listed for the air cooled with condenser >150 tons and it is not correct at 3.05 IPLV. Need to add the full load efficiency at 9.562 as well as correct the IPLV to 12.750 Refer to the ASHRAE 90.1 2010 standard for details.
- The footnotes have several errors. It shows the requirements for centrifugals apply only to products with a fluid temperature less than 36 F. Should be greater than 36 F.
- It shows the requirements for positive displacement to be less than 32 F. Should be greater than 32 F
- Recommend you take the footnotes directly from ASHRAE 90.1-2010 table 6.8.1D

There are issues with 110.E. The issues are listed below.

- There are some corrections to wording and notes in the ASHRAE 90.1-2010 addendum i that should be corrected in table 110.E as these products are federally controlled and the requirements should be the same.
- The requirements for SPVAC product will increase on 1/1/2012 and these values should be used in the table as they are federally controlled.

In section 110.2 several tables are missing for new product efficiency requirements that have been defined by ASHRAE 90.1 and federal requirements.

- Requirements for VRF equipment are missing which are federally controlled for full load efficiency. Refrigerant ASHRAE 90.1-2010 table 6.8.1H and table 6.8.1J
- ASHRAE 90.1 has added a new requirement for air conditioners and condensing units serving computer rooms. Should add the table to Title 24. Refer to ASHRAE 90.1-2010 table 6.8.1K
- ASHRAE 90.1 has added requirements for refrigeration equipment which is defined in table 6.8.1M and table 6.8.1 L. These are documented in the ASHRAE addendum g to the ASHRAE 90.1-2010 standard.

In section 120.3 for pipe insulation the proposal has picked up the new requirements for pipe insulation but many of the footnotes have not been included. Suggest you review the footnotes in ASHRAE 90.1-2010 and add them to Title 24

In section 120.5 (a), 4 there is an exception that allows for manufacturer certified economizers to be exempt from field testing. The issue is that the industry does not understand how to get an economizer certified as there are no defined requirements for the certification. Some requirements need to be added.

In section 140.4 (c), 2B the requirements for VAV fans with motors greater than 10HP has been eliminated. We believe you intended to lower the threshold for motors but there is no language replacing the text so you are exempting VAV fans from meeting the requirements which does not make sense.

In section 140.4 (c) 4 a requirement for HVAC motors and fans to be electronically commutated does not make sense the way it is worded. The wording is confusing Suggest you change as noted below. Suggest you also remove the requirement for remote control in the field or that you add some exceptions for packaged equipment. Overriding the control in an HVAC units can void the warranty and cause operation problems.

Fractional HVAC Motors for Pumps and Fans. ~~Fan motors of series fan-powered terminal units.~~ HVAC motors for pumps or fans that are ~~Fan motors of series fan-powered terminal units 1 hp or less and 1/12 hp or greater~~ greater than 1/12 HP and less than 1 HP shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. ~~These motors shall also have the means to adjust motor speed for either balancing or remote control in the field.~~

In section 140.4 (e) 1 there are new requirements extending the economizer to lower capacities. We don't see the need for the additional 1800 cfm as it will result in units larger than 54,000 Btu/h to be exempted when they run cfm/ton flow rates less than 400 cfm/ton which is common in the applications today. In fact the average unit is more like 350 cfm/ton which would raise the capacity to 61,714 Btu/h and at 300 cfm/ton which is also used would raise the limit to 72,000 Btu/h. We recommend you make the following modifications.

Each individual cooling fan system that has a design ~~supply capacity over 2,500~~1,800 cfm and a total mechanical cooling capacity over ~~7554,000~~54,000 Btu/hr shall include either:

In section 140.4 (e) 2 ii The requirements in this section are not economically justified and far exceed the payback periods. The justification for the change was lumped into the change to expand the 2 speed fan down to 65,000 Btu/h which is justified, but the analysis was not show separately for the modulating capacity requirement. The requirement was proposed because of some field problems with integrated economizers which was due to control logic issues. The industry tried to explain this to the proposer of the comment, but there was very little dialog with the manufacturers of the equipment. The issue of the integrated economizers can be solved with control logic which is already in production on some commercial available equipment in the market. The proposer of the change recommended variable capacity down to 20% which will require the use of very expensive variable capacity equipment that will impact the full load performance and possibly federal preemption as well as decrease the part load efficiency if the digital scroll is used which was the basis of the costs supplied by AHRI. The proposer also claimed that equipment is already available and listed several products below 65K capacity, but the proposal is for 65K and above. There are some compressor available but only the Copeland digital will unload to 20% but will decrease part load efficiency. Also the noise can increase as much as 10 dba. We would propose the following alternate wording which results in much lower cost and equal or better efficiency and much better payback. Carrier has conducted a detail analysis of the proposed change that was also submitted to ASHRAE 90.1. Attached you will find a copy of the analysis with some additional comments related to the Title 24 proposal. We found many assumption errors in the analysis that was done for Title 24

~~ii. Effective January 1, 2015, direct expansion systems with a cooling capacity \geq 65,000 Btu/hr^a shall be capable of staging or modulating capacity in increments of no more than 20% of total cooling capacity. Controls shall not false load the mechanical cooling system by limiting or disabling the economizer or any other means, such as hot gas bypass, except at the lowest stage of cooling capacity.~~

Effective January 1, 2015, direct expansion systems with a cooling capacity \geq 54,000 Btu/hr^a shall have mechanical capacity control that is interlocked with the economizer control such that the economizer does not begin to close until the unit leaving air temperature is less than 45 F. All constant volume units with a capacity \geq 75,000 Btu/hr including 2 speed fan systems must have a minimum of 2 stages of mechanical cooling. All variable air volume units must have a minimum of 4 stages or variable capacity with a minimum capacity of 25%

In section 140.4 (e) 4 There are new requirements for air economizers that require prescriptive requirements for capacities greater than 45,000 Btu/hr and 1,500 cfm. This appears to require economizers to lower capacities than 140.4 (e) 1. The requirements should be modified to reflect the requirements of 140.4 (e) 1. We recommend the following changes;

~~Air economizers and return air dampers on an individual cooling fan system that has a design supply capacity over 1,500 cfm and a total mechanical cooling capacity over 45,000~~ 54,000 Btu/hr shall have the following features:

In section 140.4 (e) 4 A Are the requirements for warranty parts and labor or just parts which is the typical industry warranty. Don't recall seeing the economic justification for this. There are issues with economizers but many are due to commissioning and routine maintenance.

In section 140.4 (e) 4 B- Many of the dampers in units today are direct drive, but there are many air handlers that it is not practical to have direct drive. The requirements should be performance and not prescriptive. For example the warranty requirements cover this requirement.

In section 140.4 (e) 4 G – Good idea to add sensor accuracy, but it is not clear if the requirements are +/- tolerances which are typical methods used to define accuracy. Also would be good to define the range of conditions where the accuracy is required. For example accuracy of +/-1 F is not critical at temperatures greater than 80 F or at low temperatures.

In section 140.4 (e) 4 H – Field calibration of sensors is not a great idea to do in the field as it requires accurate instrumentation to calibrate the sensors which are not typically available in most service trucks.

In section 140.4 (e) 4 J – Relief air systems typically do not have to supply 100% relief as there is always some building leakage and local exhaust. Typically the industry uses 90%. Suggest you change the requirement to 90%

Table 140.4(e)-A defines new requirements for economizer tradeoff for unitary air conditions. It is not clear if the requirements are EER or IEER. It makes no sense to use EER as a means to determine if an economizer can be eliminated. Economizers only work at part load and therefore the IEER is a better metric to use. We recommend that you remove the proposed table and replace with the ASHRAE 90.1-2010 tradeoff table that was developed based on energy analysis using the IEER and IPLV. The ASHRAE 90.1 method would have to be adopted for the California climate zones, but we would be glad to help with this. The other benefit is that the ASHRAE 90.1-2010 method also allows for the tradeoff to be used for water economizers, and other than just unitary products. Refer to ASHRAE 90.1-2010 table 6.3.2 which is shown below.

TABLE 6.3.2 Eliminate Required Economizer for Comfort Cooling by Increasing Cooling Efficiency

Climate Zone	Efficiency Improvement ^a
2a	17%
2b	21%
3a	27%
3b	32%
3c	65%
4a	42%
4b	49%
4c	64%
5a	49%
5b	59%
5c	74%
6a	56%
6b	65%
7	72%
8	77%

^a If a unit is rated with an IPLV, IEER or SEER then to eliminate the required air or water economizer, the minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric like EER or COP cooling then these must be increased by the percentage shown.

In table 140.4 (e)-C there use of fixed enthalpy, electronic enthalpy and differential enthalpy have been eliminated based on the Taylor paper presented to ASHRAE, but in section 140.4 (e) 4 G accuracy requirements have been

added for enthalpy and humidity. Requirements seem to have been based on old accuracy and not the new accuracy requirements. Also for fixed enthalpy +fixed drybulb the requirements are >28 Btu/lb or TOA>75 F. In effect the air temperature will override the enthalpy and essentially make the enthalpy non function. This could result in high interior moisture levels in humid climate zones for constant volume, variable temperature systems and exceed ASHRAE 62.1 recommendations for interior moisture levels to prevent the growth of mold. Requirements should be modified to state that the lower of the two requirements assuming that the outdoor humidity with 75 F is 100%.

In section 140.4 (h) 2 ASHRAE 90.1-2010 has recently revised the requirements for 2 speed fans for cooling towers as very few companies are using this method and have gone to variable speed fan control. Shown is the ASHRAE 90.1 requirements as defined in a new addendum. It also includes requirements for tower turndown control that should be included in Title 24.

Fan Speed Control. Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at 2/3 of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

6.5.5.2 Fan Speed Control.

6.5.5.2.1 Each fan powered by a motor of 7.5 hp or larger shall have the capability to operate that fan at two-thirds of full speed or less and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

Exceptions:

- a. Condenser fans serving multiple refrigerant circuits.
- b. Condenser fans serving flooded condensers.
- c. Installations located in climate zones 1 and 2.
- d. ~~Up to one third of the fans on a condenser or tower with multiple fans, where the lead fans comply with the speed control requirement.~~

6.5.5.2.2 Multiple cell heat rejection equipment with variable speed fan drives shall:

- a. Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components and
- b. Control all fans to the same fan speed required for the instantaneous cooling duty as opposed to staged (on/off) operation. Minimum fan speed shall comply with the minimum allowable speed of the fan drive system per the manufacturer's recommendations.

In section 140.4 (m) The requirements for single zone systems and variable volume systems have some issues and we propose the following modifications. We have done a study of a similar proposal for ASHRAE 90.1 and you will find the study that was done for ASHRAE 90.1 with some additional slides to relate it to the study done for Title 24. The following is a proposal that likely will get support from the industry and actual will result in equal or more savings than the current proposal.

Current Proposal

Fan Control. Each multiple zone system and single zone system listed in Table 140.4-D shall be designed to vary the airflow rate as a function of actual load. Single zone systems shall have controls and/or devices (such as two-speed or variable speed control) that will result in fan motor demand of no more than 50 percent of design wattage at 66 percent of design fan speed. Multiple zone systems shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume when static pressure set point equals 1/3 of the total design static pressure. ~~Variable air volume control for single zone systems. Effective January 1, 2012 all unitary air conditioning equipment and air handling units with mechanical cooling capacity at ARI conditions greater than or equal to 110,000 Btu/hr that serve single zones shall be designed for variable supply air volume with their supply fans controlled by~~

~~two-speed motors, variable speed drives, or equipment that has been demonstrated to the Executive Director to use no more energy. The supply fan controls shall modulate down to a minimum of 2/3 of the full fan speed or lower at low cooling demand.~~

Alternate Proposal.

Each multiple zone system listed in table 140.4-D shall be designed to vary the airflow rate as a function of the load such that the fan motor demand is less than 20% at 50 percent of the design air volume when static pressure set point equals 1/3 of the total design static pressure. Variable air volume units shall have a minimum of 4 stages with a minimum stage of 25% or less.

For single zone systems with air-handling and fan-coil units with chilled-water cooling coils and supply fans with motors greater than or equal to 1 hp shall have their supply fans controlled by two-speed motors or variable-speed drives. At cooling demands less than or equal to 50% for proportionally controlled units and for 2 stage control units operating on the first stage, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:

One half of the full fan speed, or

The volume of outdoor air required to meet the venti-lation requirements of Standard 62.1.

When operating at 50% airflow the fan motor demand shall be less than 25% of the full demand.

All single zone air-conditioning equipment and air-handling units with direct expansion cooling and a cooling capacity at AHRI conditions greater than or equal to 75,000 Btu/h shall have their supply fans controlled by two-speed motors or variable-speed drives. Constant volume units at cooling demands less than or equal to 50% for proportionally controlled units and for 2 staged controlled units operating on first stage, the supply fan controls shall be able to reduce the airflow to no greater than the larger of the following:

Two-thirds of the full fan speed, or

The volume of outdoor air required to meet the venti-lation requirements of Standard 62.1.

When operating at 66% airflow the fan motor demand shall be less than 35% of the full demand.

Both the chilled water and DX units shall also have a minimum of 2 stages of capacity and shall be capable of operating the economizer, if required, with 2 stage fan speed control with operation at low speed when the economizer capacity is less than 50%.

Table 140.4(m)-A also needs to be modified. The ¼ HP is probably not economically justified as the justification document did not include controls and modulating or 2 stage water valves so as noted above we limited the proposal for chilled water coils to 1 HP until additional studies can be validated by the industry. Also it is impossible for the industry to react to some of dates that are effective 1/1/2012 that were not previously defined. We propose that the table be revised as shown below

TABLE 140.4(m)-A – EFFECTIVE DATE FOR VARIABLE AIRFLOW CONTROL OF FAN SYSTEMS

<u>Cooling System Type</u>	<u>Fan Motor Size</u>	<u>Cooling Capacity</u>	<u>Effective Date</u>
<u>Direct Expansion</u>	<u>any</u>	<u>≥ 110,000 Btu/hr</u>	<u>1/1/2012</u>
<u>Direct Expansion</u>	<u>any</u>	<u>≥65,000 Btu/hr</u>	<u>1/1/2015</u>
<u>Chilled Water</u>	<u>≥5 HP</u>	<u>any</u>	<u>1/1/2012</u>
<u>Chilled Water</u>	<u>≥1 HP</u>	<u>Any</u>	<u>1/1/2015</u>
<u>Evaporative Cooling</u>	<u>≥5 HP</u>	<u>any</u>	<u>1/1/2012</u>
<u>Evaporative Cooling</u>	<u>≥1 HP</u>	<u>Any</u>	<u>1/1/2015</u>

In section 140.9 there are new requirements for computer rooms. In 140.9 (a) 5 there are requirements for unitary fan control. The requirements should just reference the requirements of 140.4 (m) as modified by this document.

If you have any questions or would like to discuss some of the requirements please let me know. We would be willing to have a conference call or even a face to face meeting. Others manufacturers in the industry would also be more than willing to do the same. We do have serious concerns about some of the requirements especially associated with the modulating capacity for unitary products down to 65,000 Btu/hr

Richard Lord

A handwritten signature in black ink that reads "Richard Lord". The signature is written in a cursive style with a large, prominent 'R' and 'L'.

Carrier Fellow
Carrier Corporation