DOCKETED	
Docket Number:	19-BSTD-03
Project Title:	2022 Energy Code Pre-Rulemaking
TN #:	237142
Document Title:	Carrier Corporation Preliminary Comments
Description:	N/A
Filer:	System
Organization:	Carrier Corporation/Richard Lord
Submitter Role:	Public
Submission Date:	3/11/2021 4:18:33 PM
Docketed Date:	3/11/2021

Comment Received From: Richard Lord
Submitted On: 3/11/2021
Docket Number: 19-BSTD-03

Carrier Corporation Preliminary Comments

The time to review the 571 page document was very short, but we have done our best to review the document in details and have provided a summary of our comments and suggestions.

With more time we will be doing further analysis and evaluation.

We have many editorial and minor comments to align with other standards like ASHRAE, but do have significant concerns with the reduced fan power allowance and the addition of DOAS that allows for the elimination of economizers.

We will be glad to work with the Title 24 team on further details and questions on the comments.

Additional submitted attachment is included below.

Introduction and Background

We have gone thru the proposed revision document in detail and in the following pages you will find a summary of our first pass comments and suggestions.

Time was very limited to review such a large document and we will continue with our review but wanted to get you the comments that we have developed.

Many of the comments are targeted to align with other standards like ASHRAE 90.1 and Federal Requirement and we have identified several products that were missing

We do have serious issues with the new fan power allowance and did some significant analysis on how our products would comply and found that even our most efficient new fan system would have issues with compliance.

We also have significant concerns with the DOAS requirements that allow for the elimination of economizers and this will be a significant loss in energy savings.

We do support the small economizer size expansion, but it should not be applied to fan coils located inside the building as it would be very expensive and not cost effective.

Comment Details

Section 100.1 – Definitions and Rules of Construction

In general, the reference standards should be review as many appear to be out of date. The following are some specifics that I found.

Section 100.1 – Definitions and Rules of Construction, Page 10 - AHRI 210/240 referenced standard is wrong version.

The reference standard for AHRI 210/240 is out of date and the current standard for SEER rated products in effect until 1/1/2023 is *AHRI 210/240 (2017): Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment (with Addendum 1)*. After 1/1/2023 the efficiency metric will change to SEER2 as defined by DOE 21CFR and the new standard for this is *AHRI 210/240-2023 (2020): Performance Rating of Unitary Air-conditioning & Air-source Heat Pump Equipment*

Section 100.1 – Definitions and Rules of Construction, Page 10 - ANSI/AHRI/CSA 320 referenced standard is no longer used and should be removed.

The old AHRI 320 standard covered water source heat pumps. Many years ago, this standard was retired and replaced by the ISO 13256-1 and ISO 13256-2 standards which are already listed as reference in on page 28 so this should be deleted

Section 100.1 – Definitions and Rules of Construction, Page 10 - ANSI/AHRI/CSA 325 referenced standard is no longer used and should be removed.

The old AHRI 325 standard covered water source heat pumps. Many years ago, this standard was retired and replaced by the ISO 13256-1 and ISO 13256-2 standards which are already listed as reference in on page 28 so this should be deleted

Section 100.1 – Definitions and Rules of Construction, page 11 AHRI 430 is incorrection shown.

The reference to AHRI 430-20 should be AHRI 430-2020

Section 100.1 – Definitions and Rules for Construction, Page 11 – AHRI 550/590 referenced standard revision shown is out of date.

AHRI 550/590 referenced standard is several versions out of date. The current AHRI 550/590 standard is version AHRI 550/590 (I-P) 2020. There is a new version that is nearly complete and will be released in 2021. It changed some of the rating conditions and scope of the equipment for use with data centers and also added new requirements on heat pump chillers and heat recovery chillers that have been added to ASHRAE 90.1-2019 with new efficiency metric and minimums.

Section 100.1 – Definitions and Rules for Construction, Page 11 – AHRI 560 referenced standards is soon going to be revised.

AHRI 560 is a standard for absorption chillers that has been update and should be published soon as version AHRI 560-2021.

Section 100.1 – ASHRAE Climate Data for Regions and possible update data and zones, page 12

I suspect the weather data may be out of date and ASHRAE has developed new data and updated the climate zone information documented in ASHRAE 169-2020. Would be nice if California aligned their climate zones with the rest of the world.

Section 100.1 – ASHRAE Handbook, Systems and Equipment Volume, page 12 Version is out of date

ASHRAE has released the 2020 version of the Handbook

Section 100.1 – ASHRAE Standard 55, page 12 ASHRAE Standard 55, page 12 Version is out of date

ASHRAE has release version 2020. Note sure the reference is need as I don't believe it is used in Title 24

Section 100.1 – ASHRAE Standard 62.1, page 12 ASHRAE Standard 62.1, page 12 Version is out of date

ASHRAE has release version 2019.

Section 100.1 – Computer Room Definition, page 17 Definition is not aligned with other standards

ASHRAE 90.1 and 90.4 have agreed on a new definition for computer rooms to have an IT equipment load larger than 10 kW vs the 20 watts/ft2 used in Title 24. It would be good to align with other standards.

Section 100.1 – Dedicated Outdoor Air System (DOAS), page 18 – Definition not aligned with other standards

AHRI 920 has been revised to change and update the definition for DOAS. Also, it would be good to clarify when a product must comply with DOAS requirements and when it must comply with standard rooftop requirements. Also do not understand how Title 24 can add requirements for the use of DOAS and have no minimum efficiency requirements?

Section 100.1 – Degree Day, Heating – Related comment

Definition for heating degree day is included by no definition for cooling degree day CDD50

Section 100.1 – DX-Dedicated Outdoor Air System (DX-DOAS), page 18 - definition question

Do you really need a separate definition for DX-DOAS or is it a subset of DOAS definition? Also, it would be good to clarify when a product must comply with DOAS requirements and when it must comply with

standard rooftop requirements. Also do not understand how Title 24 can add requirements for the use of DOAS and have no minimum efficiency requirements?

Section 100.1 – Economizer, Pumped Refrigerant, page 20 – definition question and clarification

Glad to see you added the definition, but the use of refrigerant to free cooling is not limited to cooling air and is also used to cooling water for chilled water systems without running the compressor. Suggest the definition be expanded**.**

Section 100.1 – Economizer water – Page 20 – Use of the word fluid

Minor point, but a fluid can be a liquid or a gas, so we recommend the word fluid be changed to liquid.

Section 100.1 Enthalpy Recovery Ratio (ERR), page 22 - Definition suggestions

As I suspect you will want to use industry standard certification programs it would be desirable to align the definition with the rating standard AHRI 920 and not create a slightly different standard.

Section 100.1 Integrated Seasonal Coefficient of Performance (ISCOP), page 28 – new 920 definition

AHRI 920 has been updated to 2020 version and there is a new definition for ISCOP and this should be used in Title 24. The definition is shown below. We are not clear why the definition has been added but there is no table with minimum efficiency requirements.

"Integrated Seasonal Coefficient of Performance (ISCOP2). A seasonal efficiency rating. A combined heating efficiency rating of a DX-DOAS heat pump at operating points E and F, as defined in Tables 4 and 5, based on the formulas listed in Section 6.12. Expressed in W/W."

Section 100.1 Integrated Seasonal Coefficient of Performance (ISMRE), page 28 – new 920 definition

Like the ISCOP AHRI 920 has adopted new definitions for ISMRE as shown below.

3.13 Integrated Seasonal Moisture Removal Efficiency (ISMRE2). This seasonal efficiency rating is a combined MRE rating of a DX-DOAS Unit operating at standard rating conditions A, B, C and D as defined in Tables 4 and 5 and based on the formula listed in Section 6.13. Expressed in lb. of moisture/kW·h.

> *3.13.1 Integrated Seasonal Moisture Removal Efficiency 70 (ISMRE270). This seasonal efficiency rating is a combined MRE70 rating of a DX-DOAS Unit operating at standard rating conditions A, B, C and D, as defined in Tables 4 and 5, and based on the formula listed in Section 6.13.*

Section 100.1 Integrated HVAC System, page 28 – definition question

Not sure why this definition is being added and is it just for DOAS or are you trying to require all units to have a sensible heat factor of <0.65 which is aggressive. Should this be added under DOAS definition as a further requirement or better yet in the prescriptive requirements for DOAS

Section 100.1 Mechanical Cooling, page 36 – Definition questions

Not sure why this definition is needed, but mechanical cooling not only reduces the space temperature, it also can be used to reduce the humidity and wetbulb temperature or in some cases just to remove humidity and not reduce the temperature when in dehumidification mode.

Section 100.1 Mechanical Heating page 36, Definition question

Not allowing heat recovery as a means for mechanical heating does not make sense. Often heat recovery from refrigeration system and air condition systems can be used for simultaneous heating and cooling

Section 100.1 Microchannel Condenser, page 36 – Definition question

Definition is OK, but not sure why it is needed. Also, there are now microchannel evaporators.

Section 100.1 Multiple Zone System, page 36 – Definition question and suggestion

What you are defining is a multizone VAV system so it should be labeled as such and contain the requirements on minimum airflow of 40%. Should also include a definition of single zone VAV which is defined in AHRI 340/360-2021.

Section 100.1 Single Packaged Vertical Air Conditioner (SPVAC), page 48 – Definition comments and questions

This definition is directly from AHRI 390 which is good. AHRI 390 is limited to 240,000 Btu/hr. and larger units are rated per AHRI 340/360 so that might be worth clarifying. Overall, some products have definitions but title 24 does not have definitions for all products so it seems inconsistent.

Section 101.1 Thermostat Expansion Valve, page 50 – Definition comment

Definition is OK, but is it really needed. There are many other types of expansion devices including Electronic Expansion Valves, float valves for large chillers, fixed orifices, capillary tubes and many more so again if one is defined then should all options be defined.

Section 101.1 Ventilation System, Central Fan Integration or CFI – Definition comment

This definition is focused on dwelling unit space, but ventilation systems are used on all buildings so why is the definition limited to just dwelling units. This is somewhat redundant to DOAS unit definition. Maybe it would be good to have a general definition with sub-definitions.

Section 110.2(a) – Efficiency – page 4 – missing efficiency requirements

Several tables for equipment efficiency have not been included in Title 24 but would be good to add to align with what is in ASHRAE 90.1-2019. There are also issues with some of the tables which I will cover in separate comments. The following tables are missing. Some might be in Title 20 which I did not have time to check due to the very short review cycle of 15 days. I would strongly recommend a thought line by line review of the tables as there are notes missing and some products missing.

1. Floor-Mounted Air Conditioners and Condensing Units Servicing Computer Rooms – See ASHRAE 90.1 table table 6.8.1-10
2. Commercial Refrigerators, Commercial Freezers and Refrigeration – See ASHRAE 90.1-2019 table 6.8.1-11
3. Vapor-Compression-Based Indoor Pool Dehumidifiers - See ASHRAE 90.1-2019 table 6.8.1-12
4. Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, without Energy Recovery— See ASHRAE 90.1-2019 table 6.8.1-13. All the definitions for the metrics were added but then there are no efficiency requirements.
5. Electrically Operated DX-DOAS Units, Single-Package and Remote Condenser, with Energy Recovery— See ASHRAE 90.1-2019 table 6.8.1-13. All the definitions for the metrics were added but then there are no efficiency requirements.
6. Heat Pump and Heat Recovery Chiller Packages – See ASHRAE 90.1-2019 table 6.8.1-16 and a new addendum X
7. Ceiling-Mounted Computer-Room Air Conditioners – See ASHRAE 90.1-2019 table 6.8.1-17

8. Walk-In Cooler and Freezer Display Door Efficiency Requirements – See ASHRAE 90.1-2019 table 6.8.1-18
9. Walk-In Cooler and Freezer Nondisplay Door Efficiency Requirements – See ASHRAE 90.1-2019 table 6.8.1-19
10. Walk-In Cooler and Freezer Refrigeration System Efficiency Requirements - See ASHRAE 90.1-2019 table 6.8.1-20
11. Performance Requirements for Water-Heating Equipment—Minimum Efficiency Requirements - See ASHRAE 90.1-2019 table 7.8
12. Minimum Nominal Efficiency Levels for Low-Voltage Dry-Type Distribution Transformers – See ASHRAE 90.1 table 6.8.4.4 (Note there is a new addendum being developed)
13. Motor Efficiency Tables – See ASHRAE 90.1 tables 10.8-1 thru 10.8.1-6
14. Minimum Efficiency Requirements for Single-Phase Central Air Conditioners and Heat Pumps - See ASHRAE 90.1 table F-1
15. Minimum Energy Efficiency Requirements for Water Heaters and Pool Heaters - See ASHRAE 90.1 table F-2
16. Minimum Efficiency Requirements for Room Air Conditioners – See ASHRAE 90.1 table F-3
17. Residential Furnaces—Minimum Efficiency Requirements – See ASHRAE 90.1 table F-4
18. Residential Boiler a Minimum Efficiency Requirements – See ASHRAE 90.1 table F-5

Section 110.2(a) –Table 110.2-A Air Conditioners and Condensing Units, page 7 – table errors and comments

We did a quick review of the table and we have the following comments:

- <65,000 Btu/h 3 phase products are missing. DOE has deviated from ASHRAE 90.1 and made the new SEER2 for 3 phase effective on 1/1/2025
- Foot note a is wrong and IEER applies to all products
- The reference standards are out of date and there are changes in standards that go into effect on 1/1/2023
- There could be issues with preemption. I know this is the 2022 standard but many of the efficiency requirements do not go into effect until 1/1/2023 and some are 1/1/2025

Section 110.2(a) –Table 110.2-B Air Conditioners and Condensing Units, page 8 – table errors and comments

We did a quick review of the table and we have the following comments:

- <65,000 Btu/h 3 phase products are missing. DOE has deviated from ASHRAE 90.1 and made the new SEER2 for 3 phase effective on 1/1/2025
- Foot note a is wrong and IEER applies to all products
- The reference standards are out of date and there are changes in standards that go into effect on 1/1/2023
- Might want to consider separating WSHP into a separate table which is what ASHRAE has done due to a potential new part load efficiency metric

Section 110.2(a) –Table 110.2-D Air Conditioners and Condensing Units, page 10 – table errors and comments

We did a quick review of the table and we have the following comments:

- Reference test procedures are out of date
- All efficiencies should be 4 significant figures to align with AHRI 550/590
- Footnote a is wrong and needs to be modified or eliminated

Section 110.2(a) –Table 110.2-F Air Conditioners and Condensing Units, page 14 – table errors and comments

ASHRAE 90.1 has eliminated the table as there are no efficiency requirements and modifications where made to the requirements for certification.

Section 110.2(a) –Table 110.2-G Air Conditioners and Condensing Units, page 15 – table errors and comments

Several table modifications have been made to ASHRAE 90.1 and a complete review should be conducted. Some errors that we spotted are.

- For propeller or axial fan evaporative condensers, the refrigerant for test is shown as R-507A which is no longer allowed to be used and ASHRAE 90.1 has change to R-448A and has changed the efficiency requirements.
- For centrifugal fan evaporative condensers, the refrigerant for test is shown as R-507A which is no longer allowed to be used and ASHRAE 90.1 has change to R-448A and has changed the efficiency requirements.
- The requirements for air cooled condensers references R22 as the test fluid which is no longer allowed to be used since 2010. ASHRAE 90.1 eliminated the reference to a test fluid.
- Reference standards need to be added and updated to the latest standard.

Section 110.2(a) –Table 110.2-H Air Conditioners and Condensing Units, page 16 – table errors and comments

We did a quick review of the table but would recommend a detailed review before final release. Some things we found are listed below:

- Note b is not correct and should be removed.

Section 110.2(a) –Table 110.2-I Air Conditioners and Condensing Units, page 17 – table errors and comments

We did a quick review of the table but would recommend a detailed review before final release. Some things we found are listed below:

- Do not understand why the 13.8 IEER is being changed to 14.0. This would be different than what is in ASHRAE 90.1
- Note c is not correct and should be removed.
- Note a is not part of ASHRAE 90.1 and not sure why it is there.

Section 110.2(a) –Table 110.2-K Air Conditioners and Condensing Units, page 17 – table errors and comments

The effective date for the higher efficiency levels has been changed for 3/2/2020 to 1/10/2023. Note clear why this delay is needed as the rest of the country will require the earlier date and may be an issue **with preemption**

Section 120.1 B v – Filter Rack Gasket – comment on new requirements, page 3 – comment on added gaskets

The requirements to gasket filter racks is probably to reduce leakage but is not very specific as to how much bypass it will need to meet.

Section 120.1 B D – Air Filter Pressure Drop, page 3 – comment

The pressure drop is defined as to be with clean filters but for the fan power allowance the requirements are based on mid-life pressure drop so the requirements are not aligned.

Section 120.1 (d) 4 Demand Control Ventilation Devices, page 9 – comment

The demand control ventilation is based on CO2 sensors but new technology that could be more reliable tracking occupancy is developing and this limits demand ventilation to just CO2 sensing.

Section 120.1 (d) 4 Demand Control Ventilation Devices, page 10 – comment

It may not be appropriate to reduce ventilation to zero in standby occupancy as nothing is being done for space-based ventilation and control of VOC's

Section 120.2 (i) Economizer Fault Detection and Diagnostics (FDD), page 22 – Expansion down to 33,000 Btu/h

Expanding 33,000 Btu/h is justified for units outside the building and for units adjacent to an outside wall but is not cost justified for units located inside the building.

Might want to change the title to Air Economizer as there are now water economizers and refrigerant cycle economizers and these requirements would not be applicable to the other economizer types.

Section 120.6 4 B Design Saturated Condensing Temperature, page 34 – comment

This requirement seems to be based on current and older refrigerants that are either single component refrigerants, or refrigerants with no glide but many of the new refrigerants will be mixtures and have glide the saturation temperature should be changed to midpoint temperature.

Section 120.6 (j) 3 Fan Control for Computer Room – requirements for two speed fans

The 2-speed fan on conventional HVAC can save considerable energy, but for computer rooms and IT equipment reduced airflow could cause issues with server cooling so this needs to be evaluated with the IT industry before it is added.

Section 120.10 a) Requirements for FEI – comments

The following exemption notes are in ASHRAE 90.1 and should be added:

- Fans used for moving gases at temperatures above 482°F.
- Fans used for operation in explosive atmospheres.
- Reversible fans used for tunnel ventilation.
- Fans outside the scope of AMCA 208.
- Fans that are intended to only operate during emergency conditions.

Section 140.2 (a) 2 A Requirements for Heat Pumps in Retail and Grocery Stores, page 23 - comments

The new requirements for heat pumps in retail and grocery building spaces is probably being added for electrification. But for grocery stores the heating load may be covered by refrigeration heat reclaim. Also, in some larger retail stores the heat loads may be extremely small or they are using VAV systems where heat pumps may not be the best choice. This requirement needs some further study and evaluation.

Section 140.2 (a) 2 B Requirements for Gas Furnaces in Retail and Grocery Buildings shall use furnaces, page 23 - comments

This seems to be counter to the requirements in 2A but does not make sense as there are more heat pumps available in the smaller size units

Section 140.2 (a) 2 C Requirements for Dual Fuel in Retail and Grocery Buildings shall use dual fuel page 23 - comments

Currently the availability of dual fuel in large commercial units is limited and heat pumps are not even produced for units greater than 20 tons

Section 140.2 (a) 2 D School Buildings Dual Fuel page 23 – comments

Dual fuel is available for smaller size units but for larger units' products are not available and would not even likely be a good choice for larger VAV system. Would this also eliminate the use of chiller water systems and VRF systems

Section 140.2 (a) 2 D Office, Financial Institution, and Library Building Space, page 23 – comments

Dual fuel is available for smaller size units but for larger units' products are not available and would not even likely be a good choice for larger VAV system. Would this also eliminate the use of chiller water systems and VRF systems

Section 140.2 (b) Calculations, page 23 – comments

This seems to say that only the ASHRAE Handbook can be used for load calculations which would prohibit the use of simulation and modeling tools.

Section 140.2 (c) 1 C Determining Fan System Electrical Input Power, page 31 – comments

Overall, we understand the desire to improve on the old fan power allowances that were derived from ASHRAE 90.1, but we have some serious issues with the resulting limitations it will impose on the HVAC fan systems. The approach is a good approach, but the required improvements have been taken to an extremely and even our very best fan system that was just introduced with vane axile fans will have significant range restrictions placed on the equipment.

This is a very complex proposal to evaluate and 15 days was not enough time to check every value in table 140.4 A and table 140.4 B because the metric have been changed from a static pressure drop for things like filters, gas heat, electric heat, etc. to a watts/cfm so we can not easily and quickly check.

What we did is take our basic rooftop product line with gas heat and an economizer and apply the maximum fan power limits to see what the external static would be that would comply with the requirements.

The table of watts/cfm table was developed assuming an external static for the ductwork at 1 in for supply and 0.5 in. We arrived at this based on some of the advanced information that the Case Team shared with the industry. This is shown in the following table.

Pressure allowances – baseline

Values used by Fan Working Group to Determine Basic Limit
65% fan efficiency assumed

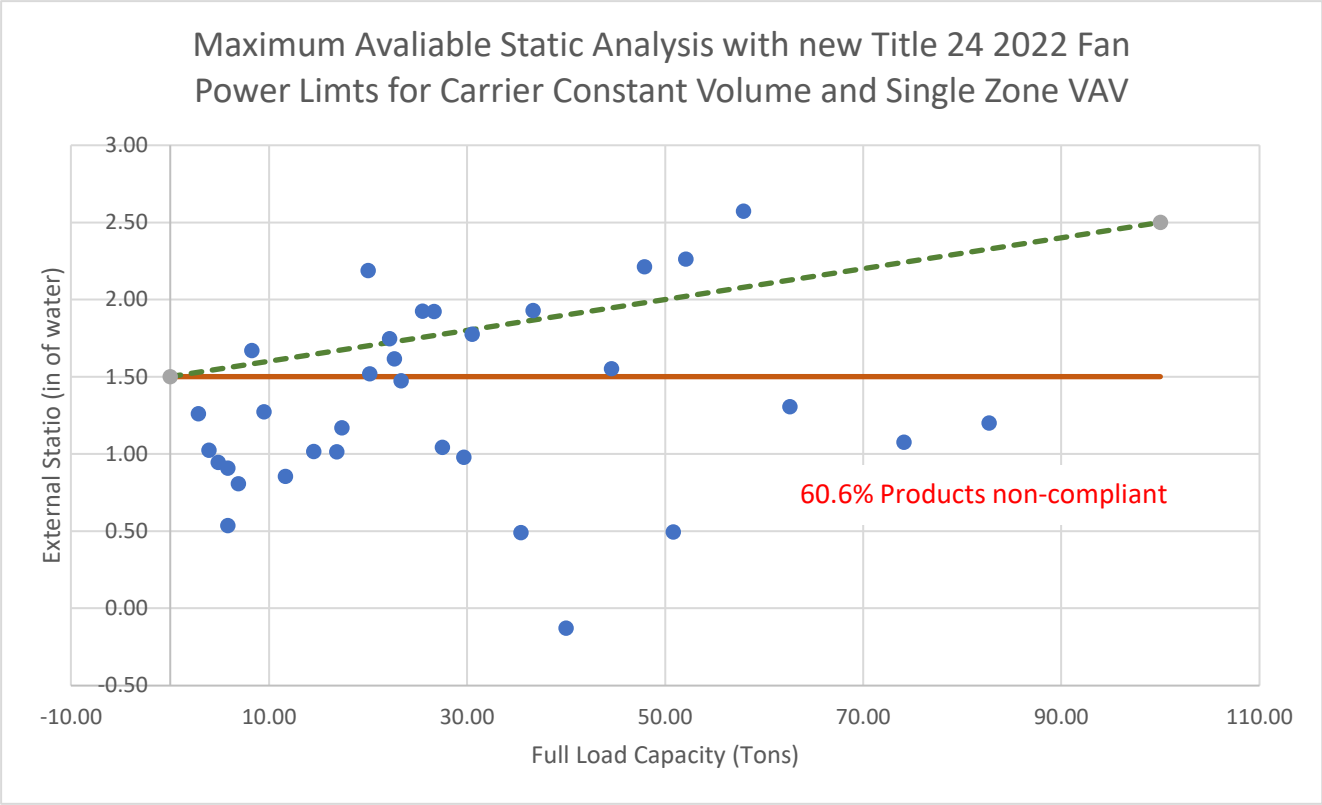
Basic Components	VAV System	CV System
Return/Exhaust ESP	1.00	0.50
Air Blender	0.20	0.20
Inlet/Mixed Air Section	0.50	0.50
Pre-Filter	0.50	0.50
Heat coil	0.30	0.30
Cooling coil	0.60	0.60
Outlet Transititon	0.25	0.25
Supply ESP	2.00	1.00
Total	**5.35**	**3.85**

= duct system losses

Duct ESP	VAV	CV/SZ-VAV
Supply	2.25	1.25
Exhaust	1.50	1.00
Total	**3.75**	**2.25**

What they consider as duct losses does not align with the rating procedures used in AHRI 340/360 where the inlet/mixed air section, outlet transition are included in the unit fan power ratings. So, the true external static pressure is 3 in-H2O for VAV and 1.5 in-H2O for CV Systems. It is not clear why a VAV system would have double the applied external static as the old system power terminals are not longer used. Also, the external statics are no constant from 3 tons thru 150 tons and this allowance should vary by size.

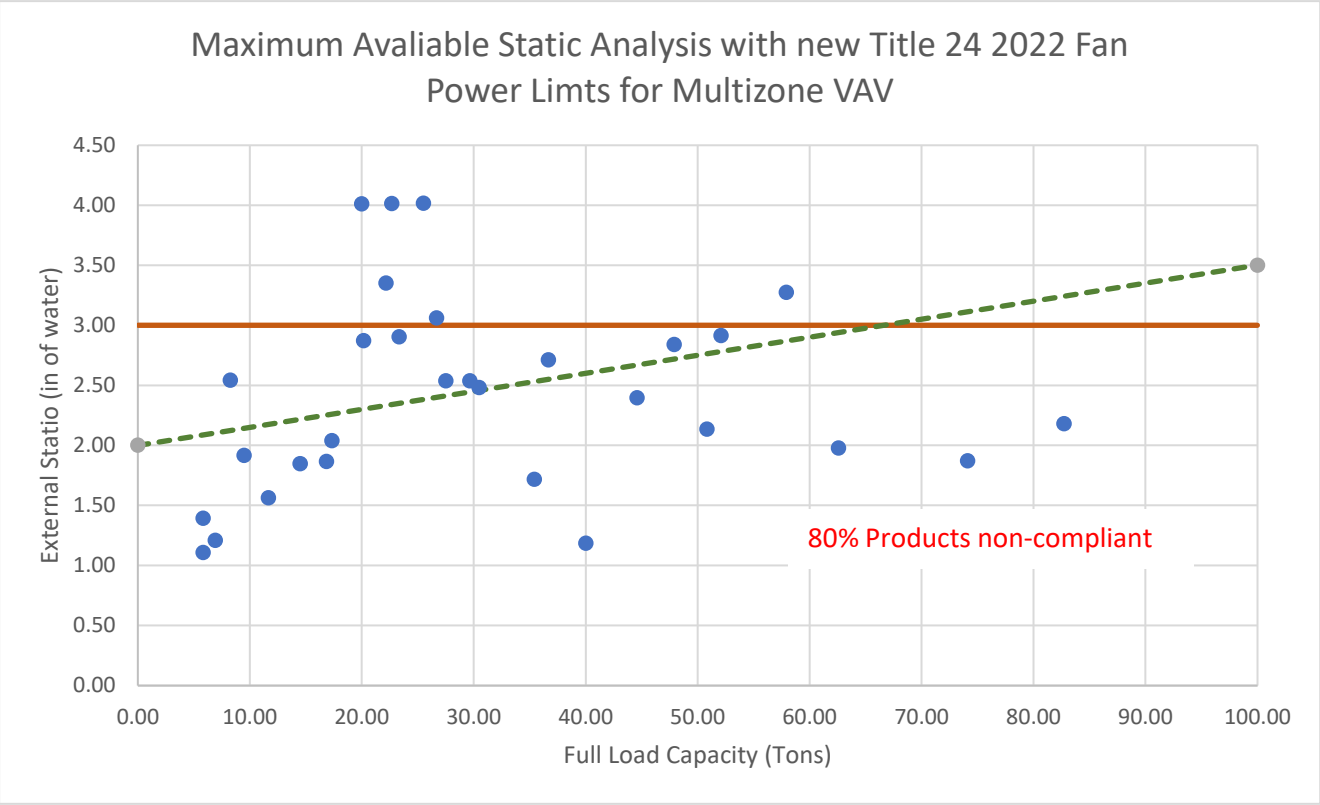
Below is the plot for the constant volume units. Each of the blue dots is the maximum external static that a unit with gas heat, an economizer, and MERV 13 filter could be applied with and meet the requirements of the table 140.1 A and 140.1 B



As you can see 60.6% of the units would not even be able to provide the assumed 1.5 in-H2) static which is shown by the orange line. The assumption on the 1.5 in-H2O static is probably OK for the smaller units but as the capacity increases so does the ductwork length and we believe a curve more like the green dashed line would be more appropriate.

There are many variations of these products and we know side supply which is used form many of the smaller product would be further limited and we plan to continue this analysis for all the many options.

We did the same analysis for the VAV multizone requirements which are different for the allowable watts/cfm and for the assumed external static of 3.0 inches. This is shown in the following curve.



80% of the products would not be able to provide the assumed static of 3 in-H2O. We do also feel the 3-inch static for all sizes is not a good assumption and we feel a number range from 2 in to 3 inch would be more appropriate. VAV has expanded and we build VAV multizone units from 6 tons to 150 tons.

Overall, we found that the new requirements were significantly lower in allowable watts than the current requirements which is summarized in the following table.

	Constant Volume			Variable Volume		
	<5000	5000-10,000	>10,000	<5000	5000-10,000	>10,000
Reduction	-25.4%	-27.6%	-24.9%	-38.9%	-21.0%	-36.8%

There are many drivers in this significant reduction.

- In the development of the fan power allowance the Case Team assumed an FEI of 1.15 be there was no justification as to why the fan power allowance was 15% better than the requirements for FEI that are also include in the Title 24 update.

Step 1: Calculate the budget *fan brake horsepower* (bhp_{budget})

$$bhp_{budget} = \frac{(Q_i + Q_o)(P_{budget} + P_o)C_A}{6343 \cdot 0.66 \cdot EF}$$

Where

bhp_{budget} = Budget *Fan system brake horsepower (hp)*

Q_i = *Actual airflow* at *fan system design conditions (acfm)*

Q_o = 250 acfm

P_{budget} = The sum of the budgeted fan system pressure losses from table 6.5.3.1.1-1 (in. H_2O)

P_o = 0.2 in. H_2O (different than the 0.4 in AMCA 208)

C_A = Altitude density correction from Table 6.5.3.1.1-2

EF = 1.15

- For almost every category the allowable static for the component allowance was based on the best available technology with considerations for how the equipment is allied. For example some internal losses could be reduced with much large cabinet sizes by when applied they will no longer fit on the same roof curb and will require conversion curbs which are allow but all the savings will be lost with conversion curb additional losses.

Overall, we understand the need to improve fan power, and have good low-pressure ductwork used with design but it was based on very optimistic assumptions and we have not seen any cost justification. It was also based on full load operation just like the FEI but most equipment run at reduced load and with variable speed fans and two speed fans the power decreases to the cube of the speed and there were no allowance for this to encourage the use of new part load fan technology that could save significantly more energy than the full load approach used by this proposal.

We also have several comments on the table as several people found the table difficult to following and understand the intent.

- Would recommend you reformat the headers with Multi-zone VAV and CV and Single Zone VAV and then under it have sub-titles with
  - <5,000
  - 5000-10,000
  - >10,000

  We would recommend it be in increase cfm and not decreasing cfm

- For the 5th column which is labeled Multi-Zone VAV Systems ≤5,000 cfm we believe this should be CV and Single-Zone VAV Systems ≤5,000 cfm
- All the products are rated with less than MERV 13. We understand California requires MERV 13 but we would recommend an allowance for MERV 8 to 13 is included, Some were also confused that there was an additional filter allowance for the return duct and some considered that to be an allowance for the standard filter just prior to the evaporator coil
- The gas heat allowance is low especially for large rooftops and is one number although the industry has multiple gas heat heat-cool ratios.
- There should probably be different allowances for return fans and exhaust fans.
- In table 141.0-D additional fan power allowances, there are some additional allowances, but it is not clear what they are to be used for. Some thought that it could be used for any replacement units, but I believe the intent was for conversion curbs. Most people are never going to even see this table as it is on page 98 and the fan power limitations are on page 31
- As this is a complex set of requirements it would be desirable to have a spreadsheet tool that has all the numbers and calculations.
- We also would like to see some expanded text describing what each of the allowances are including any exceptions.
  The 140.4-D alternate approach adds some further confusion and it might be better to just eliminate and have the one approach with a supporting tool.
- It is not clear why exception 2 to 140.4 (c) has been deleted on page 35

Section 140.2 (e) 1 Economizers, page 36 – reduction in minimum capacity for air economizers

The reduction from 54,000 Btu/h to 33,000 Btu/h for economizers for all systems is not cost justified. 33,000 Btu/h economizers are cost effective on rooftop units and units located outside a building or possibly adjacent to an outside wall but for small fan coils, WSHP's located deep inside a building would not be cost effective due to the significant to duct air to the inside of the building. The requirement should be changed to just apply to units that are outside or near an adjacent wall. There also should be some exemptions for units that are use for heat recovery in buildings with simultaneous cooling and heating. As the benefits of the heat recovery could outweigh the benefits of the economizer

The requirements for 100% outdoor air on a VAV system should be revised to more like 80% because the VAV terminals are never going to be full open during periods when the economizer is being used.

There should be an exemption for applications where the ventilation is 80% or more of the full load airflow as the incremental benefit is very small and not cost justified.

With the reduction to 33,000 Btu/h there should be an exemption for residential as the load profiles due not really show significant benefits for air economizers like we see with commercial buildings.

In the definitions there was an added definition for refrigerant pump economizers but there is no requirement listed in this section.

Exception 6 to 140.4 (e) 1 the allowance to allow economizer to be eliminated if a DOAS is being used is a significant reduction in efficiency even with the 130% increase in airflow. This will allow many systems to eliminate economizers. Further there are no efficiencies defined for DOAS units in the proposed changes and a very poor efficiency DOAS unit could be used to eliminate an economizer

Section 140.2 (p) Dedicated Outdoor Air Systems (DOAS) page 47 – comments on new requirements

How can an DOAS requirement be added to the standard that allows for elimination of significant energy savings from economizer be allow with no minimum efficiency requirements for the DOAS efficiency.

We know that the justification for this was to cycle the fans on the rooftops, but we are not clear if the analysis considered that the base units have 2 speed fans and in some cases 3 speed or even variable speed fans. The cost justification analysis has not been shared.

It is not clear what item B is doing but in the original case proposal they proposed that an economizer could be eliminated if 0.3 cfm/ft2 is provided during no mechanical cooling in the DOAS. This is essential the minimum ventilation air in many buildings and will allow for elimination of many economizers and a significant increase in energy use for California buildings. This text as implemented is not clear as to what it is trying to be required.

The requirements for energy recovery are marginal in many of the California climate zones as energy recovery is not very effective in mild temperature operating conditions.

There is no requirement for bypass on the energy recovery during economizer operation.

The requirement for ventilation fan system modulation is no specific and does not say how much modulation is required.

Delivering the air downstream from the fan coils is not how much systems are applied and the ventilation air is to the inlet to the coils so that integrated economizer operation can be used and the air is delivered effectively to the space. The added cost for this was ignored in the evaluation by the case team