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Statewide Utility Codes and Standards Team Comments on Nonresidential Fan Power

Additional submitted attachment is included below.

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

Comments on Fan System Power in 2019 Title 24, Part 6 45-Day Language

California Statewide Utility Codes and Standards Team

April 2, 2018

1. Introduction

The California Statewide Utility Codes and Standards Team (Statewide CASE Team) appreciates the opportunity to participate in the rulemaking and the thoughtful feedback we have received from the California Energy Commission (Energy Commission) on the Codes and Standards Enhancement (CASE) proposals.

The CASE initiative presents recommendations to support the Energy Commission's efforts to update California's Building Energy Efficiency Standards (Title 24, Part 6) to include new requirements or to upgrade existing requirements for various technologies. The four California Investor Owned Utilities – Pacific Gas and Electric Company, San Diego Gas and Electric, Southern California Edison and SoCalGas® – and several publicly Owned Utilities – Los Angeles Department of Water and Power, and Sacramento Municipal Utility District – sponsored this effort.

The Statewide CASE Team actively supports the Energy Commission in developing revisions to Title 24, Part 6 by developing code change proposals that will result in feasible, enforceable, and cost-effective enhancements to the building energy efficiency standards. In developing these proposals, the Statewide CASE Team conducts research and market surveys, holds stakeholder meetings, and evaluates the energy savings and cost-effectiveness of considered measures. The CASE Reports, which present pertinent information that supports the code change proposals, are posted within each measure topic page on title24stakeholders.com.

The Statewide CASE Team encourages the Energy Commission to consider the following changes for the sections pertaining to fan system power in nonresidential buildings.

2. Summary and Recommendations

The Statewide CASE Team has proposed changes to the fan system power sections of the 45-DayLanguage to prevent increased energy consumption. Without these changes, the 45-Day Language would increase statewide energy use. We recommend the Energy Commission implement the following edits to the code language to continue progress towards reducing energy used by nonresidential fan systems in California:

1. Remove the pressure drop adjustments for air filters rated at minimum efficiency reporting value (MERV) 9 and MERV 13 in Table 140.4-B
2. Introduce the 2016 Title 24, Part 6 prescriptive fan power requirements into Section 141.0(b)2C, so alterations do not have to comply with the new fan power requirements.

If the Energy Commission chooses not to make these changes, we recommend that the 2019 Title 24, Part 6 requirements for nonresidential fan system power are reverted to 2016 Title 24, Part 6 to avoid increasing energy use.

Details regarding the rationale for these changes are included in the following sections.

3. Background

Since 1992, Title 24 Part 6 has required that single zone fan systems greater than 25 hp draw no more power than 0.8 W/cfm and VAV fan systems draw no more power than 1.25 W/ft^2. The original CASE proposal recommended a more stringent fan power limitation when compared to the ASHRAE 90.1 standard in order to align with the fan power used in the Title 24, Part 6 Alternative Calculation Method (ACM). However, this analysis assumed that the difference in the ACM values and the ASHRAE values were based upon a lower pressure drop in the ACM filter (but with the same assumed MERV rating). From conversations with the Energy Commission, it was found that this stringency, combined with assumptions of duct pressure and filter pressure drop, had the potential of restricting a few unitary packaged units from being sold in California, causing possible preemption issues. For this reason, the Energy Commission reverted the fan power limitation in the 45-Day Language to be equivalent to ASHRAE 90.1.

The ASHRAE 90.1 fan power limitation is only more stringent than the 2016 Title 24, Part 6 prescriptive standard if one does not consider the added fan power allowed by the ASHRAE 90.1 standard for MERV 13 filtration. The 2019 version of Title 24, Part 6 is requiring MERV 13 filtration for indoor air quality improvements. ASHRAE 90.1 allows additional fan power equivalent to 0.9 inches of additional pressure drop when using MERV 13 filters, while the 2016 Title 24 prescriptive requirement does not allow for additional filtration pressure drop unless the filtration system is designed for greater than 1-inch pressure drop. Using the same approach as in the 2016 Title 24 standard, where the first 1-inch water column (w.c.) of pressure drop associated with filtration is included in the base efficiency, and given that MERV 13 filters are commonly designed with less than 1-inch w.c. of pressure drop, the fan power credit associated with MERV 13 filtration is proposed to be dropped from 2019 Title 24 fan power requirements.

4. Discussion

The W/cfm requirements of ASHRAE 90.1 2016 and 2016 Title 24, Part 6 are compared below, with MERV 8 and MERV 13 filters. ASHRAE 90.1 2016 only has modest savings in the MERV 8 scenario, and increases energy use in the MERV 13 scenario, illustrating the need to modify the filtration credits. The table below shows that when using MERV 13 filters, ASHRAE 90.1 is less stringent than the existing Title 24 requirement if the MERV 13 pressure adjustment is included.

Table 1: W/CFM savings of ASHRAE 90.1 2016 vs 2016 Title 24, Part 6

	With MERV 13 Pressure Credits (45-Day Language)		**Without MERV 13 Pressure Credits (CASE Team Recommendation)**	
W/cfm	**CV**	**VAV**	**CV**	**VAV**
2016 Title 24, Part 6	0.80	1.25	0.80	1.25
2019 Title 24, Part 6	0.99	1.33	0.80	1.14
Percent Savings	**-23%**	**-6%**	**0%**	**9%**

The nonresidential indoor air quality CASE report for the 2019 Title 24, Part 6 cycle included the proposed MERV 13 filtration requirement. The report compared the static pressure of MERV 8 and MERV 13 filters. It was found that while MERV 13 filters have a greater pressure drop when clean, the pressure drop between the two filters equalizes over time. MERV 13 filters will have an energy penalty when clean, but as they get dirty the design pressure drop difference between the two decreases and may disappear entirely. The pressure credits in ASHRAE 90.1 represent the design pressure, which is

typically for a dirty filter, so the MERV 13 filter may not require more pressure drop at design conditions relative to a MERV 8.

Table 2: Pressure Drop Between MERV 8 and MERV 13 Filters Over Time

Time Step	Total Static Pressure (IWG)		
	MERV 8	MERV 13	Incremental Total Static Pressure
0	0.240	0.410	0.170
1	0.324	0.476	0.151
2	0.409	0.541	0.132
3	0.493	0.607	0.113
4	0.578	0.672	0.094
5	0.662	0.738	0.076
6	0.747	0.803	0.057
7	0.831	0.869	0.038
8	0.916	0.934	0.019
9	1.000	1.000	0.000
Average Incremental Total Static Pressure			**0.085**

An additional example of the low pressure drop possible with MERV 13 filtration systems is the survey which was used to inform the fan power allowance in the 2016 ACM. NORESCO and Taylor Engineering conducted a survey of 200 fans across 30 projects and collected flowrates, pressure drops and design horsepower. Over two thirds of the surveyed fans had MERV 13 filtration, which illustrates that MERV 13 filters are not a barrier to low fan pressure drop systems, nor are they unusual.

5. Statewide Energy Savings

Based on the 45-Day Language for fan power systems, statewide energy use will increase due to the proposed changes made to fan power allowance. The statewide energy use **increase** is summarized in the Table 3. If the proposed code change markup is implemented, the statewide energy savings resulting are summarized in Table 4.

Table 3: Statewide Energy Savings due to 45-Day Language for Fan System Power

	First-Year Electricity Savings (GWh/yr)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (million therms/yr)
Total	-0.28	-0.05	0.00

Table 4: Statewide Energy Savings based on Proposed 45-Day Language Modification

	First-Year Electricity Savings (GWh/yr)	First-Year Peak Electrical Demand Reduction (MW)	First-Year Natural Gas Savings (million therms/yr)
Total	2.60	0.37	-0.01

6. Proposed Code Language Markup

Recommended revisions to the 45-Day Language are presented below in turquoise. The Statewide CASE Team's recommended language insertions are double underlined and recommended language ~~deletions are double struck~~.

Section 140.4(c)

(c) **~~Power Consumption of~~ Fans Systems.** Each fan system having a total fan system motor nameplate horsepower exceeding 5 hp used for space conditioning shall meet the requirements of Items 1, 2, ~~3~~ and ~~4~~3 below. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors.~~; however, total fan system power demand need not include (i) the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than 245 pascals or one inch water column (only the energy accounted for by the amount of pressure drop that is over 1 inch may be excluded), or (ii) fan system power caused solely by exempt process loads.~~

1. ~~**Constant volume fan systems.** The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 0.8 watts per cfm of supply air.~~

1. **Fan Power Limitation.** At design conditions each fan system shall not exceed the allowable fan system power of option 1 or 2 as specified in Table 140.4-A

TABLE 140.4 - A Fan Power Limitation

	Limit	Constant Volume	Variable Volume
Option 1: Fan system motor nameplate hp	Allowable motor nameplate hp	$hp \leq cfm_s \times 0.0011$	$hp \leq cfm_s \times 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \leq cfm_s \times 0.00094 + A$	$bhp \leq cfm_s \times 0.0013 + A$

[1]cfm_s = maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute

hp = maximum combined motor nameplate horsepower for all fans in the system

bhp = maximum combined fan-brake horsepower for all fans in the system

A = sum of (PD x cfm_D/4131)

PD = each applicable pressure drop adjustment from Table 140.4 – B, in inches of water

cfm_D = the design airflow through each applicable device from Table 140.4 – B, in cubic feet per minute

TABLE 140.4-B – Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment Credits
Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms	0.5 in. of water

Return and/or exhaust airflow control devices	0.5 in. of water
Exhaust filters, scrubbers, or other exhaust treatment	The pressure drop of device calculated at fan system design condition
~~Particulate Filtration Credit: MERV 9 through 12~~	~~0.5 in. of water~~
~~Particulate Filtration Credit: MERV 13 through 15~~	~~0.9 in. of water~~
Particulate Filtration Credit: MERV 16 and greater and electronically enhanced filters	Pressure drop calculated at 2 x clean filter pressure drop at fan system design condition
Carbon and other gas-phase air cleaners	Clean filter pressure drop at fan system design condition
Biosafety cabinet	Pressure drop of device at fan system design condition
Energy recovery device, other than coil runaround loop	For each airstream [(2.2 x Energy Recovery Effectiveness) – 0.5] in. of water
Coil runaround loop	0.6 in. of water for each airstream
Exhaust systems serving fume hoods	0.35 in. of water

Section 141.0(b)2C

C. **New or Replacement Space-Conditioning Systems** or Components other than new or replacement space-conditioning system ducts shall meet the requirements of Section 140.4 applicable to the systems or components being altered. The fan power requirements of Section 140.4(c)1 shall be replaced with the following for space conditioning alterations where ducts are not being replaced and total fan system motor nameplate horsepower exceeds 5 hp. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors. Total fan system power demand need not include the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than one-inch water column (only the energy accounted for by the amount of pressure drop that is over 1 inch may be excluded), or fan system power caused solely by exempt process loads. Where fan systems have more than 1 inch of static pressure through the filtration system, apply equation 141.0-XX, for calculating the adjusted fan power index for complying with item i and ii.

i. Constant volume fan systems. The total fan power index at design conditions of each fan system shall not exceed 0.8 watts per cfm of supply air.

ii. Variable air volume systems. The total fan power index at design conditions of each fan system shall not exceed 1.25 watts per cfm of supply air

EQUATION 141.0-XX ADJUSTED TOTAL FAN POWER INDEX

Adjusted total fan power index = Fan power index x Fan Adjustment

$$\text{Fan Adjustment} = 1 - \left(\frac{SP_a - 1}{SP_f} \right)$$

Where:

SP_a = Air pressure drop across the air-treatment or filtering system, in WC.

SP_f = Total pressure drop across the fan, in WC.

EXCEPTION 1 to Section 141.0(b)2C. Subsection (b)2C does not apply to replacements of equivalent or lower capacity electric resistance space heaters for high rise residential apartment units.

EXCEPTION 2 to Section 141.0(b)2C. Subsection (b)2C does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

EXCEPTION 3 to Section 141.0(b)2C. Section 140.4(n) is not applicable to new or replacement space conditioning systems.