DOCKETED

Docket Number:	17-BSTD-01
Project Title:	2019 Building Energy Efficiency Standards PreRulemaking
TN #:	220431
Document Title:	Armin Hauer Comments fan system power limit; electric rather than brake power
Description:	N/A
Filer:	System
Organization:	ebm-papst Inc./Armin Hauer
Submitter Role:	Public
Submission Date:	7/27/2017 2:32:28 PM
Docketed Date:	7/27/2017

Comment Received From: Armin Hauer
Submitted On: 7/27/2017
Docket Number: 17-BSTD-01

fan system power limit; electric rather than brake power

Additional submitted attachment is included below.

Armin Hauer

From: Armin Hauer
Sent: Thursday, July 27, 2017 5:11 PM
To: Alatorre, Mark@Energy
Subject: CEC T24 fan system power use electrical input power rather than fan shaft power
Attachments: 2016-NRCC-MCH-07-E-Prescriptive-Requirements-Fan-Power-Consumption, marked up.pdf

Hello Mark:

Today we investigated the Canadian building energy code for commercial facilities. A quick glance at their fan system requirements reveals their fan power limits:

1.6 watts per (liter per second) for constant volume systems
and
2.65 watts per (liter per second) for VAV systems
Most importantly for me at the moment is that the Canadian code clearly refers to the power (input) drawn by the motor and not their nameplate (output power) rating.

For 2016 the CEC-NRCC-MCH-07-E accounts for the difference between impeller brake power and actually relevant fan electrical input power. (I marked it up in 7 places to highlight this detail.)

ebm-papst advocates against going back to a mere shaft-power metric for the 2019 California building code. Taking into account also the below mentioned product efficiency regulations and the course that Ashrae 90.1 likely takes, we hope that CEC stays with electrical input power like in the 2016 code.

Thank you for your consideration.

Best regards
Armin Hauer
Engineering

ebm-papst Inc.
110 Hyde Road
Farmington, CT 06034
Phone: +1 860 507-8259 (direct)
E-mail: armin.hauer@us.ebmpapst.com
www.ebmpapst.us


our commitment to eco-friendly production

From: Armin Hauer
Sent: Saturday, June 24, 2017 7:52 PM
To: Alatorre, Mark@Energy
Cc: Ken Takahashi
Subject: 90.1 MSC preso about Fan Energy Index / Fan Electrical Power

Hello Mark,
What a great coincidence that you observed the presentation just now. You saw how everyone proceeds with the so-called wire-to-air fan metric:

- DoE has their ASRAC term sheet pending where FEP and FEI was first established.
- CEC T20 (Alejandro Galdamez, Kristen Driskell) are considering now two wire-to-air metrics:
  FEI
  or
  FER (a predecessor which was abandoned by both DoE and the fan industry at large).
  So far, the majority of the commenters to recently initiated T20 activities are also supporting wire-to-air.
- Attached form CEC-NRCC-MCH-07-E puts out wire-to-air value: watts and watts/cfm.
- European fans are regulated by electrical power, too.
- Ashrae 51 in its 2016 revision now includes a “cleanup” to fully unambiguous support wire-to-air fan testing.

I hope that T24-2019 does not go back to a shaft-to-air requirement now. I plan to file a brief public comment officially with T24 on the fan power limitation topic.

Best regards
Armin Hauer
Phone: +1 860 507-8259 (direct)

STATE OF CALIFORNIA

FAN POWER CONSUMPTION

CEC-NRCC-MCH-07-E (Revised 01/16) CALIFORNIA ENERGY COMMISSION

CERTIFICATE OF COMPLIANCE	NRCC-MCH-07-E
Power Consumption of Fans Requirements	(Page 1 of 2)
Project Name:	Date Prepared:

A. Constant Volume Fan Systems

NOTE: Provide one copy of this worksheet for each fan system with a total fan system horsepower greater than 25 hp of Constant Volume Fan Systems when using the Prescriptive Approach. See Power Consumption of fans §140.4(c).

01	02	03		04	05
FAN DESCRIPTION	DESIGN BRAKE HP	EFFICIENCY		NUMBER OF FANS	PEAK WATTS A02 x A04 x 746 / (A03a x A03b)
		MOTOR	DRIVE		

electrical power

B. Variable Air Volume Fan Systems

NOTE: Provide one copy of this worksheet for each fan system with a total fan system horsepower greater than 25 hp of Variable Air Volume (VAV) Systems when using the Prescriptive Approach. See Power Consumption of fans §140.4(c).

01	02	03		04	05
FAN DESCRIPTION	DESIGN BRAKE HP	EFFICIENCY		NUMBER OF FANS	PEAK WATTS B02 x B04 x 746 / (B03a x B03b)
		MOTOR	DRIVE		

electrical power

C. Totals and Adjustments

FILTER PRESSURE ADJUSTMENT Equation 140.4-A in §140.4(c) of the Building Energy Efficiency Standards. A) If filter pressure drop (SP_a) is greater than 1 inch W. C. or 245 Pascal then enter SP_a on line 4. Enter Total Fan pressure drop across the fan (SP_f) on line 5. B) Calculate Fan Adjustment and enter on line 6. C) Calculate Adjusted Fan Power Index and enter on row 7	01	TOTAL FAN SYSTEM POWER (WATTS, SUM COLUMN F)		W
	02	SUPPLY DESIGN AIRFLOW		CFM
	03	TOTAL FAN SYSTEM POWER INDEX (Row 1 / Row 2)[1]		W/CFM
	04	SP_a		in W.C or Pa
	05	SP_f		in W.C or Pa
	06	Fan Adjustment = $1-(SP_a - 1)/SP_f$		
	07	ADJUSTED FAN POWER INDEX (Line 3 x Line 6)[1]		W/CFM

1. TOTAL FAN SYSTEM POWER INDEX or ADJUSTED FAN POWER INDEX must not exceed 0.8 W/cfm for Constant Volume systems or 1.25 W/cfm for VAV systems.

electrical power

CERTIFICATE OF COMPLIANCE	NRCC-MCH-07-E
Power Consumption of Fans Requirements	(Page 2 of 2)
Project Name:	Date Prepared:

DOCUMENTATION AUTHOR'S DECLARATION STATEMENT	
1. I certify that this Certificate of Compliance documentation is accurate and complete.	
Documentation Author Name:	Documentation Author Signature:
Company:	Signature Date:
Address:	CEA/ HERS Certification Identification (if applicable):
City/State/Zip:	Phone:

RESPONSIBLE PERSON'S DECLARATION STATEMENT

I certify the following under penalty of perjury, under the laws of the State of California:

1. The information provided on this Certificate of Compliance is true and correct.
2. I am eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design or system design identified on this Certificate of Compliance (responsible designer).
3. The energy features and performance specifications, materials, components, and manufactured devices for the building design or system design identified on this Certificate of Compliance conform to the requirements of Title 24, Part 1 and Part 6 of the California Code of Regulations.
4. The building design features or system design features identified on this Certificate of Compliance are consistent with the information provided on other applicable compliance documents, worksheets, calculations, plans and specifications submitted to the enforcement agency for approval with this building permit application.
5. I will ensure that a completed signed copy of this Certificate of Compliance shall be made available with the building permit(s) issued for the building, and made available to the enforcement agency for all applicable inspections. I understand that a completed signed copy of this Certificate of Compliance is required to be included with the documentation the builder provides to the building owner at occupancy.

Responsible Designer Name:	Responsible Designer Signature:
Company :	Date Signed:
Address:	License:
City/State/Zip:	Phone:

NRCC-MCH-07-E User Instructions

This compliance document is used to document the calculations used in sizing equipment and demonstrating compliance with the fan power requirements when using the prescriptive approach. The PROJECT NAME and DATE should be entered at the top of the compliance document. See §140.4(c).

Note: Provide one copy of this worksheet for each fan system with a total fan system horsepower greater than 25 hp for Constant Volume Fan Systems or Variable Air Volume (VAV) Systems when using the Prescriptive Approach.

This section is used to show how the fans associated with the space-conditioning system complies with the maximum fan power requirements. All supply, return, exhaust, and space exhaust fans – such as toilet exhausts – in the space-conditioning system that operate during the peak design period must be listed. Included are supply/return/exhaust fans in packaged equipment. Economizer relief fans that do not operate at peak are excluded. Also excluded are all fans that are manually switched and all fans that are not directly associated with moving conditioned air to/from the space-conditioning system, such as condenser fans and cooling tower fans.

If the total horsepower of all fans in the system is less than 25 hp, then this should be noted in the FAN DESCRIPTION column and the rest of this section left blank. If the total system horsepower is not obvious, such as when a VAV System has many fan-powered boxes, then this section must be completed.

Note: VAV fans and Constant Volume fans should be summarized on separate compliance documents.

adjustment for brake power versus electrical power

Sections A. Constant Volume Fan Systems & Section B. Variable Air Volume Fan Systems

1. FAN DESCRIPTION lists the equipment tag or other name associated with each fan.
2. DESIGN BRAKE HORSEPOWER lists the brake horsepower, excluding drive losses, as determined from manufacturer's data.

For dual-fan, dual-duct systems, the heating fan horsepower may be the (reduced) horsepower at the time of the cooling peak. If unknown, it may be assumed to be 35% of design. If this fan will be shut down during the cooling peak, enter 0 in COLUMN 02.
If the system has fan-powered VAV boxes, the VAV box power must be included if these fans run during the cooling peak (i.e. series style boxes). The power of all boxes may be summed and listed on a single line. If the manufacturer lists power consumption in watts, then the wattage sum may be entered directly in COLUMN 05. Horsepower must still be entered in COLUMN 02 if the designer intends to show that total system has less than 25 hp.

3. EFFICIENCY lists the efficiency of the MOTOR and DRIVE. The default for a direct drive is 1.0; belt drive is 0.97. If a variable-speed or variable-frequency drive is used, the drive efficiency should be multiplied by that device's efficiency.
4. NUMBER OF FANS lists the number of identical fans included in this line.
5. PEAK WATTS is calculated as:
   ((BHP x Number of Fans x 746 W/HP) / (Motor Efficiency, E_m x Drive Efficiency, E_d) where BHP (COLUMN 02) is the design brake horsepower as described above, E_m (COLUMN 03a) and E_d (COLUMN 03b) are the efficiency of the motor and the drive, respectively.

Section C. Totals and Adjustments

1. TOTALS FANS SYSTEMS POWER is the sum of all PEAK WATTS from (COLUMN 06). Enter sum in provided box at the right.
2. SUPPLY DESIGN AIRFLOW (CFM) Enter sum in provided box at the right (under COLUMN 06) to identify the design airflow of the system.
3. TOTAL FAN SYSTEM POWER INDEX, W/CFM is calculated by dividing the total PEAK WATTS (COLUMN F) by the total CFM. To comply, total space-conditioning system power demands must not exceed 0.8 W/CFM for constant volume systems, or 1.25 W/CFM for VAV systems. See §140.4(c)

If filter pressure drop is greater than 1 inch W. C. Enter filter air pressure drop. SP_a on line 4 and total pressure drop across the fan SP_f on Line 5, otherwise leave blank and go to Line 7. See §140.4(c)3.

4. SP_a is the air pressure drop across the air treatment or filtering system.
5. SP_f is the total pressure drop across the fan.
6. FAN ADJUSTMENT is the adjusted fan power index = $1-(SP_a - 1)/ SP_f$.

7. ADJUSTED FAN POWER INDEX is the total fan systems power index multiplied with the fan adjustment (Line 3 x Line 6).

   Note: TOTAL FAN SYSTEM POWER INDEX or ADJUSTED FAN POWER INDEX must not exceed 0.8 W/CFM, for Constant Volume systems or 1.25 W/CFM for VAV systems.