

# CECD1-17-22

IECC: C403.8.1, C403.8.2 (New), TABLE C403.8.1(1) (New), TABLE C403.8.1(2) (New), TABLE C403.8.1(1), TABLE C403.8.1(2), TABLE C403.8.1(3), TABLE C403.8.1(4), C403.8.1.1, C403.8.1.2, C403.8.2

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## 2024 International Energy Conservation Code [CE Project]

Revise as follows:

**C403.8.1 Fan power.** Allowable fan horsepower. For each fan system serving an occupied space or other enclosed space that includes one or more fans or fan arrays with fan electrical input power greater than 1 kW, fan system electrical input power determined per Section C403.8.1.2 at the fan system design airflow shall not be greater than the limit is calculated in accordance with Section C403.8.1.1. This section does not apply to fans service heat rejection equipment. Each HVAC system having a total fan system motor nameplate horsepower greater than 5 hp (3.7 kW) at fan system design conditions shall not be greater than the allowable fan system motor nameplate hp (Option 1) or fan system bhp (Option 2) shown in Table C403.8.1(1). This includes supply fans, exhaust fans, return/relief fans, and fan-powered terminal units associated with systems providing heating or cooling capability. Single-zone variable air volume systems shall comply with the constant volume fan power limitation.

### Exceptions:

1. Hospital, vivarium and laboratory systems that utilize flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be permitted to use variable volume fan power limitation.
2. Individual exhaust fans with motor nameplate horsepower of 1 hp (0.746 kW) or less are exempt from the allowable fan horsepower requirement.

Add new text as follows:

**C403.8.2 Motor nameplate horsepower.** For each fan, the fan brake horsepower (bhp) shall be indicated on the construction documents and the selected motor shall be not larger than the first available motor size greater than the following: 1. For fans less than 6 bhp (4476 W), 1.5 times the fan brake horsepower.

**TABLE C403.8.1(1) FAN POWER LIMITATION**

-	LIMIT	CONSTANT VOLUME	VARIABLE VOLUME
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \leq CFMs \times 0.0011$	$hp \leq CFMs \times 0.0015$
Option 2: Fan system bhp	Allowable fan system bhp	$bhp \leq CFMs \times 0.00094 + A$	$bhp \leq CFMs \times 0.0013 + A$

For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W, 1 cfm = 0.4719 L/s.

where:

$CFM_s$  = The maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute.

hp = The maximum combined motor nameplate horsepower.

bhp = The maximum combined fan brake horsepower.

$A$  = Sum of  $[PD \times CFM_d / 4131]$ .

where:

PD = Each applicable pressure drop adjustment from Table C403.8.1(2) in w.c.

$CFM_d$  = The design airflow through each applicable device from Table C403.8.1(2) in cubic feet per minute.

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**TABLE C403.8.1(2) FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT**

<u>DEVICE</u>	<u>ADJUSTMENT</u>
<u>CREDITS</u>	=
<u>Return air or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms</u>	<u>0.5 inch w.c. (2.15 inches w.c. for laboratory and vivarium systems)</u>
<u>Return and exhaust airflow control devices</u>	<u>0.5 inch w.c.</u>
<u>Exhaust filters, scrubbers or other exhaust treatment</u>	<u>The pressure drop of device calculated at fan system design condition</u>
<u>Particulate filtration credit: MERV 9 thru 12</u>	<u>0.5 inch w.c.</u>
<u>Particulate filtration credit: MERV 13 thru 15</u>	<u>0.9 inch w.c.</u>
<u>Particulate filtration credit: MERV 16 and greater and electronically enhanced filters</u>	<u>Pressure drop calculated at 2 times the clean filter pressure drop at fan system design condition.</u>
<u>Carbon and other gas-phase air cleaners</u>	<u>Clean filter pressure drop at fan system design condition.</u>
<u>Biosafety cabinet</u>	<u>Pressure drop of device at fan system design condition.</u>
<u>Energy recovery device, other than coil runaround loop</u>	<u>For each airstream, (2.2 x energy recovery effectiveness - 0.5) inch w.c.</u>
<u>Coil runaround loop</u>	<u>0.6 inch w.c. for each airstream.</u>
<u>Evaporative humidifier/cooler in series with another cooling coil</u>	<u>Pressure drop of device at fan system design conditions.</u>
<u>Sound attenuation section (fans serving spaces with design background noise goals below NC35)</u>	<u>0.15 inch w.c.</u>
<u>Exhaust system serving fume hoods</u>	<u>0.35 inch w.c.</u>
<u>Laboratory and vivarium exhaust systems in high-rise buildings</u>	<u>0.25 inch w.c./100 feet of vertical duct exceeding 75 feet.</u>
<u>Deductions</u>	=
<u>Systems without central cooling device</u>	<u>-0.6 inch w.c.</u>
<u>Systems without central heating device</u>	<u>-0.3 inch w.c.</u>
<u>Systems with central electric resistance heat</u>	<u>-0.2 inch w.c.</u>

For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm, 1 foot = 304.8 mm.  
w.c. = Water Column, NC = Noise Criterion

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**Delete without substitution:**

**TABLE C403.8.1(1) SUPPLY FAN POWER ALLOWANCES (W/CFM)**

- a. See section C408.3.1.1 for requirements for a Multi-Zone VAV system.
- b. Power allowances require further calculation. Multiply the actual pressure drop of the device or component by the fan power allowance in Table C403.8.1(2).
- c. The 100 percent outdoor air system must serve 3 or more HVAC zones.
- d. A low-turndown single-zone VAV fan system must be capable of and configured to reduce airflow to 50 percent of design airflow and use no more than 30 percent of the design wattage at that airflow. No more than 10 percent of the design load served by the equipment shall have fixed loads.
- e. The deduction of 0.500 W/cfm is a default value for multizone VAV fan systems. If the terminal unit or fan coil manufacturer can demonstrate that the share of the unit's fan power required to move the fan system's air is less than 0.500 W/cfm, that value may be used. The W/cfm shall be calculated by dividing the power required to operate the terminal unit's fan at fan system design conditions by the airflow of the terminal unit at those conditions.

**TABLE C403.8.1(2) EXHAUST, RETURN, RELIEF, TRANSFER FAN SYSTEM POWER ALLOWANCES (W/CFM)**

- a. See Section C408.3.1.1 for requirements for a Multi-Zone VAV System.
- b. Particle filter pressure loss can only be counted once per fan system.
- c. Power allowances require further calculation. Multiply the actual pressure drop of the device or component by the fan power allowance in Table C403.8.1(2).

**TABLE C403.8.1(3) FAN POWER LIMIT ALTITUDE CORRECTION FACTOR**

**TABLE C403.8.1(4) DEFAULT VALUES FOR FAN ELECTRICAL INPUT POWER BASED ON MOTOR NAMEPLATE HP<sup>a,b</sup>**

- a. This table cannot be used for Motor Nameplate Horsepower values greater than 100.
- b. This table is to be used only with motors with a service factor ≤1.15. If the service factor is not provided, this table may not be used.

**G403.8.1.1 Determining Fan Power Limit.** The maximum allowed fan system electrical input power, shall be determined in accordance with the following steps 1 through 5:

1. The fan system's classification shall be determined. A fan system is considered to be multizone VAV where it meets the following requirements; fan systems that do not meet the following requirements shall be classified as other fans:
  - 1.1 The fan system shall serve three or more HVAC zones and airflow to each shall be individually controlled based on heating, cooling and/or ventilation requirements.
  - 1.2 The sum of the minimum airflows for each HVAC zone shall be not greater than 40 percent of the fan system design conditions.

**Exception:** Hospital, vivarium, and laboratory systems that use flow control devices on exhaust or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall use the multizone VAV fan power allowances.
2. Determine the fan system airflow and choose the applicable table(s) for fan power allowance.
  - 2.1 For single cabinet fan systems, use the fan system airflow and the power allowances in both Table C403.8.1(1) and Table C403.8.1(2).
  - 2.2 For supply only fan systems, use the fan system airflow and power allowances in Table C403.8.1(1).
  - 2.3 For relief fan systems, use the design relief airflow and the power allowances in Table C403.8.1(2).
  - 2.4 For exhaust, return and transfer fan systems, use the fan system airflow and the power allowances in Table C403.8.1(2).
  - 2.5 For complex fan systems and DOAS with energy recovery fan systems, separately calculate the fan power allowance for the supply and return/exhaust systems and sum them. For the supply airflow at the fan system design conditions, and the power allowances in Table C403.8.1(1). For the return/exhaust airflow, use return or exhaust airflow at the fan system design conditions, and the power allowances in Table C403.8.1(2).
3. For each fan system determine the components included in the fan system and sum the fan power allowances of those components. All fan systems shall include the System Base Allowance. If, for a given component, only a portion of the fan system airflow passes through the component, calculate the fan power allowance for the component per equation 4-7:

$$FPA_{adj} = (Q_{comp} / Q_{sys}) * FPA_{comp} \tag{Equation 4-7}$$

$FPA_{adj}$  = The corrected fan power allowance for the component in w/cfm  
 $Q_{comp}$  = The airflow through component in cfm  
 $Q_{sys}$  = The fan system airflow in cfm  
 $FPA_{comp}$  = The fan power allowance of the component from Table C403.8.1(1) or Table C403.8.1(2)

4. Multiply the fan system airflow by the sum of the fan power allowances for the fan system, then divide by 1000 to convert to kW.

$$FPL = (Q_{sys} * FPA_{sum}) / 1000 \tag{Equation 4-8}$$

$FPL$  = The fan power limit in kW  
 $Q_{sys}$  = The fan system airflow in cfm (L/s)  
 $FPA_{sum}$  = The sum of the fan power allowance for the system in W/cfm  
 1000 = The conversion from W to kW

5. For building sites at elevations greater than 3,000 feet (900 m), multiply the fan power limit by the correction factor from Table C408.3.1(3).

$$FPL_{alt} = FPL * C_{alt} \quad \text{(Equation 4-9)}$$

$FPL_{alt}$  = The adjusted fan power limit in KW.

FPL = The fan power limit in KW calculated in step 4.

$C_{alt}$  = The altitude correction factor from Table C408.3.1(3).

**C403.8.1.2 Determining Fan System Electrical Input Power.** The fan system electrical input power is the sum of the fan electrical input power of each fan or fan array included in the fan system other than fans with fan electrical input power  $\leq 1$  kW. If variable speed drives are used their efficiency losses shall be included. Fan system input power shall be calculated with mid-life filter pressure drop, which is the mean of the clean filter pressure drop and design final filter pressure drop. The fan electrical input power for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a fan system:

1. Use the default fan electrical input power in Table C408.3.1(4) for one or more of the fans. This method cannot be used for complex fan systems.
2. Use the fan electrical input power at fan system design conditions provided by the manufacturer of the fan, fan array, or equipment that includes the fan or fan array, calculated per a test procedure included in 10 CFR Part 430, 10 CFR Part 431, ANSI/AMCA Standard 210, ASHRAE 51 AHRI Standard 430, AHRI Standard 440, or ISO 5801.
3. Use the fan electrical input power provided by the manufacturer, calculated at fan system design conditions per one of the methods listed in section 5.3 of ANSI/AMCA 208.
4. Use the fan nameplate electrical input power.

**C403.8.2 Motor nameplate horsepower.** For each fan, the fan brake horsepower (bhp) shall be indicated on the construction documents and the selected motor shall be not larger than the first available motor size greater than the following:

1. For fans less than 6 bhp (4476 W), 1.5 times the fan brake horsepower.
2. For fans 6 bhp (4476 W) and larger, 1.3 times the fan brake horsepower.

**Exceptions:**

1. Fans equipped with electronic speed control devices to vary the fan airflow as a function of load.
2. Fans with a fan nameplate electrical input power of less than 0.89 kW.
3. Systems complying with Section C403.8.1 fan system motor nameplate hp (Option 1).
4. Fans with motor nameplate horsepower less than 1 hp (746 W).

**Reason:** This harmonizes the code with ASHRAE 90.1-2022

**Cost Impact:** The code change proposal will decrease the cost of construction.

The code change proposal will decrease the cost of construction.

Changes to Section C403.8.1 as included in the Public Draft 1 would increase the cost of construction. Reverting to the language in the 2021 IECC would reduce the cost, by comparison.