

(Effective July 1, 2020)

WAC 51-11C-4038 Section C403.8—Fan and fan controls.

C403.8 Fan and fan controls. Fans in HVAC systems shall comply with Sections C403.8.1 through C403.8.5.1.

The airflow requirements of Section C403.8.5.1 shall apply to all fan motors. Group R occupancy exhaust fans shall also comply with Section C403.8.4.

C403.8.1 Allowable fan motor horsepower. Each HVAC system having a total fan system motor nameplate horsepower exceeding 5 hp (3.7 kW) at fan system design conditions shall not exceed the allowable *fan system motor nameplate hp* (Option 1) or *fan system bhp* (Option 2) as shown in Table C403.8.1(1). This includes supply fans, exhaust fans, return/relief fans, and fan-powered VAV air 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. Zone heating and/or cooling terminal units installed in conjunction with a dedicated outdoor air system (DOAS) shall be evaluated as separate HVAC systems for allowable fan motor horsepower.

- 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 or less are exempt from allowable fan motor horsepower requirements.

**Table C403.8.1(1)
Fan Power Limitation**

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

For SI: 1 cfm = 0.471 L/s. 1 bhp = 735.5 W, 1 hp = 745.5 W.

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.

**Table C403.8.1(2)
Fan Power Limitation Pressure Drop Adjustment**

Device	Adjustment
Credits	

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

For SI: 1 inch w.c. = 249 Pa, 1 inch = 25.4 mm.
w.c. = water column.

C403.8.2 Motor nameplate horsepower. For each fan, the selected fan motor shall be no larger than the first available motor size greater than the brake horsepower (bhp). The fan brake horsepower (bhp) shall

be indicated on the design documents to allow for compliance verification by the *code official*.

- EXCEPTIONS:
1. For fans less than 6 bhp (4413 W), where the first available motor larger than the brake horsepower has a nameplate rating within 50 percent of the bhp, selection of the next larger nameplate motor size is allowed.
 2. For fans 6 bhp (4413 W) and larger, where the first available motor larger than the bhp has a nameplate rating within 30 percent of the bhp, selection of the next larger nameplate motor size is allowed.
 3. For fans used only in *approved* life safety applications such as smoke evacuation.
 4. Fans with motor nameplate horsepower less than 1 hp are exempt from this section.

C403.8.3 Fan efficiency. Fans shall have a fan efficiency grade (FEG) of 67 or higher based on manufacturers' certified data, as defined by AMCA 205. The total efficiency of the fan at the design point of operation shall be within 15 percentage points of the maximum total efficiency of the fan.

- EXCEPTION:
- The following fans are not required to have a fan efficiency grade:
1. Individual fans with a motor nameplate horsepower of 5 hp (3.7 kW) or less that are not part of a group operated as the functional equivalent of a single fan.
 2. Multiple fans in series or parallel that have a combined motor nameplate horsepower of 5 hp (3.7 kW) or less and are operated as the functional equivalent of a single fan.
 3. Fans that are part of equipment covered under Section C403.3.2.
 4. Fans included in an equipment package certified by an *approved agency* for air or energy performance.
 5. Powered wall/roof ventilators.
 6. Fans outside the scope of AMCA 205.
 7. Fans that are intended to operate only during emergency conditions.

C403.8.4 Group R occupancy exhaust fan efficacy. The Group R occupancies of the building shall be provided with ventilation that meets the requirements of the *International Mechanical Code*, as applicable, or with other approved means of ventilation. Mechanical ventilation system fans with 400 cfm or less in capacity shall meet the efficacy requirements of Table C403.8.4.

- EXCEPTIONS:
1. Group R heat recovery ventilator and energy recovery ventilator fans that are less than 400 cfm.
 2. Where whole house ventilation fans are integrated with forced-air systems that are tested and listed HVAC equipment, provided they are powered by an electronically commutated motor where required by Section C405.8.
 3. Domestic clothes dryer booster fans, domestic range hood exhaust fans, and domestic range booster fans that operate intermittently.

**Table C403.8.4
Group R Exhaust Fan Efficacy**

Fan Location	Air Flow Rate Minimum (cfm)	Minimum Efficacy (cfm/watt)	Air Flow Rate Maximum (cfm)
Exhaust fan: Bathroom, utility room, whole house	10	2.8	< 90
Exhaust fan: Bathroom, utility room, whole house	90	3.5	Any
In-line (single-port and multi-port) fans	Any	3.8	Any

C403.8.5 Fan controls. Controls shall be provided for fans in accordance with Section C403.8.5.1 and as required for specific systems provided in Section C403.

C403.8.5.1 Fan airflow control. Each cooling system listed in Table C403.8.5.1 shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. Direct expansion (DX) and chilled water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have not fewer than two stages of fan control. Low or minimum speed shall not be greater than 66 percent of full speed. At low or minimum speed, the fan system shall draw not more than 40 percent of the fan power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.

2. Other units including DX cooling units and chilled water units that control the space temperature by modulating the airflow to the space shall have modulating fan control. Minimum speed shall be not greater than 50 percent of full speed. At minimum speed, the fan system shall draw no more than 30 percent of the power at full fan speed. Low or minimum speed shall be used during periods of low cooling load and ventilation-only operation.

3. Units that include an airside economizer in accordance with Section C403.5 shall have not fewer than two speeds of fan control during economizer operation.

- EXCEPTIONS:
1. Modulating fan control is not required for chilled water and evaporative cooling units with fan motors of less than 1 hp (0.746 kW) where the units are not used to provide ventilation air and the indoor fan cycles with the load.
 2. Where the volume of outdoor air required to comply with the ventilation requirements of the *International Mechanical Code* at low speed exceeds the air that would be delivered at the minimum speed defined in Section C403.8.5, the minimum speed shall be selected to provide the required ventilation air.

**Table C403.8.5.1
Fan Control**

Cooling System Type	Fan Motor Size	Mechanical Cooling Capacity
DX cooling	Any	≥ 42,000 Btu/h
Chilled water and evaporative cooling	≥ 1/4 hp	Any

[Statutory Authority: RCW 19.27A.020, 19.27A.025, 19.27A.160 and chapter 19.27 RCW. WSR 19-24-040, § 51-11C-4038, filed 11/26/19, effective 7/1/20.]

Reviser's note: The brackets and enclosed material in the text of the above section occurred in the copy filed by the agency.