Log No. 138 Revision 3
7/21/21

STATE OF WASHINGTON

STATE BUILDING CODE COUNCIL

Washington State Energy Code Development

Standard Energy Code Proposal Form

Code being amended: ☒ Commercial Provisions ☐ Residential Provisions

Code Section # C202, C403.8.1, C403.8.1.1, C403.8.1.2, C503.4, C403.3.5.1, C403.6.10, C403.12

Brief Description:

Revises the fan power allowance tables and updates them to align with new fan power budget and allowances based on system type in the 2022 Title 24 code.

Proposed code change text: (Copy the existing text from the Integrated Draft, linked above, and then use <u>underline</u> for new text and ~~strikeout~~ for text to be deleted.)

~~**C403.8.1 Allowable fan motor horsepower.** Each HVAC system having a total fan system motor nameplate horsepower exceeding 5 hp (3.7kW) 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 the 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~~	~~$hp \le CFM_S \times 0.0011$~~	~~$hp \le CFM_S \times 0.0015$~~
~~Option 2: Fan system bhp~~	~~Allowable fan system bhp~~	~~$bhp \le CFM_S \times 0.00094 + A$~~	~~$bhp \le CFM_S \times 0.0013 + A$~~

~~For SI: 1 bhp = 735.5 W, 1 hp = 745.5 W, 1 cfm = 0.471 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* × CFMD / 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~~	
~~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 × 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 heating~~	~~-0.2 inch w.c.~~

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

C202 Definitions

ENTHALPY RECOVERY RATIO (ERR). Change in the enthalpy of the outdoor air supply divided by the difference between the outdoor air and entering exhaust air enthalpy, expressed as a percentage.

FAN SYSTEM ELECTRICAL INPUT POWER (Fan $kW_{design, system}$). The sum of the fan electrical input power **(Fan kW_{design})** of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces, ~~and/or~~ return it to the source, ~~or~~ exhaust it to the outdoors, or transfer it to another space.

FAN ELECTRICAL INPUT POWER (FAN kWdesign). The electrical input power in kilowatts required to operate an individual fan or fan array at design conditions. It includes the power consumption of motor controllers, if present.

FAN SYSTEM. Includes all the fans that contribute to the movement of air through a point of a common duct, plenum, or cabinet.

FAN SYSTEM, COMPLEX. A *fan system* that combines supply, exhaust, and/or other fans or is not captured by other *fan system* types.

FAN SYSTEM, EXHAUST / RELIEF. A *fan system* dedicated to the removal of air from interior spaces to the outdoors ~~that may operate at times other than economizer operation~~.

FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV). A *fan system* that serves three or more space-conditioning zones where airflow to each zone is individually controlled based on heating, cooling and/or ventilation requirements, indoor fan airflow varies as a function of load, and the sum of the minimum zone airflows ~~for each zone~~ is 40% or less of the fan system design conditions.

~~**FAN SYSTEM, RELIEF** is a *fan system* dedicated to the removal of air from interior spaces to the outdoors that operates only during economizer operation.~~

FAN SYSTEM, RETURN. A *fan system* dedicated to removing air from interior where some or all the air is to be recirculated except during economizer operation.

FAN SYSTEM, SUPPLY-ONLY. A *fan system* that provides supply air to interior spaces and does not recirculate the air.

FAN SYSTEM, SINGLE-CABINET. A *fan system* where a single fan, single fan array, a single set of fans operating in parallel, or fans or fan arrays in series and embedded in the same cabinet, that both supplies air to a space and recirculates the air.

FAN SYSTEM, TRANSFER. A fan system that exclusively moves air from one occupied space to another.

FAN SYSTEM AIRFLOW (cfm). The sum of the airflow of all fans with *fan electrical input power* greater than 1 kW at *fan system design conditions*, excluding the airflow that passes through downstream fans with fan input power less than 1 kW.

C403.8.1 *Fan Systems*. Each *fan system* that includes at least one fan or fan array with *fan electrical input power* ≥ 1 kW, moving air into, out of, or between conditioned spaces or circulating air for the purpose of conditioning air within a space shall comply with Sections C403.8.1.1 through C403.8.1.2.

C403.8.1.1 Determining Fan Power Budget. For each *fan system*, the *fan system electrical input power* (Fan $kW_{design,system}$) ~~calculated~~ determined per Section C403.8.1.2 at the *fan system airflow* shall not exceed Fan kW_{budget}. Calculate Fan Power Budget (Fan kW_{budget}) for each *fan system* as follows:

1. Determine the *fan system airflow* and choose the appropriate table(s) for fan power allowance.
    a. 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).
    b. For *supply-only fan systems*, use the *fan system airflow* and power allowances in Table C403.8.1(1).
    c. For *relief fan systems*, use the design relief airflow and the power allowances in Table C403.8.1(2).
    d. For exhaust, return and transfer *fan systems*, use the *fan system airflow* and the power allowances in Table C403.8.1(2).
    e. For complex 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, use 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 /exhaust airflow at the *fan system* design conditions, and the power allowances in Table C403.8.1(2).

2. 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 that component per equation 4-9:

$$FPA_{adj} = (Q_{comp}/Q_{sys}) \times FPA_{comp} \qquad \text{(EQUATION 4-9)}$$

Where:

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)

3. Multiply the *fan system airflow* by the sum of the fan power allowances for the *fan system*.
4. Divide by 1000 to convert to Fan kW_{budget}.
5. For building sites at elevations greater than 3,000', multiply Fan kW_{budget} by 0.896.

C403.8.1.2 Determining *Fan System Electrical Input Power* (Fan $kW_{design,system}$). Fan $kW_{design,system}$ is the sum of Fan kW_{design} for each fan or fan array included in the *fan system*. If variable speed drives are used, their efficiency losses shall be included. Fan input power shall be calculated with ~~mid-life~~ two-times the clean filter pressure drop~~, which is the mean of the clean filter pressure drop and design final filter pressure drop~~. The Fan kW_{design} 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 kW_{design} in Table C403.8.1(3) for one or more of the fans. This method cannot be used for *complex fan systems*.
2. Use the Fan kW_{design} 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 USDOE 10 CFR Part 430, USDOE 10 CFR Part 431, ANSI/AMCA Standard 208-2018, ANSI/AMCA Standard 210-2016, AHRI Standard 430-2020, AHRI Standard 440-2019, or ISO 5801-2017.
3. Use the Fan kW_{design} provided by the manufacturer, calculated at *fan system design conditions* per one of the methods listed in section 5.3 of ANSI/AMCA 208-2018.
4. Determine the Fan kW_{design} by using the maximum electrical input power provided on the motor nameplate.

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

Airflow	Multi-Zone VAV Systems[1] ≤5,000 cfm	Multi-Zone VAV Systems[1] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[1] >10,000 cfm	All Other *Fan Systems* ≤5,000 cfm	All Other *Fan Systems* > 5,000 and ≤10,000 cfm	All Other *Fan Systems* > 10,000 cfm
Supply System Base Allowance for AHU serving spaces ≤ 6 floors away).	0.395	0.453	0.413	0.232	0.256	0.236
Supply system base allowance for AHU serving spaces > 6 floors away	0.508	0.548	0.501	0.349	0.356	0.325
MERV 13 to MERV 16 Filter upstream of thermal conditioning equipment (~~mid-life~~two-times the clean filter pressure drop)[2]	0.136	0.114	0.105	0.139	0.120	0.107
MERV 13 to MERV 16 Final filter downstream of thermal conditioning equipment. (~~mid-life~~two-times the clean filter pressure drop)[2]	0.225	0.188	0.176	0.231	0.197	0.177
Filtration allowance for > MERV 16 or HEPA Filter (~~mid-life~~two-times the clean filter pressure drop)[2]	0.335	0.280	0.265	0.342	0.292	0.264
Central Hydronic heating coil allowance	0.046	0.048	0.052	0.046	0.050	0.054
Electric heat allowance	0.046	0.038	0.035	0.046	0.040	0.036
Gas heat allowance	0.069	0.057	0.070	0.058	0.060	0.072

Hydronic/DX cooling coil or heat pump coil (wet) allowance[3]	0.135	0.114	0.105	0.139	0.120	0.107
Solid or liquid Desiccant system allowance	0.157	0.132	0.123	0.163	0.139	0.124
~~Allowance for~~ Reheat coil for dehumidification allowance	0.045	0.038	0.035	0.046	0.040	0.036
Allowance for Evaporative humidifier/cooler in series with a cooling coil. Value shown is allowed W/cfm per 1.0 Inches of water gauge (in.w.g.) Determine pressure loss (in.w.g.) at 400 fpm or maximum velocity allowed by the manufacturer, whichever is less. [Calculation required, see note 4]	0.224	0.188	0.176	0.231	0.197	0.177
Allowance for 100% Outdoor air system[5].	0.000	0.000	0.000	0.070	0.100	0.107
Energy recovery allowance for 0.50 ≤ ERR <0.55[6]	0.135	0.114	0.105	0.139	0.120	0.107
Energy recovery allowance for 0.55 ≤ ERR <0.60[6]	0.160	0.134	0.124	0.165	0.141	0.126
Energy recovery allowance for 0.60 ≤ ERR <0.65[6]	0.184	0.155	0.144	0.190	0.163	0.146
Energy recovery allowance for 0.65 ≤ ERR <0.70[6]	0.208	0.175	0.163	0.215	0.184	0.165
Energy recovery allowance for 0.70 ≤ ERR <0.75[6]	0.232	0.196	0.183	0.240	0.205	0.184
Energy recovery allowance for 0.75 ≤ ERR <0.80[6]	0.257	0.216	0.202	0.264	0.226	0.203
Energy recovery allowance for ERR ≥ 0.80[6]	0.281	0.236	0.222	0.289	0.247	0.222
~~Allowance for sensible-only recovery~~ Coil Runaround Loop	0.135	0.114	0.105	0.139	0.120	0.107
Allowance for Gas phase filtration required by code or accredited standard. Value shown is allowed W/cfm per 1.0 in. wg air pressure drop. [Calculation required, see note 4]	0.224	0.188	0.176	0.231	0.197	0.177
Economizer damper return	0.045	0.038	0.035	0.046	0.040	0.036
Air blender allowance	0.045	0.038	0.035	0.046	0.040	0.036
Sound attenuation section [fans serving spaces with design background noise goals below NC35]	0.034	0.029	0.026	0.035	0.030	0.027
Deduction for systems that feed a terminal unit with a fan with electrical input power < 1kW	-0.100	-0.100	-0.100	-0.100	-0.100	-0.100

Low-turndown single-zone VAV fan systems meeting the requirements in note 7.	0.000	0.000	0.000	0.070	0.100	0.089

1. See definition of *FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV)* ~~in definition a Multi-Zone VAV System~~.
2. Filter fan power allowance can only be counted once per *fan system*, except *fan systems* in healthcare facilities, which can claim one of the MERV 13 to 16 filter allowances and the HEPA filter allowance if both are included in the *fan system*.
3. Healthcare facilities can claim this fan power allowance twice per *fan system* where coil design leaving air temperature is less than 44 ºF.
4. Power allowance requires further calculation by multiplying the actual inches of water gauge (in.w.g.) of the device/ component by the w/ cfm in Table C403.8.1(1).
5. The 100% outdoor air system must serve 3 or more HVAC zones and airflow during non-economizer operating periods must comply with Section C403.2.2.1.
6. Enthalpy Recovery Ratio (ERR) calculated per ANSI/ASHRAE 84-2020.
7. 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.

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

Airflow	Multi-Zone VAV Systems[1] ≤5,000 cfm	Multi-Zone VAV Systems[1] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[1] >10,000 cfm	All Other *Fan Systems* ≤5,000 cfm	All Other *Fan Systems* >5,000 and ≤10,000 cfm	All Other *Fan Systems* >10,000 cfm
Exhaust System Base Allowance	0.221	0.246	0.236	0.186	0.184	0.190
Filter (any MERV value)[2]	0.046	0.041	0.036	0.046	0.041	0.035
Energy Recovery Allowance For 0.50 ≤ ERR <0.55[3]	0.139	0.120	0.107	0.139	0.123	0.109
Energy Recovery Allowance For 0.55 ≤ ERR <0.60[3]	0.165	0.142	0.126	0.165	0.144	0.128
Energy Recovery Allowance For 0.60 ≤ ERR <0.65[3]	0.190	0.163	0.146	0.191	0.166	0.148
Energy Recovery Allowance For 0.65 ≤ ERR <0.70[3]	0.215	0.184	0.165	0.216	0.188	0.167
Energy Recovery Allowance For 0.70 ≤ ERR <0.75[3]	0.240	0.206	0.184	0.241	0.209	0.186
Energy Recovery Allowance For 0.75 ≤ ERR <0.80[3]	0.265	0.227	0.203	0.266	0.231	0.205
Energy Recovery Allowance For ERR ≥ 0.80[3]	0.289	0.248	0.222	0.291	0.252	0.225
~~Allowance For Sensible-only recovery~~ Coil Runaround Loop	0.139	0.120	0.107	0.139	0.123	0.109
~~Economizer Return Damper~~	~~0.037~~	~~0.041~~	~~0.046~~	~~0.037~~	~~0.041~~	~~0.046~~
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	0.116	0.100	0.089	0.116	0.102	0.091
Return and/or exhaust airflow control devices	0.116	0.100	0.089	0.116	0.102	0.091

Laboratory and vivarium exhaust systems in high-rise buildings for vertical duct exceeding 75 ft. Value shown is allowed W/cfm per 0.25 in. wg for each 100 feet exceeding 75 feet. [Calculation required, see note 4]	0.058	0.051	0.045	0.058	0.052	0.046
Biosafety cabinet. Value shown is allowed W/cfm per 1.0 in. wg air pressure drop. [Calculation required, see note 4]	0.231	0.198	0.177	0.232	0.202	0.179
Exhaust filters, scrubbers, or other exhaust treatment required by code or standard. Value shown is allowed W/cfm per 1.0 in. wg air pressure drop. [Calculation required, see note 4]	0.231	0.198	0.177	0.232	0.202	0.179
Healthcare facility allowance[5]	0.231	0.198	0.177	0.232	0.202	0.179
Sound attenuation section [Fans serving spaces with design background noise goals below NC35.]	0.035	0.030	0.027	0.035	0.031	0.028

1. *See definition of FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV)* ~~in definitions for Multizone~~ to be classified as a Multi-Zone VAV System.
2. Filter pressure loss can only be counted once per *fan system*.
3. Enthalpy Recovery Ratio (ERR) calculated per ANSI/ASHRAE 84-2020.
4. Power allowance requires further calculation, multiplying the actual pressure drop (in. wg.) of the device/ component by the W/cfm in the Table C403.8.1(2).
5. This allowance can only be taken for healthcare facilities.

TABLE C403.8.1(3)
DEFAULT VALUES FOR FAN KW_{DESIGN} BASED ON MOTOR NAMEPLATE HP

Motor Nameplate HP	Default Fan kW_{design} with variable speed drive (Fan kW_{design})	Default Fan kW_{design} without variable speed drive (Fan kW_{design})
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15
≥7.5 and <10	8.46	8.13
≥10 and <15	12.47	12.03
≥15 and <20	16.55	16.04
≥20 and <25	20.58	19.92
≥25 and <30	24.59	23.77
≥30 and <40	32.74	31.70
≥40 and <50	40.71	39.46
≥50 and <60	48.50	47.10
≥60 and <75	60.45	58.87
≥75 and ≤100	80.40	78.17

1. This table cannot be used for Motor Nameplate Horsepower values greater than 100.
2. 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.

C503 Alterations

C503.4 Mechanical systems. Those parts of systems which are altered or replaced shall comply with Section C403. Additions or alterations shall not be made to an existing mechanical system that will cause the existing mechanical system to become out of compliance.

Exceptions:

1. Existing mechanical systems which are altered or where parts of the system are replaced are not required to be modified to comply with Section C403.3.5 as long as mechanical cooling capacity is not added to a system that did not have cooling capacity prior to the alteration.

2. Alternate mechanical system designs that are not in full compliance with this code may be approved when the *code official* determines that existing building constraints including, but not limited to, available mechanical space, limitations of the existing structure, or proximity to adjacent air intakes or exhausts make full compliance impractical. Alternate designs shall include additional energy saving strategies not prescriptively required by this code for the scope of the project including, but not limited to, demand control ventilation, energy recovery, or increased mechanical cooling or heating equipment efficiency above that required by Tables C403.3.2(1) through C403.3.2(12).

3. Only those components of existing HVAC systems that are altered or replaced shall be required to ~~meet the requirements of~~ comply with Section C403.8.1~~, Allowable fan motor horsepower~~. ~~Components replaced or altered shall not exceed the fan power limitation pressure drop adjustment values in Table C403.8.1(2) at design conditions.~~ Section C403.8.1 does not require the removal and replacement of existing system ductwork. Additional Fan Power Allowances are available when determining the Fan Power Budget (Fan kW_{budget}) as specified in Table C503.4. These values can be added to the Fan Power Allowance values in Table C403.8.1(1) and Table C403.8.1(2) when calculating a new Fan kW_{budget} for the *fan system* being altered.

Exceptions:

1. Alterations that add or change passive components which do not increase the *fan system* static pressure.

TABLE C503.4
ADDITIONAL FAN POWER ALLOWANCES (W/CFM)

Airflow	Multi-Zone VAV Systems[1] ≤5,000 cfm	Multi-Zone VAV Systems[1] >5,000 and ≤10,000 cfm	Multi-Zone VAV Systems[1] >10,000 cfm	All Other *Fan systems* ≤5,000 cfm	All Other *Fan systems* >5,000 and ≤10,000 cfm	All Other *Fan systems* >10,000 cfm
Supply *Fan system* Additional Allowance	0.135	0.114	0.105	0.139	0.120	0.107
Supply *Fan System* Additional Allowance in unit with adapter curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/ Relief/ Return/ Transfer *Fan system* Additional Allowance	0.070	0.061	0.054	0.070	0.062	0.055
Exhaust/ Relief/ Return/ Transfer *Fan system* Additional Allowance with adapter curb	0.016	0.017	0.220	0.000	0.000	0.000

1. See definition of *FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV)* ~~for the definition of a Multi-Zone VAV System~~.

WSEC related reference fixes

C403.3.5.1 Energy recovery ventilation with DOAS. The DOAS shall include *energy recovery ventilation.* The energy recovery system shall have a 60 percent minimum sensible recovery effectiveness or have 50 percent enthalpy recovery effectiveness in accordance with Section C403.7.6. For a DOAS having without at least one fan or fan array with fan electrical input power ≥ 1 kWtotal fan system motor nameplate hp less than 5 hp, total combined fan power shall not exceed 1 W/cfm of outdoor air. For a DOAS having with at least one fan or fan array with fan electrical input power ≥ 1 kWa total fan system motor hp greater than or equal to 5 hp, refer to fan power limitations of Section C403.8.1. This fan power restriction applies to each dedicated outdoor air unit in the permitted project, but does not include the fan power associated with the zonal heating/cooling equipment. The airflow rate thresholds for energy recovery requirements in Tables C403.7.6(1) and C403.7.6(2) do not apply.

C403.6.10 High efficiency variable air volume (VAV) systems. For HVAC systems subject to the requirements of Section C403.3.5 but utilizing Exception 2 of that section, a high efficiency multiple-zone VAV system may be provided without a separate parallel DOAS when the system is designed, installed, and configured to comply with all of the following criteria (this exception shall not be used as a substitution for a DOAS per Section C406.6:

1. Each VAV system must serve a minimum of 3,000 square feet (278.7 m^2) and have a minimum of five VAV zones.
2. The VAV systems are provided with airside economizer per Section C403.5 without exceptions.
3. A *direct-digital control* (*DDC*) system is provided to control the VAV air handling units and associated terminal units per Section C403.4.11 regardless of sizing thresholds of Table C403.4.11.1.
4. Multiple-zone VAV systems with a minimum outdoor air requirement of 2,500 cfm (1180 L/s) or greater shall be equipped with a device capable of measuring outdoor airflow intake under all load conditions. The system shall be capable of increasing or reducing the outdoor airflow intake based on feedback from the VAV terminal units as required by Section C403.6.5, without exceptions, and Section C403.7.1, Demand controlled ventilation.
5. Multiple-zone VAV systems with a minimum outdoor air requirement of 2,500 cfm (1180 L/s) or greater shall be equipped with a device capable of measuring supply airflow to the VAV terminal units under all load conditions.
6. In addition to meeting the zone isolation requirements of C403.2.1 a single VAV air handling unit shall not serve more than 50,000 square feet (4645 m^2) unless a single floor is greater than 50,000 square feet (4645 m^2) in which case the air handler is permitted to serve the entire floor.
7. The primary maximum cooling air for the VAV terminal units serving interior cooling load driven zones shall be sized for a supply air temperature that is a minimum of 5°F greater than the supply air temperature for the exterior zones in cooling.
8. Air terminal units with a minimum primary airflow set point of 50 percent or greater of the maximum primary airflow set point shall be sized with an inlet velocity of no greater than 900 feet per minute. Allowable fan motor horsepower shall not exceed 90 percent of the allowable fan power budget HVAC *fan system bhp* (Option 2) as defined by Section C403.8.1.1.

C403.12 High efficiency single-zone variable air volume (VAV) systems. For HVAC systems subject to the requirements of Section C403.3.5 but utilizing Exception 2 of that section, a high efficiency single-zone VAV system may be provided without a separate parallel DOAS when the system is designed, installed, and configured to comply with all of the following criteria (this exception shall not be used as a substitution for a DOAS per Section C406.6 or as a modification to the requirements for the *Standard Reference Design* in accordance with Section C407):

1. The single-zone VAV system is provided with airside economizer in accordance with Section 403.3 without exceptions.
2. A *direct-digital control* (*DDC*) system is provided to control the system as a single zone in accordance with Section C403.4.11 regardless of sizing thresholds of Table C403.4.11.1.
3. Single-zone VAV systems with a minimum outdoor air requirement of 1,000 cfm (472 L/s) or greater shall be equipped with a device capable of measuring outdoor airflow intake under all load conditions. The system shall be capable of increasing or reducing the outdoor airflow intake based on Section C403.7.1, Demand controlled ventilation.
4. Allowable fan motor horsepower shall not exceed 90 percent of the allowable HVAC *fan system bhp* (Option 2) fan power budget as defined by Section C403.8.1.1.

Purpose of code change:

This proposal updates the approach to fan power limitations and aligns with California's Title 24 method. Existing fan power limitations applies a "one-size-fits-all" approach to limiting fan power which leads to the requirements being easy to meet for many projects, especially with smaller fan systems. It has been widely acknowledged that the design of the current code requirements is somewhat stringent on larger systems, but less stringent for smaller fan systems. An assumption about the pressure drop a fan must overcome and fan efficiency is built into the existing fan power limitations equation. Currently, the underlying total static pressure assumption in the fan power limitations is 5.35 in. wg for VAV fan systems and 3.85 in. wg for CAV systems, regardless of the fan system air flow or components. This has the effect of making it easy to meet the standard for smaller buildings with shorter duct runs with lower pressure drop, as compared to larger more complex buildings with longer duct runs (higher pressure drop).

This also moves the threshold down as there are many fan systems between 1 kW and 5 nameplate HP which were previously not subject to the fan power limitations. Fan power requirements have not changed since they were adopted by the WSEC 2012 and prior to that, 90.1-2001. Adopting Title 24 fan power budgets could save up to 12% of fan power per system, especially for multi-zone systems such as VAV and DOAS serving a larger number of spaces.

Finally, an allowance of 0.6 in. wg for supply systems and 0.3 in. wg for exhaust/return/relief systems (where the combined total equals 0.9 in. wg) is allowed for additions/alterations. In addition, an extra allowance is provided where an adapter curb is needed.

Your amendment must meet one of the following criteria. Select at least one:

- ☐ Addresses a critical life/safety need.
- ☐ The amendment clarifies the intent or application of the code.
- ☒ Addresses a specific state policy or statute. (Note that energy conservation is a state policy)
- ☐ Consistency with state or federal regulations.
- ☐ Addresses a unique character of the state.
- ☐ Corrects errors and omissions.

Check the building types that would be impacted by your code change:

- ☐ Single family/duplex/townhome
- ☐ Multi-family 1 – 3 stories
- ☒ Multi-family 4 + stories
- ☒ Commercial / Retail
- ☒ Institutional
- ☐ Industrial

Your name	Nicholas O'Neil
Your organization	Energy 350
Other contact name	Mike Kennedy
Email address	noneil@energy350.com
Phone number	503-333-8161

Instructions: Send this form as an email attachment, along with any other documentation available, to: sbcc@des.wa.gov. For further information, call the State Building Code Council at 360-407-9278.

Economic Impact Data Sheet

Briefly summarize your proposal's primary economic impacts and benefits to building owners, tenants and businesses.

Re-designs fan power allowances section to become more stringent for smaller fan systems (which comprise a large market share and were previously exempt) and keeps stringency for larger fan systems. Primarily benefits owners and tenants who pay electric bill to reduce energy consumption of fan systems serving the HVAC needs of the building.

Provide your best estimate of the construction cost (or cost savings) of your code change proposal? (See OFM Life Cycle Cost **Analysis tool** and **Instructions;** use these **Inputs**. **Webinars on the tool can be found Here and Here**)

\$0.29/square foot (For residential projects, also provide \$Click here to enter text./ dwelling unit)

Show calculations here, and list sources for costs/savings, or attach backup data pages

The incremental cost for the fan power budget was conservatively determined to be \$0.29/ft^2 and the B/C ratio averaged 3.8 across all building types modeled and all climate zones. A large office prototype model was used to determine likely layout and associated costs. Cost of ductwork designs were reviewed by a professional cost estimator and showed an incremental cost of \$0.27/ft^2 for a CAV and \$0.31/ft^2 for VAV system to comply with the new fan power budget allowances. This cost was largely due to larger diameter ductwork and better fittings selection, showing that compliance can be achieved through good design without equipment changes (though that is also another method to comply with the new fan power budget thresholds).

Detailed cost information obtained through Final CASE report for 2022 Title 24 accessed here:
https://title24stakeholders.com/wp-content/uploads/2020/09/2022_T24-Final-CASE-Report_Air-Distribution.pdf

Provide your best estimate of the annual energy savings (or additional energy use) for your code change proposal?

0.372 KWH/ square foot (or) Click here to enter text.KBTU/ square foot

(For residential projects, also provide Click here to enter text.KWH/KBTU / dwelling unit)

Show calculations here, and list sources for energy savings estimates, or attach backup data pages

This proposal changes the current fan BHP or motor nameplate HP method to fan electrical input power to capture transmission and motor efficiency losses. The fan power budget electrical input power calculation is largely based on AMCA-208-18. (AMCA 2018). It also requires a fan power budget calculation be performed separately for each fan system and denotes the fan power as a function of airflow, system type, and components of the fan system, instead of just HP or bhp with adjustments. The proposed changes modeled in California prototype buildings showed a range between 12-34 percent per fan system, leading to a ~2 percent electricity savings per building. Expected building energy consumption based on CBSA average EUI's for large office building and CASE study prototype savings.

Detailed savings information obtained through Final CASE report for 2022 Title 24 accessed here:
https://title24stakeholders.com/wp-content/uploads/2020/09/2022_T24-Final-CASE-Report_Air-Distribution.pdf

List any code enforcement time for additional plan review or inspections that your proposal will require, in hours per permit application:

Similar level of effort to existing fan power calculation and allowances, requiring code official to determine system type and use tables to determine fan power budget compared to code maximum value. Increase in review time expected in the beginning to identify whether designer correctly accounted for fan system power among all fans, especially smaller fans that were previously exempt.

All questions must be answered to be considered complete. Incomplete proposals will not be accepted.