Proposal Summary

CALIFORNIA ENERGY CODES & STANDARDS
A STATEWIDE UTILITY PROGRAM

2022 California Energy Code (Title 24, Part 6)

Air Distribution – Fan Power Budget

Updated: March 12, 2020

Prepared by: Chad Worth, Energy Solutions

Introduction

The document summarizes proposed revisions to the California Energy Code (Title 24, Part 6) that will be discussed during a utility-sponsored stakeholder meeting on March 12, 2020. The Statewide Utility Codes and Standards Enhancement (CASE) Team is seeking input and feedback. To provide your comments, email info@title24stakeholders.com.

Measure Description

This measure seeks to reduce energy used in building air distribution systems through reducing pressure drop and encouraging more efficient fans, motors and transmissions. More specifically, the fan power budget measure seeks to significantly revise the existing fan power limitations in Title 24 Part 6. This measure largely mirrors an ASHRAE measure currently under consideration to revise the fan power limitations. This measure will apply to new construction, alterations and additions in the same manner the existing fan power limitations currently apply within Title 24 Part 6 Section 140.4. This will require changes to the ACM and the compliance software.

The significant changes include:

1. Changing the input measurement from fan brake horsepower or motor horsepower to fan electrical input power to capture transmission and motor efficiency losses.
2. Creating new reference pressure tables with additional system components along with different values for low, medium, and high airflow systems.
3. Creating new definitions of various fan systems and clarifying that fan power budget calculation must be performed for each fan system:
    - Supply fan systems
    - Exhaust/Return/Relief fan systems
    - Transfer fan systems
4. Expanding the scope of fan systems covered by code from ≥5 motor nameplate horsepower to ≥1 kW fan electrical input power.
5. Inclusion of transmission and motor efficiency
6. Removing the healthcare exemption, meaning healthcare facilities will be subject to fan power requirements for the first time. The special air change and space pressure control requirements of hospitals are accounted for in a manner similar to ASHRAE 90.1.
7. Applies to all fan-systems which move air, regardless if moving air through a heating or cooling source or not.

Draft Code Language

The proposed changes to the Standards and Reference Appendices are provided below. Changes to the 2019 documents are marked with red underlining (new language) and ~~strikethroughs~~ (deletions). Additional Statewide CASE Team resources for developing these changes are also provided below[i,ii,iii].

SECTION 100.1 – DEFINITIONS AND RULES OF CONSTRUCTION

(b) Definitions.

Fan array: multiple fans in parallel and in a single enclosure between two plenum sections in an air distribution system, where plenum means a compartment or chamber that forms a part of the air distribution system, and that is not used for occupancy or storage.

Fan input power (kW): the electrical input power in kilowatts required to operate an individual fan or fan array at design conditions.

Fan system: All the fans that contribute to the movement of air through a point of a common duct, plenum, or cabinet.

Fan system, exhaust: A fan system dedicated to the removal of air from conditioned or semi-conditioned spaces to the outdoors that may operate at times other than economizer operation.

Fan system, relief: A fan system dedicated to the removal of air from conditioned or semi-conditioned spaces to the outdoors that operates only during economizer operation.

Fan system, return: A fan system dedicated to removing air from conditioned or un-conditioned spaces where some or all the air is to be recirculated except during economizer operation.

Fan system, supply-only: A fan system that exclusively provides air to conditioned or un-conditioned spaces and where any recirculated air is returned by a return fan system.

Fan system, supply/recirculation: A fan system where a single fan, single fan array, or a single set of fans operating in parallel both supply air to a space and recirculate the air.

Fan system, transfer: A fan system that exclusively moves air from one occupied space to another.

Fan system design conditions: operating conditions that can be expected to occur during normal system operation that result in the highest supply airflow rate to or from the conditioned spaces served by the fan system.

Fan system input power (kW): the sum of the fan electrical input power in kilowatts 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, return it to the source, exhaust it to the outdoors, or transfer it to another space.

SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

(c) Fan Systems. Each fan system ~~having a total fan system motor nameplate horsepower 5 HP~~ used for space conditioning shall meet the requirements of Items 1, 2, and 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.~~

1. Fan Power ~~Limitation~~Budget. ~~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~~ For each fan system with fan system input power greater than or equal to 1 kW and that includes at least one fan with fan input power ≥ 1 kW, fan system input power at fan system design conditions shall not exceed kW_{max} as calculated per section 140.4(c)1(C).

A. Fan System Airflow. The fan system airflow (cfm) used for the calculation of kW_{max} is the sum of the airflow of all fans at *fan system design conditions* with fan input power greater than 1 kW, excluding the airflow that passes through downstream fans with fan input power less than 1 kW.

B. Fan System Classification. A fan system must meet the following requirements to be classified as a multi-zone VAV system. Otherwise its classification shall be a constant volume/single zone VAV system:

i. Fan system must serve three or more space-conditioning zones and airflow to each must be individually controlled based on heating, cooling and/or ventilation requirements.

ii. The sum of the minimum airflows for each HVAC Zone must be 40% or less of the fan system design conditions.

iii. The fan system meets the requirements of section 140.4 (m).

Exception to 140.4(c)1(B) Hospital, vivarium, and laboratory systems that use flow control devices on exhaust and/or return to maintain space pressure relationships necessary for occupant health and safety or environmental control shall be classified as multi-zone VAV fan systems.

C. Calculation of kW_{max}. The maximum fan system input power shall be calculated using one of the following methods:

i. Look up the value in Table 140.4-A: Default Fan System Budget Power at 0 ft. Elevation.

ii. Calculate using the method in NA.9.

D. Determining Fan System Input Power (kW) for a fan system. The fan system input power is the sum of the fan input power for each fan or fan array included in the system with fan input power ≥ 1kW. The fan 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:

i. Fan input power at fan system design conditions provided by the manufacture of the fan, fan array, or equipment that includes the fan or fan array calculated per a test procedure included in USDOE 10 CFR 430, USDOE 10 CFR 431, ANSI/AMCA Standard 208, ANSI/AMCA Standard 210, AHRI Standard 430:2020, or AHRI Standard 440:2019.

ii. For equipment where fan shaft input power is provided by the manufacturer, calculated at design conditions per one of the methods listed in Section 5.3 of ANSI/AMCA 208.

iii. For motors with maximum electrical input power marked on the nameplate, use that value.

iv. For fans with motors with a service factor ≤1.15, use of the values in Table 140.4-C: Default values for Fan Input Power Based on Motor Nameplate Horsepower. This method shall not be used when the service factor of the motor is not provided by the manufacturer.

Table 140.4-A: Default Fan System Budget Fan Power at 0 ft Elevation (kW_{budget})

Airflow	CV/SZ-VAV pressure (Supply/ Recirculation)	CV/SZ-VAV (Supply-Only)	CV/SZ-VAV (Exhaust, Return, Relief, or transfer)	Multi-Zone VAV (Supply/ Recirculation)	Multi-Zone VAV (Supply-Only)	Multi-Zone VAV (Exhaust, Return, Relief, or transfer)
1000	0.62	0.55	0.18	1.11	0.88	0.36
2000	1.05	0.92	0.28	1.89	1.49	0.59
3000	1.46	1.29	0.38	2.67	2.10	0.81
4000	1.87	1.65	0.48	3.44	2.70	1.03
5000	2.28	2.00	0.58	4.20	3.29	1.25
6000	3.34	2.79	0.90	4.97	3.88	1.47
7000	3.84	3.21	1.03	5.73	4.47	1.68
8000	4.35	3.63	1.16	6.49	5.06	1.89
9000	4.85	4.05	1.28	7.24	5.65	2.11
10000	5.35	4.47	1.41	8.00	6.24	2.32
12000	6.88	5.82	1.66	9.51	7.41	2.74
14000	7.96	6.74	1.91	11.01	8.57	3.16
16000	9.04	7.65	2.16	12.52	9.74	3.58
18000	10.12	8.56	2.40	14.02	10.90	4.00
20000	11.20	9.47	2.65	15.52	12.07	4.41
22000	12.28	10.38	2.89	17.01	13.23	4.83
24000	13.35	11.28	3.14	18.51	14.38	5.24
26000	14.43	12.19	3.38	20.00	15.54	5.66
28000	15.50	13.09	3.63	21.49	16.70	6.07
30000	16.57	13.99	3.87	22.99	17.85	6.49
35000	19.25	16.25	4.48	26.71	20.74	7.52
40000	21.92	18.50	5.08	30.43	23.62	8.55
45000	24.58	20.75	5.69	34.14	26.50	9.58
50000	27.25	23.00	6.29	37.85	29.37	10.60
55000	29.91	25.24	6.90	41.55	32.24	11.63
60000	32.57	27.48	7.50	45.25	35.11	12.65
Notes						
1. These values apply to Fan Systems at 0' elevation. For fan systems at other elevations, multiply the value in the table by Correction Factor in Table 140.4-B.						
2. For airflow values not shown, interpolate between the next lower and next higher values.						

Table 140.4-B Correction Air Density by Altitude

Altitude (ft)	Correct factor
0	1.000
500	0.982
1,000	0.964
1,500	0.947
2,000	0.930
2,500	0.913
3,000	0.896
3,500	0.880
4,000	0.864
4,500	0.848
5,000	0.832
5,500	0.817
6,000	0.801
6,500	0.786
7,000	0.772
7,500	0.757
≥8,000	0.743

Table 140.4-C: Default values for Fan Input Power Based on Motor Nameplate Horsepower

Motor Nameplate Horsepower	Default Fan Input Power (kW)
1	0.99
1.5	1.49
2	1.86
3	2.80
5	4.66
7.5	6.15
10	8.13
15	12.03
20	16.04
25	19.92
30	23.77
40	31.70
50	39.46
60	47.10
75	58.87
100	78.17
1. This table cannot be used for Motor Nameplate Horsepowers greater than 100.	
2. For Motor Nameplate Horsepowers not shown, interpolate between the Default Fan Input Powers of the next lower and next higher values.	
3. 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.	

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 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

2. Variable air volume (VAV) systems.

A. Static Pressure Sensor Location. Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section140.4(c)2B. If this results in the sensor being located downstream of any major duct split, multiple sensors shall be installed in each major branch with fan capacity controlled to satisfy the sensor furthest below its setpoint; and

B. Setpoint Reset. For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure setpoints shall be reset based on the zone requiring the most pressure; i.e., the set point is reset lower until one zone damper is nearly wide open.

3. **Fractional HVAC Motors for Fans.**

HVAC motors for fans that are less than1 hp and 1/12 hp or greater shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

EXCEPTION 1 to Section 140.4(c)3: Motors in fan-coils and terminal units that operate only when providing heating to the space served.

EXCEPTION 2 to Section 140.4(c)3: Motors in space conditioning equipment certified under Section 110.1 or 110.2.

EXCEPTION ~~1~~ to 140.4(c): fan system power caused solely by process loads.

~~**EXCEPTION 2 to 140.4(c):** Systems serving healthcare facilities.~~

…

SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

…

(b)2

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, except that the maximum fan system input power (kW_{max}) shall be calculated using one of the following methods:. ~~For compliance with Section 140.4(c)1 additional fan adjustment credits are available as specified in Table 141.0-.~~

i, Look up the value in Table 140.1-D: Default Fan System Budget Fan Power (W_{budget}) for Additions and Alterations

ii. Calculate using the method in NA.9.

Table 141.0-D: Default Fan System Budget Fan Power (W_{budget}) for Additions and Alterations

Airflow (CFM)	CV/SZ-VAV pressure (Both Supply & Return or Exhaust)	CV/SZ-VAV pressure (Supply-Only)	CV/SZ-VAV pressure (Exhaust/ Return/ Relief)	VAV pressure (Both Supply & Return or Exhaust)	VAV pressure (Supply-Only)	VAV pressure (Exhaust/ Return/ Relief)
1000	0.83	0.69	0.26	1.31	1.01	0.43
2000	1.41	1.17	0.42	2.25	1.73	0.72
3000	1.98	1.64	0.57	3.18	2.44	0.99
4000	2.55	2.10	0.72	4.10	3.14	1.26
5000	3.11	2.56	0.87	5.02	3.84	1.53
6000	4.32	3.45	1.24	5.94	4.53	1.80
7000	4.98	3.97	1.42	6.85	5.23	2.07
8000	5.63	4.49	1.60	7.76	5.92	2.33
9000	6.29	5.01	1.78	8.67	6.61	2.60
10000	6.94	5.53	1.96	9.58	7.30	2.86
12000	8.77	7.09	2.31	11.39	8.67	3.38
14000	10.16	8.21	2.66	13.20	10.04	3.91
16000	11.55	9.32	3.01	15.01	11.41	4.43
18000	12.93	10.44	3.36	16.81	12.77	4.95
20000	14.31	11.55	3.71	18.61	14.14	5.46
22000	15.69	12.66	4.06	20.41	15.50	5.98
24000	17.07	13.76	4.40	22.21	16.86	6.50
26000	18.44	14.87	4.75	24.01	18.22	7.02
28000	19.82	15.98	5.10	25.80	19.58	7.53
30000	21.19	17.08	5.44	27.59	20.94	8.05
35000	24.62	19.84	6.31	32.07	24.32	9.33
40000	28.05	22.60	7.17	36.54	27.71	10.62
45000	31.47	25.35	8.03	41.00	31.08	11.90
50000	34.88	28.10	8.88	45.45	34.46	13.18
55000	38.29	30.84	9.74	49.91	37.83	14.46
60000	41.70	33.58	10.60	54.36	41.20	15.73
Notes						
1. These values apply to Fan Systems at 0' elevation. For fan systems at other elevations, multiply the value in the table by Correction Factor in Table 140.4-B.						
2. For airflow values not shown, interpolate between the next lower and next higher values.						

~~*Table 141.0-D Fan Power Limitation Pressure Drop Adjustment*~~

Device	Adjustment Credits
Particulate Filtration Credit: MERV 9 through 12	0.5 in. of water
Particulate Filtration Credit: MERV 13 through 15	0.9 in. of water

~~**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.~~

…

Appendix NA9 –Calculation of Budget Fan System Input Power (kW_{max})

Calculate the Fan System Budget Power manually using the following method.

Step 1: Calculate the fan system airflow

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

Step 2: Determine the reference pressure losses for the system.

For each fan system, sum the reference pressure losses for each system component in Tables NA9-1 and/or NA9-2 using the appropriate columns for fan system classification and airflow.

- For a supply-only fan system, use only Table NA9-1.
- For a supply/recirculation fan system, use both Tables NA9-1 and NA9-2.
- For all other fan systems, use only Table NA9-2.

Step 3: Calculate the reference fan brake horsepower (bhp_{ref})

$$bhp_{ref} = \frac{(Q_i + Q_o)(P_{ref} + P_o)C_A}{6343 \cdot 0.66 \cdot EF}$$

Where

bhp_{ref} = Reference Fan system brake horsepower (hp)

Q_i = Actual airflow at fan system design conditions (cfm)

Q_o = 250 cfm

P_{ref} = The sum of the reference fan system pressure losses of system components determined from Table 140.4-B (in. H_2O)

P_o = 0.2 in. H_2O

C_A = Altitude density correction from Table 140.4-A

EF = 1.15 - The Efficiency Factor

Step 4: Calculate the reference belt-drive transmission efficiency.

$\eta_{t,ref} = (bhp_{ref} / (bhp_{ref} + 2.2))^{0.05}$

Where

$\eta_{t,ref}$ = The calculated efficiency of the reference transmission.

bhp_{ref} = Reference Fan system brake horsepower (hp)

Step 5: Calculate the reference transmission horsepower input.

$$H_{t,ref} = \frac{bhp_{ref}}{\eta_{t,ref}}$$

Where

$H_{t,ref}$ = The reference transmission horsepower input.

bhp_{ref} = Reference Fan system brake horsepower (hp)

$\eta_{t,ref}$ = The calculated efficiency of the reference transmission.

Step 6: Calculate the reference motor efficiency.

$$\eta_{mtr,ref} = A \cdot \left[\log_{10}(H_{t,ref} \times 0.7457)\right]^4 + B \cdot \left[\log_{10}(H_{t,ref} \times 0.7457)\right]^3 + C \cdot \left[\log_{10}(H_{t,ref} \times 0.7457)\right]^2 + D \cdot \left[\log_{10}(H_{t,ref} \times 0.7457)\right]^1 + E$$

Where

$\eta_{mtr,ref}$ = The reference motor efficiency.

$H_{t,ref}$ = The reference transmission horsepower input.

Constants are found in Table NA-9-3

Step 7: Calculate the reference fan system electrical power input

$$kW_{max} = \frac{H_{t,ref}}{\eta_{mtr,ref}} \; X \; 0.7457$$

Where

kW_{max} = Maximum allowed fan system input power

$H_{t,ref}$ = The reference transmission horsepower input.

$\eta_{mtr,ref}$ = The reference motor efficiency.

0.7457 = Conversion factor for hp to kW

Table NA9-1 Reference Pressure Fan System Pressure Losses for Calculating P_{ref} – Supply-Only and Supply/Recirculation

Reference Pressure Loss Components - Supply Systems	**Multi-Zone VAV System[1]**	**Constant Volume/Single-zone VAV >10,000 cfm**	**Constant Volume/Single-zone VAV >5,000 cfm and ≤10,000 cfm**	**Constant Volume/Single-zone VAV ≤5,000 cfm**
System Type and Design Airflow				
Supply fan system duct and outlet losses	2.00	1.25	1.00	0.80
100% Outside air system meeting the requirements of Note 2.	N/A	0.50	0.50	0.30
Project is alteration per section 141.0(C)	0.60	0.60	0.60	0.40
Particle filtration (select only 1)[3]				
MERV 13 to MERV 16 Filter	0.60	0.60	0.60	0.40
MERV 13 to MERV 16 Filter located downstream of thermal conditioning equipment.	1.00	1.00	0.90	0.60
HEPA Filter	1.50	1.50	1.00	1.00
Gas-phase filtration (select only 1)				

General odor control	0.50	0.50	0.50	0.30
Gas phase filtration required by code or accredited standard	Pressure loss at 400 fpm or maximum velocity allowed by the manufacturer, whichever is less			
Heating				
Hydronic heating coil	0.30	0.30	0.20	0.20
Electric heat	0.20	0.20	0.20	0.20
Gas heat	0.20	0.20	0.20	0.20
Cooling and dehumidification				
Hydronic/DX cooling coil, or heat pump coil	0.60	0.60	0.60	0.60
Desiccant system – solid or liquid	0.70	0.70	0.70	0.70
Reheat coil for dehumidification	0.20	0.20	0.20	0.20
Evaporative humidifier/cooler in series with a cooling coil	Pressure loss at 400 fpm or maximum velocity allowed by the manufacturer, whichever is less			
Energy recovery (select only 1) where required by code				
Enthalpy recovery	2 X Enthalpy Recovery Ratio - 0.60			
Sensible only	0.50	0.50	0.50	0.30
Other				
Air blender	0.20	0.20	0.20	0.20
Sound attenuation section (fans serving spaces with design background noise goals below NC35}	0.15	0.15	0.15	0.15
Deduction for systems that feed a terminal unit with a fan with electrical input power < 1kW	-0.25	-0.25	-0.25	-0.25
1. See section for requirements 140.4 (c) 1 for Multi-Zone VAV System				
2. The 100% outside air system must serve 3 or more HVAC zones and airflow during non-economizer operating periods must not exceed 135% of minimum requirements of Section 120.1(c)(3).				
3. Particle filtration and pressure loss can only be counted once per fan system.				

Table NA9-2 Reference Pressure Fan System Pressure Losses for Calculating P_{ref} – Exhaust/Relief/Return/Transfer/Recirculation

Reference Pressure Loss Components - Return/Exhaust/Relief/Transfer Systems	**Multi-Zone VAV System[1]**	**Other Systems >10,000 cfm**	**Other Systems >5,000 cfm and**	**Other Systems ≤5,000 cfm**

			≤10,000 cfm	
Select one of the following:				
Exhaust system duct, plenum, inlet, and outlet	1.00	0.75	0.75	0.50
Project is alteration per section 141.0(C)	0.30	0.30	0.30	0.20
Particle filtration				
Filter - any MERV value	0.20	0.20	0.20	0.20
Energy recovery (select only 1) where required by code	-	-	-	-
Enthalpy recovery	2 X Enthalpy Recovery Ratio - 0.60			
Sensible only	0.50	0.50	0.50	0.30
Special exhaust and return system requirements				
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	0.50	0.50	0.50	0.50
Return and/or exhaust airflow control devices	0.50	0.50	0.50	0.50
Laboratory and vivararium exhaust systems in high-rise buildings	0.25 per 100 ft of vertical duct exceeding 75 ft			
Biosafety cabinet	Pressure drop of device at fan system design condition			
Exhaust filters, scrubbers, or other exhaust treatment requried by code or standard	Pressure loss at 400 sfpm or maximum velocity allowed by the manufacturer, whichever is less			
Other	-		-	-
Sound attenuation section (fans serving spaces with design background noise goals below NC35}	0.15	0.15	0.15	0.15
1. See section for requirements 140.4 (c) 1 for Multi-Zone VAV System				

Table NA9-3 Constants for Reference Motor Efficiency Equation

Constants	$H_{t,reference}$ <250 hp	$H_{t,reference}$ ≥250 hp
A	-0.003812	0
B	0.025834	0
C	-0.072577	0
D	0.125559	0
E	0.850274	0.962

[i] AHRI Standard 440:2019 - Performance Rating of Fan Coil Units.
http://www.ahrinet.org/App_Content/ahri/files/STANDARDS/AHRI/AHRI_Standard_440_I-P_2019.pdf
[ii] AHRI Standard 430:2020 - Performance Rating of Central Station Air-handling Unit Supply Fans Note: to be published later this year.
[iii] ANSI/AMCA Standard 208: 2018- Calculation of the Fan Energy Index: https://www.amca.org/publications-and-standards/standards/ansi/amca-standard-208-18-calculation-of-the-fan-energy-index.html