BSR/ASHRAE/IES Addendum a
to ANSI/ASHRAE/IES Standard 90.1-2019

Public Review Draft

Proposed Addendum a to Standard 90.1-2019, Energy Standard for Buildings Except Low-Rise Residential Buildings

First Public Review (February 2020)
(Draft Shows Proposed Changes to Current Standard)

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FOREWORD

Background: This proposal establishes minimum fan efficacy requirements for low-power ventilation fans. Additionally, the proposal establishes Standard 62.2 as the reference for determining the minimum ventilation rates for non-transient dwelling units, in accordance with the scope of 62.2 and 62.1.

Establishing minimum fan efficacy for low-power ventilation fans

Low-power ventilation fans are currently unaddressed by 90.1 and by federal standards. Within this proposal, these fans are characterized as having a motor *nameplate horsepower* less than 1/12 HP or a *fan nameplate electrical input power* of less than 180 W (i.e., the value associated with a poorly performing motor with a motor shaft output power of 1/12 hp). We use the value of *fan nameplate electrical input power* because, by industry convention, relevant shaft power values (i.e., *nameplate horsepower* values) are typically not provided for such fans, but information on fan electrical input power is readily available and is used for efficacy calculations and product performance listings. The proposed fan efficacy values in this presentation are harmonized with the following:

- ENERGY STAR Ventilating Fans Specification 4.1.
- Values used in a recent proposal to the 2021 IECC-commercial (CE140-19), which was approved by the IECC-committee at the hearings in Albuquerque and will be part of the 2021 IECC, pending final approval after the final hearings and on-line voting process.

Dryer exhaust duct power ventilators, domestic range hoods, and domestic range booster fans that operate intermittently are exempted from the proposed prescriptive fan efficacy requirements based on limited availability of compliant products in these categories.

Referencing ASHRAE 62.2

In 2015, non-transient mid- and high-rise dwelling units moved from the scope of ASHRAE 62.1 to ASHRAE 62.2. This proposal adds 62.2 to the ventilation standards referenced by 90.1 to ensure that 90.1 maps this category of occupancies to the applicable ventilation standard.

Economic Analysis: This proposal establishes minimum fan efficiency requirements at a level that can reasonably be achieved by a large number of products available on the market. According to the HVI fan database, the average efficiency of listed bath fans is around 7 CFM/W, and the average efficiency of in-line fans is around 3 CFM/W. This proposal, therefore,

places the requirement far below the market average efficiency for bath fans and close to the market average for in-line fans, making this a reasonable requirement.

The cost for fans covered by this proposal are not driven solely by efficacy. Cost is also a function of flow rate, finishes, design, and noise and whether other features like lights, sensors, or heaters are included. In some cases, fans complying with the proposed efficacy levels can be obtained for less than fans that do not comply. A comparison of entry-level and compliant exhaust fans for major manufacturers shows that this proposal can result in no incremental first costs or short simple paybacks where incremental costs are incurred.

For example, a bath fan complying with this proposal and moving a minimum of 50 to ~100 cfm at 0.25" w.c. can have either an immediate payback (i.e., no cost premium) or a simple payback estimated at less than eight years where there is a cost premium (see Tables 1 and 2).

Fan	Efficacy at 0.1" w.c. (cfm/W)	Flow at 0.25" w.c. (cfm)	Retail Price	Manufacturer's Price Premium	Simple Payback (years)
Manufacturer A: entry-level	1.4	65	$26.31	--	N/A
Manufacturer A: compliant	3.0	57	$35.89	$9.58	7.8
Manufacturer B: entry-level	1.9	70	$57.05	$10.33	N/A
Manufacturer B: compliant	3	60	$46.72	--	immediate
Manufacturer C: entry-level	4.7	54	$50.60	--	N/A
Manufacturer C: compliant	4.7	54	$50.60	$0.00	immediate
Manufacturer D: entry-level	3.3	60	$59.00	--	N/A
Manufacturer D: compliant	3.3	60	$59.00	$0.00	immediate
Manufacturer E: entry-level	12.8	53	$85.00	--	N/A
Manufacturer E: compliant	12.8	53	$85.00	$0.00	immediate

Table 1. Major manufacturer exhaust fan pricing and payback for fans having a flow rate ≥ 50 cfm and < 90 cfm at 0.25" w.c.

The 2021 IRC requires exhaust fans to be rated at a static pressure of 0.25" w.c., which is widely recognized as a typical installed static pressure found in bath fan exhaust ducts. Retail price was sourced from ACwholesalers.com and Build.com on September 26, 2019. Simple payback assumes $0.12/kWh (DOE EIA national average for residential and commercial) and 1-hour of operation per day. For manufacturers C, D, and E, the lowest price fan having a flow rate ≥ 50 cfm and < 90 cfm at 0.25" w.c. also had a fan efficacy meeting the proposed value, so there is no price premium associated with the manufacturer's lowest cost product, and payback is "immediate". For manufacturer B, the price of the compliant, energy-efficient fan was lower than that of a comparable fan with lower efficacy, so the payback is "immediate".

Fan	Efficacy at 0.1" w.c. (cfm/W)	Flow at 0.25" w.c. (cfm)	Retail Price	Manufacturer's Price Premium	Simple Payback (years)
Manufacturer A: entry-level	1.8	109	$42.41	--	N/A
Manufacturer A: compliant	3.8	90	$75.86	$33.45	2.5
Manufacturer B: entry-level	2.4	102	$63.25	--	N/A
Manufacturer B: compliant	3.9	92	$102.29	$39.04	5.6
Manufacturer C: entry-level	5.9	105	$92.90	--	immediate
Manufacturer C: compliant	5.9	105	$92.90	$0.00	immediate
Manufacturer D: entry-level	9.2	100	$85.00	--	N/A
Manufacturer D: compliant	9.2	101	$85.00	$0.00	immediate
Manufacturer E: entry-level	3.8	110	$120.00	--	N/A
Manufacturer E: compliant	3.8	110	$120.00	$0.00	immediate

Table 2. Major manufacturer exhaust fan pricing and payback for fans having a flow rate ≥ 90 cfm at 0.25" w.c.

The 2021 IRC requires exhaust fans to be rated at a static pressure of 0.25" w.c., which is widely recognized as a typical installed static pressure found in bath fan exhaust ducts. Simple payback assumes $0.12/kWh (DOE EIA national average for residential and commercial) and 8-hours of operation per day. The higher run time associated with higher flow rate bath fans is based on the assumption that such fans are more likely to be installed in commercial bathrooms and are therefore more likely to run continuously or at longer run times than within a typical apartment. For manufacturers C, D, and E, the lowest price fan having a flow rate ≥ 90 cfm at 0.25" w.c. also had a fan efficacy meeting the proposed value, so there is no price premium associated with the manufacturer's lowest cost product, and payback is "immediate".

Existing Definitions provided for reference only:

fan nameplate electrical input power: the nominal electrical input power rating stamped on a fan assembly nameplate.

nameplate horsepower (hp): the nominal motor output power rating provided on the motor nameplate.

***nameplate rating*:** the design load operating conditions of a device as shown by the manufacturer on the nameplate or otherwise marked on the device.

[Note to Reviewers: This addendum makes proposed changes to the current standard. These changes are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) except where the reviewer instructions specifically describe some other means of showing the changes. Only these changes to the current standard are open for review and comment at this time. Additional material is provided for context only and is not open for comment except as it relates to the proposed changes.]

Addendum a to 90.1-2019

6 Heating, Ventilating, and Air Conditioning
[…]

6.5 Prescriptive Path
[…]

6.5.3 Air System Design and Control
[…]

6.5.3.7 Low Power Fans

Fans that are not covered by Section 6.5.3.6 and having a *fan nameplate electrical input power* of less than 180 W or having a motor *nameplate horsepower* less than 1/12 HP (62.1 W) shall meet the fan efficacy requirements of Table 6.5.3.7 at one or more rating points.

Table 6.5.3.7 Minimum Fan Efficacy for Low Power Fans

System Type	Minimum Fan Efficacy[a, b], cfm/W (l/s/W)	Test method and rating conditions
HRV[c], ERV[d], or other system with exhaust air energy recovery	1.2 (0.57)	CAN/CSA 439-18
Transfer fans; in-line[e] supply or exhaust fan	3.8 (1.8)	ASHRAE Standard 51
Other exhaust fan, < 90 cfm (42.5 l/s)	2.8 (1.3)	
Other exhaust fan, ≥ 90 cfm (42.5 l/s) and ≤ 200 cfm (94.4 l/s)	3.5 (1.7)	
Other exhaust fan, > 200 cfm (94.4 l/s)	4.0 (1.9)	

a. Fan efficacy is the volumetric fan airflow rate divided by total fan motor electrical input power at a specified static pressure difference.
b. Fans shall be tested in accordance with the referenced test method. Fan efficacy shall be reported in the product listing or shall be derived from the fan motor electrical input power and airflow values reported in the product listing or on the label. Fan efficacy for fully ducted HRV or ERV, balanced, and in-line fans shall be determined at a static pressure difference not less than 0.2 in. of H_2O (50 Pa) for each airstream. Fan efficacy

for other ducted fan systems shall be determined at a static pressure difference not less than 0.1 in. of H_20 (25 Pa).

c. A heat recovery ventilator (HRV) is a mechanically powered ventilating device with separate intake and exhaust air streams and a heat exchanger to transfer a portion of the sensible energy, heat, from one air stream to the other.
d. An energy recovery ventilator (ERV) is a mechanically powered ventilating device with separate intake and exhaust air streams and a heat exchanger to transfer a portion of the total energy, heat and moisture, from one air stream to the other.
e. An in-line fan is an exhaust or supply fan installed with ductwork on both the fan inlet and outlet.

Exceptions to 6.5.3.7
1. Fans in *space*-conditioning *equipment*.
2. Intermittently operating dryer exhaust duct power ventilators, domestic range hoods, and domestic range booster fans.
3. Fans in radon mitigation systems.
4. Fans not covered within the scope of the test methods referenced in Table 6.5.3.7.
5. Ceiling fans regulated under 10 CFR 430 Appendix U.

6.5.3.~~7~~8 Ventilation Design
The required minimum *outdoor air* rate is the larger of the minimum *outdoor air* rate or the minimum exhaust air rate required by Standard 62.1, Standard 62.2, Standard 170, or applicable codes or accreditation standards. *Outdoor air ventilation systems* shall comply with one of the following:
a. Design minimum *system outdoor air* provided shall not exceed 135% of the required minimum *outdoor air* rate.
b. Dampers, *ductwork*, and *controls* shall be provided that allow the *system* to supply no more than the required minimum *outdoor air* rate with a single *set-point* adjustment.
c. The *system* includes exhaust air *energy* recovery complying with Section 6.5.6.1.

Modify references to existing Section 6.5.3.7 to account for renumbering:

6.3.2 Criteria…
r. The system shall comply with the demand control ventilation requirements in Section 6.4.3.8 and the ventilation design requirements in Section 6.5.3.~~7~~8.

Exceptions to 11.5.2(d)…
2. Where the minimum outdoor air intake flow in the proposed design is provided in excess of the amount required by Section 6.5.3.~~7~~8, the baseline building design shall be modeled to reflect the minimum amount required by Section 6.5.3.~~7~~8.

Chapter 12 Normative References

ASHRAE 1791 Tullie Circle, NE, Atlanta, GA 30329	
ANSI/ASHRAE Standard 51-2016	Laboratory Methods Of Testing Fans For Certified Aerodynamic Performance Rating
ANSI/ASHRAE Standard 62.2-2019	Ventilation and Acceptable Indoor Air Quality in Residential Buildings