BSR/ASHRAE/IES Addendum p
to ANSI/ASHRAE/IES Standard 90.1-2022

Public Review Draft

Proposed Addendum p to Standard 90.1-2022, Energy Standard for Sites and Buildings Except Low-Rise Residential Buildings

First Public Review (November 2023)
(Draft Shows Proposed Changes to Current Standard)

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FOREWORD

This addendum primarily addresses Section 6.5.3.8:

6.5.3.8 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.

This section was intended to allow designers and owners to provide as much outdoor air as they want to, provided the design meets one of three limitations:

a. The 135% in option a. is intended to align with the LEED credit for providing outdoor air rates 30% above ASHRAE Standard 62.1 rates to improve indoor air quality. The Standard 62.1 rates are minimums; they are not necessarily ideal for acceptable air quality and research supports providing higher rates to improve indoor air quality and associated productivity and health benefits. When this section was developed, the SSPC agreed that some allowance above Standard 62.1 rates should be allowed, and the +30% LEED credit is well known and it has now been used for about two decades. It is also referenced in ASHRAE Guideline 42P Enhanced Indoor Air Quality in Commercial and Institutional Buildings, Section 8.2.3. The use of 135% vs. 130% was to allow some control tolerance. However, this tolerance is not needed since in this instance, minimum outdoor air is just the calculated value, a setpoint, not actual outdoor air rate that may vary due to controls. So this value is proposed to be reduced back to 130% in this addendum (rephrased as 30% above code minimum to match the LEED phrasing) which helps make its LEED credit roots more apparent.
b. Option b is intended to allow designers to use any outdoor air rate above code minimum provided it could be readily reduced to code minimum by some future owner who values efficiency more than improving indoor air quality above code minimum. But almost all HVAC systems have this capability inherently – simply change the minimum outdoor air setpoint on the air handling system or airflow control device. Probably the only systems that might not comply are 100% outdoor air DOAS systems serving active chilled beams where the outdoor air rate is sized so the ACBs can meet a high cooling load, as opposed to minimum ventilation. So this option is considered a loophole and is proposed to be deleted in this addendum.

c. Option c has been misunderstood – it is intended to say that the ventilation system can provide any ventilation rate provided energy recovery is included even if Section 6.5.6.1 has exceptions that say energy recovery is not required. But even if properly interpreted and energy recovery is provided, there is an energy penalty to using excess outdoor air since energy recovery systems are not 100% efficient, have parasitic losses (e.g. added fan or runaround pump energy), and can result in simultaneous heating and cooling at the zone level (e.g. dedicated outdoor air systems supplying dehumidified cold air to spaces in excess of what is required by the cooling load). So this option too is proposed to be deleted by this addendum.

Section 6.5.3.8 is a prescriptive requirement and as currently written is very permissive with respect to ventilation rates, essentially allowing much higher rates than code minimum with little mitigation. But the two performance approaches, Section 12, "Energy Cost Budget Method" and Normative Appendix G, "Performance Rating Method", over time migrated to be more stringent. Both Section 12 and Appendix G require that the outdoor air rate in the proposed design and in the baseline (budget) design models be exactly the same, but over time, exceptions were added that limit the baseline (budget) design model to be no higher than the code minimum regardless of the proposed design outdoor air rate. This essentially penalizes the use of any amount of outdoor air above code minimum, suggesting that ventilation codes like Standard 62.1 are "exactly right" – they represent both the minimum required for acceptable air quality and also the maximum needed for optimum air quality, which is questionable fundamentally. This also makes these performance paths more stringent than the prescriptive path, which is inconsistent with the general modeling philosophy of the performance procedures: the baseline system is supposed to just meet prescriptive requirements and no more.

Another factor affecting this addendum is the June 2023 publication of ASHRAE Standard 241 "Control of Infectious Aerosols". This standard establishes "equivalent" clean airflow requirements to mitigate disease transmission that can be accomplished with outdoor air as well as with mechanically filtered recirculated air and other air cleaning systems, such as UVGI, to remove, dilute, or inactivate airborne infectious microorganisms. Systems such as improving air handler filtration and adding in-room portable air filters are almost always more energy efficient on an annual basis than supplying and conditioning increased amounts of outdoor air (see "Why Equivalent Clean Airflow Doesn't Have To Be Expensive, Zaatari et al, ASHRAE Journal September 2023). These air cleaning technologies are also almost always less expensive to install compared to upsizing ventilation, heating, and cooling systems for higher outdoor air rates. So prescriptive Standard 90.1 requirements should limit the use of outdoor air for disease transmission mitigation in favor of these other technologies.

Another factor affecting this addendum is addendum 62.1k to Standard 62.1-2022 which mandates that humidity limits be maintained 24/7, even at times when HVAC systems are off. To efficiently address this requirement, this addendum clarifies that outdoor air cannot be supplied when spaces are not scheduled or indicated to be occupied. (Note that the MSC is developing other 90.1 addenda to further limit how this Standard 62.1 humidity limit requirement can be met to minimize its energy impact.)

Another change in this addendum is to specify that the Standard 62.1 ventilation rates are determined using Ventilation Rate Procedure, including the Simplified Procedure for multiple zone recirculating systems. These are the most common approaches and airflow rates are readily and unambiguously calculated. This does not disallow designers from using the other design procedures allowed by Standard 62.1 (e.g. the Indoor Air Quality Procedure) if the resulting ventilation rates are lower. However, credit for lower rates is not allowed by modeling rules in the current Section 12 and Appendix G modeling rules, but that may change with future addenda (e.g. see addendum n to Standard 90.1-2022).

Finally, another goal of this addendum is to clean up the use of many variations of the terms "minimum outdoor air" and "minimum ventilation air", which are undefined and not used consistently. The term "ventilation air rate" is changed to "outdoor air rate" throughout the standard because as defined "ventilation" can include recirculated air but the standard primarily addresses the outdoor air component. The addition of defined terms also allows many repeated references to Standards 62.1, 62.2, and 170, and accreditation standards to be deleted. It also clarifies which requirements are tied to the code required minimum ventilation rate vs. design minimum ventilation rate, the latter of which is prescriptively allowed to exceed code minimum requirements by 30%.

In summary, this addendum:

- Makes prescriptive requirements limiting outdoor air more stringent by eliminating options b. and c. of Section 6.5.3.8 and reducing the 135% ratio relative to code to 130% (30% above code). This essentially means that the LEED credit for +30% above 62.1 rates can be implemented in the design and still comply prescriptively, rather than forcing the use of one of the performance approaches to show compliance if rates are ever higher than code minimum rates.
- Specifically limits the outdoor air component of "equivalent clean air" per Standard 241 and total supply air per Standard 170 for disease transmission mitigation to the +30% above code rate, meaning the remaining clean air rate must be provided using recirculating air filters, UV, or other air cleaning devices. These other clean air components are not limited by this standard and are left to the discretion of the designer.
- Makes Section 12, "Energy Cost Budget Method" slightly less stringent by allowing outdoor air rates to be 30% above code minimum rates without any penalties, but also now making this approach consistent with prescriptive requirements. (Normative Appendix G, "Performance Rating Method" remains as-is so it remains a constant baseline.)
- Ties minimum Standard 62.1 rates to those calculated using the Ventilation Rate Procedure and the Simplified Procedure for design flexibility and ease of demonstrating compliance.
- Disallows the supply of outdoor air during unoccupied hours unless doing so reduces energy costs.
- Creates two new defined terms, "required minimum outdoor air" and "design minimum outdoor air" to replace and clarify the terms "minimum outdoor air" and "minimum ventilation air" used throughout the standard.

Cost Statement:
This addendum includes no requirements that would increase first costs for buildings already providing code minimum outdoor air rates. For those buildings for which higher than code minimum outdoor air rates were being considered, either for improved indoor air quality or to mitigate disease transmission, this addendum limits those rates and when they can be supplied to occupiable spaces, which will in general reduce both first costs and energy costs.

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Modify Section 3 as follows:

Outdoor air rate, required minimum: the larger of the minimum *outdoor air* rate required for *ventilation*; the required minimum exhaust air rate; or the *outdoor air* rate required to meet pressurization requirements as defined by one or more of the following as applicable to the *HVAC zone* or *HVAC system*:

- ASHRAE Standard 62.1 using the Ventilation Rate Procedure for all *spaces* and *systems* and the Simplified Procedure for multiple zone recirculating *HVAC systems*
- ASHRAE Standard 62.2
- ASHRAE Standard 170
- Other codes or accreditation standards approved by the *authority having jurisdiction*

Outdoor air rate, design minimum: the lowest quantity of *outdoor air* an *HVAC system* is designed to supply to the *space*(s) it serves when these *space*(s) are occupied at design occupancy levels.

Informative note:
The design minimum outdoor air rate is selected by the designer and is typically not less than the required minimum outdoor air rate and is subject to the limits in Section 6.5.3.8.

Modify Section 6.4.3.4.2 *as follows:*

6.4.3.4.2 Shutoff Damper Controls. All *outdoor air* intake and exhaust systems shall be equipped with motorized dampers that will *automatically* shut when the *systems* or *spaces* served are not in use. *Outdoor air* and exhaust/relief *dampers* shall be capable of and configured to *automatically* shut off when *HVAC systems* are operated but *HVAC zones* served are not scheduled or indicated to be occupied by a device meeting the requirements of Sections 6.4.3.3.1, such as for ~~during pre-occupancy building~~ *warm-up, cooldown*, and *setback*, except when the supply of *outdoor air* reduces *energy* costs or when *outdoor air* must be supplied to meet ~~code requirements~~the *required minimum outdoor air rate*.
…

Modify Section 6.5.1.1.3 *as follows:*

6.5.1.1.3 High-Limit Shutoff. All *air economizers* shall be capable of and configured to automatically reduce *outdoor air* intake to the *design minimum outdoor air rate* ~~quantity~~ when *outdoor air* intake will no longer reduce cooling *energy* use. High-limit shutoff control types and associated *set points* for specific climate zones shall be chosen from Table 6.5.1.1.3.

Modify Section 6.5.2.1 (Zone Controls) *as follows:*

…

Exceptions to 6.5.2.1:

1. Zones for which the volume of air that is reheated, *recooled*, or mixed is less than the larger of the following:
   a. For *systems* without *DDC*, 30% of the zone design peak supply.
   b. For *systems* with *DDC*, the minimum primary airflow rate required to meet the Simplified Procedure *ventilation* requirements of ASHRAE Standard 62.1 for the zone based on the *design minimum outdoor air rate*, permitted to be the average airflow rate as allowed by ASHRAE Standard 62.1.
   c. Any higher rate that can be demonstrated to the satisfaction of the *authority having jurisdiction* to reduce overall *system* annual *energy* use by offsetting *reheat*/*recool energy* losses through a reduction in *outdoor air* intake for the *system.*

d. The *design minimum outdoor air rate*.~~airflow *rate* required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates~~

2. Zones with *DDC* that comply with all of the following:
   a. The airflow rate in *dead band* between heating and cooling does not exceed the larger of the following:
      i. The *minimum* primary airflow *rate* required to meet the Simplified Procedure *ventilation* requirements of ASHRAE Standard 62.1 for the zone based on the *design minimum outdoor air rate*, permitted to be the average airflow rate as allowed by ASHRAE Standard 62.1.
      ii. Any higher rate that can be demonstrated, to the satisfaction of the *authority having jurisdiction*, to reduce overall *system* annual *energy* use by offsetting *reheat*/*recool energy* losses through a reduction in *outdoor air* intake.
      iii. The *design minimum outdoor air rate*.~~airflow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.~~

…

Modify Section 6.5.2.3 *as follows:*

6.5.2.3 Dehumidification. Where humidity controls are provided, such controls shall prevent *reheating*, mixing of hot and cold airstreams, or other means of simultaneous heating and cooling of the same airstream.

Exceptions to 6.5.2.3:

1. The system is capable of and configured to reduce supply air volume to 50% or less of the design supply airflow rate or to the *design minimum outdoor air*~~*ventilation rate*specified in ASHRAE Standard 62.1 or other applicable federal, state, or local code or recognized standard~~, whichever is larger, before simultaneous heating and cooling takes place.

…

Modify Section 6.5.3.3 *as follows:*

6.5.3.3 **Multiple-Zone VAV System Ventilation Optimization Control.** Multiple-zone *VAV systems* with *DDC* of individual zone boxes reporting to a central control panel shall include means to *automatically* reduce *outdoor air* ~~intake~~ flow below the *design minimum outdoor air rate* in response to changes in *system ventilation efficiency* as defined by ASHRAE Standard 62.1, Normative Appendix A.

Exceptions to 6.5.3.3:

1. *VAV systems* with zonal transfer fans that recirculate air from other zones without directly mixing it with *outdoor air*, dual-duct dual-fan *VAV systems*, and *VAV systems* with fan-powered *terminal* units.
2. *Systems* where total design exhaust airflow is more than 70% of total *design minimum outdoor air rate*~~intake flow requirements~~.

Modify Section 6.5.3.8 *as follows:*

6.5.3.8 Ventilation Design.

6.5.3.8.1 Ventilation for Acceptable Air Quality. The *design minimum outdoor air rate* to each *HVAC zone* and each *HVAC system* ~~*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* by more than 30%. *HVAC zones* and *HVAC systems* with a *design minimum outdoor air rate* greater than 105% of the *required minimum outdoor air rate* shall include automatic zone flow control dampers or automatic *outside air* zone flow control dampers.

~~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.~~

Informative note:
This section does not limit outdoor air used for economizing in accordance with Section 6.5.1.

6.5.3.8.2 Ventilation for Disease Transmission Mitigation. Where ventilation is used to mitigate disease transmission to meet ASHRAE Standard 241 or Standard 170, the outdoor air component of the ventilation rate shall meet the limitation of Section 6.5.3.8.1.

Informative note:
Other methods of mitigating disease transmission, such as cleaned recirculated air, are not limited by this standard.

Modify Section 6.5.7.1 *as follows:*

6.5.7.1 Transfer Air. Conditioned supply air delivered to any *space* with mechanical exhaust shall not exceed the greater of

a. the supply flow required to meet the *space* heating or cooling load;
b. the *design minimum outdoor air* ~~*ventilation*~~ *rate*~~required by the *authority having jurisdiction*, the facility Environmental Health and Safety department, or ASHRAE Standard 62.1;~~ or

…

Modify Section 11.5.2.2.6 *as follows:*

11.5.2.2.6 H06: Dedicated Outdoor Air System with Zone Fan Control. Credits for this measure are only allowed where single-zone HVAC units are not required to have multispeed or variable-speed fans in accordance with Section 6.5.3.2.1. HVAC controls and *ventilation systems* shall include all of the following:

a. Zone controls shall cycle the heating/cooling-unit fans off when not providing required heating and cooling or shall limit fan power to 0.12 W/cfm of air delivered to the zone by the unit.
b. *Outdoor air* shall be supplied by an independent *ventilation system* designed to provide no more than 110% of the *required minimum outdoor air rate* to each individual occupied *space*~~as specified by Standard 62.1~~.

…

Modify Section 12.5.2. as follows:
…

d. Minimum Outdoor Air ~~Ventilation~~Rate. *Design* ~~*M*~~*minimum outdoor air* ~~*ventilation*~~*rates* shall be the same for both the *budget building design* and *proposed design*. Exhaust air *energy* recovery shall be modeled for the *budget building design* in accordance with Section 6.5.6.1.

Exceptions to 12.5.2(d):

1. When modeling *demand control ventilation* in the *proposed design* for *spaces* where *demand control ventilation* is not required per Section 6.4.3.8.
2. Where the *design minimum outdoor air rate* ~~intake flow~~ in the *proposed design* ~~is provided in excess of~~exceeds the ~~amount~~ highest rate allowed by Section 6.5.3.8, the *baseline building design* shall be modeled ~~to reflect~~using the highest rate allowed ~~minimum amount~~ by Section 6.5.3.8.

e. Economizers. All budget *building systems* as listed in Table 12.5.2-1 shall have *air economizers* in accordance with Section 6.5.1 and Section 12.5.2(i). The high-limit shutoff shall be in accordance with

Table 12.5.2-4.

f. Preheat Coils. If the *proposed design system* has a preheat coil, the *budget building design*'s *system* shall be modeled with a preheat coil controlled in the same manner.

g. Supply Airflow Rates. *System* design supply air rates for the *budget building design* shall be based on a supply-air-to-room temperature set-point difference of 20°F or the *design minimum outdoor air~~flow~~ rate*, ~~or the airflow rate required to comply with applicable codes or accreditation standards,~~whichever is greater. For *systems* with multiple zone *thermostat set points*, use the design *set point* that will result in the lowest supply air cooling *set point* or highest supply air heating *set point*. If return or relief fans are specified in the *proposed design*, the *budget building design* shall also be modeled with fans serving the same functions and sized for the budget *system* supply fan air quantity less the *design minimum outdoor air rate*, or 90% of the supply fan air quantity, whichever is larger.

Exceptions to 12.5.2(g):

1. For *systems* serving laboratory *spaces*, airflow rate shall be based on a supply-air-to-room temperature *set-point* difference of 17°F or the ~~required~~ *design minimum outdoor air rate* ~~*ventilation* air or *makeup air*~~, whichever is greater.

…

Modify Section C3.5.8 as follows:

C3.5.8 HVAC Systems. One *HVAC system* shall be provided for each thermal zone and shall have the following characteristics:

a. Constant-volume fan control.
b. Electrically provided cooling with *EER* from Table 6.8.1-1, based on requirements for split-*system* air conditioners with heating section type "all other" between 65,000 Btu/h and 135,000 Btu/h. The *EER* shall be adjusted to remove the fan power in accordance with Section 12.5.2(c).
c. Gas furnace with constant thermal *efficiency* equal to the minimum *AFUE* allowed for gas-fired warm- air furnaces with maximum capacity <225,000 Btu/h, in accordance with Table 6.8.1-5.
d. The *design minimum outdoor air* ~~*ventilation*~~ *rate* for each *building* area type shall be consistent with the *design minimum outdoor air* ~~*ventilation*~~*rate* in the *building envelope trade-off schedules and loads* for the applicable *building* area type.

…

Modify Section G3.2.2.4 as follows:

G3.2.2.4 Ventilation. *Design m~~M~~inimum ~~ventilation system~~ outdoor air* ~~intake flow~~*rate* shall be the same for the *proposed design* and *baseline building design*.

Exceptions to G3.2.2.4:

1. When modeling *demand control ventilation* in the *proposed design* in *systems* with *design minimum outdoor air rate* ~~capacity~~less than or equal to 3000 cfm serving areas with an average *design capacity* of 100 people per 1000 ft^2 or less.
2. When designing *systems* in accordance with Standard 62.1, Section 6.2, "*Ventilation* Rate Procedure," reduced *ventilation* airflow rates may be calculated for each *HVAC zone* in the *proposed design* with a zone air distribution effectiveness (E_z) > 1.0 as defined by Standard 62.1, Table 6-2. Baseline *ventilation* airflow rates in those zones shall be calculated using the *proposed design Ventilation* Rate Procedure calculation with the following change only. Zone air distribution effectiveness shall be changed to (E_z) = 1.0 in each zone having a zone air distribution effectiveness (E_z) > 1.0. *Proposed design* and baseline *building design Ventilation* Rate Procedure calculations, as described in Standard 62.1, shall be submitted to the *rating authority* to claim credit for this exception.
3. Where the *design minimum outdoor air rate* ~~intake flow~~ in the *proposed design* ~~is provided in excess of~~ exceeds the *required minimum outdoor air rate* ~~amount~~ required by the *building* code or the *rating authority*, the *baseline building design* shall be

modeled ~~to reflect~~using the *required minimum outdoor air rate* greater of that required by either the *rating authority* or the *building* code and will be less than the *proposed design*.

4. For baseline *systems* serving only laboratory *spaces* that are prohibited from recirculating return air by code or accreditation standards, the baseline *system* shall be modeled as 100% *outdoor air*.

Modify Section G3.2.2.7.1 as follows:

G3.2.2.7.1 Baseline All System Types Except System Types 9 and 10. *System* design supply airflow rates for the *baseline building design* shall be based on a supply-air-to-room temperature *set-point* difference of 20°F or the *design minimum outdoor air~~flow~~ rate*, ~~or the airflow rate required to comply with applicable codes or accreditation standards,~~ whichever is greater. For *systems* with multiple zone *thermostat set points*, use the design *set point* that will result in the lowest supply air cooling *set point* or highest supply air heating *set point*. If return or relief fans are specified in the *proposed design*, the *baseline building design* shall also be modeled with fans serving the same functions and sized for the baseline *system* supply fan air quantity less the *design minimum outdoor air rate*, or 90% of the supply fan air quantity, whichever is larger.

Exceptions to G3.2.2.7.1:

1. For *systems* serving laboratory *spaces*, airflow rate shall be based on a supply-air-to-room temperature *set-point* difference of 17°F or the required *ventilation* air or *makeup air*, whichever is greater.
2. If the *proposed design HVAC system* airflow rate based on latent loads is greater than the design airflow rate based on sensible loads, then the same supply-air-to-room-air humidity ratio difference (gr/lb) used to calculate the *proposed design* airflow shall be used to calculate design airflow rates for the *baseline building design*.

G3.2.2.7.2 Baseline System Types 9 and 10. *System* design supply airflow rates for the *baseline building design* shall be based on the temperature difference between a supply air temperature *set point* of 105°F and the design *space*-heating temperature *set point*, or the *design minimum outdoor air~~flow~~ rate*, ~~or the airflow rate required to comply with applicable codes or accreditation standards,~~ whichever is greater. If the *proposed design* includes a fan or fans sized and controlled to provide non-*mechanical cooling*, the *baseline building design* shall include a separate fan to provide non-*mechanical* cooling, sized and controlled the same as the *proposed design*.

Modify Section G3.2.3.13 and 14 as follows:

G3.2.3.13 VAV Minimum Flow Set Points (Systems 5 and 7). Minimum volume *set points* for *VAV reheat* boxes shall be 30% of zone peak airflow, or the *design minimum outdoor air~~flow~~ rate*, ~~or the airflow rate required to comply with applicable codes or accreditation standards,~~ whichever is larger.

Exception to G3.2.3.13: *Systems* serving laboratory *spaces* shall reduce the exhaust and *makeup air* volume during unoccupied periods to the largest of 50% of zone peak airflow, or the *design minimum outdoor air~~flow~~ rate~~, or the airflow rate required to comply with applicable codes or accreditation standards~~*.

G3.2.3.14 Fan Power and Control (Systems 6 and 8). Fans in parallel *VAV* fan-powered boxes shall run as the first stage of heating before the *reheat* coil is energized. Fans in parallel *VAV* fan-powered boxes shall be sized for 50% of the peak design primary air (from the *VAV* air-handling

unit) flow rate and shall be modeled with 0.35 W/cfm fan power. Minimum volume *set points* for fan-powered boxes shall be equal to 30% of peak design primary airflow rate or the ~~rate required to meet the~~ *design minimum outdoor air rate* ~~*ventilation* requirement~~, whichever is larger. The supply air temperature *set point* shall be constant at the *design condition*.

Modify Section G3.2.3.17 as follows:

G3.2.3.17 System 11 Supply Air Temperature and Fan Control. Minimum volume set point shall be 50% of the maximum design airflow rate, or the *design minimum* ~~*ventilation*~~*outdoor airflow rate*, ~~or the airflow rate required to comply with applicable codes or accreditation standards,~~ whichever is larger.

…

Add to Section 13 Normative References:

ASHRAE Standard 241-2023	Control of Infectious Aerosols	6.5.3.8.2