ADDENDA

ANSI/ASHRAE/IES Addendum t to
ANSI/ASHRAE/IES Standard 90.1-2019

Energy Standard for Buildings Except Low-Rise Residential Buildings

Approved by the ASHRAE Standards Committee on June 25, 2022; by the ASHRAE Board of Directors on June 29, 2022; by the Illuminating Engineering Society on June 17, 2022; and by the American National Standards Institute on July 29, 2022.

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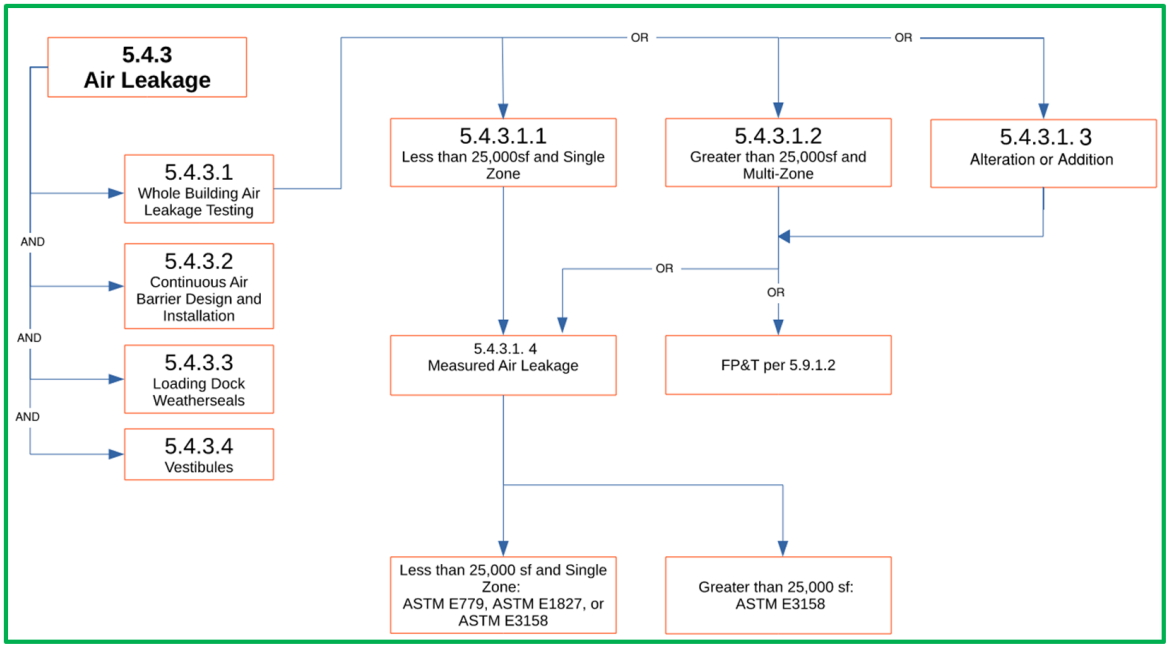
FOREWORD

Addendum t makes the following updates to Standard 90.1:

a. *Whole-building air leakage testing and measurement is required to be performed on buildings with less than 25,000 ft^2 (2300 m^2) of gross conditioned floor area, while for large buildings the option remains to test or perform visual inspection.*
b. *The air leakage rate for compliance without having to conduct further diagnostics is changed from 0.40 to 0.30 cfm/ft^2 (2.0 to 1.7 L/s·m^2).*
c. *The air leakage rate for compliance when further diagnostics are performed is changed from 0.60 to 0.45 cfm/ft^2 (3.0 to 2.2 L/s·m^2).*
d. *Definitions for "air leakage" and "infiltration" and their usage in the Standard are updated to correspond to the correct requirements of Section 5.*
e. *New ASTM E3158,* Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building*, is added to the acceptable test list in Section 5.4.1.1. ASTM E3158 is applied in the charging paragraph to replace the need for the previous Exception 1 to Section 5.4.1.1 for large and multizone buildings.*
f. *The whole-building airtightness test methods are modified to correspond to the building size and complexity to better match the ASTM methods' scopes.*
g. *Pressure value of 0.3 in. of water expressed the incorrect number of significant figures in I-P. The SI value of 75 Pascals is the underlying requirement for whole-building air leakage testing and is reflected in the I-P value.*
h. *Distinction is added in Section 11, Normative Appendix C, and Normative Appendix G to accommodate performance differences for Section 5 air leakage base requirements vs. the exception pathway (whole-building testing vs. verification only). Appendix G also provides a clearer path for capturing air leakage improvements by project designs exceeding minimum performance requirements in the standard.*
i. *Clarity is added regarding* alteration *compliance options with air leakage. As part of this, roof replacement alterations have been defined and the compliance scope clarified.*
j. *Improved performance related to airtightness requirements was reviewed and found to be cost effective.*
k. *The diagram below outlines the compliance path and flow air leakage in this proposal.*



Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum t to Standard 90.1-2019

Modify Section 3 as shown (I-P and SI).

3.2 Definitions

[. . .]

air leakage ~~***infiltration***~~***:*** the uncontrolled ~~inward~~ airflow ~~leakage~~ through the *building envelope* ~~cracks and crevices in any *building* element and around windows and doors of a *building*~~ caused by pressure differences across the *building envelope* ~~these elements~~ due to factors such as wind, inside and outside temperature differences, ~~(~~stack effect~~)~~, and imbalance between supply and exhaust air *systems*. *Air leakage* can move inward (infiltration) or outward (exfiltration) through the *building envelope*.

[. . .]

continuous air barrier: the combination of interconnected materials, assemblies, and sealed joints and components of the *building envelope* that minimize ~~air leakage~~ *air leakage* into or out of the *building envelope.*

[. . .]

replacement air: *outdoor air* that is used to replace air removed from a *building* through an exhaust *system*. *Replacement air* may be derived from one or more of the following: *makeup air*, supply air, and *transfer air*~~, and *infiltration*. However, the ultimate source of all *replacement air* is *outdoor air*. When *replacement air* exceeds exhaust, the result is exfiltration~~.

[. . .]

roof replacement: process of removing the existing *roof covering*, including *repairing* or replacing any damaged materials down to the roof deck, and installing a new *roof covering*.

Modify Section 4 as shown (I-P and SI).

4.2.5 Verification, Testing and Commissioning. Building *systems*, controls, and the *building envelope* shall comply with Sections 4.2.5.1, 4.2.5.2 and 4.2.5.3.

Informative Note: There are additional requirements within specific sections of this standard regarding documentation, procedures, independence of providers, and reporting. Requirements in individual sections are in addition to the general requirements provided in Section 4.2.5.

[. . .]

Modify Section 5 as shown (I-P and SI).

5.1.3 Envelope Alterations. *Alterations* to the *building envelope* shall comply with the requirements of Section 5 for insulation, ~~air leakage~~ *air leakage*, and *fenestration* applicable to those specific portions of the *building* that are being altered.

Exceptions to 5.1.3: The following *alterations* need not comply with these requirements, provided such *alterations* will not increase the *energy* use of the *building*:

1. Installation of storm windows or glazing panels over existing glazing, provided the storm window or glazing panel contains a low-emissivity coating. However, a low-emissivity coating is not required where the existing glazing already has a low-emissivity coating. Installation is permitted to be either on the inside or outside of the existing glazing.
2. Replacement of glazing in existing sash and frame, provided the *U-factor* and *SHGC* will be equal to or lower than before the glass replacement.
3. *Alterations* to *roof*, *wall*, or *floor* cavities that are insulated to full depth with insulation having a minimum nominal value of R-3.0/in.
4. *Alterations* to *walls* and *floors*, where the existing structure is without framing cavities and no new framing cavities are created.
5. *Roof recovering.*

6. Removal and replacement of a *roof* membrane where there is existing *roof* insulation integral to or below the *roof* deck.
7. *Roof replacement*, provided the area of the replacement *roof covering* complies with the opaque element requirements for *roofs* in Tables 5.5-0 through 5.5-8 and Section 5.5.3.1.1.

~~7.~~8. Replacement of existing doors that separate a conditioned space from the exterior shall not require the installation of a vestibule or revolving door, provided that an existing vestibule that separates a conditioned space from the exterior shall not be removed.

~~8.~~9. Replacement of existing fenestration, provided that the area of the replacement fenestration does not exceed 25% of the total fenestration area of an existing building and that the U-factor and SHGC will be equal to or lower than before the fenestration replacement.

[. . .]

5.4.3 Air Leakage

a. ~~Air leakage~~ *Air leakage* control for the *building envelope* shall comply with this section. Materials and assemblies that are part of the *continuous air barrier* and *fenestration* and *doors* shall comply with Section 5.8.3.

~~5.4.3.1 Continuous Air Barrier~~

b. The *exterior building envelope* and the *semiexterior building envelope* shall have a *continuous air barrier* complying with Sections 5.4.3.1.~~1~~ and 5.4.3.2~~1.2.~~

Exceptions to 5.4.3.~~1~~(b):

1. *Semiheated spaces* in Climate Zones 0 through 6, except as required to complete the *continuous air barrier* of an adjacent *conditioned space*.
2. Single wythe concrete masonry *buildings* in Climate Zone 2B.

5.4.3.1.~~1~~ Whole-Building Air Leakage

5.4.3.1.1 New *buildings* less than 10,000 ft^2 (930 m^2) of *gross conditioned floor area* shall comply with measured *air leakage* requirements in Section 5.4.3.1.4.

5.4.3.1.2 New *buildings* not less than 10,000 ft^2 (930 m^2) of *gross conditioned floor area* shall comply with one of the following:

a. Measured *air leakage* requirements in Section 5.4.3.1.4
b. A *continuous air barrier* design and installation verification program performed in accordance with Section 5.9.1.2

5.4.3.1.3 In *alterations* and *additions* to an *existing building* where portions of the *continuous air barrier* are impacted, those portions shall be installed or reinstalled and comply with one of the following:

a. Measured *air leakage* requirements in Section 5.4.3.1.4
b. A *continuous air barrier* design and installation verification program performed in accordance with Section 5.9.1.2

5.4.3.1.4 Measured Air Leakage. ~~Whole-building pressurization testing shall be conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party.~~ Where ~~The~~ measured ~~air leakage~~ *air leakage* is used for compliance, the rate of *air leakage* of the *building envelope* shall not exceed ~~0.40~~ 0.35 cfm/ft^2 (~~2.0~~ 1.7 L/s·m^2) under a pressure differential of 75 Pa ~~0.3~~ (0.30 in. of water) (75 Pa), with this ~~air leakage~~ *air leakage* rate normalized by the sum of the above-grade and below-grade *building envelope* areas of the *conditioned* and *semiheated space*, and in accordance with this section.

a. Whole-building pressurization testing shall be conducted in accordance with ASTM E3158. For buildings less than 10,000 ft^2 (930 m^2) of *gross conditioned floor area*, and that contain no more than one *single-zone system*, *air leakage* testing may be conducted in accordance with ASTM E779, ASTM E1827, or ASTM E3158. Testing shall be conducted excluding HVAC related elements and be performed by an independent third-party *V&T provider* in accordance with Section 4.2.5.1.
b. Where a building contains both *conditioned space* and *semiheated space*, compliance shall be shown using one of the following as applicable:
   1~~a~~. S~~s~~eparately for the *conditioned space* and for the *semiheated space*, with the ~~air leakage~~ *air leakage* rate for the *conditioned space* normalized by the *exterior building envelope* area of

the *conditioned space* and the ~~air leakage~~ *air leakage* rate for the *semiheated space* normalized by the *semiexterior building envelope* area of the *semiheated space*~~; or~~

2~~b~~.F~~f~~or the *conditioned space* and for the *semiheated space* together, with the ~~air leakage~~ *air leakage* rate for the overall *space* normalized by the sum of the *exterior building envelope* area and the *semiexterior building envelope* area minus the *semiexterior building envelope* area that separates the *conditioned space* from the *semiheated space*~~.~~

~~Reporting shall be in compliance with Section 4.2.5.1.2.~~

~~**Exception to 5.4.3.1.1:**~~

~~1. For *buildings* having over 50,000 ft2 of *gross conditioned floor area*, air leakage testing shall be permitted to be conducted on less than the whole *building*, provided the following portions of the *building* are tested and their measured air leakage is area-weighted by the surface areas of the *building envelope*:~~

~~a. a. The entire *floor* area of all *stories* that have any *spaces* directly under a *roof*.~~

~~b. b. The entire *floor* area of all *stories* that have a *building entrance* or loading dock.~~

~~c. c. Representative *above-grade wall* sections of the *building* totaling at least 25% of the *wall* area enclosing the remaining *conditioned space*. Floor area tested per (a) and (b) shall not be included in the 25%.~~

2c. Where the measured ~~air leakage~~ *air leakage* rate exceeds ~~0.40~~ 0.35 cfm/ft^2 (~~2.0~~1.7 L/s·m^2) but does not exceed ~~0.60~~ 0.45 cfm/ft^2(~~3.0~~2.2 L/s·m^2), a diagnostic evaluation, such as a smoke tracer or infrared imaging shall be conducted while the *building* is pressurized, and any leaks noted shall be sealed if such sealing can be made without destruction of *existing building* components. In addition, a visual inspection of the air barrier shall be conducted, and any leaks noted shall be sealed if such sealing can be made without destruction of *existing building* components. An additional report identifying the corrective actions taken to seal leaks shall be submitted to the *code official* and the *building* owner and shall be deemed to satisfy the requirements of this section.

d. Where the measured *air leakage* rate exceeds 0.45 cfm/ft^2 (2.2 L/s·m^2), corrective actions must be made to the *envelope* and an additional test completed where results are 0.45 cfm/ft^2 (2.2 L/s·m^2) or less in order to demonstrate compliance.

~~2. *Continuous air barrier* design and installation verification program in accordance with Section 5.9.1.2.~~

e. Reporting shall be in compliance with Section 4.2.5.1.2.

5.4.3.2~~1.2~~ Continuous Air Barrier Design and Installation. The *continuous air barrier* shall be designed and installed in the following manner:

a. Components designed to provide the *continuous air barrier*, and the component's position within of each *building envelope* assemblies, shall be clearly identified on *construction documents*.

b. The joints, interconnections, and penetrations of the *continuous air barrier* components shall be detailed in the *construction documents*.

c. The *continuous air barrier* shall extend over all surfaces of the *building envelope* and be identified in the *construction documents* to be continuous across the components of the below-grade areas, *walls*, *fenestration*, *doors*, and *roofs*.

d. The *continuous air barrier* shall be designed to resist positive and negative pressures from wind, stack effect, and mechanical *ventilation* and allow for anticipated movements.

e. The following areas of the *continuous air barrier* in the *building envelope* shall be wrapped, sealed, caulked, gasketed, or taped in an approved manner to minimize ~~air leakage~~ *air leakage*:

1. Joints around *fenestration* and *door* frames
2. Junctions between *walls* and *floors*~~,~~; between *walls* at *building* corners~~,~~; ~~and~~ between *walls* and *roofs*, including parapets and copings; and *walls* at foundations.
3. Penetrations through the *continuous air barrier* in *building envelope roofs*, *walls*, and *floors*
4. *Building* assemblies used as ducts or plenums
5. Joints, seams, connections between planes, and other changes in *continuous air barrier* materials
6. *Building* and *service* components projecting through or attached through the *continuous air barrier*

7. Junctions of the *continuous air barrier* that separate *conditioned spaces* from *unconditioned spaces*, *semiheated spaces,* and areas that are not *enclosed spaces*

5.4.3.~~3~~2 Loading Dock Weatherseals. In Climate Zones 0 and 4 through 8, cargo *doors* and loading dock *doors* shall be equipped with weatherseals to restrict ~~*infiltration*~~ *air leakage* when vehicles are parked in the doorway.

[. . .]

5.4.3.~~4~~3 Vestibules and Revolving Doors

[. . .]

5.7 Submittals

[. . .]

5.7.2 Permit Application Documentation. Application documents shall include, at a minimum, the type and *rated R-value of insulation* for each product; *opaque door* schedule showing the *U-factor* for each *opaque door* product as determined in accordance with Section 5.8.2; *fenestration* schedule showing the manufacturer, model number, orientation, area, *U-factor, SHGC*, and *VT* for each *fenestration* product, as determined in accordance with Section 5.8.2; and ~~air leakage~~ *air leakage* details in accordance with Section 5.4.3. In addition:

a. **Labeling of *space conditioning categories*.** For *buildings* that contain *spaces* that will be only *semiheated space* or *unconditioned space*, and compliance is sought using the *semiheated space building envelope* criteria, such *spaces* shall be clearly indicated on the *floor* plans.
b. **Labeling of daylight areas.** Daylighting documentation shall identify *daylight areas* on *floor* plans, including the *primary sidelighted areas*, *secondary sidelighted areas*, *daylight area under skylights*, and *daylight area under roof monitor*.
c. **Identify *air leakage* compliance.** *Continuous air barrier* compliance with whole-building pressurization testing in accordance with Section 5.4.3.1.4 or verification in accordance with Section 5.9.1.2 shall be clearly indicated on the *construction documents*.

[. . .]

5.7.3.1 Record Documents. *Construction documents* shall require that, within 90 days after the date of *building envelope* acceptance, *record documents* be provided to the *building* owner or the designated representative of the *building* owner. *Record documents* shall include, as a minimum, those items listed in Section 5.7.2, and the following:

a. A report complying with Section 4.2.5.1.2 providing the results of ~~air leakage~~ *continuous air barrier* compliance with whole-building pressurization testing in accordance with Section 5.4.3.1.4 or verification of the *building envelope* in accordance with Section ~~5.9.1.~~ 5.9.1.2.
b. Insulation documentation in accordance with 5.8.1.11.

[. . .]

5.8 Product Information and Installation Requirements

5.8.1 Insulation

[. . .]

5.8.1.6 Recessed Equipment

[. . .]

In all cases, ~~air leakage~~ *air leakage* through or around the recessed *equipment* to the *conditioned space* shall be limited in accordance with Section 5.4.3.

[. . .]

5.8.2 Fenestration and Doors

5.8.2.1 Rating of Fenestration Products. The *U-factor, SHGC, VT*, and ~~air leakage~~ *air leakage* rate for all manufactured *fenestration* products shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the National Fenestration Rating Council.

5.8.2.2 Labeling of Fenestration and Door Products. All manufactured and site-built *fenestration* and *door* products shall be *labeled*, or a signed and dated certificate shall be provided, by the *manufacturer*, listing the *U-factor, SHGC, VT*, and ~~air leakage~~ *air leakage* rate.

[. . .]

5.8.3 Air Leakage

5.8.3.1 Testing, Acceptable Materials, and Assemblies. ~~Air leakage~~ *Air leakage* for materials or assemblies used as components of the *continuous air barrier* shall be determined in accordance with the test method and minimum air pressure specified in Table 5.8.3.1 and shall not exceed the maximum ~~air leakage~~ *air leakage* specified in Table 5.8.3.1 when complying with the *continuous air barrier* design and installation verification program in accordance with Section 5.9.1.2 ~~using Exception 3 of Section 5.4.3.1.1~~. ~~Air leakage~~ *Air leakage* shall be determined by a laboratory accredited by a nationally recognized accreditation organization.

5.8.3.2 Fenestration and Doors. ~~Air leakage~~ *Air leakage* for *fenestration* and *doors* shall be determined in accordance with the test method and minimum air pressure specified in Table 5.8.3.2 and shall not exceed the maximum ~~air leakage~~ *air leakage* specified in Table 5.8.3.2 when complying with the *continuous air barrier* design and installation verification program in accordance with Section 5.9.1.2. ~~Air leakage~~ *Air leakage* shall be determined by a laboratory accredited by a nationally recognized accreditation organization and shall be *labeled* and certified by the *manufacturer*.

Exceptions to 5.8.3.2:

1. *Field-fabricated fenestration* and *doors*.
2. Metal coiling *doors* in *semiheated spaces* in Climate Zone 0 through 6 shall have an ~~air leakage~~ *air leakage* not exceeding 1.0 cfm/ft^2 (5.1 L/s m^2) when tested at a pressure of at least 1.57 psf (75 Pa) in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283.
3. Products in *buildings* that are tested and shown to comply with a whole-*building* ~~air leakage~~ *air leakage* in accordance with Section 5.4.3.1.4~~1 without using Exception 3~~.

[. . .]

5.9 Verification, Testing, Commissioning, and Inspection

5.9.1 Verification and Testing

5.9.1.1 Building Envelope Performance Verification. The *energy* performance of the *building envelope* shall be verified in accordance with this section and Section 4.2.5.1.

5.9.1.2 Verification of the Design and Installation of the Continuous Air Barrier. Where ~~V~~verification of the design and installation of the *continuous air barrier* is used for compliance in Section 5.4.3.1, it shall be determined in accordance with the following ~~by an independent third party when using Exception 3 of Section 5.4.3.1.1~~:

a. Requirements for a field inspection plan shall be included in the *construction documents* and shall include as a minimum the following:
   1. Schedule for periodic inspection(s)
   2. C*ontinuous air barrier* scope of work
   3. List of critical inspection items
   4. Inspection document requirements
   5. Provisions for corrective actions when needed
b. An independent third-party *V&T provider* in accordance with Section 4.2.5.1 shall conduct reviews and inspections as follows:
   1~~a~~. A design review shall be conducted to verify and document compliance with the requirements in Sections 5.4.3 and 5.8.3.2.
   2~~b~~.Periodic field inspection of the *continuous air barrier* materials and assemblies shall be conducted during *construction* while the *continuous air barrier* is still accessible for inspection and *repair* to verify and document compliance with the requirements of Sections 5.4.3.2~~.1.2, and~~ 5.8.3, and the field inspection plan.
   3~~c~~. Reporting shall comply with Section 4.2.5.1.2 and the field inspection plan.

[. . .]

5.9.3 Inspections

5.9.3.1 Inspection of Fenestration and Door Requirements. *Fenestration* and *doors* shall be inspected to verify compliance with the requirements of Sections 5.4.3.~~3~~2, 5.8.2.1, 5.8.2.2, and 5.8.2.3. Where testing is required to demonstrate compliance with the ~~air leakage~~ *air leakage* requirements, it shall be conducted by an independent third party.

[. . .]

Modify Section 6 as shown (I-P and SI).

6.4.4.2.1 Duct Sealing. *Ductwork* and all plenums with pressure class ratings shall be constructed to *Seal Class A*. Openings for rotating shafts shall be sealed with bushings or other devices that seal off ~~air leakage~~ leaking air. Pressure-sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory, and the tape is used in accordance with that certification. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access *doors*, access panels, and duct connections to *equipment*. Sealing that would void product listings is not required. Spiral lock seams need not be sealed. All duct pressure class ratings shall be designated in the design documents.

[. . .]

6.4.5 Walk-In Coolers and Walk-In Freezers. Site-assembled or site-constructed *walk-in coolers* and *walk-in freezers* shall conform to the following requirements:

[. . .]

b. Doorways shall have strip *doors* (curtains), spring-hinged *doors*, or other method of minimizing infiltration ~~*infiltration*~~ when *doors* are open.

[. . .]

6.5.1 Economizers. Each cooling system shall include either an air economizer or fluid economizer meeting the requirements of Sections 6.5.1.1 through 6.5.1.5.

Exceptions to 6.5.1: Economizers are not required for the following *systems*:

[. . .]

7. *Systems* that serve *spaces* whose sensible cooling load at *design conditions*, excluding transmission ~~and *infiltration* loads, is~~ less than or equal to transmission ~~and *infiltration*~~ losses at an outdoor temperature of 60°F.

[. . .]

Modify Section 11, including Table 11.5.1, as shown (I-P and SI).

Table 11.5.1 Modeling Requirements for Calculating *Design Energy Cost* and *Energy Cost Budget*

Proposed Design **(Column A)** ***Design Energy Cost*** **(DEC)**	***Budget Building Design*** **(Column B)** ***Energy Cost Budget*** **(ECB)**
[. . .]	
5. *Building Envelope*	
All components of the *building envelope* in the *proposed design* shall be modeled as shown on architectural drawings or as built for *existing building envelopes*. All uninsulated assemblies and *linear thermal bridges* and *point thermal bridges* as identified in Section 5.5.5.1 through 5.5.5.5 (e.g., projecting balconies, perimeter edges of intermediate floor slabs, concrete floor beams over parking garages, *roof* parapet) shall be modeled using either of the following techniques: a. Separate model of each of these assemblies within the *energy* simulation model. b. When present, uninsulated assemblies and *linear thermal bridges* or *point thermal bridges* as identified in Section 5.5.5.1 through 5.5.5.5 shall be modeled by adjusting the *U-factor* in accordance with Appendix A10. **Exceptions:** The following *building* elements are permitted to differ from architectural drawings. 1. Any *building envelope* assembly that covers less than 5% of the total area of that assembly type (e.g., *exterior walls*) need not be separately described. If not separately described, the area of a *building envelope* assembly must be added to the area of the adjacent assembly of that same type. 2. Exterior surfaces whose azimuth *orientation* and tilt differ by less than 45 degrees and are otherwise the same shall be described as either a single surface or by using multipliers. 3. The exterior *roof* surface shall be modeled using the aged solar *reflectance* and thermal *emittance* determined in accordance with Section 5.5.3.1.1(a). Where aged test data are unavailable, the *roof* surface shall be modeled with a solar *reflectance* of 0.30 and a thermal *emittance* of 0.90 4. Manually operated *fenestration* shading devices, such as blinds or shades, shall not be modeled. Permanent shading devices, such as fins, overhang, and lightshelves, shall be modeled. c. To simulate *air leakage*, infiltration shall be modeled using the same methodology and adjustments for weather and *building* operation in both the *proposed design* and the *budget building design*. These adjustments shall be made for each simulation time step and must account for but not be limited to weather conditions and *HVAC system* operation, including strategies that are intended to positively pressurize the *building*. The *air leakage* rate of the *building envelope* shall be in accordance with one of the following: 1. When whole-building pressurization testing is required or specified during design, and completed in accordance with Section 5.4.3.1.4, the measured *air leakage* rate of the *building envelope* (I_{75Pa}) at a fixed building pressure differential of 75 Pa (0.30 in. of water) (75 Pa) shall be modeled for purposes of demonstrating compliance with this standard. 2. For buildings providing verification in accordance with Section 5.9.1.2, the *air leakage* rate of the *building envelope* (I_{75Pa}) at a fixed building pressure differential of 75 Pa (0.30 in. of water) (75 Pa) shall be 0.45 cfm/ft^2 (2.2 L/s·m^2). The *air leakage* rate of the *building envelope* shall be converted to appropriate units for the simulation program using one of the methods in Section 11.5.3.	The *budget building design* shall have identical *conditioned floor area* and identical exterior dimensions and orientations as the *proposed design*, except as follows: a. *Opaque* assemblies, such as *roof*, *floors*, *doors*, and *walls*, shall be modeled as having the same *heat capacity* as the *proposed design* but with the minimum *U-factor* required in Section 5.5 for new *buildings* or additions and Section 5.1.3 for *alterations*. b. Where *linear thermal bridges* and *point thermal bridges* as identified in Section 5.5.5.1 through 5.5.5.5 are modeled in the *proposed design*, they shall be represented as modified *U-factors* by adjusting the *U-factor* in accordance with the default values in Appendix A10. If the proposed design does not have *linear thermal bridges* and *point thermal bridges*, as identified in Sections 5.5.5.1 through 5.5.5.5, they shall not be modeled in the *budget building design*. If the balcony length in the *proposed design* exceeds the maximum allowed by Section 5.5.5.2, Exception 2(c)(i), the area shall be reduced proportionally for each balcony until the limit set in Section 5.5.5.2, Exception 2(c)(i) is met. c. The exterior *roof* surfaces shall be modeled with a solar *reflectance* and thermal *emittance* as required in Section 5.5.3.1.1(a). All other *roofs*, including *roofs* exempted from the requirements in Section 5.5.3.1.1, shall be modeled the same as the *proposed design*. d. No shading projections are to be modeled; *fenestration* shall be assumed to be flush with the *wall* or *roof*. If the *fenestration area* for new *buildings* or additions exceeds the maximum allowed by Section 5.5.4.2, the area shall be reduced proportionally along each exposure until the limit set in Section 5.5.4.2 is met. If the *vertical fenestration area* facing west or east of the *proposed design* exceeds the area limit set in Section 5.5.4.5 then the *energy cost budget* shall be generated by simulating the *budget building design* with its actual *orientation* and again after rotating the entire *budget building design* 90, 180, 270 degrees and then averaging the results. *Fenestration U-factor* shall be equal to the criteria from Tables 5.5-0 through 5.5-8 for the appropriate climate, and the *SHGC* shall be equal to the criteria from Tables 5.5-0 through 5.5-8 for the appropriate climate. For portions of those tables where there are no *SHGC* requirements, the *SHGC* shall be equal to that determined in accordance with Section C3.6(c). The *VT* shall be equal to that determined in accordance with Section C3.6(c). The *fenestration* model for *building envelope alterations* shall reflect the limitations on area, *U-factor*, and *SHGC* as described in Section 5.1.3. e. *Skylights* shall be included in each *thermal block* when required by Section 5.5.4.2.3. **Exception:** When trade-offs are made between an addition and an *existing building*, as described in the exception to Section 4.2.1.2, the *building envelope* assumptions for the *existing building* in the *budget building design* shall reflect existing conditions prior to any revisions that are part of this permit. f. The *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa (0.30 of water) (75 Pa) shall be 0.35 cfm/ft^2 (1.7 L/s·m^2) of *building envelope* area and shall be converted to appropriate units for the simulation software using the same method as the *proposed design*.

[. . .]

11.5.3 Modeling Building Envelope Air Leakage. The *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa (0.30 in. of water) (75 Pa) shall be converted to appropriate units for the *simulation program* using one of the following formulas:

a. For methods describing *air leakage* as a function of *floor* area,

$$I_{FLR} = 0.112 \times I_{75Pa} \times S/A_{FLR}$$

b. For methods describing *air leakage* as a function of the area of *above-grade walls* that separate *conditioned spaces* and *semiheated spaces* from the exterior,

$$I_{AGW} = 0.112 \times I_{75Pa} \times S/A_{AGW}$$

c. When using the measured *air leakage* rate of the *building envelope* at a pressure differential of 75 Pa (0.30 in. of water) (75 Pa) for the *proposed design*, the *air leakage* rate shall be calculated as follows:

$$I_{75Pa} = Q/S$$

where

I_{75Pa} = *air leakage* rate of the *building envelope* in cfm/ft^2 (L/s·m^2) at a fixed *building* pressure differential of 75 Pa (0.30 in. of water) (75 Pa)

Q = volume of air in cfm (L/s) flowing through the *building envelope* when subjected to a pressure differential of 75 Pa (0.30 in. of water) (75 Pa), in accordance with ASTM E779, ASTM E1827, or ASTM E3158

S = total area of the *building envelope* in ft^2 (m^2), including the lowest *floor*, any *below-grade walls* or *above-grade walls*, and *roof* (including *vertical fenestration* and *skylights*)

I_{FLR} = adjusted *air leakage* rate of the *building envelope* cfm/ft^2 (L/s·m^2) at a reference wind speed of 10 mph (4.47 m/s) and relative to the *gross floor area*

A_{FLR} = *gross floor area*, ft^2 (m^2)

I_{AGW} = adjusted *air leakage* rate of the *building envelope* cfm/ft^2 (L/s·m^2) at a reference wind speed of 10 mph (4.47 m/s) and relative to the area of the *above-grade walls* of the *building envelope*

A_{AGW} = total area of *above-grade walls* of the *building envelope*, ft^2 (m^2)

Exception to 11.5.3: A multizone airflow model alternative method to modeling *building envelope air leakage* may be used, provided the following criteria are met:

1. Where the calculations are made independently of the *energy simulation program*, the proposed method must comply with Section 11.4.5.
2. The method for converting the *air leakage* rate of the *building envelope* at 75 Pa (0.30 in. of water) (75 Pa) to the appropriate units for the *simulation program* is fully documented and submitted to the *rating authority* for approval.

Modify Section 12 as shown (I-P and SI).

Reference	Title
[. . .]	
ASTM International **100 Barr Harbor Dr., West Conshohocken, PA 19428-2959**	
ASTM E3158-18	Standard Test Method for Measuring the Air Leakage Rate of a Large or Multizone Building

Modify Normative Appendix C as shown (I-P and SI).

C1.5 For Continuous Air Barriers. The method of compliance used for *continuous air barriers*, either whole-building pressurization testing or verification, shall be specified.

[. . .]

C3.5.5.3 Air Leakage. The ~~air leakage~~ *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa (0.30 ~~0.3~~ in. of water) (75 Pa) shall be ~~0.4~~ 0.35 cfm/ft^2 (~~2.03~~ 1.7 L/s·m^2) of *building envelope* area when *air leakage* compliance is based on whole-building pressurization testing and shall be 0.45 cfm/ft^2 (2.2 L/s·m^2) of *building envelope* area when *air leakage* compliance is based on verification. The ~~air leakage~~ *air leakage* of the *building envelope* shall be converted to the appropriate units to describe the ~~air leakage~~ *air leakage* as a function of the area of *walls* that separate *conditioned spaces* and *semiheated spaces* from the exterior as follows:

$$I_{AGW} = 0.112 \times I_{75Pa} \times S/A_{AGW}$$

where

I_{75Pa} = ~~air leakage~~ *air leakage* rate of the *building envelope* in cfm/ft^2 (L/s m^2) at a fixed *building* pressure differential of 75 Pa ~~0.3~~ (0.30 in. of water) (75 Pa), ~~or 1.57 psf~~

S = total area of the *building envelope* in ft^2 (m^2) including the lowest *floor*, any *below-grade walls* or *above-grade walls*, and *roof* (including *vertical fenestration* and *skylights*)

I_{AGW} = adjusted ~~air leakage~~ *air leakage* rate of the *building envelope* in cfm/ft^2 (L/s m^2) at a reference wind speed of 10 mph and relative to the area of the *above-grade walls*

A_{AGW} = the total area of *above-grade walls* that comprise the *building envelope*, ft^2 (m^2)

Exception to C3.5.5.3: If the *simulation program* cannot simulate ~~air leakage~~ *air leakage* as a function of the area of *walls* that separate *conditioned spaces* and *semiheated spaces* from the exterior, the ~~air leakage~~ *air leakage* of the *building envelope* shall be converted to the appropriate units to describe the ~~air leakage~~ *air leakage* as a function of *gross floor area* as follows:

$$I_{FLR} = 0.112 \times I_{75Pa} \times S/A_{FLR}$$

where

I_{FLR} = adjusted ~~air leakage~~ *air leakage* rate of the *building envelope* in cfm/ft^2 (L/s·m^2) at a reference wind speed of 10 mph (4.47 m/s) and relative to the *gross floor area*

A_{FLR} = *gross floor area*, ft^2 (m^2)

[. . .]

C3.5.5.3.1 ~~Infiltration~~ Air Leakage Schedule. To simulate *air leakage* as described in Section 5.4.3, ~~*Infiltration*~~ infiltration shall be adjusted in accordance with the ~~*infiltration*~~ infiltration schedule in the *building envelope trade-off schedules and loads* for the applicable *building* area type.

[. . .]

C3.6 Calculation of Base Envelope Performance Factor. The simulation model for calculating the *base envelope performance factor* shall modify the simulation model for calculating the *proposed envelope performance factor* as follows:

[. . .]

f. The *air leakage* rate of the *building envelope* (I_{75Pa}) at a fixed *building* pressure differential of 75 Pa (0.30 in. of water) (75 Pa) shall be 0.35 cfm/ft^2 (1.7 L/s·m^2) and shall be converted to units for the energy model using the same method as the *proposed envelope performance factor*.

[. . .]

Modify Normative Appendix G as shown (I-P and SI).

G3.1.1.4 Modeling Building Envelope Air Leakage ~~Infiltration.~~ The ~~air leakage~~ *air leakage* rate of the *building envelope* (I_{75Pa}) at a pressure differential of 75 Pa ~~0.3~~ (0.30 in. of water) (75 Pa) shall be converted to appropriate units for the *simulation program* using one of the following formulas:

[. . .]

I_{75Pa} = ~~air leakage~~ *air leakage* rate of the *building envelope* (cfm/ft^2 [L/s m^2]) at a fixed *building* pressure differential of 75 Pa ~~0.3~~ (0.30 in. of water) (75 Pa), ~~or 1.57 psf~~

Q = volume of air in cfm (L/s) flowing through the *building envelope* when subjected to a pressure differential of 75 Pa ~~0.3~~ (0.30 in. of water) (75 Pa), ~~or 1.57 psf~~, in accordance with ASTM E 779, ASTM E1827, or ASTM E3158.

[. . .]

Modify Table G3.1 as shown (I-P and SI).

Table G3.1 Model Requirements for Calculating Proposed and *Baseline Building Performance*

No.	*Proposed Building Performance*	*Baseline Building Performance*
[. . .]		
5.	Building Envelope	
[. . .]		[. . .]
	b. To simulate *air leakage*, ~~i~~infiltration shall be modeled using the same methodology and adjustments for weather and *building* operation in both the *proposed design* and the *baseline building design*. These adjustments shall be made for each simulation time step and must account for but not be limited to weather conditions, and *HVAC system* operation, including strategies that are intended to positively pressurize the *building*. ~~The air leakage rate of the *building envelope* (I_{75Pa}) at a fixed *building* pressure differential of 0.3 in. of water (75 Pa) shall be 0.6 cfm/ft^2 (3.0 L/s·m^2) for buildings providing verification in accordance with Section 5.9.2.2(a).~~ The ~~air leakage~~ *air leakage* rate of the *building envelope* shall be converted to appropriate units for the *simulation program* using one of the methods in Section G3.1.1.4. 1. When whole-building pressurization testing is required or specified during design and completed in accordance with Section 5.4.3.1.4, the measured *air leakage* rate of the *building envelope* (I_{75Pa}) at a fixed *building* pressure differential of 75 Pa (0.30 in. of water) (75 Pa) shall be modeled for purposes of demonstrating compliance with this standard. ***Informative Note:*** Before the start of pressurization testing, the maximum *air leakage* rate of the *building envelope* (I_{75Pa}) specified in Section 5.4.3.1.4 or as specified in design documents may be simulated to estimate the *energy* impact of *building envelope air leakage*. Because the final measured value is used for compliance, care should be taken when using estimated *air leakage* as a trade-off for performance-based code compliance. 2. For *buildings* providing verification in accordance with Section 5.9.1.2, the *air leakage* rate of the *building envelope* (I_{75Pa}) at a fixed *building* pressure differential of 75 Pa (0.30 in. of water) (75 Pa) shall be 0.45 cfm/ft^2 (2.2 L/s·m^2). ~~**Exception:** When whole *building* air leakage testing, in accordance with Section 5.9.2.2(b), is specified during design and completed after *construction*, the *proposed design* air leakage rate of the *building envelope* shall be as measured.~~	

Modify Table H-3 as shown.

Table H-3 Standard 90.1 Items to Verify

Subsection	Subsection Title	Standard 90.1 Items to Verify for Proper Operation or Inclusion	Status
[. . .]			
5.4.1	Insulation	Design details maintain continuity of thermal barrier.	

~~5.4.3.1.2~~ 5.4.3.1	~~Air barrier installation~~ Continuous Air Barrier	Air barriers meet the following:
		• Air barrier design and installation per Section 5.4.3.2 and either:
		  • Whole building *air leakage* testing per Section 5.4.3.1, or
		  • Design and installation verification program performed in accordance with Section 5.4.3.1 and Section 5.9.1.2.
		~~• Continuity at all transitions within the exterior wall assemblies, including, but not limited to, terminations between opaque walls and fenestration and door assemblies; envelope penetrations; wall and floors; walls and roof; and joints, seams, connection between planes, and changes in air barrier material.~~
		~~• Surfaces of substrate or membrane are clean and free of dirt, debris, oil, etc., as required by manufacture installation instructions.~~
		~~• Installed within allowed weather conditions as defined by the product manufacturer.~~
		~~• Adequately sealed and attached to the substrate.~~	

~~5.4.3.1.3~~ 5.8.3.1	Testing, acceptable materials and assemblies	Continuous air barrier materials and assemblies comply with specific manufacturer requirements or are tested for leakage resistance.	
~~5.4.3.2~~ 5.8.3.2	Fenestration and doors	*Fenestration* and *doors* have manufacturer documentation that ~~air leakage~~ *air leakage* does not exceed allowable leakage rates.	
5.5.4.2	Fenestration and doors	*Fenestration* to wall ratio and *skylight* to *roof* ratio meet either the prescriptive requirements or the proposed design in the performance path, depending on the compliance path used.	
5.8.1	Insulation installation	Insulation material meets design specifications and is continuous.	
5.9	Inspection and verification	Envelope assemblies and *fenestration* comply with requirements. *Building envelope* performance is tested or verified.	
[. . .]			

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ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

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The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

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