ADDENDA

ANSI/ASHRAE/IES Addenda q, s, z, ap, aq, ar to ANSI/ASHRAE/IES Standard 90.1-2016

Energy Standard for Buildings Except Low-Rise Residential Buildings

See Informative Appendix H for ASHRAE, IES, and ANSI approval dates.

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 ISSN 1041-2336

Approved American National Standard

www.ansi.org

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The track changes in this document show the changes made in addenda ap, aq, ar, q, s, and z.

4.2 Compliance

4.2.1 Compliance Paths

4.2.1.1 New Buildings

New *buildings* shall comply with Sections 4.2.2 through 4.2.5 and either the provisions of

a. Section 5, "*Building Envelope*"; Section 6, "Heating, Ventilating, and Air Conditioning"; Section 7, "*Service Water Heating*"; Section 8, "Power"; Section 9, "Lighting"; and Section 10, "Other *Equipment*," or

b. Section 11, "*Energy Cost Budget* Method," or

c. Normative Appendix G, "*Performance Rating Method*."

When using Appendix G, the Performance Cost Index (PCI) of new *buildings*, *additions* to *existing buildings* and/or *alterations* to *existing buildings* shall be less than or equal to the Performance Cost Index Target (PCI_t) when calculated in accordance with the following:

$$PCI_t = [BBUEC + (BPF \times BBREC) - PNA]/BBP$$

where

PCI = Performance Cost Index calculated in accordance with Section G1.2.

BBUEC = Baseline *Building* Unregulated *Energy* Cost, the portion of the annual *energy* cost of a *baseline building design* that is due to *unregulated energy use*.

BBREC = Baseline *Building* Regulated *Energy* Cost, the portion of the annual *energy* cost of a *baseline building design* that is due to *regulated energy use*.

BPF = *Building* Performance Factor from Table 4.2.1.1. For *building* area types not listed in Table 4.2.1.1 use "All others." Where a *building* has multiple *building* area types, the required BPF shall be equal to the area-weighted average of the *building* area types.

BBP = *Baseline Building Performance*.

PBP = Proposed Building Performance including the reduced, annual purchased energy cost associated with on-site renewable energy generation systems

PBP_{nre} = Proposed Building Performance without any credit for reduced annual energy costs from on-site renewable energy generation systems.

PNA = Proposed renewable energy contribution not allowed for compliance

Renewable contribution = PBP_{nre} - PBP

Renewable Fraction = (PBP_{nre} - PBP)/BBP

If Renewable Fraction ≤ 0.05 then PNA = 0, otherwise PNA = Renewable Contribution – (0.05 x BBP)

Regulated *energy* cost shall be calculated by multiplying the total *energy* cost by the ratio of *regulated energy use* to total *energy* use for each *fuel* type. Unregulated *energy* cost shall be calculated by subtracting regulated *energy* cost from total *energy* cost.

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5.4 Mandatory Provisions

5.4.1 Insulation

Where insulation is required in Section 5.5 or Section 5.6, it shall comply with the requirements found in Section 5.8.1.

5.4.2 Fenestration and Doors

Procedures for determining *fenestration* and *door* performance are described in Section 5.8.2. Product samples used for determining *fenestration* performance shall be production line units or representative of units purchased by the consumer or contractor.

5.4.3 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

The ~~entire~~ *exterior building envelope* and the *semiexterior building envelope* shall ~~be designed and constructed with~~have a *continuous air barrier* complying with Sections 5.4.3.1.1 and 5.4.3.1.2.

Exceptions to 5.4.3.1

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

Whole-building pressurization testing shall be conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the *building envelope* shall not exceed 0.40 cfm/ft^2 under a pressure differential of 0.3 in. of water, with this air leakage rate normalized by the sum of the above-grade and below-grade *building envelope* areas of the *conditioned* and *semiheated space*.

Where a *building* contains both *conditioned space* and *semiheated space* compliance shall be shown:

a. separately for the *conditioned space* and for the *semiheated space*, with the air leakage rate for the *conditioned space* normalized by the *exterior building envelope* area of the *conditioned space* and the air leakage rate for the *semiheated space* normalized by the *semiexterior building envelope* area of the *semiheated space*; or

b. for the *conditioned space* and for the *semiheated space* together, with the 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.

Exceptions to 5.4.3.1.1

1. For *buildings* having over 50,000 ft^2 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. The entire *floor* area of all *stories* that have any *spaces* directly under a *roof*.
   b. The entire *floor* area of all *stories* that have a *building entrance* or loading dock.
   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%.
2. Where the measured air leakage rate exceeds 0.40 cfm/ft^2 but does not exceed 0.60 cfm/ft^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.

3. *Continuous air barrier* design and installation verification program in accordance with Section 5.9.2.~~2~~1.

5.4.3.1.2 Continuous Air Barrier Design and Installation

The *continuous air barrier* shall be designed and ~~noted~~ installed in the following manner:

a. ~~All air barrier c~~Components designed to provide the *continuous air barrier* and the component's position within of each *building envelope* assemblies~~y~~ shall be clearly identified ~~or otherwise noted~~ on *construction documents.*

b. The joints, interconnections, and penetrations of the *continuous air barrier* components~~, including lighting *fixtures,*~~ shall be detailed in the *construction documents*~~or otherwise noted~~.

c. The *continuous air barrier* shall extend over all surfaces of the *building envelope* and be identified in the *construction documents* to be continuous~~(at the lowest *floor, walls,* and *roof*)~~.

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.

~~**5.4.3.1.2 Continuous Air Barrier Installation**~~

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:

~~a.~~ 1. Joints around *fenestration* and *door* frames ~~(both manufactured and site-built)~~.

~~b.~~ 2. Junctions between *walls* and *floors*, between *walls* at *building* corners, and between *walls* and *roofs* ~~or ceilings~~.

~~c.~~ 3. Penetrations through the *continuous air barrier* in *building envelope roofs*, *walls*, and *floors*.

~~d.~~ 4. *Building* assemblies used as ducts or *plenums.*

~~e.~~ 5. Joints, seams, connections between planes, and other changes in *continuous air barrier* materials.

~~**5.4.3.1.3 Testing, Acceptable Materials, and Assemblies**~~

~~**The *building* shall comply with whole-*building* pressurization testing in accordance with Section 5.4.3.1.3(a) or with the *continuous air barrier* requirements in Section 5.4.3.1.3(b) or 5.4.3.1.3(c).**~~

~~a. **Whole-*building* pressurization testing shall be conducted in accordance with ASTM E779 or ASTM E1827 by an independent third party. The measured air leakage rate of the *building envelope* shall not exceed 0.40 cfm/ft^2 under a pressure differential of 0.3 in. of water, with this air leakage rate normalized by the sum of the above and below-*grade building envelope* areas of the *conditioned* and *semiheated space.***~~

~~**Exceptions to 5.4.3.1.3(a)**~~

~~1. **For *buildings* having over 50,000 ft^2 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. The entire *floor* areafloor area of all stories that have any *spaces* directly under a *roof*.

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

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

2. Where the measured air leakage rate exceeds 0.40 cfm/ft^2 but does not exceed 0.60 cfm/ft^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.

b. Materials that have an air permeance not exceeding 0.004 cfm/ft^2 under a pressure differential of 0.3 in. of water (1.57 psf) when tested in accordance with ASTM E2178. The following materials meet these requirements:

1. Plywood—minimum 3/8 in.

2. Oriented strand board—minimum 3/8 in.

3. Extruded polystyrene insulation board—minimum 1/2 in.

4. Foil-faced urethane insulation board—minimum 1/2 in.

5. Exterior gypsum sheathing or interior gypsum board—minimum 1/2 in.

6. Cement board—minimum 1/2 in.

7. Built-up roofing membrane

8. Modified bituminous *roof* membrane

9. Single-ply *roof* membrane

10. A Portland cement/sand parge, stucco, or gypsum plaster—minimum 1/2 in. thick

11. Cast-in-place and precast concrete

12. Sheet metal

13. Closed-cell 2 lb/ft^3 nominal density spray polyurethane foam—minimum 1 in.

c. Assemblies of materials and components (sealants, tapes, etc.) that have an average air leakage not to exceed 0.04 cfm/ft^2 under a pressure differential of 0.3 in. of water (1.57 psf) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283. The following assemblies meet these requirements:

1. Concrete masonry *walls* that are

(a) fully grouted, or

(b) painted to fill the pores.

5.4.3.2 Fenestration and Doors

Air leakage for *fenestration* and *doors* shall be determined in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283 as specified below. Air leakage shall be determined by a laboratory accredited by a nationally recognized

~~accreditation organization, such as the National Fenestration Rating Council, and shall be *labeled* and certified by the *manufacturer*. Air leakage shall not exceed~~

~~a. 1.0 cfm/ft² for glazed swinging *entrance doors*, glazed power-operated sliding *entrance doors*, glazed power-operated folding *entrance doors*, and revolving *doors*, tested at a pressure of at least 1.57 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283;~~

~~b. 0.06 cfm/ft² for curtainwall and storefront glazing, tested at a pressure of at least 1.57 psfin accordance with NFRC 400 or ASTM E283;~~

~~c. 0.3 cfm/ft² for unit *skylights* having condensation weepage openings, tested at a pressure of at least 1.57 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400, or 0.5 cfm/ft² tested at a pressure of at least 6.24 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440;~~

~~d. 1.3 cfm/ft² for *nonswinging doors* intended for vehicular access and material transportation, with a minimum opening rate of 32 in/s, tested at a pressure of at least 1.57 psf in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283;~~

~~e. 0.4 cfm/ft² for other *opaque nonswinging doors*, glazed *sectional garage doors*, and upward acting glazed *nonswinging doors* tested at a pressure of at least 1.57 psf in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283; and~~

~~f. 0.2 cfm/ft² for all other products tested at a pressure of at least 1.57 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400, or 0.3 cfm/ft² tested at a pressure of at least 6.24 psf in accordance with AAMA/WDMA/CSA 101/I.S/A440.~~

~~**Exceptions to 5.4.3.2**~~

~~1. *Field-fabricated fenestration* and *doors*.~~

~~2. Air leakage shall not exceed 1.0 cfm/ft² when tested at a pressure of at least 1.57 psf in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283 for *metal coiling doors* in *semiheated spaces* in Climate Zones 0 through 6.~~

~~3. Products in *buildings* that comply with a whole *building* air leakage rate of 0.4 cfm/ft² under a pressure differential of0.3 in. of water, 1.57 psf when tested in accordance with ASTM E779.~~

5~~.4.3.3~~5.4.3.2 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* when vehicles are parked in the doorway.

5~~.4.3.4~~5.4.3.3 Vestibules

Building entrances that separate *conditioned space* from the exterior shall be protected with an enclosed vestibule, with all *doors* opening into and out of the vestibule equipped with self-closing devices. Vestibules shall be designed so that in passing through the vestibule it is not necessary for the interior and exterior *doors* to open at the same time. Interior and exterior *doors* shall have a minimum distance between them of not less than 7 ft when in the closed position. The floor area of each vestibule shall not exceed the greater of 50 ft² or 2% of the *gross conditioned floor area* for that level of the *building*. ~~The exterior envelope of conditioned vestibules shall comply with the requirements for a *conditioned space*. The interior and exterior envelope of unconditioned vestibules shall comply with the requirements for a *semiheated space*.~~ The exterior surfaces of both conditioned vestibules and unconditioned vestibules shall comply with the *continuous air barrier* requirements.

Exceptions to ~~5.4.3.4~~5.4.3.3

1. *Building entrances* with revolving *doors.*
2. *Doors* not intended to be used as a *building entrance.*
3. *Doors* opening directly from a *dwelling unit.*

4. *Building entrances* in *buildings* located in Climate Zone 1 or 2.
5. *Building entrances* in *buildings* that are located in Climate Zone 3, less than four *stories* above *grade*, and less than 10,000 ft^2 in *gross conditioned floor area.*
6. *Building entrances* in *buildings* that are located in Climate Zone 0, 4, 5, 6, 7, or 8 and are less than 1000 ft^2 in *gross conditioned floor area.*
7. *Doors* that open directly from a *space* that is less than 3000 ft^2 in area and is separate from the *building entrance.*
8. *Semiheated spaces*.
9. Enclosed elevator lobbies for *building entrances* directly from parking garages.

~~5.4.3.4.1~~5.4.3.3.1 Vestibules for Large Spaces

Where vestibules are required under Section 5.4.3.4, for *spaces* having a *gross conditioned floor area* for that level of the *building* of 40,000 ft^2 and greater, and when the *doors* opening into and out of the vestibule are equipped with *automatic*, electrically driven, self-closing devices, the interior and exterior *doors* shall have a minimum distance between them of not less than 16 ft.

5.5 Prescriptive Building Envelope Compliance Path

5.5.1 Exterior Building Envelope

For a *conditioned space*, the *exterior building envelope* shall comply with either the *nonresidential* or *residential* requirements in Tables 5.5-0 through 5.5-8 for the appropriate climate.

The exterior surfaces of conditioned vestibules shall comply with the *building envelope* requirements for a *conditioned space*.

5.5.2 Semi-Exterior Building Envelope

If a *building* contains any *semiheated space* or *unconditioned space* then the *semiexterior building envelope* shall comply with the requirements for *semiheated space* in Tables 5.5-0 through 5.5-8 for the appropriate climate. (See Figure 5.5.2.)

The interior surfaces and exterior surfaces of unconditioned vestibules shall comply with the *building envelope* requirements for a *semiheated space*.

• • •

5.8.3 Air Leakage

5.8.3.1 ~~5.4.3.13~~ Testing, Acceptable Materials, and Assemblies

~~The *building* shall comply with whole *building* pressurization testing in accordance with Section 5.4.3.1.3(a) or with the *continuous air barrier* requirements in Section 5.4.3.1.3(b) or 5.4.3.1.3(c).~~

~~b.~~ Air leakage for materials or assemblies ~~that~~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 specified in Table 5.8.3.1 ~~have an air permanence not exceeding~~when using Exception 3 of Section 5.4.3.1.1. ~~0.004 cfm/ft² under a pressure differential of 0.3 in. of water (1.57 psf) when tested in accordance with ASTM E2178.~~Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization.

Table 5.8.3.1 Maximum Air Leakage for Materials and Assemblies

Continuous Air	Maximum air leakage,	Minimum Test	Test Method

Barrier	**cfm/ft² (L/s• m²)**	**Pressure, psf (Pa)**	
Materials[a]	0.004 (0.02)	1.57 (75)	ASTM E2178
Assemblies[b]	0.04 (0.2)	1.57 (75)	ASTM E2357, ASTM E1677, ASTM E1680 ASTM E283

a. The following materials ~~meet these~~ comply with the requirements in Table 5.8.3.1:

1. Plywood–minimum 3/8 in. (10 mm)
2. Oriented strand board–minimum 3/8 in. (10 mm)
3. Extruded polystyrene insulation board–minimum ½ in. (12 mm)
4. Foil-faced ~~urethane~~ polyisocyanurate insulation board–minimum ½ in. (12 mm)
5. Exterior gypsum sheathing or interior gypsum board–minium ½ in. (12 mm)
6. Cement board–minimum ½ in. (12 mm)
7. Built-up roofing membrane
8. Modified bituminous *roof* membrane
9. Single-ply *roof* membrane
10. A Portland cement/sand parge, stucco, or gypsum plaster–minimum ½ in. (12 mm) thick
11. Cast-in-place and precast concrete
12. Sheet metal
13. Closed-cell 2 lb/ft³ (32 kg/m³) nominal density spray polyurethane foam–minimum 1 in. (25 mm)

~~c. Assemblies of materials and components (sealants, tapes, etc.)that used as a component of the continuous air barrier shall have an average air leakage not to exceed 0.04 cfm/ft² under a pressure differential of 0.3 in. of water (1.57 psf) when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283. The following assemblies meet these requirements:~~

b. The following assemblies ~~meet these~~ comply with the requirements in Table 5.8.3.1:

1. Concrete masonry *walls* that are
   a) fully grouted, or
   b) painted to fill the pores.
2. Shale or clay masonry units that are assembled as a solid *wall*: without weeps, with nominal width of 4-in. (100 mm) or more, and with Type S mortar.

~~5.4.3.2~~ 5.8.3.2 Fenestration and Doors

Air leakage for *fenestration* and *doors* shall be determined in accordance with ~~AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283 as specified below~~the test method and minimum air pressure specified in Table 5.8.3.2 and shall not exceed the maximum air leakage specified in Table 5.8.3.2. Air leakage shall be determined by a laboratory accredited by a nationally recognized accreditation organization~~, such as the National Fenestration Rating Council,~~ and shall be *labeled* and certified by the *manufacturer*. ~~Air leakage shall not exceed~~

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 ~~A~~air leakage ~~shall~~ not exceeding 1.0 cfm/ft² when tested at a pressure of at least 1.57 psf in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283 ~~for *metal coiling doors* in *semiheated spaces* in Climate Zones 0 through 6~~.
3. Products in *buildings* that are tested and shown to comply with a whole *building* air leakage in accordance with Section 5.4.3.1.1 without using Exception 3. ~~rate of 0.4 cfm/ft² under a pressure differential of0.3 in. of water, 1.57 psf when tested in accordance with ASTM E779.~~

Table 5.8.3.2 Maximum Air Leakage for *Fenestration* and *Doors*

Fenestration and *Door* Products	Maximum air leakage, cfm/ft² (L/s• m²)	Minimum Test Pressure, psf (Pa)	Test Method
~~a. 1.0 cfm/ft² for~~ glazed swinging *entrance doors*, glazed power-operating sliding *entrance doors*, glazed power-operated folding *entrance doors*, and revolving *doors*~~, tested at a pressure of at least 1.57 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283;~~	1.0 (5.1)	1.57 (75)	AAMA/WDMA/CSA 101/I.S.2/A440, NFRC 400, or ASTM E283;
~~b. 0.06 cfm/ft² for~~ curtainwall and storefront glazing~~, tested at a pressure of at least 1.57 psf in accordance with NFRC 400 or ASTM E283;~~	0.06 (0.3)	1.57 (75)	NRFC 400 or ASTM 283
~~c. 0.3 cfm/ft² for~~ unit *skylights* having condensation weepage openings~~, tested at a pressure of at least 1.57 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400, or 0.5 cfm/ft² tested at a pressure of at least 6.24 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440;~~	0.3 (1.5)	1.57 (75)	AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400
	OR		
	0.5 (2.5)	6.24 (300)	AAMA/WDMA/CSA 101/I.S.2/A440
~~e. 0.4 cfm/ft² for~~ other *opaque nonswinging doors*, glazed *sectional garage doors*, and upward acting glazed *nonswinging* ~~doors tested as a pressure of at least 1.57 psf in accordance with ANSI/DASMA 105, NFRC 400, or ASTM E283; and~~	0.4 (2.0)	1.57 (75)	ANSI/DASMA 105, NFRC 400, or ASTM E283
~~f. 0.2 cfm/ft² for~~ all other products ~~tested at a pressure of at least 1.57 psf in accordance with AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400, or 0.3 cfm/ft² tested at a pressure of at least 6.24 psf in accordance with AAMA/WDMA/ CSA 101/ I.S.2/A440.~~	0.2	1.57 (75)	AAMA/WDMA/CSA 101/I.S.2/A440 or NFRC 400
	OR		
	0.3 (1.5)	6.24 (300)	AAMA/WDMA/CSA 101/I.S.2/A440

...

5.9.12. Verification and Testing

5.9.12.1 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.

5.9.12.2 ~~Air Leakage~~ Verification of the Design and Installation of the *Continuous Air Barrier*

~~Air leakage v~~Verification of the design and installation of the *continuous air barrier* shall be determined in accordance with ~~one of~~ the following ~~methods~~ by an independent third party when using Exception 3 of Section 5.4.3.1.1:

~~a. An air barrier design and installation verification program shall be implemented and shall include the following elements:~~

1. A design review shall be conducted to ~~assess~~ verify and document compliance with the requirements in Sections ~~5.4.3.1.1, 5.4.3.1.2, and the applicable portions of Section 5.4.3.1.3.~~ 5.4.3 and 5.8.3.2.
2. Periodic field inspection of the *continuous air barrier* ~~components~~ 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 ~~5.4.3.1.1,~~ 5.4.3.1.2~~,~~ and 5.8.3. ~~the applicable portions of Section 5.4.3.1.3~~.
3. Reporting shall ~~be in compliance~~ comply with Section 4.2.5.1.2.

~~b. A whole-*building* air leakage verification program shall be implemented and shall include the following elements:~~

~~1. Whole-*building* pressurization testing shall be performed in accordance with Section 5.4.3.1.3(a) and the use of any exceptions shall be documented.~~

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

...

6.5.3.5 Supply Air Temperature Reset Controls

Multiple zone *HVAC systems* shall~~must~~ include controls that are capable of and configured to *automatically reset* the supply air temperature in response to representative *building* loads, or to *outdoor air* temperature. The *controls* shall *reset* the supply air temperature at least 25% of the difference between the design supply air temperature and the design room air temperature. Controls that adjust the *reset* based on zone humidity are allowed in Climate Zones 0B, 1B, 2B, 3B, 3C and 4 through 8. *HVAC ~~Z~~zones* that are expected to experience relatively constant loads~~, such as electronic *equipment* rooms,~~ shall ~~be~~ have maximum airflow designed ~~for~~ to accommodate the fully *reset* supply air temperature.

Informative Note:

HVAC zones that are expected to experience relatively constant loads typically include electronic equipment rooms and interior zones.

Exceptions to 6.5.3.5

1. *Systems* in Climate Zones 0A, 1A, ~~2A,~~ and 3A with less than 3000 cfm (1500 L/s) of design outdoor air.
2. *Systems* in Climate Zone 2A with less than 10,000 cfm (5000 L/s) of design outside air.
3. *Systems* in Climate Zones 0A, 1A, 2A, and 3A with at least 80% outside air and employing exhaust air *energy* recovery complying with Section 6.5.6.1.
4. *Systems* that prevent *reheating*, *recooling*, or mixing of heated and cooled supply air.
5. *Systems* in which at least 75% of the *energy* for *reheating* (on an annual basis) is from *site recovered energy* or *site-solar energy*.

6.5.3.5.1 Dehumidification Control Interaction

In climate zones 0A, 1A, 2A, and 3A, the system design shall allow supply air temperature *reset* while dehumidification is provided. When dehumidification *control* is active, air economizers shall be locked out.

Informative Note:

Examples of *HVAC systems* that can allow supply air temperature reset while dehumidifying include cooling of outside air with a separate cooling coil, bypassing return air around the cooling coil, a dedicated outside air system, and series energy recovery.

...

9.1 General

9.1.1 Scope

This section shall apply to the following:

a. Interior *spaces* of *buildings*.

b. Exterior lighting that is powered through the *building*'s or building site's electrical *service*.

Exception to 9.1.1

1. Emergency lighting that is *automatically* off during normal *building* operation.
2. Lighting, including exit signs, that is specifically designated as required by a health or life safety statute, ordinance, or regulation.
3. Decorative gas *lighting systems*.

...

9.2.2.3

T~~he following~~ lighting *equipment* and applications listed in Table 9.2.2.3 shall not be considered when determining the *interior lighting power allowance* developed in accordance with Section 9.5 or 9.6, nor shall the wattage for such lighting be included in the *installed interior lighting power* identified in accordance with Section 9.1.3. ~~However, any such~~This exemption shall only apply when the lighting and controls ~~shall not be exempt unless it is~~ are in compliance with the requirements of Table 9.2.2.3.~~an addition to *general lighting* and is controlled by an independent *control device*.~~ Lighting controls noted in this table are the only required controls for this equipment and these applications.

~~1. Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.~~

~~2. Lighting that is integral to *equipment* or instrumentation and is installed by its *manufacturer*.~~

~~3. Lighting specifically designed for use only during medical or dental procedures and lighting integral to medical *equipment*.~~

~~4. Lighting integral to both open and glass-enclosed refrigerator and freezer cases.~~

~~5. Lighting integral to food warming and food preparation *equipment*.~~

~~6. Lighting specifically designed for the life support of nonhuman life forms.~~

~~7. Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.~~

~~8. Lighting in interior *spaces* that have been specifically designated as a registered interior *historic* landmark.~~

~~9. Lighting that is an integral part of advertising or directional signage.~~

~~10. Exit signs.~~

~~11. Lighting that is for sale or lighting educational demonstration *systems*.~~

~~12. Lighting for theatrical purposes, including performance, stage, and film and video production.~~

~~13. Lighting for television broadcasting in sporting activity areas.~~

~~14. Casino gaming areas.~~

~~15. Furniture-mounted supplemental *task lighting* that is controlled by *automatic* shutoff and complies with Section 9.4.1.3(c).~~

~~16. Mirror lighting in dressing rooms and accent lighting in religious pulpit and choir areas.~~

~~17. Parking garage transition lighting – lighting for covered vehicle entrances and exits from *buildings* and parking structures – that complies with Section 9.4.1.2(a) and 9.4.1.2(c); each transition zone shall not exceed a depth of 66 ft inside the structure and a width of 50 ft.~~

Table 9.2.2.3 Exceptions to Interior Lighting Power and Minimum Control Requirements

Item #	Equipment/Application	In Addition to and controlled Separately from *General Lighting*	Required Controls
1	Lighting that is integral to *equipment*, medical *equipment* or instrumentation and is installed by its *manufacturer*.	YES	No control requirements
2	Lighting specifically designed for use only during medical or dental procedures.	YES	9.4.1.1(a) – Local control
3	Lighting specifically designed for the life support of non-human life forms.		
4	Lighting for theatrical purposes, including performance, stage, broadcast studio, and film and video production.		
5	Lighting in sporting activity areas for television broadcasting.		
6	Lighting for photographic processes.		
7	Lighting that is an integral part of advertising or directional signage.	YES	9.4.1.1(i) – Scheduled shutoff
8	Lighting integral to both open and glass-enclosed refrigerator and freezer cases.	YES	9.4.1.1(h) – Automatic full OFF or 9.4.1.1(i) – Scheduled shutoff
9	Casino gaming areas.	NO	
10	Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.	YES	9.4.1.1(a) – Local control and 9.4.1.1(i) – Scheduled shutoff
11	Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.	YES	9.4.1.1(a) – Local control and either 9.4.1.1(h) – Automatic full OFF or 9.4.1.1(i) – Scheduled shutoff
12	Lighting integral to food warming and food preparation *equipment*.		
13	Lighting that is for sale or lighting educational demonstration *systems*.		
14	Mirror lighting in dressing rooms.		
15	Accent lighting in religious pulpit and choir areas.		
16	Lighting in interior *spaces* that have been	NO	

	specifically designated as a registered interior *historic* landmark.		
17	Furniture-mounted supplemental *task lighting*.	YES	9.4.1.3(c) – Special Applications
18	Parking garage daylight transition lighting–lighting for covered vehicle entrances and exits from *buildings* and parking structures; each transition zone shall not exceed a depth of 66 ft inside the structure and a width of 50 ft.	YES	9.4.1.2(a) & (c) – Parking Garage Control

• • •

Exception to9.4.1.1(i)

The following lighting is not required to be on scheduled shutoff:

1. Lighting in *spaces* where lighting is required for 24/7 continuous operation.
2. Lighting in *spaces* where patient care is rendered.
3. Lighting in *spaces* where *automatic* shutoff would endanger the safety or security of the room or *building* occupants.
4. Lighting load not exceeding 0.02 W/ft^2 multiplied by the *gross lighted floor area* of the *building*.

j. *Scheduled OFF during non-business hours:* Lighting shall be scheduled to provide automatic OFF control so that lights are turned off at the end of business hours, using either (1) a time-of-day operated *control device* that *automatically* turns the lighting off at specific programmed times or (2) a signal from another *automatic control device* or alarm/security system. Any manual control installed to provide override of the scheduled control shall not turn the lighting on for more than two hours per activation during scheduled off periods.

9.4.1.2 Parking Garage Lighting Control

Lighting for parking garages shall comply with the following requirements:

a. Parking garage lighting shall have *automatic* lighting shutoff per Section 9.4.1.1(i).

b. Lighting power of each *luminaire* shall be *automatically* reduced by a minimum of 30% when there is no activity detected within a lighting zone for 20 minutes. Lighting zones for this requirement shall be no larger than 3600 ft^2.

c. Lighting for covered vehicle entrances and exits from *buildings* and parking structures shall be separately controlled by a device that *automatically* reduces the lighting by at least 50% from sunset to sunrise.

d. The power to *luminaires* within 20 ft of any perimeter *wall* structure that has a net opening-to-*wall* ratio of at least 40% and no exterior obstructions within 20 ft, shall be *automatically* reduced in response to daylight by at least 50%.

Exception to 9.4.1.2(d)

Lighting in the following areas is exempt:

1. Lighting in daylight transitions zones and ramps without parking.

9.4.1.3 Special Applications

Lighting controls noted in this section are the only required controls for this equipment and these applications. Lighting exempt from interior lighting power shall be controlled in accordance with Table 9.2.2.3. Lighting using additional interior lighting power applications shall be controlled in accordance with Section 9.6.2.

a. ~~The following lighting shall be separately controlled from~~ Lighting used for the following applications shall be equipped with a local control independent of the control of the *general lighting* ~~in all *spaces*:~~ in accordance with Section 9.4.1.1(a). In addition, such lighting shall be controlled in accordance with Section 9.4.1.1(h) or Section 9.4.1.1(i).

1. Display or accent lighting.
2. Lighting in display cases.
3. ~~Nonvisual lighting, such as for plant growth or food warming.~~
4. ~~Lighting *equipment* that is for sale or used for demonstrations in lighting education.~~

b. Guestrooms

1. All lighting and all switched receptacles in guestrooms and suites in hotels, motels, boarding houses, or similar *buildings* shall be *automatically* controlled such that the power to the lighting and switched receptacles in each *enclosed space* will be turned off within 20 minutes after all occupants leave that *space*.

Exception to 9.4.1.3(b)(1)

Enclosed spaces where the lighting and switched receptacles are controlled by card key *controls* and bathrooms are exempt.

2. Bathrooms shall have a separate *control device* installed to *automatically* turn off the bathroom lighting within 30 minutes after all occupants have left the bathroom.

Exception to 9.4.1.3(b)(2)

Night lighting of up to 5 W per bathroom is exempt.

c. ~~All s~~Supplemental *task lighting*, including *permanently installed* undershelf or undercabinet lighting, shall be controlled from either (1) a *control device* integral to the *luminaires* or (2) ~~by a *wall*-mounted *control device* that is *readily accessible* and located so that the occupant can see the controlled lighting~~ a local control independent of the control of the *general lighting* in accordance with Section 9.4.1.1(a). In addition, such lighting shall be controlled in accordance with Section 9.4.1.1(h) or Section 9.4.1.1(i).

...

~~9.4.4~~ 9.4.3 Dwelling Units

Not less than 75% of the *permanently installed* lighting *fixtures* shall use *lamps* with an *efficacy* of at least 55 lm/W or have a total *luminaire efficacy* of at least 45 lm/W. No other provisions of Section 9 apply to dwelling units.

Exception to 9.4.4:

1. Lighting that is controlled with *dimmers* or ~~*automatic control devices*~~ controlled in accordance with Section 9.4.1.1(h).
2. Hotel/motel guest rooms. The requirements for hotel/motel guest rooms are covered in Table 9.6.1 and Section 9.4.1.3(b).

...

9.6.2 Additional Interior Lighting Power

When using the Space-by-Space Method, an increase in the *interior lighting power allowance* is allowed for specific lighting functions. Additional power shall be allowed only if the specified lighting is installed and ~~automatically~~*~~automatically~~* controlled independently of the *general* lighting in accordance with Section 9.4.1.1(j)~~, separately from the *general lighting*, to be turned off during nonbusiness hours~~. This additional power shall be used only for the specified *luminaires* and shall not be used for any other purpose unless otherwise indicated. Lighting control requirements referenced in Section 9.6.2, are the only required controls for these applications.

An increase in the *interior lighting power allowance* is permitted in the following cases:

a. For each *space*~~s~~ in which lighting is specified to be installed in addition to the *general lighting* for the purpose of decorative appearance or for highlighting art or exhibits not exempted in ~~Section 9.2.2.3, Exception 1,~~ Item 11 of Table 9.2.2.3, provided that the additional lighting power shall not exceed 0.75 W/ft^2 of such *spaces*.

...

11.4.3 Renewable, Recovered, and Purchased Energy

11.4.3.1 On-Site Renewable Energy and Site-Recovered Energy

Site-recovered energy shall not be considered *purchased energy* and shall be subtracted from the *proposed design energy* consumption prior to calculating the *design energy cost*. *On-site renewable energy*~~, generated by *systems* included on the *building* permit, and used directly by the *building*~~ shall be subtracted from the *proposed design energy* consumption prior to calculating the *design energy cost*~~.~~ provided that the building owner either:

1. owns the *on-site renewable energy system* or
2. has signed a lease agreement for the *on-site renewable energy system* for at least 15 years or
3. has signed a contractual agreement to purchase *energy* generated by the *on-site renewable energy system* for at least 15 years.

The reduction in *design energy cost* associated with *on-site renewable energy* shall be no more than 5% of the calculated *energy cost budget*.

...

11.5.2 HVAC Systems

The *HVAC system* type and related performance parameters for the *budget building design* shall be determined from Figure 11.5.2, the *system* descriptions in Table 11.5.2-1 and accompanying notes, and the following rules:

a. **Budget *Building Systems* Not Listed.** Components and parameters not listed in Figure 11.5.2 and Table 11.5.2-1 or otherwise specifically addressed in this subsection shall be identical to those in the *proposed design*.

Exception to 11.5.2(a)

Where there are specific requirements in Sections 6.4 and 6.5, the component *efficiency* in the *budget building design* shall be adjusted to the lowest *efficiency* level allowed by the requirement for that component type.

b. **Minimum *Equipment Efficiency*.** All HVAC and *service water-heating equipment* in the *budget building design* shall be modeled at the

minimum *efficiency* levels, both part load and full load, in accordance with Sections 6.4 and 7.4. Chillers shall use Path A efficiencies as shown in Table 6.8.1-3.

c. **Supply Fan *Energy* in Certain Package *Equipment*.** Where *efficiency* ratings include supply fan *energy*, the *efficiency* rating shall be adjusted to remove the supply fan *energy*. For Budget *System* Types 3, 4, 6, 9, and 11, calculate the minimum *COPnfcooling* and *COPnfheating* using the equation for the applicable performance rating as indicated in Tables 6.8.1-1 through 6.8.1-4. Where a full- and part-load *efficiency* rating is provided in Tables 6.8.1-1 through 6.8.1-4, the full-load equation below shall be used:

$$COP_{nfcooling} = 7.84E\text{-}8 \times EER \times Q + 0.338 \times EER$$

$$COP_{nfcooling} = -0.0076 \times SEER^2 + 0.3796 \times SEER$$

$$COP_{nfheating} = 1.48E\text{-}7 \times COP_{47} \times Q + 1.062 \times COP_{47}$$

(applies to heat pump heating *efficiency* only)

$$COP_{nfheating} = -0.0296 \times HSPF^2 + 0.7134 \times HSPF$$

where $COP_{nfcooling}$ and $COP_{nfheating}$ are the packaged HVAC *equipment* cooling and heating *energy efficiency*, respectively, to be used in the *budget building design*, which excludes supply fan power, and *Q* is the AHRI-rated cooling capacity in Btu/h. If Q is greater than 760,000 Btu/h, use 760,000 Btu/h in the calculation.

EER, *SEER*, *COP*, and *HSPF* shall be at AHRI test conditions. Fan *energy* shall be modeled separately according to Section 11.5.2(h). Supply and return/relief *system* fans shall be modeled as operating at least whenever the *spaces* served are occupied, except as specifically noted in Table 11.5.2-1.

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

e. **Economizers.** Budget *building systems* as listed in Table 11.5.2-1 shall have *air economizers* or *fluid economizers*, the same as in the *proposed design*, in accordance with Section 6.5.1. The high-limit shutoff shall be in accordance with Table 11.5.2-4.

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-air temperature difference of 20°F. If return or relief fans are specified in the *proposed design*, the *budget building design* shall also be modeled with the same fan type sized for the budget *system* supply fan air quantity less the minimum *outdoor air*, or 90% of the supply fan air quantity, whichever is larger.

h. **Fan *System Efficiency*.** Fan *system efficiency* (bhp per cfm of supply air, including the effect of belt losses but excluding motor and motor drive losses) shall be the same as the *proposed design* or up to the limit prescribed in Section 6.5.3.1, whichever is smaller. If this limit is reached, each fan shall be proportionally reduced in brake horsepower until the limit is met. Fan electrical power shall then be determined by adjusting the calculated fan hp by the minimum motor *efficiency* prescribed by Section 10.4.1 for the appropriate motor size for each fan.

i. ***Equipment* Capacities.** The *equipment* capacities for the *budget building design* shall be sized proportionally to the capacities in the *proposed design* based on sizing runs, i.e., the ratio between the capacities used in the annual

simulations and the capacities determined by the sizing runs shall be the same for both the *proposed design* and *budget building design*. *Unmet load hours* for the *proposed design* or *baseline building designs* shall not exceed 300 hours. The *unmet load hours* for the *proposed design* shall not exceed the *unmet load hours* for the *budget building design*. Alternatively, *unmet load hours* exceeding these limits may be approved by the *building official*, provided that sufficient justification is given indicating that the accuracy of the simulation is not significantly compromised by these unmet loads.

j. **Determining the HVAC System.** Each *HVAC system* in a *proposed design* is mapped on a one-to-one correspondence with one of eleven *HVAC systems* in the *budget building design*. To determine the budget *building system*, do the following:

1. Enter Figure 11.5.2 at "Water" if the *proposed design system* condenser is water or evaporatively cooled; enter Figure 11.5.2 at "Air/None" if the condenser is air cooled. Closed-circuit dry coolers shall be considered air cooled. *Systems* utilizing district cooling shall be treated as if the condenser water type were "water." If no *mechanical cooling* is specified or the *mechanical cooling system* in the *proposed design* does not require heat rejection, the *system* shall be treated as if the condenser water type were "Air." For *proposed designs* with ground-source or groundwater-source heat pumps, the budget *system* shall be water-source heat pump (*System* 6).
2. Select the path that corresponds to the *proposed design* heat source: *electric resistance*, heat pump (including air source and water source), or *fuel*-fired. *Systems* utilizing district heating (steam or hot water) shall be treated as if the heating *system* type were "*Fossil Fuel*." *Systems* with no heating capability shall be treated as if the heating *system* type were "*Fossil Fuel*." For *systems* with mixed *fuel* heating sources, the *system* or *systems* that use the secondary heating source type (the one with the smallest total installed output capacity for the *spaces* served by the *system*) shall be modeled identically in the *budget building design*, and the primary heating source type shall be used in Figure 11.5.2 to determine budget *system* type.
3. Select the *budget building design system* category. The *system* under "Single-Zone *Residential System*" shall be selected if the *HVAC system* in the *proposed design* is a *single-zone system* and serves a *residential space*. The *system* under "Single-Zone *Nonresidential System*" shall be selected if the *HVAC system* in the *proposed design* is a *single-zone system* and serves other than *residential spaces*. The *system* under "All Other" shall be selected for all other cases.

k. **Kitchen Exhaust.** For kitchens with a total exhaust hood airflow rate greater than 5000 cfm, use a *demand ventilation system* on 75% of the exhaust air. The *system* shall reduce exhaust and *replacement air system* airflow rates by 50% for one half of the kitchen occupied hours in the *baseline building design*. If the *proposed design* uses *demand ventilation*, the same airflow rate schedule shall be used. The maximum exhaust flow rate allowed for the hood or hood section shall meet the requirements of Section 6.5.7.2.2 for the numbers and types of hoods and appliances provided in the *proposed design*.

G2.4 Renewable, Recovered, and Purchased Energy

G2.4.1 On-Site Renewable Energy and Site-Recovered Energy

Site-recovered energy shall not be considered *purchased energy* and shall be subtracted from the *proposed design energy* consumption prior to calculating the *proposed building performance*. *On-site renewable energy* ~~generated by *systems* included on the *building* permit that is used by the *building*~~ shall be subtracted from the *proposed design energy* consumption prior to calculating the *proposed building performance*~~.~~ provided that the *building* owner either:

1. owns the *on-site renewable energy system* or
2. has signed a lease agreement for the *on-site renewable energy system* for at least 15 years or
3. has signed a contractual agreement to purchase *energy* generated by the *on-site renewable energy system* for at least 15 years.

...

12. Receptacle and Other Loads	
Receptacle and *process loads*, such as those for office and other *equipment*, shall be estimated based on the *building* area type or *space* type category and shall be assumed to be identical in the *proposed design* and *baseline building design*, except as specifically approved by the *rating authority* only when quantifying performance that exceeds the requirements of Standard 90.1 but not when the *Performance Rating Method* is used as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1. These loads shall always be included in simulations of the *building*. These loads shall be included when calculating the *proposed building performance* and the *baseline building performance* as required by Section G1.2.1. Exception: When receptacle controls installed in *spaces* where not required by Section 8.4.2 are included in the *proposed building design* the hourly receptacle shall be reduced as follows: $RPC = RC \times 10\%$ Where: RPC = Receptacle power credit $EPS_{pro} = EPS_{bas} \times (1 - RPC)$ RC = Percentage of all controlled receptacles EPS_{bas} = Baseline *equipmen*t power hourly schedule (fraction) EPS_{pro} = Proposed *equipment* power hourly schedule (fraction) a. Where power and other *systems* covered by Sections 8 and 10 have been designed and submitted with design documents, those *systems* shall be determined in accordance with Sections 8 and 10. b. Where power and other *systems* covered by Sections 8 and 10 have not been submitted with design documents, those *systems* shall comply with but not exceed the requirements of those sections.	Motors shall ~~have~~ be modeled as having the *efficiency* ratings found in Table G3.9.1. Other *systems* covered by Section 10 and miscellaneous loads shall be modeled as identical to those in the *proposed design*, including schedules of operation and *control* of the *equipment*. *Energy* used for cooking *equipment*, receptacle loads, computers, medical or laboratory *equipment*, and manufacturing and industrial process *equipment* not specifically identified in the standard power and *energy* rating or capacity of the *equipment* shall be identical between the *proposed building performance* and the *baseline building performance*. Receptacle schedules shall be the same as the *proposed design* before the receptacle power credit is applied. **Exceptions:** When quantifying performance that exceeds the requirements of Standard 90.1 (but not when using the *Performance Rating Method* as an alternative path for minimum standard compliance per Section 4.2.1.1) variations of the power requirements, schedules, or *control* sequences of the *equipment* modeled in the *baseline building design* from those in the *proposed design* shall be approved by the *rating authority* based on documentation that the *equipment* installed in the *proposed design* represents a significant verifiable departure from documented current conventional practice. The burden of this documentation is to demonstrate that accepted conventional practice would result in baseline *building equipment* different from that installed in the *proposed design*. Occupancy and occupancy schedules shall not be changed.

...

G3.1.2.1 Equipment Efficiencies

All HVAC *equipment* in the *baseline building design* shall be modeled at the minimum *efficiency* levels, both part load and full load, in accordance with Tables G3.5.1 through G3.5.6. Where multiple *HVAC zones* or *residential spaces* are combined into a single *thermal block* in accordance with Table G3.1, the efficiencies (for baseline HVAC System Types 1, 2, 3, 4, 9, and 10) taken from Tables G3.5.1, G3.5.2, G3.5.4, and G3.5.5 shall be based on the equipment capacity of the *thermal block* divided by the number of *HVAC zones* or *residential spaces*. HVAC System Types 5 or 6 efficiencies taken from Table G3.5.1 shall be based on the cooling equipment capacity of a single floor when grouping identical floors in accordance with Section G3.1.1.(a).(4).

~~Chillers shall use Path A efficiencies as shown in Table 6.8.1-3. Where *efficiency* ratings include supply fan *energy*, the *efficiency* rating shall be adjusted to remove the supply fan *energy*. For Baseline *HVAC Systems* 1, 2, 3, 4, 5, and 6, calculate the minimum $COP_{nfcooling}$ and $COP_{nfheating}$ using the equation for the applicable performance rating as indicated in Tables 6.8.1-1 through 6.8.1-4. Where a full- and part-load *efficiency* rating is provided in Tables 6.8.1-1 through 6.8.1-4, the full-load equation below shall be used:~~Fan *energy* shall be modeled separately according to Section G3.1.2.9.

~~$COP_{nfcooling} = 7.84E\text{-}8 \times EER \times Q + 0.338 \times EER$~~

~~$COP_{nfcooling} = -0.0076 \times SEER^2 + 0.3796 \times SEER$~~

~~$COP_{nfheating} = 1.48E\text{-}7 \times COP_{47} \times Q + 1.062 \times COP_{47}$~~

~~(applies to heat pump heating *efficiency* only)~~

~~$COP_{nfheating} = -0.0296 \times HSPF^2 + 0.7134 \times HSPF$~~

~~where~~ $COP_{nfcooling}$ and $COP_{nfheating}$ are the packaged HVAC *equipment* cooling and heating *energy efficiency*, respectively, to be used in the *baseline building design*, which excludes supply fan power.~~, and *Q* is the AHRI rated cooling capacity in Btu. *EER*, *SEER*, *COP*, and *HSPF* shall be at AHRI test conditions. Fan *energy* shall be modeled separately according to Section G3.1.2.9.~~

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G3.1.2.9 System Fan Power

System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered *VAV* boxes) shall be calculated using the following formulas:

For *Systems* 1 and 2,

$$P_{fan} = \text{CFMs} \times 0.3$$

For *Systems* 3 through 8, and 11, 12, and 13,

$$P_{fan} = \text{bhp} \times 746/\text{fan motor } efficiency$$

For *Systems* 9 and 10 (supply fan),

$$P_{fan} = \text{CFMs} \times 0.3$$

For *Systems* 9 and 10 (non-*mechanical cooling* fan if required by Section G3.1.2.8.2),

$$P_{fan} = \text{CFM}_{nmc} \times 0.054$$

where

P_{fan} = electric power to fan motor, W

bhp = brake horsepower of baseline fan motor from Table G3.1.2.9

fan motor *efficiency* = the *efficiency* from Table G3.9.1 for the next motor size greater than the bhp ~~using a totally enclosed fan cooled motor at 1800 rpm~~

CFMs = the baseline *system* maximum design supply fan airflow rate, cfm

CFM_{nmc} = the baseline non-*mechanical cooling* fan airflow, cfm

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Table G3.5.1 *Performance Rating Method* Air Conditioners

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	~~Minimum~~ *Efficiency*	Test Procedure
Air conditioners, air-cooled	<65,000 Btu/h	All	Single-package	~~9.7 *SEER*~~3.0 $COP_{nfcooling}$	AHRI 210/240
	≥65,000 Btu/h and <135,000 Btu/h		Split-*system* and single-package	~~10.1 *EER*~~3.5 $COP_{nfcooling}$	AHRI 340/360
	≥135,000 Btu/h and <240,000 Btu/h			~~9.5 *EER*~~3.4 $COP_{nfcooling}$	
	≥240,000 Btu/h and <760,000 Btu/h			~~9.3 *EER* 9.4 *IEER*~~3.5 $COP_{nfcooling}$	
	≥760,000 Btu/h			~~9.0 *EER* 9.1 *IEER*~~3.6 $COP_{nfcooling}$	

Table G3.5.2 *Performance Rating Method* Electrically Operated Unitary and Applied Heat Pumps—Minimum *Efficiency* Requirements

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum *Efficiency*	Test Procedure
Air-cooled (cooling mode)	<65,000 Btu/h	All	Single package	~~9.7 *SEER*~~3.0 $COP_{nfcooling}$	AHRI 210/240
	≥65,000 Btu/h and <135,000 Btu/h		Split-*system* and single-package	~~9.9 *EER*~~3.4 $COP_{nfcooling}$	AHRI 340/360
	≥135,000 Btu/h and <240,000 Btu/h			~~9.1 *EER*~~3.2 $COP_{nfcooling}$	
	≥240,000 Btu/h			~~8.8 *EER* 8.9 *IEER*~~3.1 $COP_{nfcooling}$	
Air-cooled (heating mode)	<65,000 Btu/h (cooling capacity)		Single-package	~~6.6 *HSPF*~~3.4 $COP_{nfheating}$	AHRI 210/240
	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)		47°F db/43°F wb *outdoor air*	~~3.2 COP_H~~3.4 $COP_{nfheating}$	AHRI 340/360
			17°F db/15°F wb *outdoor air*	~~2.2 COP_H~~2.3 $COP_{nfheating}$	

≥135,000 Btu/h (cooling capacity)	47°F db/43°F wb *outdoor air*	~~3.1 *COP*~~ 3.4 *COP*$_{nfheating}$
	17°F db/15°F wb *outdoor air*	~~2.0 *COP*~~ 2.1 *COP*$_{nfheating}$

Table G3.5.3 *Performance Rating Method* Water Chilling Packages—Minimum *Efficiency* Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum *Efficiency*	Test Procedure
Water-cooled, electrically operated, positive displacement (rotary screw and scroll)	<150 tons	*kW*/ton	0.790 FL 0.676 *IPLV*.IP	ARI 550/590
	≥150 tons and <300 tons		0.718 FL 0.629 *IPLV*.IP	
	≥300 tons		0.639 FL 0.572 *IPLV*.IP	
Water-cooled, electrically operated, centrifugal	<150 tons	*kW*/ton	0.703 FL 0.670 *IPLV*.IP	ARI 550/590
	≥150 tons and <300 tons		0.634 FL 0.596 *IPLV*.IP	
	≥300 tons		0.576 FL 0.549 *IPLV*.IP	

Table G3.5.4 *Performance Rating Method* Electrically Operated *Packaged Terminal Air Conditioners*, *Packaged Terminal Heat Pumps*

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum *Efficiency*[a]	Test Procedure
PTAC (cooling mode)	All capacities	95°F db *outdoor air*	~~12.5 – (0.213 × Cap/1000) *EER*~~ 3.2 *COP*$_{nfcooling}$	AHRI 310/380
PTHP (cooling mode)	All capacities	95°F db *outdoor air*	~~12.3 – (0.213 × Cap/1000) *EER*~~ 3.1 *COP*$_{nfcooling}$	AHRI 310/380
PTHP (heating mode)	All capacities		~~3.2 – (0.026 × Cap/1000) *COP*~~ 3.1 *COP*$_{nfheating}$	AHRI 310/380

~~a. "Cap" means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.~~

Table G3.5.5 Performance Rating Method Warm-Air Furnaces and Unit Heaters

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum *Efficiency*	Test Procedure
Warm-air furnace, gas-fired	<225,000 Btu/h		78% *AFUE* or 80% E_t	DOE 10 CFR Part 430 or ANSI Z21.47
	≥225,000 Btu/h	Maximum capacity	80% E_c	ANSI Z21.47
Warm-air unit heaters, gas-fired	All capacities	Maximum capacity	80% E_c	ANSI Z83.8

Table G3.5.6 Performance Rating Method Gas-Fired *Boilers*—Minimum *Efficiency* Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum *Efficiency*	Test Procedure
Boilers, gas-fired	<300,000 Btu/h	Hot water	80% *AFUE*	DOE 10 CFR Part 430
	≥300,000 Btu/h and ≤2,500,000 Btu/h	Maximum capacity	75% E_t	DOE 10 CFR Part 431
	>2,500,000 Btu/h	Hot water	80% E_c	

Table G3.6 Performance Rating Method *Lighting Power Densities* for *Building* Exteriors

Tradable Surfaces (*Lighting power densities* for uncovered parking areas, *building* grounds, *building entrances* and exits, canopies and overhangs and outdoor sales areas may be traded.)	**Uncovered Parking Areas**	
	Parking lots and drives	0.15 W/ft^2
	***Building* Grounds**	
	Walkways less than 10 ft wide	1.0 W/linear foot
	Walkways 10 ft wide or greater Plaza areas Special feature areas	0.2 W/ft^2
	Stairways	1.0 W/ft^2
	***Building Entrances* and Exits**	
	Main entries	30 W/linear foot of *door* width
	Other *doors*	20 W/linear foot of *door* width
	Canopies and Overhangs	
	Canopies (free standing and attached and overhangs)	1.25 W/ft^2
	Outdoor Sales	
	Open areas (including vehicle sales lots)	0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to open-area allowance	20 W/linear foot

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Table G3.9.1 *Performance Rating Method* Motor *Efficiency* Requirements

~~Motor Horsepower~~Shaft Input Power	~~Minimum Nominal~~ Full-Load Motor *Efficiency* for Modeling, %
1.0	82.5
1.5	84.0
2.0	84.0
3.0	87.5
5.0	87.5
7.5	89.5
10.0	89.5
15.0	91.0
20.0	91.0
25.0	92.4
30.0	92.4
40.0	93.0
50.0	93.0
60.0	93.6
75.0	94.1
100.0	94.5
125.0	94.5
150.0	95.0

200.0	95.0

Table G3.9.2 *Performance Rating Method* Baseline Elevator Motor

Number of Stories (Including Basement)	Motor Type	Counterweight	Mechanical *Efficiency*	Motor Efficiency[a]
≤4	Hydraulic	None	58%	Table G3.9.3
>4	Traction	*Proposed design* counterweight, if not specified use weight of the car plus 40% of the rated load	64%	Table G3.9.1

a. Use the *efficiency* for the next motor size greater than the calculated bhp.

Table G3.9.3 *Performance Rating Method* Hydraulic Elevator Motor *Efficiency*

~~Horsepower~~Shaft Input Power	Full-Load Motor *Efficiency* for Modeling
10	72%
20	75%
30	78%
40	78%
100	80%

This appendix is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal. at ASHRAE or ANSI.

Informative Appendix H

ANSI/ASHRAE/IES Standard 90.1-2019 incorporates all addenda to ANSI/ASHRAE/IES Standard 90.1-2016. Table H-1 lists each addendum and describes the way in which the standard is affected by the change. It also lists the ASHRAE, IES, and ANSI approval dates for each addendum.

Table H-1 Addenda to ANSI/ASHRAE/IES Standard 90.1-2016

Addendum	Sections	Description of Changes[a]	ASHRAE Standard Committee Approval	ASHRAE BOD/Tech Council Approval	IES BOD Approval	ANSI Approval
bg (formerly addendum bg to 90.1-2013)	9.2, 9.3, Table 9.3	Adds a simplified building method for interior lighting in offices, schools, and retail buildings, and exterior lighting. This includes the addition of table 9.3.	1/12/2019	10/3/2019	12/14/2018	2/13/2019
dn (formerly addendum dn to 90.1-2013)	A9.4	Allows the use of the R-value of an airspace in enclosed cavities with or without insulation (Appendix A). Expands the R-value table in Appendix A (based on 2009 *ASHRAE Handbook—Fundamentals*, Chapter 26).	1/12/2019	1/16/2019	12/14/2018	1/17/2019
a	6.4.3.3.3, 6.3.3.4.2, 6.5.1.1.4	Changes term "ventilation air" to "outdoor air" in multiple locations. Revises tables and footnotes. Clarifies requirements for economizer return dampers.	1/20/2018	1/24/2018	1/8/2018	1/25/2018
b	5.5.3.1.1, 12	Updates reference to ANSI/CRRC S100 "Standard Test Methods for Determining Radiative Properties of Materials".	6/24/2017	6/24/2017	6/13/2017	6/29/2017
c	3.2	Adds rooftop monitors to definition of fixed and operable vertical fenestration.	6/24/2017	6/24/2017	6/13/2017	6/29/2017
d	Tables G3.1.1 \	Modifies text to make it consistent with other portions of Appendix G for projects undergoing phased permitting.	6/24/2017	6/24/2017	6/13/2017	6/29/2017
e	Table G3.1.11	Adds direction that SWH piping losses shall not be modeled.	6/24/2017	6/24/2017	6/13/2017	6/29/2017

f	G3.1.2.1	Modifies text to require that the capacity used for selecting the system efficiency represents that for the size of the actual zone instead of the size of the zones as combined into a single thermal block.	6/24/2017	6/24/2017	6/13/2017	6/29/2017
g	3.2, 6.3.2, 6.5.3.8	Provides definition of "occupied-standby mode" and adds new ventilation air requirements for zones served rooms in occupied-standby mode.	1/20/2018	1/24/2018	1/8/2018	1/25/2018
h	6.5.6.1	Clarifies that exhaust air energy recovery systems should be sized to meet both heating and cooling design conditions unless one mode is not exempted by existing exceptions.	1/20/2018	1/24/2018	1/8/2018	1/25/2018
j	6.4.3.8	Changes an exception related to demand control ventilation.	6/24/2017	6/24/2017	6/13/2017	6/29/2017
k	3.2, 6.4.3.3.5	Revises definition of "networked guest room control system" and aligns HVAC and lighting time-out periods for guest rooms.	6/23/2018	6/27/2018	5/30/2018	7/25/2018
l	Table G3.1.2.9	Adds requirements for fan break horsepower for two systems.	1/20/2018	1/24/2018	1/8/2018	1/25/2018
m	Table G3.1.5	Lowers baseline building performance air leakage and sets an air leakage value to be used in conjunction with the air-barrier verification path.	1/12/2019	1/16/19	12/14/2018	2/13/2019
n	3.2	Removes ten unused definitions and changes definition of "unitary cooling equipment" to "unitary air conditioners".	1/20/2018	1/24/2018	1/8/2018	1/25/2018
o	3.2, 4.2.2.3, 5.5, 5.7 through 11.7, G 1.3	Revises the submittals section of the envelope and power chapters for consistency across the standard.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
p	Table 6.1.8 -14	Revises the rating conditions for indoor pool dehumidifiers.	1/20/2018	1/24/2018	1/8/2018	1/25/2018
q	5.4.3, 5.5, 5.8.3, 5.9.1	Clarifies and restructures air leakage requirements for the building envelope.	9/14/2018	10/10/2018	10/23/2018	12/7/2018
r	G3.1.2.6	Specifies air economizer control types for Appendix G.	1/20/2018	1/24/2018	1/8/2018	1/25/2018

s	4.2.1.1, 11.4.3.1, G2.4	Modifies the Performance Cost Index (PCI) equation to implement a 5% limitation on renewable energy usage and clarifies what types of renewable energy systems are eligible.	9/14/2018	10/10/2018	10/23/2018	12/7/2018
t	9.4.2, Table 9.4.2-2	Expands the exterior LPD application table to cover additional exterior spaces that are not currently in the exterior LPD table	6/22/2019	6/26/2019	6/10/2019	7/24/2019
v	6.5.6.3	Adds section 6.5.6.3 containing heat recovery requirements for space conditioning in acute inpatient hospitals.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
x	4.1.1.2, 4.2.1.1, 4.2.1.2, 4.2.1.3	Clarifies compliance paths for new construction, additions, and alterations.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
y	G3.1.2.2	Fixes duct sizing run parameters within the Appendix G.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
z	G3.1.2.1, Table G3.5.1, Table G3.5.2	Modifies the formulas in Section 11 and G3.1.2.1 for removing fan energy from baseline packaged heating and cooling efficiency ratings to cap the system capacity equations in Section 11 to levels allowed in Section 6 and provide a fixed baseline efficiency rating for Appendix G.	9/14/2018	9/28/2018	10/23/2018	10/1/2018
ab	3.2	Modifies definition of "door", "entrance door", "fenestration", and "sectional garage door".	6/23/2018	6/27/2018	5/30/2018	6/28/2018
ac	3.1, 3.2	Clarifies use of defined terms to include the term with different tense or plurality.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
ad	5.2 through 11.2	This addendum clarifies the requirements for showing compliance using the methods in Sections 5-10, or Section 11, or Appendix G.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
ae	3.2, 6.4.3.6, G3.1.3.18	Clarify humidification and dehumidification control requirements.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
ag	Table G3.1.12	Provides accounts for the inclusion of automatic receptacle controls in a proposed building design for spaces that are not required to have them.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
ah	9.1.4	Updates the language and terminology of the lighting wattage section. Also adds a section specifically to address using DC power over Cat6 structured cable for connection of LED lighting to a remote power supply.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
ai	3.2., 4.2.5, 5.2.9, 6.7.2.4, 9.4.3, 5.9 through 10.9, 11.2	Restructures commissioning and functional testing requirements in all sections of Standard 90.1 to require verification for smaller and simpler buildings and commissioning for larger and more complex buildings.	1/12/2019	1/16/2019	12/14/2018	2/13/2019

aj	3.2, 6.5.1, 6.5.2.3, 6.5.4.4	Adds a new definition "process application" and uses it throughout Standard in place of "process load".	1/12/2019	1/16/2019	12/14/2018	2/13/2019
ak	Table G3.1.5, Tables G3.4-1 through G3.4-8	Defines SHGC baseline for buildings in zones where there is no prescriptive maximum SHGC.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
al	Table G3.1.3, Table G3.1.7	Clarifies the modeling rules within section G3.1.	6/22/2019	6/26/2019	6/10/19	7/1/2019
am	6.5.6.4	Adds an indoor pool dehumidifier energy recovery requirement in new section 6.5.6.4.	6/23/2018	6/27/2018	5/30/2018	6/28/2018
an	3.2; 10.4.7; Table 10.8-6; 12; Appendix E	Provides a new table (Table 10.8.6) of information about the new efficiency requirements for commercial and industrial clean water pumps to users of ASHRAE 90.1. It also provides new definitions that are needed to accompany the table. New section 10.4.7 was also added.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
ao	3.2; 6.5.3.1.3; 12	Introduces the revised fan product efficiency requirement FEI and complements the fan power limitation in section 6.5.3.1.1.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
ap	6.5.3.5	Revises supply air temperature reset controls.	9/14/2018	9/28/19	10/23/2018	10/1/2018
aq	9.1.1, 9.2.2.3, 9.4.1.1, 9.4.1.3, 9.4.4, 9.6.2	Clarifies lighting control requirements for applications not covered in Section 9.6.2.	9/14/2018	9/28/19	10/23/2018	10/1/2018
ar	Table G3.1.12, G3.1.2.9, Table G 3.5.5, Table G.3.5.6, Table G3.6, Table G3.9.1	Cleanup of motor requirements in Appendix G related to Addend di in Standard 90.1-2016.	9/14/2018	9/28/19	10/23/2018	10/1/2018
as	Appendix I	Adds an informative appendix specific to commissioning.	NA	NA	NA	NA
at	11.5.1; G1.2.2	Revises language for energy accounting at buildings that provide fuel or electricity to vehicles.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
au	6.5.2.1	Eliminates the requirement that zones with DDC have air flow rates that are no more than 20% of the zone design peak flow rate.	1/12/2019	1/16/2019	12/14/2018	1/17/2019
aw	3.2; Tables 5.5-0 through 5.5-8, 5.8.2.5, 12	Revises the fenestration prescriptive criteria in Tables 5.5-0 through 5.5-8.	6/22/2019	6/26/2019	6/10/2019	7/24/2019

ay	3.2, 6.5.6	Provides separate requirements for nontransient dwelling unit exhaust air energy recovery.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
az	Table G3.1.17	Revises the modeling methodology language to clarify the baseline and proposed designs for refrigeration equipment.	1/12/2019	1/16/2019	12/14/2018	1/17/2019
ba	Table G3.1.1 Table G3.1.11	Establishes a methodology for determining the baseline flow rates on projects where service water-heating is demonstrated to be reduced by water conservation measures that reduce the physical volume of service water required.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bb	Table 9.6.1	Revises the lighting power densities for the Space-by-Space method	6/22/2019	6/26/2019	6/10/2019	7/24/2019
bd	Table 6.8.1-16	Adds the minimum efficiency requirements of Heat Pump and Heat Reclaim Chiller Packages. ~~and~~	6/22/2019	6/26/2019	6/10/2019	7/1/2019
be	6.4.1.1; Table 6.8.1-10 & 6.8.1-17	Revises the efficiency requirements for Computer Room air conditioners.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bf	5.4.3.4; 10.4.5	Establishes an alternative to the requirement for vestibules by use of an air curtain that meets specific requirements prescribed in the proposed language. Adds new section 10.4.5.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
bh	Table 5.8.3.2	Corrects an omission related to nonswinging doors in Table 5.8.3.2	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bi	11.4.2; 12; Appendix C; Appendix G	Updates the reference year for Standard 140 in Sections 11 and 12 as well as Appendix C and G.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bj	6.5.5.1	Adds tables to the list of products that are exempt from meeting the requirements of section 6.5.6 - Heat Rejection Equipment.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bk	3.2, 11.4.3.2, G2.4.2	Clarifies that such projects must model the same electricity generation system in the baseline and proposed design and is aligned with the interpretation IC 90.1- 2013-16 OF ANSI/ASHRAE/IES STANDARD 90.1-2013 form January 21, 2018.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bl	Table 6.8.1-1	Revises Table 6.8.1-1 Electrically Operated Unitary Air Conditioners and Condensing Units—Minimum Efficiency Requirements.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bm	Table 6.8.1-2, 6.8.1-15	Revises Table 6.8.1-2 Electrically Operated Air Cooled Unitary Heat Pumps—Minimum Efficiency Requirements. Adds Table 6.8.1-15.	7/22/2019	8/15/2019	7/19/2019	8/19/2019

bn	3.2, Table 6.8.1-4, Table F3	Revises Table 6.8.1-4 Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps, Single-Package Vertical Air Conditioners, Single-Package Vertical Heat Pumps, Room Air Conditioners, and Room Air Conditioner Heat Pumps—Minimum Efficiency Requirements. Adds Table F-3.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bo	3; Table 6.8.1-5; Table F-4	Revises Table 6.8.1-5 Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters—Minimum Efficiency Requirements and adds Table F-4 Residential Warm Air Furnaces – Minimum Efficiency Requirements for sale in the US (see 10 CFR Part 430).	6/26/2019	8/1/2019	7/19/2019	8/26/2019
bp	Table 6.8.1-6; Table F-5	Revises Table 6.8.1.6 – Gas and Oil-Fired Boilers – Minimum Efficiency Requirements and adds table F-5 - Residential Boiler Minimum Efficiency Requirements for applications in the US (Refer to 10 CFR 430).	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bq	Table 6.8.1-7; 12	Revises Table 6.8.1-7 Performance Requirements for Heat Rejection Equipment—Minimum Efficiency Requirements.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
br	Table 6.8.1-11	Revises the previous Tables 6.8.1-12 & 13 and combines them into one table - Table 6.8.1-131 Commercial Refrigerators, Commercial Freezers and Refrigeration—Minimum Efficiency Requirements.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bs	Table 7.8; F2; Table F-2	Revises Table 7.8 Performance Requirements for Water-Heating Equipment—Minimum Efficiency Requirements and Table F-2 Minimum Energy Efficiency Requirements for Water Heaters.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bt	Table 4.2.1.1	Revises Table 4.2.1.1 Building Performance Factor (BPF).	6/22/2019	6/26/2019	6/10/2019	7/1/2019
bu	Table G3.1.1-1, G3.1.1, G3.1.3, Table G3.4-1 through Table G3.4-8	Clarifies requirements in the Appendix G as they related to HVAC zones and baseline heating.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bv	6.2.1, 6.6.2, 8.2.1, 8.6.1	Clarifies that designers have the option to use ASHRAE Standard 90.4 requirements instead of ASHRAE 90.1 requirements in computer rooms that have an IT equipment load larger than 10 kW. Adds section 8.6.1.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
bx	3.2, A6.1, A6.3	Adds heated slab F-factors for multiple combinations of under-slab and perimeter insulation in Appendix A. Adds Table A6.3.1-1&2.	6/22/2019	6/26/2019	6/10/2019	6/27/2019
bz	3.2; Appendix C1.4, C2, C3.1.2, C3.3,	Clarifies requirements of Appendix C as they pertain to informative outputs, the schedule of shades, energy costs, and updated references to Section 6.	6/22/2019	6/26/2019	6/10/2019	7/1/2019

	C3.5.5.1, C3.5.8					
ca	Table A3.2.3	Adds U-factors to Table A3.2.3 for use of continuous insulation on metal building walls with double layer cavity insulation.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
cc	A9.4.6	Clarifies the limitations of the calculation procedures in A9.4.6.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
ce	6.5.3.1.2	Makes revisions to provide energy savings potential by removing one of three criteria for fan motor selections, increasing the design options for load-matching variable-speed fan applications, accommodating new motor and drive technologies, and simplifying the motor selection criteria for fans.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
cf	6.4.5	Adds vacuum insulating glazing to the list of options for reach-in doors in walk-in coolers and freezers.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
cg	Table 9.5.1	Revises Table 9.5.1 Lighting Power Density Allowances Using the Building Area Method.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
ch	3.2; 9.4.1.1 (e)	Clarifies daylighted area requirements as they relate to skylights and clarifies primary sidelighting requirements.	6/22/2019	6/26/2019	6/10/2019	6/27/2019
ci	Table 4.2.1.1	Further revises Table 4.2.1.1 Building Performance Factor (BPF).	6/22/2019	6/26/2019	6/10/2019	7/1/2019
cj	Table 11.5.1.6; Table G3.1.6; Table G3.7	Revises the energy cost budget method in reference to lighting.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
cl	3.2; 11; Appendix G	Clarifies requirements throughout Section 11 to better align with Appendix G providing greater consistency between the two sections.	6/26/2019	8/1/2019	7/19/2019	8/26/2019
cm	6.5.2.1	Revises exceptions related to DDC enabled zones.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
cn	6.4, 6.4.1.1, 6.4.5m; Tables 6.8.1-18,19, & 20.	Cleans up outdated language regarding walk-in cooler and walk-in freezer requirements, and make the requirements consistent with current federal regulations that either already came into effect June 5, 2017 or will come into effect July 10, 2020. Adds new section 6.4.5m and Tables 6.8.1-18, 19, & 20.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
co	12	Revises the normative references in Standard 90.1.	6/22/2019	6/26/2019	6/10/2019	7/1/2019
cq	3.2; 6.4.1.2, 6.5.3.1.3	Makes clarifications ensure that the maximum fan power input is properly reported for installations both inside and outside the United States. Adds sections 6.4.1.3 and 6.5.3.1.3.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
cs	Appendix E	Revises the informative references of the Informative Appendix E.	NA	NA	NA	NA
ct	12	Updates the CTI normative reference in Standard 90.1.	7/22/2019	8/15/2019	7/19/2019	8/19/2019

cu	6.4.1.1, 6.4.1.5, Table 6.8.1-8	Revises requirements for liquid-to-liquid heat exchangers.	7/22/2019	8/15/2019	7/19/2019	8/19/2019
cv	9.4.1.2	Updates lighting control requirements for parking garages in section 9.4.1.2.	6/26/2019	8/1/2019	7/19/2019	8/26/2019
cw	9.4.1.1(e), 9.4.1.1(f)	Revises the daylight responsiveness requirements to continuous dimming.	6/26/2019	8/1/2019	7/19/2019	8/26/2019
cy	9.4.1(e)	Revises the sidelighting requirement exceptions.	7/22/2019	8/15/2019	7/19/2019	8/19/2019

NOTE

Approved errata or interpretations for this standard can be downloaded free of charge from the ASHRAE Web site at www.ashrae.org/technology.

a. *These descriptions may not be complete and are provided for information only.

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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.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

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.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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