ERRATA SHEET FOR
ANSI/ASHRAE/IES STANDARD 90.1-2019 (I-P Edition)
Energy Standard for Buildings Except Low-Rise Residential Buildings

April 9, 2025

The corrections listed in this errata sheet apply to ANSI/ASHRAE/IES Standard 90.1-2019, I-P Edition. The first printing is identified on the outside back cover of the standard as "Product code: 86270 10/19", the second printing as "Product code: 86270 2/20 Includes errata dated March 18, 2020. Shaded items have been added since the previously published errata sheet dated February 15, 2024 was distributed.

NOTICE: ASHRAE now has a list server for Standing Standards Project Committee 90.1 (SSPC 90.1). Interested parties can now subscribe and unsubscribe to the list server and be automatically notified via e-mail when activities and information related to the Standard and the User's Manual is available. To sign up for the list server please visit **Project Committee List Servers for Standard** on the Technology / Standards section of the ASHRAE website at https://www.ashrae.org/technical-resources/standards-and-guidelines/project-committee-list-servers.

Page(s)	Erratum
9	**3.2 Definitions.** Add the following definitions in Section 3.2. *(Note: Additions are shown in underline.)* **3.2 Definitions** ***energy recovery, series*:** a three-step process in which the first step is to remove energy from a single airstream without the use of mechanical cooling. In the second step the air stream is mechanically cooled for the purpose of dehumidification. In the third step the energy removed in step one is reintroduced to the air stream. ***energy recovery ratio, series (SERR):*** the difference between the dry bulb air temperatures leaving the series energy recovery unit and leaving the dehumidifying coil divided by the difference between 75˚F and the dry bulb temperature of the air leaving the dehumidifying cooling coil.
11	**3.2 Definitions.** In Section 3 add the following definition which was inadvertently removed when the 2019 edition was published. *(Note: Additions are shown in underline.)* ***computer room energy***: annual energy use of the data center, including all IT equipment energy, plus energy that supports the IT equipment and computer room space, calculated in accordance with industry-accepted standards defined as Total Annual Energy (see Informative Appendix E).
18	**Figure 3.2-5 Computing the *secondary sidelighting area.*** Replace Figure 3.2-5 with the attached.

75 **5.8.1.2 Manufacturer's Installation Instructions.** In Exception 1 to Section 5.8.1.2 change the reference to Table A9.4.2 to Table A9.4.3 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Exceptions to 5.8.1.2
1. The R-value of compressed cavity insulation is determined in accordance with Table A9.4.3 ~~A9.4.2~~.

75 **5.8.1.2 Manufacturer's Installation Instructions.** In Exception 2 to Section 5.8.1.2 change the reference to Table A9.4.5 to Table A9.4.6 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Exceptions to 5.8.1.2
1. The R-value of compressed cavity insulation is determined in accordance with Table A9.4.3.
2. Where metal building roof or wall insulation is compressed between the steel structure and the metal roof or wall panels, the overall assembly *U-factor* is determined in accordance with Section A2.3, Section A3.2, or Section ~~A9.4.5~~A9.4.6.

86 **6.4.1.3 Ceiling Fans.** Add the following informative note immediately following Section 6.4.1.3.
(Note: Additions are shown in underline.)

6.4.1.3 Ceiling Fans
Large-diameter ceiling fans shall be rated in accordance with 10 CFR 430 Appendix U or AMCA 230. The following data shall be provided:

a. Blade span (blade tip diameter)

b. Rated airflow and power consumption at the maximum speed

Informative Note: See Informative Appendix F for the U.S. Department of Energy requirements for US applications.

91 **6.4.3.4.3 Damper Leakage.** Revise Section 6.4.3.4.3 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

6.4.3.4.3 Damper Leakage
Where *outdoor air* supply and exhaust/relief dampers are required by Section 6.4.3.4~~6.4.3.4.1~~, they shall have a maximum leakage rate as indicated in Table 6.4.3.4.3.

113 **6.5.4.8 Buildings with High-Capacity Space-Heating Gas Boiler Systems.** Delete Section 6.5.4.8 in its entirety as shown below. Note that this material was inadvertently included in the published standard, the material is included in an addendum that is expected to be published to the 2019 edition at a later date.
(Note: Deletions are shown in ~~strikethrough~~.)

~~**6.5.4.8 Buildings with High-Capacity Space-Heating Gas Boiler Systems**~~
~~New buildings with gas hot-water *boiler systems* for space heating with a total *system* input of at least 1,000,000 Btu/h but not more than 10,000,000 Btu/h shall comply with Sections 6.5.4.8.1 and 6.5.4.8.2.~~

~~**Exceptions to 6.5.4.8**~~

~~1. Where 25% of the annual space heating requirement is provided by on-site renewable energy, *site-recovered energy*, or heat recovery chillers.~~
~~2. *Space heating boilers* installed in individual dwelling units.~~
~~3. Where 50% or more of the design heating load is served using perimeter convective heating, radiant ceiling panels, or both.~~
~~4. Individual gas boilers with input capacity less than 300,000 Btu/h shall not be included in the calculations of the total system input or total system efficiency.~~

~~**6.5.4.8.1 Boiler Efficiency**~~
~~Gas hot-water *boilers* shall have a minimum thermal *efficiency* (*Et*) of 90% when rated in accordance with the test procedures in Table 6.8.1-6. Systems with multiple boilers are allowed to meet this requirement if the space-heating input provided by equipment with thermal *efficiency* (*Et*) above and below 90% provides an input capacity-weighted average thermal *efficiency* of at least 90%. For boilers rated only for combustion *efficiency*, the calculation for the input capacity-weighted average thermal *efficiency* shall use the combustion *efficiency* value.~~

~~**6.5.4.8.2 Hot-Water Distribution System Design**~~
~~The hot-water distribution system shall be designed to meet all of the following:~~
~~a. Coils and other heat exchangers shall be selected so that at design conditions the hotwater return temperature entering the *boilers* is 120°F or less.~~
~~b. Under all operating conditions, the water temperature entering the boiler is 120°F or less, or the flow rate of supply hot water that recirculates directly into the return system, such as by three-way valves or minimum flow bypass controls, shall be no greater than 20% of the design flow of the operating boilers.~~

116 **6.5.6.1.2 Spaces Other than Nontransient Dwelling Units.** Revise Exception 7 of Section 6.5.6.1.2 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Exceptions to 6.5.6.1.2

7. ~~Heating energy recovery for s~~*Systems* in Climate Zones 0 through 4 requiring dehumidification ~~during heating mode~~ that employ *series energy recovery* ~~recovery~~ and have a minimum SERR of 0.40.

128 **Table 6.8.1-2 Electrically Operated Air-Cooled Unitary Heat Pumps—Minimum *Efficiency* Requirements *(Continued).*** Revise Table 6.8.1-2 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

130 **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.** Revise Table 6.8.1-4 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Equipment Type
PTAC (cooling mode) standard size
PTAC (cooling mode) nonstandard size-~~a~~b

132 **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.** Revise Table 6.8.1-5 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

134 **Table 6.8.1-7 Performance Requirements for Heat Rejection *Equipment*—Minimum *Efficiency* Requirements.** In Table 6.8.1-7 for Equipment Type "Propeller or axial fan dry coolers (air-cooled fluid coolers)" change "95°F entering wb" to "95°F entering db".

135 **Table 6.8.1-8 Electrically Operated Variable-Refrigerant-Flow Air Conditioners – Minimum *Efficiency* Requirements.** Revise the Minimum *Efficiency* column as shown in the attached Table 6.8.1-8.
(Note: Deletions are shown in ~~strikethrough~~.)

136 **Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum *Efficiency* Requirements.** Revise the Minimum *Efficiency* column as shown in the attached Table 6.8.1-9.
(Note: Deletions are shown in ~~strikethrough~~.)

141 **Table 6.8.1-11 Commercial Refrigerators, Commercial Freezers, and Refrigeration—Minimum *Efficiency* Requirements.** Revise Table 6.8.1-11 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

144 **Table 6.8.1-15 Electrically Operated Water Source Heat Pumps—Minimum *Efficiency* Requirements.** Revise Table 6.8.1-15 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

145 **Table 6.8.1-16 Heat-Pump and Heat Recovery Chiller Packages—Minimum *Efficiency* Requirements.** Revise Table 6.8.1-16 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

147/148 **Table 6.8.9-17 Ceiling-Mounted Computer-Room Air Conditioners—Minimum *Efficiency* Requirements.** Change Table 6.8.9-17 to Table 6.8.1-17.

149 **Table 6.8.1-19 Walk-In Cooler and Freezer Nondisplay Door *Efficiency* Requirements.** Revise Table 6.8.1-19 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

152 **7.4.3 Service Hot-Water Piping Insulation.** In the first sentence of Section 7.4.3 change "Table 6.8.1-3" to "Table 6.8.3-1" as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

7.4.3 Service Hot-Water Piping Insulation
The following *piping* shall be insulated to levels shown in Section 6, ~~Table 6.8.1-3~~ Table 6.8.3-1:

[…]

155 **Table 7.8 Performance Requirements for Water-Heating *Equipment*—Minimum *Efficiency* Requirements.** In Table 7.8 for Electric storage *water heaters* delete footnote "e" as shown below.
(Note: Deletions are shown in ~~strikethrough~~.)

Electric storage *water heaters*	≤12 *kW*	
	>12 *kW*~~e~~	

155/156 **Table 7.8 Performance Requirements for Water-Heating *Equipment*—Minimum *Efficiency* Requirements.** Revise Table 7.8 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Equipment Type	Size Category (Input)	
Electric instantaneous *water heaters*	≤12 kW	
	>12 kW and ≤58.6 kW [c]	
	>≤ 58.6 kW	

[…]

Equipment Type	Size Category (Input)
Oil storage *water heaters*	≤105,000 Btu/h
	>≧105,000 Btu/h and ≤140,000 Btu/h [c]
	>140,000 Btu/h

165 **9.3.2 Simplified Building Method of Calculating *Exterior Lighting Power Allowance.*** In Section 9.3.2 change "Tables 9.3.1-1, 9.3.1.-2, and 9.3.1.-3" to "Table 9.3.2" as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

9.3.2 Simplified Building Method of Calculating *Exterior Lighting Power Allowance*
For all *building* types listed in Section 9.3, exterior areas (new and *alterations*) shall comply with the *lighting power allowance* and *control* requirements of Table 9.3.2 ~~Tables 9.3.1-1, 9.3.1-2, and 9.3.1-3~~.

197 **11.2 Compliance.** In Section 11.2(e) change the reference to "Section 11.7(b)" to "Section 11.7.2(d)".

200 **11.5.2 HVAC Systems.** Revise Section 11.5.2 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

11.5.2 HVAC Systems

…

d. Minimum Outdoor Air Ventilation Rate

…

Exceptions to 12.5.2(d):

…

2. Where the minimum outdoor air intake flow in the proposed design is provided in excess of the amount required by Section 6.5.3.8, the ~~*baseline building design*~~ *budget building design* shall be modeled to reflect the minimum amount required by Section 6.5.3.8.

…

i. *Equipment* Capacities.

…

Unmet load hours for the *proposed design* or ~~*baseline building designs*~~*budget building design* shall

not exceed 300 hours (of the 8760 hours simulated). 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.

…

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*~~ *budget 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*.

203 **11.7.2 Permit Application Documentation.** Revise Section 11.7.2 to correctly show the defined terms in italics.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

11.7.2 Permit Application Documentation

Compliance shall be documented and submitted to the *building official*. The information submitted shall include the following:

a. The *energy cost budget* for the *budget building design* and the *design energy cost* for the *proposed design*.

b. The ~~simulation program~~*simulation program* used and the version of the ~~simulation program~~*simulation program*.

c. An overview of the project that includes the number of stories (above and below grade), the typical ~~floor~~*floor* size, the uses in the ~~building~~*building* (e.g., office, cafeteria, retail, parking, etc.), the gross area of each use, and whether each use is ~~conditioned~~*conditioned*.

d. A list of the *energy*-related features that are included in the design and on which compliance with the provisions of Section 11 is based. This list shall document all *energy* features that differ between the models used in the *energy cost budget* and the *design energy cost* calculations.

e. A list showing compliance for the ~~proposed design~~*proposed design* with all the requirements of Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 (mandatory provisions).

f. ~~Building~~*Building* elevations and ~~floor~~*floor* plans.

g. A diagram showing the ~~thermal blocks~~*thermal blocks* used in the computer simulation.

h. An explanation of any significant modeling assumptions.

i. Backup calculations and material to support data inputs (e.g., ~~U-factors~~ *U-factors* for ~~building envelope~~*building envelope* assemblies, NFRC ratings for ~~fenestration~~*fenestration*, end uses identified in Table 11.5.1, "1. Design Model," paragraph [a]).

j. The input and output reports from the *simulation program*, including a breakdown of e*nergy* usage by at least the following components: lights, internal *equipment* loads, *service water-heating equipment*, *space*-heating *equipment*, *space* cooling and heat- rejection *equipment*, fans, and other HVAC *equipment* (such as pumps). The output reports shall also show the amount of time any loads are not met by the *HVACsystem* for both the *proposed design* and

budget building design.

k. ~~Purchased energy rates~~*Purchased energy rates* used in the simulations.

l. An explanation of any error messages noted in the *simulation program* output.

m. For any exceptional calculation methods employed, document the predicted ~~energy~~*energy* savings by ~~energy~~*energy* type, the ~~energy~~*energy* cost savings, a narrative explaining the exceptional calculation method performed, and theoretical or empirical information supporting the accuracy of the method.

204 **Table 11.5.1 Modeling Requirements for Calculating Design Energy Cost and Energy Cost Budget.** Revise Table 11.5.1 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

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

Proposed Design (Column A) Design Energy Cost (DEC)

1. Design Model

…

b. All *conditioned spaces* in the *proposed design* shall be simulated as being both heated and cooled, even if no cooling or heating system is being installed. Temperature and humidity control *set points* and schedules, as well as *temperature control throttling range*, shall be the same for proposed design and ~~*baseline building design*~~ *budget building design*.

…

4. Schedules

…

Temperature and Humidity Schedules. Temperature and humidity control set points and schedules, as well as temperature control throttling range, shall be the same for proposed design and ~~*baseline building design*~~ *budget building design*.

…

6. Lighting

…d. *Lighting system* power shall include all *lighting system* components shown or provided for on plans (including *lamps*, *ballasts*, task *fixtures*, and furniture-mounted *fixtures*). For *dwelling units*, hotel/motel guest rooms, and other *spaces* in which *lighting systems* consist of plug-in light *fixtures* that are not shown or provided for on *design documents*, assume identical lighting power for the *proposed design* and ~~*baseline building design*~~ *budget building design* in the simulations.

…

11. Service Water Heating

…

Exceptions:

…

3. For 24-hour facilities that meet the prescriptive criteria for use of condenser heat recovery systems described in Section 6.5.6.2, a system meeting the requirements of that section shall be included in the ~~*baseline building design*~~ *budget building design*, regardless of the exceptions to Section 6.5.6.2.2. If a condenser heat recovery system meeting the requirements described in Section 6.5.6.2 cannot be modeled, the requirement for including such a system in the actual building shall be met as a prescriptive requirement in accordance with Section 6.5.6.2 and no heat recovery system shall be included in the proposed design or budget building design.

Service water-heating energy consumption shall be calculated explicitly based on the volume of service water heating required, the entering makeup water, and the leaving service water heating temperatures. Entering water temperatures shall be estimated based on the location. Leaving temperatures shall be based on the end-use requirements.

Service water loads and use shall be the same for both the proposed design and ~~*baseline building design*~~ *budget building design* and typical of the proposed building type. Piping losses shall not be modeled.

206 **Table 11.5.1 Modeling Requirements for Calculating Design Energy Cost and Energy Cost Budget.** Revise item 6.g.1 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

6. Lighting

…

g. *Automatic* lighting *controls* included in the *proposed design* but not required by Section 9.4.1 shall be modeled using the following methods for each luminaire under control:

1. *Manual*-ON or partial-auto-ON occupancy sensors shall be modeled by reducing the lighting schedule each hour by the occupancy sensor reduction factors in Table G3.7 for the applicable *space* type multiplied by 1.25~~0.25~~.

209 **Table 11.5.1 Modeling Requirements for Calculating *Design Energy Cost* and *Energy Cost Budget (Continued).*** Revise Section 13 of Table 11.5.1 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

214 **12 Normative References.** Addendum bv to Standard 90.1-2016 added a reference to ASHRAE Standard 90.4-2016 (with Addenda a and b) but that reference was inadvertently left out of Section 12. Add the following reference to Section 12 as shown below.
(Note: Additions are shown in underline.)

12 Normative References

ASHRAE
1791 Tullie Circle, NE, Atlanta, GA 30329

ANSI/ASHRAE Standard 90.4-2016 (with Addenda a and b) Energy Standard for Data Centers

220 **A2.3.3 U-Factors for Metal Building Roofs.** Revise Section A2.3.3 to change Table A2.2.3 to Table A2.3.3 in two places as shown below.

(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

A2.3.3 U-Factors for Metal Building Roofs

U-factors for *metal building roofs* shall be taken from Table A2.3.3 ~~A2.2.3~~ or determined in accordance with Section A9.2, provided the average purlin spacing for *systems* with compressed insulation is at least 52 in. *U-factors* for *metal building roof* assemblies with average purlin spacing less than 52 in. shall be determined in accordance with Section A9.2. *U-factors* in Table A2.3.3 ~~A2.2.3~~ shall not be used where the insulation is substantially compressed by the bracing between the purlins.

265 **Equation A9.4-22.** In Equation A9.4-22 replace "C = 0.00056897" with "C = 0.0056897".

271 **Table 9.4.2-1 Values for Cavity Air Spaces[a].** Change the title of Table 9.4.2-1 to "**R-Values for Cavity Air Spaces[a]**".

287 **Informative Appendix E Informative References.** Update the references as shown below. See also the revised table from Informative Appendix E attached with changes shown in red text.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

~~**LBNL Characterization and Survey of**~~
~~**Automated Fault Detection and Diagnostics Tools**~~
~~Lawrence Berkeley National Laboratory Building Technology and~~
~~Urban Systems Division Energy Technologies Area~~
~~MS 90R3111~~
~~1 Cyclotron Road~~
~~Berkeley, CA 94720 USA~~

~~**Office of Energy Efficiency and Renewable Energy (EERE)**~~
~~US Department of Energy~~
~~Better buildings~~
~~Forrestal Building~~
~~1000 Independence Avenue, SW~~
~~Washington, DC 20585~~
~~betterbuildingssolutioncenter.enmmergy.gov/alliance~~

MICA
Midwest Insulation Contractors Association
16712 Elm Circle
Omaha, NE 68130
www.micainsulation.org

IWEC2 Data
ASHRAE
1791 Tullie Circle, NE
Atlanta, GA 30329-2305
(T) 404-636-8400
(F) 404-321-5478
http://www.techstreet.com/ashrae
(Direct link: http://www.techstreet.com/ashrae/products/1876209)

NEBB

National Environmental Balancing Bureau
8575 Grovemont Circle
Gaithersburg, MD 20877
www.nebb.org

SMACNA
Sheet Metal & Air Conditioning Contractors'
National Association
4201 Lafayette Center Drive
Chantilly, VA 20151
info@smacna.org
www.smacna.org

TMY3 Data
National Renewable Energy Laboratory
NREL/RReDC
Attn: Pamela Gray-Hann
1617 Cole Blvd., MS-1612
Golden, Colorado, USA 80401
http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3

291 **Informative Appendix F U.S. Department of Energy Minimum Energy Efficiency Requirements.** Revise Informative Appendix F as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Informative Appendix F
U.S. Department of Energy Minimum Energy Efficiency Requirements, Test Procedures, and Definitions

In the United States, the U.S. Department of Energy establishes *efficiency* standards for products that it defines as "residential covered products." Since these products are used in buildings covered by this standard, ~~the~~ DOE *efficiency* requirements are shown here for convenience. All DOE *efficiency* requirements for residential products are found in the U.S. *Code of Federal Regulations*, 10 CFR ~~Part 430 Subpart C, Section~~ 430.32.

DOE also establishes definitions and test procedures for covered products. These are found in 10 CFR 430.2 and 10 CFR 430.23, respectively.

[…]

F3 DOE Test Procedure and Definitions for Ceiling Fans
DOE definitions for ceiling fans are found in 10 CFR 430.2 and 10 CFR part 430, subpart B, appendix U. On or after January 23, 2017, manufacturers of ceiling fans must make any representations with respect to energy use or efficiency in accordance with the test procedure in 10 CFR part 430, subpart B, appendix U. DOE also specifies, in 10 CFR 430.32, design requirements for ceiling fans, and for ceiling fans manufactured on or after January 21, 2020, minimum efficiency requirements.

293 **Table F-1 Minimum *Efficiency* Requirements for Single-Phase Central Air Conditioners and Heat Pumps for Sale in the U.S.** Revise Table F-1 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Product Class	Capacity Range	National Standards	Southeastern Region Standards	Southwestern Region Standards	Test Procedure[f]
Central Air Conditioners and Heat Pumps[c]					
Small-duct high-velocity *systems*	<65,000 Btu/h *single phase*	before 1/1/2023 *SEER* = 12.0 *HSPF* = 7.2 $P_{W,OFF} \leq$ 30 W after 1/1/2023 *SEER2* = 12.0 *HSPF2* = 6.1 $P_{W,OFF} \leq$ 30 W	before 1/1/2023 *SEER* = 12.0 *HSPF* = 7.2 $P_{W,OFF} \leq$ 30 W after 1/1/2023 *SEER2* = ~~11.7~~ 12.0 *HSPF2* = 6.1 $P_{W,OFF} \leq$ 30 W	before 1/1/2023 *SEER* = 12.0 *HSPF* = 7.2 $P_{W,OFF} \leq$ 30 W after 1/1/2023 *SEER2* = 12.0 *HSPF2* = 6.1 $P_{W,OFF} \leq$ 30 W	AHRI 210/240-2017 before 1/1/2023 AHRI 210/240-2023 after 1/1/2023

294 **Table F-2 Minimum Energy Efficiency Requirements for Water Heaters and Pool Heaters.** Revise Table F-2 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Product Class	Rated Storage Volume And Input Rating (if applicable)	Draw Pattern	Uniform Energy Factor (UEF) or Thermal Efficiency (E_t)	Test Procedure
Electric storage water heaters	≥20 gal and ≤55 gal	Very small	UEF = 0.8808 – (0.0008 × V_r)	10 CFR 430 Appendix E
		Low	UEF = 0.9254 – (0.0003 × V_r)	
		Medium	UEF = 0.9307 – (0.0002 × V_r)	
		High	UEF = 0.9349 – (0.0001 × V_r)	
	>55 gal and ≤~~100~~120 gal	Very small	UEF = 1.9236 – (0.0011 × V_r)	10 CFR 430 Appendix E
		Low	UEF = 2.0440 – (0.0011 × V_r)	
		Medium	UEF = 2.1171 – (0.0011 × V_r)	
		High	UEF = 2.2418 – (0.0011 × V_r)	

296 **Table F-5 Residential Boiler [a] Minimum Efficiency Requirements for U.S. Applications (see 10 CFR 430).** Revise the footnotes in Table F-5 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

a. Has a heat input rate of less than 300,000 Btu per hour for electric boilers and low-pressure steam or hot-water boilers (per § 430.2).

b. Annual Fuel Utilization Efficiency, as determined in § 430.23(n)(2).

c. Standby mode and off-mode electric power consumption as determined in § 430.23(n)(5).

d. See § ~~430.23(e)(2)(iv)~~ 430.32(e)(2)(iv) for additional details regarding automatic means for adjusting water temperature.

305 **Table G3.1 Modeling Requirements for Calculating Proposed and *Baseline Building Performance.*** Revise Table G3.1, No. 6 Lighting, item g, as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

311 **G3.1.1.4 Modeling Building Envelope Infiltration.** Revise Section G3.1.1.4 as follows.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

S = total area of the *building envelope* (ft²), including the lowest floor ~~*floor*~~, any *below-grade walls* or *above-grade walls*, and *roof* (including *vertical fenestration* and *skylights*)

312 **G3.1.2.1 Equipment Efficiencies.** In Section G3.1.2.1 add the last sentence as shown below. The text was added by Addendum z to 90.1-2016 but was inadvertently omitted from 90.1-2019.
(Note: Additions are shown in underline.)

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). Fan *energy* shall be modeled separately according to Section G3.1.2.9.

330 **Table G3.5.2 *Performance Rating Method* Electrically Operated Unitary and Applied Heat Pumps— Minimum *Efficiency* Requirements (efficiency ratings excluding supply fan power).** Revise Table G3.5.2 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

331 **Table G3.5.4 *Performance Rating Method* Electrically Operated *Packaged Terminal Air Conditioners*, *Packaged Terminal Heat Pumps* (efficiency ratings excluding supply fan power).** Revise Table G3.5.4 as shown in the attached, including deleting the superscript "a" in Minimum *Efficiency*.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

349 **Informative Appendix I Addenda Description Information.** Revise Table I-1 as shown in the attached.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

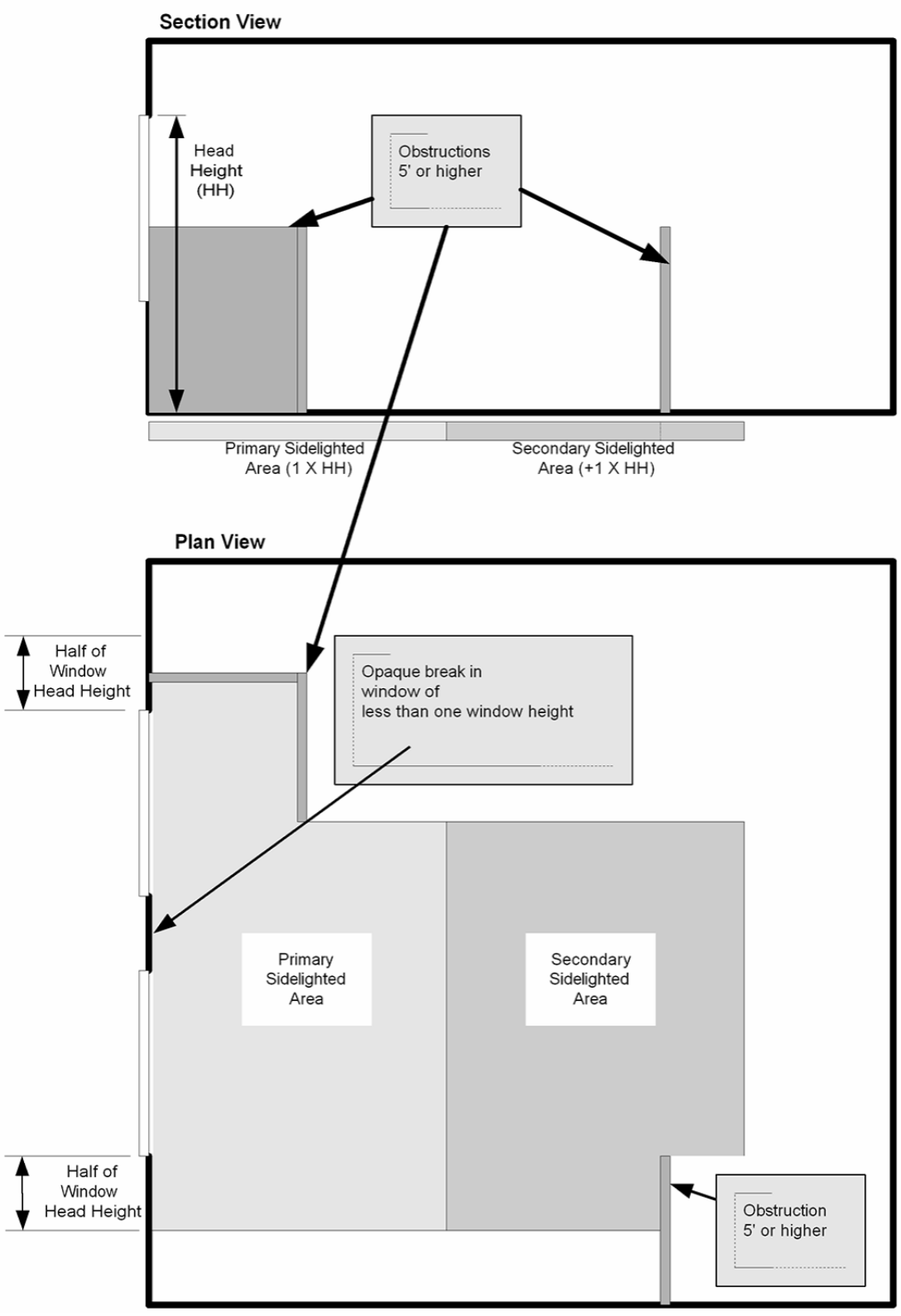

Figure 3.2-5 Computing the *secondary sidelighted area*.

Table 6.8.1-2 Electrically Operated Air-Cooled Unitary Heat Pumps—Minimum *Efficiency* Requirements *(Continued)*

***Equipment* Type**	**Size Category**	**Heating Section Type**	**Subcategory or Rating Condition**	**Minimum *Efficiency***	**Test Procedure[a]**
Air cooled (heating mode)	≥65 000 Btu/h and <135 000 Btu/h (cooling capacity)		47°F db/43°F wb *outdoor air*	3.30 COP_H before 1/1/2023 3.40 COP_H after ~~before~~ 1/1/2023	AHRI 340/360
			17°F db/15°F wb *outdoor air*	2.25 COP_H	
	≥135 000 Btu/h (cooling capacity) and <240 000 Btu/h		47°F db/43°F wb *outdoor air*	3.20 COP_H before 1/1/2023 3.30 COP_H after ~~before~~ 1/1/2023	
			17°F db/15°F wb *outdoor air*	2.05 COP_H	
	≥240 000 Btu/h (cooling capacity)		47°F db/43°F wb *outdoor air*	3.20 COP_H	
			17°F db/15°F wb *outdoor air*	2.05 COP_H	

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

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum *Efficiency*	Test Procedure[a]
Warm-air furnace, gas fired for application outside the U.S.[g]	<225 000 Btu/h	Maximum capacity[c]	80% AFUE (nonweatherized) or 81% AFUE (weatherized) or 80% E_t[b,d]	Appendix N of 10 CFR 430 or Section 2.39, Thermal Efficiency, CSA Z21.47
	≥225 000 Btu/h		80% E_t[b,d] before 1/1/2023 81% E_t[d] after 1/1/2023	Section 2.39, Thermal Efficiency, CSA Z21.47
Warm-air furnace, oil fired for application outside the U.S.[g]	<225 000 Btu/h	Maximum capacity[c]	83% AFUE (nonweatherized) or 78% AFUE (weatherized) or 80% E_t[b,d]	Appendix N of 10 CFR 430 or Section 42, Combustion, UL 727
Warm-air furnace, oil fired	≥225 000 Btu/h	Maximum capacity[c]	~~80~~81% E_t[d] before 1/1/2023 82% E_t[d] after 1/1/2023	Section 42, Combustion, UL 727
Electric furnaces for applications outside the U.S.[g]	<225 000 Btu/h	All	96% AFUE	Appendix N of 10 CFR 430
Warm-air duct furnaces, gas fired	All capacities	Maximum capacity[c]	80% *Ec*[e]	Section 2.10, Efficiency, CSA ~~-~~Z83.8
Warm-air unit heaters, gas fired	All capacities	Maximum capacity[c]	80% *Ec*[e,f]	Section 2.10, Efficiency, CSA Z83.8
Warm-air unit heaters, oil fired	All capacities	Maximum capacity[c]	80% *Ec*[e,f]	Section 40, Combustion, UL 731

a. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. Combination units (i.e, furnaces contained within the same cabinet as an air conditioner) not covered by 10 CFR 430 (i.e., three-phase power or with cooling capacity greater than or equal to 65,000 Btu/h) may comply with either rating. All other units ~~greater~~less than 225,000 Btu/h sold in the U.S. must meet the *AFUE* standards for consumer products and test using USDOE's *AFUE* test procedure at 10 CFR 430, Subpart B, Appendix N.
c. Compliance of multiple firing rate units shall be at the maximum firing rate.
d. *Et* = thermal *efficiency*. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75 percent of the input rating, and have either power venting or a *flue damper*. A *vent damper* is an acceptable alternative to a *flue damper* for those furnaces where combustion air is drawn from the *conditioned space*.
e. *Ec = combustion efficiency* (100 percent less flue losses). See test procedure for detailed discussion.
f. Units must also include an interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.
g. For U.S. applications of federal covered ~~greater~~less than 225,000 Btu/h products, see Informative Appendix F, Table F-4.

Table 6.8.1-8 Electrically Operated Variable-Refrigerant-Flow Air Conditioners-Minimum *Efficiency* Requirements

***Equipment* Type**	**Size Category**	**Heating Section Type**	**Subcategory or Rating Condition**	**Minimum *Efficiency***	**Test Procedure**
VRF air conditioners, air cooled	<65,000 Btu/h	All	*VRF* multisplit *system*	13.0 *SEER*	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	*Electric resistance* (or none)	*VRF* multisplit *system*	11.2 *EER* ~~13.1 *IEER*~~ 15.5 *IEER*	
	≥135,000 Btu/h and <240,000 Btu/h	*Electric resistance* (or none)	*VRF* multisplit *system*	11.0 *EER* ~~12.9 *IEER*~~ 14.9 *IEER*	
	≥240,000 Btu/h	*Electric resistance* (or none)	*VRF* multisplit *system*	10.0 *EER* ~~11.6 *IEER*~~ 13.9 *IEER*	

Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps-Minimum *Efficiency* Requirements

***Equipment* Type**	**Size Category**	**Heating Section Type**	**Subcategory or Rating Condition**	**Minimum *Efficiency***	**Test Procedure**
VRF air cooled (cooling mode)	<65,000 Btu/h	All	*VRF* multisplit *system*	13.0 *SEER*	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	*Electric resistance* (or none)	*VRF* multisplit *system*	11.0 *EER* ~~12.9 *IEER*~~ 14.6 *IEER*	
			VRF multisplit *system* with heat recovery	10.8 *EER* ~~12.7 *IEER*~~ 14.4 *IEER*	
	≥135,000 Btu/h and <240,000 Btu/h		*VRF* multisplit *system*	10.6 *EER* ~~12.3 *IEER*~~ 13.9 *IEER*	
			VRF multisplit *system* with heat recovery	10.4 *EER* ~~12.1 *IEER*~~ 13.7 *IEER*	
	≥240,000 Btu/h		*VRF* multisplit *system*	9.5 *EER* ~~11.0 *IEER*~~ 12.7 *IEER*	
			VRF multisplit *system* with heat recovery	9.3 *EER* ~~10.8 *IEER*~~ 12.5 *IEER*	
VRF water source (cooling mode)	<65,000 Btu/h	All	*VRF* multisplit *system* 86°F entering water	12.0 *EER* 16.0 *IEER*	AHRI 1230
			VRF multisplit *system* with heat recovery 86°F entering water	11.8 *EER* 15.8 *IEER*	
	≥65,000 Btu/h and <135,000 Btu/h		*VRF* multisplit *system* 86°F entering water	12.0 *EER* 16.0 *IEER*	
			VRF multisplit *system* with heat recovery 86°F entering water	11.8 *EER* 15.8 *IEER*	
	≥135,000 Btu/h and <240,000 Btu/h		*VRF* multisplit *system* 86°F entering water	10.0 *EER* 14.0 *IEER*	
			VRF multisplit *system* with heat recovery 86°F entering water	9.8 *EER* 13.8 *IEER*	
	≥240,000 Btu/h		*VRF* multisplit *system* 86°F entering water	10.0 *EER* 12.0 *IEER*	
			VRF multisplit *system* with heat recovery 86°F entering water	9.8 *EER* 11.8 *IEER*	
VRF groundwater source (cooling mode)	<135,000 Btu/h	All	*VRF* multisplit *system* 59°F entering water	16.2 *EER*	AHRI 1230
			VRF multisplit *system* with heat recovery 59°F entering water	16.0 *EER*	
	≥135,000 Btu/h		*VRF* multisplit *system* 59°F entering water	13.8 *EER*	
			VRF multisplit *system* with heat recovery 59°F entering water	13.6 *EER*	

Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps-Minimum *Efficiency* Requirements

***Equipment* Type**	**Size Category**	**Heating Section Type**	**Subcategory or Rating Condition**	**Minimum *Efficiency***	**Test Procedure**
VRF ground source (cooling mode)	<135,000 Btu/h	All	*VRF* multisplit *system* 77°F entering water	13.4 *EER*	AHRI 1230
			VRF multisplit *system* with heat recovery 77°F entering water	13.2 *EER*	
	≥135,000 Btu/h		*VRF* multisplit *system* 77°F entering water	11.0 *EER*	
			VRF multisplit *system* with heat recovery 59°F entering water	10.8 *EER*	
VRF air cooled (heating mode)	<65,000 Btu/h (cooling capacity)		*VRF* multisplit *system*	7.7 *HSPF*	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 47°F db/43°F wb *outdoor* air	3.3 COP_H	
			VRF multisplit *system* 17°F db/15°F wb *outdoor* air	3.25 COP_H	
	≥135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 47°F db/43°F wb *outdoor* air	3.2 COP_H	
			VRF multisplit *system* 17°F db/15°F wb *outdoor* air	2.05 COP_H	
VRF water source (heating mode)	<65,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 68°F entering water	~~4.2 COP_H~~ 4.3 COP_H	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 68°F entering water	~~4.2 COP_H~~ 4.3 COP_H	
	≥135,000 Btu/h and <240,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 68°F entering water	~~3.9 COP_H~~ 4.0 COP_H	
	≥240,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 68°F entering water	3.9 COP_H	
VRF groundwater source (heating mode)	<135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 50°F entering water	3.6 COP_H	AHRI 1230
	≥135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 50°F entering water	3.3 COP_H	
VRF ground source (heating mode)	<135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 32°F entering water	3.1 COP_H	AHRI 1230
	≥135,000 Btu/h (cooling capacity)		*VRF* multisplit *system* 32°F entering water	2.8 COP_H	

Table 6.8.1-11 Commercial Refrigerators, Commercial Freezers, and Refrigeration— Minimum *Efficiency* Requirements

Equipment Category	Condensing Unit Configuration	Equipment Family	Rating Temp. °F	Operating Temp. °F	Equipment Classification[c]	Maximum Daily Energy Consumption, Kwh/Day[d,e]	Test Standard
Remote Condensing Commercial refrigerators and commercial freezers	Remote (RC)	Vertical open (VOP)	38 (M)	≥32	VOP.RC.M	0.64 × TDA + 4.07	AHRI 1200
			0 (L)	<32	VOP.RC.L	2.20 × TDA + 6.85	
		Semivertical open (SVO)	38 (M)	≥32	SVO.RC.M	0.66 × TDA + 3.18	
			0 (L)	<32	SVO.RC.L	2.20 × TDA + 6.85	
		Horizontal open (HZO)	38 (M)	≥32	HZO.RC.M	0.35 × TDA + 2.88	
			0 (L)	<32	HZO.RC.L	0.55 × TDA + 6.88	
		Vertical closed transparent (VCT)	38 (M)	≥32	VCT.RC.M	0.15 × TDA + 1.95	
			0 (L)	<32	VCT.RC.L	0.49 × TDA + 2.61	
		Horizontal closed Transparent (HCT)	38 (M)	≥32	HCT.RC.M	0.16 × TDA + 0.13	
			0 (L)	<32	HCT.RC.L	0.34 × TDA + 0.26	
		Vertical closed solid (VCS)	38 (M)	≥32	VCS.RC.M	0.10 × V + 0.26	
			0 (L)	<32	VCS.RC.L	0.21 × V + 0.54	
		Horizontal closed solid (HCS)	38 (M)	≥32	HCS.RC.M	0.10 × V + 0.26	
			0 (L)	<32	HCS.RC.L	0.21 × V + 0.54	
		Service over counter (SOC)	38 (M)	≥32	SOC.RC.M	0.44 × TDA + 0.11	
			0 (L)	<32	SOC.RC.L	0.93 × TDA + 0.22	
Self-contained commercial refrigerators and commercial freezers with and without doors	Self-contained (SC)	Vertical open (VOP)	38 (M)	≥32	VOP.SC.M	1.69 × TDA + 4.71	AHRI 1200
			0 (L)	<32	VOP.SC.L	4.25 × TDA + 11.82	
		Semivertical open (SVO)	38 (M)	≥32	SVO.SC.M	1.70 × TDA + 4.59	
			0 (L)	<32	SVO.SC.L	4.26 × TDA + 11.51	
		Horizontal open (HZO)	38 (M)	≥32	HZO.SC.M	0.72 × TDA + 5.55	
			0 (L)	<32	HZO.~~R~~SC.L	1.90 × TDA + 7.08	
		Vertical closed transparent (VCT)	38 (M)	≥32	VCT.SC.M	0.10 × V + 0.86	
			0 (L)	<32	VCT.SC.L	0.29 × V + 2.95	
		Vertical closed solid (VCS)	38 (M)	≥32	VCS.SC.M	0.05 × V + 1.36	
			0 (L)	<32	VCS.SC.L	0.22 × V + 1.38	
		Horizontal closed transparent (HCT)	38 (M)	≥32	HCT.SC.M	0.06 × V + 0.37	
			0 (L)	<32	HCT.SC.L	0.08 × V + 1.23	
		Horizontal closed solid (HCS)	38 (M)	≥32	HCS.SC.M	0.05 × V + 0.91	
			0 (L)	<32	HCS.SC.L	0.06 × V + 1.12	
		Service over counter (SOC)	38 (M)	≥32	SOC.SC.M	0.52 × TDA + 1.00	
			0 (L)	<32	SOC.SC.L	1.10 × TDA + 2.10	
Self-contained Commercial refrigerators with transparent doors for pull-down temperature applications	Self-contained (SC)	Pull-down (PD)	38 (M)	≥32	PD.SC.M	0.11 × V + 0.81	AHRI 1200

Table 6.8.1-15 Electrically Operated Water Source Heat Pumps—Minimum *Efficiency* Requirements[b]

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Water-to-air, water loop (cooling mode)	<17 000 Btu/h	All	86°F entering water	12.2 *EER*	ISO 13256-1
	≥17 000 Btu/h and <65 000 Btu/h			13.0 *EER*	
	≥65 000 Btu/h and <135 000 Btu/h			13.0 *EER*	
Water-to-air, groundwater (cooling mode)	<135 000 Btu/h	All	59°F entering water	18.0 *EER*	ISO 13256-1
Brine-to-air, ground loop (cooling mode)	<135 000 Btu/h	All	77°F entering water	14.1 *EER*	ISO 13256-1
Water-to-water, water loop (cooling mode)	<135 000 Btu/h	All	86°F entering water	10.6 *EER*	ISO 13256-2
Water-to-water, groundwater (cooling mode)	<135 000 Btu/h	All	59°F entering water	16.3 *EER*	ISO 13256-2
Brine-to-water, ground loop (cooling mode)	<135 000 Btu/h	All	77°F entering water	12.1 *EER*	ISO 13256-2
Water-to-~~water~~air, water loop (heating mode)	<135 000 Btu/h (cooling capacity)	-	68°F entering water	4.3 COP_H	ISO 13256-1
Water-to-air, groundwater (heating mode)	<135 000 Btu/h (cooling capacity)	-	50°F entering water	3.7 COP_H	ISO 13256-1
Brine-to-air, ground loop (heating mode)	<135 000 Btu/h (cooling capacity)	-	32°F entering water	3.2 COP_H	ISO 13256-1
Water-to-water, water loop (heating mode)	<135 000 Btu/h (cooling capacity)	-	68°F entering water	3.7 COP_H	ISO 13256-1
Water-to-water, groundwater (heating mode)	<135 000 Btu/h (cooling capacity)	-	50°F entering water	3.1 COP_H	ISO 13256-2
Brine-to-water, ground loop (heating mode)	<135 000 Btu/h (cooling capacity)	-	32°F entering water	2.5 COP_H	ISO 13256-2

a. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. Single-phase, U.S. air-cooled heat pumps <19 *kW* are regulated as consumer products by 10 CFR 430. $SCOP_C$, $SCOP2_C$, $SCOP_H$ and $SCOP2_H$ values for single-phase products are set by the USDOE.
Informative Note: See Informative Appendix F for the USDOE minimum.

Table 6.8.1-16 Heat-Pump and Heat Recovery Chiller Packages—Minimum *Efficiency* Requirements

Heating Operation									
Heating Source Conditions (Entering/ Leaving Water) or OAT (db/wb) (°F)	Heat Pump Heating Full Load Efficiency (COP_H)[b] (W/W)				Heat Recovery Chiller Full Load Efficiency (COP_{HR})[b,c] (W/W) Simultaneous Cooling and Heating Full Load Efficiency (COP_{SHC})[b] (W/W)				Test Procedure
	Leaving Heating Water Temperature				Leaving Heating Water Temperature				
	Low 105°F	Medium 120°F	High 140°F	Boost 140°F	Low 105°F	Medium 120°F	High 140°F	Boost 140°F	
47 db 43 wb[d]	≥3.290	≥2.770	≥2.310	NA	NA	NA	NA	NA	AHRI 550/590
17 db 15 wb[d]	≥2.230	≥1.950	≥1.630	NA	NA	NA	NA	NA	
54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	AHRI 550/590
75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	≥6.850	
54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	≥6.850	
54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	AHRI 550/590
75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
54/44[e]	≥4.640	≥3.680	≥2.680	NA	≥8.330	≥6.410	≥4.420	NA	
75/65[e]	NA	NA	NA	≥3.550	NA	NA	NA	≥6.150	
54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	≥6.850	
54/44[e]	≥4.930	≥3.960	≥2.970	NA	≥8.900	≥6.980	≥5.000	NA	
75/65[e]	NA	NA	NA	≥3.900	NA	NA	NA	≥6.850	

Table 6.8.1-19 Walk-In Cooler and Freezer Nondisplay Door *Efficiency* Requirements

CLASS DESCRIPTOR	CLASS	MAXIMUM ENERGY CONSUMPTION, KWH/DAY*	TEST PROCEDURE
Passage door, medium temperature	PD, M	$0.05 \times A_{nd} + 1.7$	10 CFR 431
Passage door, low temperature	PD, L	$0.14 \times A_{nd} + 4.8$	10 CFR 431
Freight door, medium temperature	FD, ~~L~~M	$0.04 \times A_{nd} + 1.9$	10 CFR 431
Freight door, low temperature	FD, L	$0.12\ A_{nd} + 5.6$	10 CFR 431

* A_{nd} is the surface area (ft^2) of the non-display door.

Table 11.5.1 Modeling Requirements for Calculating *Design Energy Cost* and *Energy Cost Budget (Continued).*

13.	Refrigeration	
	Where refrigeration equipment in the proposed design is rated in accordance with AHRI 1200, the rated energy use shall be modeled. Otherwise, the proposed design shall be modeled using the actual equipment capacities and efficiencies.	Where refrigeration equipment is specified in the proposed design and listed in Table 6.8.1-~~13~~ 11 the budget building design shall be modeled as specified in 6.8.1-~~13~~ 11using the actual equipment capacities. If the refrigeration equipment is not listed in Table 6.8.1-~~13~~ 11 the budget building design shall be modeled the same as the proposed design.

Informative Appendix E Informative References

Subsection No.	Reference	Title/Source
5.7.3.2	NIBS Guideline 3-2012	Building Enclosure Commissioning Process BECx, Annex O
5.7.3.2	ASTM E2947-16a	Standard Guide for Building Enclosure Commissioning, Section 9.4
5.9.1, H1	ASTM E2947-16a	Standard Guide for Building Enclosure Commissioning
5.9.1, H1	ASTM E2813-18	Standard Practice for Building Enclosure Commissioning
6.4.1	CTI STD-201 OM (17)	Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment Cooling Technology Institute
6.4.2	2017 ASHRAE Handbook—Fundamentals	ASHRAE
6.4.3.1	ASHRAE Guideline 22-2012	Instrumentation for Monitoring Central Chilled-Water Plant Efficiency
6.4.4.1.1	MICA Insulation Standards—7th Edition	National Commercial and Industrial Insulation Standards
6.4.4.2.1	SMACNA Duct Construction Standards—2005	HVAC Duct Construction Standards, Metal and Flexible
6.4.4.2.2	SMACNA Duct Leakage Test Procedures—2012	HVAC Air Duct Leakage Test Manual Sections 3,5, and 6
6.7.3.3.1	ASHRAE Guideline 4-2019	Preparation of Operating and Maintenance Documentation for HVAC&R Systems
6.7.3.3.1	AABC 2002	Associated Air Balance Council, National Standards for Total System Balance
6.7.3.3.1	ASHRAE Standard 111-2008	Measurement, Testing, Adjusting and Balancing of Building HVAC Systems
6.9.2, H1	ASHRAE Standard 202-2018	Commissioning Process for Buildings and Systems
6.9.2, H1	ASHRAE Guideline 0-2013	The Commissioning Process
6.9.2, H1	ASHRAE Guideline 1.1-2007	HVAC&R Technical Requirements for the Commissioning Process
6.9.2, H1	NEBB Procedural Standards—2014	Procedural Standards for Building Systems Commissioning
7.4.1, 7.5	2011 ASHRAE Handbook—HVAC Applications	Chapter 49, Service Water Heating/ASHRAE
~~8.4.2~~	~~LBNL-2001075~~	~~Characterization and Survey of Automated Fault Detection and Diagnostic Tools~~
~~8.4.2~~	~~Fault Detection and Diagnostics – Enabling techno-commissioning to ease building operation and improve performance (Institute for Building Efficiency)~~	
~~8.4.2~~	~~HVAC&R RESEARCH, January 2005 Volume 11, Number 1 (ASHRAE)~~	~~Methods for Fault Detection, Diagnostics, and Prognostics for Building Systems – A Review, Part I~~
~~8.4.2~~	~~HVAC&R Research, April 2005, Volume 11, Number 2 (ASHRAE)~~	~~Methods for Fault Detection, Diagnostics, and Prognostics for Building Systems – A Review, Part I~~
~~8.4.2~~	~~US Department of Energy EERE; Better Buildings~~	~~Energy Management Information Systems (EMIS) Specification and Procurement Support Materials~~
9.6.1	IES RP-6-15	Recommended Practice for Sports and Recreational Area Lighting
9.9.2	IES Design Guide 29 – 2011	The Commissioning Process Applied to Lighting and Control Systems

Subsection No.	Reference	Title/Source
10.4.3.4	ISO 25745-2:2015	Energy performance of lifts, escalators and moving walks – Paret2: Energy calculation and classification for lifts (elevators)
10.4.5	ISO 27327-1:209 (R2014)	Air curtain units — Part 1: Laboratory Methods of Testing for Aerodynamic Performance Rating
10.4.5	ANSI/AMCA Standard 220-05 (R2012)	Laboratory Methods of Testing Air Curtain Units for Aerodynamic Performance Rating
10.4.7	ANSI/HI 1.1-1.2-2014	Rotodynamic Centrifugal Pumps for Nomenclature and Definitions
10.4.7	ANSI/HI 2.1-2.2-2014	Rotodynamic Vertical Pumps or Radial, Mixed, and Axial Flow Types for Nomenclature and Definitions
11.4.2	CWEC	Canadian Weather for Energy Calculations
11.4.2	IWEC2	International Weather for Energy Calculations, Generation 2
11.4.2	TMY3	Typical Meteorological Year, Generation 3
A9.4.6	ASHRAE Transactions 116(1):10–017	Choudhary, M.K., C. Kasprzak, R.H. Larson, and R. Venuturumilli. 2010. ASHRAE Standard 90.1 metal building U-factors—Part 1: Mathematical modeling and validation by calibrated hot box measurements
A9.4.6	ASHRAE Transactions 116(1):10–018	Choudhary, M.K., and C.P. Kasprzak. 2010. ASHRAE Standard 90.1 Metal building U-factors—Part 2: A system based approach for predicting the thermal performance of single layer fiberglass batt insulation assemblies
A9.4.6	ASHRAE Transactions 116(1):10–019	McBride, M.F., and P.M. Gavin. 2010. ASHRAE Standard 90.1 metal building U-factors—Part 3: Equations for double layers of fiberglass batt insulation in roof and wall assemblies
A9.4.6	ASHRAE Transactions 116(1):10–020	Christianson, L. 2010. ASHRAE Standard 90.1 metal building U-factors—Part 4: Metal building U-factors for walls and roof based on experimental measurements.
A9.4.6	ASHRAE Transactions 118(1):12–006	Choudhary, M.K., C.P. Kasprzak, D.E. Musick, M.J. Henry, and N.D. Fast. 2012. ASHRAE Standard 90.1 metal building U-factors—Part 5: Mathematical modeling of wall assemblies and validation by calibrated hot box measurements
A9.4.6	ASHRAE Transactions 122(1):16–014	Choudhary, M.K 2016. A general approach for predicting the thermal performance of metal building fiberglass insulation assemblies
H1	ISO/IEC 17024:2012	Community Assessment – General requirements for bodies operating certification of persons

Table G3.1 Modeling Requirements for Calculating Proposed and *Baseline Building Performance (Continued)*

No.	Proposed Building Performance	*Baseline Building Performance*
6. Lighting (continued)		
	[…] g. For lighting *controls*, at a minimum, the proposed design shall contain the mandatory *automatic* lighting *controls* specified in Section 9.4.1 (e.g., *automatic* daylight responsive *controls*, *occupancy sensors*, programmable *controls*, etc.). These *controls* shall be modeled in accordance with (~~g~~ h) and (~~h~~ i). […]	

Table G3.5.2 *Performance Rating Method* Electrically Operated Unitary and Applied Heat Pumps—Minimum *Efficiency* Requirements (efficiency ratings excluding supply fan power)

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	3.0 $COP_{nfcooling}$	AHRI 210/240
	≥65,000 Btu/h and <135,000 Btu/h		Split-*system* and single-package	3.4 $COP_{nfcooling}$	AHRI 340/360
	≥135,000 Btu/h and <240,000 Btu/h			3.2 $COP_{nfcooling}$	
	≥240,000 Btu/h			3.1 $COP_{nfcooling}$	
Air-cooled (heating mode)	<65,000 Btu/h (cooling capacity)		Single-package	~~3.4 $COP_{nfcooling}$~~ 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*	~~3.4 $COP_{nfcooling}$~~ 3.4 $COP_{nfheating}$	AHRI 340/360
			17°F db/15°F wb *outdoor air*	~~2.3 $COP_{nfcooling}$~~ 2.3 $COP_{nfheating}$	
	≥135,000 Btu/h (cooling capacity)		47°F db/43°F wb *outdoor air*	~~3.4 $COP_{nfcooling}$~~ 3.4 $COP_{nfheating}$	
			17°F db/15°F wb *outdoor air*	~~2.1 $COP_{nfcooling}$~~ 2.1 $COP_{nfheating}$	

Table G3.5.4 *Performance Rating Method* Electrically Operated *Packaged Terminal Air Conditioners*, *Packaged Terminal Heat Pumps* (efficiency ratings excluding supply fan power

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum *Efficiency*	Test Procedure
PTAC (cooling mode)	All capacities	95°F db *outdoor air*	3.2 $COP_{nfcooling}$	AHRI 310/380
PTHP (cooling mode)	All capacities	95°F db *outdoor air*	3.1 $COP_{nfcooling}$	AHRI 310/380
PTHP (heating mode)	All capacities		~~3.1 $COP_{nfcooling}$~~ 3.1 $COP_{nfheating}$	AHRI 310/380

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 I

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 I-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)	~~Table A2.3~~ 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	10/3/2014	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	~~6.5.4.1, 6.5.4.3~~ 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	~~Appendix G~~ 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	~~6.5.1~~ 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	Table~~s~~ G3.1.1 ~~G3.7, G3.8~~	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	~~3.2, 5.1.2.1~~ 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	~~8.4~~ 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, ~~6.4.3.3~~ 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	~~9.1.2~~ 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	~~9.4.1.1~~ 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	~~Table 6.5.3.1-2~~ 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	~~C3.5.8~~ 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	~~6.5.1~~ 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	~~6.5.3.3~~ 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	~~Table G3.1~~ 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	~~4.2.4, 4.2.5, 5.2.1, 5.2.9 (new section)~~ 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	~~10.4.1~~ 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	~~Tables 6.8.1-9, 6.8.1-10~~ 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	~~6.4.4.2.1~~ 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 ~~a~~ heat recovery requirements for space conditioning in acute inpatient hospitals.	6/22/2019	6/26/2019	6/10/2019	7/24/2019
x	~~Table 6.8.1-7~~ 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	~~Appendix G~~ 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	~~Table 6.5.3.1-2 11.5.2,~~ 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	9/28/19	10/23/2018	10/1/2018
ab	~~G3.1.1; Table G3.1.1-3~~ 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	~~6.5.2.1~~ 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	~~6.5.7~~ 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	~~5.5.4.5~~ 3.2,	Clarify humidification and dehumidification control requirements.	6/23/2018	6/27/2018	5/30/2018	6/28/2018

	6.4.3.6, G3.1.3.18					
ag	~~G3.1.3.1~~ 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	~~Table G3.1~~ 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	~~G3.1.2.4, G3.1.3.19~~ 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, ~~10.4.1~~ 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 7.8~~ 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	~~G3.1~~ 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	~~6.4.3.9~~ 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; 10.4.6~~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	~~9.4.1.1~~ 6.5.3.5	Revises supply air temperature reset controls.	9/14/2018	9/28/19	10/23/2018	10/1/2018

aq	~~5.5.4.1; Tables 5.5-0 through 5.5-8~~ 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	~~6.5.3.2.1, 6.5.3.2.4~~ 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	~~5.4.3.2~~ 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	~~9.4.1.2~~ 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-~~12 & 18~~ 16	~~Revises~~ 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 6.8.1-1~~1~~0 & 6.8.1-1~~9~~7	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
~~bg~~	~~9.2; 9.3~~	~~Revises lighting requirements related to the Simplified Building Method and makes revisions to the Exterior Lighting Power Allowance.~~	~~1/12/2019~~	~~1/16/2019~~	~~12/14/2018~~	~~2/13/2019~~
bh	~~5.4.3.2;~~ 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	~~11; Appendix G~~ 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	6/26/2019	8/1/2019	7/19/2019	8/26/2019

		(see 10 CFR Part 430).				
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-~~12&13~~11	Revises the previous Tables 6.8.1-12 & 13 and combines them into one table - Table 6.8.1-13~~1~~1 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	~~Appendix G~~ 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; 8; 12~~ 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	~~Appendix A~~ 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, C3.5.5.1, C3.5.8	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
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; ~~Table 6.8.1-20; Table 6.8.1-21~~ 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	~~3.2; 9.4~~ 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

a. These descriptions may not be complete and are provided for information only.
b. Formerly addendum bg to Standard 90.1-2013.
c. Formerly addendum dn to Standard 90.1-2013.