ERRATA SHEET FOR
ANSI/ASHRAE/IES STANDARD 90.1-2013 (SI 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 90.1-2013, SI Edition. The first printing is identified on the outside back cover of the standard as "Product code: 86275 10/13" and the second printing as "Product code: 86275 1/15 *Errata noted in the list dated 10/22/14 have been corrected."* The shaded items have been added since the previously published errata sheet dated March 17, 2025 was distributed.

Items identified with an asterisk "*" apply only to the first printing, they have already been incorporated into the second printing.

Items identified with two asterisk "**" apply only to the second printing.

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
1*	**CONTENTS.** In the table of contents change Informative Appendix G to Normative Appendix G.
3*	**3.2 Definitions.** Add the following definition to Section 3.2: *(Note: Additions are shown in underline.)* ***boiler system:*** one or more boilers and their piping and controls that work together to supply steam or hot water to heat output devices remote from the boiler.
4	**Footnote 1 (bottom of page).** Change the URL for the schedules and internal loads as shown below. 1. Schedules and internal loads, by building area type, are located at http://sspc901.ashraepcs.org/documents.php.
20*	**3.3 Abbreviations and Acronyms.** In Section 3.3 delete "**ENVSTD** Envelope System Performance Compliance Program".
25	**5.4.3.1.3 Acceptable Material and Assemblies.** In Section 5.4.3.1.3a and 5.4.3.1.3b delete the redundant text as shown below. *(Note: Deletions are shown in ~~strikethrough~~.)* **5.4.3.1.3 Acceptable Materials and Assemblies.**

©2025 ASHRAE. All rights reserved.

[…]
a. Materials that have an air permeance not exceeding 0.02 L/s·m^2 under a pressure differential of ~~0.02 L/s·m^2 at~~ 75 Pa when tested in accordance with ASTM E2178. The following materials meet these requirements:
[…]
b. Assemblies of materials and components (sealants, tapes, etc.) that have an average air leakage not to exceed 0.2 L/s·m^2 under a pressure differential of ~~0.2 L/s·m^2 at~~ 75 Pa when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283. The following assemblies meet these requirements:
[…]

26* **5.4.3.4 Vestibules.** Add the following exceptions shown below.
(Note: Additions are shown in underline.)
…
8. *Semiheated spaces*.

9. Enclosed elevator lobbies for *building entrances* directly from parking garages.

28 **Table 5.5-2 Building Envelope Requirements for Climate Zone 2 (A, B)*.** In Table 5.5-2, in the row for *Floors*, Mass, in the column Nonresidential, Insulation Min. R-Value, change "R-1.9" to "R-1.1".

35* **5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance.** Revise Section 5.5.3.1.1 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance. Roofs in Climate Zones 1 through 3 shall have one of the following:

a. A minimum three-year-aged solar reflectance of 0.55 and a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with CRRC-1 Standard
b. A minimum Solar Reflectance Index of 64 when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 12 W/m^2·K, based on three-year-aged solar reflectance and three-year-aged thermal emittance tested in accordance with CRRC-1 Standard
c. Increased roof insulation levels found in Table 5.5.3.1.1

Exceptions:
1. Ballasted roofs with a minimum stone ballast of 74 kg/m^2 or 117 kg/m^2 pavers
2. Vegetated roof systems that contain a minimum thickness of 63.5 mm of growing medium and covering a minimum of 75% of the roof area with durable plantings
3. Roofs where a minimum of 75% of the roof area
   a. is shaded during the peak sun angle on June 21 by permanent components or features of the building;
   b. is covered by offset photovoltaic arrays, building-integrated photovoltaic arrays, or solar air or water collectors; or
   c. is permitted to be interpolated using a combination of 1 and 2 above

4.~~d.~~ Steep-sloped roofs
5.~~e.~~ Low-sloped metal building roofs in Climate Zones 2 and 3
6.~~f.~~ Roofs over ventilated attics, roofs over semiheated spaces, or roofs over conditioned spaces that are not cooled spaces
7.~~g.~~ Asphaltic membranes in Climate Zones 2 and 3

©2025 ASHRAE. All rights reserved.

The values for three-year-aged solar reflectance and three-year-aged thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization and shall be labeled and certified by the manufacturer.

36** **5.5.4.2.3 Minimum Skylight Fenestration Area.** Change exception 2 to Section 5.5.4.2.3 as shown below.
(Note: Additions are shown in underline.)

2. Enclosed spaces where it is documented that existing structures or natural objects block direct beam sunlight on at least half of the roof over the enclosed space for more than 1500 daytime hours per year between 8 a.m. and 4 p.m.

37* **5.5.4.4.2 SGHC of Skylights.** Change exception 2 to Section 5.5.4.4.2 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

2. For dynamic glazing, the minimum SHGC shall be used to demonstrate compliance with this section. Dynamic glazing shall be considered separately from other skylights ~~vertical fenestration~~, and area-weighted averaging with other skylights ~~vertical fenestration~~ that is not dynamic glazing shall not be permitted.

41* **6.1.1.3 Alterations to Heating, Ventilating, Air Conditioning, and Refrigeration in Existing Buildings.** Change the exceptions immediately following Section 6.1.1.3.5 to read "Exceptions to 6.1.1.3:" The exceptions apply to Section 6.1.1.3 rather than Section 6.1.1.3.5 alone.

41* **6.2.1 Compliance.** Revise Section 6.2.1 as shown below.
(Note: Additions are shown in underline.)

6.2.1 Compliance. Compliance with Section 6 shall be achieved by meeting all requirements for Sections 6.1, "General"; Section 6.7, "Submittals"; Section 6.8, "Minimum Equipment Efficiency Tables"; and one of the following:

a. Section 6.3, "Simplified Approach Option for HVAC Systems"
b. Sections 6.4, "Mandatory Provisions" and 6.5, "Prescriptive Path"
c. Sections 6.4, "Mandatory Provisions" and 6.6, "Alternative Compliance Path"

43* **6.4.1.2.1 Water-Cooled Centrifugal Chilling Packages.** Change the first sentence in Section 6.4.1.2.1 as shown below. The remainder of Section 6.4.1.2.1 is unchanged.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

6.4.1.2.1 Water-Cooled Centrifugal Chilling Packages. Equipment not designed for operation at AHRI Standard 551/591 test conditions of 7.0°C leaving and 12.0°C entering chilled-fluid temperatures, and with 30.0°C ~~43.0°C~~ entering and 35.0°C leaving condenser-fluid temperatures shall have maximum full-load (FL) COP and part-load rating requirements adjusted using the following equations:

43 **6.4.1.2.1 Water-Cooled Centrifugal Chilling Packages.** Correct as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

$A = 0.0000015318 \times (\text{LIFT})^4 - 0.000202076 \times (\text{LIFT})^3 + 0.0101800 \times (\text{LIFT})^2 - 0.264958 \times \text{LIFT} +$ ~~3.9301963~~3.9302

©2025 ASHRAE. All rights reserved.

Example: Path A 2110 kW centrifugal chiller Table 6.8.1-3 efficiencies effective 1/1/2015:

FL = 6.286 COP
IPLV = 7.041 COP
LvgCond = 37.00°C
LvgEvap = 6.00°C
LIFT = 37.00 – 6.00 = 31.00°C ~~$K_{adj} = A \times B$~~
$K_{adj} = A \times B$
A = 0.0000015318 × (31.0~~30.0~~)^4 – 0.000202076 × (31.0~~30.0~~)^3 + 0.0101800 × (31.0~~30.0~~)^2 – 0.264958 × 31.0~~30.0~~ + ~~3.9301963~~.9302 = ~~0.92820~~.8941
B = 0.0027 × 6.00 + ~~0.9811~~0.982 = ~~0.9973~~0.9982
FL_{adj} = 6.286 × ~~0.9302~~0.8941 × ~~0.9973~~0.9982 = ~~5.831~~5.610 COP
PLV_{adj} = 7.041 × ~~0.9302~~0.8941 × ~~0.9973~~0.9982 = ~~6.531~~6.284 COP

46 **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 when tested in accordance with AMCA Standard 500.

46* **6.4.3.8 Ventilation Controls for High-Occupancy Areas.** Delete "greater than" from the first sentence as shown below.

6.4.3.8 Ventilation Controls for High-Occupancy Areas. Demand control ventilation (DCV) is required for spaces larger than 50 m^2 and with a design occupancy for ventilation of ~~greater than~~ ≥25 people per 100 m^2 of floor area and served by systems with one or more of the following:

48 **6.4.4.2.2 Duct Leakage Tests.** In the equation in Section 6.4.4.2.2 correct the C_L term as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

C_L = 4 ~~6~~, duct leakage class, cfm/100 ft^2 dust surface area at 1 in. wc

48 **6.4.4.2.2 Duct Leakage Tests.** Correct the equation in Section 6.4.4.2.2 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

$$L_{max} = C_L(P^{0.65}/1000)$$

where

L_{max} = maximum permitted leakage, L/s·per m^2 of duct surface area

C_L = ~~4~~0.00563, duct leakage class, L/s·per m^2 of duct surface area ~~at 250~~per Pa$^{0.65}$

P = test pressure, which shall be equal to the design duct pressure class rating, Pa

49* **6.5.1 Economizers.** In the first sentence change Section 6.5.1.6 to 6.5.1.5.

50 **6.5.1.1.6 Sensor Accuracy.** Revise Section 6.5.1.1.6b as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~)

6.5.1.1.6 Sensor Accuracy. Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies:

©2025 ASHRAE. All rights reserved.

a. Dry-bulb and wet-bulb temperatures shall be accurate to ±1.1°C over the range of 4.4°C to 27°C.
b. Enthalpy and the value of a differential enthalpy sensor shall be accurate to ±7 ~~5~~ kJ/kg over the range of 29 ~~35~~ to 66 ~~63~~ kJ/kg.
c. Relative humidity shall be accurate to ±5% over the range of 20% to 80% RH.

50-52* **6.5.1.3 Integrated Economizer Control and Table 6.5.1.4 DX Cooling Stage Requirements for Modulating Airflow Units.** Correct as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

6.5.1.3 Integrated Economizer Control. Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even when

…
a.
b.

~~6.5.1.4~~ c. Effective 1/1/2014, all other DX units, including those that control space temperature by modulating the airflow to the space, shall comply with the requirements of Table 6.5.1.3 ~~6.5.1.4.~~

6.5.1.~~5~~4 Economizer Heating System Impact.

6.5.1.6~~5~~ Economizer Humidification System Impact.

TABLE 6.5.1.3 ~~6.5.1.4~~ DX Cooling Stage Requirements for Modulating Airflow Units

51 **TABLE 6.5.1.1.3 High-Limit Shutoff Control Settings for Air Economizers.** Revise Table 6.5.1.1.3 as shown in the attached.

54-55* **Section 6.5.3.1.3 Fan Efficiency.** In Exceptions 1 and 2 to Section 6.5.3.1.3 change the word "horsepower" to "kW".

57 **TABLE 6.5.4.6 Piping System Design Maximum Flow Rate in L/s.** Change "1" L/s to "11" L/s for Nominal Pipe Size 90 mm in column 2 (≤2000 Hours/Yr, Other).

70 **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.** Remove "/1000" from the efficiency equations in Table 6.8.1-4 as shown below.
(Note: Deletions are shown in ~~strikethrough~~.)

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
PTAC (cooling mode) standard size	All capacities	35.0°Cdb outdoor air	4.04 – (0.300 × Cap~~/1000~~)[c] COP_C (before 1/1/2015) 4.10 – (0.300 × Cap~~/1000~~)[c] COP_C (as of 1/1/2015)	AHRI 310/380
PTAC (cooling mode) nonstandard size[b]	All capacities	35.0°C db outdoor air	3.19 – (0.213 × Cap~~/1000~~)[c] COPc	
PTHP (cooling mode) standard size	All capacities	35.0°C db outdoor air	4.10 – (0.300 × Cap~~/1000~~)[c] COP_c	
PTHP (cooling mode) nonstandard size[b]	All capacities	35.0°C db outdoor air	3.16 – (0.213 × Cap~~/1000~~)[c] COPc	
PTHP (heating mode) standard size	All capacities	--	3.7 – (0.052 × Cap~~/1000~~)[c] COP_H	
PTHP (heating mode) nonstandard size[b]	All capacities	--	2.9 – (0.026 × Cap~~/1000~~)[c] COP_H	

74* **Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow air Conditioners – Minimum Efficiency Requirements.** See attached corrections to Table 6.8.1-9 (in red text).
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

74 **Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow air Conditioners – Minimum Efficiency Requirements.** See attached corrections to Table 6.8.1-9 (in red text).
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

76* **Table 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps – Minimum Efficiency Requirements.** Delete "Air-to-Air" from the title of Table 6.8.1-10.

76* **Table 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps – Minimum Efficiency Requirements.** For equipment type VRF air cooled (heating mode) add "(cooling capacity)" below size category "≥19 kW and <40 kW" so it reads as shown below.

≥19 kW and
<40 kW
(cooling capacity)

76 **Table 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps—Minimum Efficiency Requirement.** See attached corrections to Table 6.8.1-10 (in red text).
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

81 **Table 6.8.3-2 Minimum Piping Insulation Thickness Cooling Systems (Chilled Water, Brine, and Refrigerant).** Change the insulation thickness requirement from "15 mm" to "13 mm" in three places.

83* **7.5.3 Buildings with High-Capacity Service Water Heating Systems.** In Section 7.5.3, first sentence only, change "29 kW" to "293 kW".

84* **Table 7.8 Performance Requirements for Water-Heating Equipment.** See attached corrections to Table 7.8 (in red text).
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

91 **9.4.2 Exterior Building Lighting Power.** In the first sentence of Section 9.4.2 change "Table 9.4.2-1" to "Table 9.4.2-2".

92 **Table 9.4.2-2 Individual Lighting Power Allowance for Building Exteriors.** For Nontradable Surfaces, Building facades, change "66 W/lin m for each illuminated wall or surface length" to "8.2 W/lin m for each illuminated wall or surface length".

93 **Table 9.4.2-2 Individual Lighting Power Allowance for Building Exteriors.** Revise Table 9.4.2-2 as shown. See Table 9.4.2-2 for changes (attached).
(Note: Deletions are shown in ~~strikethrough~~.)

112 **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~~.)

©2025 ASHRAE. All rights reserved.

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* and ~~*baseline building designs*~~ *budget building designs*.

…

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

Budget Building Design (Column B) Energy Cost Budget (ECB)

11. Service Water Heating

…

Exceptions

… c. 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. 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.

117

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

…

i.…Unmet load hours for the proposed design or ~~*baseline building designs*~~ *budget building design* shall not exceed 300. 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 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 2400 L/s, 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 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 6.5.7.1.3 for the numbers and types of hoods and appliances provided in the proposed design.

©2025 ASHRAE. All rights reserved.

137 **Table A3.1-3 Assembly U-Factors, C-Factors, *Ru, Rc*, and *HC* for Concrete Block Walls (*Continued)*.** In Table A3.1-3 for 200 mm Block, Density 1,680 kg/m³, Partly Grouted, Cells Empty, change HC from "0.8" to "208".

159 **A9.4.5.1 Single Layer.** Replace Equation A9.4-2 as shown below.

$$Y = Y_o + (Y_m - Y_o)\left(\frac{X}{2}\right)\left(2 - \frac{X}{2}\right)$$

Correct equation:

$$Y = Y_o + (Y_m - Y_o)\left(\frac{X}{L}\right)\left(2 - \frac{X}{L}\right)$$

161 **A9.5.4.2 Double Layers.** Replace Equation A9.4-12 as shown below.

$$Y = Y_o + (Y_m - Y_o)\left(\frac{X}{2}\right)\left(2 - \frac{X}{2}\right)$$

Correct equation:

$$Y = Y_o + (Y_m - Y_o)\left(\frac{X}{L}\right)\left(2 - \frac{X}{L}\right)$$

161* **A9.4.5.1 Single Layer.** In Equation A9.4-10 of Section A9.4.5.1 change "Rct" to Rci".

162* **A9.5.4.2 Double Layers.** In Equation A9.4-20 of Section A9.4.5.2 change "Uofe" to "Uadj".

187 **Footnote 1 (bottom of page).** Change the URL for the schedules and internal loads as shown below.

1. Schedules and internal loads by building area type are located at http://sspc901.ashraepcs.org/documents.php.

255* **G3.1.1 Baseline HVAC System Type and Description.** Change the first sentence in Section G3.1.1 as shown below. The remainder of Section G3.1.1 is unchanged.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

HVAC systems in the baseline building design shall be based on usage, number of floors, and conditioned floor area, and ~~heating source~~ climate zone as specified in Table G3.1.1-3 and shall conform with the system descriptions in Table G3.1.1-4.

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

6. Lighting. In the Proposed Building Performance column, item (g), change the reference from "Section 9.6.2(c)" to "Section 9.6.3" and change the reference from "Table 9.6.2" to "Table 9.6.3" in two places.

6. Lighting. In the Baseline Building Performance column, item (a), change the reference from "Section 9.6.2(c)" to "Section 9.6.3".

266* **G3.1.1.4 Modeling Building Envelope Infiltration.** Correct the I_{FLR} term in Section G3.1.1.4 as follows:

©2025 ASHRAE. All rights reserved.

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

I_{FLR} = adjusted air leakage rate (expressed in L/s·m^2) of the building envelope at a reference wind speed of 4.47 m/s and the total gross floor area ~~above ground exterior wall area~~

267* **G3.1.2.1 Equipment Efficiencies.** Revise the second sentence in Section G3.1.2.1 as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

Chillers shall use Path A efficiencies as shown in Table 6.8.1-3. W~~w~~here efficiency ratings include supply fan energy, the efficiency rating shall be adjusted to remove the supply fan energy.

269* **G3.1.2.11 Exhaust Air Energy Recovery.** Change as shown below.
(Note: Additions are shown in underline and deletions are shown in ~~strikethrough~~.)

G3.1.2.11 Exhaust Air Energy Recovery. Exhaust air energy recovery shall be modeled for the *baseline ~~budget~~ building design* in accordance with Section 6.5.6.1.

©2025 ASHRAE. All rights reserved.

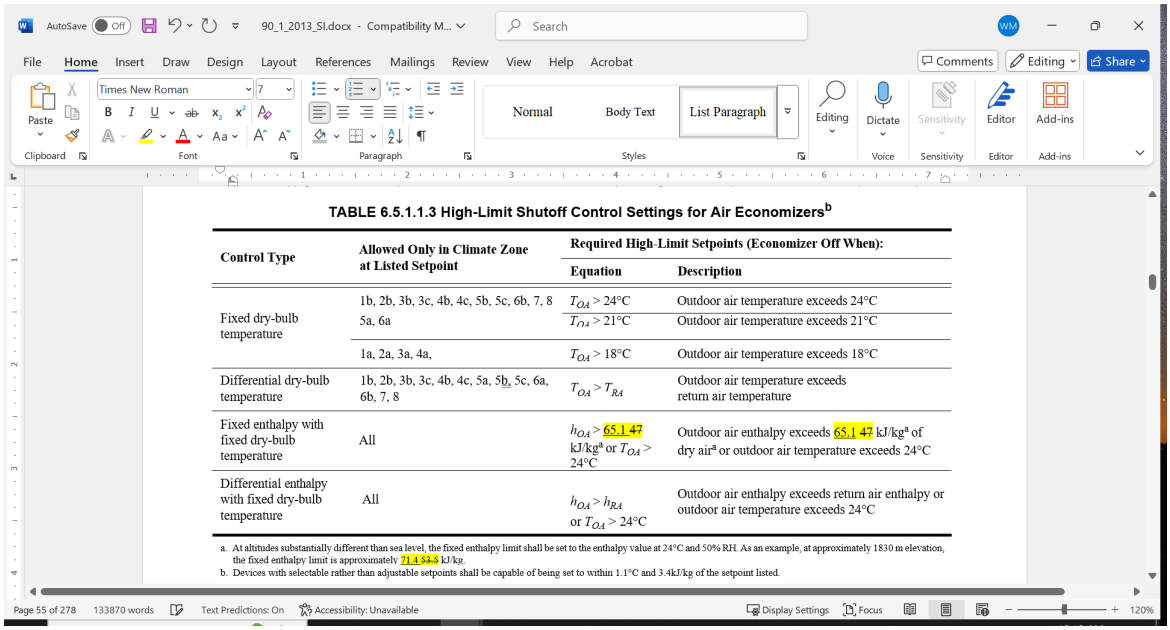

TABLE 6.5.1.1.3 High-Limit Shutoff Control Settings for Air Economizers[b]

Control Type	Allowed Only in Climate Zone at Listed Setpoint	Required High-Limit Setpoints (Economizer Off When): Equation	Description
Fixed dry-bulb temperature	1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8	$T_{OA} > 24°C$	Outdoor air temperature exceeds 24°C
	5a, 6a	$T_{OA} > 21°C$	Outdoor air temperature exceeds 21°C
	1a, 2a, 3a, 4a,	$T_{OA} > 18°C$	Outdoor air temperature exceeds 18°C
Differential dry-bulb temperature	1b, 2b, 3b, 3c, 4b, 4c, 5a, 5b, 5c, 6a, 6b, 7, 8	$T_{OA} > T_{RA}$	Outdoor air temperature exceeds return air temperature
Fixed enthalpy with fixed dry-bulb temperature	All	$h_{OA} >$ 65.1 47 kJ/kg[a] or $T_{OA} >$ 24°C	Outdoor air enthalpy exceeds 65.1 47 kJ/kg[a] of dry air[a] or outdoor air temperature exceeds 24°C
Differential enthalpy with fixed dry-bulb temperature	All	$h_{OA} > h_{RA}$ or $T_{OA} > 24°C$	Outdoor air enthalpy exceeds return air enthalpy or outdoor air temperature exceeds 24°C

a. At altitudes substantially different than sea level, the fixed enthalpy limit shall be set to the enthalpy value at 24°C and 50% RH. As an example, at approximately 1830 m elevation, the fixed enthalpy limit is approximately 21.4 53.5 kJ/kg.
b. Devices with selectable rather than adjustable setpoints shall be capable of being set to within 1.1°C and 3.4kJ/kg of the setpoint listed.

©2025 ASHRAE. All rights reserved.

Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow air Conditioners – Minimum Efficiency Requirements (Errata applies to the first printing only)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
VRF air conditioners, air cooled	<19 kW	All	VRF multisplit system	3.81 $SCOP_C$	AHRI 1230
	≥19 kW and <40 kW	Electric resistance (or none)	VRF multisplit system	3.28 COP_C ~~3.66 $ICOP_C$~~ 3.84 $ICOP_C$	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system	3.22 COP_C ~~3.60 $ICOP_C$~~ 3.75 $ICOP_C$	
	≥70 kW	Electric resistance (or none)	VRF multisplit system	2.93 COP_C ~~3.25 $ICOP_C$~~ 3.40 $ICOP_C$	

Table 6.8.1-9 Electrically Operated Variable-Refrigerant-Flow air Conditioners – Minimum Efficiency Requirements (Errata applies to the first and second printings)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
VRF air conditioners, air cooled	<19 kW	All	VRF multisplit system	3.81 $SCOP_C$	AHRI 1230
	≥19 kW and <40 kW	Electric resistance (or none)	VRF multisplit system	3.28 COP_C 3.84 $ICOP_C$	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system	3.22 COP_C ~~3.75 $ICOP_C$~~ 3.78 $ICOP_C$	
	≥70 kW	Electric resistance (or none)	VRF multisplit system	2.93 COP_C 3.40 $ICOP_C$	

©2025 ASHRAE. All rights reserved.

Table 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow and Applied Heat Pumps— Minimum Efficiency Requirements (Errata applies to first and second printing)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
VRF air cooled (cooling mode)	<19 kW	All	VRF multisplit system	3.81 $SCOP_C$	AHRI 1230
	≥19 kW and <40 kW	Electric resistance (or none)	VRF multisplit system	3.22 COP_C ~~3.60~~ 3.78 $ICOP_C$	
	≥19 kW and <40 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	3.16 COP_C ~~3.55~~ 3.72 $ICOP_C$	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system	3.11 COP_C ~~3.46~~ 3.60 ICOP $_C$	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	3.05 COP_C ~~3.40~~ 3.55 $ICOP_C$	
	≥70 kW	Electric resistance (or none)	VRF multisplit system	2.78 COP_C ~~3.11~~ 3.22 $ICOP_C$	
	≥70 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	2.73 COP_C ~~3.05~~ 3.16 $ICOP_C$	

©2025 ASHRAE. All rights reserved.

Table 7.8 Performance Requirements for Water Heating Equipment

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Performance Required [a]	Test Procedure[b,c]
Electric table-top water heaters	≤ 12 kW	Resistance ≥75.7 L	0.93–0.00035V EF	DOE 10 CFR Part 430
Electric water heaters	≤ 12 kW[e]	Resistance ≥75.7 L	0.97- 0.00035V EF	DOE 10 CFR Part 430
	>12 kW	Resistance≥75.7 L	~~0.3 + 27~~ 5.9 + 5.3/Vm %/h	Section G.2 of ANSI Z21.10.3
	≤24 Amps and ≤250 Volts	Heat Pump	0.93 - 0.00035V EF	DOE 10 CFR Part 430
Gas storage water heaters	≤22.98 kW	≥75.7 L	0.67- 0.0005V EF	DOE 10 CFR Part 430
	>22.98 kW[f]	<309.75 W/L	80% E_t (Q/799 + 16.6 √V) SL, W	Section G.1 of ANSI Z21.10.3
Gas instantaneous water heaters	>14.66 kW and <58.62 kW	≥309.75 W/L and <7.57 L	0.62- .0005V EF	DOE 10 CFR Part 430
	≥58.62 kW[d,f]	≥309.75 W/L and <37.85	80% E_t	Section G.1 of ANSI Z21.10.3
	≥58.62 kW[f]	≥309.75 W/L and ≥37.85	80% E_t (Q/799 + 16.6 √V) SL, W	
Oil storage water heaters	≤30.78 kW	≥75.7 L	0.59- 0.0005V EF	DOE 10 CFR Part 430
	>30.78 kW	<309.75 W/L	80% E_t (Q/799 + 16.6 √V) SL, W	Section G.1 of ANSI Z21.10.3
Oil instantaneous water heaters	≤61.55 kW	≥309.75 W/L and <7.57 L	0.59- 0.0005V EF	DOE 10 CFR Part 430
	>61.55 kW	≥309.75 W/L and <37.85	80% E_t	Section G.1 of ANSI Z21.10.3
	>61.55 kW	≥309.75 W/L and ≥37.85	78% E_t (Q/799 + 16.6 √V) SL, W	
Hot water supply boilers, gas and oil[f]	≥61.55 kW and <3663.8 kW	≥309.75 W/L and <37.85	80% E_t	Section G.1 of ANSI Z21.10.3
Hot water supply boilers, gas[f]		≥309.75 W/L and ≥37.85	80% E_t (Q/799 + 16.6 √V) SL, W	
Hot water supply boilers, oil		≥309.75 W/L and ≥37.85	78% E_t (Q/799 + 16.6 √V) SL,W	
Pool heaters oil and gas	All		78% E_t	ASHRAE 146

©2025 ASHRAE. All rights reserved.

Heat pump pool heaters	All		4.0 COP	~~AHRI 1160~~ ASHRAE 146
Unfired storage tanks	All		R-2.2	(none)

a. Energy factor (EF) and thermal efficiency (E_t) are minimum requirements, while standby loss (SL) is maximum W based on a 38.9°C temperature difference between stored water and ambient requirements. In the EF equation, V is the rated volume in litres. In the SL equation, V is the rated volume in litres and Q is the nameplate input rate in W. V_m is the measured volume in the tank
b. Section 12 contains a complete specification, including the year version, of the referenced test procedure.
c. Section G.1 is titled "Test Method for Measuring Thermal Efficiency" and Section G.2 is titled "Test Method for Measuring Standby Loss."
d. Instantaneous water heaters with input rates below 58.62 W must comply with these requirements if the water heater is designed to heat water to temperatures of 82.2°C or higher.
e. Electric water heaters with input rates below 12kW must comply with these requirements if the water heater is designed to heat water to temperatures of 82.2°C or higher.
f. Refer to Section 7.5.3 for additional requirements for gas storage and instantaneous water heaters and gas hot water supply boilers.

Table 9.4.2-2 Individual Lighting Power Allowances for Building Exteriors (*Continued*)

Entrances and gatehouse inspection stations at guarded facilities	No allowance	8.1 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	~~0.75~~ 8.1 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	~~0.75~~ 8.1 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	~~0.75~~ 8.1 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
Loading areas for law enforcement, fire, ambulance, and other emergency service vehicles	No allowance	5.4 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	~~0.5~~ 5.4 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	~~0.5~~ 5.4 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	~~0.5~~ 5.4 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")

©2025 ASHRAE. All rights reserved.