ADDENDA

2015 Supplement

ANSI/ASHRAE/IES Addenda a, c, d, e, g, h, j, k, m, n, o, p, q, r, s, z, aa, ac, ad, ae, ag, ak, bm, and dx to ANSI/ASHRAE/IES Standard 90.1-2013

Energy Standard for Buildings Except Low-Rise Residential Buildings

(I-P and SI)

See Appendix A for approval dates.

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ANSI/ASHRAE/IES 2015 Addenda Supplement to ANSI/ASHRAE/IES Standard 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings

NOTE

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FOREWORD

Addendum a revises the definition of conditioned space *in Section 3.2. The revised definition reflects the reduction in loads due to greater energy efficiency in Section 5.*

The revision to Section 5.1.2.1 makes the text consistent with the definitions in Section 3.2.

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

Addendum a to Standard 90.1-2013

Revise the definitions in Section 3.2 as follows; delete Table 3.2 and replace with the following (I-P and SI units).

space: an *enclosed space* within a *building*. The classifications of spaces are as follows for the purpose of determining *building envelope* requirements:

conditioned space: a *cooled space*, *heated space*, or *indirectly conditioned space* defined as follows:

a. ***cooled space:*** an *enclosed space* within a building that is cooled by a cooling *system* whose sensible output capacity is greater than or equal to ~~exceeds 5~~ 3.4 Btu/h·ft^2 (~~15~~ 10 W/m^2) of floor area.

b. ***heated space:*** an *enclosed space* within a *building* that is heated by a heating *system* whose output capacity relative to the floor area is greater than or equal to the criteria in Table 3.2.

TABLE 3.2 Heated Space Criteria (I-P Units)

Climate Zone	Heating Output (Btu/h·ft^2)
1	>5
2	>5
3A, 3B	>9
3C	>7
4A, 4B	>10
4C	> 8
5	>12
6	>14
7	>16
8	>19

TABLE 3.2 Heated Space Criteria (SI Units)

Climate Zone	Heating Output (W/m^2)
1	>15
2	>15
3A, 3B	>27
3C	>21
4A, 4B	>30
4C	>24
5	>36
6	>42
7	>48
8	>57

c. ***indirectly conditioned space:*** an *enclosed space* within a *building* that is not a *heated space* or a *cooled space*, which is heated or cooled indirectly by being connected to adjacent space(s) provided:

1. the product of the *U-factor(s)* and surface area(s) of the space adjacent to connected *space(s)* exceeds the combined sum of the product of the *U-factor(s)* and surface area(s) of the space adjoining the outdoors, *unconditioned spaces*, and to or from *semiheated spaces* (e.g., corridors) or
2. that air from heated or *cooled spaces* is intentionally transferred (naturally or mechanically) into the space at a rate exceeding 3 ach (e.g., atria).

semiheated space: an *enclosed space* within a *building* that is heated by a heating system whose output capacity is greater than or equal to 3.4 Btu/h·ft^2 (10 W/m^2) of floor area but is not a *conditioned space*.

unconditioned space: an *enclosed space* within a *building* that is not a *conditioned space* or a *semiheated space*. Crawlspaces, attics, and parking garages with natural or mechanical *ventilation* are not considered *enclosed spaces*.

Revise Section 5.1.2.1 as follows.

5.1.2.1 Separate *exterior building envelope* requirements are specified for ~~each of three categories of conditioned space:~~ (a) *nonresidential conditioned space*, (b) *residential conditioned space*, and (c) *semiheated space*.

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FOREWORD

Section 8.4.1 previously separated feeder conductors from branch circuits when limiting voltage drop. By specifying the same combined voltage drop over the combination of components, this addendum reduces first costs in certain projects while remaining neutral on energy costs.

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

Addendum c to Standard 90.1-2013

Modify the standard as follows (I-P and SI units).

8.4 Mandatory Provisions

~~**8.4.1 Voltage Drop**~~

~~**Exception:** Feeder conductors and branch circuits that are dedicated to emergency services~~

~~**8.4.1.1 Feeders.** Feeder conductors shall be sized for a maximum voltage drop of 2% at design load.~~

~~**8.4.1.2 Branch Circuits.** Branch circuit conductors shall be sized for a maximum voltage drop of 3% at design load.~~

8.4.1 Voltage Drop. The conductors for feeders and branch circuits combined shall be sized for a maximum of 5% voltage drop total.

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FOREWORD

This addendum adds deeper thermostat setups and setbacks and ventilation control to unrented hotel guestrooms and more clarity to the existing hotel guestroom requirements. These deeper setups and setbacks will provide additional energy savings without affecting occupant comfort. The technology exists from multiple manufacturers to allow for these reductions in unrented guestrooms. For stand-alone controls, rooms are considered unrented if they are unoccupied for longer than 16 hours. For systems connected to a networked guest room control, the control can be configured to indicate whether the room is scheduled to be occupied; thus setbacks and ventilation can be turned off earlier when the room is scheduled to be unoccupied, and the networked control can return setpoints to their default levels 60 minutes in advance of scheduled check-in.

This addendum also requires that ventilation air to the room be shut off during unoccupied periods. The addendum includes an exception for a "purge cycle" that would provide ventilation air to the guest room one hour before scheduled check-in to the room as indicated by a networked guest room control or through a timed outdoor air ventilation purge cycle one hour per day. It is unclear if shutting off the ventilation air during vacancy complies with ASHRAE Standard 62.1, as the 62.1 requirements regarding ventilation of unoccupied spaces are not clear. In addition, a proposal to change Standard 62.1 to allow ventilation to be shut off in response to sensed vacancy is being developed (in the form of ASHRAE Standard 62.1 addendum p) that would clearly allow the requirements contained in this addendum. However, the purge cycle exception allowed by this addendum would allow for enhanced indoor air quality beyond the requirements of Standard 62.1, while still capturing the majority of the energy savings of the ventilation shut-off for the rest of the day. The controls would typically operate from an occupancy sensor, so that cleaning crews in unrented rooms would receive ventilation necessary during cleaning.

An analysis of the small hotel prototypes results in savings and paybacks that meet ASHRAE SSPC 90.1 scalar thresholds for cost effectiveness for all climate zones for systems where the ventilation fan is simply switched off, such as PTACs. For central ventilation and exhaust systems typically provided with fan coil-units, there is some additional cost for ventilation and exhaust dampers and pressure regulation devices. Even with these added costs, the proposed measure meets the SSPC 90.1 cost-effectiveness criteria. The situation where an energy recovery ventilation device is required was investigated, and it was found that the measure meets the cost-effective criteria even with reduced savings accounting for this measure.

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Addendum d to Standard 90.1-2013

Modify Section 3.2 as follows (for both I-P and SI units).

networked guest room control system: a control system, accessible from the hotel/motel front desk or other central location, that is capable of identifying reserved rooms according to a timed schedule, and is capable of controlling HVAC in each hotel/motel guest room separately.

Modify Section 6.3.2 as follows, renumbering the existing items k through r accordingly (for both I-P and SI units).

k. Systems serving hotel/motel guest rooms shall comply with Section 6.4.3.3.5.

Add Section 6.4.3.3.5 as follows (for both I-P and SI units).

6.4.3.3.5 Automatic Control of HVAC in Hotel/Motel Guest Rooms. In hotels and motels with greater than 50 guest rooms, *automatic* controls for the HVAC equipment serving each guest room shall be configured according to the requirements in the following subsection.

6.4.3.3.5.1 Guest Room HVAC Setpoint Control. Within 30 minutes of all occupants leaving the guest room, HVAC setpoints shall be automatically raised by at least 4°F (2°C) from the occupant setpoint in the cooling mode and automatically lowered by at least 4°F (2°C) from the occupant setpoint in the heating mode. When the guest room is unrented and unoccupied, HVAC setpoints shall be automatically reset to 80°F (27°C) or higher in the cooling mode and to 60°F (16°C) or lower in the heating mode. Unrented and unoccupied guest rooms shall be determined by either of the following:

a. The guest room has been continuously unoccupied for up to 16 hours.
b. A *networked guest room control system* indicates the guest room is unrented and the guest room is unoccupied for no more than 30 minutes.

Exceptions:

1. A *networked guest room control system* shall be permitted to return the thermostat setpoints to their default occupied setpoints 60 minutes prior to the time the room is scheduled to be occupied.
2. Cooling for humidity control shall be permitted during unoccupied periods.

6.4.3.3.5.2 Guest Room Ventilation Control. Within 30 minutes of all occupants leaving the guest room, ventilation and exhaust fans shall automatically be turned off or *iso-*

lation devices serving each guest room shall automatically shut off the supply of outdoor air to the guest room and shut off exhaust air from the guest room.

Exceptions: Guest room ventilation systems shall be permitted to have an automatic daily preoccupancy purge cycle that provides daily outdoor air ventilation during unrented periods at the design ventilation rate for 60 minutes, or at a rate and duration equivalent to one air change.

6.4.3.3.5.3 Automatic Control. Captive key card systems shall be permitted to be used to comply with Section 6.4.3.3.5.

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FOREWORD

Current requirements for existing building alterations don't require compliance with most mandatory control requirements even if it is a major alteration (e.g., gutting the space or building). Major renovations of lighting should require the same compliance as new construction. Furthermore, Standard 90.1 lags behind the major codes in this arena. Title 24 2013 requires compliance with all the control requirements (in most cases) when more than 10% of the lighting is changed or more than 40 luminaires are modified-in-place. IECC 2012 requires compliance with all the control requirements when more than 50% of the lighting load is altered.

This addendum relaxes the existing threshold somewhat (20% instead of 10%) but captures high energy efficiency by requiring more of the control requirements. The cost of lighting controls has decreased and can probably be expected to decrease further, so the addition of these lighting controls in an alteration no longer represents a large barrier

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Addendum e to Standard 90.1-2013

Modify the standard as follows (IP and SI units)

9.1.2 Lighting Alterations. For the alteration of any lighting system in an interior space, that space shall comply with the lighting power density (LPD) requirements of Section 9.5.1 or 9.6.1 and the control requirements of Sections 9.4.1.1 (a), (b), (c), (d), (g), (h), and (i), as applicable to that space. ~~and the automatic shutoff requirements of Section 9.4.1.1.~~

For the alteration of any lighting system in an exterior building application, that lighting system shall comply with the lighting power density (LPD) requirements of Section 9 applicable to the area illuminated by that lighting system and the applicable control requirements of Sections 9.4.2~~1.7(a)~~ and 9.4.1.4~~7(b)~~. ~~Such alterations shall include all luminaires that are added, replaced or removed. This requirement shall also be met for alterations that involve only the replacement of lamps plus ballasts. Alterations do not include routine maintenance or repair situations.~~

Exception(s):

1. Alterations that involve 20% or less ~~than 10%~~ of the connected lighting load in a space or area need not comply with these requirements, provided that such alterations do not increase the installed LPD.
2. Lighting alterations that only involve replacement of lamps plus ballasts or only involve one-for-one luminaire replacement need only comply with LPD requirement and Section 9.4.1.1(h) or 9.4.1.1(i).
3. Routine maintenance or repair situations.

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FOREWORD

The wording in Standard 90.1-2013 regarding the fan power pressure drop limitation adjustment can be interpreted in two ways. This change is intended to clarify which equation is the one that the committee intended and that was originally used in the economic analysis.

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Addendum g to Standard 90.1-2013

Revise Table 6.5.3.1-2 as follows (I-P units)

TABLE 6.5.3.1-2 Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment
Credits	
[. . .]	
Energy Recovery Device, other than coil runaround loop	~~(2.2 × Energy Recovery Effectiveness) – 0.5 in for each airstream~~ For each airstream [(2.2 × Energy Recovery Effectiveness) – 0.5] in. wc
[. . .]	

Revise Table 6.5.3.1-2 as follows (SI units)

TABLE 6.5.3.1-2 Fan Power Limitation Pressure Drop Adjustment

Device	Adjustment
Credits	
[. . .]	
Energy Recovery Device, other than coil runaround loop	~~(550 × Energy Recovery Effectiveness) – 0.5 in. for each airstream~~ For each airstream [(550 × Energy Recovery Effectiveness – 125)] Pa
[. . .]	

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FOREWORD

The current language in Appendix C regarding HVAC fan power is contradictory. The existing language instructs the user to include fan energy in the HVAC packaged efficiency (which is cooling only) and not model the fan power explicitly. However, the current language also instructs the user to model the fan as cycling in heating. By including the fan energy in the packaged cooling efficiency, the fan energy cannot be modeled in heating. This proposed addendum modifies the language to provide an efficiency rating for the compressor and condensing unit of the packaged equipment that does not include the fan energy but reflects the standard's minimum performance requirement. Additionally, it provides a method of calculating the appropriate fan power to include in the model for heating and cooling fan energy.

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Addendum h to Standard 90.1-2013

Revise the Standard as follows (I-P and SI units).

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

a. Constant-volume fan control

b. Electrically-provided cooling with constant COP, excluding the indoor fan power equal to 4.4. ~~the minimum IEER allowed for air-cooled air conditioners of "All Other" heating section type with ≥ 65,000 Btu/h and <135,000 Btu/h capacity, in accordance with Table 6.8.1-1, divided by 3.412.~~

[. . .]

f. System design supply air rates shall be based on a supply-air-to-room-air temperature difference of 20°F(11.0°C) in cooling.

[. . .]

h. Fans shall cycle on whenever the space calls for heating or cooling. The fan ~~energy~~ power shall be 0.3 W/cfm (0.64 W·s/L) ~~included in the energy efficiency rating of the equipment~~, and the fan energy shall ~~not~~ be modeled explicitly.

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FOREWORD

Additional analysis of the interaction between ventilation optimization and exhaust recovery ventilation (ERV) has determined that, in all climates, having VAV system ventilation optimization in addition to ERV is cost effective. Previously, ventilation optimization was generally excepted wherever ERV was installed. The change proposed here removes the exception to the VAV system ventilation optimization when ERV is installed.

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Addendum j to Standard 90.1-2013

Modify the standard as follows (I-P and SI units).

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

Exceptions:

1. VAV systems with zonal transfer fans that recirculate air from other zones without directly mixing it with outdoor air, dual-duct dual-fan VAV systems, and VAV systems with fan-powered terminal units
2. ~~Systems required to have the exhaust air energy recovery complying with Section 6.5.6.1~~
3. ~~3.~~ Systems where total design exhaust airflow is more than 70%

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FOREWORD

Table G3.1, No. 5, "Building Envelope," is revised to remove ambiguity in the definition of opaque assemblies for the baseline building. It has long been the assumption of energy modelers to refer to Appendix A for definition and guidance on how to construct these lightweight assemblies for the baseline building but never directly or formally referenced to the appropriate Appendix A sections. Below-grade walls were also added as a defined opaque assembly for the baseline building.

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Addendum k to Standard 90.1-2013

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

TABLE G3.1 Modeling Requirements for Calculating Proposed and Baseline Building Performance

No.	Proposed Building Performance	Baseline Building Performance
5.	**Building Envelope**	
	a. All components of the building envelope in the proposed design shall be modeled as shown on architectural drawings or as built for existing building envelopes. **Exceptions:** The following building elements are permitted to differ from architectural drawings. 1. All uninsulated assemblies (e.g., projecting balconies, perimeter edges of intermediate floor stabs, concrete floor beams over parking garages, roof parapet) shall be separately modeled using either of the following techniques: a. Separate model of each of these assemblies within the energy simulation model. b. Separate calculation of the U-factor for each of these assemblies. The U-factors of these assemblies are then averaged with larger adjacent surfaces using an area-weighted average method. This average U-factor is modeled within the energy simulation model. Any other envelope assembly that covers less than 5% of the total area of that assembly type (e.g., exterior walls) need not be separately described, provided that it is similar to an assembly being modeled. If not separately described, the area of an envelope assembly shall be added to the area of an assembly of that same type with the same orientation and thermal properties. 2. Exterior surfaces whose azimuth orientation and tilt differ by less than 45 degrees and are otherwise the same may be described as either a single surface or by using multipliers. 3. The exterior roof surface shall be modeled using the aged solar reflectance and thermal emittance determined in accordance with Section 5.5.3.1.1(a). Where aged test data are unavailable, the roof surface may be modeled with a reflectance of 0.30 and a thermal emittance of 0.90.	Equivalent dimensions shall be assumed for each exterior envelope component type as in the proposed design; i.e., the total gross area of exterior walls shall be the same in the proposed and baseline building designs. The same shall be true for the areas of roofs, floors, and doors, and the exposed perimeters of concrete slabs on grade shall also be the same in the proposed and baseline building designs. The following additional requirements shall apply to the modeling of the baseline building design: a. **Orientation.** The baseline building performance shall be generated by simulating the building with its actual orientation and again after rotating the entire building 90, 180, and 270 degrees, then averaging the results. The building shall be modeled so that it does not shade itself. **Exceptions:** 1. If it can be demonstrated to the satisfaction of the program evaluator that the building orientation is dictated by site considerations. 2. Buildings where the vertical fenestration area on each orientation varies by less than 5%. b. **Opaque Assemblies.** Opaque assemblies used for new buildings, existing buildings, or additions shall conform with ~~the following common, lightweight assembly types~~ assemblies detailed in Appendix A and shall match the appropriate assembly maximum U-factors in Tables 5.5-1 through 5.5-8: • Roofs—Insulation entirely above deck (A2.2). • Above-grade walls—Steel framed (A3.3). • Below-grade walls – Concrete block (A4.1). • Floors—Steel joist (A5.3). • Slab-on-grade floors shall match the F-factor for unheated slabs from the same tables. (A6). • Opaque door types shall be of the same type of construction as ~~match~~ the proposed design and conform to the U-factor requirements from the same tables. (A7). (Continued on next page)

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FOREWORD

This addendum updates the text in Section 10.4.1 on electric motors to provide information about the required efficiency of small electric motors shown in Tables 10.8-4 and 10.8-5. It also makes a correction to the standard, based on the fact that small electric motors were not included in the scope of the 2007 law but now have performance requirements.

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

Addendum m to Standard 90.1-2013

Modify the standard as follows (I-P units).

10. OTHER EQUIPMENT

10.4.1 Electric Motors.

[. . .]

Small electric motors with a power rating of 0.25 hp or more, and less than or equal to 3 hp, shall have a minimum average full-load efficiency that is not less than as shown in Table 10.8-4 for polyphase *small electric motors* and Table 10.8-5 for capacitor-start capacitor-run *small electric motors* and capacitor-start induction-run *small electric motors*.

Fire-pump electric motors shall have a minimum nominal full-load efficiency that is not less than that shown in Table 10.8-6.

~~Motors that are not included in the scope of the Energy Independence and Security Act of 2007, Section 313, have no performance requirements in this section.~~

[. . .]

Modify the standard as follows (SI units).

10. OTHER EQUIPMENT

10.4.1 Electric Motors.

[. . .]

Small electric motors with a power rating of 0.19 kW or more, and less than or equal to 2.2 kW, shall have a minimum average full-load efficiency that is not less than as shown in Table 10.8-4 for polyphase *small electric motors* and Table 10.8-5 for capacitor-start capacitor-run *small electric motors* and capacitor-start induction-run *small electric motors*.

Fire-pump electric motors shall have a minimum nominal full-load efficiency that is not less than that shown in Table 10.8-6.

~~Motors that are not included in the scope of the Energy Independence and Security Act of 2007, Section 313, have no performance requirements in this section.~~

[. . .]

(This foreword 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.)

FOREWORD

In 2013, ASHRAE approved amendments to Standard 90.1 that established for the first time new part-load integrated energy efficiency ratios (IEER) for variable-refrigerant-flow (VRF) air-cooled air conditioners and heat pumps greater than 65,000 Btu/h (19 kW). The amendments had two tiers of minimum IEERs. The first tier became effective on January 1, 2013, and the second tier on July 1, 2012.

This proposal updates the IEER (ICOP) values for air-cooled VRF air conditioners and heat pumps above 65,000 Btu/h (19 kW). Depending on the cooling capacity and product classes, the new IEERs (ICOPs) are between 15% and 20% better than the values they are replacing. The new IEERs (ICOPs) will become effective on January 1, 2017.

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

Addendum n to Standard 90.1-2013

Revise Tables 6.8.1-9 and 6.8.1-10 as follows (I-P and SI units).

TABLE 6.8.1-9 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 (before 1/1/2017) 15.5 IEER (as of 1/1/2017)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	11.0 EER 12.9 IEER (before 1/1/2017) 14.9 IEER (as of 1/1/2017)	
	≥240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	10.0 EER 11.6 IEER (before 1/1/2017) 13.9 IEER (as of 1/1/2017)	

TABLE 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air 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 (before 1/1/2017) 14.6 IEER (as of 1/1/2017)	
	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	VRF multisplit system with heat recovery	10.8 EER 12.7 IEER (before 1/1/2017) 14.4 IEER (as of 1/1/2017)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	10.6 EER 12.3 IEER (before 1/1/2017) 13.9 IEER (as of 1/1/2017)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	VRF multisplit system with heat recovery	10.4 EER 12.1 IEER (before 1/1/2017) 13.7 IEER (as of 1/1/2017)	
	≥240,000 Btu/h	Electric resistance (or none)	VRF multisplit system	9.5 EER 11.0 IEER (before 1/1/2017) 12.7 IEER (as of 1/1/2017)	
	≥240,000 Btu/h	Electric resistance (or none)	VRF multisplit system with heat recovery	9.3 EER 10.8 IEER (before 1/1/2017) 12.5 IEER (as of 1/1/2017)	
VRF water source (cooling mode)	<65,000 Btu/h	All	VRF multisplit systems 86°F entering water	12.0 EER	AHRI 1230
	<65,000 Btu/h	All	VRF multisplit systems with heat recovery 86°F entering water	11.8 EER	
	≥65,000 Btu/h and <135,000 Btu/h	All	VRF multisplit system 86°F entering water	12.0 EER	
	≥65,000 Btu/h and <135,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	11.8 EER	
	≥135,000 Btu/h	All	VRF multisplit system 86°F entering water	10.0 EER	
	≥135,000 Btu/h	All	VRF multisplit system with heat recovery 86°F entering water	9.8 EER	
VRF groundwater source (cooling mode)	<135,000 Btu/h	All	VRF multisplit system 59°F entering water	16.2 EER	AHRI 1230
	<135,000 Btu/h	All	VRF multisplit system with heat recovery 59°F entering water	16.0 EER	
	≥135,000 Btu/h	All	VRF multisplit system 59°F entering water	13.8 EER	
	≥135,000 Btu/h	All	VRF multisplit system with heat recovery 59°F entering water	13.6 EER	

TABLE 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps—Minimum Efficiency Requirements (Continued)

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
	<135,000 Btu/h	All	VRF multisplit system with heat recovery 77°F entering water	13.2 EER	
	≥135,000 Btu/h	All	VRF multisplit system 77°F entering water	11.0 EER	
	≥135,000 Btu/h	All	VRF multisplit system with heat recovery 77°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	
			17°F db/15°F wb outdoor air	2.25 COP_H	
	≥135,000 Btu/h (cooling capacity)	—	VRF multisplit system 47°F db/43°F wb outdoor air	3.2 COP_H	
			17°F db/15°F wb outdoor air	2.05 COP_H	
VRF water source (heating mode)	<135,000 Btu/h (cooling capacity)	—	VRF multisplit system 68°F entering water	4.2 COP_H	AHRI 1230
	≥135,000 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 6.8.1-9 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	<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 $ICOP_C$ (before 1/1/2017) 4.54 ICOP (as of 1/1/2017)	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system	3.22 COP_C 3.78 $ICOP_C$ (before 1/1/2017) 4.37 ICOP (as of 1/1/2017)	
	≥70 kW	Electric resistance (or none)	VRF multisplit system	2.93 COP_C 3.40 $ICOP_C$ (before 1/1/2017) 4.07 ICOP (as of 1/1/2017)	

TABLE 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air 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)	<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 3.78 $ICOP_C$ (before 1/1/2017) 4.28 $ICOP_C$ (as of 1/1/2017)	
	≥19 kW and <40 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	3.16 COP_C 3.72 $ICOP_C$ (before 1/1/2017) 4.22 $ICOP_C$ (as of 1/1/2017)	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system	3.11 COP_C 3.60 $ICOP_C$ (before 1/1/2017) 4.07 $ICOP_C$ (as of 1/1/2017)	
	≥40 kW and <70 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	3.05 COP_C 3.55 $ICOP_C$ (before 1/1/2017) 4.01 ICOP (as of 1/1/2017)	
	≥70 kW	Electric resistance (or none)	VRF multisplit system	2.78 COP_C 3.22 $ICOP_C$ (before 1/1/2017) 3.72 $ICOP_C$ (as of 1/1/2017)	
	≥70 kW	Electric resistance (or none)	VRF multisplit system with heat recovery	2.73 COP_C 3.16 $ICOP_C$ (before 1/1/2017) 3.66 $ICOP_C$ (as of 1/1/2017)	
VRF water source (cooling mode)	<19 kW	All	VRF multisplit systems 30°C entering water	3.52 COP_C	AHRI 1230
	<19 kW	All	VRF multisplit systems with heat recovery 30°C entering water	3.46 COP_C	
	≥19 kW and <40 kW	All	VRF multisplit system 30°C entering water	3.52 COP_C	
	≥19 kW and <40 kW	All	VRF multisplit system with heat recovery 30°C entering water	3.46 COP_C	
	≥40 kW	All	VRF multisplit system 30°C entering water	2.93 COP_C	
	≥40 kW	All	VRF multisplit system with heat recovery 30°C entering water	2.87 COP_C	
VRF groundwater source (cooling mode)	<40 kW	All	VRF multisplit system 15°C entering water	4.75 COP_C	AHRI 1230
	<40 kW	All	VRF multisplit system with heat recovery 15°C entering water	4.69 COP_C	
	≥40 kW	All	VRF multisplit system 15°C entering water	4.04 COP_C	
	≥40 kW	All	VRF multisplit system with heat recovery 15°C entering water	3.98 COP_C	

TABLE 6.8.1-10 Electrically Operated Variable-Refrigerant-Flow Air-to-Air and Applied Heat Pumps—Minimum Efficiency Requirements (Continued)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
VRF ground source (cooling mode)	<40 kW	All	VRF multisplit system 25°C entering water	3.93 COP_C	AHRI 1230
	<40 kW	All	VRF multisplit system with heat recovery 25°C entering water	3.87 COP_C	
	≥40 kW	All	VRF multisplit system 25°C entering water	3.22 COP_C	
	≥40 kW	All	VRF multisplit system with heat recovery 25°C entering water	3.16 COP_C	
VRF air cooled (heating mode)	<19 kW (cooling capacity)	—	VRF multisplit system	2.25 $SCOP_H$	AHRI 1230
	≥19 kW and <40 kW (cooling capacity)	—	VRF multisplit system 8.3°C db/6.1°C wb outdoor air	3.3 COP_H	
			–8.3°C db/–9.4°C wb outdoor air	2.25 COP_H	
	≥40 kW (cooling capacity)	—	VRF multisplit system 8.3°C db/6.1°C wb outdoor air	3.2 COP_H	
			–8.3°C db/–9.4°C wb outdoor air	2.05 COP_H	
VRF water source (heating mode)	<40 kW (cooling capacity)	—	VRF multisplit system 20°C entering water	4.2 COP_H	AHRI 1230
	≥40 kW (cooling capacity)	—	VRF multisplit system 20°C entering water	3.9 COP_H	
VRF groundwater source (heating mode)	<40 kW (cooling capacity)	—	VRF multisplit system 10°C entering water	3.6 COP_H	AHRI 1230
	≥40 kW (cooling capacity)	—	VRF multisplit system 10°C entering water	3.3 COP_H	
VRF ground source (heating mode)	<40 kW (cooling capacity)	—	VRF multisplit system 0°C entering water	3.1 COP_H	AHRI 1230
	≥40 kW (cooling capacity)	—	VRF multisplit system 0°C entering water	2.8 COP_H	

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FOREWORD

This addendum clarifies wording regarding duct seal class to avoid any possible misinterpretation that compliance with the deleted text could substitute for the seal class requirement.

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

Addendum o to Standard 90.1-2013

Modify Section 6.4.4.2.1 as follows (I-P and SI units).

6.4.4.2.1 Duct Sealing. Ductwork and all plenums with pressure class ratings shall be constructed to Seal Class A~~, as required to meet the requirements of Section 6.4.4.2.2, and with standard industry practice (see Informative Appendix E)~~. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage. Pressure-sensitive tape shall not be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent testing laboratory and the tape is used in accordance with that certification. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels, and duct connections to equipment. Sealing that would void product listings is not required. Spiral lock seams need not be sealed. All duct pressure class ratings shall be designated in the design documents.

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FOREWORD

This addendum makes several changes to the standard. Reference to CTI Standard 201 in Table 6.8.1-7, "Performance Requirements for Heat Rejection Equipment," has been updated. This certification standard has been divided into Standard 201 RS and Standard 201 OM. Standard 201 RS sets forth a program whereby the Cooling Tower Institute will certify that all models of a line of evaporative heat rejection equipment offered for sale by a specific manufacturer will perform thermally in accordance with the manufacturer's published ratings. Standard 201 OM is a manual to guide program participants in complying with the provisions of the latest edition of Standard 201 RS. Taken together, STD-201 RS (13) and STD-201 OM (13) are functionally equivalent to the original STD-201 (11).

For the purpose of this table, STD-201 RS and either CTI ATC-105 (open-circuit cooling towers) or CTI ATC-105S (closed-circuit cooling towers) are the proper reference standards for rating and testing this equipment. References to the appropriate test codes (ATC-105 and ATC-105S) remain unchanged. Section 12, "Normative References" has been updated to reflect this change to STD-201. Also, STD-201 OM, the operations manual for the CTI thermal certification program, has been added to Informative Appendix E for reference.

Note that all CTI standards referenced in ASHRAE/IES Standard 90.1 have been developed using the consensus procedure outlined in CTI Operating Procedure 304.

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

Addendum p to Standard 90.1-2013

Modify Table 6.8.1-7 as follows (I-P and SI units). The addition of "RS" is the only change to these tables.

TABLE 6.8.1-7 Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition[h]	Performance Required[a,b,c,d,f,g]	Test Procedure[e]
Propeller or axial fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥40.2 gpm/hp	CTI ATC-105 and CTI STD-201 RS
Centrifugal fan open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering wb	≥20.0 gpm/hp	CTI ATC-105 and CTI STD-201 RS
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥14.0 gpm/hp	CTI ATC-105S and CTI STD-201 RS
Centrifugal closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering wb	≥7.0 gpm/hp	CTI ATC-105S and CTI STD-201 RS
Propeller or axial fan evaporative condensers	All	R-507A test fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥157,000 Btu/h·hp	CTI ATC-106
Propeller or axial fan evaporative condensers	All	Ammonia test fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥134,000 Btu/h·hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	R-507A test fluid 165°F entering gas temperature 105°F condensing temperature 75°F entering wb	≥135,000 Btu/h·hp	CTI ATC-106
Centrifugal fan evaporative condensers	All	Ammonia test fluid 140°F entering gas temperature 96.3°F condensing temperature 75°F entering wb	≥110,000 Btu/h·hp	CTI ATC-106
Air cooled condensers	All	125°F condensing temperature 190°F entering gas temperature 15°F subcooling 95°F entering db	≥176,000 Btu/h·hp	AHRI 460

a. For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 6.8.1-7 divided by the fan motor nameplate power.

b. For purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the thermal rating condition listed in Table 6.8.1-7 divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

c. For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

d. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

e. The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field-erected cooling towers.

f. All cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories and/or options included in the capacity of the cooling tower.

g. For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table, divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.

h. Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A must meet the minimum efficiency requirements listed above with R-507A as the test fluid.

TABLE 6.8.1-7 Performance Requirements for Heat Rejection Equipment

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition[h]	Performance Required[a,b,c,d,f,g]	Test Procedure[e]
Propeller or axial fan open-circuit cooling towers	All	35.0°C entering water 29.4°C leaving water 23.9°C entering wb	≥3.40 L/s·kW	CTI ATC-105 and CTI STD-201 RS
Centrifugal fan open-circuit cooling towers	All	35.0°C entering water 29.4°C leaving water 23.9°C entering wb	≥1.7 L/s·kW	CTI ATC-105 and CTI STD-201 RS
Propeller or axial fan closed-circuit cooling towers	All	38.9°C entering water 32.2°C leaving water 23.9°C entering wb	≥1.18 L/s·kW	CTI ATC-105S and CTI STD-201 RS
Centrifugal closed-circuit cooling towers	All	38.9°C entering water 32.2°C leaving water 23.9°C entering wb	≥0.59 L/s·kW	CTI ATC-105S and CTI STD-201 RS
Propeller or axial fan evaporative condensers	All	R-507A test fluid 73.9°C entering gas temperature 40.6°C condensing temperature 23.9°F entering wb	≥61.6 COP	CTI ATC-106
Propeller or axial fan evaporative condensers	All	Ammonia test fluid 60°C entering gas temperature 35.7°C condensing temperature 23.9°C entering wb	≥52.6 COP	CTI ATC-106
Centrifugal fan evaporative condensers	All	R-507A test fluid 73.9°C entering gas temperature 40.6°C condensing temperature 23.9°F entering wb	≥53.0 COP	CTI ATC-106
Centrifugal fan evaporative condensers	All	Ammonia test fluid 60°C entering gas temperature 35.7°C condensing temperature 23.9°C entering wb	≥43.2 COP	CTI ATC-106
Air cooled condensers	All	52°C condensing temperature 88°C entering gas temperature 8°C subcooling 35°C entering db	≥69 COP	AHRI 460

a. For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the thermal rating condition listed in Table 6.8.1-7 divided by the fan motor nameplate power.

b. For purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the thermal rating condition listed in Table 6.8.1-7 divided by the sum of the fan motor nameplate power and the integral spray pump motor nameplate power.

c. For purposes of this table, air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power.

d. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

e. The efficiencies and test procedures for both open- and closed-circuit cooling towers are not applicable to hybrid cooling towers that contain a combination of separate wet and dry heat exchange sections. The certification requirements do not apply to field-erected cooling towers.

f. All cooling towers shall comply with the minimum efficiency listed in the table for that specific type of tower with the capacity effect of any project-specific accessories and/or options included in the capacity of the cooling tower.

g. For purposes of this table, evaporative condenser performance is defined as the heat rejected at the specified rating condition in the table, divided by the sum of the fan motor nameplate power and the integral spray pump nameplate power.

h. Requirements for evaporative condensers are listed with ammonia (R-717) and R-507A as test fluids in the table. Evaporative condensers intended for use with halocarbon refrigerants other than R-507A must meet the minimum efficiency requirements listed above with R-507A as the test fluid.

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

12. NORMATIVE REFERENCES

Cooling Technology Institute (CTI) **2611 FM 1960 West, Suite A-101, Houston, TX 77068-3730; P.O. Box 73383, Houston, TX 77273-3383**	
CTI ATC-105 (00)	Acceptance Test Code for Water Cooling Towers
CTI ATC-105S (11)	Acceptance Test Code for Closed-Circuit Cooling Towers
CTI ATC-106 (11)	Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers
~~CTI STD-201 (11)~~	~~Standard for Thermal Performance Certification of Evaporative Heat Transfer Equipment~~
CTI STD-201 RS (13)	Performance Rating of Evaporative Heat Rejection Equipment

Modify Informative Appendix E as follows (I-P and SI units).

INFORMATIVE APPENDIX E
INFORMATIVE REFERENCES

Address/Contact Information

Cooling Technology Institute (CTI)
2611 FM 1960 West, Suite A-101, Houston, TX 77068-3730;
P.O. Box 73383, Houston, TX 77273-3383

Subsection No.	Reference	Title/Source
6.4.1	CTI STD-201 OM (13) Operations Manual for Thermal Performance Certification of Evaporative Heat Rejection Equipment	Cooling Technology Institute

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FOREWORD

This addendum limits the systems that can take advantage of the fan power pressure allowance for fully ducted return and/or exhaust air systems. For example, previously, a rooftop unit with a ducted return in a small commercial office building or with a concentric diffuser would have qualified for the fully ducted fan power credit.

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

Addendum q to Standard 90.1-2013

Modify Table 6.5.3.1-2 as follows (IP and SI units)

TABLE 6.5.3.1-2 Fan Power Limitation Pressure Drop Adjustment (I-P and SI)

Device	Adjustment
Credits	
~~Fully ducted return and/or exhaust air systems~~Return or exhaust systems required by code or accreditation standards to be fully ducted, or systems required to maintain air pressure differentials between adjacent rooms.	0.5 in. wc (125 Pa) (2.15 in. wc [535 Pa] for laboratory and vivarium systems)
[. . .]	

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FOREWORD

Section G3.1.1, "Baseline HVAC System Type and Description," is revised to confirm the hierarchy for selecting baseline HVAC systems, clarify what floors to count, and specify what building type to use when no one use is predominant. Table G3.1.1-3, "Baseline HVAC System Types," is revised so that heading names are consistent with Section G3.1.1.

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

Addendum r to Standard 90.1-2013

Modify the standard as follows (I-P and SI units). The existing exceptions to Section G3.1.1 are renumbered as list items G3.1.1 (b) through G3.1.1(i).

G3.1.1 Baseline HVAC System Type and Description. HVAC systems in the baseline building design shall comply with the following:

a. HVAC systems in the *baseline building design* shall be determined in the following order of priority ~~based on~~:
   1. ~~usage~~ the building type with the largest conditioned floor area,
   2. number of floors (including floors above and below grade, but not including floors solely devoted to parking),
   3. gross conditioned floor area, and
   4. climate zone as specified in Table G3.1.1-3 and shall conform with the system descriptions in Table G3.1.1-4. For systems 1, 2, 3, 4, 9, 10, 11, and 12, each thermal block shall be modeled with its own HVAC system. For systems 5, 6, 7, and 8 each floor shall be modeled with a separate HVAC system. Floors with identical thermal blocks can be grouped for modeling purposes.

~~**Exceptions:**~~

Modify Table G3.1.1-3 as follows (I-P and SI units).

TABLE G3.1.1-3 Baseline HVAC System Types

Building Type, Number of Floors, and Gross Conditioned Floor Area	Climate Zones 3b, 3c, and 4–8	Climate Zones 1–3a
[. . .]	[. . .]	[. . .]

[. . .]

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FOREWORD

Exception 2 to 6.5.2.1 addresses single-duct VAV reheat systems with DDC. It unintentionally places undue requirements on other VAV systems with DDC that have an alternate means of heating, such as fan-powered boxes, dual duct, and baseboard, and even non-VAV systems, such as DOAS with radiant or chilled beams. This is resolved by making Exception 1 also apply to systems with DDC but with lower reheat minimums as compared to systems without DDC (e.g., pneumatic control). This would allow, for example, a fan-powered box with a 20% minimum on the primary air.

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

Addendum s to Standard 90.1-2013

Modify Exception 1 to Section 6.5.2.1, "Zone Controls." (I-P and SI units).

Exceptions:

1. Zones ~~without DDC~~ for which the volume of air that is reheated, recooled, or mixed is less than the larger of the following:
   a. 20% of the zone design peak supply for systems with DDC and 30% ~~of the zone design peak supply rate~~ for other systems

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FOREWORD

This addendum clarifies and modifies the modeling of a baseline HVAC system with air-source heat pumps and electric auxiliary heat. Thermostat "stages," as described in the current text, may not be applicable to variable-speed equipment, resulting in confusion about how to model the system. Rather than using auxiliary heat on the last thermostat stage and when the outdoor temperature is less than 40°F (4°C), auxiliary heat is used in all hours with outdoor temperatures below 40°F (4°C). In addition, the revision clarifies that the heat pump shall be modeled to continue operation while auxiliary heat is used.

It should be noted that electric air-source heat pumps are only used as the baseline system for Climate Zones 1 through 3. While it is probably unrealistic to model air-source heat pumps as continuing to operate in extremely low temperature conditions, relatively few locations in Climate Zones 1 through 3 experience heating design temperatures lower than 15°F (–9°C).

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

Addendum z to Standard 90.1-2013

Revise the standard as follows (IP and SI units).

G3.1.3.1 Heat Pumps (Systems 2 and 4). Electric air-source heat pumps shall be modeled with electric auxiliary heat and an outdoor air thermostat. The systems shall be controlled ~~with multistage space thermostats and an outdoor air thermostat wired~~ to energize auxiliary heat only ~~on the last thermostat stage and~~ when the outdoor air temperature is less than 40°F (4°C). The air-source heat pump shall be modeled to continue to operate while auxiliary heat is energized.

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FOREWORD

This addendum clarifies the exception in the "Design Model" section of Table G3.1 for when a conditioned space in the proposed design does not have to be both heated and cooled. The existing exception language referenced spaces served by baseline systems 9 and 10 but that would not apply to the proposed building model. Instead, a complete definition of the applicable spaces served by heating-only systems that comply with the exception is now included.

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

Addendum aa to Standard 90.1-2013

Revise the standard as follows (I-P and SI units).

TABLE G3.1 Modeling Requirements for Calculating Proposed and Baseline Building Performance (I-P and SI)

No.	Proposed Building Performance	Baseline Building Performance
1.	**Design Model**	
a.	The simulation model of the proposed design shall be consistent with the design documents, including proper accounting of fenestration and opaque envelope types and areas; interior lighting power and controls; HVAC system types, sizes, and controls; and service water heating systems and controls. All end-use load components within and associated with the building shall be modeled, including, but not limited to, exhaust fans, parking garage ventilation fans, snow-melt and freeze-protection equipment, facade lighting, swimming pool heaters and pumps, elevators and escalators, refrigeration, and cooking. Where the simulation program does not specifically model the functionality of the installed system, spreadsheets or other documentation of the assumptions shall be used to generate the power demand and operating schedule of the systems.	The baseline building design shall be modeled with the same number of floors and identical conditioned floor area as the proposed design.
b.	All conditioned spaces in the proposed design shall be simulated as being both heated and cooled even if no heating or cooling system is to be installed.	
Exceptions:	Spaces ~~using Baseline System types 9 and 10 not be simulated with mechanical cooling.~~ designed with heating only systems serving storage rooms, stairwells, vestibules, electrical/mechanical rooms, and restrooms not exhausting or transferring air from mechanically cooled thermal zones in the proposed design shall not be modeled with mechanical cooling.	
c.	When the performance rating method is applied to buildings in which energy-related features have not yet been designed (e.g., a lighting system), those yet-to-be-designed features shall be described in the proposed design exactly as they are defined in the baseline building design. Where the space classification for a space is not known, the space shall be categorized as an office space.	

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FOREWORD

Text Modifications

The modifications to the text intend to clarify when the airspace R-values can be used. The criterion was taken from the original research (Housing Research Paper No. 32), which was the source of the ASHRAE Handbook—Fundamentals *table.*

Table Modifications

Table A9.4.2-1: Significant difference in effective R-values exists for floor and ceilings with reflective materials and air spaces in different climate zones. These values currently assume that buildings are only heated and are not properly quantified in the current version of the code. The performance of a horizontal (floor/attic applications) airspace varies significantly based on the direction of the heat flow and currently only assumes a mean temperature of 75°F with heat moving out of the building. The revised table uses the reflective values in the ASHRAE Handbook—Fundamentals *(50–30 for both winter and summer conditions) and weights the value for each climate zone based on the HDD and CDD for the ASHRAE Standard 90.1 representative city in that zone. Effective emittance levels of 0.03 have been removed because of concerns related to the durability and repeatability of this level of thermal performance.*

Table A9.4.2-2: Two of the values did not translate when applying the effective emissivity formula. Also, the aluminum foil with condensate categories were removed, as they are not considered useful for code compliance.

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Addendum ac to Standard 90.1-2013

Modify Appendix A as follows, renumbering subsequent sections where applicable (I-P and SI).

A9.4 Calculation Procedures and Assumptions. The following procedures and assumptions shall be used for all calculations. R-values for air films, airspaces, insulation, and building materials shall be taken from Sections A9.4.1 through A9.4.~~3~~4, respectively. In addition, the appropriate assumptions listed in Sections A2 through A8, including framing factors, shall be used.

[. . .]

A9.4.1.3 Interior surfaces are surfaces within enclosed spaces.

A9.4.1.4 ~~The R-value for cavity airspaces shall be taken from Table A9.4A based on the emissivity of the cavity from Table A9.4B. No credit shall be given for airspaces in cavities that are less than 0.5 in. The values for 3.5 in. cavities shall be used for cavities of that width and greater.~~

A9.4.2 Airspaces. The R-value for airspaces shall be taken from Table A9.4.2-1 based on the effective emittance of the surfaces facing the airspace from Table A9.4.2-2 provided the following criteria are satisfied:

a. The airspace shall be an enclosed and unventilated cavity designed to minimize airflow into and out of the enclosed air space. Airflow shall be deemed minimized when the enclosed airspace is located on the interior of the continuous air barrier and bounded on all sides by building components.
b. Reflective insulation as defined in ASTM C1224, where used, shall be fitted closely around all non-heat producing components and taped or otherwise sealed to eliminate gaps or voids through which air, dust, or water vapor has the potential to pass.
c. Nonparallel spaces shall use the average distance to determine the thickness of the airspace.
d. Airspaces less than 0.5 in. (13 mm) thickness shall have no R-value.
e. The R-value for 3.5 in. (89 mm) airspaces shall be used for airspaces of that thickness or greater provided that airspace does not exceed 12 in. (300 mm) between the surfaces at any point.

For material emissivity properties not listed in Table A9.4.2-2, Equation A9.4.2 shall be permitted to calculate the effective emissivity for the airspace.

$$1/e_{eff} = 1/e_1 + 1/e_2 - 1 \qquad \text{(A9.4.2)}$$

where

e_{eff} = effective emittance for the airspace
e_1 = surface 1 emittance
e_2 = surface 2 emittance

Renumber Sections A9.4.2 through A.9.4.5 as follows (I-P and SI).

A9.4.2~~3~~
A9.4.3~~4~~
A9.4.4~~5~~
A9.4.5~~6~~

Delete the current Table A9.4.1.4-1 and replace with Table A9.4.2-1 (I-P and SI units).

TABLE A9.4.2-1 Values For Cavity Air Spaces[a]

Component	Airspace Thickness, in.	Climate Zone 1 Effective Emittance				Climate Zone 2 Effective Emittance				Climate Zone 3 Effective Emittance			
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82
Roof	0.50	2.5	1.9	1.2	0.9	2.4	1.8	1.2	0.9	2.2	1.7	1.1	0.9
	0.75	3.5	2.4	1.4	1.0	3.2	2.2	1.4	1.0	2.8	2.0	1.3	0.9
	1.50	5.6	3.1	1.7	1.1	4.9	2.9	1.6	1.1	4.2	2.5	1.5	1.0
	3.50	8.0	3.8	1.9	1.2	7.0	3.4	1.7	1.1	5.9	3.0	1.6	1.1
Wall	0.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	0.75	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9
	1.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	3.50	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9
Floor	0.50	1.6	1.3	1.0	0.8	1.8	1.4	1.0	0.8	1.9	1.5	1.1	0.8
	0.75	1.7	1.4	1.0	0.8	2.0	1.5	1.1	0.8	2.4	1.7	1.2	0.9
	1.50	1.9	1.5	1.1	0.8	2.5	1.8	1.2	0.9	3.2	2.1	1.3	0.9
	3.50	2.1	1.6	1.1	0.8	3.2	2.0	1.2	0.9	4.3	2.4	1.4	1.0
Component	**Airspace Thickness, in.**	**Climate Zone 4 Effective Emittance**				**Climate Zone 5 Effective Emittance**				**Climate Zone 6 Effective Emittance**			
		0.05	**0.20**	**0.50**	**0.82**	**0.05**	**0.20**	**0.50**	**0.82**	**0.05**	**0.20**	**0.50**	**0.82**
Roof	0.50	2.0	1.6	1.1	0.8	1.9	1.5	1.1	0.8	1.8	1.4	1.0	0.8
	0.75	2.5	1.8	1.2	0.9	2.3	1.7	1.1	0.9	2.1	1.6	1.1	0.8
	1.50	3.5	2.2	1.3	0.9	3.1	2.0	1.3	0.9	2.8	1.9	1.2	0.9
	3.50	4.7	2.6	1.4	1.0	4.1	2.4	1.4	1.0	3.6	2.2	1.3	0.9
Wall	0.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	0.75	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9
	1.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9
	3.50	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9
Floor	0.50	2.1	1.6	1.1	0.8	2.2	1.7	1.1	0.9	2.3	1.7	1.2	0.9
	0.75	2.7	1.9	1.2	0.9	2.9	2.0	1.3	0.9	3.1	2.1	1.3	1.0
	1.50	3.9	2.4	1.4	1.0	4.3	2.6	1.5	1.0	4.7	2.7	1.5	1.1
	3.50	5.5	2.9	1.5	1.1	6.0	3.1	1.6	1.1	6.6	3.3	1.7	1.1
Component	**Airspace Thickness, in.**	**Climate Zone 7 Effective Emittance**				**Climate Zone 8 Effective Emittance**							
		0.05	**0.20**	**0.50**	**0.82**	**0.05**	**0.20**	**0.50**	**0.82**				
Roof	0.50	1.8	1.4	1.0	0.8	1.6	1.3	1.0	0.8				
	0.75	2.0	1.6	1.1	0.8	1.8	1.4	1.0	0.8				
	1.50	2.6	1.8	1.2	0.9	2.1	1.6	1.1	0.8				
	3.50	3.2	2.0	1.3	0.9	2.4	1.7	1.2	0.9				
Wall	0.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9				
	0.75	2.8	2.0	1.3	0.9	2.8	2.0	1.3	0.9				
	1.50	2.5	1.8	1.2	0.9	2.5	1.8	1.2	0.9				
	3.50	2.6	1.9	1.3	0.9	2.6	1.9	1.3	0.9				
Floor	0.50	2.3	1.8	1.2	0.9	2.5	1.8	1.2	0.9				
	0.75	3.2	2.2	1.4	1.0	3.4	2.3	1.4	1.0				
	1.50	4.9	2.8	1.6	1.1	5.4	3.1	1.7	1.1				
	3.50	6.9	3.4	1.7	1.1	7.7	3.7	1.8	1.2				

a. Interpolation shall be permitted to be used for effective emittance values and airspace thicknesses between those listed. Extrapolation below an effective emittance of 0.05 is not permitted.

TABLE A9.4.2-1 Values For Cavity Air Spaces[a]

Component	Airspace Thickness, cm	Climate Zone 1 Effective Emittance				Climate Zone 2 Effective Emittance				Climate Zone 3 Effective Emittance			
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82
Roof	1.3	0.44	0.33	0.22	0.16	0.41	0.31	0.21	0.15	0.38	0.29	0.20	0.15
	1.9	0.61	0.42	0.25	0.18	0.56	0.38	0.24	0.17	0.50	0.35	0.22	0.16
	3.8	0.98	0.55	0.30	0.20	0.86	0.50	0.28	0.19	0.74	0.45	0.26	0.18
	8.9	1.42	0.67	0.33	0.21	1.23	0.60	0.30	0.20	1.03	0.53	0.28	0.19
Wall	1.3	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16
	1.9	0.49	0.35	0.23	0.17	0.49	0.35	0.23	0.17	0.49	0.35	0.23	0.17
	3.8	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16
	8.9	0.45	0.33	0.22	0.16	0.45	0.33	0.22	0.16	0.45	0.33	0.22	0.16
Floor	1.3	0.28	0.23	0.17	0.13	0.31	0.25	0.18	0.14	0.34	0.27	0.19	0.14
	1.9	0.30	0.24	0.18	0.14	0.35	0.27	0.19	0.14	0.41	0.31	0.20	0.15
	3.8	0.33	0.26	0.19	0.14	0.45	0.31	0.21	0.15	0.57	0.37	0.23	0.16
	8.9	0.38	0.29	0.20	0.15	0.56	0.35	0.22	0.16	0.76	0.43	0.24	0.17
Component	Airspace Thickness, cm	Climate Zone 4 Effective Emittance				Climate Zone 5 Effective Emittance				Climate Zone 6 Effective Emittance			
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82
Roof	1.3	0.35	0.27	0.19	0.14	0.34	0.26	0.19	0.14	0.32	0.25	0.18	0.14
	1.9	0.44	0.32	0.21	0.16	0.41	0.30	0.20	0.15	0.37	0.28	0.19	0.15
	3.8	0.62	0.39	0.23	0.17	0.55	0.36	0.22	0.16	0.49	0.33	0.21	0.16
	8.9	0.83	0.46	0.25	0.18	0.73	0.42	0.24	0.17	0.63	0.38	0.23	0.16
Wall	1.3	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16
	1.9	0.49	0.35	0.23	0.17	0.49	0.35	0.23	0.17	0.49	0.35	0.23	0.17
	3.8	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16
	8.9	0.45	0.33	0.22	0.16	0.45	0.33	0.22	0.16	0.45	0.33	0.22	0.16
Floor	1.3	0.37	0.29	0.20	0.15	0.39	0.30	0.20	0.15	0.40	0.30	0.21	0.15
	1.9	0.48	0.34	0.22	0.16	0.51	0.36	0.23	0.16	0.54	0.37	0.23	0.17
	3.8	0.70	0.43	0.25	0.17	0.76	0.45	0.26	0.18	0.82	0.48	0.27	0.19
	8.9	0.96	0.50	0.27	0.19	1.06	0.54	0.28	0.19	1.17	0.58	0.30	0.20
Component	Airspace Thickness, cm	Climate Zone 7 Effective Emittance				Climate Zone 8 Effective Emittance							
		0.05	0.20	0.50	0.82	0.05	0.20	0.50	0.82				
Roof	1.3	0.31	0.25	0.18	0.14	0.29	0.23	0.17	0.13				
	1.9	0.36	0.27	0.19	0.14	0.32	0.25	0.18	0.14				
	3.8	0.45	0.32	0.21	0.15	0.37	0.28	0.19	0.15				
	8.9	0.57	0.36	0.22	0.16	0.43	0.31	0.20	0.15				
Wall	1.3	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16				
	1.9	0.49	0.35	0.23	0.17	0.49	0.35	0.23	0.17				
	3.8	0.43	0.32	0.22	0.16	0.43	0.32	0.22	0.16				
	8.9	0.45	0.33	0.22	0.16	0.45	0.33	0.22	0.16				
Floor	1.3	0.41	0.31	0.21	0.15	0.44	0.32	0.21	0.16				
	1.9	0.55	0.38	0.24	0.17	0.60	0.41	0.25	0.18				
	3.8	0.86	0.50	0.28	0.19	0.94	0.54	0.29	0.20				
	8.9	1.22	0.60	0.30	0.20	1.36	0.65	0.32	0.21				

a. Interpolation shall be permitted to be used for effective emittance values and airspace thicknesses between those listed. Extrapolation below an effective emittance of 0.05 is not permitted.

Modify Table A9.4.1.4-2 as follows (I-P and SI units).

TABLE A9.4.2-2 Emittance Values of Various Surfaces and Effective Emittances of Air Spaces

Surface	Average Emissivity *e*	Effective Emissivity Effective Emissivity of Air Space	
		One Surface *e*; Other, 0.9	Both Surfaces Emissivity *e*
Aluminum foil, bright	0.05	0.05	0.03[a]
~~Aluminum foil, with condensate just visible (>0.7 gr/ft^2)~~	~~0.30~~	~~0.29~~	—
~~Aluminum foil, with condensate clearly visible (>2.9 gr/ft^2)~~	~~0.70~~	~~0.65~~	—
Metalized film, tested[b]	0.05	0.05	0.03[a]
Aluminum sheet	0.12	0.12	0.06
Aluminum coated paper, polished	0.20	0.20	0.11
Steel, galv., bright	0.25	0.24	~~0.15~~0.14
Aluminum paint	0.50	0.47	~~0.35~~0.32
Building materials: wood, paper, masonry, nonmetallic paints	0.90	0.82	0.82
Regular glass	0.84	0.77	0.72

a. When referencing Table A9.4A, use an effective emittance of 0.05.
b. Tested emittance in accordance with ASTM C1224 at 0.05 or less

TABLE A9.4.2-2 Emittance Values of Various Surfaces and Effective Emittances of Air Spaces

Surface	Average Emissivity *e*	Effective Emissivity Effective Emissivity of Air Space	
		One Surface *e*; Other, 0.9	Both Surfaces Emissivity *e*
Aluminum foil, bright	0.05	0.05	0.03[a]
~~Aluminum foil, with condensate just visible (>0.5 g/m^2)~~	~~0.30~~	~~0.29~~	—
~~Aluminum foil, with condensate clearly visible (>2.0 g/m^2)~~	~~0.70~~	~~0.65~~	—
Metalized film, tested[b]	0.05	0.05	0.03[a]
Aluminum sheet	0.12	0.12	0.06
Aluminum coated paper, polished	0.20	0.20	0.11
Steel, galv., bright	0.25	0.24	~~0.15~~0.14
Aluminum paint	0.50	0.47	~~0.35~~0.32
Building materials: wood, paper, masonry, nonmetallic paints	0.90	0.82	0.82
Regular glass	0.84	0.77	0.72

a. When referencing Table A9.4A, use an effective emittance of 0.05.
b. Tested emittance in accordance with ASTM C1224 at 0.05 or less

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

Reference	Title
[. . .]	
ASTM International **100 Barr Harbor Dr.,West Conshohocken, PA 19428-2959**	
ASTM C1224-11	Standard Specification for Reflective Insulation for Building Applications
[. . .]	

(This foreword 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.)

FOREWORD

This addendum revises the preheat coil requirement for the Baseline Building model in Appendix G to apply to only system types that would logically employ the use of one (baseline system types 5 through 8). The fixed setpoint control eliminates any potential simultaneous cooling and heating by the system cooling coil and preheat coil. Since the preheat coil requirement is now a system-specific requirement, this section was moved to Section G3.1.3.19.

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

Addendum ad to Standard 90.1-2013

Revise the standard as follows (I-P and SI units).

~~**G3.1.2.4 (Not Used) Preheat Coils.** If the HVAC system in the proposed design has a preheat coil and a preheat coil can be modeled in the baseline system, the baseline system shall be modeled with a preheat coil controlled in the same manner as the proposed design.~~

G3.1.3.19 Preheat Coils (Systems 5 through 8). The baseline system shall be modeled with a preheat coil controlled to a fixed setpoint 20°F (11°C) less than the design room heating temperature setpoint.

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FOREWORD

This addendum updates Section 3.2 text for the definitions used with motors and Section 10.4.1 text for small electric motors. Many small motors provide information on the input and output power, and the revision to definitions clarifies the power rating used for efficiency requirements of small (and large) electric motors.

The changes to Section 10.4.1 help to clarify that specialized small electric motors, used in niche applications, do not have efficiency requirements in Tables 10.8-4 and 10.8-5.

These modifications are editorial and do not change any of the efficiency values in the tables.

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

Addendum ae to Standard 90.1-2013

Revise Section 3.2 as follows (I-P units).

3.2 Definitions

nameplate horsepower (hp): the nominal motor output power ~~horsepower~~ rating stamped on the motor nameplate.

Revise Section 10.4.1 as follows (I-P units).

10.4.1 Electric Motors. [. . .]

General purpose ~~S~~s*mall electric motors* with ~~a~~ an output power rating of 0.25 hp or more, and less than or equal to 3 hp, shall have a minimum average full-load efficiency that is not less than as shown in Table 10.8-4 for polyphase *small electric motors* and Table 10.8-5 for capacitor-start capacitor-run *small electric motors* and capacitor-start induction run *small electric motors*.

[. . .]

Revise Section 3.2 as follows (SI units).

nameplate kilowatts (kW): the nominal motor shaft output power ~~kilowatt~~ rating stamped on the motor nameplate.

Revise Section 10.4.1 as follows (SI units).

10.4.1 Electric Motors. [. . .]

General purpose ~~S~~s*mall electric motors* with ~~a~~ an output power rating of 0.19 kW or more, and less than or equal to 2.2 kW, shall have a minimum average full-load efficiency that is not less than as shown in Table 10.8-4 for polyphase *small electric motors* and Table 10.8-5 for capacitor-start capacitor-run *small electric motors* and capacitor-start induction run *small electric motors*.

[. . .]

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FOREWORD

Vestibules are installed to reduce infiltration into the building. The benefit of a vestibule during the cooling season is negated if the vestibule is cooled to the cooling setpoint of the adjacent space. This addendum limits mechanical cooling for vestibules. An exception for temperature limits is allowed when the vestibule is tempered with transfer air or heated with recovered energy. Transfer air tempering is beneficial because that conditioned air is destined to be exhausted anyway, and pressurizing the vestibule may reduce infiltration further. Little cost is added for this measure, as it requires only a reconfiguration of required controls.

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

Addendum ag to Standard 90.1-2013

Revise the standard as follows (IP and SI units)

6.4.3.9 Heated or Cooled Vestibules ~~Heating in Vestibules.~~ Heating for vestibules~~,~~ ~~in accordance with Section 5.4.3.4,~~ and for air curtains with integral heating shall include automatic controls configured to shut off the heating system when outdoor air temperatures are above 45°F (7°C). Vestibule heating and cooling systems shall ~~also~~ be controlled by a thermostat in the vestibule ~~with a setpoint~~ that limit~~sed~~ heating to a maximum of 60°F (16°C) and cooling to a minimum of 85°F (29°C).

Exception: ~~Vestibules with no h~~Heating or cooling provided by site-recovered energy or by ~~system or that are tempered with~~ transfer air that would otherwise be exhausted.

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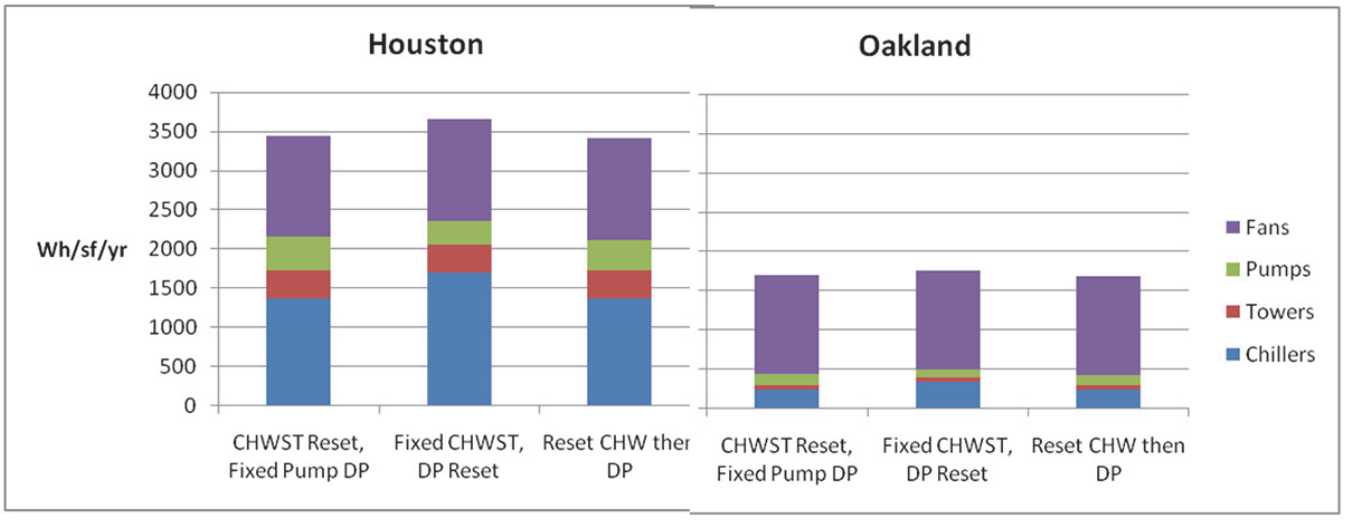
FOREWORD

This addendum is intended to address the following issues:

1. *The scope of Section 6.5.4.1 is now limited to heating and cooling hydronic systems since Section 6.5.4.4. addresses condenser water systems.*
2. *Exception (a) to Section 6.5.4.1 was unclear and could exempt all systems that have flow limitations for primary equipment, such as all chillers and most boilers. When chillers are selected for large ΔT, it is not uncommon for the minimum flow to be greater than 50% of the design flow, but there is still value in using variable flow distribution. So rather than exempt systems with flow limitations from complying with the entire section, the flow limits are incorporated into the first sentence. Minimum flow can be met by minimum flow bypass, primary/secondary pumping, and (for one chiller/one boiler systems) by a few three-way valves.*
3. *The 50% lower flow limit is reduced to 25%. Other than the equipment flow limitations, the only other reason not to go to zero flow is to engage the mass of water in the piping system to reduce short cycling of chillers and boilers and to prevent pump deadheading. All that is required are some end-of-run three-way valves. The 25% value is conservatively high for these purposes.*
4. *Exception (b) to Section 6.5.4.1 is also incorporated into the first sentence.*
5. *The 10 hp (7.5 kW) size exception is eliminated. There is no size limit to this section since, in most applications, variable flow systems are less expensive than constant flow systems, two-way valves are less expensive than three-way valves, and VFDs on pumps are not required on hot-water systems and small chilled-water systems. Small systems with one chiller or boiler can meet the requirement as revised by using two-way valves in almost all cases and enough three-way valves as needed to maintain minimum chiller/boiler flow. Multiple chiller/boiler systems are inherently large enough to handle the cost of bypasses, etc., required for variable flow.*
6. *Currently Section 6.5.4.1 requires dew-point setpoint reset using valve position for DDC systems, and chilled-water reset is not required when variable flow is used due to Exception (b) to Section 6.5.4.3. This addendum revises this to allow valve position to be used for either dew-point setpoint reset or for chilled-water setpoint reset. For systems with high pump heads, using a constant chilled-water setpoint can be the most efficient option. But for low-head pumping systems, chilled-water setpoint reset is the best option, particularly in mild climates, because chiller energy savings due to reduced lift offsets the pump energy increase due to warmer supply water temperatures, as shown in Figure 1. Because the optimum logic varies, this addendum allows the design engineer to choose either option, and even to reset both simultaneously as shown in Figure 1.*
7. *Exception (a) to Section 6.5.4.3 is proposed to be deleted since there are really no comfort HVAC applications we can think of that require an exact single setpoint all the time (an exception is provided for process applications). There will always be a range of temperatures that work, and reset always saves energy. The large majority of boiler and chiller controllers (particularly those larger than 300,000 Btu/h [90 kW]) have the capability to reset supply temperature setpoint based on return water temperature (in fact, many small chiller controllers can only control off of return water temperature) and include an option for outdoor air temperature reset for which the only added cost is installing a $35 thermistor outside.*



One can simply limit the range of the reset to what the user thinks is needed, but whatever the range, it will be cost effective given there is little or no cost for this capability.

8. *Valve position reset of chilled- and hot-water temperatures is proposed to be required for DDC systems as noted above. The range of the reset includes a clause "setpoint limits of the… application have been reached." This is to allow someone to limit the reset for some perceived application limitation, one of the most common of which is dehumidification. In fact, there is no reason to limit reset for dehumidification when valve position is used since almost the same supply air humidity condition (near saturation) will result when supply air temperature is maintained, regardless of chilled-water temperature (this will be explained further in the 2013 user's manual). This clause is included to avoid negative feedback from those who might come up with an application that has temperature limits.*

9. *An exception is added to eliminate chilled-water reset for systems where the water is already cold, such as district cooling or TES. Reset in this case will actually increase energy use by increasing pump energy without any commensurate reduction in chiller energy.*

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Addendum ak to Standard 90.1-2013

Revise the standard as follows (I-P and SI units).

6.5.4.1 Hydronic Variable Flow Systems. ~~HVAC pumping~~ Chilled- and hot-water distribution systems ~~having a total pump system power exceeding 10 hp [7.5 kW]~~ that include three (3) or more control valves designed to modulate or step open and close as a function of load shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to no more than the larger of ~~50~~25% ~~or less~~ of the design flow rate or the minimum flow required by the heating/cooling equipment manufacturer for the proper operation of equipment. Individual chilled water pumps serving variable flow systems having motors exceeding 5 hp (3.7 kW) shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure. The differential pressure setpoint shall be no more than 110% of that required to achieve design flow through the heat exchanger. Where differential pressure control is used to comply with this section and DDC controls are used the setpoint shall be reset downward based on valve positions until one valve is nearly wide open.

Exceptions: Differential pressure setpoint reset is not required where valve position is used to comply with Section 6.5.4.3.

~~a. Systems where the minimum flow is less than the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system, such as chillers, and where total pump system power is 75 hp or less.~~

~~b. Systems that include no more than three control valves.~~

[. . .]

6.5.4.3 Chilled- and Hot-Water Temperature Reset Controls. Chilled- and hot-water systems with a design capacity exceeding 300,000 Btu/h (90kW) supplying chilled or heated water ~~(or both)~~ to comfort conditioning systems shall include controls that automatically reset supply water temperatures by representative building loads (including return water temperature) or by outdoor air temperature. Where DDC is used to control valves, the setpoint shall be reset based on valve positions until one valve is nearly wide open or setpoint limits of the system equipment or application have been reached.

Exceptions:

~~a. Where the supply temperature reset controls cannot be implemented without causing improper operation of heating, cooling, humidifying, or dehumidifying systems.~~

~~b. Hydronic systems, such as those required by Section 6.5.4.1 that use variable flow to reduce pumping energy.~~

a. Where chilled-water supply is already cold, such as chilled water supplied from a district cooling or thermal energy storage system, such that blending would be required to achieve the reset chilled-water supply temperature

b. Where a specific temperature is required for a process

c. Water temperature reset is not required where valve position is used to comply with Section 6.5.4.1

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FOREWORD

This addendum takes the requirements from 90.1-2004 and makes them the baseline for modeling when using Appendix G. In addition, it allows Appendix G to be used as a compliance path in 90.1 when models show the proposed building is 45% more stringent than the 2004 baseline.

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

Addendum bm to Standard 90.1-2013

Revise Section 3 as follows (I-P and SI units).

3. DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

[. . .]

baseline building design: a computer representation of a hypothetical design based on the proposed building project. This representation is used as the basis for calculating the baseline building performance for rating above-standard design or when using the performance rating method as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

baseline building performance: the annual energy cost for a building design intended for use as a baseline for rating above-standard design or when using the performance rating method as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

performance rating method: a calculation procedure that generates an index of merit for the performance of building designs that substantially exceeds the energy efficiency levels required by this standard or when using the performance rating method as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1.

rating authority: the organization, building official, or agency that adopts, enforces, or sanctions use of this rating methodology

regulated energy use: energy used by building systems and components with requirements prescribed in Sections 5 through 10. This includes energy used for HVAC, lighting, service water heating, motors, transformers, vertical transportation, refrigeration equipment, computer-room cooling equipment, and other building systems, components, and processes with requirements prescribed in Sections 5 through 10.

unregulated energy use: energy used by building systems and components that is not *regulated energy use*.

Revise Section 4.2.1.1 as follows (I-P and SI units).

4.2 Compliance

4.2.1 Compliance Paths

4.2.1.1 New Buildings. New *buildings* shall comply with either the provisions of

a. Sections 5, "Building Envelope"; Section 6, "Heating, Ventilating, and Air Conditioning"; Section 7, "Service Water Heating"; Section 8, "Power"; Section 9, "Lighting"; and Section 10, "Other Equipment," or
b. Section 11, "Energy Cost Budget Method~~,~~" or
c. Appendix G, "Performance Rating Method."

When using Appendix G, the Performance Cost Index (PCI) shall be less than or equal to the Performance Cost Index Target (PCI_t) when calculated in accordance with the following:

$$PCI_t = (BBUEC + (BPF \times BBREC)) / BBP$$

where

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

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

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

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

BBP = *Baseline Building Performance*.

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

Revise Section G1 as follows (I-P and SI units).

G1. GENERAL

G1.1 Performance Rating Method Scope. This building performance rating method is a modification of the Energy Cost Budget (ECB) Method in Section 11 and is intended for use in rating the energy efficiency of building designs that exceed the requirements of this standard. This appendix ~~does NOT~~ offers an alternative compliance path for minimum standard compliance per Section 4.2.1.1~~, that is the intent of Section 11, Energy Cost Budget Method. Rather, this appendix~~ and is also provided for those wishing to use the methodology

TABLE 4.2.1.1 Building Performance Factor (BPF)

Building Area Typea	Climate Zone																
	1A	1B	2A	2B	3A	3B	3C	4A	4B	4C	5A	5B	5C	6A	6B	7	8
Multifamily	0.73	0.73	0.71	0.69	0.74	0.73	0.68	0.78	0.81	0.81	0.76	0.80	0.81	0.76	0.79	0.74	0.80
Healthcare/ hospital	0.64	0.56	0.60	0.56	0.60	0.56	0.54	0.57	0.53	0.55	0.59	0.52	0.55	0.57	0.52	0.56	0.56
Hotel/motel	0.64	0.65	0.62	0.60	0.63	0.65	0.64	0.62	0.64	0.62	0.60	0.61	0.60	0.59	0.61	0.57	0.58
Office	0.58	0.62	0.57	0.62	0.60	0.64	0.54	0.58	0.60	0.58	0.60	0.61	0.58	0.61	0.61	0.57	0.61
Restaurant	0.62	0.62	0.58	0.61	0.60	0.60	0.61	0.58	0.55	0.60	0.62	0.58	0.60	0.63	0.60	0.65	0.68
Retail	0.52	0.58	0.53	0.58	0.54	0.62	0.60	0.55	0.60	0.60	0.55	0.59	0.61	0.55	0.58	0.53	0.53
School	0.46	0.53	0.47	0.53	0.49	0.52	0.50	0.49	0.50	0.49	0.50	0.50	0.50	0.49	0.50	0.47	0.51
Warehouse	0.51	0.52	0.56	0.58	0.57	0.59	0.63	0.58	0.60	0.63	0.60	0.61	0.65	0.66	0.66	0.67	0.67
All others	0.62	0.61	0.55	0.57	0.56	0.61	0.59	0.58	0.57	0.61	0.60	0.57	0.61	0.56	0.56	0.53	0.52

a. In cases where both a general building area type and a specific building area type are listed, the specific building area type shall apply

developed for this standard to quantify performance that substantially exceeds the requirements of Standard 90.1. It shall be used for evaluating the performance of all such *proposed designs*, including *alterations* and *additions* to *existing buildings*, except designs with no mechanical systems.

G1.2 Performance Rating. [. . .]

G1.2.1 Mandatory ~~Requirements~~Provisions. This performance rating method requires conformance with the following provisions:

a. All requirements of Sections 5.4, 6.4, 7.4, 8.4, 9.4, and 10.4 ~~are~~ shall be met. These sections contain the mandatory provisions of the standard and are prerequisites for this rating method.
b. The interior lighting power shall not exceed the interior lighting power allowance determined using either Tables G3.7 or G3.8 and the methodology described in Section 9.6.1 and 9.6.2.

G1.2.2 Performance Rating Calculation. The ~~improved~~ performance of the proposed building design is calculated in accordance with provisions of this appendix using the following formula:

~~Percentage improvement~~Performance Cost Index
= *Proposed building performance*/
Baseline building performance

Notes:

1. Both the *proposed building performance* and the *baseline building performance* shall include all end-use load components when calculating the Performance Cost Index~~such as receptacle and process loads~~.
2. Neither the proposed building performance nor the baseline building performance are predictions of actual energy consumption or costs for the proposed design after construction. Actual experience will differ from these calculations due to variations such as occupancy, building operation and maintenance, weather, energy use not covered by this procedure, changes in energy rates between design of the building and occupancy, and the precision of the calculation tool.

G1.3 Trade-Off Limits. When the proposed modifications apply to less than the whole building, only parameters related to the systems to be modified shall be allowed to vary. Parameters relating to unmodified existing conditions or to future building components shall be identical for determining both the baseline building performance and the proposed building performance. Future building components shall meet the prescriptive requirements of Sections 5.5, 6.5, 7.5, ~~9.5,~~ and either 9.5 or 9.6.

When using the Performance Rating Method as an alternative path for minimum standard compliance per Section 4.2.1.1, trade-offs and credits for energy efficiency improvement shall be limited to the scope of work identified in the building permit. For new buildings or additions, the Performance Rating Method results shall not be submitted for building permit approval to the rating authority prior to submittal for approval of the building envelope design.

G1.4 Documentation Requirements. Simulated performance shall be documented, and documentation shall be submitted to the *rating authority*. The information shall be submitted in a report and shall include the following:

a. A brief description of the project, the key energy efficiency improvements compared with the requirements in Sections 5 through 10, the simulation program used, the version of the simulation program, and the results of the energy analysis. This summary shall contain the calculated values for the baseline building performance, the proposed building performance, and the percentage improvement.

[. . .]

G3.1.1 Baseline HVAC System Type and Description

[. . .]

Exceptions:

[. . .]

c. For laboratory spaces in a building having a total laboratory exhaust rate greater than 15,000 cfm (425 m^3/s), use a single system of type 5 or 7 serving only those spaces. For all electric buildings, the heating shall be electric resistance.

~~d. For kitchens with a total exhaust hood airflow rate greater than 5,000 cfm, use system type 5 or 7 with 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. If the proposed design uses demand ventilation the same air flow 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 for the in the proposed design. For all-electric buildings, the heating shall be electric resistance.~~

[. . .]

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 ~~Section 6.4~~.Tables G3.5.1 through G3.5.6. Where efficiency ratings, such as ~~I~~EER and ~~I~~COP, include fan energy, the descriptor shall be broken down into its components so that supply fan energy can be modeled separately

[. . .]

G3.1.2.6 Ventilation. Minimum ventilation system outdoor air intake flow shall be the same for the proposed and baseline building designs.

Exceptions:

a. When modeling demand-control ventilation in the proposed design ~~when it's use is not required by Section 6.3.2(p) or Section 6.4.3.9~~ in systems with outdoor air capacity less than or equal to 3000 cfm (85 m^3/s) serving areas with an average design capacity of 100 people per 1000 ft^2 (93m^2) or less.

[. . .]

G3.1.2.11 Exhaust Air Energy Recovery. ~~Exhaust air energy recovery shall be modeled for the *budget building design* in accordance with Section 6.5.6.1.~~ Individual fan systems that have both a design supply air capacity of 5000 cfm (142 m^3/s) or greater and have a minimum design outdoor air supply of 70% or greater shall have an energy recovery system with at least 50% recovery effectiveness. Fifty percent energy recovery effectiveness shall mean a change in the enthalpy of the *outdoor air* supply equal to 50% of the difference between the *outdoor air* and return air at design conditions. Provision shall be made to bypass or control the heat-recovery system to permit air economizer operation, where applicable.

Exceptions: If any of these exceptions apply, exhaust air energy recovery shall not be included in the *baseline building design*.

a. Systems serving spaces that are not cooled and that are heated to less than 60°F (15.5°C).

b. Systems exhausting toxic, flammable, or corrosive fumes or paint or dust. This exception shall only be used if exhaust air energy recovery is not used in the *proposed design*.

c. Commercial kitchen hoods (grease) classified as Type 1 by NFPA 96. This exception shall only be used if exhaust air energy recovery is not used in the *proposed design*.

d. Heating systems in Climate Zones 1 through 3.

e. Cooling systems in Climate Zones 3c, 4c, 5b, 5c, 6b, 7, and 8.

f. Where the largest exhaust source is less than 75% of the design *outdoor airflow*. This exception shall only be used if exhaust air energy recovery is not used in the proposed design.

g. Systems requiring dehumidification that employ energy recovery in series with the cooling coil. This exception shall only be used if exhaust air energy recovery and series-style energy recovery coils are not used in the *proposed design*.

[. . .]

G3.1.4.11 Heat Rejection (Systems 7, 8, 11, and 12). The heat rejection device shall be an axial fan open circuit cooling tower with variable-speed fan control and shall ~~meet the performance requirements of Table 6.8.1-7~~ have an efficiency of 38.2 gpm/hp (3.23 L/s·kW) at the conditions specified in Table 6.8.1-7.

TABLE G3.1 Modeling Requirements for Calculating Proposed and Baseline Building Performance (I-P and SI)

No.	Proposed Building Performance	Baseline Building Performance
1.	**Design Model**	
[. . .]		[. . .] The baseline building design shall be developed by modifying the proposed building design as described in Section G3. Except as specifically instructed, all building systems and equipment shall be modeled identically in the baseline building design and proposed building design.
[. . .]		
5.	**Building Envelope**	
	All components of the building envelope in the proposed design shall be modeled as shown on architectural drawings or as built for existing building envelopes. **Exceptions:** The following building elements are permitted to differ from architectural drawings. a. All uninsulated assemblies (e.g., projecting balconies, perimeter edges of intermediate floor stabs, concrete floor beams over parking garages, roof parapet) shall be separately modeled using either of the following techniques: 1. Separate model of each of these assemblies within the energy simulation model. 2. Separate calculation of the U-factor for each of these assemblies. The U-factors of these assemblies are then averaged with larger adjacent surfaces using an area-weighted average method. This average U-factor is modeled within the energy simulation model. Any other envelope assembly that covers less than 5% of the total area of that assembly type (e.g., exterior walls) need not be separately described provided that it is similar to an assembly being modeled. If not separately described, the area of an envelope assembly shall be added to the area of an assembly of that same type with the same orientation and thermal properties. b. Exterior surfaces whose azimuth orientation and tilt differ by less than 45 degrees and are otherwise the same may be described as either a single surface or by using multipliers. c. The exterior roof surface shall be modeled using the aged solar reflectance and thermal emittance determined in accordance with Section 5.5.3.1.2(a). Where aged test data is unavailable, the roof surface may be modeled with a reflectance of 0.30 and a thermal emittance of 0.90. d. Manual fenestration shading devices such as blinds or shades shall be modeled or not modeled, the same as in the baseline. Automatically controlled fenestration shades or blinds shall be modeled. Permanent shading devices such as fins, overhangs, and light shelves shall be modeled. e. Automatically controlled dynamic glazing may be modeled. Manually controlled dynamic glazing shall use the average of the minimum and maximum SHGC and VT.	Equivalent dimensions shall be assumed for each exterior envelope component type as in the proposed design; i.e., the total gross area of exterior walls shall be the same in the proposed and baseline building designs. The same shall be true for the areas of roofs, floors, and doors, and the exposed perimeters of concrete slabs on grade shall also be the same in the proposed and baseline building designs. The following additional requirements shall apply to the modeling of the baseline building design: a. **Orientation.** The baseline building performance shall be generated by simulating the building with its actual orientation and again after rotating the entire building 90, 180, and 270 degrees, then averaging the results. The building shall be modeled so that it does not shade itself. **Exceptions:** 1. If it can be demonstrated to the satisfaction of the ~~Program Evaluator~~ Rating Authority that the building orientation is dictated by site considerations. 2. Buildings where the vertical fenestration area on each orientation varies by less than 5%. b. **Opaque Assemblies.** Opaque assemblies used for new buildings or additions shall conform with the following common, lightweight assembly types and shall match the appropriate assembly maximum U-factors in Tables ~~5.5-1 through 5.5-8~~ G3.4-1 through G3.4-8: • Roofs—Insulation entirely above deck • Above-grade walls—Steel-framed • Floors—Steel-joist • Opaque door types shall match the proposed design and conform to the U-factor requirements from the same tables. • Slab-on-grade floors shall match the F-factor for unheated slabs from the same tables. Opaque assemblies used for alterations shall conform with Section 5.1.3. c. **Vertical Fenestration**. For building area types included in Table G3.3, vertical fenestration areas for new buildings and additions shall equal that in Table G3.3, based on gross above grade exterior wall area. Where a building has multiple building area types, each type shall use the values in the table. The vertical fenestration shall be distributed on each face of the building in the same proportion as the proposed design. For building areas not shown in Table G3.3, vertical fenestration areas for new buildings and additions shall equal that in the proposed design or 40% of gross above-grade wall area, whichever is smaller, and shall be distributed on each face of the building in the same proportions in the proposed design. Fenestration U-factors shall match the appropriate in Tables ~~5.5-1 through 5.5-8~~ G3.4-1 through G3.4-8 for the applicable glazing percentage for U_{fixed}. Fenestration SHGC shall match the appropriate requirements in Tables ~~5.5-1 through 5.5-8~~ G3.4-1 through G3.4-8 using the value for $SHGC_{all}$ for the applicable vertical glazing percentage. All vertical glazing shall be assumed to be flush with the exterior wall, and no shading projections shall be modeled. Manual window shading devices such as blinds or shades are not required to be modeled. The fenestration areas for envelope alterations shall reflect the limitations on area, U-factor, and SHGC as described in Section 5.1.3. d. **Skylights and Glazed Smoke Vents**. Skylight area shall be equal to that in the proposed building design or 5% of the gross roof area that is part of the building envelope, whichever is smaller. If the skylight area of the proposed building design is greater than 5% of the gross roof area, baseline skylight area shall be decreased by an identical percentage in all roof components in which skylights are located to reach the 5% skylight-to-roof ratio. Skylight orientation and tilt shall be the same as in the proposed building design. Skylight U-factor and SHGC properties shall match the appropriate requirements in Tables ~~5.5-1 through 5.5-8~~ G3.4-1 through G3.4-8 using the value for skylights without curb and the applicable skylight percentage. e. **Roof Solar Reflectance and Thermal Emittance**. The exterior roof surfaces shall be ~~modeled with a solar reflectance and thermal emittance as required in Section 5.5.3.1.2(a). All other roofs, including roofs exempted from the requirements in Section 5.5.3.1.2, shall be~~ modeled using a solar reflectance of 0.30 and a thermal emittance of 0.90. f. **Existing Buildings**. For existing building envelopes, the baseline building design shall reflect existing conditions prior to any revisions that are part of the scope of work being evaluated.

TABLE G3.1 Modeling Requirements for Calculating Proposed and Baseline Building Performance (I-P and SI) *(Continued)*

No.	Proposed Building Performance	Baseline Building Performance
6.	**Lighting**	
	Lighting power in the proposed design shall be determined as follows: a. Where a complete lighting system exists, the actual lighting power for each thermal block shall be used in the model. b. Where a lighting system has been designed and submitted with design documents, lighting power shall be determined in accordance with Sections 9.1.3 and 9.1.4. c. Where lighting neither exists nor is ~~specified~~ submitted with design documents, lighting ~~power~~ shall comply with but not exceed the requirements of Section 9. Lighting power shall be determined in accordance with the Building Area Method ~~for the appropriate building type~~. d. Lighting system power shall include all lighting system components shown or provided for on the plans (including lamps and ballasts and task and furniture mounted fixtures). **Exception:** For multifamily dwelling units, hotel/motel guest rooms, and other spaces in which lighting systems are connected via receptacles and are not shown or provided for on building plans, assume identical lighting power for the proposed and baseline building designs in the simulations. e. Lighting power for parking garages and building facades shall be modeled. f. The lighting schedules in the proposed design shall reflect the mandatory automatic lighting control requirements in Section 9.4.1(e.g., programmable controls or occupancy sensors). **Exception:** Automatic daylighting controls required by Section 9.4.1 shall be modeled directly in the proposed building design or through schedule adjustments determined by a separate daylighting analysis approved by the rating authority g. Automatic lighting controls included in the proposed design but not required by Section 9.4.1 may be modeled directly in the building simulation or be modeled in the building simulation through schedule adjustments determined by a separate analysis approved by the authority having jurisdiction. As an alternative to modeling such lighting controls, the proposed design lighting power may be reduced by the sum of all additional allowances per section 9.6.2c and Table 9.6.2 which are calculated individually as the lighting power under control multiplied by cf, where cf is the appropriate control factor given in Table 9.6.2 corresponding to the space type and the lighting controls designed to be used. h. ~~For automatic lighting controls in addition to those required for minimum code compliance under Section 9.4.1, credit may be taken for automatically controlled systems~~ Credit may be taken for programmable timing controls or occupancy sensors. **Exception:** No credit is allowed for occupancy sensors in employee lunch and break rooms, conference/meeting rooms, and classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms.)	a. Interior ~~L~~lighting power in the baseline building design shall be determined using the ~~same categorization procedure (building area or space function) and categories as the proposed design with lighting power set equal to the maximum allowed for the corresponding method and category in Section 9.2~~ values in Table G3.7 and the methodology described in Section 9.6.1 and 9.6.2. Lighting shall be modeled having the automatic shutoff controls in buildings >5,000 ft^2 (500 m^2) and occupancy sensors in employee lunch and break rooms, conference/meeting rooms, and classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms) ~~and manual controls in Section 9.4.~~ Additional interior lighting power for nonmandatory controls allowed in Section 9.6.2 shall not be included in the baseline building design~~, as the lighting schedules used are understood to reflect the mandatory control requirements in this standard~~. Exterior lighting in areas identified as "Tradable Surfaces" in Table G3.6 shall be modeled with the baseline lighting power shown in Table G3.6. Other exterior lighting shall be modeled the same in the baseline building as in the proposed design. b. Mandatory automatic lighting controls required by Section 9.4.1 shall be modeled the same as the proposed design.
[. . .]		
10.	**HVAC Systems**	
	b. Where an HVAC system has been designed and submitted with design documents, the HVAC model shall be consistent with design documents. Mechanical equipment efficiencies shall be adjusted from actual design conditions to the standard rating conditions specified in Section 6.4.1 if required by the simulation model. [. . .] c. Where no heating system exists or no heating system has been ~~specified~~ submitted with design documents, the system ~~characteristics~~ type shall be ~~identical to~~ the same ~~system~~ as modeled in the baseline building design and shall comply with but not exceed the requirements of Section 6. d. Where no cooling system exists or no cooling system has been ~~specified~~ submitted with design documents, the cooling system type shall be ~~identical to~~ the same as ~~system~~ modeled in the baseline building design and shall comply with the requirements of Section 6.	

TABLE G3.1 Modeling Requirements for Calculating Proposed and Baseline Building Performance (I-P and SI) *(Continued)*

No.	Proposed Building Performance	Baseline Building Performance
11.	**Service Hot-Water Systems**	
	The service hot-water system type and all related performance parameters, such as equipment capacities and efficiencies, in the proposed design shall be determined as follows: [. . .] b. Where a service hot-water system has been ~~specified~~ designed and submitted with design documents, the service hot-water model shall be consistent with design documents. c. Where no service hot-water system exists or has been ~~specified~~ submitted with design documents but the building will have service hot-water loads, a service hot water system shall be modeled that matches the system type in the baseline building design, ~~and~~ serves the same hot-water loads, and shall comply with but not exceed the requirements of Section 7.	
12.	**Receptacle and Other Loads**	
	Receptacle and process, such as those for office and other equipment, shall be estimated based on the building type or space type category and shall be assumed to be identical in the proposed and baseline building designs, except as specifically authorized by the *rating authority* only when quantifying performance that exceeds the requirements of Standard 90.1 but not when the Performance Rating Method is used as an alternative path for minimum standard compliance per Section 4.2.1.1. These loads shall always be included in simulations of the building. ~~and~~ These loads shall be included when calculating the baseline building performance and proposed building performance as required by Section G1.2.1. a. Where power and other systems covered by Sections 8 and 10 have been designed and submitted with design documents, those systems shall be determined in accordance with Sections 8 and 10. b. Where power and other systems covered by Sections 8 and 10 have not been submitted with design documents, those systems shall comply with but not exceed the requirements of those sections.	Other systems, such as motors covered by Section 10, and miscellaneous loads shall be modeled as identical to those in the proposed design including schedules of operation and control of the equipment. Where there are specific efficiency requirements listed in Sections 5 through 10, these systems or components shall be modeled as having the lowest efficiency allowed by those requirements. Where no efficiency requirements exist, such energy used for cooking equipment, receptacle loads, computers, medical or laboratory equipment, and manufacturing and industrial process equipment not specifically identified in the standard power and energy rating or capacity of the equipment shall be identical between the baseline building and the proposed design. ~~with the following exception:~~ **Exception:** When quantifying performance that exceeds the requirements of Standard 90.1 (but not when using the Performance Rating Method as an alternative path for minimum standard compliance per Section 4.2.1.1), variations of the power requirements, schedules, or control sequences of the equipment modeled in the baseline building from those in the proposed design shall be allowed by the rating authority based upon documentation that the equipment installed in the proposed design represents a significant verifiable departure from documented current conventional practice. The burden of this documentation is to demonstrate that accepted conventional practice would result in baseline building equipment different from that installed in the proposed design. Occupancy and occupancy schedules shall not be changed.

TABLE G3.1.1A Baseline HVAC System Types (I-P and SI)

Building Type	Fossil Fuel, Fossil/Electric Hybrid, and Purchased Heat	Electric and Other
[. . .]		

Notes:

[. . .]

For laboratory spaces in a building having a total laboratory exhaust rate greater than 15,000 cfm (425 m^3/s), use a single system of type 5 or 7 serving only those spaces. For all-electric buildings, the heating shall be electric resistance

TABLE G3.4-1 Performance Rating Method Building Envelope Requirements for Climate Zone 1 (A,B)* (I-P)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.063	U-0.063	U-1.282
Walls, Above-Grade			
Steel-framed	U-0.124	U-0.124	U-0.352
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Floors			
Steel-joist	U-0.350	U-0.350	U-0.350
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
Opaque Doors			
Swinging	U-0.700	U-0.700	U-0.700
Nonswinging	U-1.450	U-1.450	U-1.450

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
Skylight All, % of Roof						
0%–2.0%	U_{all}-1.36	$SHGC_{all}$-0.36	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-2 Performance Rating Method Building Envelope Requirements for Climate Zone 2 (A,B)* (I-P)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.063	U-0.063	U-0.218
Walls, Above-Grade			
Steel-framed	U-0.124	U-0.124	U-0.352
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Floors			
Steel-joist	U-0.052	U-0.052	U-0.350
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
Opaque Doors			
Swinging	U-0.700	U-0.700	U-0.700
Nonswinging	U-1.450	U-1.450	U-1.450

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
Skylight All, % of Roof						
0%–2.0%	U_{all}-1.36	$SHGC_{all}$-0.36	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-3 Performance Rating Method Building Envelope Requirements for Climate Zone 3 (A,B,C)* (I-P)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.063	U-0.063	U-0.218
Walls, Above-Grade			
Steel-framed	U-0.124	U-0.084	U-0.352
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Floors			
Steel-joist	U-0.052	U-0.052	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
Opaque Doors			
Swinging	U-0.700	U-0.700	U-0.700
Nonswinging	U-1.450	U-0.500	U-1.450

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-0.57	$SHGC_{all}$-0.25	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-0.57	$SHGC_{all}$-0.25	U_{all}-0.57	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-0.57	$SHGC_{all}$-0.25	U_{all}-0.57	$SHGC_{all}$-0.25	U_{all}-1.22	$SHGC_{all}$-NR
Skylight All, % of Roof						
0%–2.0%	U_{all}-0.69	$SHGC_{all}$-0.39	U_{all}-0.69	$SHGC_{all}$-0.36	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-0.69	$SHGC_{all}$-0.19	U_{all}-0.69	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR

Fenestration (for Zone 3C)	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-1.22	$SHGC_{all}$-0.61	U_{all}-1.22	$SHGC_{all}$-0.61	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-1.22	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-0.61	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-1.22	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-1.22	$SHGC_{all}$-0.34	U_{all}-1.22	$SHGC_{all}$-0.34	U_{all}-1.22	$SHGC_{all}$-NR
Skylight All, % of Roof						
0%–2.0%	U_{all}-1.36	$SHGC_{all}$-0.61	U_{all}-1.36	$SHGC_{all}$-0.39	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-1.36	$SHGC_{all}$-0.39	U_{all}-1.36	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.
b. Insulation is not required for nonresidential mass walls in Climate Zone 3A located below the "Warm-Humid" line, and in Zone 3B.

TABLE G3.4-4 Performance Rating Method Building Envelope Requirements for Climate Zone 4 (A,B,C)* (I-P)

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum		Assembly Maximum		Assembly Maximum	
Roofs						
Insulation entirely above deck	U-0.063		U-0.063		U-0.218	
Walls, Above-Grade						
Steel-framed	U-0.124		U-0.064		U-0.124	
Wall, Below-Grade						
Below-grade wall	C-1.140		C-1.140		C-1.140	
Floors						
Steel-joist	U-0.052		U-0.038		U-0.069	
Slab-on-Grade Floors						
Unheated	F-0.730		F-0.730		F-0.730	
Opaque Doors						
Swinging	U-0.700		U-0.700		U-0.700	
Nonswinging	U-1.450		U-0.500		U-1.450	
Fenestration	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-0.58	$SHGC_{all}$-0.36	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-0.69	$SHGC_{all}$-0.39	U_{all}-0.58	$SHGC_{all}$-0.19	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-5 Performance Rating Method Building Envelope Requirements for Climate Zone 5 (A,B,C)* (I-P)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.063	U-0.063	U-0.173
Walls, Above-Grade			
Steel-framed	U-0.084	U-0.064	U-0.124
Wall, Below-Grade			
Below-grade wall	C-1.140	C-1.140	C-1.140
Floors			
Steel-joist	U-0.052	U-0.038	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
Opaque Doors			
Swinging	U-0.700	U-0.700	U-0.700
Nonswinging	U-1.450	U-0.500	U-1.450

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-0.69	$SHGC_{all}$-0.39	U_{all}-0.69	$SHGC_{all}$-0.39	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.

TABLE G3.4-6 Performance Rating Method Building Envelope Requirements for Climate Zone 6 (A,B)* (I-P)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.063	U-0.063	U-0.173
Walls, Above-Grade			
Steel-framed	U-0.084	U-0.064	U-0.124
Wall, Below-Grade			
Below-grade wall	C-1.140	C-0.119	C-1.140
Floors			
Steel-joist	U-0.038	U-0.038	U-0.069
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.730	F-0.730
Opaque Doors			
Swinging	U-0.700	U-0.500	U-0.700
Nonswinging	U-0.500	U-0.500	U-1.450

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-0.57	$SHGC_{all}$-0.39	U_{all}-1.22	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-0.58	$SHGC_{all}$-0.49	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-0.69	$SHGC_{all}$-0.49	U_{all}-0.58	$SHGC_{all}$-0.39	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.

TABLE G3.4-7 Performance Rating Method Building Envelope Requirements for Climate Zone 7* (I-P)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.063	U-0.063	U-0.173
Walls, Above-Grade			
Steel-framed	U-0.064	U-0.064	U-0.124
Wall, Below-Grade			
Below-grade wall	C-0.119	C-0.119	C-1.140
Floors			
Steel-joist	U-0.038	U-0.038	U-0.052
Slab-on-Grade Floors			
Unheated	F-0.730	F-0.540	F-0.730
Opaque Doors			
Swinging	U-0.700	U-0.500	U-0.700
Nonswinging	U-0.500	U-0.500	U-1.450

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-0.57	$SHGC_{all}$-0.49	U_{all}-1.22	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-0.69	$SHGC_{all}$-0.68	U_{all}-0.69	$SHGC_{all}$-0.64	U_{all}-1.36	$SHGC_{all}$-NR
2.1%+	U_{all}-0.69	$SHGC_{all}$-0.64	U_{all}-0.69	$SHGC_{all}$-0.64	U_{all}-1.36	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.

TABLE G3.4-8 Performance Rating Method Building Envelope Requirements for Climate Zone 8* (I-P)

	Nonresidential		Residential		Semiheated	
Opaque Elements	**Assembly Maximum**		**Assembly Maximum**		**Assembly Maximum**	
Roofs						
Insulation entirely above deck	U-0.048		U-0.048		U-0.093	
Walls, Above-Grade						
Steel-framed	U-0.064		U-0.055		U-0.124	
Wall, Below-Grade						
Below-grade wall	C-0.119		C-0.119		C-1.140	
Floors						
Steel-joist	U-0.038		U-0.032		U-0.052	
Slab-on-Grade Floors						
Unheated	F-0.540		F-0.520		F-0.730	
Opaque Doors						
Swinging	U-0.500		U-0.500		U-0.700	
Nonswinging	U-0.500		U-0.500		U-1.450	
Fenestration	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-1.22	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-1.22	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-1.22	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-0.46	$SHGC_{all}$-NR	U_{all}-1.22	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-0.58	$SHGC_{all}$-NR	U_{all}-0.58	$SHGC_{all}$-NR	U_{all}-0.81	$SHGC_{all}$-NR
2.1%+	U_{all}-0.58	$SHGC_{all}$-NR	U_{all}-0.58	$SHGC_{all}$-NR	U_{all}-0.81	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.5.1 Performance Rating Method Air Conditioners (I-P)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air conditioners, air-cooled	<65,000 Btu/h	All	Single-package	9.7 SEER	ARI 210/240
Air conditioners, air-cooled	≥65,000 Btu/h and <135,000 Btu/h	All	Split-system and single-package	10.1 EER	ARI 340/360
	≥135,000 Btu/h and <240,000 Btu/h	All	Split-system and single-package	9.5 EER	
	≥240,000 Btu/h and <760,000 Btu/h	All	Split-system and single-package	9.3 EER 9.4 IEER	
	≥760,000 Btu/h	All	Split-system and single-package	9.0 EER 9.1 IEER	

TABLE G3.5.2 Performance Rating Method Electrically Operated Unitary and Applied Heat Pumps—Minimum Efficiency Requirements (I-P)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air-cooled (cooling mode)	<65,000 Btu/h	All	Single package	9.7 SEER	ARI 210/240
Air-cooled (cooling mode)	≥65,000 Btu/h and <135,000 Btu/h	All	Split-system and single-package	9.9 EER	ARI 340/360
	≥135,000 Btu/h and <240,000 Btu/h	All	Split-system and single-package	9.1 EER	
	≥240,000 Btu/h	All	Split-system and single-package	8.8 EER 8.9 IEER	
Air-cooled (heating mode)	<65,000 Btu/h (cooling capacity)	—	Single-package	6.6 HSPF	ARI 210/240
Air-cooled (heating mode)	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.2 COP	ARI 340/360
			17°F db/15°F wb outdoor air	2.2 COP	
	≥135,000 Btu/h (cooling capacity)	—	47°F db/43°F wb outdoor air	3.1 COP	
			17°F db/15°F wb outdoor air	2.0 COP	

TABLE G3.5.3 Performance Rating Method Water Chilling Packages—Minimum Efficiency Requirements (I-P)

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

TABLE G3.5.4 Performance Rating Method Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps (I-P)

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

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

TABLE G3.5.5 Warm-Air Furnaces and Unit Heaters (I-P)

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

TABLE G3.5.6 Gas-Fired Boilers—Minimum Efficiency Requirements (I-P)

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

TABLE G3.6 Lighting Power Densities for Building Exteriors (I-P)

Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.)	**Uncovered Parking Areas**	
	Parking lots and drives	0.15 W/ft^2
	Building Grounds	
	Walkways less than 10 ft wide	1.0 W/linear foot
	Walkways 10 ft wide or greater	
	Plaza areas	0.2 W/ft^2
	Special feature areas	
	Stairways	1.0 W/ft^2
	Building Entrances and Exits	
	Main entries	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width
	Canopies and Overhangs	
	Canopies (free standing and attached and overhangs)	1.25 W/ft^2
	Outdoor Sales	
	Open areas (including vehicle sales lots)	0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to open-area allowance	20 W/linear foot
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	**Building Facades**	0.2 W/ft^2 for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
	Automated teller machines (ATMs) and night depositories	270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities	1.25 W/ft^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	0.5 W/ft^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	Drive-up windows at fast food restaurants	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry

TABLE G3.7 Performance Rating Method Lighting Power Density Allowances Using the Space-by-Space Method (I-P)

Common Space Types[a]	Lighting Power Density, W/ft^2	Building Type Specific Space Types1	Lighting Power Density, W/ft^2
Audience Seating Area		**Assisted Living Facility**	
... in an auditorium	0.90	*... in a chapel (used primarily by residents)*	2.77
... in a convention center	0.70	*... in a recreation room (used primarily by residents)*	3.02
... in an exercise center	0.30	**Automotive (See "Vehicular Maintenance Area")**	
... in a gymnasium	0.40	**Convention Center—Exhibit Space**	1.30
... in a motion picture theater	1.20	**Dormitory—Living Quarters**	1.11
... in a penitentiary	0.70	**Fire Station—Sleeping Quarters**	0.30
... in a performing arts theater	2.60	**Gymnasium/Fitness Center**	
... in a religious building	1.70	*... in an exercise area*	0.90
... in a sports arena	0.40	*... in a playing area*	1.40
... in a transportation facility	0.50	**Healthcare Facility**	
... all other audience seating area	0.90	*... in an emergency room*	2.70
Atrium		*... in an exam/treatment room*	1.50
... that is ≤40 ft in height	0.0375 per foot in total height	*... in an imaging room*	0.40
... that is >40 ft in height	0.50 + 0.025 per foot in total height	*....in a medical supply room*	1.40
Banking Activity Area	1.50	*... in a nursery*	0.60
Breakroom (See Lounge/ Breakroom)		*... in a nurse's station*	1.00
Classroom/Lecture Hall/ Training Room		*... in an operating room*	2.20
... in a penitentiary	1.30	*... in a patient room*	0.70
... all other classroom/lecture hall/training room	1.40	*... in a physical therapy room*	0.90
Conference/Meeting/ Multipurpose Room	1.30	*... in a recovery room*	0.80
Confinement Cells	0.90	**Library**	
Copy/Print Room	0.90	*... in a reading area*	1.20
Corridor		*... in the stacks*	1.70
... in an assisted living facility (and used primarily by residents)	1.15	**Manufacturing Facility**	
... in a hospital	1.00	*... in a detailed manufacturing area*	2.10
... in a manufacturing facility	0.50	*... in an equipment room*	1.20
... all other corridor	0.50	*... in an extra-high bay area (>50 ft floor-to-ceiling height)*	1.32
Courtroom	1.90	*... in a high bay area (25–50 ft floor-to-ceiling height)*	1.70
Computer Room	2.14	*... in a low bay area (<25 ft floor-to-ceiling height)*	1.20

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply

TABLE G3.7 Performance Rating Method Lighting Power Density Allowances Using the Space-by-Space Method (I-P) *(Continued)*

Common Space Types[a]	Lighting Power Density, W/ft^2	Building Type Specific Space Types1	Lighting Power Density, W/ft^2
Dining Area		**Museum**	
... in a penitentiary	1.30	*... in a general exhibition area*	1.00
... in an assisted living facility (and used primarily by residents)	3.32	*... in a restoration room*	1.70
... in bar/lounge or leisure dining	1.40	**Post Office—Sorting Area**	1.20
... in cafeteria or fast food dining	0.90	**Religious Buildings**	
... in family dining	2.10	*... in a fellowship hall*	0.90
... all other dining area	0.90	*... in a worship/pulpit/choir area*	2.40
Electrical/Mechanical Room	1.50	**Retail Facilities**	
Emergency Vehicle Garage	0.80	*... in a dressing/fitting room*	0.89
Food Preparation Area	1.20	*... in a mall concourse*	1.70
Guest Room	1.10	**Sports Arena—Playing Area**	
Judges Chambers	1.30	*... for a Class I facility*	4.61
Laboratory		*... for a Class II facility*	3.01
... in or as a classroom	1.40	*... for a Class III facility*	2.26
... all other laboratory	1.40	*... for a Class IV facility*	1.50
Laundry/Washing Area	0.60	**Transportation Facility**	
Loading Dock, Interior	0.59	*... in a baggage/carousel area*	1.00
Lobby		*... in an airport concourse*	0.60
... in an assisted living facility (and used primarily by residents)	2.26	*... at a terminal ticket counter*	1.50
... for an elevator	0.80	**Warehouse—Storage Area**	
... in a hotel	1.10	*...for medium to bulky, palletized items*	0.90
... in a motion picture theater	1.10	*... for smaller, hand-carried items*	1.40
... in a performing arts theater	3.30		
... all other lobby	1.30		
Locker Room	0.60		
Lounge/Breakroom			
... in a healthcare facility	0.80		
... all other lounge/breakroom	1.20		
Office			
... enclosed	1.10		
... open plan	1.10		
Parking Area, Interior	0.20		
Pharmacy Area	1.20		
Restroom			
... in an assisted living facility (and used primarily by residents)	1.52		
... all other restroom	0.90		

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply

TABLE G3.7 Performance Rating Method Lighting Power Density Allowances Using the Space-by-Space Method (I-P) *(Continued)*

Common Space Types[a]	Lighting Power Density, W/ft^2	Building Type Specific Space Types1	Lighting Power Density, W/ft^2
Sales Area	1.70		
Seating Area, General	0.68		
Stairwell	0.60		
Storage Room			
... in a hospital	0.90		
... that is ≥50 ft^2	0.80		
... that is <50 ft^2	0.80		
Vehicular Maintenance Area	0.70		
Workshop	1.90		

a. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply

TABLE G3.8 Performance Rating Method Lighting Power Densities Using the Building area Method (I-P)

Building Area Type	Lighting Power Density, W/ft^2
Automotive facility	0.90
Convention center	1.20
Courthouse	1.20
Dining: Bar lounge/leisure	1.30
Dining: Cafeteria/fast food	1.40
Dining: Family	1.60
Dormitory	1.00
Exercise center	1.00
Fire station	1.00
Gymnasium	1.10
Health-care clinic	1.00
Hospital	1.20
Hotel	1.00
Library	1.30
Manufacturing facility	1.30
Motel	1.00
Motion picture theater	1.20
Multifamily	0.70
Museum	1.10
Office	1.00
Parking garage	0.30
Penitentiary	1.00
Performing arts theater	1.60
Police station	1.00
Post office	1.10
Religious building	1.30
Retail	1.50
School/university	1.20
Sports arena	1.10
Town hall	1.10
Transportation	1.00
Warehouse	0.80
Workshop	1.40

TABLE G3.4-1 Performance Rating Method Building Envelope Requirements for Climate Zone 1 (A,B)* (SI)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.360	U-0.360	U-7.280
Walls, Above-Grade			
Steel-framed	U-0.705	U-0.705	U-1.998
Wall, Below-Grade			
Below-grade wall	C-6.473	C-6.473	C-6.473
Floors			
Steel-joist	U-1.986	U-1.986	U-1.986
Slab-on-Grade Floors			
Unheated	F-1.264	F-1.264	F-1.264
Opaque Doors			
Swinging	U-3.975	U-3.975	U-3.975
Nonswinging	U-8.233	U-8.233	U-8.233

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-NR
10.1%–20.0%	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-NR
20.1%–30.0%	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-NR
30.1%–40.0%	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-0.25	U_{alt}-6.93	$SHGC_{alt}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{alt}-7.72	$SHGC_{alt}$-0.36	U_{alt}-7.72	$SHGC_{alt}$-0.19	U_{alt}-7.72	$SHGC_{alt}$-NR
2.1%+	U_{alt}-7.72	$SHGC_{alt}$-0.19	U_{alt}-7.72	$SHGC_{alt}$-0.19	U_{alt}-7.72	$SHGC_{alt}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-2 Performance Rating Method Building Envelope Requirements for Climat2e Zone 2 (A,B)* (SI)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.360	U-0.360	U-1.240
Walls, Above-Grade			
Steel-framed	U-0.705	U-0.705	U-1.998
Wall, Below-Grade			
Below-grade wall	C-6.473	C-6.473	C-6.473
Floors			
Steel-joist	U-0.296	U-0.296	U-1.986
Slab-on-Grade Floors			
Unheated	F-1.264	F-1.264	F-1.264
Opaque Doors			
Swinging	U-3.975	U-3.975	U-3.975
Nonswinging	U-8.233	U-8.233	U-8.233

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-7.72	$SHGC_{all}$-0.36	U_{all}-7.72	$SHGC_{all}$-0.19	U_{all}-7.72	$SHGC_{all}$-NR
2.1%+	U_{all}-7.72	$SHGC_{all}$-0.19	U_{all}-7.72	$SHGC_{all}$-0.19	U_{all}-7.72	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-3 Performance Rating Method Building Envelope Requirements for Climate Zone 3 (A,B,C)* (SI)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.360	U-0.360	U-1.240
Walls, Above-Grade			
Steel-framed	U-0.705	U-0.479	U-1.998
Wall, Below-Grade			
Below-grade wall	C-6.473	C-6.473	C-6.473
Floors			
Steel-joist	U-0.296	U-0.296	U-0.390
Slab-on-Grade Floors			
Unheated	F-1.264	F-1.264	F-1.264
Opaque Doors			
Swinging	U-3.975	U-3.975	U-3.975
Nonswinging	U-8.233	U-2.839	U-8.233

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-3.24	$SHGC_{all}$-0.25	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-3.24	$SHGC_{all}$-0.25	U_{all}-3.24	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-3.24	$SHGC_{all}$-0.25	U_{all}-3.24	$SHGC_{all}$-0.25	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-3.92	$SHGC_{all}$-0.39	U_{all}-3.92	$SHGC_{all}$-0.36	U_{all}-7.72	$SHGC_{all}$-NR
2.1%+	U_{all}-3.92	$SHGC_{all}$-0.19	U_{all}-3.92	$SHGC_{all}$-0.19	U_{all}-7.72	$SHGC_{all}$-NR
Fenestration (for Zone 3C)	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-6.93	$SHGC_{all}$-0.61	U_{all}-6.93	$SHGC_{all}$-0.61	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-6.93	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-0.61	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-6.93	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-6.93	$SHGC_{all}$-0.34	U_{all}-6.93	$SHGC_{all}$-0.34	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-7.72	$SHGC_{all}$-0.61	U_{all}-7.72	$SHGC_{all}$-0.39	U_{all}-7.72	$SHGC_{all}$-NR
2.1%–5.0%	U_{all}-7.72	$SHGC_{all}$-0.39	U_{all}-7.72	$SHGC_{all}$-0.19	U_{all}-7.72	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.
b. Insulation is not required for nonresidential mass walls in Climate Zone 3A located below the "Warm-Humid" line, and in Zone 3B.

TABLE G3.4-4 Performance Rating Method Building Envelope Requirements for Climate Zone 4 (A,B,C)* (SI)

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum		Assembly Maximum		Assembly Maximum	
Roofs						
Insulation entirely above deck	U-0.360		U-0.360		U-1.240	
Walls, Above-Grade						
Steel-framed	U-0.705		U-0.365		U-0.705	
Wall, Below-Grade						
Below-grade wall	C-6.473		C-6.473		C-6.473	
Floors						
Steel-joist	U-0.296		U-0.214		U-0.390	
Slab-on-Grade Floors						
Unheated	F-1.264		F-1.264		F-1.264	
Opaque Doors						
Swinging	U-3.975		U-3.975		U-3.975	
Nonswinging	U-8.233		U-2.839		U-8.233	
Fenestration	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-3.92	$SHGC_{all}$-0.49	U_{all}-3.29	$SHGC_{all}$-0.36	U_{all}-7.72	$SHGC_{all}$-NR
2.1%+	U_{all}-3.92	$SHGC_{all}$-0.39	U_{all}-3.29	$SHGC_{all}$-0.19	U_{all}-7.72	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-5 Performance Rating Method Building Envelope Requirements for Climate Zone 5 (A,B,C)* (SI)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.360	U-0.360	U-0.982
Walls, Above-Grade			
Steel-framed	U-0.479	U-0.365	U-0.705
Wood-framed and other	U-0.504	U-0.504	U-0.504
Wall, Below-Grade			
Below-grade wall	C-6.473	C-6.473	C-6.473
Floors			
Steel-joist	U-0.296	U-0.214	U-0.390
Slab-on-Grade Floors			
Unheated	F-1.264	F-1.264	F-1.264
Opaque Doors			
Swinging	U-3.975	U-3.975	U-3.975
Nonswinging	U-8.233	U-2.839	U-8.233

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-3.92	$SHGC_{all}$-0.49	U_{all}-3.92	$SHGC_{all}$-0.49	U_{all}-7.72	$SHGC_{all}$-NR
2.1%+	U_{all}-3.92	$SHGC_{all}$-0.39	U_{all}-3.92	$SHGC_{all}$-0.39	U_{all}-7.72	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-6 Performance Rating Method Building Envelope Requirements for Climate Zone 6 (A,B)* (SI)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.360	U-0.360	U-0.982
Walls, Above-Grade			
Steel-framed	U-0.479	U-0.365	U-0.705
Wall, Below-Grade			
Below-grade wall	C-6.473	C-0.678	C-6.473
Floors			
Steel-joist	U-0.214	U-0.214	U-0.390
Slab-on-Grade Floors			
Unheated	F-1.264	F-1.260	F-1.264
Opaque Doors			
Swinging	U-3.975	U-2.839	U-3.975
Nonswinging	U-2.839	U-2.839	U-8.233

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-3.24	$SHGC_{all}$-0.39	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-3.92	$SHGC_{all}$-0.49	U_{all}-3.29	$SHGC_{all}$-0.49	U_{all}-7.72	$SHGC_{all}$-NR
2.1%+	U_{all}-3.92	$SHGC_{all}$-0.49	U_{all}-3.29	$SHGC_{all}$-0.39	U_{all}-7.72	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-7 Performance Rating Method Building Envelope Requirements for Climate Zone 7* (SI)

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum		Assembly Maximum		Assembly Maximum	
Roofs						
Insulation entirely above deck	U-0.360		U-0.360		U-0.982	
Walls, Above-Grade						
Steel-framed	U-0.365		U-0.365		U-0.705	
Wall, Below-Grade						
Below-grade wall	C-0.678		C-0.678		C-6.473	
Floors						
Steel-joist	U-0.214		U-0.214		U-0.296	
Slab-on-Grade Floors						
Unheated	F-1.264		F-0.935		F-1.264	
Opaque Doors						
Swinging	U-3.975		U-2.839		U-3.975	
Nonswinging	U-2.839		U-2.839		U-8.233	
Fenestration	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-3.24	$SHGC_{all}$-0.49	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-3.92	$SHGC_{all}$-0.68	U_{all}-3.92	$SHGC_{all}$-0.64	U_{all}-7.72	$SHGC_{all}$-NR
2.1%+	U_{all}-3.92	$SHGC_{all}$-0.64	U_{all}-3.92	$SHGC_{all}$-0.64	U_{all}-7.72	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.4-8 Performance Rating Method Building Envelope Requirements for Climate Zone 8* (SI)

Opaque Elements	Nonresidential	Residential	Semiheated
	Assembly Maximum	Assembly Maximum	Assembly Maximum
Roofs			
Insulation entirely above deck	U-0.273	U-0.273	U-0.527
Walls, Above-Grade			
Steel-framed	U-0.365	U-0.315	U-0.705
Wall, Below-Grade			
Below-grade wall	C-0.678	C-0.678	C-6.473
Floors			
Steel-joist	U-0.214	U-0.183	U-0.296
Slab-on-Grade Floors			
Unheated	F-0.935	F-0.900	F-1.264
Opaque Doors			
Swinging	U-2.839	U-2.839	U-3.975
Nonswinging	U-2.839	U-2.839	U-8.233

Fenestration	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC	Assembly Max. U	Assembly Max. SHGC
Vertical Glazing, % of Wall						
0%–10.0%	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-6.93	$SHGC_{all}$-NR
10.1%–20.0%	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-6.93	$SHGC_{all}$-NR
20.1%–30.0%	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-6.93	$SHGC_{all}$-NR
30.1%–40.0%	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-2.61	$SHGC_{all}$-NR	U_{all}-6.93	$SHGC_{all}$-NR
Skylight, All, % of Roof						
0%–2.0%	U_{all}-3.29	$SHGC_{all}$-NR	U_{all}-3.29	$SHGC_{all}$-NR	U_{all}-4.60	$SHGC_{all}$-NR
2.1%+	U_{all}-3.29	$SHGC_{all}$-NR	U_{all}-3.29	$SHGC_{all}$-NR	U_{all}-4.60	$SHGC_{all}$-NR

* The following definitions apply: c.i. = continuous insulation (see Section 3.2), NR = no (insulation) requirement.
a. Exception to A3.1.3.1 applies.

TABLE G3.5.1 Performance Rating Method Air Conditioners (SI)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air conditioners, air-cooled	<19 kW	All	Single-package	2.84 SCOP	ARI 210/240
Air conditioners, air-cooled	≥19 kW and <40 kW	All	Split-system and single-package	2.96 COP	ARI 340/360
	≥40 kW and <70 kW	All	Split-system and single-package	2.78 COP	
	≥70 kW and <223 kW	All	Split-system and single-package	2.73 COP 2.76 ICOP	
	≥223 kW	All	Split-system and single-package	2.64 COP 2.67 ICOP	

TABLE G3.5.2 Performance Rating Method Electrically Operated Unitary and Applied Heat Pumps—Minimum Efficiency Requirements (SI)

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Air-cooled (cooling mode)	<19 kW	All	Single-package	9.7 SEER	ARI 210/240
Air-cooled (cooling mode)	≥19 kW and <40 kW	All	Split-system and single-package	9.9 EER	ARI 340/360
	≥40 kW and <70 kW	All	Split-system and single-package	9.1 EER	
	≥70 kW	All	Split-system and single-package	2.58 COP 2.61 ICOP	
Air-cooled (heating mode)	<19 kW (Cooling Capacity)	—	Single-package	6.6 HSPF	ARI 210/240
Air-cooled (heating mode)	≥19 kW and <40 kW (Cooling Capacity)	—	8.3°C db/6.1°C wb outdoor air	3.2 COP	ARI 340/360
			–8.3°C db/–9.4°C wb outdoor air	2.2 COP	
	≥40 kW (Cooling Capacity)	—	8.3°Cdb/6.1°C wb outdoor air	3.1 COP	
			–8.3°C db/-9.4°C wb outdoor air 8.3°C db/6.1°C wb	2.0 COP	

TABLE G3.5.3 Performance Rating Method Water Chilling Packages—Minimum Efficiency Requirements (SI)

Equipment Type	Size Category	Unit	Minimum Efficiency	Test Procedure
Water-cooled, electrically operated, positive displacement (rotary screw and scroll)	<528 kW	COP	4.45 COP 5.20 IPLV	ARI 550/590
	≥528 kW and <1055 kW		4.90 COP 5.60 IPLV	
	≥1055 kW		5.50 COP 6.15 IPLV	
Water-cooled, electrically operated, centrifugal	<528 kW		5.00 COP 5.25 IPLV	ARI 550/590
	≥528 kW and <1055 kW		5.55 COP 5.90 IPLV	
	≥1055 kW		6.10 COP 6.40 IPLV	

TABLE G3.5.4 Performance Rating Method Electrically Operated Packaged Terminal Air Conditioners, Packaged Terminal Heat Pumps (SI)

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[a]	Test Procedure
PTAC (cooling mode)	All capacities	35°C db outdoor air	3.66 – (0.213 × Cap/1000) COP	ARI 310/380
PTHP (cooling mode)	All capacities	35°C db outdoor air	3.60 – (0.213 × Cap/1000) COP	
PTHP (heating mode)	All capacities		3.2 – (0.026 × Cap/1000) COP	

a. "Cap" means the rated cooling capacity of the product in kW. If the unit's capacity is less than 2.1 kW, use 2.1 kW in the calculation. If the unit's capacity is greater than 4.4 kW, use 4.4 kW in the calculation.

TABLE G3.5.5 Warm-Air Furnaces and Unit Heaters (SI)

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Warm-air furnace, gas-fired	<66 kW	—	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or ANSI Z21.47
	≥66 kW	Maximum capacity	80% E_c	ANSI Z21.47
Warm-air unit heaters, gas-fired	All capacities	Maximum capacity	80% E_c	ANSI Z83.8

TABLE G3.5.6 Gas- and Oil-Fired Boilers—Minimum Efficiency Requirements (SI)

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Boilers, gas-fired	≤88 kW	Hot water	80% AFUE	DOE 10 CFR Part 430
	≥88 kW and ≤733 kW	Maximum capacity	75% E_t	DOE 10 CFR Part 431
	>733 kW	Hot water	80% E_c	

TABLE G3.6 Lighting Power Densities for Building Exteriors (SI)

Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.)	**Uncovered Parking Areas**		
		Parking lots and drives	1.6 W/m^2
	Building Grounds		
		Walkways less than 3 m wide	3.3 W/linear metre
		Walkways 3 m wide or greater	
		Plaza areas	2.2 W/m^2
		Special feature areas	
		Stairways	10.8 W/m^2
	Building Entrances and Exits		
		Main entries	98 W/linear metre of door width
		Other doors	66 W/linear metre of door width
	Canopies and Overhangs		
	Canopies (free standing and attached and overhangs)		13.5 W/m^2
	Outdoor Sales		
		Open areas (including vehicle sales lots)	5.4 W/m^2
		Street frontage for vehicle sales lots in addition to open-area allowance	66 W/linear metre
Nontradable Surfaces (Lighting power density calculations for the following applications can be used only for the specific application and cannot be traded between surfaces or with other exterior lighting. The following allowances are in addition to any allowance otherwise permitted in the "Tradable Surfaces" section of this table.)	**Building Facades**		2.2 W/m^2 for each illuminated wall or surface or 5.0W/linear meter for each illuminated wall or surface length
	Automated teller machines (ATMs) and night depositories		270 W per location plus 90 W per additional ATM per location
	Entrances and gatehouse inspection stations at guarded facilities		13.5 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		5.4 W/m^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
	Drive-up windows at fast food restaurants		400 W per drive-through
	Parking near 24-hour retail entrances		800 W per main entry

TABLE G3.7 Performance Rating Method Lighting Power Density Allowances Using the Space-by-Space Method (SI)

Common Space Types[1]	Lighting Power Density, W/m^2	Building Type Specific Space Types1	Lighting Power Density, W/m^2
Audience Seating Area		**Assisted Living Facility**	
... in an auditorium	9.69	*... in a chapel (used primarily by residents)*	29.82
... in a convention center	7.53	*... in a recreation room (used primarily by residents)*	32.51
... in an exercise center	3.23	**Automotive (See "Vehicular Maintenance Area")**	
... in a gymnasium	4.41	**Convention Center—Exhibit Space**	13.99
... in a motion picture theater	12.92	**Dormitory—Living Quarters**	11.95
... in a penitentiary	7.53	**Fire Station—Sleeping Quarters**	3.23
... in a performing arts theater	27.99	**Gymnasium/Fitness Center**	
... in a religious building	18.30	*... in an exercise area*	9.69
... in a sports arena	4.31	*... in a playing area*	15.07
... in a transportation facility	5.38	**Healthcare Facility**	
... all other audience seating area	9.69	*... in an emergency room*	29.06
Atrium		*... in an exam/treatment room*	16.15
... that is ≤12.2 m in height	0.404 per meter in total height	*... in an imaging room*	4.31
... that is >12.2 m in height	5.382 + 0.269 per meter in total height	*....in a medical supply room*	15.07
Banking Activity Area	16.15	*... in a nursery*	6.46
Breakroom (See Lounge/ Breakroom)		*... in a nurse's station*	10.76
Classroom/Lecture Hall/ Training Room		*... in an operating room*	23.68
... in a penitentiary	13.99	*... in a patient room*	7.53
... all other classroom/lecture hall/ training	15.07	*... in a physical therapy room*	9.69
Conference/Meeting/ Multipurpose Room	13.99	*... in a recovery room*	8.61
Confinement Cells	9.69	**Library**	
Copy/Print Room	9.69	*... in a reading area*	12.92
Corridor		*... in the stacks*	18.30
... in an assisted living facility (and used primarily by residents)	12.38	**Manufacturing Facility**	
... in a hospital	10.76	*... in a detailed manufacturing area*	22.60
... in a manufacturing facility	5.38	*... in an equipment room*	12.92
... all other corridor	5.38	*... in an extra-high bay area (>15.2 m floor-to-ceiling height)*	14.21
Courtroom	20.45	*... in a high bay area (7.6–15.2 m floor-to-ceiling height)*	18.30
Computer Room	23.03	*... in a low bay area (<7.6 m floor-to-ceiling height)*	12.92

1. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply

TABLE G3.7 Performance Rating Method Lighting Power Density Allowances Using the Space-by-Space Method (SI) *(Continued)*

Common Space Types[1]	Lighting Power Density, W/m^2	Building Type Specific Space Types1	Lighting Power Density, W/m^2
Dining Area		**Museum**	
… in a penitentiary	13.99	*... in a general exhibition area*	10.76
... in an assisted living facility (and used primarily by residents)	35.74	*... in a restoration room*	18.30
... in bar/lounge or leisure dining	15.07	**Post Office—Sorting Area**	12.92
... in cafeteria or fast food dining	9.69	**Religious Buildings**	
... in family dining	22.60	*... in a fellowship hall*	9.69
... all other dining area	9.69	*... in a worship/pulpit/choir area*	25.83
Electrical/Mechanical Room	16.15	**Retail Facilities**	
Emergency Vehicle Garage	8.61	*... in a dressing/fitting room*	9.58
Food Preparation Area	12.92	*... in a mall concourse*	18.30
Guest Room	11.84	**Sports Arena—Playing Area**	
Judges Chambers	13.99	*... for a Class I facility*	49.62
Laboratory		*... for a Class II facility*	32.40
... in or as a classroom	15.07	*... for a Class III facility*	24.33
... all other laboratory	15.07	*... for a Class IV facility*	16.15
Laundry/Washing Area	6.46	**Transportation Facility**	
Loading Dock, Interior	6.35	*... in a baggage/carousel area*	10.76
Lobby		*... in an airport concourse*	6.46
... in an assisted living facility (and used primarily by residents)	24.33	*... at a terminal ticket counter*	16.15
... for an elevator	8.61	**Warehouse—Storage Area**	
... in a hotel	11.84	*...for medium to bulky, palletized items*	9.69
... in a motion picture theater	11.84	*... for smaller, hand-carried items*	15.07
... in a performing arts theater	35.52		
... all other lobby	13.99		
Locker Room	6.46		
Lounge/Breakroom			
... in a healthcare facility	8.61		
... all other lounge/breakroom	12.92		
Office			
... enclosed	11.84		
... open plan	11.84		
Parking Area, Interior	2.15		
Pharmacy Area	12.92		
Restroom			
... in an assisted living facility (and used primarily by residents)	16.36		
... all other restroom	9.69		

1. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply

TABLE G3.7 Performance Rating Method Lighting Power Density Allowances Using the Space-by-Space Method (SI) *(Continued)*

Common Space Types[1]	Lighting Power Density, W/m^2	Building Type Specific Space Types1	Lighting Power Density, W/m^2
Sales Area	18.30		
Seating Area, General	0.68		
Stairwell	6.46		
Storage Room			
... in a hospital	9.69		
... that is ≥4.6 m^2	8.61		
... that is <4.6 m^2	8.61		
Vehicular Maintenance Area	7.53		
Workshop	20.45		

1. In cases where both a common space type and a building area specific space type are listed, the building area specific space type shall apply

TABLE G3.8 Lighting Power Densities Using the Building area Method (SI

Building Area Type	Lighting Power Density, W/ft^2
Automotive facility	10.79
Convention center	13.62
Courthouse	13.62
Dining: Bar lounge/leisure	13.62
Dining: Cafeteria/fast food	12.14
Dining: Family	12.81
Dormitory	7.69
Exercise center	11.33
Fire station	9.04
Gymnasium	12.68
Health-care clinic	12.14
Hospital	14.16
Hotel	7.82
Library	16.05
Manufacturing facility	19.69
Motel	7.55
Motion picture theater	10.25
Multifamily	6.88
Museum	13.76
Office	11.06
Parking garage	2.83
Penitentiary	10.92
Performing arts theater	18.75
Police station	11.73
Post office	11.73
Religious building	13.49
Retail	16.99
School/university	11.73
Sports arena	12.27
Town hall	12.00
Transportation	9.44
Warehouse	8.90
Workshop	16.05

(This foreword is not part of this addendum. 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.)

FOREWORD

At the January 2013 Dallas meeting, SSPC 90.1 approved sending out for public review addenda "bm," "co," and "cr" as second PR-ISCs, and a new Addendum "dl" for publication/public review (PPR).

The following explains the chronological changes embodied in these addenda.

- *bm—The first PR draft of addendum "bm" makes revisions to Appendix G that include adding Table G3.7 with values to use in the LPD calculation based on the space-by-space method. The second PR-ISC for addendum "bm" makes further revisions to Table G3.7 and adds an additional Table G3.8 with values to use in the LPD calculation based on the building area method.*
- *co—The second PR-ISC draft of addendum "co" makes further revisions to values in Table 9.5.1 to use in the LPD calculation based on the building area method.*
- *cr—The second PR-ISC draft of addendum "cr" makes further revisions to Table 9.6.1 by replacing the term "Assisted Living Facility" with "Facility for the Visually Impaired" for the LPD calculations using the space-by-space method.*
- *dl—The first PR of addendum "dl" makes further revisions to values in Table 9.5.1 to use in the LPD calculation based on the building area method.*

While these addenda are out for public review these changes reflected by addenda "co," "cr," and "dl" are not reflected in the second PR-ISC of addendum "bm," so this new addendum has been created to address those changes

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

Addendum dx to Standard 90.1-2013

Revise Tables G3.7 and G3.8 as follows (I-P and SI units).

TABLE G3.7 Lighting Power Density Allowances Using the Space-by-Space Method

Common Space Types[1]	Lighting Power Density, W/ft^2 (W/m^2)	Building Type Specific Space Types1	Lighting Power Density, W/ft^2 (W/m^2)
[. . .]			
Corridor			
... in ~~an assisted living facility~~ a facility for the visually impaired (and used primarily by residents)	1.15 (12.41)	*... in a reading area*	1.33
[. . .]			
Dining Area		*... in a detailed manufacturing area*	1.62
... in ~~an assisted living facility~~ a facility for the visually impaired (and used primarily by residents)	3.32 (35.74)	*... in an extra high bay area (>50 ft floor-to-ceiling height)*	1.32
[. . .]			
Guest Room	~~0.59~~1.14 (~~6.34~~12.26)	**Post Office—Sorting Area**	1.18
[. . .]			
Lobby		*... for a Class I facility*	4.61
... in ~~an assisted living facility~~ a facility for the visually impaired (and used primarily by residents)	2.26 (24.27)	*... for a Class II facility*	3.01
[. . .]			
Restroom			
... in ~~an assisted living facility~~ a facility for the visually impaired (and used primarily by residents)	1.52 (16.32)		
[. . .]			

[. . .]

TABLE G3.8 Lighting Power Densities Using the Building Area Method

Building Area Type	LPD, W/ft^2 (W/m^2)
[. . .]	
Hotel/Motel	~~0.73~~ 1.09 (~~3.01~~4.52)
[. . .]	
Manufacturing facility	~~1.83~~ 1.17 (~~6.02~~12.59)
~~Motel~~	~~0.70 (2.99)~~
[. . .]	

(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 A
2015 ADDENDA TO ANSI/ASHRAE/IES STANDARD 90.1-2013

This supplement includes Addenda a, c, d, e, g, h, j, k, m, n, o, p, q, r, s, z, aa, ac, ad, ae, ag, ak, bm, and dx to ANSI/ASHRAE/IES Standard 90.1-2013. The following table 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 A-1 2015 Addenda Supplement to ANSI/ASHRAE/IES Standard 90.1-2013

Addendum	Section(s) Affected	Description of Changes*	ASHRAE Standards Committee Approval	ASHRAE BOD Approval	IES BOD Approval	ANSI Approval
a	5. "Building Envelope"	Addendum a revises the definition of and heating output thresholds for conditioned space. The revised heating output thresholds reflects the reduction in loads due to greater energy efficiency in Section 5, "Building Envelope."	9/16/2014	10/3/2014	7/1/2014	10/29/2014
c	8. "Power"	Section 8.4.1 previously separated feeder conductors from branch circuits when limiting voltage drop. By specifying the same combined voltage drop over the combination of components, this addendum reduces first costs in certain projects while remaining neutral on energy costs.	9/16/2014	10/3/2014	7/1/2014	10/6/2014
d	6. "Heating, Ventilating and Air Conditioning"	This addendum adds deeper thermostat setups and setbacks and ventilation control to unrented hotel guestrooms and more clarity to the existing hotel guestroom requirements.	9/16/2014	10/3/2014	7/1/2014	10/6/2014
e	9. "Lighting"	This addendum relaxes the existing threshold somewhat for lighting alterations (20% instead of 10%) but captures high energy efficiency by requiring more of the lighting control requirements.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
g	6. "Heating, Ventilating and Air Conditioning"	The wording in Standard 90.1-2013 regarding the fan power pressure drop limitation adjustment can be interpreted in two ways. This change is intended to clarify which equation is the one that the committee intended and was originally used in the economic analysis.	9/16/2014	10/3/2014	7/1/2014	10/6/2014
h	Appendix C	The current language in Appendix C regarding HVAC fan power is contradictory. The existing language instructs the user to include fan energy in the HVAC packaged efficiency (which is cooling only) and not model the fan power explicitly. However, the current language also instructs the user to model the fan as cycling in heating. By including the fan energy in the packaged cooling efficiency, the fan energy cannot be modeled in heating. This addendum modifies the language to provide an efficiency rating for the compressor and condensing unit of the packaged equipment that does not include the fan energy but reflects the standard's minimum performance requirement.	9/16/2014	10/3/2014	7/1/2014	10/6/2014
j	6. "Heating, Ventilating and Air Conditioning"	This addendum removes the exception to the variable-air-volume system ventilation optimization when energy recovery ventilation is installed.	1/28/2015	1/28/2015	1/19/2015	1/29/2015
k	Appendix G	This addendum requires envelope assemblies to comply with Appendix A, "Rated R-Value of Insulation and Assembly U-Factor, C-Factor, and F-Factor Determinations," when complying with the Energy Cost Budget Method in Appendix G.	1/28/2015	1/28/2015	1/19/2015	1/29/2015

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

TABLE A-1 2015 Addenda Supplement to ANSI/ASHRAE/IES Standard 90.1-2013

Addendum	Section(s) Affected	Description of Changes*	ASHRAE Standards Committee Approval	ASHRAE BOD Approval	IES BOD Approval	ANSI Approval
m	10. "Other Equipment"	This addendum updates the text in Section 10.4.1 on electric motors to provide information about the required efficiency of small electric motors shown in Tables 10.8-4 and 10.8-5. In addition, small electric motors were not included in the scope of the Energy Independence and Security Act of 2007 but now have performance requirements and are being added to the standard.	1/28/2015	1/28/2015	1/19/2015	1/29/2015
n	6. "Heating, Ventilating and Air Conditioning"	This proposal updates the IEER (ICOP) values for air-cooled VRF air conditioners and heat pumps above 65,000 Btu/h. Depending on the cooling capacity and product classes, the new IEERs (ICOPs) are between 15% and 20% better than the values they are replacing. The new IEERs (ICOPs) will become effective on January 1, 2017.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
o	6. "Heating, Ventilating and Air Conditioning"	This addendum modifies wording regarding duct seal class to avoid any possible misinterpretation that compliance with the deleted text could substitute for the seal class.	1/28/2015	1/28/2015	1/19/2015	1/29/2015
p	12. "Normative References"	This addendum updates the reference to CTI Standard 201, which has been split into two different standards.	1/28/2015	1/28/2015	1/19/2015	1/29/2015
q	6. "Heating, Ventilating and Air Conditioning"	This addendum limits the systems that can take advantage of the fan power pressure allowance for fully ducted return and/or exhaust air systems.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
r	Appendix G	This addendum revises Section G3.1.1, "Baseline HVAC System Type and Description," to confirm the hierarchy for selecting baseline HVAC systems, clarify what floors to count, and specify what building type to use when no one use is predominant. Table G3.1.1-3, "Baseline HVAC System Types," is revised so that heading names are consistent with Section G3.1.1.	1/28/2015	1/28/2015	1/19/2015	1/29/2015
s	6. "Heating, Ventilating and Air Conditioning"	This addendum modifies exceptions to Section 6.5.2.1. Exception 2 addresses single-duct variable-air-volume (VAV) reheat systems with direct digital control (DDC). It unintentionally places undue requirements on other VAV systems with DDC that have an alternate means of heating, such as fan-powered boxes, dual duct, and baseboard, and even non-VAV systems, such as dedicated outdoor air system with radiant or chilled beams.	1/28/2015	1/28/2015	1/19/2015	1/29/2015
z	Appendix G	This addendum clarifies and modifies the modeling of a baseline HVAC system with air-source heat pumps and electric auxiliary heat in Appendix G, "Performance Rating Method."	5/27/2015	6/4/2015	6/1/2015	6/26/2015
aa	Appendix G	This addendum clarifies the exception in the "Design Model" section of Table G3.1, "Modeling Requirements for Calculating Proposed and Baseline Building Performance," for when a conditioned space in the proposed design does not have to be both heated and cooled. The existing exception language referenced spaces served by baseline systems 9 and 10, but that would not apply to the proposed building model. Instead, a complete definition of the applicable spaces served by heating-only systems that comply with the exception is now included.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
ac	Appendix A	The modifications to the text intend to clarify when the airs pace R-values can be used.	9/16/2014	10/3/2014	7/1/2014	10/6/2014
ad	Appendix G	This addendum revises the preheat coil requirement for the Baseline Building Model in Appendix G, "Performance Rating Method" to apply to only system types that would logically employ the use of one (baseline system types 5 through 8). The fixed setpoint control eliminates any potential simultaneous cooling and heating by the system cooling coil and preheat coil.	5/27/2015	6/4/2015	6/1/2015	6/26/2015

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

TABLE A-1 2015 Addenda Supplement to ANSI/ASHRAE/IES Standard 90.1-2013

Addendum	Section(s) Affected	Description of Changes*	ASHRAE Standards Committee Approval	ASHRAE BOD Approval	IES BOD Approval	ANSI Approval
ae	10. "Other Equipment"	This addendum updates Section 3.2 text for the definitions used with motors and Section 10.4.1, "Electric Motors," text for small electric motors. Many small motors provide information on the input and output power, and the revision to definitions clarifies the power rating used for efficiency requirements of small (and large) electric motors.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
ag	5. "Building Envelope" 3. "Definitions"	This addendum limits mechanical cooling for vestibules. An exception for temperature limits is allowed when the vestibule is tempered with transfer air or heated with recovered energy. Transfer air tempering is beneficial because that conditioned air is destined to be exhausted anyway, and pressurizing the vestibule may reduce infiltration further. Little cost is added for this measure as it requires only a reconfiguration of required controls.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
ak	6. "Heating, Ventilating and Air Conditioning"	This addendum limits the scope of Section 6.5.4.1, "Hydronic Variable Flow Systems," so it only covers heating and cooling hydronic systems since other sections cover condenser water systems.	1/18/2014	1/22/2014	1/15/2014	1/23/2014
bm	Appendix G	This addendum changes the application of Appendix G by setting Standard 90.1-2004 as the baseline for energy modeling using the Performance Rating Method. This addendum also allows a compliance path in Standard 90.1 using Appendix G.	5/27/2015	6/4/2015	6/1/2015	6/26/2015
dx	Appendix G	This addendum modifies the rules for modeling air infiltration when using Appendix G, "Performance Rating Method."	7/26/2013	7/30/2013	7/29/2013	7/31/2013

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

NOTE

When addenda, interpretations, or errata to this standard have been approved, they can be downloaded free of charge from the ASHRAE Web site at http://www.ashrae.org.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

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

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

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

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

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

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

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

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