Attachment R

District of Columbia Construction Codes Supplement of 2017 12-I[CE] and 12-I[RE] DCMR – Energy Conservation Codes Supplement of 2017

DISTRICT OF COLUMBIA
CONSTRUCTION CODES SUPPLEMENT OF 2017
12-I[CE] and 12-I[RE] DCMR - ENERGY CONSERVATION CODES SUPPLEMENT OF 2017[1]

The District of Columbia adopts ANSI/ASHRAE/IES 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1) as the *Energy Conservation Code-Commercial Provisions,* and the *Residential Provisions* of the 2015 edition of the *International Energy Conservation Code* (IECC) as the *Energy Conservation Code-Residential Provisions*, as amended by this Supplement.

ENERGY CONSERVATION CODE SUPPLEMENT OF 2017 – COMMERCIAL PROVISIONS (12-I[CE] DCMR)

[Commercial Provisions]

ASHRAE 90.1 SECTIONS AMENDED BY THIS SUPPLEMENT

SECTION 1 GENERAL
SECTION 2 SCOPE
SECTION 3 DEFINITIONS, ABBREVIATIONS, AND ACRONYMS
SECTION 4 ADMINISTRATION AND ENFORCEMENT
SECTION 5 BUILDING ENVELOPE
SECTION 6 HEATING, VENTILATING, AND AIR CONDITIONING
SECTION 7 SERVICE WATER HEATING
SECTION 8 POWER
SECTION 9 LIGHTING
SECTION 10 OTHER EQUIPMENT
SECTION 11 ENERGY COST BUDGET METHOD
SECTION 12 NORMATIVE REFERENCES
SECTION 13 RENEWABLE ENERGY
NORMATIVE APPENDIX A [ASHRAE 90.1] RATED R-VALUE OF INSULATION AND ASSEMBLY U-FACTOR, C-FACTOR AND F-FACTOR DETERMINATIONS
NORMATIVE APPENDIX B [ASHRAE 90.1] BUILDING ENVELOPE CLIMATE CRITERIA
NORMATIVE APPENDIX C [ASHRAE 90.1] METHODOLOGY FOR BUILDING ENVELOPE TRADE-OFF OPTION IN SECTION 5.6
NORMATIVE APPENDIX D [ASHRAE 90.1] CLIMATIC DATA
INFORMATIVE APPENDIX E [ASHRAE 90.1] INFORMATIVE REFERENCES

---

[1] The *District of Columbia Energy Conservation Code (2017)*, referred to as the "Energy Conservation Code," consists of ANSI/ASHRAE/IES 90.1-2013, Energy Standard for Buildings Except Low-Rise Residential Buildings (ASHRAE 90.1) and substantial portions of Chapter 7 of ANSI/ASHREA/IES 189.1-2014, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings (ASHRAE 189.1), published by the American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE), and the Residential Provisions of the 2015 edition of the International Energy Conservation Code (International Energy Conservation Code), published by the International Code Council (ICC), as amended by the *Energy Conservation Code Supplement of 2017 – Commercial Provisions* (12-I[CE] DCMR) and the *Energy Conservation Code Supplement of 2017 – Residential Provisions* (12-I[RE] DCMR). The International Energy Conservation Code is copyrighted by the ICC and therefore is not republished here. However, a copy of the text may be obtained at: https://codes.iccsafe.org/public/document/IECC2015. ASHRAE 90.1 is copyrighted by ASHRAE and therefore is not republished here. However, the text of ASHRAE 90.1 may be reviewed at: https://www.ashrae.org/standards-research--technology. Portions of Chapter 7 of ASHRAE 189.1 are reprinted in the District of Columbia Energy Conservation Code Supplement by permission of ASHRAE and ICC.

INFORMATIVE APPENDIX F [ASHRAE 90.1] ADDENDA DESCRIPTION INFORMATION
NORMATIVE APPENDIX G [ASHRAE 90.1] PERFORMANCE RATING METHOD
APPENDIX Z NET ZERO ENERGY COMPLIANCE PATH

ENERGY CONSERVATION CODE SUPPLEMENT OF 2017 – RESIDENTIAL PROVISIONS (12-I[RE] DCMR)

[Residential Provisions]
IECC SECTIONS AMENDED BY THIS SUPPLEMENT

CHAPTER 1 [RE]	SCOPE AND ADMINISTRATION
CHAPTER 2[RE]	DEFNITIONS
CHAPTER 3 [RE]	GENERAL REQUIREMENTS
CHAPTER 4 [RE]	RESIDENTIAL ENERGY EFFICIENCY
CHAPTER 5[RE]	EXISTING BUILDINGS
CHAPTER 6[RE]	REFERENCED STANDARDS
APPENDIX RA	RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS
APPENDIX RB	SOLAR READY PROVISIONS

ENERGY CONSERVATION CODE SUPPLEMENT OF 2017 – COMMERCIAL PROVISIONS (12-I[CE] DCMR)

ASHRAE 90.1 SECTIONS AMENDED BY THIS SUPPLEMENT

SECTION 1 GENERAL
SECTION 2 SCOPE
SECTION 3 DEFINITIONS, ABBREVIATIONS, AND ACRONYMS
SECTION 4 ADMINISTRATION AND ENFORCEMENT
SECTION 5 BUILDING ENVELOPE
SECTION 6 HEATING, VENTILATING, AND AIR CONDITIONING
SECTION 7 SERVICE WATER HEATING
SECTION 8 POWER
SECTION 9 LIGHTING
SECTION 10 OTHER EQUIPMENT
SECTION 11 ENERGY COST BUDGET METHOD
SECTION 12 NORMATIVE REFERENCES
SECTION 13 RENEWABLE ENERGY
NORMATIVE APPENDIX A [ASHRAE 90.1] RATED R-VALUE OF INSULATION AND ASSEMBLY U-FACTOR, C-FACTOR AND F-FACTOR DETERMINATIONS
NORMATIVE B [ASHRAE 90.1] BUILDING ENVELOPE CLIMATE CRITERIA
NORMATIVE C [ASHRAE 90.1] METHODOLOGY FOR BUILDING ENVELOPE TRADE-OFF OPTION IN SECTION 5.6
NORMATIVE D [ASHRAE 90.1] CLIMATIC DATA
INFORMATIVE APPENDIX E [ASHRAE 90.1] INFORMATIVE REFERENCES
INFORMATIVE APPENDIX F [ASHRAE 90.1] ADDENDA DESCRIPTION INFORMATION
NORMATIVE APPENDIX G [ASHRAE 90.1] PERFORMANCE RATING METHOD
APPENDIX Z NET ZERO ENERGY COMPLIANCE PATH

Strike Section 1 of ASHRAE 90.1 in its entirety and insert a new Section 1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

SECTION 1 GENERAL

1.1 INTENT. The intent of the *Energy Conservation Code-Commercial Provisions* shall be as defined in Chapter 1 of Title 12-A DCMR.

Strike Section 2 of ASHRAE 90.1 in its entirety and insert a new Section 2 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

SECTION 2 SCOPE

2.1 SCOPE. The scope of the *Energy Conservation Code-Commercial Provisions* shall be as defined in Chapter 1 of Title 12-A DCMR.

SECTION 3 DEFINITIONS, ABBREVIATIONS, AND ACRONYMS

Strike Section 3.1 in ASHRAE 90.1 and insert new Section 3.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

3.1 GENERAL. Certain terms, abbreviations, and acronyms are defined in this section solely for the purposes of the *District of Columbia Energy Conservation Code-Commercial Provisions* (the "ECC(C)"). These definitions are solely applicable to all sections of the ECC(C), and not to any other International Codes adopted by the District of Columbia. Terms that are not defined shall have their ordinarily accepted meanings within the context in which they are used.

3.2 DEFINITIONS

Insert the following new definition in Section 3.2 of ASHRAE 90.1 to read as follows:

***airflow, minimum outdoor*:** the outdoor airflow provided by a ventilation system to meet requirements for indoor air quality, excluding any additional outdoor air intake to reduce or eliminate the need for mechanical cooling.

Strike the definitions of "baseline building design" and "baseline building performance" in ASHRAE 90.1 and insert new definitions in their place in the Energy Conservation Code-Commercial Provisions to read as follows:

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.

Insert the following new definitions in Section 3.2 of ASHRAE 90.1 in the Energy Conservation Code-Commercial Provisions to read as follows:

building project: a building, or group of buildings, and site that utilize a single submittal for a construction permit or that are within the boundary of contiguous properties under single ownership or effective control. Phased development that is permitted over a period of five years for the same building shall be considered a single project.

classroom: a *space* primarily used for scheduled instructional activities.

climate zone: see Section 5.1.4.

commissioning authority (CxA): an entity identified by the *owner* who leads, plans, schedules, and coordinates the commissioning team to implement the building *commissioning process*.

(See *commissioning* [*Cx*] *process*.)

commissioning (Cx) plan: a document that outlines the organization, schedule, allocation of resources, and documentation requirements of the building *commissioning process*. (See *commissioning* [*Cx*] *process*.)

commissioning (Cx) process: a quality-focused process for enhancing the delivery of a project. The process focuses upon verifying and documenting that the facility and all of its systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the *owner's project requirements*. (See *owner's project requirements*.)

daylight area:

Strike the definition of "primary sidelighted area" and "secondary sidelighted area" under "daylight area" in ASHRAE 90.1 and the associated Figures 3.2-3 and 3.2-4.

Insert a new definition of "sidelighted area" under "daylight area" in the Energy Conservation Code-Commercial Provisions to read as follows:

sidelighted area: Each sidelighted area is directly adjacent to vertical fenestration below the ceiling .

a. The sidelighted area width is the width of the vertical fenestration plus, on each side, the smaller of:

    1. 3 ft., or

    2. the distance to any 5 ft. or higher opaque vertical obstruction.

b. The sidelighted area depth is the horizontal distance perpendicular to the vertical fenestration which is the smaller of:

    1. 15 ft., or

    2. the distance to any 5 ft. or higher opaque vertical obstruction.

Insert the following new definitions in Section 3.2 of ASHRAE 90.1 in the Energy Conservation Code-Commercial Provisions to read as follows:

daylight hours: the period from 30 minutes after sunrise to 30 minutes before sunset.

densely occupied space: those *spaces* with a design occupant density greater than or equal to 25 people per 1000 $ft.^2$ (100 m^2).

electronics: computers and accessories; monitors; printers; and other equipment, such as scanners, fax machines, electric typewriters, cell phones, telephones, answering machines, shredders, postage machines, televisions, VHS/DVD players, portable cassette/CD players with radio devices, and stereo equipment.

geothermal energy: heat extracted from the Earth's interior and used to produce electricity or mechanical power or provide thermal energy for heating buildings or processes. *Geo- thermal energy* does not include systems such as heat pumps that use energy independent of the geothermal source to raise the temperature of the extracted heat.

high efficacy lamps. *LEDs, Compact fluorescent lamps, T-5 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:*

1. *60 lumens per watt for lamps over 40 watts,*
2. *50 lumens per watt for lamps over 15 watts to 40 watts, and*
3. *40 lumens per watt for lamps 15 watts or less.*

high-speed door: a non-swinging door used primarily to facilitate vehicular access or material transportation, and having an *automatic* closing device with an opening rate of not less than 32 in./s (810 mm/s) and a closing rate of not less than 24 in./s (610 mm/s).

lighting zone (LZ): an area defining limitations for outdoor lighting.

> ***LZ0:*** undeveloped areas within national parks, state parks, *forest land*, rural areas, and other undeveloped areas as defined by the *AHJ.*
> ***LZ1:*** developed areas of national parks, state parks, *forest land*, and rural areas.
> ***LZ2:*** areas predominantly consisting of *residential* zoning, neighborhood business districts, light industrial with limited night time use, and *residential* mixed-use areas.
> ***LZ3:*** all areas not included in *LZ0*, *LZ1*, *LZ2*, or *LZ4*.
> ***LZ4:*** high-activity commercial districts in major metropolitan areas as designated by the local jurisdiction.

networked guest-room control system: an energy management 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 each hotel/motel guest room separately.

on-site renewable energy system: photovoltaic, solar thermal, *geothermal energy*, biogas, wastewater thermal and wind systems used to generate energy and located on the *building project.*

owner: as term is defined in Section 202, Title 12-A DCMR.

owner's project requirements (OPR): a written document that details the functional requirements of a project and the expectations of how it will be used and operated. These include project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.

Strike the definitions of "performance rating method" and "rating authority" in ASHRAE 90.1 and insert new definitions in their place in the Energy Conservation Code-Commercial Provisions to read as follows:

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.

Insert the following new definitions in Section 3.2 of ASHRAE 90.1 in the Energy Conservation Code-Commercial Provisions to read as follows:

thermal barrier: the boundary between conditioned and unconditioned space which does not contain *thermal bridges*.

thermal bridge: part of a building's conditioned envelope which spans between the conditioned and unconditioned space, has an R-value of 1.5 per inch or less, and is not otherwise insulated along the one-dimensional conductive heat transfer pathway of less than R-3/inch for 1 inch. For the purposes of this definition, fenestration is not counted as a thermal bridge.

water factor (WF):

a. ***clothes washer (residential* and *commercial):*** the quantity of water in gallons (liters) used to wash each cubic foot (cubic meter) of machine capacity.
b. ***residential dishwasher:*** the quantity of water use in gallons (liters) per full machine wash and rinse cycle.

3.3 ABBREVIATIONS AND ACRONYMS

Insert a new abbreviation into Section 3.3 of ASHRAE 90.1 in the Energy Conservation Code-Commercial Provisions to read as follows:

CxA *commissioning authority*

SECTION 4 ADMINISTRATION AND ENFORCEMENT

Strike Section 4 of ASHRAE 90.1 in its entirety and insert a new Section 4 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

4.1 ADMINISTRATION AND ENFORCEMENT. Administration and enforcement of the *Energy Conservation Code-Commercial Provisions* shall be governed by Chapter 1, Title 12-A DCMR.

SECTION 5 BUILDING ENVELOPE
5.1 GENERAL
5.2 COMPLIANCE PATHS
5.4 MANDATORY PROVISIONS
5.5 PRESCRIPTIVE BUILDING ENVELOPE

5.1 GENERAL

Strike Section 5.1.3 of ASHRAE 90.1 in its entirety and insert a new Section 5.1.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

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

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

1. Installation of storm windows or glazing panels over existing glazing, provided the storm window or glazing panel contains a low-emissivity coating. However, a low-emissivity coating is not required where the existing glazing already has a low-emissivity coating. Installation is permitted to be either on the inside or outside of the existing glazing.

2. Replacement of glazing in existing sash and frame due to individual broken panes and considered repair only, provided the U-factor and SHGC will be equal to or lower than before the glass replacement.

3. Alterations to roof/ceiling, wall, or floor cavities that are insulated to full depth with insulation having a minimum nominal value of R-3.0/in.

4. Alterations to walls and floors, where the existing structure is without framing cavities and no new framing cavities are created.

5. *Roof recovering.*

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

5.2 COMPLIANCE PATHS

Strike Section 5.2.2 of ASHRAE 90.1 in its entirety and insert a new Section 5.2.2 in the Energy Conservation Code-Commercial Provisions to read as follows:

5.2.2 Projects using the Performance Method (See Section Appendix G) must comply with Section 5.4, the mandatory provisions of this section, as a portion of that compliance path.

5.4 MANDATORY PROVISIONS

Insert a new Section 5.4.1.1 in in the Energy Conservation Code-Commercial Provisions to read as follows:

5.4.1.1 Continuous *Thermal Barrier.* The entire building envelope shall be designed and constructed with a continuous *thermal barrier*. This includes, but is not limited to parapet walls, intersections between conditioned walls and roof, intersections between conditioned walls and unconditioned floors, common walls/ceilings, floors adjacent to other buildings, and wall/roof/flooring framing members. Where structural elements limit the ability of a continuous *thermal barrier*, the applicant is authorized to extend a minimum of R-8 continuous insulation on one side of the thermal bypass for 24 inches. The opposite side of the thermal bypass must meet the insulation requirements of Table 5.5. For the purposes of modeling via Appendix G or Section 5.6, applicants shall not include the additional R-8 as part of the insulated assembly U-value, but are allowed to represent the reference energy model to include no thermal bypasses, and maintain the full R-value or U-value of the primary assembly. The thermal performance of the building assemblies shall be calculated in accordance with Appendix A.

Exceptions:

1. Electrical wiring used for transmission of energy.

2. Plumbing penetrations.

3. Flashing requirements for moisture management.

4. Wall insulation extending past the slab-on-grade into the ground shall use the slab edge insulation requirements on one side of the footing per Table 5.5-4. The full depth of the slab does not have to be insulated provided that the project complies with Table 5.5-4.

5. Slabs below grade where the adjacent wall is between conditioned space and the ground.

6. Bypasses protected by the minimum continuous insulation requirement.

7. Metal framed or metal building components insulated to >= R-10 continuous.

8. Wood framing components summing less than 5% of gross envelope area.

9. Wood framing components insulated with >= R-3 continuous.

10. In existing buildings, at specific locations where application of Section 5.4.1.1 would conflict with the Zoning Regulations, cause an encroachment into adjoining premises, cause an unacceptable projection in the public space, cause an increase of fire resistance rating requirements, result in a reduction of allowable openings for

the affected walls, or create a conflict with other provisions of the *Construction Codes.*

Strike Exception 2 to Section 5.4.3.2 of ASHRAE 90.1 in its entirety without substitution:

Strike Section 5.4.3.4 of ASHRAE 90.1 in its entirety and insert a new Section 5.4.3.4 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

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

Exceptions:

1. Revolving doors
2. Doors not intended to be used as a building entrance, including service entrance doors
3. Doors opening directly from a dwelling unit
4. Doors that open directly from a space that is less than 3,000 ft.2 in area
5. Semiheated spaces
6. Enclosed elevator lobbies for building entrances directly from parking garages

[*No change to Section 5.4.3.4.1*]

Insert a new Section 5.4.4 in ASHRAE 90.1 to read as follows:

5.4.4 *On-Site Renewable Energy Systems.* *Building project* design shall show allocated space and pathways for future installation of *on-site renewable energy systems* and associated infrastructure to cover no less than 25% of horizontal projection of the *gross roof area.*

Exceptions:

1. *Building* projects that have an annual daily average incident solar radiation available to a flat plate collector oriented due south at an angle from horizontal equal to the latitude of the collector location less than 1.2 kBtu/ft.2·day (4.0 kWh/m2·day), accounting for existing buildings, permanent infrastructure that is not part of the building project,

topography, or trees.

2. Building projects that comply with Section 13.1.

5.5 PRESCRIPTIVE BUILDING ENVELOPE OPTION

Strike Section 5.5.1 of ASHRAE 90.1 in its entirety and insert a new Section 5.5.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

5.5.1 For a conditioned space, the exterior building envelope shall comply with either the nonresidential or residential requirements in Tables 5.5.

Strike Section 5.5.2 of ASHRAE 90.1 in its entirety and insert a new Section 5.5.2 in its place to read as follows:

5.5.2 If a building contains any semiheated space or unconditioned space, then the semi-exterior building envelope shall comply with the requirements for semiheated space in Table 5.5. (See Figure 5.5.2.)

Strike Tables 5.5-1 through 5.5-8 of ASHRAE 90.1 and insert a new Table 5.5 in their place in the Energy Conservation Code-Commercial Provisions to read as follows:

TABLE 5.5 BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 4 (A,B,C)*

Opaque Elements	Nonresidential		Residential		Semiheated	
	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value	Assembly Maximum	Insulation Min. R-Value
Roofs						
Insulation entirely above Deck	U-0.048	R-20 c.i.	U-0.039	R-25 c.i.	U-0.218	R-3.8 c.i.
Metal Building[a]	U-0.041	R-10 + R-19 FC	U-0.041	R-10 + R-19 FC	U-0.115	R-10
Attic and Other	U-0.027	R-38	U-0.027	R-38	U-0.081	R-13
Walls, above Grade						
Mass	U-0.580	NR	U-0.151[b]	R-5.7 c.i.[b]	U-0.580	NR
Metal Building	U-0.094	R-0 + R-9.8 c.i.	U-0.094	R-0 + R-9.8 c.i.	U-0.352	NR
Steel Framed	U-0.124	R-13	U-0.124	R-13	U-0.352	NR
Wood Framed and Other	U-0.089	R-13	U-0.089	R-13	U-0.292	NR
Wall, below Grade						
Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR
Floors						
Mass	U-0.322	NR	U-0.322	NR	U-0.322	NR
Steel Joist	U-0.350	NR	U-0.350	NR	U-0.350	NR

Wood Framed and Other	U-0.282	NR		U-0.282	NR		U-0.282	NR	
Slab-on-Grade Floors									
Unheated	F-0.730	NR		F-0.730	NR		F-0.730	NR	
Heated	F-1.020	R-7.5 for 12 in.		F-1.020	R-7.5 for 12 in.		F-1.020	R-7.5 for 12 in.	
Opaque Doors									
Swinging	U-0.700			U-0.500			U-0.700		
Nonswinging	U-1.450			U-0.500			U-1.450		
Fenestration	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Min. VT/SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Min. VT/SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Min. VT/SHGC**
Vertical Fenestration, 0%–40% of Wall		(for all frame types)			(for all frame types)			(for all frame types)	
Nonmetal framing, all	U-0.50[c]			U-0.50[c]			U-0.93		
Metal framing, fixed	U-0.57[c]			U-0.57[c]			U-1.20		
Metal framing,		SHGC-0.25	1.10		SHGC-0.25	1.10		NR	NR

operable	U-0.65[c]			U-0.65[c]			U-1.20		
Metal framing, entrance door	U-1.10[c]			U-1.10[c]			U-1.10[c]		
Skylight, 0%–3% of Roof									
All types	U-0.75	SHGC-0.35	NR	U-0.75	SHGC-0.35	NR	U-1.80	NR	NR

Opaque Elements	**Nonresidential**		**Residential**		**Semiheated**	
	Assembly Maximum	**Insulation Min. R-Value**	**Assembly Maximum**	**Insulation Min. R-Value**	**Assembly Maximum**	**Insulation Min. R-Value**
Roofs						
Insulation Entirely above Deck	U-0.028	R-33 c.i.	U-0.028	R-33 c.i.	U-0.093	R-10 c.i.
Metal Building[a]	U-0.033	R-21 + R-12 Ls or R-28 + R-9 Ls	U-0.033	R-21 + R-12 Ls or R-28 + R-9 Ls	U-0.082	R-19
Attic and Other	U-0.0189	R- 54	U-0.0189	R-54	U-0.034	R-30
Walls, above Grade						
Mass	U-0.094	R-11 c.i.	U-0.081	R-12.5 c.i.	U-0.580	NR
Metal Building	U-0.054	R-0 + R-17.5 c.i.	U-0.045	R-0 + R-21 c.i.	U-0.162	R-13
Steel Framed	U-0.058	R-15 + R-8 c.i.	U-0.058	R-15 + R-8 c.i	U-0.124	R-13
Wood Framed and Other	U-0.058	R-15 + R-4.1 c.i.	U-0.058	R-15 + R-4.1 c.i.	U-0.089	R-13
Wall, below Grade						
Below Grade Wall	C-0.119	R- 8 c.i.	C-0.092	R-11 c.i.	C-1.	
Floors						
Mass	U- 0.051	R- 16 c.i.	U- 0.046	R-18.4 c.i.	U-0.107	R-6.3 c.i.
Steel Joist	U- 0.035	R- 33	U- 0.034	R- 33	U-0.052	R-19
Wood Framed and Other	U- 0.030	R- 33	U- 0.030	R- 33	U-0.051	R-19
Slab-on-Grade Floors						
Unheated	F-0.520	R-20 for 24 in.	F-0.520	R-20 for 24 in.	F-0.730	NR
Heated	F-0.843	R-25 for 24 in.	F-0.688	R-25 for 48 in.	F-0.900	R-10 for 24 in.
Opaque Doors						
Swinging	U- 0.45		U-0.45		U-0.700	
Nonswinging	U-0.45		U-0.45		U-1.450	

Fenestration

Vertical Fenestration, 0%–40% of Wall	*(for all frame types)*	*(for all frame types)*	*(for all frame types)*

Nonmetal framing, all	*U-0. 33*			*U-0. 33*			*U-0.51*		
Metal framing fixed U- 0.38 U0.38 U-0.	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Min. VT/SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Min. VT/SHGC**	**Assembly Max. U**	**Assembly Max. SHGC**	**Assembly Min. VT/SHG**
Metal framing,									
SHGC-0.36									
SHGC-0.36 NR NR operable	U- 0.45			U- 0.45			U-0.81		
Metal framing, entrance door	U- 0.69			U- 0.61			U-0.77		
Skylight, 0%–3% of Roof									
All types	U-0.45	SHGC- 0.36	NR	U-0.45	SHGC-0.36	NR	U-1.15	NR	NR

*

The following definitions apply: c.i. = continuous insulation (see Section 3.2), FC = filled cavity (see Section A2.3.2.5), Ls = liner system (see Section A2.3.2.4), NR = no (insulation) requirement.

a. When using the R-value compliance method for metal building roofs, a thermal spacer

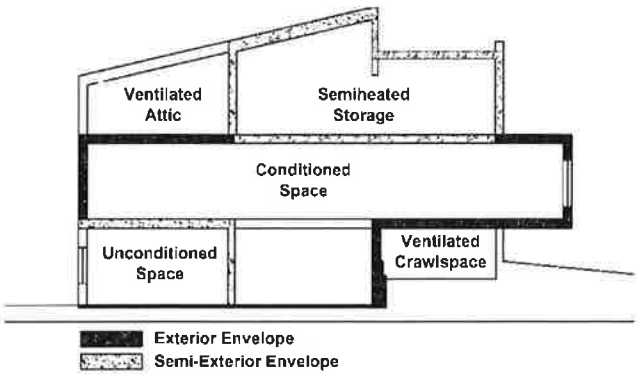

Figure 5.5.2. Exterior and semiexterior building envelope.

Strike Sections 5.5.3.1 through 5.5.3.6 of ASHRAE 90.1 in their entirety and insert new Sections 5.5.3.1 through 5.5.3.6 in their place in the Energy Conservation Code-Commercial Provisions to read as follows:

5.5.3.1 Roof Insulation. All roofs shall comply with the insulation values specified in Table 5.5. Sky-light curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5.0, whichever is less.

5.5.3.1.1 Roof Solar Reflectance and Thermal Emittance. Roofs in Climate Zone 4 shall have one of the following:

1. A minimum three-year-aged solar reflectance of 0.55 and a minimum three-year-aged thermal emittance of 0.75 when tested in accordance with CRRC-1 Standard.

2. A minimum initial Solar Reflectance Index of 82 64 for roofs 2:12 or less and 39 for roofs greater than 2:12 in slope, when determined in accordance with the Solar Reflectance Index method in ASTM E1980 using a convection coefficient of 2.1 Btu/h·ft2·°F, based on three-year-aged solar reflectance and three-year-aged thermal emittance tested in accordance with CRRC-1 Standard.

Exceptions:

1. Ballasted roofs with a minimum stone ballast of 17 lb/ft.^{2} or 23 lb/ft.^{2} pavers.

2. Vegetated roof systems that contain a minimum thickness of 2.5 in. of growing medium and covering a minimum of 75% of the roof area with durable plantings.

3. Roofs where a minimum of 75% of the roof area

    a. is shaded during the peak sun angle on June 21 by permanent components or features of the building; or

b. is permitted using a combination of 1 and 2 above.

4. Decks constructed using wood or an *approved* bio-based decking material.

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

5.5.3.2 Above-Grade Wall Insulation. All above-grade walls shall comply with the insulation values specified in Table 5.5.

Exception: Alternatively, for mass walls, where the requirement in Table 5.5 is for a maximum assembly U-0.151 followed by footnote "b," ASTM C90 concrete block walls, ungrouted or partially grouted at 32 in. or less on center vertically and 48 in. or less on center horizontally, shall have ungrouted cores filled with material having a maxi- mum thermal conductivity of 0.44 Btu·in./h·ft2·°F. Other mass walls with integral insulation shall meet the criteria when their U-factors are equal to or less than those for the appropriate thickness and density in the "Partly Grouted, Cells Insulated" column of Table A3.1-3. When a wall consists of both above-grade and below-grade portions, the entire wall for that story shall be insulated on either the exterior or the interior or be integral.

1. If insulated on the interior, the wall shall be insulated to the above-grade wall requirements.

2. If insulated on the exterior or integral, the below- grade wall portion shall be insulated to the below-grade wall requirements, and the above- grade wall portion shall be insulated to the above-grade wall requirements.

5.5.3.3 Below-Grade Wall Insulation. Below-grade walls shall have a rated R-value of insulation no less than the insulation values specified in Tables 5.5.

Exception: Where framing, including metal and wood studs, is used, compliance shall be based on the maximum assembly C-factor.

5.5.3.4 Floor Insulation. All floors shall comply with the insulation values specified in Tables 5.5.

5.5.3.5 Slab-on-Grade Floor Insulation. All slab-on-grade floors, including heated slab-on-grade floors and unheated slab-on-grade floors, shall comply with the insulation values specified in Tables 5.5.

5.5.3.6 Opaque Doors. All opaque doors shall have a U- factor not greater than that specified in Tables 5.5.

Insert a new Section 5.5.3.7 in the Energy Conservation Code-Commercial Provisions to read as follows:

5.5.3.7 *High-Speed Doors.* *High-speed doors* that are intended to operate on average at least 75 cycles per day shall not exceed a maximum U-factor of 1.20 Btu/hr·ft^2·°F (6.81 W/m^2·K). Opening rate, closing rate, and average cycles per day shall be included in construction drawings. Sections 5.5.3.6 and 5.5.4.3 shall not apply for *high-speed doors* complying with all criteria in this section.

Strike Table 5.5.3.1.1 of ASHRAE 90.1 in its entirety without substitution.

5.5.4.2 Fenestration Area

Strike Sections 5.5.4.2.1 and 5.5.4.2.2 of ASHRAE 90.1 in their entirety and insert new Sections 5.5.4.2.1 and 5.5.4.2.2 in their place in the Energy Conservation Code-Commercial Provisions to read as follows:

5.5.4.2.1 Vertical Fenestration Area. The total vertical fenestration area shall not be greater than that specified in Tables 5.5.

Exception: Vertical fenestration complying with Exception (3) to Section 5.5.4.4.1.

5.5.4.2.2 Maximum Skylight Fenestration Area. The total skylight area shall not be greater than that specified in Table 5.5.

Exception: The total skylight area is permitted to be increased to no greater than 6% of the gross roof area, provided the skylights meet all of the criteria in Exception (1) to Section 5.5.4.4.2 and the total daylight area under skylights is a minimum of half the floor area of the space.

Strike Section 5.5.4.3 of ASHRAE 90.1 in its entirety and insert a new Section 5.5.4.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

5.5.4.3 Fenestration U-Factor. Fenestration shall have a U-factor not greater than that specified in Tables 5.5. However, for locations in Climate Zone 1 with a cooling design temperature of 95°F and greater, the maximum allowed U-factors for vertical fenestration for all conditioned spaces, nonresidential and residential, are U-0.32 for non- metal framing, U-0.50 for fixed metal framing, U-0.65 for operable metal framing, and U-0.83 for entrance door metal framing.

Exception: The U-factor for skylights is permitted to be increased to no greater than 0.90 Btu/h·ft^2·°F in Climate Zones 1 through 3 and 0.75 Btu/h•ft2•°F in Climate Zones 4 through 8, provided the skylights meet all of the criteria in Exception (1) to Section 5.5.4.4.2.

Strike Table 5.5.4.4.1 of ASHRAE 90.1 in its entirety and substitute a new Table 5.5.4.4.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

TABLE 5.5.4.4.1 SHGC MULTIPLIERS FOR PERMANENT PROJECTIONS

Projection Factor	SHGC Multiplier (all Other Orientations)	SHGC Multiplier (North-Oriented)
0–0.60	1.00	1.00
>0.60–0.70	0.92	0.96
>0.70–0.80	0.84	0.94
>0.80–0.90	0.77	0.93
>0.90–1.00	0.72	0.90

SECTION 6 HEATING, VENTILATING, AND AIR CONDITIONING
6.3 SIMPLIFIED APPROACH OPTION FOR HVAC SYSTEMS
6.4 MANDATORY PROVISIONS
6.5 PRESCRIPTIVE PATH
6.8 MINIMUM EQUIPMENT EFFICIENCY TABLES

6.3 SIMPLIFIED APPROACH OPTION FOR HVAC SYSTEMS

Strike criteria c. in Section 6.3.2 of ASHRAE 90.1 in its entirety and insert a new criteria c in Section 6.3.2 in the Energy Conservation Code Commercial Provisions in its place to read as follows:

6.3.2 Criteria. The HVAC system must meet all of the following criteria:

[no change to criteria a. and b.]

c. Cooling (if any) shall be provided by a unitary packaged or split-system air conditioner that is either air cooled or evaporatively cooled, with efficiency meeting the requirements shown in Table 6.8.1-1 (air conditioners), Table 6.8.1-2 (heat pumps), or Table 6.8.1-4 (packaged terminal and room air conditioners and heat pumps) for the applicable equipment category. All *building projects* complying with the Alternate Renewables Approach in Section 13.1.1.2 shall comply with the equipment efficiency requirements in Section 13.1.1.2 in place of Tables 6.8.1-1 through 6.8.1-11 and shall comply with the applicable ENERGY STAR heating and cooling requirements in Section 10.11.2.

[no change to criteria d. through r.]

6.4 MANDATORY PROVISIONS

Insert new Sections 6.4.1.1.1 and 6.4.1.1.2 in ASHRAE 90.1 in the Energy Conservation Code-Commercial Provisions to read as follows:

6.4.1.1.1 Higher-Efficiency Requirements. All *building projects* complying with the Alternate Renewables Approach in **Section 13.1.1.2** shall comply with the equipment efficiency requirements in Section 13.1.1.2 in place of Tables 6.8.1-1 through 6.8.1-11 and shall comply with the applicable ENERGY STAR heating and cooling requirements in Section 10.11.2.

6.4.1.1.2 Heat Pump Requirement. For spaces which are both heated and cooled using unitary cooled systems per Tables 6.8.1-1 through 6.8.1-2, and Table 6.8.1-4, heating shall also include use of a heat pump for primary heating. Packaged systems shall not include electric resistance heating unless used as back-up heat and controlled per Section 6.4.3.5.

Exceptions:

a. Water cooled systems in Tables 6.8.1-1 and 6.8.1-2 where no additional water heating is provided during the heating season.

b. In retrofit applications and additions, where the use of a central heating system is already being used such as hydronic heating or central forced air furnace.

Strike Section 6.4.3.8 of ASHRAE 90.1 in its entirety and insert new Sections 6.4.3.8 and 6.4.3.8 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.4.3.8 Ventilation Controls for High-Occupancy Areas. *Demand control ventilation (DCV)* shall be provided for *densely occupied spaces* served by systems with one or more of the following:

a. Air-side economizer.

b. Automatic modulating control of outdoor air dampers.

c. Design outdoor airflow greater than 1000 cfm.

Exceptions to Section 6.4.3.8:

1. Systems with the exhaust air energy recovery complying with Section 6.5.6.1.

2. Systems with a design outdoor airflow less than.

3. 750 cfm (375 L/s).

4. *Spaces* where more than 75% of the *space* design *outdoor airflow* is utilized as *makeup air* or *transfer air* to provide *makeup air* for other *space(s)*.

5. *Spaces* with one of the following occupancy categories as defined in ASHRAE Standard 62.1: cells in correctional facilities; daycare sickrooms; science laboratories; barbers; beauty and nail salons; and bowling alleys.

6.4.3.8.1 Design of DCV System. The DCV system shall be designed to be in compliance with Section 6.2.7 of ANSI/ASHRAE Standard 62.1-2013. Occupancy assumptions shall be shown in the design documents for spaces provided with DCV. All CO_2 sensors used as part of a DCV system or any other system that dynamically controls outdoor air shall meet the following requirements:

a. *Spaces* with CO_2 sensors or air-sampling probes leading to a central CO_2 monitoring station shall be provided with at least one sensor or probe for each 10,000 ft.^{2} (1000 m^2) of floor *space*. Sensors or probes shall be installed between 3 and 6 ft. (1 and 2 m) above the floor.

b. CO_2 sensors must be accurate to ±50 ppm at 1000 ppm.

c. *Outdoor air* CO_2 concentrations shall be determined one of the following:

1. *Outdoor air* CO_2 concentrations shall be dynamically measured using a CO_2 sensor.

2. When documented statistical data are available on the local ambient CO_2 concentrations, a fixed value typical of the location where the building is located shall be allowed in lieu of an outdoor sensor.

d. Occupant CO_2 generation rate assumptions shall be shown in the design documents.

Strike Section 6.4.4.1.2 of ASHRAE 90.1 in its entirety and insert a new Section 6.4.4.1.2 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.4.4.1.2 Duct and Plenum Insulation. All supply and return ducts and plenums installed as part of an HVAC air distribution system shall be thermally insulated in accordance with Tables 6.8.2-1 and 6.8.2-2. Projects complying with Chapter 13 shall instead reference Tables 13-16 and 13-17.

Exceptions:

1. Factory-installed plenums, casings, or ductwork furnished as a part of HVAC equipment tested and rated in accordance with Section 6.4.1.

2. Ducts or plenums located in heated spaces, semiheated spaces, or cooled spaces.

3. For runouts less than 10 ft. in length to air terminals or air outlets, the rated R-value of insulation need not exceed R 3.5.

4. Backs of air outlets and outlet plenums exposed to unconditioned or indirectly conditioned spaces with face areas exceeding 5 ft.2 need not exceed R-2; those 5 ft.2 or smaller need not be insulated.

Strike Table 6.5.1-1and 6.5.1-2 of ASHRAE 90.1 in their entirety and insert new Table 6.5.1-1 in the Energy Conservation Code to read as follows:

TABLE 6.5.1-1 Minimum Fan-Cooling Unit Size for which an Economizer is Required for Comfort Cooling

Climate Zones	Cooling Capacity for Which an Economizer is Required
1a, 1b 2a, 2b, 3a, 4a, 5a, 6a 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8	No economizer requirement ≥ 33,000 Btu/h[a]

a. Where economizers are required, the total capacity of all systems without economizers shall not exceed 480,000 Btu/h (140 kW) per building or 10% of the building's installed cooling capacity, whichever is greater.

6.5 PRESCRIPTIVE PATH

Strike Section 6.5.1 of ASHRAE 90.1 in its entirety and insert a new Section 6.5.1 Code in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.1 Economizers. Each cooling system that has a fan shall include either an air or water economizer meeting the requirements of Sections 6.5.1.1 through 6.5.1.5.

a. The minimum size requirements for economizers for comfort cooling and for computer rooms are defined in Table 6.5.1-1.

b. Air-cooled packaged units with a capacity of less than 54,000 Btu/h (16 kW) shall have two stages of capacity control, with the first stage controlling the economizer and the second stage controlling mechanical cooling. Units with a capacity equal to or greater than 54,000 Btu/h (16 kW) shall comply with the staging requirements defined in Section 6.5.3.1

c. For systems that control to a fixed leaving air temperature (*i.e.*, variable-air-volume [VAV] systems), the system shall be capable of resetting the supply air temperature up at least 5°F (3°C) during economizer operation.

Exceptions: Economizers are not required for the following systems:

1. Individual fan-cooling units with a supply capacity less than the minimum listed in Table 6.5.1-1 for comfort cooling applications and Table 6.5.1-2 for computer room applications.

2. Systems that include nonparticulate air treatment as required by Section 6.2.1 in Standard 62.1.

3. In hospitals and ambulatory surgery centers, where more than 75% of the air designed to be supplied by the system is to spaces that are required to be humidified above 35°F dew-point temperature to comply with applicable codes or accreditation standards; in all other buildings, where more than 25% of the air designed to be supplied by the system is to spaces that are designed to be humidified above 35°F dew-point temperature to satisfy process needs. This exception does not apply to computer rooms.

4. Systems that include a condenser heat recovery system with a minimum capacity as defined in Section 6.5.6.2.2.

5. Systems that serve residential spaces where the system capacity is less than five times the requirement listed in Table 6.5.1-1.

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

7. Systems expected to operate less than 20 hours per week.

8. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems.

9. For comfort cooling where the cooling efficiency meets or exceeds the efficiency improvement requirements in Table 6.5.1-3.

    a. Where the reduced renewable approach defined in Section 13.1.1.2 is used, Exception (9) shall be permitted to eliminate the economizer requirement, provided the requirements in Table 6.5.1-3 are applied to the efficiency requirements required by Section 13.1.1.2. If the standard renewable approach is chosen as defined in Section 13.1.1.1 then the requirements in Table 6.5.1-3 shall be applied to the efficiency requirements in Tables 6.8.1-1 through 6.8.1-11.

10. Systems primarily serving computer rooms where:

    a. the total design cooling load of all computer rooms in the building is less than 3,000,000 Btu/
    b. h and the building in which they are located is not served by a centralized chilled water plant;

    c. the room total design cooling load is less than 600,000 Btu/h and the building in which they are located is served by a centralized chilled water plant;

    d. the local water authority does not allow cooling towers; or

e. less than 600,000 Btu/h of computer-room cooling equipment capacity is being added to an existing building.

11. For water-cooled units with a capacity less than 54,000 Btu/h (16 kW) that are used in systems where heating and cooling loads are transferred within the building (i.e., water-source heat pump systems), the requirement for an air or water economizer can be eliminated if the condenser-water temperature controls are capable of being set to maintain full-load heat rejection capacity down to a 55°F (12°C) condenser-water supply temperature, and the HVAC equipment is capable of operating with a 55°F (12°C) condenser-water supply temperature.

12. Variable refrigerant volume or variable refrigerant flow systems. (VRV/VRF).

Strike Section 6.5.2.1 of ASHRAE 90.1 in its entirety and insert a new Section 6.5.2.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.2.1 Zone Controls. Zone thermostatic controls shall prevent:

a. reheating;

b. recooling;

c. mixing or simultaneously supplying air that has been previously mechanically heated and air that has been previously cooled, either by mechanical cooling or by economizer systems; and

d. other simultaneous operation of heating and cooling systems to the same zone.

Exceptions:

1. Commercial kitchens.

2. Zones with DDC that comply with all of the following:

    a. The airflow rate in dead band between heating and cooling does not exceed the larger of the following:

        (1) 20% of the zone design peak supply rate.

        (2) The design *outdoor airflow* rate for the zone.

        (3) Any higher rate that can be demonstrated, to the satisfaction of the authority having jurisdiction, to reduce overall system annual energy usage by offsetting reheat/ recool energy losses through a reduction in outdoor air intake.

        (4) The airflow rate required to comply with applicable codes or accreditation standards, such as pressure relationships or minimum air change rates.

b. The airflow rate that is reheated, recooled, or mixed shall be less than 50% of the zone design peak supply rate.

c. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint while the airflow is maintained at the dead band flow rate.

d. The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.

3. Laboratory exhaust systems that comply with Section 6.5.7.2.

4. Zones where at least 75% of the energy for reheating or for providing warm air in mixing systems is provided from a site-recovered (including condenser heat) or site-solar energy source.

Strike Section 6.5.3 of ASHRAE 90.1 in its entirety and insert a new Section 6.5.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.3 Air System Design and Control. Each HVAC system having a total fan system motor nameplate hp exceeding 5 hp shall meet the provisions of Sections 6.5.3.1 through 6.5.3.5. Hotels and motels with more than 50 guest rooms shall comply with Section 6.5.12.

Strike Table 6.5.3.1-1 of ASHRAE 90.1 in its entirety and insert a new Table 6.5.3.1-1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

TABLE 6.5.3.1-1 FAN POWER LIMITATION[a]

	Limit	**Constant Volume**	**Variable Volume**
Option 1: Fan system motor nameplate hp	Allowable nameplate motor hp	$hp \le cfm_S \cdot 0.00099$	$hp \le cfm_S \cdot 0.00135$
Option 2:Fan system bhp	Allowable fan system bhp	$bhp \le cfm_S \cdot 0.00084 + A$	$bhp \le cfm_S \cdot 0.00117 + A$

a. where: cfm_S = maximum design supply airflow rate to conditioned spaces served by the system in cubic feet per minute hp=maximum combined motor nameplate horsepower

hp= maximum combined fanbrake horsepower

A= sum of $(PD \times cfm_D/4131)$

where:

PD= each applicable pressure drop adjustment from Table 6.5.3.1-2 in in. wc

cfm_D=the design airflow through each applicable device from Table 6.5.3.1-2 in cubic feet per minute

Strike Section 6.5.3.1.3 of ASHRAE 90.1 in its entirety and insert a new Section 6.5.3.1.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.3.1.3 Fan Efficiency. Fans shall have a fan efficiency grade (FEG) of 67 or higher based on manufacturers' certified data, as defined by AMCA 205. The total efficiency of the fan at the design point of operation shall be within 10 percentage points of the maximum total efficiency of the fan.

Exceptions:

1. Single fans with a motor nameplate kilowatts of 5 hp or less.

2. Multiple fans in series or parallel (*e.g.*, fan arrays) that have a combined motor nameplate kilowatts of 5 hp or less and are operated as the functional equivalent of a single fan.

3. Fans that are part of equipment listed under Section 6.4.1.1.

4. Fans included in equipment bearing a third- party-certified seal for air or energy performance of the equipment package.

5. Powered wall/roof ventilators (PRV).

6. Fans outside the scope of AMCA 205.

7. Fans that are intended to only operate during emergency conditions.

6.5.6 Energy Recovery

Strike Section 6.5.6.1 of ASHRAE 90.1 in its entirety and insert a new Section 6.5.6.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.6.1 Exhaust Air Energy Recovery. Each fan system shall have an energy recovery system when the system's sup- ply airflow rate exceeds the value listed in Tables 6.5.6.1-1 and 6.5.6.1-2, based on the climate zone and percentage of outdoor airflow rate at design conditions. Table 6.5.6.1-1 shall be used for all ventilation systems that operate less than 8000 hours per year, and Table 6.5.6.1-2 shall be used for all ventilation systems that operate 8000 or more hours per year.

Energy recovery systems required by this section shall have at least 60% energy recovery effectiveness. Sixty percent energy recovery effectiveness shall mean a change in the enthalpy of the outdoor air supply equal to 60% of the difference between the outdoor air and return air enthalpies at design conditions. Provision shall be made to bypass or control the energy recovery system to permit air economizer operation as required by Section 6.5.1.1.

Exceptions:

1. Laboratory systems meeting Section 6.5.7.2.

2. Systems serving spaces that are not cooled and that are heated to less than 60°F.

3. Systems exhausting toxic, flammable, paint, or corrosive fumes or dust.

4. Commercial kitchen hoods used for collecting and removing grease vapors and smoke.

5. Where more than 60% of the outdoor air heating energy is provided from site-recovered or site solar energy.

6. Where the largest source of air exhausted at a single location at the building exterior is less than 75% of the design outdoor airflow rate.

7. Systems requiring dehumidification that employ energy recovery in series with the cooling coil.

8. Systems expected to operate less than 20 hours per week at the outdoor air percentage covered by Table 6.5.6.1-1.

Insert a new Section 6.5.6.3 in in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.6.3 Supermarket Heat Recovery. Supermarkets with a floor area of 25,000 ft.^{2} (2500 m^2) or greater shall recover waste heat from the condenser heat rejection on *permanently installed* refrigeration and/or HVAC equipment meeting one of the following criteria:

a. 25% of the refrigeration system full-load total heat rejection.
b. 80% of the *space* heat, *service water heating*, and dehumidification reheat.

If a recovery system is used that is installed in the refrigeration system, the system shall not increase the saturated condensing temperature at design conditions by more than 5°F (3°C) and shall not impair other head pressure control/energy reduction strategies.

6.5.7.1 Kitchen Exhaust Systems

Strike Section 6.5.7.1.3 of ASHRAE 90.1 in its entirety and insert a new Section 6.5.7.1.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.7.1.3 For kitchen/dining facilities with total kitchen hood exhaust airflow rate greater than 2000 cfm, the maximum exhaust flow rate for each hood shall be determined in accordance with Table 6.5.7.1.3 For single hoods, or hood sections installed over appliances with different duty ratings, the maximum allowable exhaust flow rate for the hood or hood section shall be determined in accordance with Table 6.5.7.1.3 for the highest appliance duty rating under the hood or hood section. Refer to ASHRAE Standard 154 for definitions of hood type, appliance duty, and net exhaust flow rate.

Exception: When at least 75% of all the replacement air is *transfer air* that would otherwise be exhausted.

Strike Section 6.5.7.1.4 of ASHRAE 90.1 in its entirety and insert new Section 6.5.7.1.4 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

6.5.7.1.4 Kitchen/dining facilities with total kitchen hood exhaust airflow rate greater than 2000 cfm shall comply with at least one of the following:

a. At least 50% of all replacement air must be *transfer air* that would otherwise be exhausted.

b. At least 75% of kitchen hood exhaust air shall be controlled by a demand ventilation system(s), which shall:

1. be capable of reducing exhaust and replacement air system airflow rates by no more than the larger of:

i. 50% of total design exhaust and replacement air system airflow rate or

ii. the outdoor airflow and exhaust rates required to meet the ventilation and exhaust requirements of Sections 6.2 and 6.5 of ANSI/ASHRAE Standard 62.1 for the zone.

2. include controls to modulate airflow in response to appliance operation and to maintain full capture and containment of smoke, effluent, and combustion products during cooking and idle;

3. include controls that result in full flow when the demand ventilation system(s) fail to modulate airflow in response to appliance operation; and

4. allow occupants to temporarily override the system(s) to full flow.

Insert a new Section 6.5.12 in the in the Energy Conservation Code-Commercial Provisions to read as follows:

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

6.5.12.1 HVAC Setpoint Control. Within 30 minutes of all occupants leaving the guest room, HVAC setpoints shall be automatically raised by at least 5°F (3°C) from the occupant setpoint in the cooling mode and automatically lowered by at least 5°F (3°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 criteria:

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.

Exception to 6.5.12.1:

1. A *networked guest-room control system* may return the thermostat setpoints to their default 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.

6.5.12.2 Ventilation Control. Within 30 minutes of all occupants leaving the guest room, ventilation and exhaust fans shall be automatically turned off, or *isolation devices* serving each guest room shall automatically shut off the supply of *outdoor air* to the room and shut off exhaust air from the guest room.

Exception: Central exhaust systems for bathrooms.

6.8 MINIMUM EQUIPMENT EFFICIENCY TABLES

Strike Tables 6.8.1-1, 6.8.2-1, and 6.8.2-2 of ASHRAE 90.1 in their entirety.

Insert a new Table 6.8.1-1 in in the Energy Conservation Code-Commercial Provisions to read as follows:

Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air conditioners, air cooled	<65,000 Btu/h[b]	All	Split system	13.0 SEER	AHRI 210/240
			Single package	13.0 SEER (before 1/20/15) 14 SEER (as of 1/1/2015)	
Through the wall, air cooled	≤30,000 Btu/h[b]	All	Split system	12.0 SEER	
			Single package	12.0 SEER	
Small duct high velocity, air cooled	<65,000 Btu/h[b]	All	Split System	11.0 SEER	
Air conditioners, air cooled	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	Split system and single package	11.2 EER 11.4 IEER (before 1/1/2016) 12.9 IEER (as of 1/1/2016)	AHRI 340/360
		All other	Split system and single package	11.0 EER 11.2 IEER (before 1/1/2016) 12.7 IEER (as of 1/1/2016)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	11.0 EER 11.2 IEER (before 1/1/2016) 12.4 IEER (as of 1/1/2016)	
		All other	Split system and single package	10.8 EER 11.0 IEER (before 1/1/2016) 12.2 IEER (as of 1/1/2016)	
	≥240,000 Btu/h and <760,000 Btu/h	Electric resistance (or none)	Split system and single package	10.0 EER 10.1 IEER (before 1/1/2016) 11.6 IEER (as of 1/1/2016)	
		All other	Split system and single package	9.8 EER 9.9 IEER (before 1/1/2016) 11.4 IEER (as of 1/1/2016)	
			≥ 760,000 Btu/h	9.7 EER , 0 0 0	Btu/h

Electric resistance (or none)	Split system and single package	9.8 IEER (before 1/1/2016) 11.2 IEER (as of 1/1/2016)	
	All other	Split system and single package	(before 1/1/2016) 9.5 EER 9.6 IEER (as of 1/1/2016) 11.0 IEER

a. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure. b. Single-phase, air-cooled air conditioners <65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

TABLE 6.8.1-1 Electrically Operated Unitary Air Conditioners and Condensing Units— Minimum Efficiency Requirements *(Continued)*

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air conditioners, water cooled	<65,000 Btu/h	All	Split system and single package	12.1 EER 12.3 IEER	AHRI 210/240
	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	Split system and single package	12.1 EER 12.3 IEER (before 1/1/2016) 13.9 IEER (as of 1/1/2016)	AHRI 340/360
		All other	Split system and single package	11.9 EER 12.1 IEER (before 1/1/2016) 13.7 IEER (as of 1/1/2016)	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	12.5 EER 12.5 IEER (before 1/1/2016) 13.9 IEER (as of 1/1/2016)	
		All other	Split system and single package	12.3 EER 12.5 IEER (before 1/1/2016) 13.7 IEER (as of 1/1/2016)	
	≥240,000 Btu/h and <760,000 Btu/h	Electric resistance (or none)	Split system and single package	12.4 EER 12.6 IEER (before 1/1/2016) 13.6 IEER (as of 1/1/2016)	AHRI 340/360
		All other	Split system and single package	12.2 EER 12.4 IEER (before 1/1/2016) 13.4 IEER (as of 1/1/2016)	
	≥760,000 Btu/h	Electric resistance (or none)	Split system and single package	12.2 EER 12.4 IEER (before 1/1/2016) 13.5 IEER (as of 1/1/2016)	AHRI 340/360
		All other	Split system and single package	12.0 EER 12.2 IEER (before 1/1/2016) 13.3 IEER (as of 1/1/2016)	

a. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure. b. Single-phase, air-cooled air conditioners <65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

Minimum Efficiency Requirements *(Continued)*

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air conditioners, evaporatively cooled	<65,000 Btu/h[b]	All	Split system and single package	12.1 EER 12.3 IEER	AHRI 210/ 240
	≥65,000 Btu/h and <135,000 Btu/h	Electric resistance (or none)	Split system and single package	12.1 EER 12.3 IEER	AHRI 340/ 360
		All other	Split system and single package	11.9 EER 12.1 IEER	
	≥135,000 Btu/h and <240,000 Btu/h	Electric resistance (or none)	Split system and single package	12.0 EER 12.2 IERR	
		All other	Split system and single package	11.8 EER 12.0 IEER	
	≥240,000 Btu/h and <760,000 Btu/h	Electric resistance (or none)	Split system and single package	11.9 EER 12.1 IEER	
		All other	Split system and single package	11.7 EER 11.9 IEER	
	≥760,000 Btu/h	Electric resistance (or none)	Split system and single package	11.7 EER 11.9 IEER	
		All other	Split system and single package	11.5 EER 11.7 IEER	
Condensing units, air cooled	≥135,000 Btu/h			10.5 EER 11.8 IEER	AHRI 365
Condensing units, water cooled	≥135,000 Btu/h			13.5 EER 14.0 IEER	
Condensing units, evaporatively cooled	≥135,000 Btu/h			13.5 EER 14.0 IEER	

a. Section 12 contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure. b. Single-phase, air-cooled air conditioners <65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

Equipment Type	Size Category	Heating Section Type	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure[a]
Air cooled (cooling mode)	<65,000 Btu/h[b]	Heat Pump with Elec. Backup, Gas	Split system	14 SEER	AHRI 210/240
		Heat Pump with Elec. Backup, Gas	Single package	14 SEER	
Through the wall, air cooled (cooling mode)	≤30,000 Btu/h[b]	Heat Pump with Elec. Backup, Gas	Split system	12.0 SEER	
			Single package	12.0 SEER	
Small duct high velocity, air cooled	<65,000 Btu/h[b]		Split System	11.0 SEER	
Air cooled (cooling mode)	≥65,000 Btu/h and <135,000 Btu/h	None	Split system and single package	11.0 EER 12.2 IEER	AHRI 340/360
		Heat Pump with Elec. Backup, Gas	Split system and single package	10.8 EER 12.0 IEER	
	≥135,000 Btu/h and <240,000 Btu/h	None	Split system and single package	10.6 EER 11.6 IEER	
		Heat Pump with Elec. Backup, Gas	Split system and single package	10.4 EER 11.4 IEER	
	≥240,000 Btu/h	None	Split system and single package	9.5 EER 10.6 IEER	
		Heat Pump with Elec. Backup, Gas	Split system and single package	9.3 EER 10.4 IEER	

a. Section 12 contains a complete specification of the referenced test procedure,

including the referenced year version of the test procedure.

b. Single-phase, air-cooled air conditioners <65,000 Btu/h are regulated by NAECA. SEER values are those set by NAECA.

7.4 MANDATORY PROVISIONS

Strike Section 7.4.2 of ASHRAE 90.1 in its entirety and insert a new Section 7.4.2 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

7.4.2 Equipment Efficiency. All water heating equipment, hot-water supply boilers used solely for heating potable water, pool heaters, and hot-water storage tanks shall meet the criteria listed in Table 7.8, except for projects complying with the Alternate Renewables Approach in Section 13.1.1.2, which shall comply with Table 13-9 and the ENERGY STAR requirements in Section 10.11.2. Where multiple criteria are listed, all criteria shall be met. Omission of minimum performance requirements for certain classes of equipment does not preclude use of such equipment where appropriate. Equipment not listed in Table 7.8 has no minimum performance requirements.

Exceptions: All water heaters and hot-water supply boilers having more than 140 gal of storage capacity are not required to meet the standby loss (SL) requirements of Table 7.8 when:

a. the tank surface is thermally insulated to R-12.5,

b. a standing pilot light is not installed, and

c. gas- or oil-fired storage water heaters have a flue damper or fan-assisted combustion.

Insert a new Section 7.4.5.2.1 in in the Energy Conservation Code-Commercial Provisions to read as follows:

7.4.5.2.1 Insulation for Spas and Pools. Spas and pools heated to more than 90°F (32°C) shall also have side and bottom surfaces insulated on the exterior with a minimum insulation value of R-12.

SECTION 8 POWER
8.1 GENERAL
8.4 MANDATORY PROVISIONS
8.5 PRESCRIPTIVE PATH

8.1 GENERAL

Insert a new Section 8.1.5 into the Energy Conservation Code-Commercial Provisions to read as follows:

8.1.5 Establishing an open and interoperable automated demand response (Auto-DR) infrastructure. Buildings that contain heating, ventilation, or air conditioning (HVAC) systems shall comply with Sections 8.1.5.1 through 8.1.5.3. Actual participation in demand response programs is not required.

Exceptions: Auto-DR infrastructure is not required for the following:

1. Buildings located where the electric utility or regional Independent System Operator (ISO) or Regional Transmission Operator (RTO) does not offer a demand response program to buildings regulated by this code.

2. Buildings with a peak electric demand not greater than 0.75 times that of the standard reference design.

3. Buildings that have incorporated on-site renewable energy generation to provide 20 percent or more of the building's energy demand.

8.1.5.1 Software clients. Demand response automation software clients shall be capable of communicating with a demand response automation server via the Internet or other communication relay.

8.1.5.2 Heating, ventilating and air-conditioning (HVAC) systems. The Auto-DR strategy for HVAC systems shall be capable of reducing the building peak cooling or heating HVAC demand by not less than 10 percent when signaled from the electric utility, regional independent system operator (ISO) or regional transmission operator (RTO), through any combination of the strategies and systemic adjustments, including, but not limited to the following:

Exceptions: The Auto-DR strategy is not required to include the following buildings and systems:

1. Hospitals and critical emergency response facilities.

2. Ventilation and exhaust systems required by Chapter 5 of the *Mechanical Code* for the control or removal of dust, particles, odors, fumes, spray, gas, smoke or other hazardous materials, considered to be irritating or injurious to health or

safety, and produced by or involved in operations or processes, including hazardous materials storage.

3. Manufacturing process systems.

4. Group R occupancies.

8.1.5.2.1 Rebound avoidance. The Auto-DR strategy shall include logic to prevent a rebound peak. When the signal for Auto-DR is ended, a gradual return to normal heating, ventilation and air-conditioning (HVAC) equipment operations shall be part of the Auto-DR strategy, through any combination of the strategies and systemic adjustments, including, but not limited to the following:

1. Where close to the unoccupied period, the Auto-DR period shall be extended using rebound avoidance, extended Auto-DR control strategy until the initiation of the unoccupied period.

2. Rebound avoidance, slow recovery control strategies, gradually increasing or decreasing space temperature setpoints or a variance in the timing by cooling or heating zone.

3. Rebound avoidance, slow recovery control strategies, gradually increasing or decreasing zone supply air temperatures.

4. Rebound avoidance, slow recovery control strategies, gradually increasing or decreasing chilled water temperatures or decreasing hot water temperatures.

5. Rebound avoidance, sequential equipment recovery strategies, gradually restoring demand limited equipment capacity.

6. Rebound avoidance, sequential equipment recovery strategies, gradually restoring equipment that was turned off during the Auto-DR period.

7. Rebound avoidance, slow recovery control strategies, gradually increasing capacity for air moving and pumping systems.

8. Rebound avoidance, sequential equipment recovery or rebound avoidance, slow recovery control where chilled water or hot water and other capacity control valves are sequentially or gradually allowed to return to normal operation, respectively.

8.4 MANDATORY PROVISIONS

Strike Section 8.4.2 of ASHRAE 90.1 in its entirety and insert a new Section 8.4.2 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

8.4.2 Automatic Receptacle Control. The following shall be automatically controlled:

1. One (1) 125-volt 15- and 20-amp duplex receptacles in each private offices, and individual workstation to be located at the desk area and 50% of 125-volt 15- and 20-amp duplex receptacles in, conference rooms, rooms used primarily for printing and/or copying functions, break rooms, and classrooms.

2. Twenty-five percent (25%) of the circuits feeding each base feed point of modular furniture or a minimum of one (1) circuit.

This control shall function using one of the following methods:

a. A scheduled basis using a time-of-day operated control device that turns receptacles off at specific programmed times—an independent program schedule shall be pro- vided for controlled areas of no more than 5000 ft.^{2} and not more than one floor (the occupant shall be able to manually override the control device for up to two hours),

b. An occupant sensor that shall turn receptacles off within 20 minutes of all occupants leaving a space, or

c. An automated signal from another control or alarm sys- tem that shall turn receptacles off within 20 minutes after determining that the area is unoccupied.

All controlled receptacles shall be permanently marked to visually differentiate them from uncontrolled receptacles and are to be uniformly distributed throughout the space.

Plug-in devices shall not be used to comply with Section 8.4.2.

Exceptions: Receptacles for the following shall not require an automatic control device:

1. Receptacles specifically designated for equipment requiring continuous operation (24 hours/day, 365 days/year).

2. Spaces where an automatic control would endanger the safety or security of the room or building occupant(s).

Strike Section 8.4.3 of ASHRAE 90.1 in its entirety and insert a new Section 8.4.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

8.4.3 Energy Metering, Monitoring and Reporting. The provisions of Section 8.4.3 shall only apply to new construction and projects that are undertaking a complete electrical system replacement. Section 8.4.3 shall not apply to Group R occupancies, other than Group R-1 occupancies.

8.4.3.1 Purpose. The purpose of this section is to provide requirements that will ensure that projects are constructed or altered in a way that will provide the capability for their

energy use, production and reclamation to be measured, monitored and reported. This includes the design of energy distribution systems so as to isolate load types, the installation of or ability to install in the future meters, devices and a data acquisition system, and the installation of, or the ability to provide, energy displays and other appropriate reporting mechanisms in the future.

All forms of energy delivered to the building and building site, produced on the building site or in the building, and reclaimed at the building site or in the building shall be metered and all energy load types measured in accordance with this section.

8.4.3.1.1 Buildings **with tenants within the scope of Section 8.4.3.** The metering required by Section 8.4.3 shall be collected for the entire building and for each floor in the building. Tenants within the scope of Section 8.4.3 shall have access to all data collected for the floors in which they have occupancy. Means of access shall be left to the discretion of the owner.

8.4.3.2 Energy distribution design requirements and load type isolation in buildings. Energy distribution systems within, on or adjacent to and serving a building shall be designed such that each primary circuit, panel, feeder, piping system or supply mechanism supplies only one energy use type as defined in Sections 8.4.3.2.1 through 8.4.3.2.5. The energy use type served by each distribution system shall be clearly designated on the energy distribution system with the use served, and adequate space shall be provided for installation of metering equipment or other data collection devices, temporary or permanent, to measure their energy use. The energy distribution system shall be designed to facilitate the collection of data for each of the building energy use categories in Section 8.4.3.4 and for each of the end use categories listed in Sections 8.4.3.2.1 through 8.4.3.2.5. Where there are multiple buildings on a building site, each building shall comply separately with the provisions of Section 8.4.3.

Exception: Buildings designed and constructed such that the total usage of each of the load types described in Sections 8.4.3.2.1 through 8.4.3.2.5 shall be permitted to be measured through the use of installed sub-meters or other equivalent methods as approved.

8.4.3.2.1 HVAC system total energy use. The HVAC system total energy use category shall include all energy used to heat, cool, and provide ventilation to the building including, but not limited to, fans, pumps, boiler energy, chiller energy and hot water.

8.4.3.2.2 Lighting system total energy use. The lighting system total energy use category shall include all interior and exterior lighting used in occupant spaces and common areas.

8.4.3.2.3 Plug loads. The plug loads energy use category shall include all energy use by devices, appliances and equipment connected to convenience receptacle outlets.

8.4.3.2.4 Process loads. The process loads energy use category shall include the energy used by any single load associated with activities within the building, such as, but not limited to, data centers, manufacturing equipment and commercial kitchens, that exceeds 5 percent of the peak connected load of the whole building.

8.4.3.2.5 Energy used for building operations loads and other miscellaneous loads. The category of energy used for building operations loads and other miscellaneous loads shall include all vertical transportation systems, automatic doors, motorized shading systems, ornamental fountains and fireplaces, swimming pools, inground spas, snow-melt systems, exterior lighting that is mounted on the building or used to illuminate building facades and the use of any miscellaneous loads in the building not specified in Sections 8.4.3.2.1 through 8.4.3.2.4.

8.4.3.3 Energy-type metering. Buildings shall be provided with the capability to determine energy use and peak demand as provided in this section for each of the energy types specified in Sections 8.4.3.3.1 through 8.4.3.3.7. Utility energy meters or supplemental sub-meters are permitted to be used to collect whole building data, and shall be equipped with a local data port connected to a data acquisition system in accordance with Section 8.4.3.5.

8.4.3.3.1 Gaseous fuels. Gaseous fuels including, but not limited to, natural gas, LP gas, coal gas, hydrogen, landfill gas, digester gas and biogas shall be capable of being metered at the building site to determine the gross consumption and peak demand of each different gaseous fuel by each building on a building site. The installation of gas meters and related piping shall be in accordance with the *Fuel Gas Code*.

8.4.3.3.2 Liquid fuels. Liquid fuels including, but not limited, to fuel oil, petroleum-based diesel, kerosene, gasoline, bio diesel, methanol, ethanol and butane shall be capable of being metered at the building site to allow a determination of the gross consumption and peak demand of each liquid fuel use by each building on a building site. The installation of meters and related piping shall be in accordance with the *Mechanical Code*.

8.4.3.3.3 Solid fuels. Solid fuels including, but not limited to, coal, charcoal, peat, wood products, grains, and municipal waste shall be capable of having their use determined at the building site to allow a determination of the gross consumption and peak demand of each solid fuel use by each building on a building site.

8.4.3.3.4 Electric power. Electric power shall be capable of being metered at the building site to allow a determination of the gross consumption and peak demand by each building on a building site. The installation of electric meters and related wiring shall be in accordance with NFPA 70.

8.4.3.3.5 District heating and cooling. Hot water, steam, chilled water, and brine shall be capable of being metered at the building site, or where produced on the

building site, to allow a determination of the gross consumption of heating and cooling energy by each building on a building site. Energy use associated with the production of hot water, steam, chilled water or brine shall be determined based on the fuel used.

8.4.3.3.6 Combined heat and power. Equipment and systems with a connected load greater than 125,000 Btu/hr (36.63 kW) providing combined heat and power (CHP) shall be capable of being metered to allow a determination of the gross consumption of each form of delivered energy to the equipment. The output of CHP shall be metered in accordance with the applicable portions of Section 8.4.3 based on the forms of output from the CHP.

8.4.3.3.7 Renewable energy. Equipment and systems providing energy from renewable energy sources which is included in the determination of the building zEPI, shall be capable of being metered to allow a determination of the output of equipment and systems in accordance with Sections 8.4.3.3.7.1 through 8.4.3.3.7.3.

8.4.3.3.7.1 Solar electric. Equipment and systems providing electric power through conversion of solar energy directly to electric power shall be capable of being metered so that the peak electric power (kW) provided to the building and its systems or to off-site entities can be determined at 15-minute intervals, and the amount of electric power (kWh) provided to the building and its systems can be determined at intervals of one hour or less.

8.4.3.3.7.2 Wind power systems. Equipment and systems providing electric power through conversion of wind energy directly to electric power shall be capable of being metered so that the peak electric power (kW) provided to the building and its systems or to off-site entities can be determined at 15-minute intervals, and the amount of electric power (kWh) provided to the building and its systems can be determined at intervals of one hour or less.

8.4.3.3.7.3 Other renewable energy electric production systems. Equipment and systems providing electric power through conversion of other forms of renewable energy directly to electric power shall be capable of being metered so that the peak electric power (kW) provided to the building and its systems or to off-site entities can be determined at 15-minute intervals, and the amount of electric power (kWh) provided to the building and its systems can be determined at intervals of one hour or less.

8.4.3.4 Energy load type sub-metering. For projects that are 25,000 square feet (2323 m^2) or larger in total floor area, the energy use of the categories specified in Section 8.4.3.2 shall be metered through the use of sub-meters or other approved equivalent methods meeting the capability requirements of Section 8.4.3.3.

8.4.3.4.1 Projects less than 25,000 square feet. For projects that are less than

25,000 square feet (2323 m^2) in total floor area, and encompass at least one entire floor, the energy distribution system shall be designed and constructed to accommodate the future installation of sub-meters and other approved devices in accordance with Section 8.4.3.4. This includes, but is not limited to, providing access to distribution lines and ensuring adequate space for the installation of submeters and other approved devices.

8.4.3.5 Minimum energy measurement and verification. Meters, sub-meters, and other approved devices installed in compliance with Sections 8.4.3.3 and 8.4.3.4 shall be connected to a data acquisition and management system capable of storing not less than 36 months' worth of data collected by all meters and other approved devices.

Strike Section 8.5 of ASHRAE 90.1 in its entirety and insert a new Section 8.5 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

8.5 PRESCRIPTIVE PATH

8.5.1 Automatic Control of Equipment in Hotel/Motel Guest Rooms. In hotels and motels with more than 50 guest rooms, *automatic* controls for switched outlets and televisions serving each guest room shall be configured according to the following requirements.

8.5.1.1 Switched Outlet Control. Within 30 minutes of all occupants leaving the guest room, power for lighting and switched outlets shall be automatically turned off.

8.5.1.2 Television Control. Within 30 minutes of all occupants leaving the guest room, televisions shall be automatically turned off or placed in sleep or standby mode.

SECTION 9 LIGHTING
9.1 GENERAL
9.4 MANDATORY PROVISIONS
9.5 BUILDING AREA METHOD COMPLIANCE PATH
9.6 ALTERNATIVE COMPLIANCE PATH: SPACE-BY-SPACE METHOD

9.1 GENERAL

Strike Section 9.1.1 of ASHRAE 90.1 in its entirety and insert a new Section 9.1.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

9.1.1 Scope. This section shall apply to the following:

a. Interior spaces of buildings.

b. Exterior building features, including façades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies.

c. Exterior building grounds lighting provided through the building's electrical service.

Exceptions:

1. Emergency lighting that is automatically off during normal building operation.

2. Lighting within dwelling units provided that 85% of the lamps in permanently installed luminaires are *high efficacy*.

3. Lighting that is specifically designated as required by a health or life safety statute, ordinance, or regulation.

4. Decorative gas lighting systems.

Strike Section 9.1.2 of ASHRAE 90.1 in its entirety and insert a new Section 9.1.2 in its place to read as follows:

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 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 sys- tem 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 9.4.1.4(a) and 9.4.1.4(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: Alterations that involve replacing less than 50% 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.

Strike Section 9.1.4 of ASHRAE 90.1 in its entirety and insert a new Section 9.1.4 in its place to read as follows:

9.1.4 Interior and Exterior Luminaire Wattage. Luminaire wattage, when used to calculate either installed interior lighting power or installed exterior lighting power, shall be determined in accordance with the following criteria:

a. The wattage of line-voltage luminaires not containing permanently installed ballasts, transformers, or similar devices shall be the manufacturers' labeled maximum wattage of the luminaire.

Exception: Where lighting is connected to a current limiter and containing *high efficacy* lamping shall be designed to use the wattage of the current limiter.

b. The wattage of luminaires with permanently installed or remote ballasts, transformers, or similar devices shall be the operating input wattage of the maximum lamp/auxiliary combination based on values from the auxiliary manufacturers' literature or recognized testing laboratories or shall be the maximum labeled wattage of the luminaire.

Exception: Lighting power calculations for ballasts with adjustable ballast factors shall be based on the ballast factor that will be used in the space, provided that the ballast factor is not user changeable.

c. For line-voltage lighting track and plug-in busway designed to allow the addition and/or relocation of luminaires without altering the wiring of the system, the wattage shall be

1. The specified wattage of the luminaires included in the system with a minimum of 30 W/lin ft.,

2. The wattage limit of the system's circuit breaker or

3. The wattage limit of other permanent current-limiting device(s) on the system.

d. The wattage of low-voltage lighting track, cable conductor, rail conductor, and other flexible lighting systems that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the specified wattage of the transformer supplying the system.

e. The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.

9.4 MANDATORY PROVISIONS

Strike Section 9.4.1 of ASHRAE 90.1 in its entirety and insert a new Section 9.4.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

9.4.1.1 Interior Lighting Controls. For each space in the building, all of the lighting control functions indicated in Table 9.6.1, for the appropriate space type in column A, and as described below, shall be implemented. All control functions labeled with an "REQ" are mandatory and shall be implemented. If a space type has control functions labeled "ADD1" then at least one of those functions indicated as "ADD1" shall be implemented. If a space type has control functions labeled "ADD2" then at least one of those functions indicated as "ADD2" shall be implemented. For space types not listed, select a reasonably equivalent type.

If using the Space-by-Space Method for LPD requirements, the space type used for determining control requirements shall be the same space type used to determine the LPD.

a. *Local control:* There shall be one or more manual lighting controls in the space that controls all of the lighting in the space. Each control device shall control an area (1) no larger than 2500 ft^2 (232.25 m^2) if the space is 10,000 ft^2 (929.03 m^2), and (2) no larger than 10,000 $ft.^2$ ((929.03 m^2) otherwise. The device installed to comply with this provision shall be readily accessible and located so that the occupants can see the controlled lighting when using the control device.

   Exception: Remote location of this local control device or devices shall be permitted for reasons of safety or security when each remote control device has an indicator pilot light as part of or next to the control device and the light is clearly labeled to identify the controlled lighting.

b. *Restricted to manual ON:* None of the lighting shall be automatically turned on.

   Exception: Manual ON is not required where manual ON operation of the general lighting would endanger the safety or security of the room or building occupants.

c. *Restricted to partial automatic ON:* No more than 50% of the lighting power for the general lighting shall be allowed to be automatically turned on, and none of the remaining lighting shall be automatically turned on.

d. *Bilevel lighting control:* The general lighting in the space shall be controlled so as to provide at least one intermediate step in lighting power or continuous dimming in addition to full ON and full OFF. At least one intermediate step shall be between 30% and 70% (inclusive) of full lighting power.

   Exception: Existing and/or renovation spaces shall not be required to provide bi-level lighting control in areas where no work is to be performed or where only the existing light switch is being relocated due to door relocations.

e. *Automatic daylight responsive controls for sidelighting:* In any space where the combined input power of all general lighting completely or partially within the primary side- lighted areas is 150 W or greater, the general lighting in the primary sidelighted areas shall be controlled by photocontrols.

   The control system shall have the following characteristics:

1. The calibration adjustments shall be readily accessible.

2. The photocontrol shall reduce electric lighting in response to available daylight using continuous dimming or with at least one control point between 50% and 70% of design lighting power, a second control point between 20% and 40% of design lighting power or the lowest dimming level the technology allows, and a third control point that turns off all the controlled lighting.

   Exceptions: The following areas are exempted from Section 9.4.1.1(e):

   1. Primary sidelighted areas where the top of any existing adjacent structure is twice as high above the windows as its distance away from the windows.

   2. Sidelighted areas where the total glazing area is less than 20 $ft.^2$

   3. Retail spaces.

   4. Where the total interior lighting power (watts) of the building is no more than 80 percent of the interior lighting power allowance calculated by the Building Area Method in Section 9.5, or no more than 80 percent of the interior lighting power allowance calculated by the Space-by-Space Method in Section 9.6.

f. *Automatic daylight responsive controls for toplighting:* In any space where the combined input power for all general lighting completely or partially within daylight areas under skylights and daylight areas under roof monitors is 105 W or greater, general lighting in the daylight area shall be controlled by photocontrols having the following characteristics:

   1. The calibration adjustments shall be readily accessible.

   2. The photocontrol shall reduce electric lighting in response to available daylight using continuous dimming or with at least one control point that is between 50% and 70% of design lighting power, a second control point between 20% and 40% of design lighting power or the lowest dimming level the technology allows, and a third control point that turns off all the controlled lighting.

   3. General lighting in overlapping toplighted and side- lighted daylight areas shall be controlled together with general lighting in the daylight area under sky- lights or daylight areas under roof monitors.

      Exceptions: The following areas are exempted from Section 9.4.1.1(f):

      1. Daylight areas under skylights where it is documented that existing adjacent structures or natural objects block direct sunlight for more than 1500 daytime hours per year between 8 a.m. and 4 p.m.

      2. Daylight areas where the skylight visual transmittance (VT) is less than 0.4.

      3. In each space within buildings in Climate Zone 8 where the input power of the general lighting within daylight areas is less than 200 W.

4. Where the total interior lighting power (watts) of the building is no more than 80 percent of the interior lighting power allowance calculated by the Building Area Method in Section 9.5, or no more than 80 percent of the interior lighting power allowance calculated by the Space-by-Space Method in Section 9.6.

g. *Automatic partial OFF (full OFF complies):* The general lighting power in the space shall be automatically reduced by at least 50% within 20 minutes of all occupants leaving the space.

Exceptions: This requirement does not have to be complied with in spaces that meet all three of the following requirements:

1. The space has an LPD of no more than 0.80 W/ft.^{2}

2. The space is lighted by HID.

3. The general lighting power in the space is automatically reduced by at least 30% within 20 minutes of all occupants leaving the space.

h. *Automatic full OFF:* All lighting shall be automatically shut off within 20 minutes of all occupants leaving the space, except for restrooms, which shall be set to a maximum of 30 minutes. A control device meeting this requirement shall control no more than 5000 ft.^{2}.

Exceptions: The following lighting is not required to be automatically shut off:

1. General lighting and task lighting in shop and laboratory classrooms.

2. General lighting and task lighting in spaces where automatic shutoff would endanger the safety or security of room or building occupants.

3. Lighting required for 24/7 operation or emergency lighting.

i. *Scheduled shutoff:* All lighting in the space not exempted by Exception (1) to Section 9.1.1 shall be automatically shut off during periods when the space is scheduled to be unoccupied using either (1) a time-of-day operated control device that automatically turns the lighting off at specific programmed times or (2) a signal from another automatic control device or alarm/security system. The control device or system shall provide independent control sequences that (1) control the lighting for an area of no more than 25,000 ft.^{2}, (2) include no more than one floor, and (3) shall be programmed to account for weekends and holidays. Any manual control installed to provide override of the scheduled shutoff control shall not turn the lighting on for more than two hours per activation during scheduled off periods and shall not control more than 5000 ft.^{2}.

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

1. Lighting in spaces where lighting is required for 24/7 continuous operation or emergency lighting.

2. Lighting in spaces where patient care is rendered.

3. Lighting in spaces where automatic shutoff would endanger the safety or security of the room or building occupants.

Strike Section 9.4.1.4 of ASHRAE 90.1 in its entirety and insert a new Section 9.4.1.4 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

9.4.1.4 Exterior Lighting Control. Lighting for exterior applications not exempted in Section 9.1 shall meet the following requirements:

a. Lighting shall be controlled by a device that automatically turns off the lighting when sufficient daylight is available.

b. All building façade and landscape lighting shall be automatically shut off between midnight or business closing, whichever is later, and 6 a.m. or business opening, whichever comes first, or between times established by the authority having jurisdiction.

c. Lighting not specified in Section 9.4.1.4(b) and lighting for signage shall be controlled by a device that automatically reduces the connected lighting power by at least 30% for at least one of the following conditions:

1. From 12 midnight or within one (1) hour of the end of business operations, whichever is later, until 6 a.m. or business opening, whichever is earlier.

2. During any period when no activity has been detected for a time of no longer than 15 minutes.

All time switches shall be capable of retaining programming and the time setting during loss of power for a period of at least ten hours.

Exceptions:

1. Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

2. Lighting that is integral to signage and installed in the signage by the manufacturer.

9.4.1.4.1 Parking Lighting. This section supersedes Section 9.4.1.4 for lighting serving uncovered parking areas. Outdoor luminaires serving uncovered parking areas shall be controlled by all of the following:

a. Luminaires shall be controlled by a device that automatically turns off the luminaire during *daylight hours*.

b. Luminaires shall be controlled by a timeclock or other control that automatically turns off the luminaire according to a timed schedule.

c. For luminaires having a rated input wattage of more than 50 W and where the bottom of the luminaire is mounted 24 ft. (7.3 m) or less above the ground, the luminaires shall be controlled by one or more devices that automatically reduce lighting power of each luminaire by a minimum of 40% when there is no activity detected in the controlled zone for a period no longer than 15 minutes. No more than 1500 input watts of lighting power shall be controlled together.

Exceptions to 9.4.1.4.1(c):

1. Lighting serving uncovered parking areas does not include lighting for outdoor sales, including vehicle sales lots.

2. Lighting for covered vehicle entrances or exits from buildings or parking structures where required for safety, security, or eye adaptation.

TABLE 9.4.2-2 INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS

	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
Base Site Allowance (base allowance may be used in tradable or non-tradable surfaces)					
	No base site in Zone 0	500 W	600 W	750 W	1300 W
Tradable Surfaces (LPDs for uncovered parking areas, building grounds, building entrances, exits and loading docks, canopies and overhangs, and outdoor sales areas may be traded.)					
Uncovered Parking Areas					
Parking areas and drives	No allowance	0.03 W/ft^2	0.05 W/ft^2	0.09 W/ft^2	0.12 W/ft^2
Building Grounds					
Walkways less than 10 ft wide	No allowance	0.63 W/linear foot	0.63 W/linear foot	0.76 W/linear foot	.95 W/linear foot
Walkways 10 ft wide or greater Plaza areas Special feature areas	No allowance	0.12 W/ft^2	0.12 W/ft^2	0.15 W/ft^2	0.19 W/ft^2
Stairways	No allowance	0.67 W/ft^2	0.9 W/ft^2	0.95 W/ft^2	0.95 W/ft^2
Pedestrian tunnels	No allowance	0.13 W/ft^2	0.13 W/ft^2	0.19 W/ft^2	0.28 W/ft^2
Landscaping	No allowance	0.03 W/ft^2	0.04 W/ft^2	0.04 W/ft^2	0.04 W/ft^2
Building Entrances, Exits, and Loading Docks					
Main entries width	No allowance	18 W/lin ft of door width		18 W/lin ft of door width	
Other doors	No allowance	18 W/lin ft of door		18 W/lin ft of door	

28.5 W/lin ft of door width 19 W/lin ft of door width			28.5 W/lin ft of door width 19 W/lin ft of door width		
Entry canopies	No allowance	0.22 W/ft^2	0.22 W/ft^2	0.38 W/ft^2	0.38 W/ft^2
Loading docks	No allowance	0.45 W/ft^2	0.45 W/ft^2	0.47 W/ft^2	0.47 W/ft^2
Sales Canopies					
Free standing and attached	No allowance	0.54 W/ft^2	0.54 W/ft^2	0.76 W/ft^2	0.95 W/ft^2
Outdoor Sales					
Open areas (including vehicle sales lots)	No allowance	0.22 W/ft^2	0.22 W/ft^2	0.47 W/ft^2	0.66 W/ft^2
Street frontage for vehicle sales lots in addition to "open area" allowance	No allowance	No allowance	9 W/linear foot	9.5 W/linear foot	28.5 W/linear foot
Nontradable Surfaces (LPD 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	No allowance	No allowance	0.09 W/ft^2 for each illuminated wall or surface or 2.37 W/ linear foot for each illuminated wall or surface length	0.14 W/ft^2 for each illuminated wall or surface or 3.56 W/ linear foot for each illuminated wall or surface length	0.19 W/ft^2 for each illuminated wall or surface or 4.75 W/ linear foot for each illuminated wall or surface length
Automated teller machines and night depositories	No allowance	256.5 W per location plus 85.5 W per additional ATM per location	256.5 W per location plus 85.5 W per additional ATM per location	256.5 W per location plus 85.5 W per additional ATM per location	256.5 W per location plus 85.5 W per additional ATM per location

TABLE 9.4.2-2 INDIVIDUAL LIGHTING POWER ALLOWANCES FOR BUILDING EXTERIORS *(CONTINUED)*

	Zone 0	Zone 1	Zone 2	Zone 3	Zone 4
Entrances and gatehouse inspection stations at guarded facilities	No allowance	0.71 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.71 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.71 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.71 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	No allowance	0.47 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.47 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.47 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")	0.47 W/ft.^{2} of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradable Surfaces")
Drive-through windows/ doors	No allowance	380 W per drive-through	380 W per drive-through	380 W per drive-through	380 W per drive-through
Parking near 24-hour retail entrances	No allowance	760 W per main entry	760 W per main entry	760 W per main entry	760 W per main entry
Roadway/parking entry, trail head, and toilet facility, or other locations approved by the authority having jurisdiction.	A single luminaire of 60 W or less may be installed for each roadway/ parking entry, trail head, and toilet facility, or other locations approved by the authority having jurisdiction	No allowance	No allowance	No allowance	No allowance

9.5 BUILDING AREA METHOD COMPLIANCE PATH

9.5.1 Building Area Method Compliance Path

Strike Table 9.5.1 in ASHRAE 90.1 in its entirety and insert new Table 9.5.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

TABLE 9.5.1 LIGHTING POWER DENSITIES USING THE BUILDING AREA METHOD

Building Area Type[a]	LPD, W/ft.^{2}

Automotive facility	0.80
Convention center	1.01
Courthouse	0.95
Dining: Bar lounge/leisure	1.01
Dining: Cafeteria/fast food	0.85
Dining: Family	0.90
Dormitory	0.54
Exercise center	0.79
Fire station	0.67
Gymnasium	0.94
Health-care clinic	0.85
Hospital	0.99
Hotel/Motel	0.87
Library	1.13
Manufacturing facility	1.17
Motion picture theater	0.76
Multifamily	0.48
Museum	1.02
Office	0.77
Parking garage	0.21
Penitentiary	0.76
Performing arts theater	1.39
Police station	0.82
Post office	0.87
Religious building	0.95
Retail	1.26
School/university	0.78
Sports arena	0.91
Town hall	0.84
Transportation	0.66
Warehouse	0.66
Workshop	1.19

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.

a. For spaces in which lighting is specified to be installed in addition to the general lighting for the purpose of decorative appearance or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 5% of the lighting power allowance across the entire project space permitted in Sections 9.5.1 or 9.6.1.
b. For lighting equipment installed in sales areas and specifically designed and directed to highlight merchandise, calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance =
1000 W + (For Retail Area 1, 10% base power allowance for the sales area per Table 9.5.1 or Table 9.6.1)

Insert a new Section 9.5.2 in the Energy Conservation Code-Commercial Provisions to read as follows:

9.5.2 Prescriptive Control Requirements

9.5.2.1 *Automatic* Control of Lights in Group R-1 Occupancies. In Group R-1 occupancies with more than 50 guest rooms, *automatic controls* for the lighting shall be configured according to the following requirements.

9.5.2.1.1 Lighting and Switched Outlet Control. Within 30 minutes of all occupants leaving the guest room, power for lighting shall be automatically turned off.

9.5.2.2 Occupancy Sensor Controls with Multilevel Switching or Dimming. The lighting in commercial and industrial storage stack areas shall be controlled by an occupant sensor with multilevel switching or dimming system that reduces lighting power a minimum of 50% within 20 minutes of all occupants leaving the stack area.

Exception: Storage stack areas illuminated by high- intensity discharge (HID) lighting with a lighting power density of 0.8 W/ft.^{2} (8.6 W/m^2) or less.

9.5.2.3 *Automatic* Controls for Egress and Security Lighting. Lighting in any area within a building that is required to be continuously illuminated for reasons of building security or emergency egress shall not exceed 0.1 W/ft.^{2} (1 W/m^2). Additional egress and security lighting shall be allowed, provided it is controlled by an *automatic* control device that turns off the additional lighting.

9.5.2.4 Controls for Exterior Sign Lighting. All exterior sign lighting, including internally illuminated signs and lighting on externally illuminated signs, shall comply with the requirements of Sections 9.5.2.4.1 or 9.5.2.4.2.

Exceptions:

1. Sign lighting that is specifically required by a health or life safety statute, ordinance, or regulation.

2. Signs in tunnels.

9.5.2.4.1 All sign lighting that operates more than one hour per day during *daylight hours* shall include controls to automatically reduce the input power to a maximum of 35% of full power for a period from one hour after sunset to one hour before sunrise.

Exception: Sign lighting using metal halide, high-pressure sodium, induction, cold cathode, or neon lamps that includes controls to automatically reduce the input power to a maximum of 70% of full power for a period from one hour after sunset to one hour before sunrise.

9.5.2.4.2 All other sign lighting shall include the following:

a. Controls to automatically reduce the input power to a maximum of 70% of full power for a period from mid- night or within one hour of the end of business operations, whichever is later, until 6:00 am or business opening, which- ever is earlier.

b. Controls to automatically turn off during *daylight hours.*

9.6 ALTERNATIVE COMPLIANCE PATH: SPACE-BY-SPACE METHOD

TABLE 9.6.1 LIGHTING POWER DENSITY ALLOWANCES USING THE SPACE-BY-SPACE METHOD AND MINIMUM CONTROL REQUIREMENTS USING EITHER METHOD

Strike TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method, in ASHRAE 90.1 and insert new Table 9.6.1 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

Strike Section 9.6.2 of ASHRAE 90.1 in its entirety and insert a new Section 9.6.2 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

9.6.2 Additional Interior Lighting Power. When using the Space-by-Space Method, an increase in the interior lighting power allowance is allowed for specific lighting functions. Additional power shall be allowed only if the specified lighting is installed and automatically controlled, separately from the general lighting, to be turned off during nonbusiness hours. This additional power shall be used only for the specified luminaires and shall not be used for any other purpose unless otherwise indicated.

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

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD, W/ft^2	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Electrical/Mechanical Room[7]	0.42	6	REQ	—	—	—	REQ	REQ	—	—	—
Emergency Vehicle Garage	0.56	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
Food Preparation Area	1.21	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Guest Room	0.91	6	See Section 9.4.1.3b								
Laboratory											
... in or as a classroom	1.43	6	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2
... all other laboratories	1.81	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Laundry/Washing Area	0.60	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Loading Dock, Interior	0.47	6	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
Lobby											
... in a facility for the visually impaired (and not used primarily by the staff)[3]	1.80	4	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... for an elevator	0.64	6	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a hotel	1.06	4	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a motion picture theater	0.59	4	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a performing arts theater	2.00	6	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... all other lobbies	0.90	4	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
Locker Room	0.75	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
Lounge/Breakroom											
... in a healthcare facility	0.92	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft^2 shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft^2. The additional 0.53 w/ft^2 allowance shall not be used for any other purpose.

... all other lounges/breakrooms	0.73	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft^2 shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft^2. The additional 0.53 w/ft^2 allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD, W/ft.[2]	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Conference/Meeting/Multipurpose Room	1.10	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
Confinement Cells	0.81	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Copy/Print Room	0.72	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
Corridor[2]											
... in a facility for the visually impaired (and not used primarily by the staff)[3]	0.92	width <8 ft.	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... in a hospital	0.99	width <8 ft.	REQ	—	—	—	REQ	REQ	ADD2	ADD2	ADD2
... in a manufacturing facility	0.41	width <8 ft.	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... all other corridors	0.56	width <8 ft.	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
Courtroom	1.46	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Computer Room	1.71	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Dining Area											
... in a penitentiary	0.96	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a facility for the visually impaired (and not used primarily by staff)[3]	2.65	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in bar/lounge or leisure dining	1.07	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in cafeteria or fast food dining	0.65	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in family dining	0.75	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... all other dining areas	0.58	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD, W/ft.^{2}	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Electrical/Mechanical Room[7]	0.42	6	REQ	—	—	—	REQ	REQ	—	—	—
Emergency Vehicle Garage	0.56	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
Food Preparation Area	1.21	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Guest Room	0.91	6	See Section 9.4.1.3b								
Laboratory											
... in or as a classroom	1.43	6	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2
... all other laboratories	1.71	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Laundry/Washing Area	0.57	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Loading Dock, Interior	0.47	6	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
Lobby											
... in a facility for the visually impaired (and not used primarily by the staff)[3]	1.80	4	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... for an elevator	0.54	6	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a hotel	1.06	4	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a motion picture theater	0.56	4	REQ	—	—	—	REQ	REQ	—	ADD2	ADD2
... in a performing arts theater	2.00	6	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2
... all other lobbies	0.85	4	REQ	—	—	—	REQ	REQ	REQ	ADD2	ADD2

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Locker Room	0.75	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
Lounge/Breakroom											
... in a healthcare facility	0.78	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
... all other lounges/breakrooms	0.62	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Common Space Types[1]	LPD, W/ft.^{2}	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Office											
... enclosed and ≤250 ft.^{2}	1.05	8	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—
... enclosed and >250 ft.^{2}	1.05	8	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... open plan	0.93	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Parking Area, Interior	0.19	4	See Section 9.4.1.2.								
Pharmacy Area	1.68	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Restroom											
... in a facility for the visually impaired (and not used primarily by the staff)[3]	1.21	8	REQ	—	—	—	REQ	REQ	—	REQ	—
... all other restrooms	0.98	8	REQ	—	—	—	REQ	REQ	—	REQ	—
Sales Area[4]	1.36	6	REQ	ADD1	ADD1	REQ	—	REQ	—	ADD2	ADD2
Seating Area, General	0.54	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
Stairway			The space containing the stairway shall determine the LPD and control requirements for the stairway.								
Stairwell	0.69	10	REQ	—	—	REQ	REQ	REQ	REQ	ADD2	ADD2
Storage Room											
... <50 ft.^{2}	1.24	6	REQ	—	—	—	—	—	—	ADD2	ADD2
... ≥50 ft.^{2} and ≤ 1000 ft.^{2}	0.63	6	REQ	ADD1	ADD1	—	REQ	REQ	—	REQ	—
... all other storage rooms	0.63	6	REQ	ADD1	ADD1	—	REQ	REQ	REQ	ADD2	ADD2
Vehicular Maintenance Area	0.67	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Workshop	1.59	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Building Type Specific/Space Types[1]	LPD W/ft.^{2}	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Facility for the Visually Impaired[3]											
... in a chapel (used primarily by residents)	2.21	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a recreation room/common living room (and not used primarily by staff)	2.41	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Automotive (See "Vehicular Maintenance Area")											
Convention Center—Exhibit Space	1.23	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Dormitory—Living Quarters Fire	0.38	8	REQ	—	—	—	—	—	—	—	—
Station—Sleeping Quarters Facility	0.22	6	REQ	—	—	—	—	—	—	—	—
for the Visually Impaired [3]											
Gymnasium/Fitness Center											
... in an exercise area	0.61	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a playing area	1.20	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Healthcare Facility											
... in an exam/treatment room	1.41	8	REQ	—	—	REQ	REQ	REQ	—	ADD2	ADD2
... in an imaging room	1.51	6	REQ	—	—	REQ	—	—	—	ADD2	ADD2
...in a medical supply room	0.66	6	(See "Storage Room" under "Common Space Types" for control requirements)								
... in a nursery	0.74	6	REQ	—	—	REQ	REQ	REQ	—	ADD2	ADD2

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Building Type Specific/Space Types[1]	LPD W/ft.[2]	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
... in a nurse's station	0.63	6	REQ	—	—	REQ	REQ	REQ	—	ADD2	ADD2
... in an operating room	2.48	6	REQ	—	—	REQ	—	—	—	ADD2	ADD2
... in a patient room	0.55	6	REQ	—	—	REQ	REQ	REQ	—	ADD2	ADD2
... in a physical therapy room	0.77	6	REQ	—	—	REQ	REQ	REQ	—	ADD2	ADD2
... in a recovery room	1.15	6	REQ	—	—	REQ	REQ	REQ	—	ADD2	ADD2
Library											
... in a reading area	1.06	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in the stacks	1.62	4	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2
Manufacturing Facility											
... in a detailed manufacturing area	1.29	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in an equipment room	0.74	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in an extra high bay area (>50 ft. floor-to-ceiling height)	1.05	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a high bay area (25–50 ft. floor-to-ceiling height)	1.04	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a low bay area (<25 ft. floor-to-ceiling height)	1.01	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Museum											
... in a general exhibition area	1.05	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a restoration room	1.02	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Performing Arts Theater—Dressing Room	0.61	6	REQ	ADD1	ADD1	REQ	REQ	REQ	—	REQ	—

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.1 Lighting Power Density Allowances Using the Space-by-Space Method and Minimum Control Requirements Using Either Method *(Continued)*

Informative Note: **This table is divided into two sections; this first section covers space types that can be commonly found in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

The control functions below shall be implemented in accordance with the descriptions found in the referenced paragraphs within Section 9.4.1.1. For each space type:
(1) All REQs shall be implemented.
(2) At least one ADD1 (when present) shall be implemented.
(3) At least one ADD2 (when present) shall be implemented.

Building Type Specific/Space Types[1]	LPD W/ft.[2]	RCR Threshold	a Local Control (See Section 9.4.1.1[a])	b Restricted to Manual ON (See Section 9.4.1.1[b])	c Restricted to Partial Automatic ON (See Section 9.4.1.1[c])	d Bilevel Lighting Control (See Section 9.4.1.1[d])	e Automatic Daylight Responsive Controls for Sidelighting (See Section 9.4.1.1[e][6])	f Automatic Daylight Responsive Controls for Toplighting (See Section 9.4.1.1[f][6])	g Automatic Partial OFF (See Section 9.4.1.1[g] [Full Off complies])	h Automatic Full OFF (See Section 9.4.1.1[h])	i Scheduled Shutoff (See Section 9.4.1.1[i])
Post Office—Sorting Area	0.94	4	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2
Religious Buildings											
... in a fellowship hall	0.64	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... in a worship/pulpit/choir area	1.53	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Retail Facilities											
... in a dressing/fitting room	0.71	8	REQ	ADD1	ADD1	REQ		REQ	—	REQ	—
... in a mall concourse	1.10	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Sports Arena—Playing Area											
... for a Class I facility	3.68	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... for a Class II facility	2.40	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... for a Class III facility	1.80	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
... for a Class IV facility	1.20	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Transportation Facility											
... in a baggage/carousel area	0.47	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... in an airport concourse	0.32	4	REQ	ADD1	ADD1	—	REQ	REQ	—	ADD2	ADD2
... at a terminal ticket counter	0.68	4	REQ	ADD1	ADD1	REQ	REQ	REQ	—	ADD2	ADD2
Warehouse—Storage Area											
...for medium to bulky, palletized items	0.49	4	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2
... for smaller, hand-carried items[5]	0.95	6	REQ	ADD1	ADD1	REQ	REQ	REQ	REQ	ADD2	ADD2

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
2. In corridors, the extra lighting power density allowance is permitted when the width of the corridor is less than 8 ft. and is not based on the RCR.
3. A "Facility for the Visually Impaired" is a facility that can be documented as being designed to comply with the light levels in ANSI/IES RP-28 and is licensed or will be licensed by local/state authorities for either senior long-term care, adult daycare, senior support and/or people with special visual needs.
4. For accent lighting, see Section 9.6.2(b).
5. Sometimes referred to as a "Picking Area."
6. Automatic daylight responsive controls are mandatory only if the requirements of the specified sections are present.
7. An additional 0.53 w/ft.^{2} shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft.^{2}. The additional 0.53 w/ft.^{2} allowance shall not be used for any other purpose.

TABLE 9.6.3 Control Factors Used in Calculating Additional Interior Lighting Power Allowance

Additional Control Method (in Addition to Mandatory Requirements)	Space Type				
	Open Office	Private Office	Conference Room, Meeting Room, Classroom (Lecture/ Training)	Retail Sales Area	Lobby, Atrium, Dining Area, Corridors/ Stairways, Gym/ Pool, Mall Concourse, Parking Garage
Manual, continuous dimming control or programmable multilevel dimming control	0.05	0.05	0.10	0.10	0
Programmable multilevel dimming control using programmable time scheduling	0.05	0.05	0.10	0.10	0.10
Occupancy sensors controlling the downlight component of workstation specific luminaires with continuous dimming to off capabilities	0.25[a]	0	0	0	0
Occupancy sensors controlling the downlight component of workstation specific luminaires with continuous dimming to off operation, in combination with personal continuous dimming control of downlight illumination by workstation occupant	0.30[a,b]	0	0	0	0
Automatic continuous daylight dimming in secondary sidelighted areas	0.10[c]	0.10[c]	0.10[c]	0.10[c]	0.10[c]

a. Control factor is limited to workstation-specific luminaires in partitioned single occupant work spaces contained within an open office environment (i.e. direct-indirect luminaires with separately controlled downlight and uplight components, with the downward component providing illumination to a single occupant in an open plan workstation). Within 30 minutes of the occupant leaving the space, the downward component shall continuously dim to off over a minimum of two minutes. Upon the occupant entering the space, the downward component shall turn on at the minimum level and continuously raise the illumination to a preset level over a minimum of 30 seconds. The uplight component of workstation specific luminaire shall comply with Section 9.4.1.1(h) (automatic full off).

b. In addition to the requirements described in footnote (b), the control shall allow the occupant to select their preferred light level via a personal computer, handheld device, or similarly accessible device located within the workstation.

c. Control factors may not be used if controls are used to satisfy exceptions to Section 5.5.4.2.3

+ (For Retail Area 2, 10% base power allowance for the sales area per Table 9.5.1 or Table 9.6.1)
+ (For Retail Area 3, 30% base power allowance for the sales area per Table 9.5.1 or Table 9.6.1)
+ (For Retail Area 4, 50% base power allowance for the sales area per Table 9.5.1 or Table 9.6.1),

Retail Area 1 = the floor area for all products not listed in Retail Areas 2, 3, or 4

Retail Area 2 = the floor area used for the sale of vehicles, sporting goods, and small electronics

Retail Area 3 = the floor area used for the sale of furniture, clothing, cosmetics, and artwork

Retail Area 4 = the floor area used for the sale of jewelry, crystal, and china

Exception: Other merchandise categories may be included in Retail Areas 2 through 4 above, provided that justification documenting the need for additional lighting power based on visual inspection, contrast, or other critical display is approved by the authority having jurisdiction.

Strike Section 9.6.3 of ASHRAE 90.1 in its entirety and insert a new Section 9.6.3 in its place to read as follows:

9.6.3 Prescriptive Controls. Projects shall comply with the prescriptive control requirements of 9.5.2, 9.5.3, 9.5.4, and 9.5.5.

SECTION 10 OTHER EQUIPMENT
10.5 PRESCRIPTIVE COMPLIANCE PATH

Strike Section 10.5 of ASHRAE 90.1 in its entirety and insert a new Section 10.5 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

10.5 PRESCRIPTIVE COMPLIANCE PATH. All *building projects* shall comply with the requirements in Section 10.5.1 and all *building projects* complying with the Alternate Renewables Approach in Section 13.1.1.2 shall also comply with Section 10.5.2.

10.5.1 ENERGY STAR Requirements for New Equipment not Covered by Federal Appliance Efficiency Regulations (All *Building Projects*). The following equipment within the scope of the applicable ENERGY STAR program shall comply with the equivalent criteria required to achieve the ENERGY STAR label if installed prior to the issuance of the certificate of occupancy:

a. Appliances

   1. Room air cleaners: ENERGY STAR Program Requirements for Room Air Cleaners

   2. Water coolers: ENERGY STAR Program Requirements for Water Coolers

b. Heating and Cooling

   1. Programmable thermostats: ENERGY STAR Program Requirements for Programmable Thermostats

   2. Ventilating fans: ENERGY STAR Program Requirements for *Residential* Ventilating Fans

c. Lighting

   1. Integral LED lamps: ENERGY STAR Program Requirements for Integral LED Lamps

d. Commercial Food Service

   1. Commercial fryers: ENERGY STAR Program Requirements for Commercial Fryers

   2. Commercial hot food holding cabinets: ENERGY STAR Program Requirements for Hot Food Holding Cabinets

   3. Commercial steam cookers: ENERGY STAR Program Requirements for Commercial Steam Cookers (see also water efficiency requirements in Section 6.4.2.2)

   4. Commercial dishwashers: ENERGY STAR Program Requirements for Commercial Dishwashers

5. Commercial griddles: ENERGY STAR Program Requirements for Commercial Griddles

6. Commercial ovens: ENERGY STAR Program Requirements for Commercial Ovens (see also water efficiency requirements in Section 6.4.2.2)

Exception to 10.5.1: Products with minimum efficiencies addressed in the Energy Policy Act (EP Act) and the Energy Independence and Security Act (EISA) when complying with Section 13.1.1.2 are exempted from Section 10.5.1.

10.5.2 ENERGY STAR Requirements for New Equipment Covered by Federal Appliance Efficiency Regulations (Alternate Renewables Approach). For all *building projects* complying with the Alternate Renewables Approach in Section 13.1.1.2, the following equipment within the scope of the applicable ENERGY STAR program shall comply with the equivalent criteria required to achieve the ENERGY STAR label if installed prior to the issuance of the certificate of occupancy. For those products listed below that are also contained in Normative Appendix B, the installed equipment shall comply by meeting or exceeding both the requirements in this section and in Normative Appendix B.

a. Appliances

   1. Clothes washers: ENERGY STAR Program Requirements for Clothes Washers (see also the water efficiency requirements in Section 6.3.2.2 of ASHRAE 189.1)

   2. Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers

   3. Dishwashers: ENERGY STAR Program Requirements Product Specifications for *Residential Dish- washers* (see also the water efficiency requirements in Section 6.3.2.2 of ASHRAE 189.1)

   4. Refrigerators and freezers: ENERGY STAR Program Requirements for Refrigerators and Freezers

   5. Room air conditioners: ENERGY STAR Program Requirements and Criteria for Room Air Conditioners

b. Heating and Cooling

   1. *Residential* air-source heat pumps: ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners (see also the energy efficiency requirements in Section 13.1).

   2. *Residential* boilers: ENERGY STAR Program Requirements for Boilers (see also the energy efficiency requirements in Section 13.1).

   3. *Residential* central air conditioners: ENERGY STAR Program Requirements for ASHPs and Central Air Conditioners (see also the energy efficiency requirements in Section 13.1).

4. *Residential* ceiling fans: ENERGY STAR Program Requirements for *Residential* Ceiling Fans

5. Dehumidifiers: ENERGY STAR Program Requirements for Dehumidifiers

6. *Residential* warm air furnaces: ENERGY STAR Program Requirements for Furnaces

7. *Residential* geothermal heat pumps: ENERGY STAR Program Requirements for Geothermal Heat Pumps

c. Water Heaters: ENERGY STAR Program Requirements for *Residential* Water Heaters

d. Lighting

1. Lamps: ENERGY STAR Program Requirements for Lamps (Light Bulbs)

2. Luminaires: ENERGY STAR Program Requirements for Luminaires

3. *Residential* light fixtures: ENERGY STAR Program Requirements for *Residential* Light Fixtures

e. Commercial Food Service

1. Commercial refrigerators and freezers: ENERGY STAR Program Requirements for Commercial Refrigerators and Freezers

2. Commercial ice machines: ENERGY STAR Program Requirements for Commercial Ice Machines

10.5.3 Programmable Thermostats. *Residential* programmable thermostats shall meet the requirements of NEMA Standards Publication DC 3, Annex A, "Energy-Efficiency Requirements for Programmable Thermostats."

10.5.4 Refrigerated Display Cases. All open refrigerated display cases shall be covered by using field-installed strips, curtains, or doors.

SECTION 11 CONSTRUCTION AND PLANS FOR OPERATION
11.1 SCOPE
11.2 COMPLIANCE
11.3 MANDATORY PROVISIONS

Strike Section 11 of ASHRAE 90.1 in its entirety and insert a new Section 11 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

11.1 **SCOPE.** This section specifies requirements for construction and plans for operation, including the *commissioning (Cx) process*, building acceptance testing, measurement and *verification*, and energy use reporting. *Projects* that are 20,000 ft^2 or larger or have a minimum HVAC equipment size of 600,000 BTUs shall comply with this section.

11.1.1 Systems. The following systems and associated controls, if included in the *project*, shall be commissioned:

a. Heating, ventilating, air-conditioning, and refrigeration systems (mechanical and/or passive).

b. *Building envelope* systems, components, and assemblies to verify the airtightness and thermal and moisture integrity. *Building envelope* airtightness commissioning shall also comply with Section 11.3.1.2.5.

c. Lighting systems.

d. *Fenestration* control systems: *Automatic* controls for shading devices and *dynamic glazing*.

e. Irrigation.

f. Domestic and process water pumping and mixing systems.

g. *Service water heating* systems.

h. Renewable energy systems.

i. Water measurement devices.

j. Energy measurement devices.

11.2 **COMPLIANCE.** All of the provisions of Section 10 are mandatory provisions.

11.3 **MANDATORY PROVISIONS**

11.3.1 Construction

11.3.1.1 Building Acceptance Testing. Acceptance testing shall be performed on all buildings in accordance with this section using *generally accepted engineering standards* and handbooks acceptable to the *authority having jurisdiction* (*AHJ*).

An acceptance testing process shall be incorporated into the design and construction of the *project* that verifies systems specified in this section perform in accordance with *construction documents*.

11.3.1.1.1 Activities Prior to Building Permit. Complete the following:

a. Designate a project *acceptance representative* to lead, review, and oversee completion of acceptance testing activities.

b. *Construction documents* shall indicate who is to perform acceptance tests and the details of the tests to be per- formed.

c. *Acceptance representative* shall review *construction documents* to verify that relevant sensor locations, devices, and control sequences are properly documented.

11.3.1.1.2 Activities Prior to Building Occupancy. Complete the following:

a. Verify proper installation and start up of the systems.

b. Perform acceptance tests. For each acceptance test, complete test form and include a signature and license number, as appropriate, for the party who has performed the test.

c. Verify that a systems manual has been prepared that includes operation and maintenance (O&M) documentation and full warranty information and provides operating staff the information needed to operate building systems.

11.3.1.1.3 Acceptance Testing. The following systems, if included in the *project*, shall have acceptance testing:

a. Mechanical systems: heating, ventilating, air conditioning and refrigeration systems (mechanical and/or passive) and associated controls.

b. Lighting systems: *automatic* daylighting controls, manual daylighting controls, occupancy sensing devices, and *automatic* shut-off controls.

c. *Fenestration* control systems: *Automatic* controls for shading devices and *dynamic glazing*.

d. Renewable energy systems.

e. Water measurement devices.

f. Energy measurement devices.

11.3.1.1.4 Documentation. The *owner* shall retain completed acceptance test forms.

11.3.1.2 *Project* Commissioning. Commissioning shall be performed in accordance with this section using *generally accepted engineering standards* and handbooks acceptable to the *AHJ*. Buildings undergoing the *Cx process* will be deemed to comply with the requirements of Section 11.3.1.1, "Building Acceptance Testing."

A *Cx process* shall be incorporated into the predesign, design, construction, and postoccupancy of the *project* that verifies that the delivered building and its components, assemblies, and systems comply with the documented *owner's project requirements* (*OPR*). Procedures, documentation, tools, and training shall be provided to the building operating staff to sustain features of the building assemblies and systems for the service life of the building. This material shall be assembled and organized into a systems manual that pro- vides necessary information to the building operating staff to operate and maintain all commissioned systems identified within the *project*.

11.3.1.2.1 Activities Prior to Building Permit. The following activities shall be completed:

a. Designate a project *commissioning authority* (*CxA*) to lead, review, and oversee completion of the *Cx process* activities prior to completion of schematic design.

b. The *owner*, in conjunction with the design team as necessary, shall develop the *OPR* during the predesign phase. The *OPR* shall be updated during the design phase as necessary by the design team, in conjunction with the *owner* and the Cx team. The *OPR* will be distributed to all parties participating in project programming, design, construction, and operations, and to the Cx team members.

c. The design team shall develop the *Basis of Design (BoD)*. The *BoD* document shall include all the information required in Section 6.2, "Documentation," of ANSI/ ASHRAE Standard 55.

d. The *CxA* shall review both the *OPR* and *BoD* to ensure that no conflicting requirements or goals exist and that the *OPR* and *BoD*, based on the professional judgment and experience of the *CxA*, are sufficiently detailed for the project being undertaken.

e. Construction phase commissioning requirements shall be incorporated into project specifications and other *construction documents* developed by the design team.

f. The *CxA* shall conduct two focused *OPR* reviews of the *construction documents*,

the first at near 50% design completion and the second of the final *construction documents* prior to delivery to the contractor. The purpose of these reviews is to verify that the documents achieve the construction phase *OPR* and that the *BoD* document fully supports the *OPR* with sufficient details.

g. Develop and implement a *commissioning* (*Cx*) *plan* containing all required forms and procedures for the complete testing of all equipment, systems, and controls included in Section 11.3.1.2.4.

11.3.1.2.2 Activities Prior to Building Occupancy. The following activities shall be completed:

a. Verify the installation and performance of the systems to be commissioned, including completion of the *construction checklist* and *verification.*

Exception to 11.3.1.2.2(a): Systems that, because their operation is seasonally dependent, cannot be fully commissioned in accordance with the *Cx plan* at time of occupancy. These systems shall be commissioned at the earliest time after occupancy when operation of systems is allowed to be fully demonstrated as determined by *CxA*.

b. It shall be verified that the *owner* requirements for the training of operating personnel and building occupants is completed. Where systems cannot be fully commissioned at the time of occupancy because of seasonal dependence, the training of personnel and building occupants shall be completed when the systems' operation can be fully demonstrated by the *CxA*.

c. Complete preliminary *Cx* report.

d. Verify that a systems manual has been prepared that includes O&M documentation and full warranty information and provides operating staff the information needed to operate the commissioned systems as designed.

11.3.1.2.3 Postoccupancy Activities. Complete the following:

a. Complete any commissioning activities called out in the *Cx plan* for systems whose commissioning can only be completed subsequent to building occupancy, including trend logging and off-season testing.

b. Verify that the *owner* requirements for training operating personnel and building occupants are completed for those systems whose seasonal operational dependence mean they were unable to be fully commissioned prior to building occupancy.

c. Complete a final *Cx* report.

11.3.1.2.4 *Building Envelope* Airtightness. *Building envelope* airtightness shall

comply with one of the following:

a. Whole building pressurization testing shall be conducted in accordance with ASTM E779, CAN/CGSB-149.10-M86, CAN/CGSB-149.15-96 or equivalent. The measured air leakage rate of the *building envelope* shall not exceed 0.25 cfm/ft.^{2} (1.25 L/s·m^2) under a pressure differential of 0.3 in. wc (75 Pa), with this air leakage rate normalized by the sum of the above- and below-grade *building envelope* areas of the *conditioned* and *semiheated space*.

Exception: For multifamily buildings, projects may be deemed to comply with the pressurization testing if individual tenant spaces can show compartmentalization when tested to not exceed 0.30 CFM per square feet of enclosure at 50 Pascal using ASTM E779 2010 or ASTM E1827. Sampling procedures are described in the ENERGY STAR Multifamily Midrise T&V Protocols Section 8.1, "Fan Pressure Testing" and "Sampling Requirements."

b. An air-barrier commissioning program consistent with ASTM-E2813-12 that consists of the following elements shall be implemented:

1. A third-party design review shall be conducted and documented to assess the design documentation describing the air-barrier systems and materials, the manner in which continuity will be maintained across joints between air-barrier components and at all envelope penetrations, and the constructability of the air- barrier systems.

2. Incremental field inspection and testing of air-barrier components shall be conducted and documented during construction to ensure proper construction of key components while they are still accessible for inspection and repair.

11.3.1.2.5 Documentation. The *owner* shall retain the systems manual and final *Cx* report.

SECTION 12. NORMATIVE REFERENCES

Insert new normative references in Section 12 of ASHRAE 90.1 to read as follows:

Reference	Title
ASHRAE **1791 Tullie Circle, NE, Atlanta, GA 30329**	
62.1-2013	**Ventilation for Acceptable Indoor Air Quality**
189.1-2014	Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

ASTM International
100 Barr Harbor Dr., West Conshohocken, PA 19428-2959

ASTM E1827-11	Standard Test Methods for Determining Airtightness of Buildings Using an Orifice Blower Door
ASTM E2813-12	Standard Practice for Building Enclosure Commissioning

Canadian General Standards Board (CGSB)
Place du Portage III, 6B1, 11 Laurier Street, Gatineau, Quebec, K1A 1G6 Canada

CAN/CGSB-149.10-M86	Determination of the Airtightness of Building Envelopes by the Fan Depressurization Method
CAN/CGSB 149.15-96	Determination of the Overall Envelope Airtightness of Buildings by the Fan Pressurization Method Using the Building's Air Handling Systems

ENERGY STAR, United States Department of Energy
Office of Energy Efficiency & Renewable Energy, 1000 Independence Ave., SW, Washington, DC 20585

ENERGY STAR Multifamily Midrise T&V Protocols, 8.1	**Fan Pressure Testing; Sampling Requirements**

SECTION 13 RENEWABLE ENERGY
13.1 PRESCRIPTIVE RENEWABLE PATH

Insert a new Section 13 into ASHRAE 90.1 to read as follows:

13.1 PRESCRIPTIVE RENEWABLE PATH

13.1.1 *On-Site Renewable Energy Systems.* *Building projects* shall comply with either the Standard Renewables Approach in Section 13.1.1.1 or the Alternate Renewables Approach in Section 13.1.1.2.

Exceptions: Buildings that demonstrate compliance with both of the following are not required to contain *on-site renewable energy systems*:

1. An annual daily average incident solar radiation available to a flat plate collector oriented due south at an angle from horizontal equal to the latitude of the collector location less than 4.0 kWh/ m^2·day (1.2 kBtu/$ft.^2$/day), accounting for existing buildings, permanent infrastructure that is not part of the *building project*, topography, and trees.

2. A commitment to purchase renewable electricity products complying with the Green-e Energy National Standard for Renewable Electricity Products of at least 7 kWh/$ft.^2$ (75 kWh/m^2) of *conditioned space* each year until the cumulative purchase totals 70 kWh/$ft.^2$ (750 kWh/m^2) of *conditioned space*.

13.1.1.1 Standard Renewables Approach: Baseline *On-Site Renewable Energy Systems.* *Building projects* shall contain *on-site renewable energy systems* that provide the annual energy production equivalent of not less than 6.0 kBtu/ $ft.^2$ (20 kWh/m^2) multiplied by the *gross roof area* in $ft.^2$ (m^2) for single-story buildings, and not less than 10.0 kBtu/$ft.^2$ (32 kWh/m^2) multiplied by the *gross roof area* in $ft.^2$ (m^2) for all other buildings. The annual energy production shall be the combined sum of all *on-site renewable energy systems.*

13.1.1.2 Alternate Renewables Approach: Reduced *On-Site Renewable Energy Systems* and Higher-Efficiency Equipment. *Building projects* complying with this approach shall comply with the applicable equipment efficiency requirements in Normative Appendix B of ASHRAE 189.1 (Prescriptive Equipment Efficiency Tables for the Alternate Reduced Renewables and Increased Equipment Efficiency Approach in Section 7.4.1.1.2), the water-heating efficiency requirements in Section 7.4.4.1 of ASHRAE 189.1, equipment efficiency requirements in Section 10.6 of ASHRAE 189.1, and the applicable ENERGY STAR® requirements in Section 10.11.2 of 189.1, and shall contain *on-site renewable energy systems* that provide the annual energy production equivalent of not less than 4.0 kBtu/$ft.^2$ (13 kWh/m^2) multiplied by the *gross roof area* in $ft.^2$ (m^2) for single-story buildings, and not less than 7.0 kBtu/$ft.^2$ (22 kWh/m^2) multiplied by the *gross roof area* in $ft.^2$ (m^2) for all other buildings. The annual energy production shall be the combined sum of all *on-site renewable energy systems.*

For equipment listed in Section 10.11.2 of ASHRAE 189.1 that is also contained in Normative Appendix B of ASHRAE 189.1, the installed equipment shall comply by meeting or exceeding both requirements.

Exception: If *building project* includes less than 75% of build-out of net-occupiable floor area, then the project team cannot use Alternate Renewables Approach in 13.1.1.2, and shall use the Standard Renewables Approach in 13.1.1.1.

13.2 ADOPTION OF NORMATIVE APPENDIX B. Normative Appendix B, *Prescriptive Equipment Efficiency Tables for the Alternate Reduced Renewables and Increased Equipment Efficiency Approach in Section 7.4.1.1.2*, of ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, is hereby adopted in the District of Columbia and incorporated by reference into the *Energy Conservation Code-Commercial Provisions.*

Normative Appendix A in ASHRAE 90.1, ***RATED R-VALUE OF INSULATION AND ASSEMBLY U-FACTOR, C-FACTOR, AND F-FACTOR DETERMINATIONS****, is adopted in the District of Columbia.*

Normative Appendix B in ASHRAE 90.1, ***BUILDING ENVELOPE CLIMATE CRITERIA****, is adopted in the District of Columbia.*

Normative Appendix C in ASHRAE 90.1, ***METHODOLOGY FOR BUILDING ENVELOPE TRADE-OFF OPTION IN SECTION 5.6****, is adopted in the District of Columbia*

Normative Appendix D in ASHRAE 90.1, ***CLIMATIC DATA****, is adopted in the District of Columbia*

Informative Appendix E in ASHRAE 90.1, ***INFORMATIVE REFERENCES****, is adopted in the District of Columbia*

Informative Appendix F in ASHRAE 90.1, ***ADDENDA DESCRIPTION INFORMATION****, is adopted in the District of Columbia*

NORMATIVE APPENDIX G PERFORMANCE RATING METHOD

Normative Appendix G in ASHRAE 90.1 is deleted in its entirety and a new Normative Appendix G is inserted in its place in the Energy Conservation Code-Commercial Provisions to read as follows:

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 offers an alternative compliance path for minimum standard compliance per Chapter 1, Section 101.10.6 of Title 12-A DCMR and is provided for those wishing to use the methodology 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 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 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 performance of the proposed building design is calculated in accordance with provisions of this appendix using the following formula:

Percentage improvement
= 100 x (Baseline building performance
– Proposed building performance) / Baseline building performance

Informative Notes:

1. When using the Performance Rating Method to quantify performance that exceeds the requirements of ASHRAE 90.1, both the *proposed building performance* and the *baseline building performance* shall include all end-use load components when calculating the percentage improvement.

2. When using the Performance Rating Method as an alternative path, energy that is not *regulated energy use* shall be subtracted from both the *proposed building performance* and the *baseline building performance* after simulations are completed, but prior to calculating the percentage improvement. This includes but is not limited to energy used for cooking equipment, receptacle loads, computers, medical or laboratory equipment, and manufacturing and industrial process

equipment not specifically identified in the standard.

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 G1.2.2. For building area types not listed in Table G1.2.2 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.

3. 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.

TABLE G1.2.2 BUILDING PERFORMANCE FACTOR (BPF)

Building Area Types[a]	Climate Zone 4
Multifamily	0.68
Healthcare/ hospital	0.47
Hotel/motel	0.52
Office	0.48
Restaurant	0.48
Retail	0.45
School	0.39
Warehouse	0.48
All others	0.48

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

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, and either 9.5 or 9.6.

When using the Performance Rating Method as an alternative path for minimum standard compliance per Section G1.2.2, 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.

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

c. A list of the energy-related features that are included in the design and on which the performance rating is based. This list shall document all energy features that differ between the models used in the baseline building performance and proposed building performance calculations.

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

e. A list identifying those aspects of the proposed design that are less stringent than the requirements of 5.5, 6.5, 7.5, 9.5, and 9.6 (prescriptive provisions).

f. A table with a summary by end use of the energy cost savings in the proposed building performance.

g. A site plan showing all adjacent buildings and topography which may shade the proposed building (with estimated height or number of stories).

h. Building elevations and floor plans (schematic is acceptable).

i. A diagram showing the thermal blocks used in the computer simulation.

j. An explanation of any significant modeling assumptions.

k. Backup calculations and material to support data inputs (*e.g.*, U-factors for envelope assemblies, NFRC ratings for fenestration, end-uses identified in 1. Design Model, paragraph [a], in Table G3.1).

l. Input and output report(s) from the simulation program or compliance software including a breakdown of energy usage by at least the following components: lights, internal equipment loads, service water heating equipment, space heating equipment, space cooling and heat rejection equipment, fans, and other HVAC equipment (such as pumps). The output reports shall also show the amount of unmet load hours for both the proposed design and baseline building design.

m. Purchased energy rates used in the simulations.

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

o. For any exceptional calculation method(s) employed, document the predicted energy savings by energy type, the energy cost savings, a narrative explaining the exceptional calculation method performed, and theoretical or empirical information supporting the accuracy of the method.

p. The reduction in proposed building performance associated with on-site renewable energy.

G2. SIMULATION GENERAL REQUIREMENTS

G2.1 Performance Calculations. The proposed building performance and baseline building performance shall be calculated using the following:

a. The same simulation program,

b. The same weather data, and

c. The same energy rates.

G2.2 Simulation Program. The simulation program shall be a computer-based program for the analysis of energy consumption in buildings (a program such as, but not limited to, DOE-2, BLAST, or EnergyPlus). The simulation program shall include calculation methodologies for the building components being modeled. For components that cannot be modeled by the simulation program, the exceptional calculation methods requirements in Section G2.5 shall be used.

G2.2.1 The simulation program shall be approved by the rating authority and shall, at a minimum, have the ability to explicitly model all of the following:

a. 8760 hours per year.

b. Hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation, defined separately for each day of the week and holidays.

c. Thermal mass effects.

d. Ten or more thermal zones.

e. Part-load performance curves for mechanical equipment.

f. Capacity and efficiency correction curves for mechanical heating and cooling equipment.

g. Air-side economizers with integrated control.

h. Baseline building design characteristics specified in Section G3.

G2.2.2 The simulation program shall have the ability to either (1) directly determine the proposed building performance and baseline building performance or (2) produce hourly reports of energy use by an energy source suitable for determining the proposed building performance and baseline building performance using a separate calculation engine.

G2.2.3 The simulation program shall be capable of per- forming design load calculations to determine required HVAC equipment capacities and air and water flow rates in accordance with generally accepted engineering standards and handbooks (for example, *ASHRAE Handbook—Fundamentals*) for both the proposed design and baseline building design.

G2.2.4 The simulation program shall be tested according to ASHRAE Standard 140, except Sections 7 and 8, and the results shall be furnished by the software provider.

G2.3 Climatic Data. The simulation program shall perform the simulation using hourly values of climatic data, such as temperature and humidity from representative climatic data, for the site in which the proposed design is to be located. For cities or urban regions with several climatic data entries, and for locations where weather data are not available, the designer shall select available weather data that best represent the climate at the construction site. The selected weather data shall be approved by the rating authority.

G2.4 Renewable, Recovered, And Purchased Energy.

G2.4.1 On-Site Renewable Energy and Site-Recovered Energy. Site-recovered energy shall not be considered purchased energy and shall be subtracted from the proposed design energy consumption prior to calculating the proposed building performance. On-site renewable energy generated by systems included on the building permit that is used by the building shall be subtracted from the proposed design energy consumption prior to calculating the proposed building performance.

G2.4.2 Annual Energy Costs. The design energy cost and baseline energy cost shall be determined using either actual rates for purchased energy or state average energy prices published by DOE's Energy Information Administration (EIA) for commercial building customers, but rates from different sources may not be mixed in the same project. Where on-site renewable energy or site-recovered energy is used, the base- line building design shall be based on the energy source used as the backup energy source or the baseline system energy source in that category if no backup energy source has

been specified.

Informative Note: The above provision allows users to gain credit for features that yield load management benefits. Where such features are not present, users can simply use state average unit prices from EIA, which are updated annually and readily available on EIA's web site (http:// www.eia.doe.gov/).

G2.5 Exceptional Calculation Methods. When the simulation program does not model a design, material, or device of the proposed design, an Exceptional Calculation Method shall be used if approved by the Rating Authority. If there are multiple designs, materials, or devices that the simulation pro- gram does not model, each shall be calculated separately and Exceptional Savings determined for each. At no time shall the total Exceptional Savings constitute more than half of the difference between the baseline building performance and the proposed building performance. All applications for approval of an exceptional method shall include:

a. Step-by-step documentation of the Exceptional Calculation Method performed detailed enough to reproduce the results;

b. Copies of all spreadsheets used to perform the calculations;

c. A sensitivity analysis of energy consumption when each of the input parameters is varied from half to double the value assumed;

d. The calculations shall be performed on a time step basis consistent with the simulation program used; and

e. The Performance Rating calculated with and without the Exceptional Calculation Method.

G3. CALCULATION OF THE PROPOSED AND BASELINE BUILDING PERFORMANCE

G3.1 Building Performance Calculations. The simulation model for calculating the proposed and baseline building performance shall be developed in accordance with the requirements in Table G3.1.

1. Design Model

Baseline Building Performance	Proposed Building Performance
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. 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. **Exception:** Spaces 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.	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.

2. Additions and Alterations

Baseline Building Performance	Proposed Building Performance

It is acceptable to predict performance using building models that exclude parts of the existing building provided that all of the following conditions are met: a. Work to be performed in excluded parts of the building shall meet the requirements of Sections 5 through 10. b. Excluded parts of the building are served by HVAC systems that are entirely separate from those serving parts of the building that are included in the building model. c. Design space temperature and HVAC system operating setpoints and schedules on either side of the boundary between included and excluded parts of the building are essentially the same. d. If a declining block or similar utility rate is being used in the analysis, and the excluded and included parts of the building are on the same utility meter, the rate shall reflect the utility block or rate for the building plus the addition.	Same as proposed building design

3. Space Use Classification

Baseline Building Performance	Proposed Building Performance
Usage shall be specified using the building type or space type lighting classifications in accordance with Section 9.5.1 or 9.6.1. The user shall specify the space use classifications using either the building type or space type categories but shall not combine the two types of categories. More than one building type category may be used in a building if it is a mixed-use facility. If space type categories are used, the user may simplify the placement of the various space types within the building model, provided that building-total areas for each space type are accurate.	Same as proposed building design

4. Schedules

Baseline Building Performance	Proposed Building Performance
Schedules capable of modeling hourly variations in occupancy, lighting power, miscellaneous equipment power, thermostat setpoints, and HVAC system operation shall be used. The schedules shall be typical of the proposed building type as determined by the designer and approved by the rating authority. **Temperature and Humidity Schedules.** Temperature	Same as proposed building design **Exceptions:** 1. Setpoints and schedules for HVAC systems that automatically provide occupant thermal comfort via means other than directly controlling the air dry-bulb and wet-bulb temperature may

and humidity control setpoints and schedules as well as temperature control throttling range shall be the same for proposed and baseline building designs. **HVAC Fan Schedules.** Schedules for HVAC fans that provide outdoor air for ventilation shall run continuously whenever spaces are occupied and shall be cycled on and off to meet heating and cooling loads during unoccupied hours. **Exceptions:** 1. Where no heating and/or cooling system is to be installed, and a heating or cooling system is being simulated only to meet the requirements described in this table, heating and/or cooling system fans shall not be simulated as running continuously during occupied hours but shall be cycled on and off to meet heating and cooling loads during all hours. 2. HVAC fans shall remain on during occupied and unoccupied hours in spaces that have health- and safety-mandated mini- mum ventilation requirements during unoccupied hours. 3. HVAC fans shall remain on during occupied and unoccupied hours in systems primarily serving computer rooms.	be allowed to differ, provided that equivalent levels of occupant thermal comfort are demonstrated via the methodology in Section 5.2.3 of ASHRAE Standard 55, "Elevated Air Speed," or Appendix D of Standard 55, "Computer Program for Calculation of PMV-PPD." 2. Schedules may be allowed to differ between proposed design and baseline building design when necessary to model nonstandard efficiency measures, provided that the revised schedules have the approval of the rating authority. Measures that may warrant use of different schedules include, but are not limited to, automatic lighting controls, automatic natural ventilation controls, automatic demand control ventilation controls, and automatic controls that reduce service water heating loads. In no case shall schedules differ where the controls are manual (e.g., manual operation of light switches or manual operation of windows).

5. Building Envelope

Baseline Building Performance	Proposed Building Performance
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	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

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.

4. 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.

5. Automatically controlled dynamic glazing may be modeled.

Manually controlled dynamic glazing shall use the average of the minimum and maximum SHGC and VT.

Infiltration shall be modeled using the same methodology, air leakage rate, and adjustments for weather and building operation in both the proposed design and the baseline design. These adjustments shall be made for each simulation time step and must account for but not be limited to weather conditions and HVAC system operation, including strategies that are intended to positively pressurize the building. The air leakage rate of the building envelope (I_{75Pa}) at a fixed building pressure differential of 0.3 in.

shade itself.

Exceptions:

1. If it can be demonstrated to the satisfaction of the authority having jurisdiction 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 assemblies detailed in Appendix A and shall match the appropriate assembly maximum U-factors in Tables G3.4-1 through G3.4-8:

- 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)
- Opaque door types shall be of the same type of construction as the proposed design and conform to the U-factor requirements from the same tables. (A7)
- Slab-on-grade floors shall match the F-factor for unheated slabs from the same tables. (A6)

c. **Vertical Fenestration Areas.** For building area types included in Table G3.1.1-1, vertical fenestration areas for new buildings and additions shall equal that in Table G3.1.1-1 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 in the proposed design. For building areas not shown in Table G3.1.1-1, vertical fenestration areas for new buildings and additions shall equal that in the proposed design or the maximum allowed in Tables G3.4-1 through G3.4-8, whichever is smaller, and shall be distributed on each face of the building in the same proportions in the proposed design. The fenestration area for an existing building shall equal the existing fenestration area prior to the proposed work and shall be distributed on each face of the building

H_2O shall be 0.4 cfm/ft.^{2}. The air leakage rate of the building envelope shall be converted to appropriate units for the simula- tion program using one of the methods in Section G3.1.1.4. **Exception:** When whole-building air leakage testing, in accordance with ASTM E779, is specified during design and completed after construction, the proposed design air leakage rate of the building envelope shall be as measured.	in the same proportions as the existing building. For portions of those tables where there are no SHGC requirements, the SHGC shall be equal to that determined in accordance with Section C3.6(c). The VT shall be equal to that determined in accordance with Section C3.6(c). d. **Vertical Fenestration Assemblies.** Fenestration for new buildings, existing buildings, and additions shall comply with the following: • Fenestration U-factors shall match the appropriate requirements in Tables G3.4-1 through G3.4-8 for the applicable glazing percentage for U_{fixed}. • Fenestration SHGCs shall match the appropriate requirements in Tables G3.4-1 through G3.4-8 using the value for $SHGC_{all}$ for the applicable vertical glazing percentage. • All vertical fenestration 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. e. **Skylights and Glazed Smoke Vents.** Skylight area shall be equal to that in the proposed building design or the maximum allowed in Table 5.5, whichever is smaller. If the skylight area of the proposed building design is greater than the maximum area allowed in Table 5.5, base- line skylight area shall be decreased by an identical percentage in all roof components in which skylights are located to reach the maximum allowed in Table 5.5. 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 G3.4-1 through G.3.4-8 using the value for skylights without curbs and the applicable skylight percentage. f. **Roof Solar Reflectance and Thermal Emittance.** The exterior roof surfaces shall be modeled using a solar reflectance of 0.30 and a thermal emittance of 0.90. g. **Roof Albedo.** All roof surfaces shall be modeled with a reflectivity of 0.30.

6. Lighting

Baseline Building Performance	Proposed Building Performance
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. 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 building 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. Credit may be taken for programmable timing controls or occupancy sensors by reducing the connected lighting power by the applicable percentages listed in Table G3.2. Alternatively, credit may be taken for these devices by modifying	Interior lighting power in the baseline building design shall be determined using the values in Table G.3.7 and the methodology described in Section 9.6.1 and 9.6.2. Lighting shall be modeled having automatic shutoff controls in buildings >5,000 ft^2 and occupancy sensors in employee lunch and break rooms, conference/meeting rooms, and classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12^{th} grade classrooms). b. No additional automatic lighting controls (e.g., automatic controls for daylight utilization) shall be modeled in the *baseline building design.* c. Mandatory automatic lighting controls required by Section 9.4.1 shall be modeled the same as the proposed building design. d. Exterior lighting in areas identified as tradable surfaces in Table G.3.6 shall be modeled with the baseline lighting power shown in Table G.3.6. Other exterior lighting shall be modeled the same in the baseline building as in the proposed design.

the lighting schedules used for the proposed design, provided that credible technical documentation for the modifications are provided to the authority having jurisdiction. **Exception**: No credit is allowed for occupancy sensors in employee lunch and break rooms, conference/meeting rooms, classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th grade classrooms) 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.)	

7. Thermal Blocks—HVAC Zones Designed

Baseline Building Performance	Proposed Building Performance
Where HVAC zones are defined on HVAC design drawings, each HVAC zone shall be modeled as a separate thermal block. **Exception:** Different HVAC zones may be combined to create a single thermal block or identical thermal blocks to which multipliers are applied, provided that all of the following conditions are met: 1. The space use classification is the same throughout the thermal block. 2. All HVAC zones in the thermal block that are adjacent to glazed exterior walls face the same orientation or their orientations vary by less than 45 degrees. 3. All of the zones are served by the same HVAC system or by the same kind of HVAC system.	Same as proposed building design

8. Thermal Blocks—HVAC Zones Not Designed

Baseline Building Performance	Proposed Building Performance
Where the HVAC zones and systems have not yet been designed, thermal blocks shall be defined based on similar internal load densities, occupancy, lighting, thermal and space temperature schedules, and in combination with the following guidelines: a. Separate thermal blocks shall be assumed for interior and perimeter spaces. Interior spaces shall be those located greater than 15 ft. from an exterior wall. Perimeter spaces shall be those located within 15 ft. of an exterior wall. b. Separate thermal blocks shall be assumed for spaces adjacent to glazed exterior walls; a separate zone shall be provided for each orientation, except that orientations that differ by less than 45 degrees may be considered to be the same orientation. Each zone shall include all floor area that is 15 ft. or less from a glazed perimeter wall, except that floor area within 15 ft. of glazed perimeter walls having more than one orientation shall be divided proportionately between zones. c. Separate thermal blocks shall be assumed for spaces having floors that are in contact with the ground or exposed to ambient conditions from zones that do not share these features. d. Separate thermal blocks shall be assumed for spaces having exterior ceiling or roof assemblies from zones that do not share these features.	Same as proposed building design

9. Thermal Blocks—Multifamily Residential

Baseline Building Performance	Proposed Building Performance
Residential spaces shall be modeled using at least one thermal block per dwelling unit, except that those units facing the same orientations may be combined into one thermal block. Corner units and units with roof or floor loads shall only be combined with units sharing these features.	Same as proposed building design

10. HVAC Systems

Baseline Building Performance	Proposed Building Performance
The HVAC system type and all related performance	The HVAC system(s) in the baseline building

parameters in the proposed design, such as equipment capacities and efficiencies, shall be determined as follows: a. Where a complete HVAC system exists, the model shall reflect the actual system type using actual component capacities and efficiencies. 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. Where efficiency ratings include supply fan energy, the efficiency rating shall be adjusted to remove the supply fan energy from the efficiency rating in the baseline building design. The equations in Section G3.1.2.1 shall not be used in the proposed building. The proposed building HVAC system shall be modeled using manufacturers' full- and part-load data for the HVAC system without fan power. c. Where no heating system exists or no heating system has been specified and submitted with design documents, the system characteristics and 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 and submitted with design documents, the cooling system type shall be identical to the same system modeled in the baseline building design and shall comply with the requirements of Section 6. **Exception to (d):** Spaces using baseline HVAC system types 9 and 10.	design shall be of the type and description specified in Section G3.1.1, shall meet the general HVAC system requirements specified in Section G3.1.2, and shall meet any system-specific requirements in Section G3.1.3 that are applicable to the baseline HVAC system type(s). If the proposed design includes computer room humidification then the computer room humidification system, schedules, and setpoints in the baseline building design shall be the same as in the proposed design. For systems serving computer rooms, the baseline shall not have reheat for the purpose of dehumidification. Fossil fuel systems shall be modeled using natural gas as their fuel source. **Exception:** For fossil fuel systems where natural gas is not avail- able for the proposed building site as determined by the rating authority, the baseline HVAC system(s) shall be modeled using propane as their fuel source.

11. Service Hot-Water Systems

Baseline Building Design	Proposed Building Design
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:	The service hot-water system in the baseline building design shall conform with the following conditions:

a. Where a complete service hot-water system exists, the proposed design shall reflect the actual system type using actual component capacities and efficiencies. b. Where a service hot-water system has been specified 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 and 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. d. For buildings that will have no service hot-water loads, no service hot-water system shall be modeled. e. Where a combined system has been specified to meet both space heating and service water heating loads, the proposed design shall reflect the actual system type using actual component capacities and efficiencies.	a. Where the complete service hot-water system exists, the base- line building design shall be as specified in Table G3.1.1-2 using the actual component capacities. b. Where a new service hot-water system has been specified, the heating method shall be as specified in Table G3.1.1-2. The system shall be sized according to the provisions of Section 7.4.1 and the equipment shall match the minimum efficiency requirements in Section 7.4.2. c. Where no service hot-water system exists or has been specified but the building will have service hot-water loads, a service water system(s) using the heating method as specified in Table G3.1.1-2 and matching minimum efficiency requirements of Section 7.4.2 shall be assumed and modeled identically in the proposed and baseline building designs. d. For buildings that will have no service hot-water loads, no service hot-water heating shall be modeled. e. Where a combined system has been specified to meet both space heating and service water heating loads, the baseline building system shall use separate systems meeting the mini- mum efficiency requirements applicable to each system individually. f. For large, 24-hour-per-day facilities that meet the prescriptive criteria for use of condenser heat recovery systems described in Section 6.5.6.2, a system meeting the requirements of that section shall be included in the baseline building design regardless of the exceptions to Section 6.5.6.2. **Exception:** If a condenser heat recovery system meeting the requirements described in Section 6.5.6.2 cannot be modeled, the requirement for including such a system in the actual building shall be met as a prescriptive requirement in accordance with Section 6.5.6.2, and no heat-recovery system shall be included in the proposed or baseline building designs. g. Service hot-water energy consumption shall be calculated explicitly based upon the volume of service hot water required and the entering makeup water and the leaving service

	hot- water temperatures. Entering water temperatures shall be estimated based upon the location. Leaving temperatures shall be based upon the end-use requirements. h. Where recirculation pumps are used to ensure prompt availability of service hot water at the end use, the energy consumption of such pumps shall be calculated explicitly. i. Service water loads and usage shall be the same for both the base- line building design and the proposed design and shall be documented by the calculation procedures described in Section 7.2.1. **Exceptions:** 1. Service hot-water usage can be demonstrated to be reduced by documented water conservation measures that reduce the physical volume of service water required. Examples include low-flow shower heads. Such reduction shall be demonstrated by calculations. 2. Service hot-water energy consumption can be demonstrated to be reduced by reducing the required temperature of service mixed water, by increasing the temperature, or by increasing the temperature of the entering makeup water. Examples include alternative sanitizing technologies for dishwashing and heat recovery to entering makeup water. Such reduction shall be demonstrated by calculations. 3. Service hot-water usage can be demonstrated to be reduced by reducing the hot fraction of mixed water to achieve required operational temperature. Examples include shower or laundry heat recovery to incoming cold- water supply, reducing the hot-water fraction required to meet required mixed-water temperature. Such reduction shall be demonstrated by calculations. j. Gas storage water heaters shall be modeled using natural gas as their fuel source. **Exception:** Where natural gas is not available for the proposed building site, as determined by the rating authority, gas storage water heaters

	shall be modeled using propane as their fuel source.

12. Receptacle and Other Loads

Baseline Building Design	Proposed Building Design
Receptacle and process loads, such as those for office and other equipment, shall be estimated based on the building type or space type cate- gory and shall be assumed to be identical in the proposed and baseline building designs, except as specifically authorized by the *authority having jurisdiction, and* 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 Chapter 1, Section 101.4.7.2 of the *Building Code*. These loads shall always be included in simulations of the building. 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. Where power and other systems covered by Section 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. ***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 pro- posed design shall be allowed by the authority having jurisdiction 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.

13. Modeling Limitations to the Simulation

Baseline Building Design	Proposed Building Design
If the simulation program cannot model a component or system included in the proposed	Same as proposed building design

design explicitly, substitute a thermodynamically similar component model that can approximate the expected performance of the component that cannot be modeled explicitly.	

14. Exterior Conditions

Baseline Building Design	Proposed Building Design
a. **Shading by Adjacent Structures and Terrain.** The effect that structures and significant vegetation or topographical features have on the amount of solar radiation being received by a structure shall be adequately reflected in the computer analysis. All elements whose effective height is greater than their distance from a proposed building and whose width facing the proposed building is greater than one-third that of the proposed building shall be accounted for in the analysis. b. **Ground Temperatures for Below-Grade Wall and Basement Floor Heat-Loss Calculations.** It is acceptable to use either an annual average ground temperature or monthly average ground temperatures for calculation of heat loss through below-grade walls and basement floors. c. **Water Main Temperatures for Service Water Heating Calculations.** It is acceptable to use either an annual water main supply temperature or monthly average water main supply temperatures for calculating service water heating. If annual or monthly water main supply temperatures are not available from the local water utility, annual average ground temperatures may be used.	

15. Distribution Transformers

Baseline Building Design	Proposed Building Design
Low-voltage dry-type distribution transformers shall be modeled if the transformers in the proposed design exceed the efficiency required in Table 8.4.4.	Low-voltage dry-type distribution transformers shall be modeled only if the proposed building transformers exceed the efficiency requirements of Table 8.4.4. If modeled, the efficiency requirements from Table 8.4.4 shall be used. The ratio of the capacity to peak electrical load of the transformer shall be the same as the ratio in the pro- posed design.

TABLE G3.1.1-1 BASELINE BUILDING VERTICAL FENESTRATION PERCENTAGE OF GROSS ABOVE-GRADE-WALL AREA

Building Area Types[a]	Baseline Building Gross Above-Grade-
Grocery Store	7%
Healthcare (outpatient)	21
Hospital	27
Hotel/motel (≤75 rooms)	24
Hotel/motel (>75 rooms)	34
Office (≤5000 ft.^{2})	19
Office (5000 to 50,000 ft.^{2})	31
Office (>50,000 ft.^{2})	40
Restaurant (quick service)	34
Restaurant (full service)	24
Retail (stand alone)	11
Retail (strip mall)	20
School (primary)	22
School (secondary and university)	22
Warehouse (nonrefrigerated)	6%

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.

TABLE G3.1.1-2 BASELINE SERVICE HOT-WATER SYSTEM

Building Area Type	Baseline Heating Method
Automotive facility	Gas storage water heater
Convention center	Electric resistance storage water heater
Courthouse	Electric resistance storage water heater
Dining: Bar lounge/leisure	Gas storage water heater
Dining: Cafeteria/fast food	Gas storage water heater
Dining: Family	Gas storage water heater
Dormitory	Gas storage water heater
Exercise center	Gas storage water heater
Fire station	Gas storage water heater
Gymnasium	Gas storage water heater
Health-care clinic	Gas storage water heater
Hospital	Gas storage water heater
Hotel	Gas storage water heater
Library	Electric resistance storage water heater

Manufacturing facility	Gas storage water heater
Motel	Gas storage water heater
Motion picture theater	Electric resistance storage water heater
Multifamily	Gas storage water heater
Museum	Electric resistance storage water heater
Office	Electric resistance storage water heater
Parking garage	Electric resistance storage water heater
Penitentiary	Gas storage water heater
Performing arts theater	Gas storage water heater
Police station	Electric resistance storage water heater
Post office	Electric resistance storage water heater
Religious building	Electric resistance storage water heater
Retail	Electric resistance storage water heater
School/university	Gas storage water heater
Sports arena	Gas storage water heater
Town hall	Electric resistance storage water heater
Transportation	Electric resistance storage water heater
Warehouse	Electric resistance storage water heater
Workshop	Gas storage water heater
All Others	Gas storage water heater

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

1. HVAC systems in the *baseline building design* shall be determined in the following order of priority:

    a. the building type with the largest conditioned floor area.

    b. number of floors, (including floors above and below grade, but not including floors solely devoted to parking).

    c. gross conditioned floor area.

    d. 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, 12, and 13 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:

1. Use additional system type(s) for nonpredominant conditions (i.e., residential/nonresidential or heating source) if those conditions apply to more than 20,000 ft.^{2} of conditioned floor area.

2. If the baseline HVAC system type is 5, 6, 7, 8, 9,10, 11, 12, or 13 use separate single-zone systems conforming with the requirements of System 3 or System 4 (depending on building heating source) for any spaces that have occupancy or process loads or schedules that differ significantly from the rest of the building. Peak thermal loads that differ by 10 Btu/h·ft^2 or more from the average of other spaces served by the system or schedules that differ by more than 40 equivalent full-load hours per week from other spaces served by the system are considered to differ significantly. Examples where this exception may be applicable include, but are not limited to, natatoriums and continually occupied security areas. This exception does not apply to computer rooms.

3. For laboratory spaces in a building having a total laboratory exhaust rate greater than 15000 cfm, use a single system of type 5 or 7 serving only those spaces. The lab exhaust fan shall be modeled as constant horsepower reflecting constant-volume stack discharge with outdoor air bypass.

4. Thermal zones designed with heating only systems in the proposed design, serving storage rooms, stair- wells, vestibules, electrical/mechanical rooms, and restrooms not exhausting or transferring air from mechanically cooled thermal zones in the proposed design shall use System type 9 or 10 in the baseline building design.

5. If the baseline HVAC system type is 9 or 10, all spaces that are mechanically cooled in the proposed building design shall be assigned to a separate baseline system determined by using the area and heating source of the mechanically cooled spaces.

6. Computer rooms in buildings with a total computer room peak cooling load >3,000,000 Btu/h kW or a total computer room peak cooling load >600,000 Btu/h where the baseline HVAC system type is 7 or 8 shall use System 11. All other computer rooms shall use System 3 or 4.

7. For hospitals, depending on building type, use Sys- tem 5 or 7 in all climate zones.

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**		
Residential	System 1—PTAC		
Public assembly <120,000 ft.^{2}	System 3—PSZ-AC		
Public assembly ≥120,000 ft.^{2}	System 12—SZ-CV-HW		
Nonresidential and 3 floors or fewer and <25,000 ft.^{2}	System 3—PSZ-AC		
Nonresidential and 4 or 5 Floors and <25,000 ft.^{2} or 5 floors or fewer and 25,000 ft.^{2} to 150,000 ft.^{2}	System 5—Packaged VAV with reheat		
Nonresidential and more than 5 floors or >150,000 ft.^{2}	System 7—VAV with reheat	Heated-only storage	System 9—
Heating and ventilation	Retail and 2 floors or fewer	System 3—PSZ-AC	

Notes:

1. Residential building types include dormitory, hotel, motel, and multifamily. Residential space types include guest rooms, living quarters, private living space, and sleeping quarters.
   Other building and space types are considered nonresidential.
2. Where attributes make a building eligible for more than one baseline system type, use the predominant condition to determine the system type for the entire building except as noted in Exception (1) to Section G3.1.1.
3. For laboratory spaces in a building having a total laboratory exhaust rate greater than 15000 cfm, use a single system of type 5 or 7 serving only those spaces.
4. For hospitals, depending on building type, use System 5 or 7 in all climate zones.
5. Public assembly building types include houses of worship, auditoriums, movie theaters, performance theaters, concert halls, arenas, enclosed stadiums, ice rinks, gymnasiums, convention centers, exhibition centers, and natatoriums.

TABLE G3.1.1-4 BASELINE SYSTEM DESCRIPTIONS

System No.	System Type	Fan Control	Cooling Type	Heating Type
1. PTAC	Packaged terminal air conditioner	Constant volume	Direct expansion	Hot-water fossil fuel boiler
2. PTHP	Packaged terminal heat pump	Constant volume	Direct expansion	Electric heat pump
3. PSZ-AC	Packaged rooftop air conditioner	Constant volume	Direct expansion	Fossil fuel furnace
4. PSZ-HP	Packaged rooftop heat pump	Constant volume	Direct expansion	Electric heat pump
5. Packaged VAV with Reheat	Packaged rooftop VAV with reheat	VAV	Direct expansion	Hot-water fossil fuel boiler
6. Packaged VAV with PFP Boxes	Packaged rooftop VAV with parallel fan power boxes and reheat	VAV	Direct expansion	Electric resistance
7. VAV with Reheat	VAV with reheat	VAV	Chilled water	Hot-water fossil fuel boiler
8. VAV with PFP Boxes	VAV with parallel fan-powered boxes and reheat	VAV	Chilled water	Electric resistance
9. Heating and Ventilation	Warm air furnace, gas fired	Constant volume	None	Fossil fuel furnace
10. Heating and Ventilation	Warm air furnace, electric	Constant volume	None	Electric resistance
11. SZ–VAV	Single-zone VAV	VAV	Chilled water	See note.
12. SZ-CV-HW	Single zone	Constant volume	Chilled water	Hot-water fossil fuel boiler
13. SZ-CV-ER	Single zone	Constant volume	Chilled water	Electric resistance

Notes:

1. For purchased chilled water and purchased heat, see G3.1.1.3.
2. Where the proposed design heating source is electric or other, the heating type shall be electric resistance. Where the proposed design heating source is fossil fuel, fossil/electric hybrid, or purchased heat, the heating type shall be hot-water fossil fuel boiler.

G3.1.1.1 Purchased Heat. For systems using purchased hot water or steam, the heating source shall be modeled as purchased hot water or steam in both the proposed and base- line building designs. Hot water or steam costs shall be based on actual utility rates, and on-site boilers, electric heat, and furnaces shall not be modeled in the baseline building design.

G3.1.1.2 Purchased Chilled Water. For systems using purchased chilled water, the cooling source shall be modeled as purchased chilled water in both the proposed and baseline building designs. Purchased chilled water costs shall be based on actual utility rates, and on-site chillers and direct expansion equipment shall not be modeled in the baseline building design.

G3.1.1.3 Baseline HVAC System Requirements for Systems Utilizing Purchased Chilled Water and/or Purchased Heat. If the proposed building design uses purchased chilled water and/or purchased heat, the following modifications to the Baseline HVAC System Types in Table G3.1.1-4 shall be used:

G3.1.1.3.1 Purchased Heat Only. If the proposed building design uses purchased heat, but does not use purchased chilled water, then Tables G3.1.1-3 and G3.1.1-4 shall be used to select the Baseline HVAC System Type and purchased heat shall be substituted for the Heating Type in Table G3.1.1-4. The same heating source shall be used in the pro- posed and baseline building design.

G3.1.1.3.2 Purchased Chilled Water Only. If the pro- posed building design uses purchased chilled water, but does not use purchased heat, then Tables G3.1.1-3 and G3.1.1-4 shall be used to select the Baseline HVAC System Type, with the modifications listed below:

a. Purchased chilled water shall be substituted for the Cooling Types in Table G3.1.1-4.

b. System 1 and 2 shall be constant-volume fan-coil units with fossil fuel boiler(s).

c. System 3 and 4 shall be constant-volume single-zone air handlers with fossil fuel furnace(s).

d. System 7 shall be used in place of System 5.

e. System 8 shall be used in place of System 6.

G3.1.1.3.3 Purchased Chilled Water and Purchased Heat. If the proposed building design uses purchased chilled water and purchased heat, then Tables G3.1.1-3 and G3.1.1-4 shall be used to select the Baseline HVAC System Type, with the following modifications:

a. Purchased heat and purchased chilled water shall be substituted for the Heating Types and Cooling Types in Table G3.1.1-4.

b. System 1 shall be constant-volume fan-coil units.

c. System 3 shall be constant-volume single-zone air handlers.

d. System 7 shall be used in place of System 5.

G3.1.1.3.4 On-Site Distribution Pumps. All on-site distribution pumps shall be modeled in both the baseline and proposed designs.

G3.1.1.4 Modeling Building Envelope Infiltration. The air leakage rate of the building envelope (I_{75Pa}) at a pressure differential of 0.3 in. H_2O shall be converted to appropriate units for the simulation program using one of the following formulas:

For methods describing infiltration as a function of floor area,

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

For methods describing infiltration as a function of exterior wall area,

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

When using the measured air leakage rate of the building envelope at a pressure differential of 0.3 in. H_2O for the pro- posed design, the air leakage rate shall be calculated as follows:

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

where

I_{75Pa} = air leakage rate of the building envelope expressed in cfm/ft.^{2} at a fixed building pressure differential of 0.3 in. H_2O, or 1.57 psf

Q = volume of air in cfm flowing through the whole- building envelope when subjected to an indoor/ outdoor pressure differential of 0.3 in. H_2O, or 1.57 psf, in accordance with ASTM E 779

S = total area of the envelope air pressure boundary (expressed in ft.^{2}), including the lowest floor, any below- or above-grade walls, and roof (or ceiling) (including

windows and skylights), separating the interior conditioned space from the unconditioned environment measured

I_{FLR} = adjusted air leakage rate (expressed in cfm/ft.^{2}) of the building envelope at a reference wind speed of 10 mph and the total gross floor area

A_{FLR} = total gross floor area, ft.^{2}

I_{EW} = adjusted air leakage rate (expressed in cfm/ft.^{2}) of the building envelope at a reference wind speed of 10 mph and the above ground exterior wall area

A_{EW} = total above-grade exterior wall area, ft.^{2}

Exception: A multizone airflow model alternate method to model building envelope infiltration may be used provided the following criteria are met:

1. If the calculations are made independently of the energy simulation program, the proposed method must comply with Section G2.5.
2. The method for converting the air infiltration rate of the building envelope at 0.3 in. H_2O, or 1.57 psf, to the appropriate units for the simulation program is fully documented and submitted to the rating authority for approval.

G3.1.2 General Baseline HVAC System Requirements. HVAC systems in the baseline building design shall conform with the general provisions in this section.

G3.1.2.1 Equipment Efficiencies. All HVAC equipment in the baseline building design shall be modeled at the minimum efficiency levels, both part load and full load, in accordance with Tables G.3.5.1 through G.3.5.6. Chillers shall use Path A efficiencies as shown in Table 6.8.1-3. Where efficiency ratings include supply fan energy, the efficiency rating shall be adjusted to remove the supply fan energy. For Baseline HVAC Systems 1, 2, 3, 4, 5, and 6, calculate the minimum $COP_{nfcooling}$ and $COP_{nfheating}$ using the equation for the applicable performance rating as indicated in Tables 6.8.1-1 through 6.8.1-4.

Where a full- and part-load efficiency rating is provided in Tables 6.8.1-1 through 6.8.1-4, the full-load equation below shall be used:

$COP_{nfcooling} = 7.84E\text{-}8 \times EER \times Q + 0.338 \times EER$ $COP_{nfcooling} = -0.0076 \times SEER^2$

$+ 0.3796 \times SEER$

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

(applies to heat-pump heating efficiency only) $COP_{nfheating} = -0.0296 \times HSPF^2 +$

0.7134 × HSPF

where $COP_{nfcooling}$ and $COP_{nfheating}$ are the packaged HVAC equipment cooling and heating energy efficiency, respectively, to be used in the baseline building, which excludes supply fan power, and Q is the AHRI-rated cooling capacity in Btu/h. EER, SEER, COP, and HSPF shall be at AHRI test conditions. Fan energy shall be modeled separately according to Section G3.1.2.10.

G3.1.2.2 Equipment Capacities. The equipment capacities (i.e. system coil capacities) for the baseline building design shall be based on sizing runs for each orientation (per Table G3.1, No. 5a) and shall be oversized by 15% for cooling and 25% for heating, *i.e.*, the ratio between the capacities used in the annual simulations and the capacities determined by the sizing runs shall be 1.15 for cooling and 1.25 for heat- g.

G3.1.2.2.1 Sizing Runs. Weather conditions used in sizing runs to determine baseline equipment capacities shall be based either on hourly historical weather files containing typical peak conditions or on design days developed using 99.6% heating design temperatures and 1% dry-bulb and 1% wet-bulb cooling design temperatures.

G3.1.2.3 Unmet Loads. Unmet load hours for the pro- posed design or baseline building designs shall not exceed 300 (of the 8760 hours simulated). Alternatively, unmet load hours exceeding these limits may be accepted at the discretion of the rating authority provided that sufficient justification is given indicating that the accuracy of the simulation is not significantly compromised by these unmet loads.

G3.1.2.4 Fan System Operation. Supply and return fans shall operate continuously whenever spaces are occupied and shall be cycled to meet heating and cooling loads during unoccupied hours. If the supply fan is modeled as cycling and fan energy is included in the energy-efficiency rating of the equipment, fan energy shall not be modeled explicitly. Sup- ply, return, and/or exhaust fans will remain on during occupied and unoccupied hours in spaces that have health and safety mandated minimum ventilation requirements during unoccupied hours.

G3.1.2.5 Ventilation. Minimum ventilation system out- door air intake flow shall be the same for the proposed and baseline building designs.

Exceptions:

1. When modeling demand-control ventilation in the proposed design in systems with outdoor air capacity less than or equal to 3,000 cfm serving areas with an average design capacity of 100 people per 1,000 ft^2 or less.

2. When designing systems in accordance with Standard 62.1, Section 6.2, "Ventilation Rate Procedure," reduced ventilation airflow rates may be calculated for each HVAC zone in the proposed design with a zone air distribution effectiveness (E_Z) > 1.0 as defined by Table 6-2 in Standard 62.1. Baseline ventilation airflow rates

in those zones shall be calculated using the proposed design Ventilation Rate Procedure calculation with the following change only. Zone air distribution effectiveness shall be changed to (E_Z) = 1.0 in each zone having a zone air distribution effectiveness (E_Z) > 1.0. Proposed design and baseline design Ventilation Rate Procedure calculations, as described in Standard 62.1, shall be submitted to the rating authority to claim credit for this exception.

3. If the minimum outdoor air intake flow in the proposed design is provided in excess of the amount required by the rating authority or building official then the baseline building design shall be modeled to reflect the greater of that required by the rating authority or building official and will be less than the proposed design.

4. For baseline systems serving only laboratory spaces that are prohibited from recirculating return air by code or accreditation standards, the baseline system shall be modeled as 100% out- door air.

G3.1.2.6 Economizers. Outdoor air economizers shall not be included in baseline HVAC Systems 1, 2, 9, and 10. Outdoor air economizers shall be included in baseline HVAC Systems 3 through 8, and 11, 12, and 13 based on climate as specified in Table G3.1.2.7.

Exceptions: Economizers shall not be included for systems meeting one or more of the exceptions listed below.

1. Systems that include gas-phase air cleaning to meet the requirements of Section 6.1.2 in Standard 62.1. This exception shall be used only if the sys- tem in the proposed design does not match the building design.

2. Where the use of outdoor air for cooling will affect supermarket open refrigerated casework systems. This exception shall only be used if the system in the proposed design does not use an economizer. If the exception is used, an economizer shall not be included in the baseline building design.

3. Systems that serve computer rooms complying with Section G3.1.2.7.1.

TABLE G3.1.2.7 CLIMATE CONDITIONS UNDER WHICH ECONOMIZERS ARE INCLUDED FOR COMFORT COOLING FOR BASELINE SYSTEMS 3 THROUGH 8 AND 11, 12, AND 13

Climate Zone	Conditions
1a, 1b, 2a, 3a, 4a	NR
Others	Economizer Included

Note: NR means that there is no conditioned building floor area for which economizers are included for the type of zone and climate.

TABLE G3.1.2.8 ECONOMIZER HIGH-LIMIT SHUTOFF

Climate Zone	High-Limit Shutoff
1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8	75°F
2a, 3a, 4a	28 Btu/lb
5a, 6a, 7a	70°F
Others	65°F

G3.1.2.7.1 Computer Room Economizers. Systems that serve computer rooms that are HVAC System 3 or 4 shall not have an economizer. Systems that serve computer rooms that are HVAC System 11 shall include an integrated water- side economizer meeting the requirements of Section 6.5.1.2 in the baseline building design. If the simulation software cannot model an integrated water-side economizer, then an air-side economizer shall be modeled.

G3.1.2.8 Economizer High-Limit Shutoff. The high- limit shutoff shall be a dry-bulb fixed switch with setpoint temperatures in accordance with the values in Table G3.1.2.8.

G3.1.2.9 Design Airflow Rates

G3.1.2.9.1 Baseline All System Types Except System Types 9 and 10. System design supply airflow rates for the baseline building design shall be based on a supply-air-to-room-air temperature difference of 20°F or the minimum out- door airflow rate, or the airflow rate required to comply with applicable codes or accreditation standards, whichever is greater. If return or relief fans are specified in the proposed design, the baseline building design shall also be modeled with fans serving the same functions and sized for the base- line system supply fan air quantity less the minimum outdoor air, or 90% of the supply fan air quantity, whichever is larger.

Exceptions:

1. For systems serving laboratory spaces, use a supply-air-to-room-air temperature difference of 17°F or the required ventilation air or makeup air, whichever is greater.

2. If the proposed design HVAC design airflow rate based on latent loads is greater than the design airflow rate based on sensible loads, then the same supply-air-to-room-air humidity ratio difference (gr/lb) used to calculate the proposed design airflow shall be used to calculate design airflow rates for the baseline building design.

G3.1.2.9.2 Baseline System Types 9 and 10. System design supply airflow rates for the baseline building design shall be based on the temperature difference between a supply air temperature setpoint of 105°F and the design space heating temperature setpoint, the minimum outdoor airflow rate, or the airflow rate required to comply with applicable codes or accreditation standards, whichever is greater. If the Proposed Building Design includes a fan(s) sized and controlled to provide non-mechanical cooling, the baseline building design shall include a separate fan to provide non-mechanical cooling, sized and controlled the same as the proposed building design.

G3.1.2.10 System Fan Power. System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes) shall be calculated using the following formulas:

For Systems 1 and 2,

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

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

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

For Systems 9 and 10 (supply fan),

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

For Systems 9 and 10 (nonmechanical cooling fan if required by Section G3.1.2.9.2)

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

where

P_{fan}	=	electric power to fan motor (watts)
bhp	=	brake horsepower of baseline fan motor from Table G3.1.2.10
fan motor efficiency	=	the efficiency from Table 10.8-2 for the next motor size greater than the bhp using a totally enclosed fan cooled motor at 1800 rpm.
CFMs	=	the baseline system maximum design supply fan airflow rate in cfm
CFM_{nmc}	=	the baseline non-mechanical cooling fan airflow in cfm

Exceptions to G3.1.2.10: 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.

(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 air* flow. 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.*

G3.1.2.10.1 The calculated system fan power shall be distributed to supply, return, exhaust, and relief fans in the same proportion as the proposed design.

G3.1.2.11 Exhaust Air Energy Recovery. Individual fan systems that have both a design supply air capacity of 5000 cfm 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*.

TABLE G3.1.2.10 BASELINE FAN BRAKE HORSEPOWER

Baseline Fan Motor Brake Horsepower		
Constant Volume Systems 3–4	**Variable Volume Systems 5–8**	**Variable Volume System 11**
$CFM_s \cdot 0.00094 + A$	$CFM_s \cdot 0.0013 + A$	$CFM_s \times 0.00062 + A$

Notes:

1. Where A is calculated according to Section 6.5.3.1.1 using the pressure drop adjustment from the proposed building design and the design flow rate of the baseline building system.
2. Do not include pressure drop adjustments for evaporative coolers or heat recovery devices that are not required in the baseline building system by Section G3.1.2.10.

TABLE G3.1.3.7 TYPE AND NUMBER OF CHILLERS

Building Peak Cooling Load	Number and Type of Chiller(s)
≤300 tons	1 water-cooled screw chiller
>300 tons, <600 tons	2 water-cooled screw chillers sized equally
≥600 tons	2 water-cooled centrifugal chillers minimum with chillers added so that no chiller is larger than 800 tons, all sized equally

G3.1.3 System-Specific Baseline HVAC System Requirements. Baseline HVAC systems shall conform with provisions in this section, where applicable, to the specified baseline system types as indicated in section headings.

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 thermostat. The systems shall be controlled to energize auxiliary heat only when the out-door air temperature is less than 40°F. The air-source heat pump shall be modeled to continue to operate while auxiliary heat is energized.

G3.1.3.2 Type and Number of Boilers (Systems 1, 5, and 7). The boiler plant shall use the same fuel as the pro- posed design and shall be natural draft, except as noted in Section G3.1.1.1. The baseline building design boiler plant shall be modeled as having a single boiler if the baseline building design plant serves a conditioned floor area of 15,000 $ft.^2$ or less and as having two equally sized boilers for plants serving more than 15,000 $ft.^2$. Boilers shall be staged as required by the load.

G3.1.3.3 Hot-Water Supply Temperature (Systems 1, 5, 7, and 12). Hot-water design supply temperature shall be modeled as 180°F and design return temperature as 130°F.

G3.1.3.4 Hot-Water Supply Temperature Reset (Systems 1, 5, 7, 11, and 12). Hot-water supply temperature shall be reset based on outdoor dry-bulb temperature using the following schedule: 180°F at 20°F and below, 150°F at 50°F and above, and ramped linearly between 180°F and 150°F at temperatures between 20°F and 50°F.

G3.1.3.5 Hot-Water Pumps. The baseline building design hot-water pump power shall be 19 W/gpm. The pumping system shall be modeled as primary-only with continuous variable flow. Hot-water systems serving 120,000 $ft.^2$or more shall be modeled with variable-speed drives, and systems serving less than 120,000 $ft.^2$shall be modeled as riding the pump curve.

Exception: The pump power for systems using purchased heat shall be 14 W/gpm.

G3.1.3.6 Piping Losses (Systems 1, 5, 7, 8, and 11). Piping losses shall not be modeled in either the proposed or baseline building designs for hot-water, chilled-water, or steam piping.

G3.1.3.7 Type and Number of Chillers (Systems 7, 8, 11, 12, and 13). Electric chillers shall be used in the baseline building design regardless of the cooling energy source, e.g. direct fired absorption or absorption from purchased steam. The baseline building design's chiller plant shall be modeled with chillers having the number and type as indicated in Table G3.1.3.7 as a function of building peak cooling load.

Exception: Systems using purchased chilled water shall be modeled in accordance with

Section G3.1.1.3.

G3.1.3.8 Chilled-Water Design Supply Temperature (Systems 7, 8, 11, 12, and 13). Chilled-water design supply temperature shall be modeled at 44°F and return water temperature at 56°F.

G3.1.3.9 Chilled-Water Supply Temperature Reset (Systems 7, 8, 11, 12, and 13). Chilled-water supply temperature shall be reset based on outdoor dry-bulb temperature using the following schedule: 44°F at 80°F and above, 54°F at 60°F and below, and ramped linearly between 44°F and 54°F at temperatures between 80°F and 60°F.

Exception: If the baseline chilled-water system serves a computer room HVAC system, the supply chilled- water temperature shall be reset higher based on the HVAC system requiring the most cooling; i.e., the chilled-water setpoint is reset higher until one cooling-coil valve is nearly wide open. The maximum reset chilled-water supply temperature shall be 54°F.

G3.1.3.10 Chilled-Water Pumps (Systems 7, 8, and 11). The baseline building design pump power shall be 22 W/ gpm. Chilled-water systems with a cooling capacity of 300 tons or more shall be modeled as primary/secondary systems with variable-speed drives on the secondary pumping loop. Chilled-water pumps in systems serving less than 300 tons cooling capacity shall be modeled as a primary/secondary systems with secondary pump riding the pump curve. For computer room systems using System 11 with an integrated water-side economizer, the baseline building design primary chilled-water pump power shall be increased 5 W/gpm for flow associated with the water-side economizer.

Exception: The pump power for systems using purchased chilled water shall be 16 W/gpm.

G3.1.3.11 Heat Rejection (Systems 7, 8, 9, 12, and 13). 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. Condenser water design supply temperature shall be calculated using the cooling tower approach to the 0.4% evaporation design wet- bulb temperature as generated by the formula below, with a design temperature rise of 10°F.

$$\text{Approach}_{10°F\ Range} = 25.72 - (0.24 \times \text{WB})$$

where WB is the 0.4% evaporation design wet-bulb tempera- ture in °F; valid for wet bulbs from 55°F to 90°F. The tower shall be controlled to maintain a 70°F leaving water temperature where weather permits, floating up to leaving water temperature at design conditions. The baseline building design condenser-water pump power shall be 19 W/gpm. For computer room systems using System 11 with an integrated water-side economizer, the baseline building design

condenser water-pump power shall be increased 5 W/gpm for flow associated with the water-side economizer. Each chiller shall be modeled with separate condenser water and chilled-water pumps interlocked to operate with the associated chiller.

G3.1.3.12 Supply Air Temperature Reset (Systems 5 through 8). The air temperature for cooling shall be reset higher by 5°F under the minimum cooling load conditions.

G3.1.3.13 VAV Minimum Flow Setpoints (Systems 5 and 7). Minimum volume setpoints for VAV reheat boxes shall be 30%of zone peak airflow, the minimum outdoor air- flow rate or the airflow rate required to comply with applicable codes or accreditation standards, whichever is larger.

Exception: Systems serving laboratory spaces shall reduce the exhaust and makeup air volume during unoccupied periods to the largest of 50% of zone peak airflow, the minimum outdoor airflow rate, or the airflow rate required to comply with applicable codes or accreditation standards.

G3.1.3.14 Fan Power (Systems 6 and 8). Fans in parallel VAV fan-powered boxes shall be sized for 50% of the peak design primary air (from the VAV air-handling unit) flow rate and shall be modeled with 0.35 W/cfm fan power. Minimum volume setpoints for fan-powered boxes shall be equal to 30% of peak design primary airflow rate or the rate required to meet the minimum outdoor air ventilation requirement, whichever is larger. The supply air temperature setpoint shall be constant at the design condition.

G3.1.3.15 VAV Fan Part-Load Performance (Systems 5 through 8 and 11). VAV system supply fans shall have variable-speed drives, and their part-load performance characteristics shall be modeled using either Method 1 or Method 2 specified in Table G3.1.3.15.

TABLE G3.1.3.15 PART-LOAD PERFORMANCE FOR VAV FAN SYSTEMS

Method 1—Part-Load Fan Power Data

Fan Part-Load Ratio	Fraction of Full-Load Power
0.00	0.00
0.10	0.03
0.20	0.07
0.30	0.13
0.40	0.21
0.50	0.30
0.60	0.41
0.70	0.54
0.80	0.68
0.90	0.83
1.00	1.00

Method 2—Part-Load Fan Power Equation

$$P_{fan} = 0.0013 + 0.1470 \times PLR_{fan} + 0.9506 \times (PLR_{fan})^2 - 0.0998 \times (PLR_{fan})^3$$

where

P_{fan} = fraction of full-load fan power and

PLR_{fan} = fan part-load ratio (current L/s/design L/s)

G3.1.3.16 Computer Room Equipment Schedules. Computer room equipment schedules shall be modeled as a constant fraction of the peak design load per the following monthly schedule:

Month 1, 5, 9—25%
Month 2, 6, 10—50%
Month 3, 7, 11—75%
Month 4, 8, 12—100%

G3.1.3.17 System 11 Supply Air Temperature and Fan Control. Minimum volume setpoint shall be 50% of the maximum design airflow rate, the minimum ventilation outdoor airflow rate, or the airflow rate required to comply with applicable codes or accreditation standards, whichever is larger.

Fan volume shall be reset from 100% airflow at 100% cooling load to minimum airflow at 50% cooling load. Supply air temperature setpoint shall be reset from minimum supply air temperature at 50% cooling load and above to space temperature at 0% cooling load. In heating mode supply air temperature shall be modulated to maintain space temperature, and fan volume shall be fixed at the minimum airflow.

G3.1.3.18 Dehumidification (Systems 3 through 8). If the proposed design HVAC system(s) have humidistatic controls, then the baseline building design shall use mechanical cooling for dehumidification and shall have reheat available to avoid overcooling. When the baseline building design HVAC system does not comply with any of the exceptions in Section 6.5.2.3, then only 25% of the system reheat energy shall be included in the baseline building performance. The reheat type shall be the same as the system heating type.

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.

TABLE G3.4.4
BUILDING ENVELOPE REQUIREMENTS FOR CLIMATE ZONE 4 (A,B,C)

		Nonresidential		Residential		Semiheated	
		Assembly	Insulation Min.	Assembly	Insulation Min.	Assembly	Insulation Min.
	Opaque Elements	Maximum	R-Value	Maximum	R-Value	Maximum	R-Value
Roofs							
	Insulation Entirely above Deck	U-0.063	R-15.0 ci	U-0.063	R-15.0 ci	U-0.218	R-3.8 ci
	Metal Building	U-0.065	R-19.0	U-0.065	R-19.0	U-0.097	R-10.0
	Attic and Other	U-0.034	R-30.0	U-0.027	R-38.0	U-0.081	R-13.0
Walls, Above Grade							
	Mass	U-0.151[a]	R-5.7 ci[a]	U-0.104	R-9.5 ci	U-0.580	NR
	Metal Building	U-0.113	R-13.0	U-0.113	R-13.0	U-0.134	R-10.0
	Steel Framed	U-0.124	R-13.0	U-0.064	R-13.0 + R-7.5 ci	U-0.124	R-13.0
	Wood Framed and Other	U-0.089	R-13.0	U-0.089	R-13.0	U-0.089	R-13.0
Wall, Below Grade							
	Below Grade Wall	C-1.140	NR	C-1.140	NR	C-1.140	NR

Floors							
	Mass	U-0.107	R-6.3 ci	U-0.087	R-8.3 ci	U-0.322	NR
	Steel Joist	U-0.052	R-19.0	U-0.038	R-30.0	U-0.069	R-13.0
	Wood Framed and Other	U-0.051	R-19.0	U-0.033	R-30.0	U-0.066	R-13.0
Slab-On-Grade Floors							
	Unheated	F-0.730	NR	F-0.730	NR	F-0.730	NR
	Heated	F-0.950	R-7.5 for 24 in.	F-0.840	R-10 for 36 in.	F-1.020	R-7.5 for 12 in.
Opaque Doors							
	Swinging	U-0.700		U-0.700		U-0.700	
	Non-Swinging	U-1.450		U-0.500		U-1.450	
		Assembly	**Assembly Max.**	**Assembly**	**Assembly Max.**	**Assembly**	**Assembly Max.**
		Max. U	**SHGC (All**	**Max. U**	**SHGC (All**	**Max. U**	**SHGC (All**
		(Fixed/	**Orientations/**	**(Fixed/**	**Orientations/**	**(Fixed/**	**Orientations/**
	Fenestration	**Operable)**	**North-Oriented)**	**Operable)**	**North-Oriented)**	**Operable)**	**North-Oriented)**
Vertical Glazing,% of Wall							
	0-10.0%	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-1.22	$SHGC_{all}$-NR
		U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-1.27	$SHGC_{north}$NR
	10.1-20.0%	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-1.22	$SHGC_{all}$-NR
		U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-1.27	$SHGC_{north}$NR
	20.1-30.0%	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-1.22	$SHGC_{all}$-NR
		U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-1.27	$SHGC_{north}$NR
	30.1-40.0%	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-0.57	$SHGC_{all}$-0.39	U_{fixed}-1.22	$SHGC_{all}$-NR
		U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-0.67	$SHGC_{north}$-0.49	U_{oper}-1.27	$SHGC_{north}$NR
	40.1% +	U_{fixed}-0.46	$SHGC_{all}$-0.25	U_{fixed}-0.46	$SHGC_{all}$-0.25	U_{fixed}-0.98	$SHGC_{all}$-NR
		U_{oper}-0.47	$SHGC_{north}$-0.36	U_{oper}-0.47	$SHGC_{north}$-0.36	U_{oper}-1.02	$SHGC_{north}$NR
Skylight with Curb, Glass,% of Roof							
	0-2.0%	U_{all}-1.17	$SHGC_{all}$-0.49	U_{all}-0.98	$SHGC_{all}$-0.36	U_{all}-1.98	$SHGC_{all}$-NR
	2.1%+	U_{all}-1.17	$SHGC_{all}$-0.39	U_{all}-0.98	$SHGC_{all}$-0.19	U_{all}-1.98	$SHGC_{all}$-NR
Skylight with Curb, Plastic,% of Roof							
	0-2.0%	U_{all}-1.30	$SHGC_{all}$-0.65	U_{all}-1.30	$SHGC_{all}$-0.62	U_{all}-1.90	$SHGC_{all}$-NR
	2.1%+	U_{all}-1.30	$SHGC_{all}$-0.34	U_{all}-1.30	$SHGC_{all}$-0.27	U_{all}-1.90	$SHGC_{all}$-NR
Skylight without Curb, 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
a	Exception to A3.1.3.1 applies.						

TABLE G3.5.1 AIR CONDITIONERS AND CONDENSING UNITS

Equipment Type	Size Category	Heating Section Type	Sub-Category 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 9.5 IPLV	
	≥760,000 Btu/h	All	Split System and Single Package	9.0 EER 9.2 IPLV	

TABLE G3.5.2 ELECTRICALLY OPERATED UNITARY AND APPLIED HEAT PUMPS— MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Heating Section Type	Sub-Category 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 9.0 IPLV	
Air Cooled (Heating Mode)	<65,000 Btu/hc(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 WATER CHILLING PACKAGES– MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	<150 tons		4.45 COP 5.20 IPLV	ARI 550/590
	≥150 tons and <300 tons		4.90 COP 5.60 IPLV	
	≥300 tons		5.50 COP 6.15 IPLV	
Water Cooled, Electrically Operated, Centrifugal	<150 tons		5.00 COP 5.25 IPLV	ARI 550/590
	≥150 tons and <300 tons		5.55 COP 5.90 IPLV	
	≥300 tons		6.10 COP 6.40 IPLV	

TABLE G3.5.4 ELECTRICALLY OPERATED PACKAGED TERMINAL AIR CONDITIONERS, PACKAGED TERMINAL HEAT PUMPS

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	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	

TABLE G3.5.5 WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS, WARM AIR DUCT FURNACES AND UNIT HEATERS

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Warm Air Furnace, Gas-Fired	<225,000 Btu/h		78% AFUE or 80% *Et*	DOE 10 CFR Part 430 or ANSI Z21.47
	≥225,000 Btu/h	Maximum Capacity	80% Ec	ANSI Z21.47
Warm Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity	80% *Ec*	ANSI Z83.8

TABLE G3.5.6 GAS- AND OIL-FIRED BOILERS– MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency	Test Procedure
Boilers, Gas-Fired	<300,000 Btu/h	Hot Water	80% AFUE	DOE 10 CFR Part 430
		Steam	75% AFUE	
	≥300,000 Btu/h and ≤2,500,000 Btu/h	Maximum Capacity	75% *Et* b	H.I. Htg Boiler Std.
	>2,500,000 Btu/ha	Hot Water	80% *Ec*	
	>2,500,000 Btu/ha	Steam	80% *Ec*	
	>2,500,000 Btu/ha	Hot Water	83% *Ec*	
	>2,500,000 Btu/ha	Steam	83% *Ec*	

TABLE G3.6 LIGHTING POWER DENSITIES FOR BUILDING EXTERIORS

Tradable Surfaces (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs and outdoor sales areas may be traded.)	**Uncovered Parking Areas**	
	Parking Lots and drives	**0.15**W/ft2
	Building Grounds	
	Walkways less than 10 feet wide	**1.0**W/linear foot
	Walkways 10 feet wide or greater Plaza areas Special Feature Areas	**0.2**W/ft2
	Stairways	**1.0** W/ft2
	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/ft2
	Outdoor Sales	
	Open areas (including vehicle sales lots)	**0.5**W/ft2
	Street frontage for vehicle sales lots in addition to "open area" allowance	**20**W/linear foot
Non-Tradable 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/ft2 for each illuminated wall or surface or **5.0**W/linear foot for each illuminated wall or surface length
	Automated teller machines 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/ft2of 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/ft2of 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 - LIGHTING POWER DENSITY ALLOWANCES USING THE SPACE-BY-SPACE METHOD

Common Space Types1	LPD (watts/sq.ft)		Building Type Specific Space Types1	LPD (watts/sq.ft)
Audience Seating Area			**Assisted Living Facility**	
... in an auditorium	0.79		... in a chapel (used primarily by residents)	3.31
... in a convention center	1.03		... in a recreation room (used primarily by residents)	3.02
... in an Exercise Center	0.81		**Automotive (See Vehicular Maintenance Area above)**	
... in a gymnasium	0.81			
... in a motion picture theater	1.43		**Convention Center - Exhibit Space**	1.82
... in a penitentiary	0.35		**Dormitory - Living Quarters**	0.48
... in a performing arts theater	3.04		**Fire Station - Sleeping Quarters**	0.28
... in a religious building	1.92		**Gymnasium/Fitness Center**	
... in a sports arena	0.54		*... in an Exercise Area*	0.90
... in a transportation facility	0.68		*... in a Playing Area*	1.50
... otherwise	0.54		**Healthcare Facility**	
Atrium			*... in an Imaging Room*	1.89
... that is <= 40' in height	0.0375 per foot in total height		*... in an Exam/Treatment Room*	2.08
... that is > 40' in height	0.50 +0.025 per foot in total height		*... in an Imaging Room*	1.89
Banking Activity Area	1.27		*....in a Medical Supply Room*	0.93
Breakroom (See Lounge/Breakroom)			*... in a Nursery*	1.10
Classroom/Lecture Hall/Training Room			*... in a Nurse's Station*	0.89
... in a penitentiary	1.68		*... in an Operating Room*	3.11
... otherwise	1.55		*... in a Patient Room*	0.78
Conference/Meeting/Multipurpose Room	1.54		*... in a Physical Therapy Room*	1.14
Confinement Cells	1.01		*... in a Recovery Room*	1.44
Copy/Print Room	0.90		**Library**	
Corridor				

... in an Assisted Living Facility (and used primarily by residents)	1.15		*... in a Reading Area*	1.33
... in a hospital	1.24			
... in a manufacturing facility	0.51		*... in the Stacks*	2.14
... otherwise	0.83			
Courtroom	2.15		**Manufacturing Facility**	
Computer Room	2.14			
Dining Area			*... in a detailed manufacturing area*	1.62
... in a penitentiary	1.20		*... in an Equipment Room*	0.93
... in an Assisted Living Facility (and used primarily by residents)	3.32		*... in an Extra High Bay Area (> 50' floor-to-ceiling height)*	1.32
... in Bar/Lounge or Leisure Dining	1.34		*... in a High Bay Area (25-50' floor-to-ceiling height)*	
... in Cafeteria or Fast Food Dining	0.81			1.54
... in Family Dining	1.12			
			... in a Low Bay Area (< 25' floor-to-ceiling height)	
... otherwise	0.81			1.49
Electrical/Mechanical Room	0.53		**Museum**	
Emergency Vehicle Garage	0.70		*... in a General Exhibition Area*	1.32
Food Preparation Area	1.52		*... in a Restoration Room*	1.28
Guest Room	0.59		**Post Office - Sorting Area**	1.18
Judges Chambers	1.39		**Religious Buildings**	
			... in a Fellowship Hall	0.80
Laboratory			*... in a Worship/Pulpit/Choir Area*	1.92
... in or as a classroom	1.79		**Retail Facilities**	
... otherwise	2.27		*... in a Dressing/Fitting Room*	0.89
Laundry/Washing Area	0.75		*... in a Mall Concourse*	1.38
Loading Dock, Interior	0.59		**Sports Arena - Playing Area**	
Lobby			*... for a Class I facility*	4.61
... in an Assisted Living Facility (and used primarily by residents)	2.26		*... for a Class II facility*	3.01

... for an elevator	0.80		*... for a Class III facility*	2.26
... in a hotel	1.33		*... for a Class IV facility*	1.50
... in a motion picture theater	0.74			
... in a performing arts theater	2.51			
... otherwise	1.13		**Transportation Facility**	
Locker Room	0.94		*... in a baggage/carousel Area*	0.66
Lounge/Breakroom			*... in an Airport Concourse*	0.45
... in a healthcare facility	1.15		*... at a Terminal Ticket Counter*	1.00
... otherwise	0.91		**Warehouse - Storage Area**	
Office			*...for medium to bulky, palletized items*	0.73
... enclosed	1.39		*... for smaller, hand-carried items*	1.19
... open plan	1.23			
Parking Area, Interior	0.24			
Pharmacy Area	2.10			
Restroom				
... in an Assisted Living Facility (and used primarily by residents)	1.52			
... otherwise	1.23			
Sales Area	1.80			
Seating Area, General	0.68			
Stairwell	0.86			
Storage Room				
... in a hospital	0.93			
... that is >= 50 sqft	0.79			
... that is < 50 sqft	1.55			
Vehicular Maintenance Area	0.84			
Workshop	1.99			
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				

Add new Table G.3.8

TABLE G.3.8 LIGHTING POWER DENSITIES USING THE BUILDING AREA METHOD

Building Area Type	LPD (W/ft2)
Automotive facility	1.00
Convention center	1.27
Courthouse	1.27
Dining: bar lounge/leisure	1.27
Dining: cafeteria/fast food	1.13
Dining: family	1.19
Dormitory	0.71
Exercise center	1.05
Fire station	0.84
Gymnasium	1.18
Health-care clinic	1.13
Hospital	1.32
Hotel	0.73
Library	1.49
Manufacturing facility	1.83
Motel	0.70
Motion picture theater	0.95
Multifamily	0.64
Museum	1.28
Office	1.03
Parking garage	0.26
Penitentiary	1.01
Performing arts theater	1.74
Police station	1.09
Post office	1.09
Religious building	1.25
Retail	1.58
School/university	1.09
Sports arena	1.14
Town hall	1.12
Transportation	0.88
Warehouse	0.83
Workshop	1.49

APPENDIX Z NET ZERO ENERGY COMPLIANCE PATH

Insert a new Appendix Z in the Energy Conservation Code-Commercial Provisions to read as follows:

Z1. GENERAL. Appendix Z is intended to be an optional alternative compliance path for projects to comply with the *Energy Conservation Code-Commercial Provisions*.

The design of a *net-zero energy building* shall be achieved through the use of three complementary approaches, to be employed to the maximum extent feasible, in the following order:

1. Reducing building energy demand for heating and cooling through the use of passive design and improved envelope performance techniques.

2. Reducing total building energy demand through the installation of high efficiency mechanical, lighting and power systems.

3. Supplying remaining building energy needs from a renewable source of energy.

Appendix Z draws on existing requirements outlined in the *Energy Conservation Code-Commercial Provisions*. Additional minimum performance requirements for building thermal energy performance and airtightness have been set to ensure new construction achieves a high degree of energy conservation consistent with Passive House levels of building performance, in accordance with the *Passive Building Standard for North America*. Passive House-certified buildings use substantially less energy for space heating and cooling, while simultaneously improving occupant comfort, improving building resilience under extreme weather conditions, and reducing energy costs.

Z1.1. Definitions. In addition to definitions contained in Chapter 2 of the *Building Code* and in Section 3.2 of the *Energy Conservation Code-Commercial Provisions*, the following definitions shall apply to projects opting to use Appendix Z:

Airtightness. The rate of air leakage through the building envelope, measured in cubic feet per minute per square foot of building envelope (cfm/ft^2_{env}), typically measured at 0.0073 psig (50 Pa) of pressure difference.

Annual cooling demand. The total amount of thermal energy required to cool a building over the course of a year, measured in thousands of British thermal units per square foot of interior conditioned floor area, per year ($kBtu/ft^2$ $_{iCFA}$/yr).

Annual heating demand. The total amount of thermal energy required to heat a building over the course of a year, measured in thousands of British thermal units per square foot of interior conditioned floor area, per year (kBtu/sf $_{iCFA}$/yr).

Energy Use Intensity (EUI). The annual energy use of the building expressed in kBtu divided by gross square feet ($kbtu/ ft^2$).

Low-carbon neighborhood thermal energy system. A district-scale energy system that uses renewable energy to produce steam, hot water, or chilled water for the purposes of providing for building heating, cooling, and/or domestic hot water needs.

Net-zero energy building. A highly energy-efficient building that produces on-site, or procures through the construction of new renewable energy generation, enough energy to meet or exceed the annual energy consumption of its operations.

Renewable energy microgrid. (As defined by the U.S. Department of Energy) A group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid.

Z1.2. Scope and intent. The provisions of Appendix Z regulate the design, construction, commissioning and operation of buildings and their associated building sites for compliance with the *Energy Conservation Code-Commercial Provisions*. The intent of this Appendix is the reduction of energy use to achieve net-zero performance.

Z1.3. Administration and enforcement. Administration and enforcement of Appendix Z shall be governed by Chapter 1 of the *Building Code*, 12-A DCMR.

Z1.4. Application. The provisions of Appendix Z shall apply to each project that is new construction, or classified as a Level 3 alteration under the *Existing Building Code*, and for which this compliance path option has been chosen.

Z1.5 Compliance. Compliance with Appendix Z requires that the building and its site comply with the provisions of Sections Z2, Z3, Z4, and Z5.

Z2. MINIMUM PERFORMANCE REQUIREMENTS. Minimum performance requirements for building energy use intensity have been set to ensure maximum energy efficiency prior to adding renewable energy generation. The building and its site be designed and constructed to meet the mandatory prescriptive requirements in sections Z2.1, Z.2, Z.3, Z.4, and Z.5.

Z2.1. Building energy use intensity. Applicant shall submit, with the building permit application, *permit documents* with data and calculations sufficient to ascertain compliance with the net-zero energy performance target for buildings and their sites, using predictive modeling. Predictive modeling shall use a source energy unit of measurement, expressed in kBtu/sf.yr, based on the use of the *Zero Energy Performance Index (zEPI)* as outlined in section Z2.1.1. In a mixed-use building, all uses shall be included in demonstrating compliance, and an area-weighted calculation method shall be used to account for each use.

Z2.1.1. Zero Energy Performance Index, zEPI. Building design shall demonstrate a zEPI of 40 or lower as determined in accordance with Equation 1.

$$zEPI = 75 \times (EUIp/EUI) \qquad \text{(Equation 1)}$$

Where:

EUIp = The annual energy use of the building in source kBtu/ft^2, for the proposed design of the building and its site, calculated in accordance with Section Z2.1.2, not taking into account any on-site or off-site renewable energy.

EUI = The annual energy use of the building in source kBtu/ft^2 for a baseline building and its site, calculated in accordance with Section Z2.1.2, not taking into account any on-site or off-site renewable energy.

Z2.1.2. Annual energy use indices. The EUIp of the building and building site, and the EUI, shall be calculated in accordance with Appendix G to ASHRAE 90.1-2004~~16~~, as modified by Sections Z2.1.2.1 and Z2.1.2.2, and *approved* modeling guidelines published by the *Department* in *administrative bulletins*. The annual energy use shall include all energy used for the building systems and its anticipated occupancies.

Z2.1.2.1. Additional Modeling Rules and Procedures. Modeling inputs shall be in accordance with the *COMNet Rules and Procedures Manual.*

Z2.1.2.2. Electricity. In calculating the annual energy use indices, consistent units shall be used for electric energy use, converting the electric energy use, measured at the utility meter or metered point of delivery, from kWh to kBtu by multiplying the annual electric energy use, in kWh, by 3.412 kBtu/kWh.and multiplying the result by the dimensionless conversion factor found in Table 1.

TABLE 1
ELECTRICITY GENERATION ENERGY CONVERSION FACTOR
BASED ON EPA eGRID SUB-REGION

eGRID 2010 SUB-REGION ACRONYM	eGRID 2010 SUB-REGION NAME	CONVERSION FACTOR
RFCE	RFC East	0.543

Z2.2. Building Thermal Energy Performance and Airtightness. Building thermal energy performance and thermal envelope tightness shall comply with Sections Z2.2.1 through Z2.2.3.

Z2.2.1. Annual heating demand. Building design shall demonstrate a maximum *annual heating demand* of 4.2 kBtu/ft^2 $_{iCFA}$/yr (4.8x10^4 kJ/m$^2{}_{iCFA}$/yr).

Z2.2.2. Annual cooling demand. Building design shall demonstrate a maximum *annual cooling demand* of 6.4 kBtu/ft^2 $_{iCFA}$/yr (7.3x10^4 kJ/m$^2{}_{iCFA}$/yr).

Z2.3. Multiple buildings on a site. Where there is more than one building on a site, each building shall comply with Sections Z2.2.1 and Z2.2.2 or the combined demands of all the buildings on the site shall comply with Sections Z2.2.1 and Z2.2.2.

Z2.3.1. Assignment of energy to multiple buildings on a site. For building sites with multiple buildings and that are employing district energy systems, the energy use associated with the building site shall be assigned to each building proportionally to the gross floor area of each building as a fraction of the total gross floor area of all buildings on the building site.

Where energy is derived from either renewable or waste energy, or both sources, either located on the building site, within individual buildings, or on individual buildings and delivered to multiple buildings, the energy so derived shall be assigned on a proportional basis to the buildings served, based on each served building gross floor area. Energy delivered from renewable or waste energy sources located on or within a building shall be assigned to that building.

Exception: Where it can be shown that energy to be used at the building site is associated with a specific building, that energy use shall be assigned to that specific building.

Z2.4. Registered design professional in responsible charge of building energy simulation. Where the *applicant* chooses to utilize Appendix Z as the path of compliance with the *Energy Conservation Code-Commercial Provisions*, the *code official* is authorized to require the owner to engage the services of, and designate on the building permit application, a registered design professional who shall act as the registered design professional in responsible charge of building energy simulation. Building energy simulation services engaged by the registered design professional shall be certified by an *approved* accrediting entity as determined by the *code official*. Where the circumstances justify it, the owner is authorized to designate a substitute registered design professional who shall perform the duties required of the original registered design professional in responsible charge of building energy simulation. The owner shall notify the *code official*, in writing, whenever the registered design professional in responsible charge of building energy simulation is changed or is unable to continue to perform his or her duties.

Z2.5. Building Commissioning. All systems shall be commissioned in accordance with this section and the *Energy Conservation Code=Commercial Provisions*. Energy systems commissioning and completion shall be performed for the following systems and their associated controls:

- Building envelope;
- HVAC (both mechanical and passive systems);
- Lighting and daylighting systems;
- Domestic hot water systems; and
- Renewable energy systems.

Z2.6. Airtightness Testing. A whole-building test for airtightness of the building envelope shall be performed in accordance with the *U.S. Army Corps of Engineers Air Leakage Test Protocol for Building Envelopes.* The owner shall provide the *code official* with a copy of the test results before the respective *Certificate of Occupancy* is issued.

Z3. RENEWABLE ENERGY. The building and building site shall be provided with renewable energy equal to the EUIp on an annual basis and calculated in accordance with Section Z2.1.1. Sources of renewable energy shall comply with Sections Z3.1 through Z3.3.

Z3.1. On-site combustion. On-site combustion of fossil fuels shall not be permitted for the provision of thermal energy to the building.

Z3.2. Acceptable sources of renewable energy. Renewable energy shall be generated on-site wherever feasible. Acceptable sources of on-site renewable energy to be used on the building site include:

- Photovoltaic panels;

- Solar thermal systems;
- Wind turbines; and
- Biogas.

No other source of on-site renewable energy is acceptable for building design, unless the rationale for its selection is approved by the *code official*.

Z3.3. Procurement of off-site renewable energy. The procurement of off-site renewable energy is acceptable only where the energy is procured from a qualified electricity supplier providing energy from Tier 1 and Tier 2 renewable sources meeting the minimum percentages of the District of Columbia Renewable Portfolio Standard. Before procuring off-site renewable energy, a minimum of 5% of the total building energy consumption shall first be met by solar energy installed on the building roof or site, provided there is adequate solar access as determined by Chapter 13 of the *Energy Conservation Code-Commercial Provisions.* Acceptable conditions for the procurement of off-site renewable energy include any of the following:

- Owner signs a power purchase agreement for a minimum period of 10 years, for a new solar energy installation, with solar electricity suppliers that are either located within the District of Columbia or in locations with transmission and distribution lines serving the District of Columbia;

- Connection to a *renewable energy microgrid*; or

- Connection to a *low-carbon neighborhood thermal energy system.*

Z4. ENERGY METERING, MONITORING AND REPORTING.

Z4.1 Scope. The provisions of this Section Z4 shall apply to all projects that opted for Appendix Z as a path of code compliance.

Z4.2. Purpose. The purpose of this Section Z4 is to provide requirements that will ensure that buildings are constructed or altered in a way that will provide the capability for their energy use, production and reclamation to be measured, monitored and reported. This includes the design of energy distribution systems so as to isolate load types, the installation of meters, devices and a data acquisition system, and the installation of energy displays and other appropriate reporting mechanisms.

Z4.3 Energy metering. All forms of energy delivered to the building and building site, or produced on the building site or in the building, shall be metered and all energy load types measured.

Z4.4. Ventilation flow rate. In addition to requirements outlined in the *Energy Conservation Code-Commercial Provisions*, all centrally ventilated building systems shall be designed to enable the collection of real-time and historical ventilation flow rate data.

Z4.5. Grid integration. In places where equipment constraints in the distribution network render net metering impossible, onsite storage options shall be considered.

Z5. ENERGY REPORTING. Owners of buildings that used Appendix Z as a path for code compliance shall comply with this Section.

Z5.1. Post Occupancy Measurement and Reporting.

Z5.1.1. Owners of buildings that use Appendix Z as a path for code compliance must annually benchmark and report their energy and water performance using the Energy Star® Portfolio Manager tool, including renewable energy generation and green power usage, pursuant to rules in *20 DCMR 3513,* regardless of square footage.

Z5.1.2. Energy Star Portfolio Manager account. The *owner* of a *building* that used Appendix Z as a path for compliance with the *Energy Conservation Code-Commercial Provisions* shall create an Energy Star® Portfolio Manager account and property record on the U.S. Environmental Protection Agency's benchmarking website, and share the property with the District of Columbia's Department of Energy and Environment. The *code official* is authorized to require proof of compliance with this Section Z5.3.1 and proof that all utilities have been linked to the account.

Z5.2. Performance Verification. Within 36 months of occupancy, the owner or owner's representative shall submit documentation to the *code official* demonstrating 12 continuous months of operation with no less than 90% occupancy where the energy consumed by the building and building site as measured in accordance with Section Z4 are equal to or less than the renewable energy associated with the building and building site in accordance with Section Z3. Documentation shall be in a form acceptable to the *code official.*

Z5.2.1. Normalization for abnormal conditions. At the discretion of the *code official*, the owner or owner's representative may submit documentation demonstrating that abnormal weather or occupancy conditions during the compliance period are responsible for the variance between the energy consumed by the energy and energy site and the renewable energy associated with the building and building site and that the building would comply with Z5.2 under normal conditions.

Z6. NORMATIVE REFERENCES

Section numbers indicate where the reference occurs in Appendix Z.

U.S. Army Corps of Engineers

Standard Reference number	Title	Referenced in code section number
Version 3: 2012-05-11	Air Leakage Test Protocol for Building Envelopes	Appendix Z, Z2.6

Passive House Institute US (PHIUS)

116 W Illinois St #5e
Chicago, IL 60654

Standard reference number	Title	Referenced in code section number
Version 1.03 July 27 2016	Passive Building Standard for North America	Appendix Z, Z.1

RESNET

P.O Box 4561 Oceanside, CA 92052 www.resnet.us

Standard reference number	Title	Referenced in code section number
August 16, 2010	*COMNET Rules and Procedures Manual*	Appendix Z, Z2.1.2.1

DC Renewable Portfolio Standard

Standard reference number	Title	Referenced in code section number
Section 15-2901 RPS Compliance Requirements Section 15-2902 Generator Certification Section 15-2999 Definitions	*DC Renewable Portfolio Standard*	Appendix Z, Z3.3

ENERGY CONSERVATION CODE SUPPLEMENT OF 2017 – RESIDENTIAL PROVISIONS (12-I[RE] DCMR)

[Residential Provisions]
IECC SECTIONS AMENDED BY THIS SUPPLEMENT

CHAPTER 1 [RE]	SCOPE AND ADMINISTRATION
CHAPTER 2[RE]	DEFNITIONS
CHAPTER 3 [RE]	GENERAL REQUIREMENTS
CHAPTER 4 [RE]	RESIDENTIAL ENERGY EFFICIENCY
CHAPTER 5[RE]	EXISTING BUILDINGS
CHAPTER 6[RE]	REFERENCED STANDARDS
APPENDIX RA	RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS
APPENDIX RB	SOLAR READY PROVISIONS

CHAPTER 1[RE] SCOPE AND ADMINISTRATION
R101 SCOPE AND GENERAL REQUIREMENTS

Strike Chapter 1 [RE] of the International Energy Conservation Code in its entirety and insert a new Chapter 1 [RE] into the Energy Conservation Code-Residential Provisions in its place to read as follows:

PART 1—SCOPE AND APPLICATION

R101 SCOPE AND GENERAL REQUIREMENTS

R101.1 General. Administration and enforcement of the *Energy Conservation Code-Residential Provisions* shall be governed by Chapter 1 of the *Building Code*, Title 12-A DCMR.

R101.2 Scope. The scope of the *Energy Conservation Code-Residential Provisions* shall be as defined in Chapter 1 of Title 12-A DCMR.

CHAPTER 2[RE] DEFINITIONS
R202 DEFINITIONS

R202 DEFINITIONS

Strike the definitions for Energy Simulation Tool, Energy Cost and High-Efficacy Lamps in Section R202 of the International Energy Conservation Code in their entirety and insert new definitions for Energy Modeling Software and High Efficacy Lamps in the Energy Conservation Code-Residential Provisions to read as follows:

ENERGY MODELING SOFTWARE. An *approved* software program or calculation-based methodology that projects the annual energy use of a building.

HIGH-EFFICACY LAMPS. LED, compact fluorescent lamps (CFL's), T-5 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts;

2. 50 lumens per watt for lamps over 15 watts to 40 watts; and

3. 40 lumens per watt for lamps 15 watts or less.

CHAPTER 3 [RE] GENERAL REQUIREMENTS
R301 DISTRICT OF COLUMBIA CLIMATE ZONE
R302 DESIGN CONDITIONS
R303 MATERIALS, SYSTEMS, AND EQUIPMENT

Strike Section R301 in its entirety, including all Tables, in the International Energy Conservation Code and insert new Sections R301 and R301.1, and new Figure R301.1, in the Energy Conservation Code-Residential Provisions in its place to read as follows:

R301 DISTRICT OF COLUMBIA CLIMATE ZONE

R301.1 General. The District of Columbia, Virginia and Maryland are located in climate zone 4A per Figure R301.1.

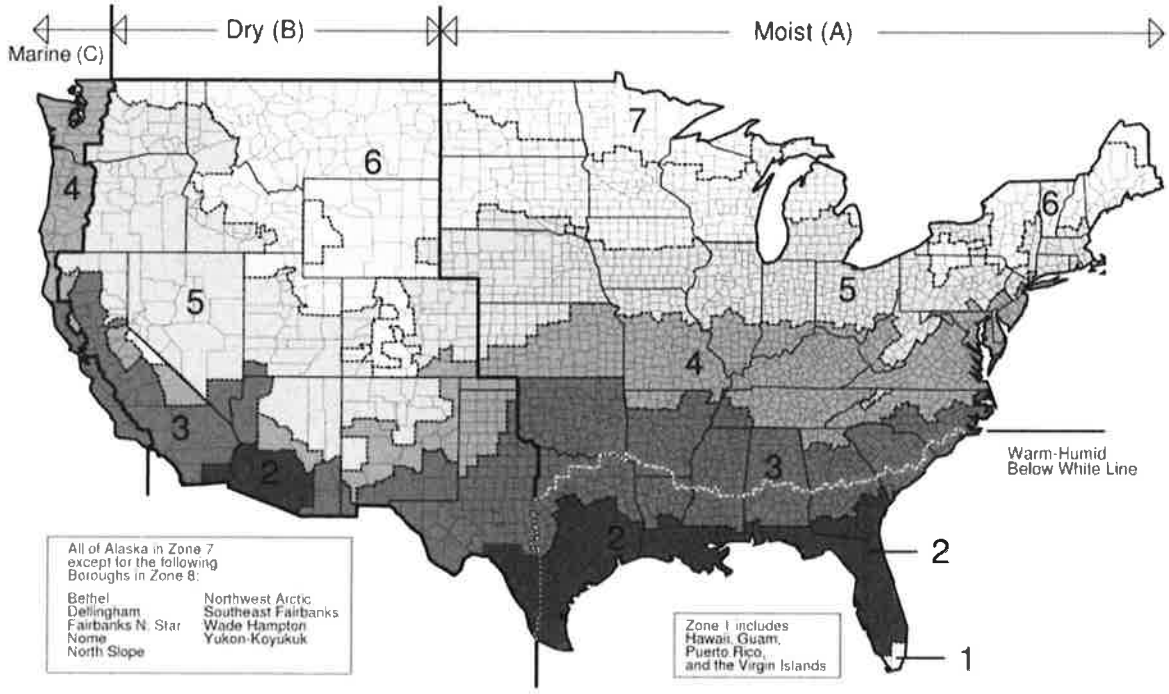

FIGURE R301.1 CLIMATE ZONES

Strike Section R302 in the International Energy Conservation Code in its entirety and insert new Section R302 in the Energy Conservation Code-Residential Provisions in its place to read as follows:

R302 DESIGN CONDITIONS

R302.1 Interior design conditions.
The interior design temperatures used for heating and cooling load calculations shall be a maximum of 72°F (22°C) for heating and minimum of 75°F (24°C) for cooling.

Strike Section R303 in the International Energy Conservation Code in its entirety and insert new Section R303 in the Energy Conservation Code-Residential Provisions in its place to read as follows:

R303 MATERIALS, SYSTEMS, AND EQUIPMENT

R303.1 Identification. Materials, systems and equipment shall be identified in a manner that will allow a determination of compliance with the applicable provisions of this code.

R303.1.1 Building thermal envelope insulation. An *R*-value identification mark shall be applied by the manufacturer to each piece of *building thermal envelope* insulation 12 inches (305 mm) or greater in width. Alternately, the insulation installers shall provide a certification listing the type, manufacturer and *R*-value of insulation installed in each element of the *building thermal envelope*. For blown or sprayed insulation (fiberglass and cellulose), the initial installed thickness, settled thickness, settled *R*-value, installed density, coverage area and number of bags installed shall be *listed* on the certification. For sprayed polyurethane foam (SPF) insulation, the installed thickness of the areas covered and *R*-value of installed thickness shall be *listed* on the certification. For insulated siding, the *R*-value shall be labeled on the product's package and shall be *listed* on the certification. The insulation installer shall sign, date and post the certification in a conspicuous location on the job site.

R303.1.1.1 Blown or sprayed roof/ceiling insulation. The thickness of blown-in or sprayed roof/ceiling insulation (fiberglass or cellulose) shall be written in inches (mm) on markers that are installed at least one for every 300 square feet (28 m^2) throughout the attic space. The markers shall be affixed to the trusses or joists and marked with the minimum initial installed thickness with numbers not less than 1 inch (25 mm) in height. Each marker shall face the attic access opening. Spray polyurethane foam thickness and installed *R*-value shall be *listed* on certification provided by the insulation installer.

R303.1.2 Insulation mark installation. Insulating materials shall be installed such that the manufacturer's *R*-value mark is readily observable upon inspection.

R303.1.3 Fenestration product rating. *U*-factors of fenestration products (windows, doors and skylights) shall be determined in accordance with NFRC 100.

Exception: Where required, garage door *U*-factors shall be determined in accordance with either NFRC 100 or ANSI/DASMA 105.

U-factors shall be determined by an accredited, independent laboratory, and *labeled* and certified by the manufacturer.

Products lacking such a *labeled* *U*-factor shall be assigned a default *U*-factor from Table R303.1.3(1) or R303.1.3(2). The solar heat gain coefficient (SHGC) and *visible transmittance* (VT) of glazed fenestration products (windows, glazed doors and skylights) shall be determined in accordance with NFRC 200 by an accredited, independent laboratory, and *labeled* and certified by the manufacturer. Products lacking such a *labeled* SHGC or VT shall be assigned a default SHGC or VT from Table R303.1.3(3).

TABLE R303.1.3(1)
DEFAULT GLAZED FENESTRATION *U*-FACTORS

FRAME TYPE	SINGLE PANE	DOUBLE PANE	SKYLIGHT	
			Single	Double
Metal	1.20	0.80	2.00	1.30
Metal with Thermal Break	1.10	0.65	1.90	1.10
Nonmetal or Metal Clad	0.95	0.55	1.75	1.05
Glazed Block	0.60			

TABLE R303.1.3(2)
DEFAULT DOOR *U*-FACTORS

DOOR TYPE	*U*-FACTOR
Uninsulated Metal	1.20
Insulated Metal	0.60
Wood	0.50
Insulated, nonmetal edge, max 45% glazing, any glazing double pane	0.35

TABLE R303.1.3(3)
DEFAULT GLAZED FENESTRATION SHGC AND VT

	SINGLE GLAZED		DOUBLE GLAZED		GLAZED BLOCK
	Clear	Tinted	Clear	Tinted	
SHGC	0.8	0.7	0.7	0.6	0.6
VT	0.6	0.3	0.6	0.3	0.6

R303.1.4 Insulation product rating. The thermal resistance (*R*-value) of insulation shall be determined in accordance with the U.S. Federal Trade Commission *R*-value rule (CFR Title 16, Part 460) in units of h · ft^2 · °F/Btu at a mean temperature of 75°F (24°C).

R303.1.4.1 Insulated siding. The thermal resistance (*R*-value) of insulated siding shall be determined in accordance with ASTM C 1363. Installation for testing shall be in accordance with the manufacturer's instructions.

R303.2 Installation. Materials, systems and equipment shall be installed in accordance with the manufacturer's instructions and the *International Building Code* or *International Residential Code*, as applicable.

R303.2.1 Protection of exposed foundation insulation. Insulation applied to the exterior of basement walls, crawlspace walls and the perimeter of slab-on-grade floors shall have a rigid, opaque and weather-resistant protective covering to prevent the degradation of the insulation's thermal performance. The protective covering shall cover the exposed exterior insulation and extend not less than 6 inches (153 mm) below grade.

R303.3 Maintenance information. Maintenance instructions shall be furnished for equipment and systems that require preventive maintenance. Required regular maintenance actions shall be clearly

stated and incorporated on a readily accessible label. The label shall include the title or publication number for the operation and maintenance manual for that particular model and type of product.

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

R401 GENERAL
R402 BUILDING THERMAL ENVELOPES
R403 SYSTEMS
R404 ELECTRICAL POWER LIGHTING SYSTEMS
R405 ADDITIONAL EFFICIENCY PACKAGE
R406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

R401 GENERAL

Strike Sections R401.2 and R401.3 of the International Energy Conservation Code in their entirety and insert new Sections R401.2 and R401.3 into the Energy Conservation Code-Residential Provisions in their place to read as follows:

R401.2 Compliance. Projects shall comply with one of the following:

1. Sections R401 through R405.

2. Section R406.

R401.3 Certificate (Mandatory). For new construction and Level 3-*alteration* projects, an *approved* permanent certificate shall be completed by the builder or registered design professional and posted on a wall in the space where the furnace is located, a utility room or an *approved* location inside the building. Where located on an electrical panel, the certificate shall not cover or obstruct the visibility of the circuit directory label, service disconnect label or other required labels. The certificate shall list the predominant *R*-values of insulation installed in or on ceiling/roof, walls, foundation (slab, basement wall, crawlspace wall and floor) and ducts outside conditioned spaces; *U*-factors for fenestration and the solar heat gain coefficient (SHGC) of fenestration, and the results from any required duct system and building envelope air leakage testing done on the building. Where there is more than one value for each component, the certificate shall list the value covering the largest area. The certificate shall list the types and efficiencies of heating, cooling and service water heating equipment. Where a gas-fired unvented room heater, electric furnace or baseboard electric heater is installed in the residence, the certificate shall list "gas-fired unvented room heater," "electric furnace" or "baseboard electric heater," as appropriate. An efficiency shall not be *listed* for gas-fired unvented room heaters, electric furnaces or electric baseboard heaters.

R402 BUILDING THERMAL ENVELOPE

Strike Section R402.1.1 of the International Energy Conservation Code in its entirety without substitution.

Strike Section R402.1.2 of the International Energy Conservation Code in its entirety and insert new section R402.1.2 in the Energy Conservation Code in its place to read as follows.

R402.1.2 Insulation and fenestration criteria. The *building thermal envelope* shall meet the requirements of Table R402.1.2.

Strike Table R402.1.2 of the International Energy Conservation Code in its entirety and insert new Table R402.1.2 in the Energy Conservation Code -Residential Provisions in its place to read as follows.

TABLE R402.1.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

FENESTRATION U-FACTOR[b]	0.30 U-Factor
SKYLIGHT[b] U-FACTOR	0.55 U-Factor
GLAZED FENESTRATION SHGC[b]	0.40 Solar Heat Gain Coefficient (SHGC)
CEILING	R-49
WOOD FRAME WALL AND RIM JOISTS	R-19 in cavity + R-5 continuous on the exterior, **or** R-13 in cavity + R-10 continuous on the exterior, **or** R-15 continuous
MASS WALL[i]	R-15 continuous on the exterior, or R-20 continuous on the interior
FRAME FLOOR	R-25 + R-5 continuous
ELEVATED SLAB	R-15 continuous
BASEMENT WALL	R-19 cavity + R-5 continuous on the exterior, **or** R-13 in cavity + R-10 continuous on the exterior, **or** R-15 continuous
SLAB ON GRADE[d]	R-10 perimeter insulation for a depth of 2 ft.
CRAWLSPACE WALL	R-19 cavity + R-5 continuous on the exterior, **or** R-13 in cavity + R-10 continuous on the exterior, **or** R-15 continuous

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. The second *R*-value applies when more than half the insulation is on the interior of the mass wall.

Strike Table R402.1.4 of the International Energy Conservation Code in its entirety and insert new Table R402.1.4 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

TABLE R402.1.4
EQUIVALENT U-FACTORS[a]

FENESTRATION U-FACTOR	0.30 U-Factor

SKYLIGHT U-FACTOR	0.55 U-Factor
CEILING U-FACTOR	0.026 U-Factor
WOOD FRAME WALL U-FACTOR	0.045 U-Factor
MASS WALL U-FACTOR	0.060 U-Factor
FRAME FLOOR U-FACTOR	0.033 U-Factor
MASS FLOOR U-FACTOR	0.058 U-Factor
BASEMENT WALL U-FACTOR	0.045 U-Factor
CONDITIONED CRAWLSPACE WALL U-FACTOR	0.045 U-Factor

a. Nonfenestration *U*-factors shall be obtained from measurement, calculation or an approved source.

Strike Section R402.2.1 of the International Energy Conservation Code in its entirety and insert new section R402.2.1 in the Energy Conservation Code in its place to read as follows.

R402.2.1 Ceilings with attic spaces. Where Section R402.1.2 would require R-49 insulation in the ceiling but the depth of the roof rafters does not allow R49, the ceiling insulation value may be reduced to R-38. This reduction shall not apply to the *U*-factor alternative approach in Section R402.1.4 and the total UA alternative in Section R402.1.5.

Strike Section R402.2.2 of the International Energy Conservation Code in its entirety without substitution.

Strike Section R402.2.3 of the International Energy Conservation Code in its entirety and insert new section R402.2.3 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.2.3 Eave baffle. For air-permeable insulation in vented attics utilizing eave vents, a baffle shall be installed adjacent to soffit and eave vents. Baffles shall maintain an opening equal or greater than the size of the vent. The baffle shall extend over the top of the attic insulation. The baffle may be any solid material.

Strike Section R402.2.4 of the International Energy Conservation Code in its entirety and insert new Section R402.2.4 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.2.4 Access hatches and doors. Access doors from conditioned spaces to unconditioned spaces such as attics and crawl spaces shall be weatherstripped and insulated to a level equivalent to the insulation on the surrounding surfaces. Access shall be provided to all equipment that prevents damaging or compressing the insulation. A wood-framed or equivalent baffle or retainer is required to be provided when loose-fill insulation is installed, the purpose of which is to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed *R*-value of the loose-fill insulation.

Exception: Vertical doors that provide access from conditioned to unconditioned spaces shall be permitted to meet the fenestration requirements of Table R402.1.2.

Strike Section R402.2.9 of the International Energy Conservation Code in its entirety without substitution.

Strike Section R402.2.10 of the International Energy Conservation Code in its entirety and insert new Section R402.2.10 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.2.10 Slab-on-grade floors. Slab-on-grade floors with a floor surface less than 30 inches (762 mm) below grade shall be insulated in accordance with Table R402.1.2. The insulation shall extend downward from the top of the slab on the outside or inside of the foundation wall. Insulation located below grade shall be extended the distance provided in Table R402.1.2 by any combination of vertical insulation, insulation extending under the slab or insulation extending out from the building. Insulation extending away from the building shall be protected by pavement or by not less than 10 inches (254 mm) of soil. The top edge of the insulation installed between the *exterior wall* and the edge of the interior slab shall be permitted to be cut at a 45-degree (0.79 rad) angle away from the *exterior wall.* Slab-edge insulation is not required in jurisdictions designated by the *code official* as having a very heavy termite infestation.

Strike Section R402.2.11 of the International Energy Conservation Code in its entirety and insert new Section R402.2.11 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.2.11 Crawl space walls. As an alternative to insulating floors over crawl spaces, crawl space walls may be insulated when the crawl space is not vented to the outside. Crawl space wall insulation shall be permanently fastened to the wall and extend downward from the underside of the floor, including the band joist area, to the finished grade level and then vertically and/or horizontally for at least an additional 24 inches (610 mm). Exposed earth in unvented crawl space foundations shall be covered with a continuous Class I vapor retarder in accordance with the *International Building Code* or *International Residential Code*, as applicable. All joints of the vapor retarder shall overlap by 6 inches (153 mm) and be sealed or taped. The edges of the vapor retarder shall extend not less than 6 inches (153 mm) up the stem wall and shall be attached to the stem wall.

Strike Section R402.2.13 of the International Energy Conservation Code in its entirety and insert new Section R402.2.13 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.2.13 Sunroom insulation. *Sunrooms* enclosing conditioned space shall meet the insulation requirements of this code.

Strike Section R402.3.5 of the International Energy Conservation Code in its entirety and insert new Section R402.3.5 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.3.5 Sunroom fenestration. *Sunrooms* enclosing *conditioned space* shall meet the fenestration requirements of this code.

Strike Table R402.4.1.1 of the International Energy Conservation Code in its entirety and insert new Table R402.4.1.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

TABLE R402.4.1.1
AIR BARRIER AND INSULATION INSTALLATION

COMPONENT	AIR BARRIER CRITERIA	INSULATION INSTALLATION CRITERIA
General requirements	A continuous six-sided air barrier shall be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier shall be sealed.	Air-permeable insulation shall not be used as a sealing material. All ceiling, wall, floor and slab insulation shall achieve Grade I installation per the RESNET Standards or, alternatively, Grade II for surfaces that contain a layer of continuous, air impermeable insulation > R5.
Ceiling/attic	The air barrier in any dropped ceiling/soffit shall be aligned with the insulation and any gaps in the air barrier shall be sealed. Access openings, drop down stairs or knee wall doors to unconditioned attic spaces shall be sealed.	The insulation in any dropped ceiling/soffit shall be aligned with the air barrier.
Walls	The junction of the foundation and sill plate shall be sealed. The junction of the top plate and the top of exterior walls shall be sealed. Knee walls shall be sealed.	Cavities within corners and headers of frame walls shall be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls shall be installed in substantial contact and continuous alignment with the air barrier.
Windows, skylights and doors	The space between window/door jambs and framing, and skylights and framing shall be sealed. Doors adjacent to unconditioned space or ambient conditions shall be made substantially air-tight with weather stripping or equivalent gasket.	Continuous exterior insulation shall continue over window and door headers. Skylight and window chases through unconditioned attic space must be insulated to exterior wall values per table 402.1.2.
Rim joists	Rim joists shall include continuous air barrier.	Rim joists shall be insulated per Table 402.1.2.
Floors (including above garage and cantilevered floors)	The air barrier shall be installed at any exposed edge of insulation.	Floor framing cavity insulation shall be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation shall be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of floor framing and extends from the bottom to the top of all perimeter floor framing members.
Crawl space walls	Exposed earth in unvented crawl spaces shall be covered with a Class I vapor retarder with overlapping joints taped.	Where provided instead of floor insulation, insulation shall be permanently attached to the crawlspace walls.
Shafts, penetrations	Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space shall be sealed.	Duct shafts or chases next to exterior or unconditioned space shall be insulated.
Narrow cavities		Batts in narrow cavities shall be cut to fit, or narrow cavities shall be filled by insulation that on installation readily conforms to the available cavity space.
Garage separation	Air sealing shall be provided between the garage and conditioned spaces.	Walls next to unconditioned garage space shall be insulated.

Recessed lighting	Recessed light fixtures installed in the building thermal envelope shall be sealed to the drywall.	Recessed light fixtures installed in the building thermal envelope shall be air tight and IC rated.
Plumbing and wiring	Seal any plumbing or wiring that penetrates the building envelope.	Batt insulation shall be cut neatly to fit around wiring and plumbing in exterior walls, or insulation that on installation readily conforms to available space shall extend behind piping and wiring.
Shower/tub on exterior wall	The air barrier installed at exterior walls adjacent to showers and tubs shall separate them from the showers and tubs.	Exterior walls adjacent to showers and tubs shall be insulated.
Electrical/phone box on exterior walls	The air barrier shall be installed behind electrical or communication boxes or air-sealed boxes shall be installed.	
Common wall separating dwelling units	Air barrier is installed in common wall between dwelling units.	
HVAC register boots	HVAC register boots that penetrate building thermal envelope shall be sealed to the subfloor or drywall.	
Concealed sprinklers	When required to be sealed, concealed fire sprinklers shall only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants shall not be used to fill voids between fire sprinkler cover plates and walls or ceilings.	
Fireplace	An air barrier shall be installed on fireplace walls.	

a. In addition, inspection of log walls shall be in accordance with the provisions of ICC-400.

Strike Section R402.4.1.2 of the International Energy Conservation Code in its entirety and insert new Section R402.4.1.2 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.4.1.2 Air Leakage Testing. Each *dwelling unit* shall comply with Table R401.4.1.2. Testing shall be conducted in accordance with ASTM E 779 or ASTM E 1827 and reported at a pressure of 0.2 inch w.g. (50 Pascals). Testing shall be conducted by an *approved* third party. A written report of the results of the test shall be signed by the *approved* third party conducting the test and provided to the *code official* before issuance of the certificate of occupancy or final inspection. Testing shall be performed at any time after creation of all penetrations of the *building thermal envelope*. *Approved* sampling protocols approved by the code official may be used.

Insert new Table R402.4.1.2 in the Energy Conservation Code-Residential Provisions to read as follows.

TABLE R402.4.1.2
AIR LEAKAGE TESTING REQUIREMENTS

	New construction	Level 3 Alteration affecting 80% or more of the aggregate work of the building (Gut Rehabilitation)
Single family detached, two family	3 ACH50	3 ACH50

attached (duplex), townhouses, flats		
Dwelling units in Multifamily buildings 3 stories and less	.30 CFM50/SF enclosure area of each unit or 3 ACH50	.30 CFM50/SF enclosure area of each unit or 3 ACH50

Strike Section R402.4.4 of the International Energy Conservation Code in its entirety and insert new Section R402.4.4 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.4.4 Fuel Burning Appliances and Equipment. For new construction, all new fuel burning appliances and equipment located inside the building envelope must be sealed combustion.

Existing buildings undertaking a Level 3 *alteration* at 80% of aggregate area must comply with one of the following:

1. New equipment and appliances shall be sealed combustion; or

2. Locate open combustion appliances and equipment outside the building thermal envelope or enclosed in a room, isolated from the thermal envelope. Such rooms shall be sealed and insulated in accordance with the envelope requirements of Table R402.1.2, where the walls, floors and ceilings shall meet not less than the basement wall *R*-value requirement. The door into the room shall be fully gasketed and any water lines and ducts in the room insulated in accordance with Section R403. The combustion air duct shall be insulated where it passes through conditioned space to a minimum of R-8.

In an existing building Level 3 *alteration* at 80% of aggregate area that contains open combustion equipment or appliances, a "worst-case testing of atmospheric venting systems" shall be conducted by an *approved* party in accordance with Appendix RA. Testing reports shall be provided to the *code official*. If the building fails the test in accordance with Appendix RA, the existing equipment must comply with either option 1 or 2.

Exceptions:

1. Power-vented equipment and appliances.

2. Fireplaces and stoves complying with Section R402.4.2 and Section R1006 of the *Residential Code*.

Strike Section R402.5 of the International Energy Conservation Code in its entirety and insert new Section R402.5 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R402.5 Maximum fenestration U-factor and SHGC (Mandatory). The area-weighted average maximum fenestration *U*-factor permitted using tradeoffs from Section R402.1.5 or R406 shall be 0.40 for vertical fenestration, and 0.75 for skylights.

Insert new Sections R402.6 and R402.6.1in the Energy Conservation Code-Residential Provisions to read as follows.

R402.6 Cool Roof Requirements. Roof coverings for roof slopes less than or equal to two units vertical in 12 units horizontal (17 percent slope or less) for buildings and covered parking shall conform to this section. A minimum of 75 percent of the entire roof surface not used for roof penetrations, renewable energy power systems (e.g., photovoltaics or solar thermal collectors), harvesting systems for rainwater to be used on-site, or green roofing systems shall be covered with products that comply with one or both of the following:

1. Have a minimum three-year-aged Solar Reflective Index (SRI) of 64.

2. Comply with the criteria for roof products as defined in "ENERGY STAR® Program Requirements, Product Specification for Roof Products, Eligibility Criteria."

Exceptions:

1. Building projects where an annual energy analysis simulation demonstrates that the total annual building energy consumption with the proposed roof is 2 percent less than it would be with a roof having a three-year-aged SRI of 64.

2. Roofs used to shade or cover parking and roofs over semi-heated spaces or used as outdoor recreation space by the occupants of the building shall be permitted to be either landscaped or have a minimum initial SRI of 29. A default SRI value of 35 for new concrete without added color pigment is allowed to be used in lieu of measurements.

3. Terraces on setbacks comprising less than 25 percent of the area of the largest floor plate in the building.

4. Green roofs shall be permitted to comprise part or all of the 75 percent required area coverage.

R402.6.1 Solar Reflective Index. Initial and aged values of the SRI shall be calculated in accordance with ASTM E1980 for medium-speed wind conditions, using a convection coefficient of [2.1 BTU/(h · ft^2 · °F)] or the metric equivalent [12 W/(m^2 · K)]. The SRI shall be based upon solar reflectance as measured in accordance with ASTM E1918 or ASTM C1549, and the thermal emittance as measured in accordance with ASTM E408 or ASTM C1371. For roofing products, the values for solar reflectance and thermal emittance shall be determined by a laboratory accredited by a nationally recognized accreditation organization, such as the Cool Roof Rating Council CRRC-1 Product Rating Program, and shall be labeled and certified by the manufacturer.

R403 SYSTEMS

Strike Section R403.3.1 of the International Energy Conservation Code in its entirety and insert new Section R403.3.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.3.1 Insulation (Mandatory). Supply and return ducts outside of the *building thermal envelope* shall be insulated to a minimum of R-8.

Exception: Where ducts are less than 3 inches (76mm) in diameter, a minimum of R6 is allowed.

Strike Section R403.3.2.1 of the International Energy Conservation Code in its entirety and insert new Section R403.3.2.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.3.2.1 Sealed air handler. Air handlers shall have a manufacturer's designation for an air leakage of no more than 2 percent of the design air flow rate when tested in accordance with ASHRAE 193.

Exception: ENERGY STAR-certified heating and cooling systems are deemed to be compliant.

Strike Section R403.3.3 of the International Energy Conservation Code in its entirety and insert new Section R403.3.3 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.3.3 Duct testing (Mandatory). Testing shall be conducted by an *approved* third party. A written report of the result of the test shall be signed by the party conducting the test and provided to the code official before issuance of the certificate of occupancy or final inspection. Ducts shall be pressure tested to determine air leakage by one of the following methods:

1. Rough-in test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the system, including the manufacturer's air handler enclosure if installed at the time of the test. All registers shall be taped or otherwise sealed during the test.

2. Postconstruction test: Total leakage shall be measured with a pressure differential of 0.1 inch w.g. (25 Pa) across the entire system, including the manufacturer's air handler enclosure. Registers shall be taped or otherwise sealed during the test.

Exception:

1. Where the ducts and air handlers are located entirely within the building thermal envelope.

2. Where ducts from an existing heating and cooling system are extended to an addition, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces.

Strike Section R403.5.3 of the International Energy Conservation Code in its entirety and insert new Section R403.5.3 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.5.3 Hot water pipe insulation (Mandatory). Insulate hot water pipe with a minimum thermal resistance (*R*-value) of R-3

Strike Section R403.5.4 of the International Energy Conservation Code in its entirety without substitution.

Strike Section R403.6 of the International Energy Conservation Code in its entirety and insert new Section R403.6 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.6 Mechanical ventilation (Mandatory). The building shall be provided with ventilation that meets the requirements of the *Residential Code* or *the Mechanical Code*, as applicable.

Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

Strike Section R403.6.1 of the International Energy Conservation Code in its entirety and insert new Section R403.6.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.6.1 Mechanical ventilation system fan efficacy. Mechanical ventilation system fans shall meet the efficacy requirements of Table R403.6.1 or be certified to the most current version of ENERGY STAR.

Exception: Where mechanical ventilation fans are integral to tested and listed HVAC equipment, they shall be powered by an electronically commutated motor.

Strike Table R403.6.1 of the International Energy Conservation Code in its entirety and insert new Table R403.6.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

TABLE R403.6.1
MECHANICAL VENTILATION SYSTEM FAN EFFICACY

FAN LOCATION	AIR FLOW RATE MINIMUM (CFM)	MINIMUM EFFICACY (CFM/WATT)	AIR FLOW RATE MAXIMUM (CFM)
Range hoods	Any	2.8 cfm/watt	Any
In-line fan	Any	2.8 cfm/watt	Any
Bathroom or, utility room	10	1.4 cfm/watt	< 90
Bathroom or, utility room	90	2.8 cfm/watt	Any

For SI: 1 cfm = 28.3 L/min.

Strike Section R403.7 of the International Energy Conservation Code in its entirety and insert new Section R403.7 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.7 Equipment sizing and efficiency rating (Mandatory). Heating and cooling equipment shall be sized in accordance with ACCA Manual S based on building loads calculated in accordance with ACCA Manual J or other *approved* heating and cooling calculation methodologies. New or replacement heating and cooling equipment shall have an efficiency rating equal to or greater than the minimum required by federal law for the geographic location where the equipment is installed. If available equipment cannot satisfy the latent and sensible loads calculated while complying with ACCA Manual S, the next larger size may be selected.

Exceptions:

1. Where the new cooling equipment utilizes multistage technology or variable refrigerant flow technology.

2. Where the new heating and/or cooling equipment is 1.5 tons or less.

3. Where ductwork is being extended from an existing equipment into an addition.

4. Where there is a replacement in kind of an existing system, as long as the BTU's of the new system are equivalent or smaller to the new equipment and the building thermal envelope is not being altered.

Strike Section R403.8 of the International Energy Conservation Code in its entirety and insert new Section R403.8 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.8 Systems serving multiple dwelling units (Mandatory). Systems serving multiple dwelling units shall comply with Sections Section 6 and Section 7 of the DC Commercial Energy Code in lieu of Section R403.

Exception: Accessory Dwelling Unit (ADU) and *flats* are exempt.

Strike Section R403.10.3 of the International Energy Conservation Code in its entirety and insert new Section R403.10.3 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R403.10.3 Covers. Outdoor heated pools and outdoor permanent spas shall be provided with permanent, operable ~~a~~-vapor-retardant cover or other *approved* vapor-retardant means.

Exception: Where more than 70 percent of the energy for heating, computed over an operation season, is from site-recovered energy, such as from a heat pump or solar energy source, covers or other vapor-retardant means shall not be required.

Strike Section R404 of the International Energy Conservation Code in its entirety and insert new Section R404 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R404 ELECTRICAL POWER LIGHTING SYSTEMS

Strike Sections R404.1 and R404.1.1.1 of the International Energy Conservation Code in their entirety and insert new Sections R404.1 and R404.1.1 in the Energy Conservation Code-Residential Provisions in their place to read as follows.

R404.1 Lighting equipment (Mandatory). Not less than 85 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps or not less than 85 percent of the permanently installed lighting fixtures shall contain only *high-efficacy lamps*. *High efficacy lamps* are either LED, compact fluorescent lamps (CFL's), T-8 or smaller diameter linear fluorescent lamps, or lamps with a minimum efficacy of:

1. 60 lumens per watt for lamps over 40 watts;

2. 50 lumens per watt for lamps over 15 watts to 40 watts; and

3. 40 lumens per watt for lamps 15 watts or less.

R404.1.1 Lighting equipment (Mandatory). Fuel gas lighting systems shall not have continuously burning pilot lights.

Strike Section R405 of the International Energy Conservation Code in its entirety and insert new Section R405 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R405 ADDITIONAL EFFICIENCY PACKAGE

R405.1 Requirements. New buildings shall comply with at least one of the following:

1. Enhanced HVAC performance in accordance with Section R405.2.

2. Enhanced Building Envelope in accordance with Section R405.3.

3. Enhanced Air Leakage and Heat Recovery Ventilation in accordance with Section R405.4.

4. Enhanced Water Heating System in accordance with Section R405.5.

Exception: *Alterations* are exempt from Section R405.

R405.2 Efficient Heating and Cooling Systems. All heating and cooling equipment shall meet the minimum efficiency requirements of Table R405.2.

TABLE R405.2

Equipment Type	Efficiency
Split and Packaged Air Conditioners	≥ 15 SEER [a]
Split and Packaged Air Source Heat Pumps	≥ 15 SEER [a], ≥ 9.0 HSPF[b]
Gas-fired Furnace	≥ 90% AFUE[c] and Furnace Fan Efficiency ≤ 2.0%
Gas-fired Boiler	≥ 90% AFUE[c]
Ground Source Heat Pump	≥ 17.1 EER[d] and ≥ 3.6 COP[e]

a. SEER - Seasonal Energy Efficiency Ratio
b. HSPF – Heating Seasonal Performance Factor
c. AFUE – Annual Fuel Utilization Efficiency
d. EER – Energy Efficiency Ratio
e. COP – Coefficient of Performance

R405.3 Enhanced Building Thermal Envelope. *Building Thermal Envelope* shall comply with Table R405.3 in addition to Table R402.1.2.

TABLE R405.3
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT

FENESTRATION	Windows = 0.24 U-Factor ENERGY STAR Compliant Doors
SKYLIGHT U-FACTOR	0.45 U-Factor
GLAZED FENESTRATION SHGC	0.40 Solar Heat Gain Coefficient (SHGC)
CEILING	R60
MASS WALL	U-factor less than or equal to .035 or R-19 cavity + R-10 continuous, or R-13 in cavity + R-15 continuous, or R-25 continuous
WOOD FRAME	U-factor less than or equal to .035 or R-19 cavity + R-10 continuous, or R-13 in cavity + R-15 continuous, or R-25 continuous
METAL FRAME WALL	U-factor less than or equal to .035
CONTINUOUS SLAB INSULATION	R10 continuous

R405.4 Enhanced Air Leakage and Heat Recovery Ventilation. Buildings shall meet the minimum air leakage requirements of Table R405.4 and install a heat or energy recovery ventilation system.

TABLE R405.4
AIR LEAKAGE TESTING REQUIREMENTS

	New construction
Single family detached, two family attached (duplex), townhouses, flats	2 ACH50
Dwelling units in Multifamily buildings 3 stories and less	.25 CFM50/SF enclosure area of each unit or 2 ACH50

R405.5 Efficient Appliances and Water Heating. All refrigerators, freezers, dishwashers, clothes washers, and ceiling fans must be ENERGY STAR Qualified, and water heater(s) shall meet the minimum efficiency requirements of Table R405.5.

TABLE R405.5

Equipment Type	Efficiency
Gas Storage Water Heaters	≥ 0.90 Energy Factor (EF)
Tankless Water Heaters	≥ 0.95 Energy Factor (EF) with electronic ignition
Electric Water Heaters	≥ 2.2 Energy Factor (EF)

R406 ENERGY RATING INDEX COMPLIANCE ALTERNATIVE

Strike Section R406.2 (including Table R406.2) of the International Energy Conservation Code in their entirety and insert new Section R406.2 and Table R406.2 in the Energy Conservation Code-Residential Provisions in their place to read as follows.

R406.2 Mandatory requirements. Compliance with this section requires that the provisions identified in Sections R401 through R404 labeled as "mandatory" be met. The building thermal envelope shall be greater than or equal to Table R406.2.

TABLE R406.2
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

FENESTRATION U-FACTOR[b]	0.35 U-Factor
SKYLIGHT[b] U-FACTOR	0.60 U-Factor
GLAZED FENESTRATION SHGC[b]	No Requirement
CEILING	R-38
WOOD FRAME WALL	R-13
MASS WALL	R-5 exterior continuous or R-10 interior continuous
FRAME FLOOR	R-19
MASS FLOOR	R-15
BASEMENT WALL	R-10 continuous or R-13 in cavity
SLAB c R-VALUE & DEPTH	R-10 for the first 2 feet
CONDITIONED CRAWLSPACE WALL	R-10 continuous or R-13 in cavity

For SI: 1 foot = 304.8 mm.

a. R-values are minimums. *U*-factors and SHGC are maximums. When insulation is installed in a cavity which is less than the label or design thickness of the insulation, the installed *R*-value of the insulation shall not be less than the *R*-value specified in the table.
b. The fenestration *U*-factor column excludes skylights. The SHGC column applies to all glazed fenestration.
c. R-5 shall be added to the required slab edge R-values for heated slabs.

Strike Section R406.4 (including Table R406.4) of the International Energy Conservation Code in their entirety and insert new Section R406.4 and Table 406.4 in the Energy Conservation Code-Residential Provisions in their place to read as follows.

R406.4 ERI-based compliance. Compliance based on an ERI analysis requires that the *rated design* be shown to have an ERI less than or equal to 58 when compared to the *ERI reference design*.

R406.4.1 Renewable energy.

The use of renewable energy is not allowed to meet the minimum requirement of 58 as listed in R406.4.

CHAPTER 5 (RE) EXISTING BUILDINGS

R501 GENERAL

Strike Section R501.2 of the International Energy Conservation Code in its entirety and insert new Section R501.2 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R501.2 Existing buildings. The *Energy Conservation Code* shall not be used to require the removal, *alteration* or abandonment of, nor prevent the continued use and maintenance of, an *existing building* or *building* system lawfully in existence at the time of adoption of *the Energy Conservation Code*.

Strike Section R501.4 of the International Energy Conservation Code in its entirety without substitution.

Strike Section R501.6 of the International Energy Conservation Code in its entirety and insert new Section R501.6 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R501.6 Historic buildings. Any *building* or other *structure* that is listed (either as an individual listing or as a contributing resource to a listed historic district) in the D.C. or National Register of Historic Places shall be exempt from provisions of the *Energy Conservation Code*, provided that the D.C. Historic Preservation Officer or the Keeper of the National Register of Historic Places certifies that compliance with the that provision of the *Energy Conservation Code* will cause the loss of irretrievable historic components that may lead to the de-listing of the *building* or other *structure*.

R502 ADDITIONS

Strike Section R502.1.2 of the International Energy Conservation Code in its entirety and insert new Section R502.1.2 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R502.1.2 Existing plus addition compliance (Energy Rating Index Compliance Alternative). The addition shall be deemed to comply where the annual site energy use of the addition and the existing building, and any alterations that are part of the project, is less than or equal to the annual site energy use of the existing building when modeled in accordance with Section R406. The addition and any alterations that are part of the project shall comply with Section R406 in its entirety.

R503 ALTERATIONS

Strike Section R503.1.1 of the International Energy Conservation Code and insert new Section R503.1.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R503.1.1 Building envelope. Building envelope assemblies that are part of the alteration shall comply with Section R402.1.2 or R402.1.4, Sections R402.2.1 through R402.2.12, R402.3.1, R402.3.2, R402.4.1.1, R402.4.3 and R402.4.4.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

1. Storm windows installed over existing fenestration.

[Retain current exceptions 2 through 6 as they are in IECC 2015]

[Retain current Section R503.1.1.1]

Insert new Section R503.1.1.2 in the Energy Conservation Code-Residential Provisions to read as follows.

R503.1.1.2 Additional Insulation Requirements for *Level 3 Alterations* affecting 80 percent or more of the aggregate area of the building. Existing exterior wall, ceiling, and floor assemblies that are not part of the scope of work of the *alteration* but are in an existing building undertaking ~~an~~ Level 3 *alteration* affecting 80 percent or more of the aggregate area of the building are required to comply with the following minimum insulation requirements:

1. Existing exterior walls shall be insulated to a minimum of R-7.5 continuous insulation or R-13 cavity insulation. Air permeable cavity insulation shall also be sufficient to fill the cavity.

2. Existing ceilings must be insulated to R-49 or have the cavity filled with insulation to the maximum extent possible.

3. Existing floors must be insulated to R-25 or have the cavity filled with insulation to the maximum extent possible.

Exception: Existing exterior walls where space constraints would make it impractical to meet this section without substantial reconfiguration of interior spaces or features.

Insert new Section R503.1.1.3 in the Energy Conservation Code-Residential Provisions to read as follows.

R503.1.1.3 Air Leakage Testing. *Level 3 alterations* affecting 80 percent or more of the aggregate area of the building must comply with air leakage requirements and procedures per Section R402.4.1.2.

Strike Sections R503.1.2 through R503.1.4 of the International Energy Conservation Code in their entirety and insert new Sections R503.1.2 through R503.1.4 in the Energy Conservation Code-Residential Provisions in their place to read as follows.

R503.1.2 Heating and cooling systems. New heating, cooling and duct systems that are part of the alteration shall comply with Sections R403.1, R403.2, R403.3 R403.4, R403.6, and R403.7.

Exception: Where ducts from an existing heating and cooling system are extended, duct systems with less than 40 linear feet (12.19 m) in unconditioned spaces shall not be required to be tested in accordance with Section R403.3.3.

R503.1.3 Service hot water systems. New service hot water systems that are part of the alteration shall comply with Section R403.5.

R503.1.4 Lighting. New lighting fixtures that are part of the alteration shall comply with Section R404.

Strike Section R503.2 of the International Energy Conservation Code in its entirety and insert new Section R503.2 in the Energy Conservation Code-Residential Provisions in its place to read as follows.

R503.2 Change in space conditioning. Any nonconditioned or low-energy space, as defined in R402.1 that is altered to become *conditioned space* shall be required to be brought into full compliance with this code.

CHAPTER 6 [RE] REFERENCED STANDARDS

ASTM
ASTM International
100 Barr Harbor
West Conshohocken, PA 19428-2959

Insert the following new standard references in Chapter 6 [RE] of the Energy Conservation Code-Residential Provisions under subheading ASTM to read as follows:

Standard reference number	Title	Referenced in code section number
E408-71 (2008)	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques	R402.6
C1549-09	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer	R402.6
C1371-04a	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers	R402.6
E1980-11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces	R402.6
E1918-06	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field	R402.6

EPA
Environmental Protection Agency
Ariel Rios Building
1200 Pennsylvania Avenue, NW
Washington, D.C. 20460

Insert the following new referenced standards in Chapter 6 [RE] of the Energy Conservation Code-Residential Provisions under subheading EPA to read as follows:

Standard reference number	Title	Referenced in code section number
ENERGY STAR	Energy Star Program Requirements, Product Specification for Roof Products, Eligibility Criteria, version 2.2 (October 2010)	R402.6

Appendix RA to the International Energy Conservation Code is adopted in the District of Columbia as ***APPENDIX RA, RECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS****, to the Energy Conservation Code-Residential Provisions.*

Appendix RB to the International Energy Conservation Code is adopted in the District of Columbia, as amended by the Energy Conservation Code Supplement, as ***APPENDIX RB, SOLAR-READY PROVISIONS****, to the Energy Conservation Code-Residential Provisions.*

APPENDIX RB SOLAR-READY PROVISIONS
SECTION RB101 SCOPE
SECTION RB102 DEFINITIONS
SECTION RB103 SOLAR-READY ZONE

SECTION RB101 SCOPE

RB101.1 General. These provisions shall be applicable for new construction and Level 3 *alteration* affecting 80% or more of the aggregate area of the building.

SECTION RB102 DEFINITIONS

RB102.1 General. For purposes of this Appendix, the following terms are defined as follows:

SOLAR-READY ZONE. A section or sections of the roof or building overhang designated and reserved for the future installation of a solar photovoltaic or solar thermal system.

SECTION RB103 SOLAR-READY ZONE

RB103.1 General.
A *residential building* with a roof area of 600 square feet (55.74 m2) or more oriented between 110 degrees and 270 degrees of true north shall comply with Sections RB103.2 through RB103.8.

Exceptions:

1. *Residential buildings* with a permanently installed on-site renewable energy system with a minimum size of 2 kilowatts (KW) per *dwelling unit*.
2. A building with a *solar-ready zone* that is shaded for more than 70 percent of daylight hours annually.

RB103.2 Construction document requirements for solar-ready zone. *Construction documents* shall indicate the solar-ready zone.

RB103.3 Solar-ready zone. The total *solar-ready zone* ~~area~~ shall be not less than 300 square feet (27.87 m2) exclusive of mandatory access or set back areas as required by the *Fire Code*. <u>*Residential buildings*</u> with a total floor area less than or equal to 2,000 square feet (185.8 m^2) per dwelling shall have a *solar-ready zone* ~~area~~ of not less than 150 square feet (13.94 m^2). The *solar-ready zone* shall be composed of areas not less than 5 feet (1524 mm) in width and not less than 80 square feet (7.44 m^2) exclusive of access or set back areas as required by the ~~International~~ *Fire Code*.

RB103.4 Obstructions. *Solar-ready zones* shall be free from obstructions, including but not limited to vents, chimneys, and roof-mounted equipment.

RB103.5 Roof load documentation. The structural design loads for roof dead load and roof live load

shall be clearly indicated on the *construction documents*.

RB103.6 Interconnection pathway. *Construction documents* shall indicate pathways for routing of conduit or plumbing from the solar-ready zone to the electrical service panel or service hot water system.

RB103.7 Electrical service reserved space. The main electrical service panel shall have a reserved space to allow installation of a dual pole circuit breaker for future solar electric installation and shall be labeled "For Future Solar Electric." The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.

RB103.8 Construction documentation certificate. A permanent certificate, indicating the *solar-ready zone* and other requirements of this section, shall be posted near the electrical distribution panel, water heater or other conspicuous location by the builder or *registered design professional*.

RB103.9 Shading. The *solar-ready zone* shall be set back from any existing or new, permanently affixed object on the building or site that is located south, east or west of the *solar-ready zone* a distance not less than two times the object's height above the nearest point on the roof surface. Such objects include, but are not limited to, taller portions of the building itself, parapets, chimneys, antennas, signage, rooftop equipment, trees and roof plantings.

All persons desiring to comment on these proposed regulations should submit comments in writing to Jill Stern, Chairperson, Construction Codes Coordinating Board, Department of Consumer and Regulatory Affairs, 1100 Fourth Street, S.W., Room 5100, Washington, D.C. 20024, or via e-mail at jill.stern@dc.gov, not later than thirty (30) days after publication of this notice in the *D.C. Register*. Persons with questions concerning this Notice of Proposed Rulemaking should call (202) 442-8944. Electronic copies of the proposed rules can be obtained from the email address listed above or via the website of the District of Columbia Office of Documents and Administrative Issuances at http://www.dcregs.dc.gov/.