**DISTRICT OF COLUMBIA**

**CONSTRUCTION CODES SUPPLEMENT OF 2017**

**12-I[CE] and 12-I[RE] DCMR - ENERGY CONSERVATION CODE**

**SUPPLEMENT OF 2017[[1]](#footnote-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 OR NEWLY CREATED IN THIS SUPPLEMENT:**

SECTION 1 PURPOSE

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

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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

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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 OR NEWLY CREATED IN THIS SUPPLEMENT:**

CHAPTER 1 [RE] SCOPE AND ADMINISTRATION

CHAPTER 2[RE] DEFINITIONS

CHAPTER 3 [RE] GENERAL REQUIREMENTS

CHAPTER 4 [RE] RESIDENTIAL ENERGY EFFICIENCY

CHAPTER 5[RE] EXISTING BUILDINGS

CHAPTER 6[RE] REFERENCED STANDARDS

APPENDIX RARECOMMENDED 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 PURPOSE

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

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

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 PURPOSE**

**1.1 INTENT**

**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**

**2.1 SCOPE**.The **s**cope of the *Energy Conservation Code-Commercial Provisions* shall be as defined in Chapter 1 of Title12-A DCMR.

**SECTION 3 DEFINITIONS, ABBREVIATIONS, AND ACRONYMS**

**3.1 GENERAL**

**3.2 DEFINITIONS**

**3.3 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 *Energy Conservation Code-Commercial Provisions* as such code is defined in Title 12-A DCMR, Section 101.10 (the “ECC[CE]”). These definitions are solely applicable to all sections of the ECC[CE], and not to any other *Construction Codes* (as defined in 12-A DCMR § 101.1)*.* 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*.)

***construction checklist:*** a form used by the contractor to verify that appropriate components are on site, ready for installation, correctly installed, and functional.

***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 without replacement.*

*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 .

1. 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.
2. The sidelighted area depth is the horizontal distance perpendicular to the vertical fenestration which is the smaller of:
3. 15 ft, or
4. 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 ft2 (100 m2).

***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 inSection 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.

***verification:*** the process by which specific documents, components, equipment, assemblies, systems, and interfaces among systems are confirmed to comply with the criteria described in the *owner’s project requirements*. (See *owner’s project requirements*.)

***water factor (WF):***

1. ***clothes washer (residential* and *commercial):*** the quantity of water in gallons (liters) used to wash each cubic foot (cubic meter) of machine capacity.
2. ***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:*

***AHJ*** *authority having jurisdiction*

***CxA*** *commissioning authority*

*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:*

**SECTION 4 ADMINISTRATION AND ENFORCEMENT**

**4.1 ADMINISTRATION AND ENFORCEMENT**

**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 OPTION**

**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.

*Strike Section 5.1.4.2 of ASHRAE 90.1 in its entirety without substitution.*

**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 Appendix G) shall 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 the Energy Conservation Code-Commercial Provisions to read as follows:*

**5.4.1.1 Accounting for Thermal Conduction Components.** Where a component of the *building envelope* assembly reduces the overall U-value of the rest of the assembly, that component shall be thermally represented and integrated into the area-weighted U-value as described by the following default methodology. This default methodology shall be used in all energy compliance pathways including: Prescriptive U-value compliance, Section 5.6 Trade-off, and Appendix G energy model. Prescriptive R-value compliance with Table 5.5 and the energy model baseline shall assume Default Cladding Attachment Coefficients = 1 from Table 5.4.1.1(1) and no Linear Anomalies as described in Table 5.4.1.1(2). Tables 5.4.1.1(1) and 5.4.1.1(2) shall be used in conjunction with Equation 5.4.1.1 and associated default calculation methodology to account for common thermal conduction situations not currently described in Appendix A. In lieu of the equation and methodology the project team may demonstrate to the *authority having jurisdiction* two dimensional heat flow modeling, three dimensional heat flow modeling, linear transmission calculations per ASHRAE D RP-1365, or hot box-testing results showing the resultant area-weighted U-value as acceptable to the *authority having jurisdiction*. If using this alternate methodology, all thermal bridges described by ASHRAE D RP-1365 shall be represented.

**Exceptions:**

* 1. Electrical wiring used for transmission of energy.
  2. Plumbing penetrations complying with prescriptive insulation requirements of Section 7.
  3. Mechanical penetrations complying with prescriptive insulation requirements of Section 6.

1. Non-metal flashing for moisture management.

Equation 5.4.1.1: U-value(Overall including Thermal Bridges) =

Where:

Ubw = “Overall U-Factor for Entire Base Wall Assembly” (such as from ASHRAE 90.1, Normative Appendix A, Table A3.3, A3.4 – Insulation in stud cavity, plus gypsum, thermal boundary layers)

Re = Nominal Exterior insulation R-value (From Project Design)

Cac = Cladding Attachment Coefficient (from Table 5.4.1.1(1))

Wac = Wall Anomaly Coefficient (from Table 5.4.1.1(2))

Default Methodologies:

Option A – Specification Approach:

1. If complying with the Prescriptive R-value requirements per Table 5.5-4 the *building project* must have:
   1. No Linear Anomalies for Vertical Assemblies as described in Table 5.4.1.1
   2. For projects using exterior insulation “Materials and/or Orientations” identified in Table 5.4.1.1(1) with Cladding Attachment Coefficients (Cac) of 1 shall be explicitly specified in the drawings and/or specifications.

Option B – Simplified Approach:

1. Find the lowest Default Linear Anomaly for Vertical Assembly applicable to the proposed design. Use this value to include in Equation 5.4.1.1
2. Determine the Default Cladding Attachment Coefficient for the proposed design
3. Use equation 5.4.1.1 to determine U-value(Overall including Thermal Bridges) for vertical walls
4. Use the calculated U-value(Overall including Thermal Bridges) for compliance with prescriptive U-value compliance per Table 5.5-4, Trade off method section 5.6 (via COMCheck), or the proposed energy model via Appendix G.
5. Calculations and assumptions shall be presented to the *authority having jurisdiction*

Option C – Detailed Approach:

1. Define a new rectangular vertical wall area associated with one Default Linear Anomaly per story, or part of a story (includes stories below grade)
2. If there is more than one Default Linear Anomaly per vertical, rectangular wall section (for example such as a wall with both a concrete balcony and a parapet), select the lowest Default Linear Anomaly Coefficient for Vertical Assembly and use that for Equation 5.4.1.1
3. Determine the Default Cladding Attachment Coefficient for the proposed design wall section.
4. Use equation 5.4.1.1 to determine U-value(Overall including Thermal Bridges)
5. Use the calculated U-value(Overall including Thermal Bridges) for compliance with prescriptive U-value compliance per Table 5.5-4, Trade off method section 5.6 (via COMCheck), or the proposed energy model via Appendix G.
6. Each unique vertical wall assembly shall be evaluated and/or included for the compliance Options C step 5
7. Calculations and assumptions shall be presented to the *authority having jurisdiction*

See following Tables:

|  |  |  |
| --- | --- | --- |
| **Table 5.4.1.1(1) - Default Cladding Attachment Coefficient** | | |
| **Attachment type through Rigid Insulation** | **Material and/or Orientation** | **Cladding Attachment Coefficient, Cac** |
| Girts | Metal Vertical girt (Detail 1\*) | 53% |
| Horizontal Metal girt (Detail 2\*) | 62% |
| Horizontal Non-Metal girt | 100% |
| Clips | Metal Clips | 75% |
| Stainless Steel Clips | 85% |
| Thermal Stop Clips | 90% |
| Fiberglass Clip | 100% |
| Brick Ties | Steel Brick Ties | 78% |
| Stainless Steel Brick Ties | 90% |
| Thermal Break Brick Ties | 100% |
| Long Screws | Galvanized Long Screws | 80% |
| Stainless Long Screws | 100% |

\*Detail Associated with ASHRAE D RP-1365

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Table 5.4.1.1(2) - Default Linear Anomaly Coefficient for Vertical Assembly** | | | | |
| **Construction Type** | **Wall Linear Anomaly** | **Insulation Placement** | **ASHRAE D RP -1365 Detail #** | **Wall Anomaly Coefficient, Wac** |
| All Wall Facades | Concrete Balcony  or Concrete Floor | Uninsulated at top and bottom, exterior and in stud cavity insulation | 5 | 36% |
| Concrete Balcony  or Concrete Floor | Insulated at top of slab, exterior and in stud cavity insulation | 5 | 39% |
| Concrete Balcony  or Concrete Floor | insulated at top and bottom of slab, exterior and in stud cavity insulation | 5a | 42% |
| All Facades with Structural Steel | Steel Support for Floor | Interior Insulated Wall | 16 | 64% |
| Steel Support for Floor | Exterior & Interior Insulated | 17 | 80% |
| Metal or Masonry Parapet | Exterior Rigid and Interior Framed | 10 | 72% |
| Brick Facade | Concrete Slab with Standard Metal Shelf Angle or Metal Flashing | Exterior Rigid and Interior Framed | 14 | 54% |
| Concrete Slab with Reduced-Contact Metal Shelf Angle | Exterior Rigid and Interior Framed | 15 | 65% |
| Metal or Masonry Parapet | Both sides insulated with rigid, with Roof insulation | 9 | 100% |
| Metal or Masonry Parapet | Interior wall metal framed insulation with roof insulation | 20 | 65% |
| Spandrel Panels | Slab Intersection | No Stud Insulation and Back Pan Insulation | 22 | 34% |
| Slab Intersection | Stud Insulation and Back Pan Insulation | 23 | 44% |
| Metal or Masonry Parapet | Stud Insulation and Back Pan Insulation | 25 | 41% |
| Precast Walls | Slab Intersection | Interior Metal Framed Insulation | 29 | 73% |
| Metal or Masonry Parapet | Exterior Metal Framed Insulation | 30 | 76% |
| Slab Intersection | Sandwich Panel, at slab intersection | 32 | 63% |
| Metal or Masonry Parapet | Sandwich Panel, at roof intersection | 33 | 65% |
| Concrete Block  With Exterior Rigid Insulation | Metal Shelf Angle | Exterior Rigid and Metal Shelf Angle | 35 | 62% |
| Reduced Contact Shelf Angle | Exterior Rigid and Reduced Contact Shelf Angle | 36 | 70% |
| Metal or Masonry Parapet | Brick Ties at Parapet and Roof | 37 | 69% |
| No Linear Anomalies  as Described Above | All | All | - | 100% |

*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 ft2 or 2% of the gross conditioned floor area for that level of the building. The exterior envelope of conditioned vestibules shall comply with the requirements for a conditioned space. The interior and exterior envelope of unconditioned vestibules shall comply with the requirements for a semiheated space.

**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 ft2 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 spaceand pathways for future installation of *on-site renewable energy systems* and associated infrastructureto cover no less than 25% of horizontal projection of the *gross roof area*.

**Exceptions:**

1. *Building project*s 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/ft2·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 Table 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 Table5.5. (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**

*Roofs*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Assembly** | **Insulation** | **Assembly** | **Insulation** | **Assembly** | **Insulation** |
| **Maximum** | **Min. R-Value** | **Maximum** | **Min. R-Value** | **Maximum** | **Min. R-Value** |

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 Buildinga 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 LsU-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

*Wall, below Grade*

R-15 + R-4.1 c.i.

U-0.058

R-15 + R-4.1 c.i.

U-0.089 R-13

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

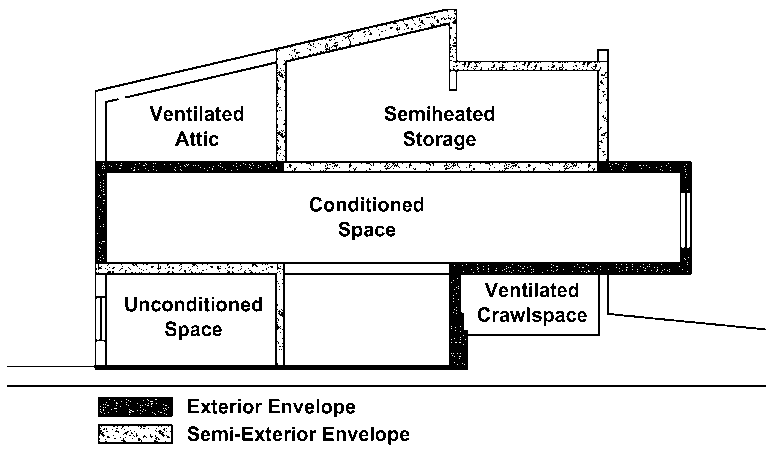
*Skylight, 0%–3% of Roof*

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 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/ft2 or 23 lb/ft2 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
4. is shaded during the peak sun angle on June 21 by permanent components or features of the building; or
5. is permitted using a combination of 1 and 2 above.
6. 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 Table 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 Table 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 Table 5.5.

**5.5.3.6 Opaque Doors.** All opaque doors shall have a U- factor not greater than that specified in Table 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·ft2·°F (6.81 W/m2·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 Table 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 Table 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·ft2·°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 |

**S****ECTION 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 shall meet all of the following criteria:

*[no change to criteria a. and b.]*

1. 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 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:**

1. 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.
2. 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 6.4.3.8.1 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:

1. Air-side economizer.
2. Automatic modulating control of outdoor air dampers.
3. 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 750 cfm (375 L/s).

3. *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)*.

4. *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 CO2 sensors used as part of a DCV system or any other system that dynamically controls outdoor air shall meet the following requirements:

1. *Spaces* with CO2 sensors or air-sampling probes leading to a central CO2 monitoring station shall be provided with at least one sensor or probe for each 10,000 ft2 (1000 m2) of floor *space*. Sensors or probes shall be installed between 3 and 6 ft (1 and 2 m) above the floor.
2. CO2 sensors shall be accurate to ±50 ppm at 1000 ppm.
3. *Outdoor air* CO2 concentrations shall be determined one of the following:
4. *Outdoor air* CO2 concentrations shall be dynamically measured using a CO2 sensor.
5. When documented statistical data are available on the local ambient CO2 concentrations, a fixed value typical of the location where the building is located shall be allowed in lieu of an outdoor sensor.
6. Occupant CO2 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. *Building project*s complying with Chapter 13 shall instead reference Normative Appendix A, ASHRAE 189.1-2014, Table A-2, Minimum Duct Installation R-Value Heating and Cooling-Only Supply Ducts and Return Ducts (I-P), and Table A-3, Minimum Duct Installation R-Value Combined Heating and Cooling Supply Ducts and Return Ducts (I-P).

**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 conditioned 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 ft2 need not exceed R-2; those 5 ft2 or smaller need not be insulated.

*Strike Section 6.4.4.1.3 of ASHRAE 90.1 in its entirety and insert a new Section 6.4.4.1.3 in its place in the Energy Conservation Code-Commercial Provisions to read as follows:*

**6.4.4.1.3 Piping Insulation.** Piping, including but not limited to, all branch piping and piping components, shall be thermally insulated in accordance with Tables 6.8.3-1 and 6.8.3-2.

**Exceptions:**

1. Factory-installed piping within HVAC equipment tested and rated in accordance with Section 6.4.1.

2. Piping that conveys fluids having a design operating temperature range between 60°F and 105°F, inclusive.

3. Piping that conveys fluids that have not been heated or cooled through the use of fossil fuels or electricity (such as roof and condensate drains, domestic cold-water supply, natural-gas piping).

4. Where heat gain or heat loss will not increase energy usage (such as liquid refrigerant piping).

5. In piping 1 inch (2.54 cm) or less, insulation is not required for strainers, control valves, and balancing valves.

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

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

**Cooling Capacity for Which**

**Climate Zones**

**an Economizer is Required**

1a, 1b No economizer requirement

2a, 2b, 3a, 4a, 5a, 6a

3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8

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.

 Btu/ha

**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.

1. The minimum size requirements for economizers for comfort cooling and for computer rooms are defined in Table 6.5.1-1.
2. 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
3. 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.
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.
10. 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.
11. Systems primarily serving computer rooms where:
    1. The total design cooling load of all computer rooms in the building is less than 3,000,000 Btu/h and the building in which they are located is not served by a centralized chilled water plant;
    2. 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;
    3. The local water authority does not allow cooling towers; or
    4. Less than 600,000 Btu/h of computer-room cooling equipment capacity is being added to an existing building.
12. 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.
13. Variable refrigerant volume with energy recovery or variable refrigerant flow with energy recovery 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:

* 1. Reheating;
  2. Recooling;
  3. 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
  4. 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:
   1. The airflow rate in dead band between heating and cooling does not exceed the larger of the following:

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

(ii) The design outdoor airflowrate for the zone.

(iii) 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.

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

* 1. The airflow rate that is reheated, recooled, or mixed shall be less than 50% of the zone design peak supply rate.
  2. 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.
  3. 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 LIMITATIONa**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Limit** | **Constant Volume** | **Variable Volume** |
| Option 1: Fan system motor nameplate hp | Allowable nameplate motor hp | hp  cfm*S* · 0.00099 | hp  cfm*S* · 0.00135 |
| Option 2: Fan system bhp | Allowable fan system bhp | bhp  cfm*S* · 0.00084 +*A* | bhp  cfm*S* · 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 × 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 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 ft2 (2500 m2) 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:

* 1. 25% of the refrigeration system full-load total heat rejection.
  2. 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:

1. At least 50% of all replacement air shall be *transfer air* that would otherwise be exhausted.
2. 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:
      1. 50% of total design exhaust and replacement air system airflow rate or
      2. 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 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, and insert a new Table 6.8.1-1 in their place in the Energy Conservation Code-Commercial Provisions to read as follows:*

**TABLE 6.8.1-1**

**Minimum Efficiency Requirements**

**Equipment**

**Type Size Category**

**Heating**

**Section Type**

**Subcategory or**

**Rating Condition**

**Minimum**

**Efficiency**

**Test**

**Procedurea**

Air conditioners, b

Split system 13.0 SEER

air cooled <65,000 Btu/h

All

Single package

14 SEER

AHRI

Through the wall, b

air cooled 30,000 Btu/h

Small duct

Split system 12.0 SEER All

Single package 12.0 SEER

210/240

high velocity, air cooled

<65,000 Btu/hb All Split System 11.0 SEER

11.2 EER

65,000 Btu/h and

<135,000 Btu/h

Electric resistance

(or none)

Split system and single package

12.9 IEER

11.0 EER

All other Split system and single package

12.7 IEER

11.0 EER

135,000 Btu/h and

<240,000 Btu/h

Electric resistance

(or none)

Split system and single package

12.4 IEER

10.8 EER

Air conditioners, air cooled

All other Split system and single package

12.2 IEER

10.0 EER

AHRI

340/360

240,000 Btu/h and

<760,000 Btu/h

Electric resistance

(or none)

Split system and single package

11.6 IEER

9.8 EER

All other Split system and single package

11.4 IEER

9.7 EER

760,000 Btu/h

Electric resistance

(or none)

Split system and single package

11.2 IEER

9.5 EER

All other Split system and single package

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**

**Procedurea**

<65,000 Btu/h All Split system and single package

12.1 EER

12.3 IEER

12.1 EER

AHRI

210/240

65,000 Btu/h and

<135,000 Btu/h

Electric resistance

(or none)

Split system and single package

13.9 IEER

11.9 EER

All other Split system and single package

13.7 IEER

12.5 EER

AHRI

340/360

135,000 Btu/h and

<240,000 Btu/h

Electric resistance

(or none)

Split system and single package

13.9 IEER

12.3 EER

Air conditioners, water cooled

All other Split system and single package

13.7 IEER

12.4 EER

240,000 Btu/h and

Electric resistance

(or none)

Split system and single package

13.6 IEER

AHRI

<760,000 Btu/h

All other Split system and single package

12.2 EER

13.4 IEER

12.2 EER

340/360

Electric resistance

(or none)

Split system and single package

13.5 IEER

AHRI

760,000 Btu/h

All other Split system and single package

12.0 EER

13.3 IEER

340/360

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**

**Procedurea**

<65,000 Btu/hb 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

All other Split system and single package

11.9 EER

12.1 IEER

Air conditioners, evaporatively cooled

135,000 Btu/h and

<240,000 Btu/h

240,000 Btu/h and

<760,000 Btu/h

Electric resistance

(or none) All other

Electric resistance

(or none)

Split system and single package

Split system and single package

Split system and single package

12.0 EER

12.2 IERR

11.8 EER

12.0 IEER

11.9 EER

12.1 IEER

AHRI 340/

360

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

Condensing units,

air cooled 135,000 Btu/h

Condensing units,

water cooled 135,000 Btu/h

Condensing units,

evaporatively cooled 135,000 Btu/h

All other Split system and single package

11.5 EER

11.7 IEER

10.5 EER

11.8 IEER

13.5 EER

14.0 IEER

13.5 EER

14.0 IEER

AHRI

365

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**

Heat Pump with Elec. Backup, Gass

**Rating Condition**

Split system

**Minimum**

**Efficiency**

14 SEER

**Test**

**Procedurea**

Air cooled b

(cooling mode) <65,000 Btu/h

Heat Pump with Elec. Backup, Gas

Single package

14 SEER

AHRI

210/240

Through the wall, air cooled (cooling mode)

30,000 Btu/hb

Split system 12.0 SEER

Single package 12.0 SEER

Small duct high velocity, b

air cooled <65,000 Btu/h

Split System 11.0 SEER

65,000 Btu/h and

<135,000 Btu/h

None

Heat Pump with Elec. Backup, Gass

Split system and single package

11.0 EER

12.2 IEER

10.8 EER

Split system and single package

12.0 IEER

Air cooled

(cooling mode)

135,000 Btu/h and

<240,000 Btu/h

None

Heat Pump with Elec. Backup, Gass

Split system and single package

10.6 EER

)

11.6 IEER

10.4 EER

AHRI

340/360

Split system and single package

11.4 IEER

240,000 Btu/h

None

Heat Pump with Elec. Backup, Gass

Split system and single package

9.5 EER

10.6 IEER

9.3 EER

Split system and single package

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.

**SECTION 7 SERVICE WATER HEATING**

**7.4 MANDATORY PROVISIONS**

**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 *building project*s 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 the Energy Conservation Code-Commercial Provisions to read as follows:*

**7.4.5.2.1** **Insulation for Spas and Pools.** Spas andpools 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 office, 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 ft2 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 system 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 *building project*s 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 *building 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 *building projects* that are 25,000 square feet (2323 m2) 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 *building projects* that are less than 25,000 square feet (2323 m2) 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 AutomaticControl of Equipment in Hotel/Motel Guest Rooms.** In hotels and motels with more than 50 guest rooms, *automatic* controlsfor 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:

* 1. 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 system shall comply with the lighting power density (LPD) requirements of Section 9 applicable to the area illuminated by that lighting system and the applicable control requirements of Sections 9.4.1.4(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 9.4.1.1 of ASHRAE 90.1 in its entirety and insert a new Section 9.4.1.1 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 ft2 (232.25 m2) if the space is 10,000 ft2 (929.03 m2), and (2) no larger than 10,000 ft2 ((929.03 m2) 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 ft2.

3. Retail spaces.

1. 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.

1. 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/ft2

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 ft2.

**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 ft2, (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 ft2.

**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.

1. 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/ft2 0.05 W/ft2 0.09 W/ft2 0.12 W/ft2

**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/ft2

0.12 W/ft2

0.15 W/ft2

0.19 W/ft2

Stairways No allowance 0.67 W/ft2 0.9 W/ft2 0.95 W/ft2 0.95 W/ft2

Pedestrian tunnels No allowance 0.13 W/ft2 0.13 W/ft2 0.19 W/ft2 0.28 W/ft2

Landscaping No allowance 0.03 W/ft2 0.04 W/ft2 0.04 W/ft2 0.04 W/ft2

**Building Entrances, Exits, and Loading Docks**

Main entries No allowance 18 W/lin ft of door width

Other doors No allowance 18 W/lin ft of door width

18 W/lin ft of door width

18 W/lin ft of door width

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/ft2 0.22 W/ft2 0.38 W/ft2 0.38 W/ft2

Loading docks No allowance 0.45 W/ft2 0.45 W/ft2 0.47 W/ft2 0.47 W/ft2

**Sales Canopies**

Free standing and attached No allowance 0.54 W/ft2 0.54 W/ft2 0.76 W/ft2 0.95 W/ft2

**Outdoor Sales**

Open areas (including 2

vehicle sales lots) No allowance 0.22 W/ft

Street frontage for vehicle

0.22 W/ft2

0.47 W/ft2

0.66 W/ft2

sales lots in addition to

“open area” allowance

**Nontradable Surfaces**

No allowance No allowance 9 W/linear foot 9.5 W/linear foot 28.5 W/linear foot

(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/ft2 for each illuminated wall or surface or 2.37 W/ linear foot for each illuminated wall or surface length

0.14 W/ft2 for each illuminated wall or surface or 3.56 W/ linear foot for each illuminated wall or surface length

0.19 W/ft2 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

Loading areas for law enforcement, fire, ambulance,

and other emergency service vehicles

No allowance

No allowance

0.71 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.47 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.71 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.47 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.71 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.47 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.71 W/ft2 of uncovered area (covered areas are included in the “Canopies and Overhangs” section of “Tradable Surfaces”)

0.47 W/ft2 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 Typea** | **LPD, W/ft2** |
| 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.

*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/ft2 (8.6 W/m2) 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/ft2 (1 W/m2). 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:*

**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**

**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.**

**in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

**Local Control**

**(See Section**

**9.4.1.1[a])**

**Restricted to Manual ON (See Section**

**9.4.1.1[b])**

**Restricted to Partial Automatic ON (See Section**

**9.4.1.1[c])**

**Bilevel Lighting Control**

**(See Section**

**9.4.1.1[d])**

**Automatic**

**Daylight Responsive Controls for Sidelighting (See Section**

**9.4.1.1[e]6)**

**Automatic**

**Daylight Responsive Controls for Toplighting (See Section**

**9.4.1.1[f]6)**

**Automatic Partial OFF (See Section**

**9.4.1.1[g] [Full Off complies])**

**Automatic Full OFF (See Section**

**9.4.1.1[h])**

**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

**Common Space Types1 LPD, W/ft2**

**RCR Threshold**

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**a b c d e f g h i**

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**Atrium**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| … that is <20 ft in height | 0.03/ft total height | NA | REQ | ADD1 | ADD1 | — | REQ | REQ | — | ADD2 | ADD2 |

… that is 20 ft and

40 ft in height 0.03/ft total height NA REQ ADD1 ADD1 REQ REQ REQ — ADD2 ADD2

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| … that is >40 ft in height 0. | 0 + 0.02/ft total | NA | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| **Audience Seating Area** | | | | | | | | | | | |
| ... in an auditorium | 0.63 | 6 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| ... in a convention center | 0.82 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| … in a gymnasium | 0.65 | 6 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| ... in a motion picture theater | 1.14 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| ... in a penitentiary | 0.28 | 4 | REQ | ADD1 | ADD1 | — | REQ | REQ | — | ADD2 | ADD2 |
| ... in a performing arts theater | 2.43 | 8 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| ... in a religious building | 1.53 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| ... in a sports arena | 0.43 | 4 | REQ | ADD1 | ADD1 | — | REQ | REQ | — | ADD2 | ADD2 |
| … all other audience seating areas | 0.43 | 4 | REQ | ADD1 | ADD1 | — | REQ | REQ | — | ADD2 | ADD2 |
| **Banking Activity Area** | 1.01 | 6 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| **Breakroom**  **(See Lounge/Breakroom)** |  |  |  |  |  |  |  |  |  |  |  |
| **Classroom/Lecture Hall/Training Room** |  |  |  |  |  |  |  |  |  |  |  |
| … in a penitentiary | 1.34 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | REQ | — |
| … all other classrooms/lecture halls/  training rooms | 1.24 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | REQ | — |

***Informative Note:* This table is divided into two sections; this first section covers space types that can be commonly found**

**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.**

**in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

**Local Control**

**(See Section**

**9.4.1.1[a])**

**Restricted to Manual ON (See Section**

**9.4.1.1[b])**

**Restricted to Partial Automatic ON (See Section**

**9.4.1.1[c])**

**Bilevel Lighting Control**

**(See Section**

**9.4.1.1[d])**

**Automatic**

**Daylight Responsive Controls for Sidelighting (See Section**

**9.4.1.1[e]6)**

**Automatic**

**Daylight Responsive Controls for Toplighting (See Section**

**9.4.1.1[f]6)**

**Automatic Partial OFF (See Section**

**9.4.1.1[g] [Full Off complies])**

**Automatic Full OFF (See Section**

**9.4.1.1[h])**

**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Common Space Types1**  **Conference/Meeting/Multipurpose**  **Room Confinement Cells Copy/Print Room**  **Corridor2**  … in a facility for the visually impaired  (and not used primarily by the staff)3  … in a hospital  … in a manufacturing facility  … all other corridors | | **LPD, W/ft2** | **RCR Threshold** | **a** | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** |
| 1.10 | 6 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | REQ | — |
| 0.81 | 6 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| 0.72 | 6 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | REQ | — |
| 0.92 | width <8 ft | REQ | — | — | — | REQ | REQ | REQ | ADD2 | ADD2 |
| 0.99 | width <8 ft | REQ | — | — | — | REQ | REQ | ADD2 | ADD2 | ADD2 |
| 0.41 | width <8 ft | REQ | — | — | — | REQ | REQ | — | ADD2 | ADD2 |
| 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**  **Dining Area** | … in a penitentiary | 1.71  0.96 | 4  6 | REQ  REQ | ADD1  ADD1 | ADD1  ADD1 | REQ  REQ | REQ  REQ | REQ  REQ | —  — | ADD2  ADD2 | ADD2  ADD2 |
| … in a facility for  (and not us | the visually impaired  ed primarily by staff)3 | 2.65 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| … in bar/lo | unge or leisure dining | 1.07 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | ADD2 | ADD2 |
| … in cafete | ria 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

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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/ft2 shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft2. The additional 0.53 w/ft2 allowance shall not be used for any other purpose.

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**in multiple building types. The second part of this table covers space types that are typically found in a single building type.**

**Local Control**

**(See Section**

**9.4.1.1[a])**

**Restricted to Manual ON (See Section**

**9.4.1.1[b])**

**Restricted to Partial Automatic ON (See Section**

**9.4.1.1[c])**

**Bilevel Lighting Control**

**(See Section**

**9.4.1.1[d])**

**Automatic**

**Daylight Responsive Controls for Sidelighting (See Section**

**9.4.1.1[e]6)**

**Automatic**

**Daylight Responsive Controls for Toplighting (See Section**

**9.4.1.1[f]6)**

**Automatic Partial OFF (See Section**

**9.4.1.1[g] [Full Off complies])**

**Automatic Full OFF (See Section**

**9.4.1.1[h])**

**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

**Common Space Types1 LPD, W/ft2**

**RCR Threshold**

**a b c d e f g h i**

**Electrical/Mechanical Room7** 0.42 6 REQ — — — REQ REQ — — —

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**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**  **Lobby** | 0.47 | 6 | REQ | ADD1 | ADD1 | — | REQ | REQ | — | ADD2 | ADD2 |
| … 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 |
| **Locker Room**  **Lounge/Breakroom**  … in a healthcare facility | 0.75  0.78 | 6  6 | REQ  REQ | ADD1  ADD1 | ADD1  ADD1 | REQ  REQ | REQ  REQ | REQ  REQ | —  — | REQ  REQ | —  — |
| … all other lounges/breakrooms | 0.62 | 4 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | REQ | — |

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**9.4.1.1[a])**

**Restricted to Manual ON (See Section**

**9.4.1.1[b])**

**Restricted to Partial Automatic ON (See Section**

**9.4.1.1[c])**

**Bilevel Lighting Control**

**(See Section**

**9.4.1.1[d])**

**Automatic**

**Daylight Responsive Controls for Sidelighting (See Section**

**9.4.1.1[e]6)**

**Automatic**

**Daylight Responsive Controls for Toplighting (See Section**

**9.4.1.1[f]6)**

**Automatic Partial OFF (See Section**

**9.4.1.1[g] [Full Off complies])**

**Automatic Full OFF (See Section**

**9.4.1.1[h])**

**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

ANSI/ASHRAE/IES Standard 90.1-2013 (I-P Edition)

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Common Space Types1 LPD, RCR a**  **W/ft2 Threshold** | | | | | **b** | **c** | **d** | **e** | **f** | **g** | **h** | **i** |
| **Office** | | | | | | | | | | | | |
| … enclosed and 250 ft2 | | 1.05 | 8 | REQ | ADD1 | ADD1 | REQ | REQ | REQ | — | REQ | — |
| … enclosed and >250 ft2 | | 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 Area4** | | 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 ft2 | 1.24 | 6 | REQ | — | — | — | — | — | — | ADD2 | ADD2 |
|  | … 50 ft2 and  1000 ft2 | 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 |

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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.

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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/ft2 shall be allowed, provided that the additional lighting is controlled separately from the base allowance of 0.42 W/ft2. The additional 0.53 w/ft2 allowance shall not be used for any other purpose.

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**Bilevel Lighting Control**

**(See Section**

**9.4.1.1[d])**

**Automatic**

**Daylight Responsive Controls for Sidelighting (See Section**

**9.4.1.1[e]6)**

**Automatic**

**Daylight Responsive Controls for Toplighting (See Section**

**9.4.1.1[f]6)**

**Automatic Partial OFF (See Section**

**9.4.1.1[g] [Full Off complies])**

**Automatic Full OFF (See Section**

**9.4.1.1[h])**

**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

**Building Type Specific/Space Types1 LPD W/ft2**

**RCR Threshold**

**a b c d e f g h i**

**Facility for the Visually Impaired3**

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… 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 |
| 0.38 | 8 | REQ | — | — | — | — | — | — | — | — |
| 0.22 | 6 | REQ | — | — | — | — | — | — | — | — |

**Dormitory—Living Quarters Fire Station—Sleeping Quarters Facility 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 |

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**Automatic Full OFF (See Section**

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**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

**Building Type Specific/Space Types1 LPD W/ft2**

**RCR Threshold**

**a b c d e f g h i**

**Library**

… 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

… 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—**

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**Dressing Room** 0.61 6 REQ ADD1 ADD1 REQ REQ REQ — REQ —

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**Scheduled**

**Shutoff**

**(See Section**

**9.4.1.1[i])**

**Building Type Specific/Space Types1 LPD W/ft2**

**RCR Threshold**

**a b c d e f g h i**

**Post Office—Sorting Area** 0.94 4 REQ ADD1 ADD1 REQ REQ REQ REQ ADD2 ADD2

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**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,

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| REQ | ADD1 | ADD1 | REQ | REQ | REQ | REQ | ADD2 | ADD2 |
| REQ | ADD1 | ADD1 | REQ | REQ | REQ | REQ | ADD2 | ADD2 |

palletized items 0.49 4

… for smaller, hand-carried items5 0.95 6

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

**Additional Control Method**

**(in Addition to Mandatory Requirements)**

**Open**

**Office**

**Private**

**Office**

**Space Type**

**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

0.25a 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

0.30a,b 0 0 0 0

Automatic continuous daylight dimming in secondary sidelighted c c c c c

areas 0.10

0.10

0.10

0.10

0.10

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 down- ward 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

*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:

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:

+ (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.** *Building project*s 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, 10.5.3 and 10.5.4. All *building project*scomplying 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

1. *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. *Building projects* shall comply with the following conditions as applicable:

1. All projects shall comply with Section 11.3.1.1-Acceptance Testing.
2. The following *building projects* shall comply with Section 11.3.1.2-Project Commissioning:
   * + 1. New construction (including additions) 10,000 sf (929 m2) or greater.
       2. Level III alterations *alteration area* of 10,000 sf (929 m2) or greater.
       3. Alterations of 20,000 sf (1858.06 m2) or greater.
       4. New, replaced, or relocated mechanical, electrical, or plumbing equipment that serves 20,000 sf (1858.06 m2) or larger.
       5. Projects having a new, replaced, and/or relocated, HVAC system with a heating equipment size of 480,000 BTU’s or greater, or with a cooling equipment size of 600,000 BTUs or greater.
3. The following *building projects* shall comply with Section 11.3.1.3-Building Envelope Commissioning (BECx):
4. New Construction or additions 50,000 sf (4645.12 m2) or greater.
5. Alterations and/or additions: for buildings over 50,000 sf (4645.12 m2), where at least 25 percent of the vertical, above-grade *building envelope* is being replaced, altered, and/or added.

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

1. 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 11.3.1.3.

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 11 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 *building 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. *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 per manufacturer requirements, code requirements, owner’s requirements, permit drawings, and designer’s intent of operation.

b. Perform acceptance tests. For each acceptance test, complete test form and include date, a signature, and license number, as appropriate, for the party who has performed the test. Acceptance testing shall include, but not limited to, Testing and Balancing, for applicable systems and system components.

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 *building 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. Completed acceptance testing forms shall be provided to the *AHJ* for review upon request.

**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*. Reference *AHJ* Cx guidelines.

A *Cx process* shall be incorporated into the predesign, design, construction, and post-occupancy of the *building 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 *building* *project*.

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

a. The project owner or owner representative, but not a design firm or construction firm involved in the design or construction of the *building project*, shall contract with a project *CxA* to lead, review, and oversee completion of the *Cx process* activities prior to completion of schematic design. The *CxA* shall be approved by the *AHJ* to conduct commissioning, having credentials set forth by the *AHJ*. The *CxA* shall not be a member of any construction or design firm involved in the design or construction of the *building project*.

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. Once the *building project* receives the required permits, the *BoD* shall include the *AHJ* approved permit drawings and documents, and any deviations from these plans shall be noted by the *CxA* as a deficiency in their Cx reports unless updated and *AHJ* approved construction documents are provided.

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 *building 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.

**11.3.1.2.2 Activities Prior to Building Rough Inspection completion.** The following activities shall be completed:

a. Develop and implement a *Cx plan* containing required forms and procedures for the complete testing of equipment, systems, and controls. Include all Acceptance testing forms to be used by the acceptance testers, all Functional Performance Tests written out including test sequence, measurable criteria for performance pass/fail, required test instruments, and expected/acceptable response of operating parameters.

b. Provide complete *Cx plan* to the *AHJ* for review.

c. Provide complete *Cx plan* to project owner, project general contractor, and sub-contractors with whom are performing work related to the commissioning process.

**11.3.1.2.3 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*. The *AHJ* has the authority to provide flexibility in accepting the preliminary Cx report without all required Functional Performance Tests completed, provided that these tests have been substantially completed, completed test results have been provided, and a schedule for completion has been provided.

**Exception to 11.3.1.2.3(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 the *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 a preliminary Cx report. This shall include all deficiencies identified by the *CxA* or acceptance testing throughout the *Cx process* listing corrective measures taken, and identified as corrected, outstanding, and/or accepted by the owner. Any deficiencies in violation with any sections listed in Chapters 6, 7, 8, 9, 10, or 13 of the *Energy Conservation Code*-*Commercial Provisions* or applicable sections of the *Green Construction Code*, if applicable, shall be listed as an deficiency in acceptance testing and/or Cx testing and verification. Such code violation deficiencies shall be corrected prior to submitting the completed preliminary Cx report to *AHJ* for review.

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.

e. A copy of the completed *preliminary Cx report* shall be provided to, reviewed by, and approved by the AHJ and to the project owner.

f. Completed *Preliminary Cx report* shall include testing and/or verification of all applicable energy code requirements for the *building project* within Chapters 6, 7, 8, 9, 10, and 13 of the D.C. Energy Conservation Code and all applicable section of the D.C. Green Construction Code, if applicable.

**11.3.1.2.4 Post-occupancy 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 Cxreport with all deficiencies identified in preliminary Cx report either corrected with corrective measures taken listed or accepted by the owner. Any deficiencies in violation with any sections listed in chapters 6, 7, 8, 9, 10, or 13 of the *Energy Conservation Code-Commercial Provisions* can only be approved by the *AHJ* and shall be listed in the final Cx report as an unresolved deficiency. This report shall be submitted for review to the *AHJ* and project owner within 180 days of the project completion (first Certificate of Occupancy for an above grade floor for the project).

**11.3.1.3 Building Envelope Commissioning (BECx)** BECx 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/ft2 (1.25 L/s·m2) 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, *building 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. A *building envelope* *commissioning authority*, (*BECxA*,) with building envelope commissioning credentials as approved by the *AHJ*, shall be contracted by the project owner to conduct building air-barrier commissioning prior to permit for the *building project*. A fundamental envelope commissioning program consistent with ASTM-E2813-12 that consists of the following elements shall be implemented:

1. A *BECxA* 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. This review shall be completed prior to permit application and results and documentation of this review provided with construction documents in permit drawings and supporting documentation.

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*.*

3. The Fundamental BECx program shall include addressing ASTM-E2813-12 sections relating to air infiltration, condensation resistance, thermal performance, and water penetrations at a minimum.

4. The BECx plan shall be provided to the *AHJ* prior to *building envelope* installation:

5. The BECx report shall be submitted to the *AHJ* for review at or prior to final inspection.

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

**SECTION 12 NORMATIVE REFERENCES**

*Under heading “ASHRAE” in Section 12 of ASHRAE 90.1, strike reference to “ANSI/ASHRAE Standard 62.1-2007Ventilation for Acceptable Indoor Air Quality” and insert a new standard in its place in the Energy Conservation Code-Commercial Provisions to read as follows:*

**Reference Title**

**ASHRAE**

**1791 Tullie Circle, NE, Atlanta, GA 30329**

ANSI/ASHRAE Standard 62.1-2013 Ventilation for Acceptable Indoor Air Quality

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*Under heading “ASHRAE” in Section 12 of ASHRAE 90.1, insert a new reference in the Energy Conservation Code-Commercial Provisions to “ANSI/ASHRAE Standard 189.1-2014” to read as follows:*

**ASHRAE**

**1791 Tullie Circle, NE, Atlanta, GA 30329**

ANSI/ASHRAE Standard 189.1-2014 Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

*Under heading “ASTM International” in Section 12 of ASHRAE 90.1, insert new references in the Energy Conservation Code-Commercial Provisions to read as follows:*

**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

*Under heading “Canadian General Standards Board” in Section 12 of ASHRAE 90.1, insert new references in the Energy Conservation Code-Commercial Provisions to read as follows:*

**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

*Under heading “United States Department of Energy” in Section 12 of ASHRAE 90.1, insert a new reference in the Energy Conservation Code-Commercial Provisions to read as follows:*

**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**

**13.2 ADOPTION OF ASHRAE 189.1-2014** **NORMATIVE APPENDICES**

*Strike Section 13 in ASHRAE 90.1 in its entirety and insert a new Section 13 in the Energy Conservation Code-Commercial Provisions 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 where any of the following conditions are met:

* + - 1. New construction of 10,000 sf (929 m2) or greater, not including first time tenant fit-outs within a newly constructed core and shell building/space.
      2. Additions of 10,000 sf (929 m2) or greater.
      3. *Alteration* area of 10,000 sf (929 m2) or greater in Level 3 *alteration*.
      4. Combined Level 3 *alteration* and addition area of 10,000 sf (929 m2) or greater.

**Exceptions:** Buildings that demonstrate compliance with both of the following conditions 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/ m2·day (1.2 kBtu/ft2/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/ft2 (75 kWh/m2) of *conditioned space* each year until the cumulative purchase totals 70 kWh/ft2 (750 kWh/m2) 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/ ft2 (20 kWh/m2) multiplied by the *gross roof area* in ft2 (m2) for single-story buildings, and not less than 10.0 kBtu/ft2 (32 kWh/m2) multiplied by the *gross roof area* in ft2 (m2) 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/ft2 (13 kWh/m2) multiplied by the *gross roof area* in ft2 (m2) for single-story buildings, and not less than 7.0 kBtu/ft2 (22 kWh/m2) multiplied by the *gross roof area* in ft2 (m2) 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 ASHRAE 189.1, NORMATIVE APPENDICES**

The following Normative Appendices in ANSI/ASHRAE/USGBC/IES Standard 189.1-2014, Standard for the Design of High-Performance Green Buildings Except Low-Rise Residential Buildings, are hereby adopted, in whole or in part, in the District of Columbia and incorporated by reference into the *Energy Conservation Code-Commercial* *Provisions* as provided below.

1. Normative Appendix B*, Prescriptive Equipment Efficiency Tables for the Alternate Reduced Renewables and Increased Equipment Efficiency Approach in Section 7.4.1.1.2*;
2. Normative Appendix A, Table A-2, Minimum Duct Installation R-Value Heating and Cooling-Only Supply Ducts and Return Ducts (I-P), and Table A-3, Minimum Duct Installation R-Value Combined Heating and Cooling Supply Ducts and Return Ducts (I-P).

**NORMATIVE APPENDICES**

*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 as Normative Appendix A in the Energy Conservation Code-Commercial Provisions.*

*Normative Appendix B in ASHRAE 90.1,* ***BUILDING ENVELOPE CLIMATE CRITERIA****, is adopted in the District of Columbia as Normative Appendix B in the Energy Conservation Code-Commercial Provisions with the following amendments:*

*Revise the list of U.S. Climate Zones in Normative Appendix B in ASHRAE 90.1 to delete the names of all U.S. States with the exception of the District of Columbia.*

*Strike the Table titled “Canadian Climatic Zones” in Normative Appendix B in ASHRAE 90.1 in its entirety without substitution.*

*Strike Tables B1-3 and B1-4 in Normative Appendix B in ASHRAE 90.1 in their entirety without substitution.*

*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 as Normative Appendix C in the Energy Conservation Code-Commercial Provisions.*

*Normative Appendix D in ASHRAE 90.1,* ***CLIMATIC DATA****, is adopted in the District of Columbia as Normative Appendix D in the Energy Conservation Code-Commercial Provisions with the following amendments:*

*Revise Table D-1 in Normative Appendix D in ASHRAE 90.1 to delete the names of all U.S. states and territories with the exception of the District of Columbia.*

*Strike Tables D-2 and D-3 in Normative Appendix D in ASHRAE 90.1 in their entirety without substitution.*

*Informative Appendix E in ASHRAE 90.1,* ***INFORMATIVE REFERENCES****, is adopted in the District of Columbia as Informative Appendix E in the Energy Conservation Code-Commercial Provisions.*

*Informative Appendix F in ASHRAE 90.1,* ***ADDENDA DESCRIPTION INFORMATION****, is adopted in the District of Columbia as Informative Appendix F in the Energy Conservation Code-Commercial Provisions.*

*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:*

**NORMATIVE APPENDIX G PERFORMANCE RATING METHOD**

**G1 GENERAL**

**G2 SIMULATION GENERAL REQUIREMENTS**

**G3 CALCULATION OF THE PROPOSED DESIGN AND BASELINE BUILDING PERFORMANCE**

**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:

1. All requirements of Sections 5.4, 6.4, 7.4, 8.4, 9.4, 10.4, and 11 shall be met. These sections contain the mandatory provisions of the standard and are prerequisites for this rating method.
2. 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 9.5.1 and 9.6.1.

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

Performance Cost Index= Proposed building performance / Baseline building performance

Both the *proposed building performance* and the *baseline building performance* shall include all end-use load components within and associated with the building when calculating the Performance Cost Index.

***Informative Note:***

1. 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.

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

PCIt = (BBUEC + (BPF xBBREC))/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)**

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| --- | --- |
| **Building Area Typesa** | **Climate Zone 4A** |
| Multifamily | 0.58 |
| 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.

**G1.2.3 Additions to Existing Buildings.** When an addition to an existing building cannot comply by itself, trade-offs will be allowed by modification to one or more of the existing components of the existing building. Modeling of the modified components of the existing building and addition shall employ the procedures of Appendix G; the addition shall not increase the energy consumption of the existing building plus the addition beyond the energy that would be consumed by the existing building plus the addition if the addition alone did comply.

**G1.2.4 Alterations of Existing Buildings.** Alterations of existing buildings shall comply with the provisions of Section 5, 6, 7, 8, 9, 10, 11, 13 or Appendix G.

**G1.3 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 11, 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 Sections 5.4, 6.4, 7.4, 8.4, 9.4, 10.4 and 11 (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 that 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 *building envelope* assemblies, NFRC ratings for fenestration, end-uses identified in Table G3.1, “1.Design Model,” paragraph [a]).

l. Input and output reports from the simulation program or compliance software including a breakdown of energy use 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 methods 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.

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 set points, 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 mechanical cooling equipment.

g. Air 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 performing 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 baseline 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.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 as approved by the rating authority. Where there are multiple designs, materials, or devices that the simulation program 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 the following:

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;

e. The performance rating calculated with and without the exceptional calculation method.

**G3 CALCULATION OF THE PROPOSED DESIGN 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.

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| **Table G3.1 Modeling Requirements for Calculating Proposed and**  ***Baseline Building Performance*** | | |
| **No.** | **Proposed Building Performance** | **Baseline Building Performance** |
| 1. Design Model | | |
| * The simulation model of the *proposed design* shall be consistent with the design documents, including proper accounting of *fenestration* and *opaque* *building 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*. * 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. * *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*. * 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 modeled with the same number of *floors* and identical *conditioned floor area* as the *proposed design*.  The *baseline building design* shall be developed by modifying the *proposed design* as described in Section G3. Except as specifically instructed, all *building* *systems* and *equipment* shall be modeled identically in the *proposed design* and *baseline building design*. |
| 2. Additions and *Alterations* | | |
| 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:   * Work to be performed in excluded parts of the *building* shall meet the requirements of Sections 5 through 10. * 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. * Design *space* temperature and *HVAC system* operating *set points* and schedules on either side of the boundary between included and excluded parts of the *building* are essentially the same. * 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. | | If the proposed *design* excludes parts of the *existing building*, the *baseline building* *design* shall exclude them as well.  When modeled, unmodified *existing building* components shall follow the same rules as new and modified *building* components. |
| 3. *Space* Use Classification | | |
| Use 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 design. |
| 4. Schedule | | |
| Schedules capable of modeling hourly variations in occupancy, lighting power, miscellaneous *equipment* power, *thermostat* *set points*, 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 and humidity *control* *set points* and schedules as well as *temperature control throttling range* shall be the same for *proposed design* and *baseline building design*.  **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.   * 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. * HVAC fans shall remain on during occupied and unoccupied hours in *spaces* that have health- and safety-mandated minimum *ventilation* requirements during unoccupied hours. * HVAC fans shall remain on during occupied and unoccupied hours in *systems* primarily serving *computer rooms*. | | Same as *proposed design.*   * *Set points* 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 be allowed to differ, provided that equivalent levels of occupant thermal comfort are demonstrated via the methodology in ASHRAE Standard 55, Section 5.3.3, “Elevated Air Speed,” or Standard 55, Appendix B, “Computer Program for Calculation of PMV-PPD.” * 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 been approved by 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* | | |
| * 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* per the U-value methodologies provided for in section 5.4 and associated subsections. * The following *building* elements are permitted to differ from architectural drawings: * All uninsulated assemblies (*e.g*., concrete *floor* beams over parking garages, *roof* parapet) shall be separately modeled using either of the following techniques: * Separate model of each of these assemblies within the *energy* simulation model. * Separate calculation of the *U-factor* for each of these assemblies. The *U-factors* of these assemblies are then averaged with larger adjacent surfaces using an area-weighted average method. This average *U-factor* is modeled within the *energy* simulation model.      * 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. | | Equivalent dimensions shall be assumed for each *building envelope* component type as in the *proposed design*; i.e., the total gross area of *walls* shall be the same in the *proposed design* and *baseline building design*. 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 design* and *baseline building design*. The following additional requirements shall apply to the modeling of the *baseline building design*:   * ***Orientation*.** The *baseline building performance* shall be generated by simulating the *building* with its actual *orientation* and again after rotating the entire *building* 90, 180, and 270 degrees, then averaging the results. The *building* shall be modeled so that it does not shade itself. * If it can be demonstrated to the satisfaction of the *rating authority* that the *building* *orientation* is dictated by site considerations. * *Buildings* where the *vertical fenestration area* on each *orientation* varies by less than 5%. * ***Opaque* Assemblies.** *Opaque* assemblies used for new *buildings*, *existing buildings*, or additions shall conform with assemblies detailed in Appendix A and shall match the appropriate assembly maximum *U-factors* in Table G3.4. * Roofs—Insulation entirely above deck (A2.2). * *Above-grade walls*—*Steel-framed* (A3.3). * *Below-grade walls*—Concrete block (A4). * *Floors*—*Steel-joist* (A5.3). * *Slab-on-grade floors* shall match the *F-factor* for unheated slabs from the same tables (A6). |
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| 5. *Building Envelope* (contd.) | | |
| * 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. * *Manual* *fenestration* shading devices, such as blinds or shades, shall be modeled or not modeled the same as in the *baseline building design*. Automatically controlled *fenestration* shades or blinds shall be modeled. Permanent shading devices, such as fins, overhangs, and light shelves shall be modeled. * 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 building 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* (*I75Pa*) at a *fixed* *building* pressure differential of 0.3 in. of water shall be 0.4 cfm/ft2. The air leakage rate of the *building envelope* shall be converted to appropriate units for the *simulation program* using one of the methods in Section **Error! Reference source not found.**. * 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. | | * *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). * ***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 the area of gross *above-grade walls* that separate *conditioned spaces* and *semiheated spaces* from the exterior. 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 40% of gross *above-grade wall* area, whichever is smaller, and shall be distributed on each face of the *building* in the same proportions in the *proposed design*. 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* 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). * ***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 Table G3.4 for the applicable glazing percentage for U*all*. * *Fenestration* *SHGCs* shall match the appropriate requirements in Table G3.4 using the value for *SHGCall* 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. * ***Skylights* and Glazed Smoke Vents.** *Skylight* area shall be equal to that in the *proposed design* or 3%, whichever is smaller. If the *skylight* area of the *proposed design* is greater than 3%, baseline *skylight* area shall be decreased by an identical percentage in all *roof* components in which *skylights* are located to reach 3%. *Skylight* *orientation* and tilt shall be the same as in the *proposed design*. *Skylight* *U-factor* and *SHGC* properties shall match the appropriate requirements in Tables G3.4-1 through G3.4-8 using the value and the applicable *skylight* percentage. * ***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 | | |
| Lighting power in the *proposed design* shall be determined as follows:   * Where a complete *lighting system* exists, the actual lighting power for each *thermal block* shall be used in the model. * 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. * Where lighting neither exists nor is submitted with design documents, lighting shall comply with but not exceed the requirements of Section 9. Lighting power shall be determined in accordance with the *Building* Area Method. * *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*). * 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 design* and *baseline building design* in the simulations. * Lighting power for parking garages and *building* facades shall be modeled. * For lighting *controls*, at a minimum, the proposed design shall contain the mandatory *automatic* lighting *controls* specified in Section 9.4.1 (e.g., *automatic* daylight responsive *controls*, occupancy sensors, programmable *controls*, etc.). These *controls* shall be modeled in accordance with (g) and (h). * *Automatic* daylighting responsive *controls* shall be modeled directly in the *proposed design* or through schedule adjustments determined by a separate daylighting analysis approved by the *rating authority*. Modeling and schedule adjustments shall separately account for *primary sidelighted areas*, *secondary sidelighted areas*, and toplighted areas. * Other *automatic* lighting *controls* included in the *proposed design* shall be modeled directly in the *building* simulation by reducing the lighting schedule each hour by the occupancy sensor reduction factors in Table G3.7 for the applicable *space* type. This reduction shall be taken only for lighting controlled by the occupancy sensors. Credit for other programmable lighting *control* in *buildings* less than 5000 ft2 can be taken by reducing the lighting schedule each hour by 10%. | | Interior lighting power in the *baseline building design* shall be determined using the values in Table G3.7. Lighting shall be modeled having the *automatic* shutoff *controls* in *buildings* >5000 ft2 and occupancy sensors in employee lunch and break rooms, conference/meeting rooms, and classrooms (not including shop classrooms, laboratory classrooms, and preschool through 12th-grade classrooms). These *controls* shall be reflected in the *baseline building design* lighting schedules. No additional *automatic* lighting *controls,* e.g., *automatic* *controls* for daylight utilization and occupancy sensors in *space* types not listed above, shall be modeled in the *baseline building design*.  Exterior lighting in areas identified as “Tradable Surfaces” in Table G3.6 shall be modeled with the baseline lighting power shown in Table G3.6. Other exterior lighting shall be modeled the same in the *baseline building design* as in the *proposed design*. |
| 7. *Thermal Blocvks*—*HVAC Zones* Designed | | |
| Where *HVAC zones* are defined on HVAC design drawings, each *HVAC zone* shall be modeled as a separate *thermal block*.   * 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: * The *space* use classification is the same throughout the *thermal block*. * All *HVAC zones* in the *thermal block* that are adjacent to glazed *exterior walls* and glazed *semiexterior walls* face the same *orientation* or their orientations vary by less than 45 degrees. * All of the zones are served by the same *HVAC system* or by the same kind of *HVAC system*. | | Same as *proposed design*. |
| 8. *Thermal Blocks*—*HVAC Zones* Not Designed | | |
| 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:   * 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* or *semiexterior wall*. Perimeter *spaces* shall be those located within 15 ft of an *exterior wall* or *semiexterior wall*. A separate thermal zone does not need to be modeled for areas adjacent to *semiexterior walls* that separate *semiheated space* from *conditioned space*. * Separate *thermal blocks* shall be assumed for *spaces* adjacent to glazed *exterior walls* or glazed *semiexterior 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. * 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. * 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 design*. |
| 9. *Thermal Blocks*—Multifamily *Residential* *Buildings* | | |
| *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 design*. |
| 10. *HVAC Systems* | | |
| The *HVAC system* type and all related performance parameters in the *proposed design*, such as *equipment* capacities and efficiencies, shall be determined as follows:   * Where a complete *HVAC system* exists, the model shall reflect the actual *system* type using actual component capacities and efficiencies. * 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 design*. The *proposed design* *HVAC system* shall be modeled using *manufacturers*’ full- and part-load data for the *HVAC system* without fan power. * Where no heating *system* exists or no heating *system* has been submitted with design documents, the *system* type shall be the same *system* as modeled in the *baseline building design* and shall comply with but not exceed the requirements of Section 6. | | The *HVAC systems* in the *baseline building 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* types.  If the *proposed design* includes humidification then the *baseline building design* shall use adiabatic humidification.   * If the proposed *building* humidification *system* complies with Section 6.5.2.4 then the *baseline building design* shall use nonadiabatic humidification.   For *systems* serving *computer rooms*, the *baseline building design* shall not have *reheat* for the purpose of dehumidification.  *Fossil fuel* *systems* shall be modeled using natural gas as their *fuel* source.   * For *fossil fuel* *systems* where natural gas is not available for the proposed *building* site as determined by the *rating authority*, the baseline *HVAC system*s shall be modeled using propane as their *fuel*. |
| 10. *HVAC Systems* (contd.) | | |
| * Where no cooling *system* exists or no cooling *system* has been submitted with design documents, the cooling *system* type shall be the same as modeled in the *baseline building design* and shall comply with the requirements of Section 6. * *Spaces* using baseline *HVAC system* types 9 and 10. | |  |
| 11. *Service* *Water-Heating* *Systems* | | |
| The *service* *water-heating* *system* type and all related performance parameters, such as *equipment* capacities and efficiencies, in the *proposed design* shall be determined as follows:   * Where a complete *service* *water-heating* *system* exists, the *proposed design* shall reflect the actual *system* type using actual component capacities and efficiencies. * Where a *service* *water-heating* *system* has been designed and submitted with design documents, the *service* *water-heating model* shall be consistent with design documents. * Where no *service* *water-heating* *system* exists or has been designed and submitted with design documents but the *building* will have *service* *water-heating* loads, a *service* *water-heating* *system* shall be modeled that matches the *system* type in the *baseline building design*, serves the same *water-heating* loads, and shall comply with but not exceed the requirements of Section 7. * For *buildings* that will have no *service* *water-heating* loads, no *service* *water-heating* *system* shall be modeled.   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. | | The *service* *water-heating* *system* in the *baseline building design* shall be as specified in Table G3.1.1-2 and conform with the following conditions:   * Where a complete *service* *water-heating* *system* exists or a new *service* *water-heating* *system* has been specified, one *service water-heating* *system* shall be modeled for each *building* area type in the proposed *building*. Each *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. * Where no *service* *water-heating* *system* exists or has been specified but the *building* will have *service* *water-heating* loads, one *service water-heating* *system* shall be modeled for each anticipated *building* area type in the *proposed design*. Each *system* shall meet the minimum *efficiency* requirements of Section 7.4.2 and be modeled identically to the *proposed design*. * For *buildings* that will have no *service* *water-heating* loads, no *service* *water-heating* shall be modeled. * 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 minimum *efficiency* requirements applicable to each *system* individually. * 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. * If a condenser heat recovery *system* meeting the requirements described in Section 6.5.6.2 cannot be modeled, the requirement for including such a *system* in the actual *building* shall be met as a prescriptive requirement in accordance with Section 6.5.6.2, and no heat recovery *system* shall be included in the *proposed design* or *baseline building design*. * *Service* *water-heating* *energy* consumption shall be calculated explicitly based upon the volume of *service* *water heating* required and the entering makeup water and the leaving *service* *water-heating* temperatures. Entering water temperatures shall be estimated based upon the location. Leaving temperatures shall be based upon the end-use requirements. * Where recirculation pumps are used to ensure prompt availability of *service* *water-heating* at the end use, the *energy* consumption of such pumps shall be calculated explicitly.  1. *Service* water loads and use shall be the same for both the *proposed design* and *baseline building design* and shall be documented by the calculation procedures described in Section 7.4.1.   *Service water-heating* use 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. |
| 11. *Service Water-Heating* *Systems* (contd.) | | |
|  | | * *Service water-heating* *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. * *Service* *water heating* use 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. * Gas storage *water heaters* shall be modeled using natural gas as their *fuel*.   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*. |
| 12. Receptacle and Other Loads | | |
| Receptacle and *process loads*, such as those for office and other *equipment*, shall be estimated based on the *building area type* or *space* type category and shall be assumed to be identical in the *proposed design* and *baseline building design*, except as specifically approved by the *rating authority* only when quantifying performance that exceeds the requirements of Standard 90.1 but not when the *Performance Rating Method* is used as an alternative path for minimum standard compliance in accordance with Section 4.2.1.1. These loads shall always be included in simulations of the *building*. These loads shall be included when calculating the *proposed building performance* and the *baseline building performance* as required by Section G1.2.1.   * 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 Sections 8 and 10 have not been submitted with design documents, those *systems* shall comply with but not exceed the requirements of those sections. | | Motors shall have the *efficiency* ratings found in Table G3.9.1. Other *systems* covered by Section 10 and miscellaneous loads shall be modeled as identical to those in the *proposed design*, including schedules of operation and *control* of the *equipment*. *Energy* used for cooking *equipment*, receptacle loads, computers, medical or laboratory *equipment*, and manufacturing and industrial process *equipment* not specifically identified in the standard power and *energy* rating or capacity of the *equipment* shall be identical between the *proposed building performance* and the *baseline building performance*.  When quantifying performance that exceeds the requirements of Standard 90.1 (but not when using the *Performance Rating Method* as an alternative path for minimum standard compliance per Section 4.2.1.1) variations of the power requirements, schedules, or *control* sequences of the *equipment* modeled in the *baseline building design* from those in the *proposed design* shall be approved by the *rating authority* based on documentation that the *equipment* installed in the *proposed design* represents a significant verifiable departure from documented current conventional practice. The burden of this documentation is to demonstrate that accepted conventional practice would result in baseline *building* *equipment* different from that installed in the *proposed design*. Occupancy and occupancy schedules shall not be changed. |
| 13. Modeling Limitations to the *Simulation Program* | |  |
| If the *simulation program* cannot model a component or *system* included in the *proposed design* explicitly, substitute a thermodynamically similar component model that can approximate the expected performance of the component that cannot be modeled explicitly. | | Same as *proposed design*. |
| 14. Exterior Conditions | | |
| **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. | | Same as *proposed design*. |
| 14. Exterior Conditions (contd.) | | |
| * **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*.   **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. | | Same as *proposed design.* |
| 15. Distribution *Transformers* | | |
| 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 design* *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 *proposed design*. |
| 16. Elevators | | |
| Where the *proposed* *design* includes elevators, the elevator motor, *ventilation* fan, and light load shall be included in the model. The cab *ventilation* fan and lights shall be modeled with the same schedule as the elevator motor. | | Where the *proposed design* includes elevators, the *baseline building design* shall be modeled to include the elevator cab motor, *ventilation* fans, and lighting power.  The elevator peak motor power shall be calculated as follows:  bhp = (Weight of Car + Rated Load – Counterweight) × Speed of Car/(33,000 × *hmechanical*)  *Pm*= bhp × 746/*hmotor*  where  Weight of Car = the *proposed design* elevator car weight, lb  Rated Load = the *proposed design* elevator load at which to operate, lb  Counterweight of Car = the elevator car counterweight, from Table G3.9.2, lb  Speed of Car = the speed of the proposed elevator, ft/min  *hmechanical* = the mechanical *efficiency* of the elevator from Table G3.9.2  *hmotor* = the motor *efficiency* from  Table G3.9.2  *Pm* = peak elevator motor power,W  The elevator motor use shall be modeled with the same schedule as the *proposed design*.  When included in the *proposed design*, the baseline elevator cab *ventilation* fan shall be 0.33 W/cfm and the *lighting power density* shall be 3.14 W/ft2; both operate continuously. |
| 17. Refrigeration | | |
| The *proposed design* shall be modeled using the actual *equipment* capacities and efficiencies. | | Where refrigeration *equipment* is specified in the *proposed design* and listed in Tables G3.10.1 and G3.10.2, the *baseline building design* shall be modeled as specified in Tables G3.10.1 and G3.10.2 using the actual *equipment* capacities.  If the refrigeration *equipment* is not listed in Tables G3.10.1 and G3.10.2, the *baseline building design* shall be modeled the same as the *proposed design*. |

* **Baseline HVAC System Type and Description**

*HVAC systems* in the *baseline building design* shall comply with the following:

* *HVAC systems* in the *baseline building design* shall be determined in the following order of priority:
* The *building* type with the largest *conditioned floor area*.
* Number of *floors* (including *floors* above grade and below *grade* but not including *floors* solely devoted to parking).
* *Gross conditioned floor area*.
* Climate zone as specified in Table G3.1.1-3, which 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.

**TABLE G3.1.1-1 BASELINE BUILDING VERTICAL FENESTRATION**

**PERCENTAGE OF GROSS ABOVE-GRADE-WALL AREA**

|  |  |
| --- | --- |
| **Building Area Typesa** | **Baseline Building Gross Above-Grade-Wall Area** |
| Grocery Store | 7% |
| Healthcare (outpatient) | 21% |
| Hospital | 27% |
| Hotel/motel (≤75 rooms) | 24% |
| Hotel/motel (>75 rooms) | 34% |
| Office (≤5000 ft2) | 19% |
| Office (5000 to 50,000 ft2) | 31% |
| Office (>50,000 ft2) | 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% |

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| --- | --- | --- | --- |
| * **Baseline *Service* *Water-Heating* *System*** | | | |
| ***Building* Area Type** | **Baseline Heating Method** | ***Building* Area Type** | **Baseline Heating Method** |
| Automotive facility | Gas storage *water heater* | Performing arts theater | Gas storage *water heater* |
| Convenience store | *Electric resistance* *water heater* | Police station | *Electric resistance* storage *water heater* |
| Convention center | *Electric resistance* storage *water heater* | Post office | *Electric resistance* storage *water heater* |
| Courthouse | *Electric resistance* storage *water heater* | Religious *facility* | *Electric resistance* storage *water heater* |
| Dining: Bar lounge/leisure | Gas storage *water heater* | Retail | *Electric resistance* storage *water heater* |
| Dining: Cafeteria/fast food | Gas storage *water heater* | School/university | Gas storage *water heater* |
| Dining: Family | Gas storage *water heater* | Sports arena | Gas storage *water heater* |
| Dormitory | Gas storage *water heater* | Town hall | *Electric resistance* storage *water heater* |
| Exercise center | Gas storage *water heater* | Transportation | *Electric resistance* storage *water heater* |
| Fire station | Gas storage *water heater* | Warehouse | *Electric resistance* storage *water heater* |
| Grocery store | Gas storage *water heater* | Workshop | *Electric resistance* storage *water heater* |
| Gymnasium | Gas storage *water heater* | All others | Gas storage *water heater* |
| Health-care clinic | *Electric resistance* storage *water heater* |  | |
| Hospital and outpatient surgery center | 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* |

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| * **Baseline *HVAC System* Types** | | |
| ***Building* Type, Number of *Floors*, and**  **Gross Conditioned Floor Area** | **Climate Zones 3B, 3C, and 4 to 8** | **Climate Zones 0 to 3A** |
| Residential | *System* 1—*PTAC* | *System* 2—*PTHP* |
| Public assembly <120,000 ft2 | *System* 3—PSZ-AC | *System* 4—PSZ-HP |
| Public assembly 120,000 ft2 | *System* 12—SZ-CV-HW | *System* 13—SZ-CV-ER |
| Heated-only storage | *System* 9—Heating and *ventilation* | *System* 10—Heating and *ventilation* |
| Retail and 2 *floors* or fewer | *System* 3—PSZ-AC | *System* 4—PSZ-HP |
| Other residential and 3 *floors* or fewer and <25,000 ft2 | *System* 3—PSZ-AC | *System* 4—PSZ-HP |
| Other residential and 4 or 5 *floors* and <25,000 ft2 or  5 *floors* or fewer and 25,000 ft2 to 150,000 ft2 | *System* 5—Packaged *VAV* with *reheat* | *System* 6—Packaged *VAV* with PFP boxes |
| Other residential and more than 5 *floors* or >150,000 ft2 | *System* 7—*VAV* with *reheat* | *System* 8—*VAV* with PFP boxes |
| 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 Section G3.1.1.  3. For laboratory *spaces* in a *building* having a total laboratory exhaust rate greater than 15,000 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. | | |

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| * **Baseline *System* Descriptions** | | | | |
| ***System* No.** | ***System* Type** | **Fan *Control*** | **Cooling Typea** | **Heating Typea** |
| 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 (b). |
| 12. SZ-CV-HW | Single-zone system | Constant volume | Chilled water | Hot-water *fossil fuel* *boiler* |
| 13. SZ-CV-ER | Single-zone system | Constant volume | Chilled water | Electric resistance |
| a. For purchased chilled water and purchased heat, see G3.1.1.3.  b. For Climate Zones 0 through 3A, the heating type shall be *electric resistance*. For all other climate zones the heating type shall be hot-water fossil-*fuel* *boiler*. | | | | |

* Use additional *system* types for nonpredominant conditions (*i.e*., *residential*/*nonresidential* or heating source) if those conditions apply to more than 20,000 ft2 of *conditioned floor area*.
* 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·ft2 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*.
* For laboratory *spaces* in a *building* having a total laboratory exhaust rate greater than 15,000 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.
* Thermal zones designed with heating-only *systems* in the *proposed design* 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 use *system* type 9 or 10 in the *baseline building design*.
* If the baseline *HVAC system* type is 9 or 10, all *spaces* that are mechanically cooled in the *proposed design* shall be assigned to a separate baseline *system* determined by using the area and heating source of the mechanically *cooled spaces*.
* *Computer rooms* in *buildings* with a total *computer room* peak cooling load >3,000,000 Btu/h 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.
* For hospitals, depending on *building* type, use *System* 5 or 7 in all climate zones.

**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 design and baseline building design. 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 design and baseline building design. 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 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 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 proposed design and baseline building design.

**G3.1.1.3.2 Purchased Chilled Water Only.** If the proposed 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 boilers.

c. System 3 and 4 shall be constant-volume single-zone air handlers with fossil fuel furnaces.

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 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 proposed design and base building design.

**G3.1.1.4 Modeling Building Envelope Infiltration.** The air leakage rate of the *building envelope* (*I75Pa*) at a pressure differential of 0.3 in. of water shall be converted to appropriate units for the simulation program using one of the following formulas:

For methods describing air leakage as a function of floor area,

*IFLR* = 0.112 × *I75Pa* × *S*/*AFLR*

For methods describing air leakage as a function of the area of above-grade walls that separate conditioned spaces and semiheated spaces from the exterior ,

*IAGW* = 0.112 × *I75Pa* × *S/ AAGW*

When using the measured air leakage rate of the *building envelope* at a pressure differential of 0.3 in. of water for the proposed design, the air leakage rate shall be calculated as follows:

*I75Pa* = *Q/S*

where

*I75Pa* = air leakage rate of the *building envelope* (cfm/ft2)at a fixed building pressure differential of 0.3 in. of water, or 1.57 psf

*Q* = volume of air in cfm flowing through the *building envelope* when subjected to a pressure differential of 0.3 in. of water, or 1.57 psf, in accordance with ASTM E 779

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

*IFLR* = adjusted air leakage rate of the *building envelope* (cfm/ft2) at a reference wind speed of 10 mph and relative to the *gross floor area*

*AFLR* = gross floor area, ft2

*IAGW* = adjusted air leakage rate of the *building envelope* (cfm/ft2) at a reference wind speed of 10 mph and relative to the area of the *above-grade walls* of the *building envelope*

*AAGW*= total area of *above-grade walls* of the *building envelope*, ft2

**Exception:** A multizone airflow model alternative method to modeling *building envelope* air leakage may be used provided the following criteria are met:

1. Where the calculations are made independently of the energy simulation program, the proposed method mustshall comply with Section G2.5.

2. The method for converting the air leakage rate of the *building envelope* at 0.3 in. of water, 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-8 × EER × *Q* + 0.338 × EER COP*nfcooling* = –0.0076 × SEER2 + 0.3796 × SEER

COP*nfheating* = 1.48E-7 × COP*47* × *Q* + 1.062 × COP*47*

(applies to heat-pump heating efficiency only) COP*nfheating* = –0.0296 × HSPF2 +

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 design, which excludes supply fan power, and *Q* is the AHRI-rated cooling capacity in Btu. EER, SEER, COP, and HSPF shall be at AHRI test conditions. Fan energy shall be modeled separately according to Section G3.1.2.9.

**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 heating.

**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 proposed design or baseline building design shall not exceed 300 (of the 8760 hours simulated). Alternatively, unmet load hours exceeding these limits shall be permitted to be accepted upon approval 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. Supply, 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.

**G3.1.2.4**

For *Systems* 6 and 8, only the *terminal*-unit fan and *reheat* coil shall be energized to meet heating *set point* during unoccupied hours.

**G3.1.2.5 Ventilation.** Minimum ventilation system outdoor air intake flow shall be the same for the proposed design and baseline building design.

**Exception to G3.1.2.5:**

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 ft2 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 (*Ez*) > 1.0 as defined by Standard 62.1, in Table 6-2. 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 (*Ez*) = 1.0 in each zone having a zone air distribution effectiveness (*Ez*) > 1.0. Proposed design and baseline building 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. Where the minimum outdoor air intake flow in the proposed design is provided in excess of the amount required by the building code or the rating authority, then the baseline building design shall be modeled to reflect the greater of that required by either the rating authority or the building code 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**. Air economizers shall not be included in baseline HVAC Systems 1, 2, 9, and 10. Air economizers shall be included in baseline HVAC Systems 3 through 8, and 11, 12, and 13 based on climate as specified in Table G3.1.2.6.

|  |  |
| --- | --- |
| * **Climate Conditions under which Economizers are Included for Comfort Cooling for Baseline *Systems* 3 through 8 and 11, 12, and 13** | |
| **Climate Zone** | **Conditions** |
| 0A, 0B, 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. | |

**Exception to G3.1.2.6:** 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 system 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 G3.1.2.6.1.

**G3.1.2.6.1 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 fluid economizer meeting the requirements of Section 6.5.1.2 in the baseline building design.

**G3.1.2.7 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 G3.1.2.7.

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| * **Economizer High-Limit Shutoff Temperature** | |
| **Climate Zone** | **Dry-Bulb Temperature *Set Point*** |
| 2B, 3B, 3C, 4B, 4C, 5B, 5C, 6B, 7, 8 | 75°F |
| 5A, 6A | 70°F |

**G3.1.2.8 Design Airflow Rates**

**G3.1.2.8.1 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- temperature set-point difference of 20°F or the *minimum outdoor airflow* rate, or the airflow rate required to comply with applicable codes or accreditation standards, whichever is greater. For systems with multiple zone thermostat set-points, use the design set point that will result in the lowest supply air cooling set point or highest supply air heating set point. 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 baseline system supply fan air quantity less the minimum outdoor air, or 90% of the supply fan air quantity, whichever is larger.

**Exception to G3.1.2.8.1:**

1. For systems serving laboratory spaces, airflow rate shall be based on a supply-air-to-room- temperature set-point difference of 17°F or the required ventilation air or makeup air, whichever is greater.

2. If the proposed design HVAC system 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.

**G3.1.2.8.2 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 design includes a fan 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 design.

**G3.1.2.9 System Fan Power.** System fan electrical power for supply, return, exhaust, and relief (excluding power to fan-powered VAV boxes) shall be calculated using the following formulas:

For Systems 1 and 2,

*Pfan* = CFMs × 0.3

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

*Pfan* = bhp × 746/fan motor efficiency

For Systems 9 and 10 (supply fan),

*Pfan* = CFMs × 0.3

For Systems 9 and 10 (nonmechanical cooling fan if required by Section G3.1.2.8.2)

*Pfan* = CFM*nmc* × 0.054

where

*Pfan* = electric power to fan motor, W

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

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

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

CFM*nmc* = the baseline non-*mechanical cooling* fan air

flow, cfm

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| --- | --- | --- |
| * **Baseline *Fan Brake Horsepower*** | | |
| **Baseline Fan Motor Brake Horsepower** | | |
| **Constant-Volume *Systems* 3 to 4** | **Variable-Volume *Systems* 5 to 8** | **Variable-Volume *System* 11** |
| CFM*s*× 0.00094 + *A* | CFM*s* × 0.0013 + *A* | CFM*s* × 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 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. | | |

**G3.1.2.9.1** The calculated *system* fan power shall be distributed to supply, return, exhaust, and relief fans in the same proportion as the *proposed design*.

**G3.1.2.10 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% *enthalpy recovery ratio*. Fifty percent *enthalpy recovery ratio* 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 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 0 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.*

**G3.1.3 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 air thermostat. The systems shall be controlled to energize auxiliary heat only when the outdoor 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 proposed 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 ft2 or less and as having two equally sized boilers for plants serving more than 15,000 ft2. 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.

**Exception to G3.1.3.4**

Systems served by purchased heat.

**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 and a minimum of 25% of the design flow rate. Hot-water systems serving 120,000 ft2or more shall be modeled with variable-speed drives, and systems serving less than 120,000 ft2shall be modeled as riding the pump curve.

**Exception to G3.1.3.5:** 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 design or baseline building design 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.

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| * **Type and Number of Chillers** | |
| ***Building* Peak Cooling Load** | **Number and Type of Chillers** |
| 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 |

**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 to G3.1.3.9:**

* 1. 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.
  2. Systems served by purchased chilled water.

**G3.1.3.10 Chilled-Water Pumps (Systems 7, 8, and 11).** Chilled-water *systems* shall be modeled as primary/secondary *systems* with constant-flow primary loop and variable-flow secondary loop. For *systems* with cooling capacity of 300 tons or more, the secondary pump shall be modeled with variable-speed drives and a minimum flow of 25% of the design flow rate. For *systems* with less than 300 tons cooling capacity, the secondary pump shall be modeled as riding the pump curve. The baseline *building* constant-volume primary pump power shall be modeled as 9 W/gpm, and the variable-flow secondary pump power shall be modeled as 210 W/gpm at *design conditions*. For *computer room* *systems* using *System* 11 with an integrated *fluid economizer*, the *baseline building design* primary chilled-water pump power shall be increased by 3 W/gpm for flow associated with the *fluid economizer*.

**Exception to G3.1.3.10**

For *systems* using purchased chilled water, the *building* distribution pump shall be modeled with variable-speed drive, a minimum flow of 25% of the design flow rate, and a pump power of 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 have an efficiency of 38.2 gpm/hp at the conditions specified in 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 5.6°C.

Approach*10°F Range* = 25.72 – (0.24 × WB)

where WB is the 0.4% evaporation design wet-bulb temperature in °F; valid for wet bulbs from 55°F to 90°F. The tower shall be controlled to maintain a leaving water temperature, where weather permits, per Table G3.1.3.11, floating up to the design leaving water temperature for the cooling tower. The baseline building design condenser-water pump power shall be 19 W/gpm and modeled as constant volume. For computer room systems using System 11 with an integrated water-side economizer, the baseline building design condenser water-pump power shall be increased by 3 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.

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| * **Heat-Rejection Leaving Water Temperature** | |
| **Climate Zone** | **Leaving Water Temperature** |
| 5B, 5C, 6B, 8 | 65°F |
| 0B, 1B, 2B, 3B, 3C, 4B, 4C, 5A, 6A, 7 | 70°F |
| 3A,4A | 75°F |
| 0A, 1A, 2A | 80°F |

**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 to G3.1.3.13:** 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 airfl*ow 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 run as the first stage of heating before the *reheat* coil is energized. 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.

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| --- | --- |
| * **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** | |
| *Pfan* = 0.0013 + 0.1470  PLR*fan* + 0.9506  (PLR*fan*)2 – 0.0998  (PLR*fan*)3  where  *Pfan* = fraction of full-load fan power and  PLR*fan* = fan part-load ratio (current cfm/design cfm). | |

**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 and 11, 12, and 13).** 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 less than the design room heating temperature setpoint.

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| **Table G3.4 *Performance Rating Method* *Building Envelope* Requirements for Climate Zone 4 (A,B,C)\*** | | | | | | |
| ***Opaque* Elements** | **Nonresidential** | | **Residential** | | **Semiheated** | |
| **Assembly Maximum** | | **Assembly Maximum** | | **Assembly Maximum** | |
| Roofs | | | | | | |
| Insulation entirely above deck | U-0.063 | | U-0.063 | | U-0.218 | |
| Walls, Above-Grade | | | | | | |
| Steel-framed | U-0.124 | | U-0.064 | | U-0.124 | |
| Wall, Below-Grade | | | | | | |
| Below-grade wall | C-1.140 | | C-1.140 | | C-1.140 | |
| Floors | | | | | | |
| Steel-joist | U-0.052 | | U-0.038 | | U-0.069 | |
| Slab-on-Grade Floors | | | | | | |
| Unheated | F-0.730 | | F-0.730 | | F-0.730 | |
| Opaque Doors | | | | | | |
| Swinging | U-0.700 | | U-0.700 | | U-0.700 | |
| Nonswinging | U-1.450 | | U-0.500 | | U-1.450 | |
| **Fenestration** | **Assembly**  **Max. U** | **Assembly Max. *SHGC*** | **Assembly**  **Max. U** | **Assembly Max. *SHGC*** | **Assembly**  **Max. U** | **Assembly Max. *SHGC*** |
| Vertical Glazing, % of *Wall* | | | | | | |
| 0% to 10.0% | U*all*-0.57 | *SHGCall*-0.39 | U*all*-0.57 | *SHGCall*-0.39 | U*all*-1.22 | *SHGCall*-NR |
| 10.1% to 20.0% | U*all*-0.57 | *SHGCall*-0.39 | U*all*-0.57 | *SHGCall*-0.39 | U*all*-1.22 | *SHGCall*-NR |
| 20.1% to 30.0% | U*all*-0.57 | *SHGCall*-0.39 | U*all*-0.57 | *SHGCall*-0.39 | U*all*-1.22 | *SHGCall*-NR |
| 30.1% to 40.0% | U*all*-0.57 | *SHGCall*-0.39 | U*all*-0.57 | *SHGCall*-0.39 | U*all*-1.22 | *SHGCall*-NR |
| *Skylight* All, % of *Roof* | | | | | | |
| 0% to 2.0% | U*all*-0.69 | *SHGCall*-0.49 | U*all*-0.58 | *SHGCall*-0.36 | U*all*-1.36 | *SHGCall*-NR |
| 2.1%+ | U*all*-0.69 | *SHGCall*-0.39 | U*all*-0.58 | *SHGCall*-0.19 | U*all*-1.36 | *SHGCall*-NR |
| \*The following definitions apply: c.i. = *continuous insulation* (see Section 3.2), NR = no (insulation) requirement.  a. Exception to Section A3.1.3.1 applies. | | | | | | |

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

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

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| --- | --- | --- | --- | --- |
| * ***Performance Rating Method* Water Chilling Packages—Minimum *Efficiency* Requirements** | | | | |
| ***Equipment* Type** | **Size Category** | **Subcategory or Rating Condition** | **Minimum *Efficiency*** | **Test Procedure** |
| Water-cooled, electrically operated, positive displacement (rotary screw and scroll) | <150 tons | *kW*/ton | 0.790 FL 0.676 *IPLV*.IP | ARI 550/590 |
| 150 tons and <300 tons | 0.718 FL 0.629 *IPLV*.IP |
| 300 tons | 0.639 FL 0.572 *IPLV*.IP |
| Water-cooled, electrically operated, centrifugal | <150 tons | *kW*/ton | 0.703 FL 0.670 *IPLV*.IP | ARI 550/590 |
| 150 tons and <300 tons | 0.634 FL  0.596 *IPLV*.IP |
| 300 tons | 0.576 FL   * 1. *IPLV*.IP |

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

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| --- | --- | --- | --- | --- |
| **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  ARI 310/380  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 |

* **Warm-Air Furnaces and Unit Heaters**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Equipment Type** | **Size Category** | **Subcategory or Rating Condition** | **Minimum Efficiency** | **Test Procedure** |
| Warm Air Furnace, Gas-Fired | <225,000 Btu/h |  | 78% AFUE or 80% *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 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * **Gas-Fired *Boilers*—Minimum *Efficiency* Requirements** | | | | |
| ***Equipment* Type** | **Size Category** | **Subcategory or Rating Condition** | **Minimum *Efficiency*** | **Test Procedure** |
| *Boilers*, gas-fired | <300,000 Btu/h | Hot water | 80% *AFUE* | DOE 10 CFR Part 430 |
| 300,000 Btu/h and  2,500,000 Btu/h | Maximum capacity | 75% *Et* | DOE 10 CFR Part 431 |
| >2,500,000 Btu/h | Hot water | 80% *Ec* |

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| * ***Lighting Power Densities* for *Building* Exteriors** | | |
|  | | **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 | **0.2**W/ft2 | |
| **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.) | | Special Feature Areas |  | |
| 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 | |

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| * ***Performance Rating Method* *Lighting Power Density* Allowances and Occupancy Sensor Reductions Using the Space-by-Space Method** | | |
| **Common *Space* Typesa** | ***Lighting Power Density*, W/ft2** | **Occupancy Sensor Reductionb** |
| **Audience Seating Area** | | |
| Auditorium | 0.90 | 10% |
| Convention center | 0.70 | 10% |
| Exercise center | 0.30 | 10% |
| Gymnasium | 0.40 | 10% |
| Motion picture theater | 1.20 | 10% |
| Penitentiary | 0.70 | 10% |
| Performing arts theater | 2.60 | 10% |
| Religious facility | 1.70 | 10% |
| In a sports arena | 0.40 | 10% |
| Transportation facility | 0.50 | 10% |
| All other audience seating area | 0.90 | 10% |
| **Atrium** | | |
| 40 ft in height | 0.0375 per foot in total height | 10% |
| >40 ft in height | 0.50 + 0.025 per foot in total height | 10% |
| Banking Activity Area | 1.50 | 10% |
| Breakroom (See Lounge/Breakroom) | | |
| Classroom/Lecture Hall/Training Room | | |
| Penitentiary | 1.30 | None |
| Preschool through 12th grade, laboratory, and shop classrooms | 1.40 | 30% |
| All other classroom/lecture hall/training room | 1.40 | None |
| Conference/Meeting/Multipurpose Room | 1.30 | None |
| Confinement Cells | 0.90 | 10% |
| Copy/Print Room | 0.90 | 10% |
| **Corridor** | | |
| Facility for the visually impaired (and used primarily by residents) | 1.15 | 25% |
| Hospital | 1.00 | 25% |
| Manufacturing facility | 0.50 | 25% |
| All other corridor | 0.50 | 25% |
| Courtroom | 1.90 | 10% |
| Computer Room | 2.14 | 35% |
| **Dining Area** | | |
| Penitentiary | 1.30 | 35% |
| Facility for the visually impaired (and used primarily by residents) | 3.32 | 35% |
| Bar/lounge or leisure dining | 1.40 | 35% |
| Cafeteria or fast food dining | 0.90 | 35% |
| Family dining | 2.10 | 35% |
| All other dining area | 0.90 | 35% |
| Electrical/Mechanical Room | 1.50 | 30% |
| Emergency Vehicle Garage | 0.80 | 10% |
| Food Preparation Area | 1.20 | 30% |
| Guest Room | 1.14 | 45% |
| Judges Chambers | 1.30 | 30% |
| Common *Space* Typesa | *Lighting Power Density*, W/ft2 | Occupancy Sensor Reductionb |
| Laboratory | | |
| In or as a classroom | 1.40 | None |
| All other laboratory | 1.40 | 10% |
| Laundry/Washing Area | 0.60 | 10% |
| Loading Dock, Interior | 0.59 | 10% |
| Lobby | | |
| Facility for the visually impaired (and used primarily by residents) | 2.26 | 25% |
| Elevator | 0.80 | 25% |
| Hotel | 1.10 | 25% |
| Motion picture theater | 1.10 | 25% |
| Performing arts theater | 3.30 | 25% |
| All other lobby | 1.30 | 25% |
| *Locker Room* | *0.60* | *25%* |
| *Lounge/Breakroom* | | |
| Healthcare facility | 0.80 | None |
| All other lounge/breakroom | 1.20 | None |
| Office | | |
| Enclosed | 1.10 | 30% |
| Open plan | 1.10 | 15%c |
| Parking Area, Interior | 0.20 | 15% |
| Pharmacy Area | 1.20 | 10% |
| Restroom | | |
| Facility for the visually impaired (and used primarily by residents) | 1.52 | 45% |
| All other restroom | 0.90 | 45% |
| Sales Area | 1.70 | 15% |
| Seating Area, General | 0.68 | 10% |
| Stairwell | 0.60 | 75% |
| Storage Room | | |
| Hospital | 0.90 | 45% |
| **50 ft2 | 0.80 | 45% |
| <50 ft2 | 0.80 | 45% |
| Vehicular Maintenance Area | 0.70 | 10% |
| Workshop | 1.90 | 10% |
| *Building* Type Specific *Space* Types a | *Lighting Power Density*, W/ft2 | Occupancy Sensor Reduction b |
| Assisted Living Facility | | |
| Chapel (used primarily by residents) | 2.77 | 10% |
| Recreation room (used primarily by residents) | 3.02 | 10% |
| Automotive (See “Vehicular Maintenance Area”) | | 10% |
| Convention Center—Exhibit *Space* | 1.30 | 35% |
| Dormitory—Living Quarters | 1.11 | 10% |
| Fire Station—Sleeping Quarters | 0.30 | 10% |
| ***Building* Type Specific *Space* Types a** | ***Lighting Power Density*, W/ft2** | **Occupancy Sensor Reduction b** |
| **Gymnasium/Fitness Center** | | |
| Exercise area | 0.90 | 35% |
| Playing area | 1.40 | 35% |
| Healthcare Facility | | |
| Emergency room | 2.70 | 10% |
| Exam/treatment room | 1.50 | 10% |
| Medical supply room | 1.40 | 45% |
| Nursery | 0.60 | 10% |
| Nurse's station | 1.00 | 10% |
| Operating room | 2.20 | 10% |
| Patient room | 0.70 | 10% |
| Physical therapy room | 0.90 | 10% |
| Recovery room | 0.80 | 10% |
| Library | | |
| Reading area | 1.20 | 15% |
| Stacks | 1.70 | 15% |
| Manufacturing Facility | | |
| Detailed manufacturing area | 2.10 | 10% |
| *Equipment* room | 1.20 | 10% |
| Extra-high bay area (>50 ft *floor*-to-ceiling height) | 1.32 | 10% |
| High bay area (25 to 50 ft *floor*-to-ceiling height) | 1.70 | 10% |
| Low bay area (<25 ft *floor*-to-ceiling height) | 1.20 | 10% |
| Museum | | |
| General exhibition area | 1.00 | 10% |
| Restoration room | 1.70 | 10% |
| Post Office—Sorting Area | 1.20 | 10% |
| **Religious Facility** | | |
| Fellowship hall | 0.90 | 10% |
| Worship/pulpit/choir area | 2.40 | 10% |
| Retail Facilities | | |
| Dressing/fitting room | 0.89 | 10% |
| Mall concourse | 1.70 | 10% |
| Sports Arena—Playing Area | | |
| Class I facility | 4.61 | 10% |
| Class II facility | 3.01 | 10% |
| Class III facility | 2.26 | 10% |
| Class IV facility | 1.50 | 10% |
| Transportation Facility | | |
| Baggage/carousel area | 1.00 | 10% |
| Airport concourse | 0.60 | 10% |
| *Terminal* ticket counter | 1.50 | 10% |
| Warehouse—Storage Area | | |
| Medium to bulky, palletized items | 0.90 | 45% |
| Smaller, hand-carried items | 1.40 | 45% |
| a. In cases where both a common *space* type and a *building* area specific *space* type are listed, the *building* area specific *space* type shall apply  b. For *manual*-on or partial-auto-on occupancy sensors, the occupancy sensor reduction factor shall be multiplied by 1.25.  c. For occupancy sensors controlling individual workstation lighting, occupancy sensor reduction factor shall be 30%. | | |
|  | | |

*Add new Table G.3.8*

*Table G3.8 Performance Rating Method* *Lighting Power Densities* Using  
the *Building* Area Method

|  |  |
| --- | --- |
| Building Area Type | LPD (W/ft2) |
| Automotive facility |  | 0.90 |
| Convention center |  | 1.20 |
| Courthouse |  | 1.20 |
| Dining: bar lounge/leisure |  | 1.30 |
| Dining: cafeteria/fast food |  | 1.40 |
| Dining: family |  | 1.60 |
| Dormitory |  | 1.00 |
| Exercise center |  | 1.00 |
| Fire station |  | 1.00 |
| Gymnasium |  | 1.10 |
| Health-care clinic |  | 1.00 |
| Hospital |  | 1.20 |
| Hotel |  | 1.09 |
| Library |  | 1.30 |
| Manufacturing facility |  | 1.17 |
|  |  |  |
| Motion picture theater |  | 1.20 |
| Multifamily |  | 0.70 |
| Museum |  | 1.10 |
| Office |  | 1.00 |
| Parking garage |  | 0.30 |
| Penitentiary |  | 1.00 |
| Performing arts theater |  | 1.60 |
| Police station |  | 1.00 |
| Post office |  | 1.10 |
| Religious building |  | 1.30 |
| Retail |  | 1.50 |
| School/university |  | 1.20 |
| Sports arena |  | 1.10 |
| Town hall |  | 1.10 |
| Transportation |  | 1.00 |
| Warehouse |  | 0.80 |
| Workshop |  | 1.40 |
|  |  |

|  |  |
| --- | --- |
| * ***Performance Rating Method* Motor *Efficiency* Requirements** | |
| **Motor Horsepower** | **Minimum Nominal Full-Load *Efficiency*, %** |
| 1.0 | 82.5 |
| 1.5 | 84.0 |
| 2.0 | 84.0 |
| 3.0 | 87.5 |
| 5.0 | 87.5 |
| 7.5 | 89.5 |
| 10.0 | 89.5 |
| 15.0 | 91.0 |
| 20.0 | 91.0 |
| 25.0 | 92.4 |
| 30.0 | 92.4 |
| 40.0 | 93.0 |
| 50.0 | 93.0 |
| 60.0 | 93.6 |
| 75.0 | 94.1 |
| 100.0 | 94.5 |
| 125.0 | 94.5 |
| 150.0 | 95.0 |
| 200.0 | 95.0 |

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| * ***Performance Rating Method* Baseline Elevator Motor** | | | | |
| **Number of Stories (Including Basement)** | **Motor Type** | **Counterweight** | **Mechanical *Efficiency*** | **Motor Efficiencya** |
| 4 | Hydraulic | None | 58% | Table G3.9.3 |
| >4 | Traction | *Proposed design* counterweight, if not specified use weight of the car plus 40% of the rated load | 64% | Table G3.9.1 |
| a. Use the *efficiency* for the next motor size greater than the calculated bhp. | | | | |

|  |  |
| --- | --- |
| * ***Performance Rating Method* Hydraulic Elevator Motor *Efficiency*** | |
| **Horsepower** | **Full-Load *Efficiency*** |
| 10 | 72% |
| 20 | 75% |
| 30 | 78% |
| 40 | 78% |
| 100 | 80% |

|  |  |  |  |
| --- | --- | --- | --- |
| * ***Performance Rating Method* Commercial Refrigerators and Freezers** | | | |
| ***Equipment* Type** | **Application** | ***Energy* Use Limits,**  **kWh/day** | **Test Procedure** |
| Refrigerator with solid *doors* | Holding temperature | 0.125 × *V* + 2.76 | AHRI 1200 |
| Refrigerator with transparent *doors* | 0.172 × *V* + 4.77 |
| Freezers with solid *doors* | 0.398 × *V* + 2.28 |
| Freezers with transparent *doors* | 0.94 × *V* + 5.10 |
| Refrigerators/freezers with solid *doors* | 0.12 × *V* + 4.77 |
| Commercial refrigerators | Pulldown | 0.181 × *V* + 5.01 |
| ***Note:*** *V* is the chiller or frozen compartment volume (ft3) as defined in Association of Home Appliance Manufacturers Standard HRF-1. | | | |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| * ***Performance Rating Method* Commercial Refrigeration** | | | | | |
| ***Equipment* Type** | | | | | |
| ***Equipment* Classa** | **Family Code** | **Operating Mode** | **Rating Temperature** | ***Energy* Use Limits,b,c kWh/day** | **Test Procedure** |
| VOP.RC.M | Vertical open | Remote condensing | Medium temperature | 1.01 × TDA + 4.07 | AHRI 1200 |
| SVO.RC.M | Semivertical open | Remote condensing | Medium temperature | 1.01 × TDA + 3.18 |
| HZO.RC.M | Horizontal open | Remote condensing | Medium temperature | 0.51 × TDA + 2.88 |
| VOP.RC.L | Vertical open | Remote condensing | Low temperature | 2.84 × TDA + 6.85 |
| HZO.RC.L | Horizontal open | Remote condensing | Low temperature | 0.68 × TDA + 6.88 |
| VCT.RC.M | Vertical transparent *door* | Remote condensing | Medium temperature | 0.48 × TDA + 1.95 |
| VCT.RC.L | Vertical transparent *door* | Remote condensing | Low temperature | 1.03 × TDA + 2.61 |
| SOC.RC.M | *Service* over counter | Remote condensing | Medium temperature | 0.62 × TDA + 0.11 |
| VOP.*SC*.M | Vertical open | Self-contained | Medium temperature | 2.34 × TDA + 4.71 |
| SVO.*SC*.M | Semivertical open | Self-contained | Medium temperature | 2.23 × TDA + 4.59 |
| HZO.*SC*.M | Horizontal open | Self-contained | Medium temperature | 1.14 × TDA + 5.55 |
| HZO.*SC*.L | Horizontal open | Self-contained | Low temperature | 2.63 × TDA + 7.08 |
| VCT.*SC*.I | Vertical transparent *door* | Self-contained | Ice cream | 1.63 × TDA + 3.29 |
| VCS.*SC*.I | Vertical solid *door* | Self-contained | Ice cream | 0.55 × *V* + 0.88 |
| HCT.*SC*.I | Horizontal transparent *door* | Self-contained | Ice cream | 1.33 × TDA + 0.43 |
| SVO.RC.L | Semivertical open | Remote condensing | Low temperature | 2.84 × TDA + 6.85 |
| VOP.RC.I | Vertical open | Remote condensing | Ice cream | 3.6 × TDA + 8.7 |
| SVO.RC.I | Semivertical open | Remote condensing | Ice cream | 3.6 × TDA + 8.7 |
| HZO.RC.I | Horizontal open | Remote condensing | Ice cream | 0.87 × TDA + 8.74 |
| VCT.RC.I | Vertical transparent *door* | Remote condensing | Ice cream | 1.2 × TDA + 3.05 |
| HCT.RC.M | Horizontal transparent *door* | Remote condensing | Medium temperature | 0.39 × TDA + 0.13 | AHRI 1200 |
| HCT.RC.L | Horizontal transparent *door* | Remote condensing | Low temperature | 0.81 × TDA + 0.26 |
| HCT.RC.I | Horizontal transparent *door* | Remote condensing | Ice cream | 0.95 × TDA + 0.31 |
| VCS.RC.M | Vertical solid *door* | Remote condensing | Medium temperature | 0.16 × *V* + 0.26 |
| VCS.RC.L | Vertical solid *door* | Remote condensing | Low temperature | 0.33 × *V* + 0.54 |
| VCS.RC.I | Vertical solid *door* | Remote condensing | Ice cream | 0.39 × *V* + 0.63 |
| HCS.RC.M | Horizontal solid *door* | Remote condensing | Medium temperature | 0.16 × *V* + 0.26 |
| HCS.RC.L | Horizontal solid *door* | Remote condensing | Low temperature | 0.33 × *V* + 0.54 |
| HCS.RC.I | Horizontal solid *door* | Remote condensing | Ice cream | 0.39 × *V* + 0.63 |
| SOC.RC.L | *Service* over counter | Remote condensing | Low temperature | 1.3 × TDA + 0.22 |
| SOC.RC.I | *Service* over counter | Remote condensing | Ice cream | 1.52 × TDA + 0.26 |
| VOP.*SC*.L | Vertical open | Self contained | Low temperature | 5.87 × TDA + 11.82 |
| VOP.*SC*.I | Vertical open | Self-contained | Ice cream | 7.45 × TDA + 15.02 |
| SVO.*SC*.L | Semivertical open | Self-contained | Low temperature | 5.59 × TDA + 11.51 |
| SVO.*SC*.I | Semivertical open | Self-contained | Ice cream | 7.11 × TDA + 14.63 |
| HZO.*SC*.I | Horizontal open | Self-contained | Ice cream | 3.35 × TDA + 9.0 |
| SOC.*SC*.I | *Service* over counter | Self-contained | Ice cream | 2.13 × TDA + 0.36 |
| HCS.*SC*.I | Horizontal solid *door* | Self-contained | Ice cream | 0.55 × *V* + 0.88 |
| a. *Equipment* class designations consist of a combination (in sequential order separated by periods [AAA].[BB].[C]) of the following: (AAA) An *equipment* family code (VOP = vertical open, SVO = semivertical open, HZO = horizontal open, VCT = vertical transparent *doors*, VCS = vertical solid *doors*, HCT = horizontal transparent *doors*, HCS = horizontal solid *doors*, and SOC = *service* over counter); (BB) An operating mode code (RC = remote condensing and *SC* = self-contained); and (C) A rating temperature code (M = medium temperature [38°F], L = low temperature [0°F], or I = ice cream temperature [15°F]). For example, “VOP.RC.M” refers to the “vertical open, remote condensing, medium temperature” *equipment* class.  b. *V* is the volume of the case (ft3) as measured in AHRI Standard 1200, Appendix C.  c. TDA is the total display area of the case (ft2) as measured in AHRI Standard 1200, Appendix D. | | | | | |

*Insert a new Appendix Z in the Energy Conservation Code-Commercial Provisions to read as follows:*

**APPENDIX Z NET-ZERO ENERGY COMPLIANCE PATH**

**Z1 GENERAL**

**Z2 MINIMUM PERFORMANCE REQUIREMENTS**

**Z3 RENEWABLE ENERGY**

**Z4 ENERGY METERING, MONITORING AND REPORTING**

**Z5** **ENERGY REPORTING**

**Z6 NORMATIVE REFERENCES**

**Z1 GENERAL.** Appendix Z is intended to be an optional alternative compliance path for *building 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, cooling, lighting and ventilation through the use of passive design and improved envelope performance techniques.
2. Reducing total building energy demand through the installation of high-efficiency mechanical systems, hot water systems, power systems, lighting, and process equipment.
3. Supplying remaining building energy needs from renewable sources 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 testing have been set to ensure new construction achieves a high degree of energy conservation.

**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 *building 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/ft2env), at 0.0109 psig (75 Pa) of pressure differential.

**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/ft2 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).

**Building Code**. See 12-A DCMR §101.2.

**Energy Use Intensity (EUI).** The annual energy use of the building expressed in kBtu divided by square feet (kbtu/ ft2).

**Low-carbon neighborhood thermal energy system.** A district-scale energy system that uses acceptable sources of renewable energy per section Z3.2 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 renewable energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid.

**Zero Energy Performance Index (zEPI).** A scale representing the ratio of the energy performance of a proposed design or an existing building compared to the mean energy performance of the building stock from the benchmark year of 2000 (Commercial Buildings Energy Consumption Survey, US Department of Energy, 2003 Average).

**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.** Administrationand 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 *building 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 shall 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/ft2/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 30 or lower as determined in accordance with Equation 1.

zEPI = 50.4 × (EUIp/EUI) (Equation 1)

Where:

EUIp = The annual energy use of the building in source kBtu/ft2, 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/ft2 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 90.1-2016, 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. KWh shall be converted 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 Z2.1.2.2**

**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 | 3.28 |

**Z2.2. Building Thermal Energy Performance .** Building thermal energy performance shall comply with Sections Z2.2.1 through Z2.2.2.

**Z2.2.1. Annual heating demand.** Building design shall demonstrate a maximum *annual heating demand* of 4.2 kBtu/ft2 iCFA/yr (4.8x104 kJ/m2iCFA/yr).

**Z2.2.2. Annual cooling demand.** Building design shall demonstrate a maximum *annual cooling demand* of 6.4 kBtu/ft2 iCFA/yr (7.3x104 kJ/m2iCFA/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 employing district energy systems and with multiple buildings, 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 owner shall 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*. As authorized by the *code official*, the owner is allowed 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 completionshall be performed for the following systems and their associated controls:

* *Building envelope*;
* HVAC (both mechanical and passive systems as well as HVAC controls);
* Lighting, daylighting, and lighting control systems;
* Domestic hot water systems; and
* Renewable energy systems.

**Z2.6. Airtightness Testing.** A whole building pressurization testing shall be conducted in accordance with Section 11.3.1.2.4(a) of the *Energy Conservation Code – Commercial Provisions* to measure the airtightness of the *building envelope*. Theowner shall verify that the airtightness specified in the final approved predictive energy model is achieved in the field by providing the *code official* with a copy of the test results before the final *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 except as specified by the *code official.*

**Z3.2. Acceptable sources of renewable energy.** 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 On-site renewable energy.** Renewable energy shall be generated on-site wherever feasible. Before procuring off-site renewable energy, a *building project* must demonstrate one of the following:

1. A minimum of 5% of the total building energy consumption shall first be met by an acceptable source of renewable energy installed on the building roof or site.
2. For projects generating onsite renewable energy through solar photovoltaic systems, a minimum of 25% of total site area, including building footprint, shall be allocated for photovoltaic array and energy production.

**Exception:** Where there is not adequate solar access as determined by Chapter 13 of the *Energy Conservation Code-Commercial Provisions.*

**Z3.4. 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 renewable sources meeting the minimum percentages of the District of Columbia Renewable Portfolio Standard. Acceptable methods for the procurement of off-site renewable energy include any of the following or as approved by the *code official*:

* Owner shall provide the *code official* with documentation of a signed, legally-binding contract to procure off-site renewable energy through a power purchase agreement for a minimum period of 5 years for electricity generation from, solar or wind-generation facilities that are located within the District of Columbia, Maryland, or Virginia. The owner remains subject to, and must comply with, the District of Columbia’s Renewable Portfolio Standard;
* 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 *building 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 shall 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 24 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 RARECOMMENDED PROCEDURE FOR WORST-CASE TESTING OF ATMOSPHERIC VENTING SYSTEMS

APPENDIX RB SOLAR READY PROVISIONS

**CHAPTER 1[RE] SCOPE AND ADMINISTRATION**

**PART 1—SCOPE AND APPLICATION**

**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 **s**cope of the *Energy Conservation Code-Residential Provisions* shall be as defined in Chapter 1 of Title12-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-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.

**CHAPTER 3[RE] GENERAL REQUIREMENTS**

**R301 DISTRICT OF COLUMBIA CLIMATE ZONE**

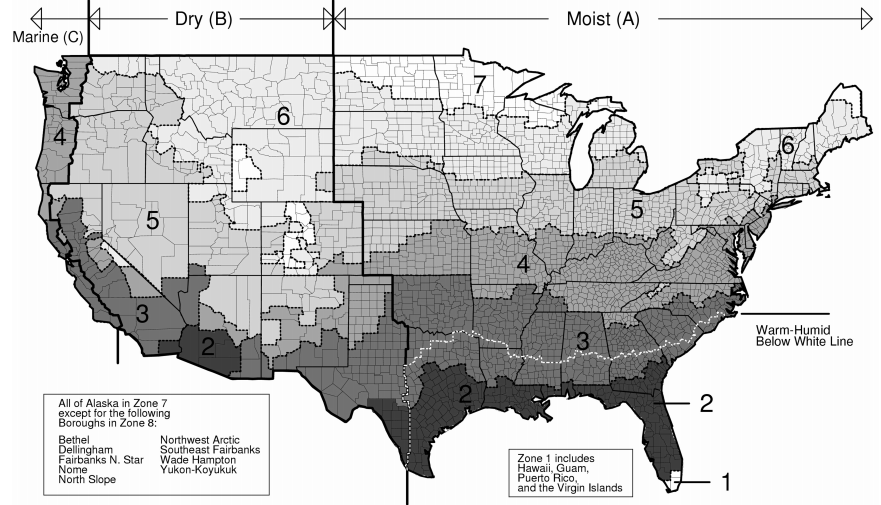
**R302 DESIGN CONDITIONS**

**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. Alternatively, 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 m2) 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 · ft2 · °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 ENVELOPE**

**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 of the International Energy Conservation Code in its entirety and insert new Section R402.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows:*

**R402.1 General (Prescriptive).**

The building thermal envelope shall meet the requirements of Sections R402.1.2 through R402.1.5.

**Exception:** The following low-energy buildings, or portions thereof, separated from the remainder of the building by building thermal envelope assemblies complying with this section shall be exempt from the building thermal envelope provisions of Section R402.

1. Those with a peak design rate of energy usage less than 3.4 Btu/h · ft2 (10.7 W/m2) or 1.0 watt/ft2 of floor area for space-conditioning purposes.
2. Those that do not contain conditioned space.

*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-Residential Provisions 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 COMPONENTa**

|  |  |
| --- | --- |
| **FENESTRATION U-FACTORb** | 0.30 U-Factor |
| **SKYLIGHTb U-FACTOR** | 0.55 U-Factor |
| **GLAZED**  **FENESTRATION SHGCb** | 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 WALLi** | 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 GRADEd** | R-10 perimeter insulation for a depth of 2 ft |
| **CONDITIONED 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.

d. R-5 shall be added to the required slab edge R-values for heated slabs

**R402.1.3 *R*-value computation. (no change)**

**R402.1.4 *U*-factor alternative.**

*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*-FACTORSa**

|  |  |
| --- | --- |
| **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 |
| **ELEVATED SLAB** | 0.066 *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.

**R402.1.5 Total UA alternative. (no change)**

**R402.2 Specific insulation requirements (Prescriptive).**

*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 weather stripped 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 Table R402.2.6 of the International Energy Conservation Code in its entirety and insert new Table R402.2.6 in the Energy Conservation Code-Residential Provisions in its place to read as follows.*

**TABLE R402.2.6  
STEEL-FRAME CEILING, WALL AND FLOOR INSULATION  
(R-VALUE)**

|  |  |
| --- | --- |
| **WOOD FRAME *R*-VALUE REQUIREMENT** | **COLD-FORMED STEEL EQUIVALENT *R*-VALUEa** |
| **Steel Truss Ceilingsb** | |
| R-30 | R-38 or R-30 + 3 or R-26 + 5 |
| R-38 | R-49 or R-38 + 3 |
| R-49 | R-38 + 5 |
| **Steel Joist Ceilingsb** | |
| R-30 | R-38 in 2 × 4 or 2 × 6 or 2 × 8 R-49 in any framing |
| R-38 | R-49 in 2 × 4 or 2 × 6 or 2 × 8 or 2 × 10 |
| **Steel-Framed Wall, 16" on center** | |
| R-13 | R-13 + 4.2 or R-19 + 2.1 or R-21 + 2.8 or R-0 + 9.3 or R-15 + 3.8 or R-21 + 3.1 |
| R-13 + 3 | R-0 + 11.2 or R-13 + 6.1 or R-15 + 5.7 or R-19 + 5.0 or R-21 + 4.7 |
| R-20 | R-0 + 14.0 or R-13 + 8.9 or R-15 + 8.5 or R-19 + 7.8 or R-19 + 6.2 or R-21 + 7.5 |
| R-19 + 5 | R-15 continuous or R-13 + 12.2 or R-15 + 11.8 or  R-19 + 11.2 or R-21 + 10.9 or R-25 + 10.5 |
| R-21 | R-0 + 14.6 or R-13 + 9.5 or R-15 + 9.1 or R-19 + 8.4 or R-21 + 8.1 or R-25 + 7.7 |
| **Steel Framed Wall, 24" on center** | |
| R-13 | R-0 + 9.3 or R-13 + 3.0 or R-15 + 2.4 |
| R-13 + 3 | R-0 + 11.2 or R-13 + 4.9 or R-15 + 4.3 or R-19 + 3.5 or R-21 + 3.1 |
| R-20 | R-0 + 14.0 or R-13 + 7.7 or R-15 + 7.1 or R-19 + 6.3 or R-21 + 5.9 |
| R-19 + 5 | R-15 continuous or R-13 + 11.1 or R-15 + 10.4 or  R-19 + 9.7 or R-21 + 9.2 or R-25 + 8.7 |
| R-21 | R-0 + 14.6 or R-13 + 8.3 or R-15 + 7.7 or R-19 + 6.9 or R-21 + 6.5 or R-25 + 5.9 |
| **Steel Joist Floor** | |
| R-13 | R-19 in 2 × 6, or R-19 + 6 in 2 × 8 or 2 × 10 |
| R-19 | R-19 + 6 in 2 × 6, or R-19 + 12 in 2 × 8 or 2 × 10 |
| R-25 + 5 | R-15 + 15 |

a Cavity insulation *R*-value is listed first, followed by continuous insulation *R*-value.

b. Insulation exceeding the height of the framing shall cover the framing.

*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 *Building Code* or *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 downstairs 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 R402.4.1.2. 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  
MAXIMUM ALLOWED AIR LEAKAGE RATES**

|  |  |  |
| --- | --- | --- |
|  | New construction | Level 3 Alteration affecting 80% or more of the aggregate work of the building (Gut Rehabilitation) |
| Single family detached, two family attached (duplex), townhouses, flats | 3 ACH50 | 3 ACH50 |
| 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 R402.6.1 in 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 ∙ ft2 ∙ °F)] or the metric equivalent [12W/(m2 ∙ 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  
WHOLE-HOUSE MECHANICAL VENTILATION SYSTEM FAN EFFICACYa**

|  |  |  |  |
| --- | --- | --- | --- |
| **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.

a. When tested in accordance with HVI Standard 916.

*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 6 and 7 of the *Energy Conservation Code-Residential Provisions* 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 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 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  
MINIMUM EFFICIENCY FOR HEATING AND COOLING EQUIPMENT**

|  |  |
| --- | --- |
| Equipment Type | Efficiency |
| Split and Packaged Air Conditioners | ≥ 15 SEER a |
| Split and Packaged Air Source Heat Pumps | ≥ 15 SEER a, ≥ 9.0 HSPFb |
| Gas-fired Furnace | ≥ 90% AFUEc and Furnace Fan Efficiency ≤ 2.0% |
| Gas-fired Boiler | ≥ 90% AFUEc |
| Ground Source Heat Pump | ≥ 17.1 EERd and ≥ 3.6 COPe |

* 1. SEER - Seasonal Energy Efficiency Ratio
  2. HSPF – Heating Seasonal Performance Factor
  3. AFUE – Annual Fuel Utilization Efficiency
  4. EER – Energy Efficiency Ratio
  5. 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  
MINIMUM EFFICIENCY FOR WATER HEATERS**

|  |  |
| --- | --- |
| 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 COMPONENTa**

|  |  |
| --- | --- |
| **FENESTRATION *U*-FACTORb** | 0.35 *U*-Factor |
| **SKYLIGHTb *U*-FACTOR** | 0.60 *U*-Factor |
| **GLAZED**  **FENESTRATION SHGCb** | 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 54 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 54 as listed in R406.4.

**CHAPTER 5[RE] EXISTING BUILDINGS**

**R501 GENERAL**

**R502 ADDITIONS**

**R503 ALTERATIONS**

**R501 GENERAL**

*Strike Sections R501.1 through 501.6 of the International Energy Conservation Code in their entirety and insert new Section R501.1 in the Energy Conservation Code-Residential Provisions in its place to read as follows.*

**R501.1 Scope.** The scope and intentof this chapter shall be governed by Section 101.10 of the *Building Code*, Title 12-A DCMR.

**R501.1.1 Additions, alterations or repairs: General.** Additions, alterations or repairs to an existing building, building system or portion thereof shall comply with Sections R502, R503 or R504. Unaltered portions of the existing building or building system shall not be required to comply with this code.

**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* affecting80 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 a 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. Existingexterior wallsshall 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 buildingmust 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* 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*. *Residential buildings* with a total floor area less than or equal to 2,000 square feet (185.8 m2) per dwelling shall have a *solar-ready zone* of not less than 150 square feet (13.94 m2). 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 m2) exclusive of access or set back areas as required by the *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.

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. [↑](#footnote-ref-1)