

CORE ENERGY CODE – PROPOSED 2012 IECC LANGUAGE FOR ADDITIONAL ENERGY EFFICIENCY IN COMMERCIAL BUILDINGS

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Based on proposals submitted jointly or severally by New Buildings Institute, American Institute of Architects and the US Department of Energy to the 2012 International Code Council. Subject to revision during the IECC Code Development Cycle.



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Revise Section 101.2 to read as follows:

101.2 Scope. This code applies to *residential and commercial buildings and the building site and associated systems and equipment.*

Change/Add definitions in Section 202 as follows:

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy, including any mechanical systems, service water heating systems and electric power and lighting systems located on the building site and supporting the building.

BUILDING COMMISSIONING. A process that verifies and documents that the selected building systems have been designed, installed, and function according to the owner's project requirements and construction documents, and to minimum code requirements.

BUILDING SITE: a contiguous area of land that is under the ownership or control of one entity.

BUILDING THERMAL ENVELOPE. The basement walls, exterior walls, floor, roof, and any other building element that encloses conditioned space. This boundary also includes the boundary between conditioned space and any exempt or unconditioned space or provides a boundary between conditioned space and exempt or unconditioned space.

CONTINUOUS AIR BARRIER. A combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

FENESTRATION PRODUCT, FIELD-FABRICATED is a fenestration product including an exterior glass door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-built fenestration with a label certificate or products required to have temporary or permanent labels.

FENESTRATION PRODUCT, SITE-BUILT is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.

FURNACE ELECTRICITY RATIO. The ratio of furnace electricity use to total furnace energy computed as
$$\text{ratio} = (3.412 * E_{AE}) / (1000 * E_F + 3.412 * E_{AE})$$
, where E_{AE} (average annual auxiliary electrical consumption) and E_F (average annual fuel energy consumption) are defined in Appendix N to subpart B of part 430 of title 10 of the Code of Federal Regulations and E_F is expressed in millions of Btu's per year.

ON-SITE RENEWABLE ENERGY. Energy derived from solar radiation, wind, waves, tides, landfill gas, biomass, or the internal heat of the earth. The energy system providing on-site renewable energy shall be located on or adjacent to the project site.

Revise Section 501.1 as follows:

501.1 Scope. The requirements contained in this chapter are applicable to commercial buildings, or portions of commercial buildings. ~~These commercial buildings shall meet either requirements of ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except for Low-Rise Residential Buildings, or the requirements contained in this chapter.~~

Revise Section 501.2 as follows:

501.2 Application. The *commercial building* project shall comply with the requirements in Sections 502 (Building envelope requirements), 503 (Building mechanical systems), 504 (Service water heating), 505 (Electrical power and lighting systems) in its entirety, and one of the additional options as presented in Section 506. As an alternative the *commercial building* project shall exceed by at least 25% ~~comply with~~ the requirements of ASHRAE/IESNA Standard 90.1, Energy Standard for Buildings Except for Low Rise Residential Buildings, Appendix G in its entirety.

Exceptions:

1. Buildings conforming to Section 507, provided Sections 502.4, 503.2, 504, 505.2, 505.3, 505.4, 505.6 and 505.7 are each satisfied. Building energy cost shall be equal to or less than 75% of the standard reference design building.
2. Additions, alterations and repairs shall comply with the applicable requirements in Sections 502, 503, 504, and 505 only or with ASHRAE/IESNA 90.1.

Revise Section 502.2.1 as follows:

502.2.1 Roof assembly. The minimum thermal resistance (*R*-value) of the insulating material installed either between the roof framing or continuously on the roof assembly shall be as specified in Table 502.2(1), based on construction materials used in the roof assembly. Skylight curbs shall be insulated to the level of roofs with insulation entirely above deck or R-5, whichever is less.

Exception: Continuously insulated roof assemblies where the thickness of insulation varies 1 inch (25 mm) or less and where the area-weighted *U*-factor is equivalent to the same assembly with the *R*-value specified in Table 502.2(1).

Insulation installed on a suspended ceiling with removable ceiling tiles shall not be considered part of the minimum thermal resistance of the roof insulation.

Add a new Section 502.2.1.1 as follows:

502.2.1.1 Roof solar reflectance and thermal emittance. Roofs in climate zones 1 to 3 not over ventilated attics or not over cooled spaces shall have a minimum three-year aged - solar reflective index (SRI) of 64 when determined in accordance with the SRI method in ASTM E1980 using a convection coefficient of (12W/m²·K) or a minimum three-year-aged solar reflectance of 0.55 when tested in accordance with ASTM C1549, ASTM E903 or ASTM E1918 and a minimum three-year-aged thermal emittance of at least 0.75 when testing in accordance with ASTM C1371 or ASTM E408.

Exceptions:

1. Ballasted roofs with a minimum stone ballast of 17 lbs/ft² (74 kg/m²) or 23 lbs/ft² pavers (117 kg/m²).
2. Roofs, where a minimum of 75% of the roof area is shaded during the peak sun angle on June 21st by permanent features of the building and/or is covered by off-set photovoltaic arrays, building-integrated photovoltaic arrays, or solar water collectors.
3. Metal building roofs or asphaltic membranes in climate zone 3.

Revise Section 502.2.6 as follows:

502.2.6 Slabs on grade. The minimum thermal resistance (R -value) of the insulation around the perimeter of unheated or heated slab-on-grade floors shall be as specified in Table 502.2(1). The insulation shall be placed on the outside of the foundation or on the inside of ~~a~~ the foundation wall. The insulation shall extend downward from the top of the slab for a minimum distance as shown in the table or to the top of the footing, whichever is less, or downward to at least the bottom of the slab and then horizontally to the interior or exterior for the total distance shown in the table. Where extending outside of the foundation the insulation shall be covered by pavement or by soil a minimum of 10 in. thick. For the purposes of this section a slab on grade floor is a slab floor that is in contact with the ground and that is either above grade or less than or equal to 24 in. below the final elevation of the nearest exterior grade.

Revise Tables 502.1.2 and 502.2(1) as follows:

**TABLE 502.1.2
BUILDING ENVELOPE REQUIREMENTS OPAQUE ELEMENT, MAXIMUM U-FACTORS**

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8	
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R
Roofs																
Insulation entirely above deck	U-0.063 U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048	U-0.048 U-0.039	U-0.048 U-0.039	U-0.048 U-0.039	U-0.048 U-0.039	U-0.048 U-0.032	U-0.048 U-0.032	U-0.039 U-0.028	U-0.039 U-0.028	U-0.039 U-0.028	U-0.039 U-0.028
Metal buildings	U-0.065 U-0.044	U-0.065 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.055 U-0.035	U-0.049 U-0.031	U-0.049 U-0.031	U-0.049 U-0.029	U-0.049 U-0.029	U-0.035 U-0.029	U-0.035 U-0.029
Attic and other	U-0.034 U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027	U-0.027 U-0.027	U-0.027 U-0.027	U-0.027 U-0.027	U-0.027 U-0.027	U-0.027 U-0.027	U-0.027 U-0.027
Walls, Above Grade																
Mass	U-0.587 U-0.142	U-0.151 U-0.142	U-0.151 U-0.142	U-0.123	U-0.123 U-0.110	U-0.104	U-0.104	U-0.090	U-0.090 U-0.078	U-0.080 U-0.078	U-0.080 U-0.078	U-0.071	U-0.071 U-0.061	U-0.071 U-0.061	U-0.071 U-0.061	U-0.052 U-0.061
Metal building	U-0.093 U-0.179	U-0.093 U-0.079	U-0.093 U-0.079	U-0.093 U-0.052	U-0.084 U-0.079	U-0.084 U-0.052	U-0.084 U-0.052	U-0.084 U-0.052	U-0.069 U-0.052	U-0.069 U-0.052	U-0.069 U-0.052	U-0.069 U-0.052	U-0.057	U-0.057	U-0.057	U-0.057
Metal framed	U-0.124 U-0.077	U-0.124 U-0.077	U-0.124 U-0.077	U-0.064	U-0.084 U-0.077	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.064	U-0.057	U-0.064	U-0.052	U-0.064 U-0.045	U-0.037
Wood framed and other	U-0.089 U-0.064	U-0.089 U-0.064	U-0.089 U-0.064	U-0.089 U-0.064	U-0.089 U-0.064	U-0.089 U-0.064	U-0.089 U-0.064	U-0.064	U-0.064	U-0.051	U-0.051	U-0.051	U-0.051	U-0.051	U-0.036	U-0.036
Walls, Below Grade																
Below-grade wall ^a	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140	C-1.140 C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119	C-0.119 C-0.092	C-0.092	C-0.119 C-0.092	C-0.075 C-0.092
Floors																
Mass	U-0.322	U-0.322	U-0.107	U-0.087	U-0.107 U-0.076	U-0.087 U-0.076	U-0.087 U-0.076	U-0.074	U-0.074	U-0.064	U-0.064	U-0.057	U-0.064 U-0.055	U-0.051	U-0.057 U-0.055	U-0.051
Joist/Framing	U-0.282 U-0.066	U-0.282 U-0.066	U-0.052 U-0.033	U-0.052 U-0.033	— U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033	U-0.033
Slab-on-Grade Floors																
Unheated slabs	F-0.73	F-0.73	F-0.73	F-0.73	F-0.73	F-0.73	F-0.73 F-0.54	F-0.54	F-0.73 F-0.54	F-0.54	F-0.54	F-0.54	F-0.52	F-0.52 F-0.40	F-0.52 F-0.40	F-0.52 F-0.40
Heated slabs	F-1.02 F-0.70	F-1.02 F-0.70	F-1.02 F-0.70	F-1.02 F-0.70	F-0.90 F-0.70	F-0.90 F-0.70	F-0.90 F-0.70	F-0.86 F-0.65	F-0.86 F-0.65	F-0.860 F-0.58	F-0.860 F-0.58	F-0.860 F-0.58	F-0.688 F-0.55	F-0.83 F-0.55	F-0.688 F-0.55	F-0.688 F-0.55

Table 502.2(1)
BUILDING ENVELOPE REQUIREMENTS - OPAQUE ASSEMBLIES

CLIMATE ZONE	1		2		3		4 EXCEPT MARINE		5 AND MARINE 4		6		7		8		
	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	All other	Group R	
Roofs																	
Insulation entirely above deck	R-15 R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20ci	R-20 R-25ci	R-20 R-25ci	R-20 R-25ci	R-20 R-25ci	R-20 R-30ci	R-20 R-30ci	R-25 R-35ci	R-25 R-35ci	R-25 R-35ci	R-25 R-35ci	
Metal buildings (with R-5 R-3.5 thermal blocks ^{ab})	R-19 R-19 + R11Ls	R-19 R-19 + R11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 13 R-13 +R19 R-11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 13 R-19 R-11Ls	R-13 +R- 19 R-25 R-11Ls	R-13 +R- 19 R-25 R-11Ls	R-13 +R- 19 R-30 R-30 + R-11Ls	R-13 +R- 19 R-30 R-30 + R-11Ls	R-13 +R- 19 R-30 R-30 + R-11Ls	R-13 +R- 19 R-30 R-30 + R-11Ls	R-13 +R- 19 R-30 R-30 + R-11Ls
Attic and other	R-30 R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-38	R-49	R-49
Walls, Above Grade																	
Mass	NR R-5.7ci	R-5.7ci	R-5.7ci	R-7.6ci	R-7.6ci	R-9.5ci	R-9.5ci	R-11.4ci	R-11.4ci	R-13.3ci	R-13.3ci	R-15.2ci	R-15.2ci	R-15.2ci	R-25ci	R-25ci	
Metal building ^b	R-16 R-13+ R- 6.5ci	R-16 R-13+ R- 6.5ci	R-16 R-13+ R- 6.5ci	R-16 R-13+ R- 13ci	R-19 R-13+ R- 6.5ci	R-16 R-13+ R- 13ci	R-16 R-13+ R- 13ci	R-16 R-13+ R- 13ci	R-16 R-13+ R- 13ci	R-13 +R- 5.6ei R-13+ R- 13ci	R-13 +R- 5.6ei R-13+ R- 13ci	R-13 +R- 5.6ei R-13+ R- 13ci	R-13 +R- 5.6ei R-13+ R- 13ci	R-19 +R- 5.6ei R-13+ R- 13ci	R-19 +R- 5.6ei R-13+ R- 13ci	R-19 +R- 5.6ei R-13+ R- 13ci	R-19 +R- 5.6ei R-13+ R- 13ci
Metal framed	R-13 + R-5 ci	R-13 +R-5 ci	R-13 +R-5 ci	R-13 +R- 7.5ci	R-13 +R- 3.8ei R-5 ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 15.6ci	R-13 +R- 7.5ci	R-13 +R- 18.8ci	
Wood framed and other	R-13 + 3.8ci or R- 20	R-13 + 3.8ci or R- 20	R-13 + 3.8ci or R- 20	R-13 + 3.8ci or R- 20	R-13 + 3.8ci or R- 20	R-13 + 3.8ci or R- 20	R-13 + 3.8ci or R- 20	R-13 +R- 3.8ci or R- 20	R-13 +R- 3.8ci or R- 20	R-13 +R- 3.8ci or R- 20	R-13 +R- 3.8ci or R- 20	R-13 +R- 7.5 ci or R- 20	R-13 +R- 7.5 ci or R- 20	R-13 +R- 7.5ci	R-13 +R- 7.5ci	R-13 +R- 15.6ci	R-13 +R- 15.6ci
Walls, Below Grade																	
Below-grade wall ^d	NR	NR	NR	NR	NR	NR	NR R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ci	R-7.5ei R-10ci	R-10ci	R-7.5ei R-10ci	R-12.5ci
Floors																	
Mass	NR	NR	R-6.3ci	R-8.3ci	R-6.3ei R-10ci	R-8.3ei R-10ci	R-10ci	R-10.4ci	R-10ci	R-12.5ci	R-12.5ci	R-14.6ci	R-15ci	R-16.7ci	R-15ci	R-16.7ci	
Joist/Framing	NR	NR	R-19	R-30	R-19	R-30	R-30	R-30	R-30	R-30	R-30	R-30 ^e	R-30	R-30 ^e	R-30 ^e	R-30 ^e	
Slab-on-Grade Floors																	
Unheated slabs	NR	NR	NR	NR	NR	NR	NR R-10 for 24 in. below	R-10 for 24 in. below	NR R-10 for 24 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 24 in. below	
Heated slabs	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-7.5 for 12 in. below	R-10 for 24 in. below	R-10 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-15 for 24 in. below	R-20 for 48 in. below	R-20 for 24 in. below	R-20 for 48 in. below	R-20 for 48 in. below	R-20 for 48 in. below	
Opaque Doors																	
Swinging	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.70 U-0.61	U-0.50 U-0.37	U-0.50 U-0.37	U-0.50 U-0.37	U-0.50 U-0.37
Roll-up or sliding	U-1.45 R-4.75	U-1.45 R-4.75	U-1.45 R-4.75	U-1.45 R-4.75	U-1.45 R-4.75	U-1.45 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	U-0.50 R-4.75	

For SI: 1 inch = 25.4 mm.
ci = Continuous insulation. NR = No requirement.

- a. When using *R*-value compliance method, a thermal spacer block is required, otherwise use the *U*-factor compliance method. [See Tables 502.1.2 and 502.2(2)].
- b. Assembly descriptions can be found in Table 502.2(2).
- c. R-5.7 ci is allowed to be substituted with concrete block walls complying with ASTM C 90, ungrouted or partially grouted at 32 inches or less on center vertically and 48 inches or less on center horizontally, with ungrouted cores filled with material having a maximum thermal conductivity of 0.44 Btu-in./h-f² F.
- d. When heated slabs are placed below grade, below-grade walls must meet the exterior insulation requirements for perimeter insulation according to the heated slab-on-grade construction.
- e. Steel floor joist systems shall to be R-38.

Revise Table 502.2(2) as follows:

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS-OPAQUE ASSEMBLIES

ROOFS	DESCRIPTION	REFERENCE
R-19	Standing seam roof with single fiberglass insulation layer. This construction is R-19 faced fiberglass insulation batts draped perpendicular over the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-13 + R-13 R-13 + R-19	Standing seam roof with two fiberglass insulation layers. The first <i>R</i> value is for faced fiberglass insulation batts draped over purlins. The second <i>R</i> value is for unfaced fiberglass insulation batts installed parallel to the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
R-11 + R-19 FC	Filled cavity fiberglass insulation. A continuous vapor barrier is installed below the purlins and uninterrupted by framing members. Both layers of uncompressed, unfaced fiberglass insulation rest on top of the vapor barrier and are installed parallel, between the purlins. A minimum R-3.5 thermal spacer block is placed above the purlin/batt, and the roof deck is secured to the purlins.	ASHRAE/IESNA 90.1 Table A2.3 including Addendum "G"
WALLS		
R-16, R-19	Single fiberglass insulation layer. The construction is faced fiberglass insulation batts installed vertically and compressed between the metal wall panels and the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"
R-13 + R-5.6 ci R-19 + R-5.6 ci	The first <i>R</i> value is for faced fiberglass insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated <i>R</i> value is for continuous rigid insulation installed between the metal wall panel and steel framing, or on the interior of the steel framing.	ASHRAE/IESNA 90.1 Table A3.2 including Addendum "G"

TABLE 502.2(2)
BUILDING ENVELOPE REQUIREMENTS-OPAQUE ASSEMBLIES
Table 502.2(2) METAL BUILDING ASSEMBLY DESCRIPTIONS

<u>ROOFS</u>	<u>DESCRIPTION</u>	<u>REFERENCE</u>
<u>R-19+R-11 LS</u> <u>R-25+R-11 LS</u> <u>R-30+R-11 LS</u>	<p><u>Liner System with thermal spacer block.</u></p> <p><u>A continuous membrane is installed below the purlins and uninterrupted by framing members. Uncompressed, un-faced insulation rests on top of the membrane between the purlins.</u></p>	<p><u>ASHRAE/IESNA 90.1 A2.3.2.4 and Table A2.3 including proposed 90.1-2007 Addendum "bb"</u></p>
<u>WALLS</u>	-	-
<u>R-19</u>	<p><u>Single layer fiberglass insulation.</u></p> <p><u>The layer of R-19 fiberglass insulation is installed continuously perpendicular to the girts and is compressed when the metal skin is attached to the girts.</u></p>	<p><u>ASHRAE/IESNA 90.1 A2.3.2.4 and Table A2.3 including proposed 90.1-2007 Addendum "bb"</u></p>
<u>R-13+R-6.5c.i.</u> <u>R-13+ R-13 c.i.</u> <u>R-13+ R-19.5 c.i</u> <u>R-13+ R-26 c.i</u>	<p><u>Single layer fiberglass insulation with continuous insulation.</u></p> <p><u>The first R-value is for faced insulation batts installed perpendicular and compressed between the metal wall panels and the steel framing. The second rated R-value is for continuous rigid insulation installed between the metal panel and steel framing, or on the interior of the steel framing..</u></p>	<p><u>ASHRAE/IESNA 90.1 A2.3.2.4 and Table A2.3 including proposed 90.1-2007 Addendum "bb"</u></p>

Revise Table 502.3 as follows:

**TABLE 502.3
BUILDING ENVELOPE REQUIREMENTS: FENESTRATION**

CLIMATE ZONE	1	2	3	4, except Marine	5 and Marine 4	6	7	8
Vertical Fenestration (40% maximum of above-grade wall)								
Framing materials other than metal with or without metal reinforcement or cladding								
<i>U</i> -Factor ^a	1.20/ 0.57	0.75/ 0.57	0.65/ 0.40	0.40/ 0.35	0.35	0.35	0.35	0.35
Metal framing with or without thermal break								
Curtain Wall/Storefront <i>U</i> -Factor ^a	1.0/ 0.57	0.70/ 0.57	0.60/ 0.50	0.50/ 0.42	0.45/ 0.42	0.45/ 0.42	0.40	0.40
Entrance Door <i>U</i> -Factor	1.20	1.10	0.90	0.85	0.80	0.80	0.80	0.80
All Other <i>U</i> -Factor ^{a,b}	1.20/ 0.65	0.75/ 0.65	0.65/ 0.60	0.55/ 0.50	0.55/ 0.50	0.55/ 0.50	0.45	0.45/ 0.40
SHGC- All Frame Types								
SHGC: PF < 0.25	0.25	0.25	0.25	0.40	0.40	0.40	0.45	0.45
SHGC: 0.25 ≤ PF < 0.5	0.33	0.33	0.33	NR	NR	NR	NR	NR
SHGC: PF ≥ 0.5	0.40	0.40	0.40	NR	NR	NR	NR	NR
Skylights (3% maximum, 5% maximum with automatic day lighting controls^c)								
<i>U</i> -Factor	0.75	0.75/ 0.65	0.65/ 0.55	0.60/ 0.50	0.60/ 0.50	0.60/ 0.50	0.60/ 0.50	0.60/ 0.50
SHGC ^d	0.35	0.35	0.35	0.40	0.40	0.40	NR	NR

NR = No requirement.

PF = Projection factor (see Section 502.3.2).

- The first *U*-factor applies when impact rated glazing is installed.
- "All others" includes operable windows, fixed windows, and non-entrance doors other than entrance doors.
- Automatic day lighting controls shall meet the requirements of Section 505.2.2.3.3.
- The SHGC for Climate Zones 1 – 6 can be increased to SHGC no greater than 0.60 if the Visible Transmittance (VT) is not less than 0.60 and automatic day lighting controls are installed that meet the requirements of Section 505.2.2.3.3.

Delete Sections 502.4.1 502.4.2 and 502.4.3 and replace with the following:

502.4.1 Air Barriers. The building envelope shall be designed and constructed with a continuous air barrier that complies with Section 502.4.1.1 and 502.4.1.2 to control air leakage into, or out of, the conditioned space. Construction documents shall identify the air barrier components for each assembly, including detailing joints, interconnections and sealing of penetrations. The opaque building envelope air barrier shall be located on the inside or, outside of, or be integral with the building envelope; or any combination thereof.

Exception: Buildings in climate Zones 1, 2 and 3.

Section 502.4.1.1 The *continuous air barrier* shall have the following characteristics:

1. It shall be continuous throughout the envelope (at the lowest floor, exterior walls, and ceiling or roof). Air barrier joints and seams shall be sealed; including sealing transitions in planes and changes in materials. Air barrier penetrations shall be sealed.
2. The air barrier component of each assembly shall be joined and sealed in a flexible manner to the air barrier component of adjacent assemblies. The joints and seals shall allow for the relative movement of the assemblies and materials without damage to the air seal.
3. The air barrier shall be installed in accordance with the manufacturer's instructions in a manner that achieves the performance requirements.
4. Where lighting fixtures with ventilation holes or other similar objects are to be installed in such a way as to penetrate the continuous air barrier, provisions shall be made to maintain the integrity of the continuous air barrier.

Exception: Buildings that comply with Section 502.4.1.2(3) below are not required to comply with either 1 or 4.

Section 502.4.1.2 Air barrier compliance options. A continuous air barrier for the opaque building envelope shall meet the requirements of at least one of the compliance options in Section 502.4.1.2(1), 502.4.1.2(2), or 502.4.1.2(3).

502.4.1.2(1) Materials. Individual materials shall have an air permeability not to exceed $0.02 \text{ L/s}\cdot\text{m}^2$ under a pressure differential of 75 Pa (0.004 cfm/ft^2 under a pressure differential of 0.3 in. water (1.57 lb/ft^2)) when tested in accordance with ASTM E2178. The following materials comply with this requirement when all joints are sealed:

1. Plywood - minimum 3/8 in (10 mm)
2. Oriented strand board - minimum 3/8 in (10 mm)
3. Extruded polystyrene insulation board - minimum 3/4 in (19 mm)
4. Foil-back urethane insulation board - minimum 3/4 in (19 mm)
5. Closed cell spray foam meeting air permeability requirement
6. Open cell spray foam meeting air permeability requirement
7. Weather resistant barrier meeting air permeability requirement
8. Exterior or interior gypsum board - minimum 1/2 in (12 mm)
9. Cement board - minimum 1/2 in (12 mm)
10. Built up roofing membrane
11. Modified bituminous roof membrane
12. Fully adhered single-ply roof membrane
13. A Portland cement/sand parge, or gypsum plaster minimum 5/8 in (16 mm) thick
14. Cast-in-place and precast concrete.
15. Fully grouted concrete block masonry.
16. Sheet steel or aluminum

502.4.1.2(2) Assemblies. Assemblies of materials and components shall have an average air leakage not to exceed $0.2 \text{ L/s}\cdot\text{m}^2$ @ 75 Pa (0.04 cfm/ft^2 under a pressure differential of 0.3" w.g. (1.57 psf)) when tested in accordance with ASTM E2357 or ASTM E1677. The following assemblies comply with this requirement when all joints are sealed and every characteristic in Section 502.4.4.1.1 is met:

- 1) Concrete masonry walls coated with one application either of block filler and two applications of a paint or sealer coating;
- 2) A Portland cement/sand parge, stucco or plaster minimum 1/2 in (12 mm) thick.

502.4.1.2(3) Building Test. The completed building shall be tested and the air leakage rate of the building envelope shall not exceed $2.0 \text{ L/s}\cdot\text{m}^2$ @ 75 Pa (0.40 cfm/ft^2 at a pressure differential of 0.3" w.g. (1.57 psf)) in accordance with ASTM E779 or an equivalent method approved by the code official.

502.4.2 Air Barrier Penetrations. All penetrations of the air barrier and paths of air infiltration / exfiltration shall be made air tight and shall be sealed with caulking materials or closed with gasketing systems compatible with the construction materials and location. Joints and seals shall be sealed in the same manner or taped or covered with a moisture vapor-permeable wrapping material. Sealing materials spanning joints between construction materials shall allow for expansion and contraction of the construction materials.

502.4.3 Fenestration and doors. The air leakage of fenestration assemblies and doors shall meet the provisions of Table 502.4.3. Testing shall be performed in accordance with the applicable reference test standard by an accredited and independent testing laboratory and all fenestration assemblies *listed and labeled*.

Exception: Site built fenestration assemblies that are sealed in accordance with Section 502.4.1.

Add a new Table 502.4.3 to read as follows:

Table 502.4.3
Maximum Air Infiltration Rate for Fenestration Assemblies

Fenestration Assembly	Maximum Rate
Windows	0.20^a
Sliding Doors	0.20^a
Swinging Doors	0.20^a
Skylights	0.20^a
Curtain Walls	0.06^b
Storefront Glazing	0.06^b
Commercial Glazed Swinging Entrance Doors	1.00^c
Revolving Doors	1.00^c
Rolling doors	1.00^c

- a. cfm per square foot of fenestration or door area when tested in accordance with NFRC 400 or AAMA/WDMA/CSA101/I.S.2/A440 at 1.57 psf (75 Pa). Alternatively the maximum rate is permitted to be 0.3 cfm per square foot of fenestration or door area when tested in accordance with AAMA/WDMA/CSA101/I.S.2/A440 at 6.24 psf (300 Pa)
- b. cfm per square foot of fenestration area when tested in accordance with NFRC 400 or ASTM E283 at 1.57 psf (75 Pa)
- c. cfm per square foot of fenestration or door area when tested in accordance with NFRC 400, AAMA/WDMA/CSA101/I.S.2/A440, or ASTM E283 at 1.57 psf (75 Pa)

Add a new Section 502.4.4 as follows:

502.4.4 Doors and Access Openings to Shafts, Chutes, Stairwells, and Elevator Lobbies. These doors and access openings shall either meet the requirements of 502.4.3 or shall be equipped with weather seals.

Exception: Weatherseals on elevator lobby doors are not required when a smoke control system is installed.

Revise Section 502.4.5 as follows:

502.4.5 Outdoor air intakes and exhaust openings. Stair and elevator shaft vents and other outdoor air intakes and exhaust openings integral to the building envelope shall be equipped with not less than a Class I motorized dampers, leakage-rated damper with a maximum leakage rate of 4 cfm per square foot (6.8 L/s · C m²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D shall be provided with dampers in accordance with Sections 502.4.5.1 and 502.4.5.2.

Dampers shall be installed with controls so that they are capable of automatically opening upon:

1. the activation of any fire alarm initiating device of the building's fire alarm system;
2. the interruption of power to the damper.

502.4.5.1 Stair and shaft vents. Stair and shaft vents shall be provided with Class IA motorized dampers with a maximum leakage rate of 3 cfm per square foot (5.1 L/s · C m²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

502.4.5.2 Outdoor air intakes and exhausts. Outdoor air supply and exhaust openings shall be provided with Class IA motorized dampers with a maximum leakage rate of 3 cfm per square foot (5.1 L/s · C m²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D.

Exception: Gravity (nonmotorized) dampers having a maximum leakage rate of 20 cfm per square foot (34 L/s · C m²) at 1.0 inch water gauge (w.g.) (1250 Pa) when tested in accordance with AMCA 500D are permitted to be used in buildings less than three stories in height above grade where the design outdoor air intake or exhaust capacity does not exceed 300 cfm.

Revise Section 502.4.8 as follows:

502.4.8 Recessed lighting. Recessed luminaires installed in the *building thermal envelope* shall be sealed to limit air leakage between conditioned and unconditioned spaces. All recessed luminaires shall be IC-rated and labeled as having an air leakage rate or no more 2.0 cfm (0.944 L/s) ~~meeting ASTM E 283 when tested in accordance with ASTM E 283 at a 1.57 psf (75 Pa) pressure differential with no more than 2.0 cfm (0.944 L/s) of air movement from the conditioned space to the ceiling cavity.~~ All recessed luminaires shall be sealed with a gasket or caulk between the housing and the interior wall or ceiling covering.

Revise Section 503.2.1 as follows:

503.2.1 Calculation of heating and cooling loads. Design loads shall be determined in accordance with the procedures described in the ASHRAE/ACCA Standard 183. The design loads shall account for the building envelope, lighting, ventilation and occupancy loads based on the project design. Heating and cooling loads shall be adjusted to account for load reductions that are achieved when energy recovery systems are utilized in the HVAC system in accordance with the ASHRAE *HVAC Systems and Equipment Handbook*. Alternatively, design loads shall be determined by an *approved* equivalent computation procedure, using the design parameters specified in Chapter 3.

Revise Section 503.2.2 as follows:

503.2.2 Equipment and system sizing. ~~Equipment and system sizing.~~ The output capacity of heating and cooling equipment and systems capacity shall not exceed the loads calculated in accordance with Section 503.2.1. A single piece of equipment providing both heating and cooling must satisfy this provision for one function with the capacity for the other function as small as possible, within available equipment options.

Add a new Section 503.2.4.3.3 to read as follows:

503.2.4.3.3 Automatic start capabilities. Controls designed to automatically adjust the start time of an HVAC system each day to allow for automatically brining the space to desired occupied temperature levels immediately before scheduled occupancy shall be provided on each system.

Revise Section 503.2.5.1 as follows:

503.2.5.1 Demand controlled ventilation. Demand control ventilation (DCV) is required for spaces larger than 500 ft² (50m²) and with an average occupant load of ~~40~~ 25 people per 1000 ft²(93 m²) of floor area (as established in Table 403.3 of the *International Mechanical Code*) and served by systems with one or more of the following:

1. An air-side economizer;
2. Automatic modulating control of the outdoor air damper; or
3. A design outdoor airflow greater than 3,000 cfm (1400 L/s).

Exceptions:

1. Systems with energy recovery complying with Section 503.2.6.
2. Multiple-zone systems without direct digital control of individual zones communicating with a central control panel.
3. System with a design outdoor airflow less than 1,200 cfm (600 L/s).
4. Spaces where the supply airflow rate minus any makeup or outgoing transfer air requirement is less than 1,200 cfm (600 L/s).
5. Building spaces where the primary ventilation needs are for process loads.

Revise Section 503.2.6 as follows:

503.2.6 Energy recovery ventilation systems. ~~Individual fan systems that have both a design supply air capacity of 5,000 cfm (2.36 m³/s) or greater and a minimum outside air supply of 70 percent or greater of the design supply air quantity shall have an energy recovery system that provides a change in the enthalpy of the outdoor air supply of 50 percent or more of the difference between the outdoor air and return air at design conditions. Provision shall be made to bypass or control the energy recovery system to permit cooling with outdoor air where cooling with outdoor air is required. Each fan system shall have an energy recovery system when the system's supply airflow rate exceeds the value listed in Table 503.2.6 based on the climate zone and percentage of *outdoor air* at design conditions. Required energy recovery systems shall have the capability to provide a change in the enthalpy of the *outdoor air* supply equal to at least 50% 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 503.4~~

Table 503.2.6 Energy Recovery Requirement

Zone	% Outdoor air at full design airflow rate					
	≥30% and < 40%	≥40% and < 50%	≥50% and < 60%	≥60% and < 70%	≥70% and < 80%	≥80%
	Design Supply Fan airflow rate (cfm)					
3B, 3C, 4B, 4C, 5B	NR	NR	NR	NR	≥5000	≥5000
1B, 2B, 5C	NR	NR	≥26000	≥12000	≥5000	≥4000
6B	≥11000	≥5500	≥4500	≥3500	≥2500	≥1500
1A, 2A, 3A, 4A, 5A, 6A	≥5500	≥4500	≥3500	≥2000	≥1000	>0
7,8	≥2500	≥1000	>0	>0	>0	>0

Exception: An energy recovery ventilation system shall not be required in any of the following conditions:

1. Where energy recovery systems are prohibited by the *International Mechanical Code*.
2. Laboratory fume hood systems that include at least one of the following features:
 - 2.1. Variable-air-volume hood exhaust and room supply systems capable of reducing exhaust and makeup air volume to 50 percent or less of design values.
 - 2.2. Direct makeup (auxiliary) air supply equal to at least 75 percent of the exhaust rate, heated no warmer than 2°F (1.1°C) above room setpoint, cooled to no cooler than 3°F (1.7°C) below room setpoint, no humidification added, and no simultaneous heating and cooling used for dehumidification control.
3. Systems serving spaces that are not cooled and are heated to less than 60°F (15.5°C).
4. Where more than 60 percent of the outdoor heating energy is provided from site-recovered or site solar energy.
5. Heating systems in climates with less than 3,600 HDD. Heating energy recovery in climate zones 1 and 2.
6. Cooling systems in climates with a 1 percent cooling design wet bulb temperature less than 64°F (18°C). Cooling energy recovery in climate zones 3c, 4c, 5b, 5c, 6b, 7, and 8.
7. Systems requiring dehumidification that employ series-style energy recovery coils wrapped around the cooling coil.

Delete Section 503.2.9 and replace as follows:

503.2.9 Mechanical systems commissioning and completion requirements. Mechanical systems commissioning and completion shall be in accordance with the provisions of Section 503.2.9.1 through 503.2.9.3.4.

503.2.9.1 System commissioning. The construction documents shall require commissioning and completion requirements in accordance with this section. The construction documents shall be permitted to refer to equipment specifications for further requirements. Copies of all documentation shall be given to the owner by the registered design professional. The building official may request commissioning documentation for review purposes. At the time of plan submittal, the code official shall be provided, by the permittee, a letter of intent to commission the building in accordance with this code.

503.2.9.1.1 Commissioning plan. A commissioning plan shall be prepared and shall include as a minimum the following items:

1. A detailed explanation of the building's project requirements for mechanical design,
2. A narrative describing the activities that will be accomplished during each phase of commissioning, including guidance on who accomplishes the activities and how they are completed.

3. Equipment and systems to be tested, including the extent of tests.
4. Functions to be tested (for example calibration, economizer control, etc.).
5. Conditions under which the test shall be performed (for example winter and summer design conditions, full outside air, etc.), and
6. Measurable criteria for acceptable performance.

503.2.9.1.2 Systems adjusting and balancing. All HVAC systems shall be balanced in accordance with generally accepted engineering standards. Air and water flow rates shall be measured and adjusted to deliver final flow rates within 10% of design rates. Test and balance activities shall include as a minimum the following items:

1. Air systems balancing: Each supply air outlet and zone terminal device shall be equipped with means for air balancing in accordance with the requirements of Chapter 6 of the International Mechanical Code. Discharge dampers are prohibited on constant volume fans and variable volume fans with motors 10 hp (18.6 kW) and larger. Air systems shall be balanced in a manner to first minimize throttling losses then, for fans with system power of greater than 1 hp, Fan speed shall be adjusted to meet design flow conditions.

Exception: Fans with fan motors of 1 hp or less.

2. Hydronic systems balancing: Individual hydronic heating and cooling coils shall be equipped with means for balancing and pressure test connections. Hydronic systems shall be proportionately balanced in a manner to first minimize throttling losses, then the pump impeller shall be trimmed or pump speed shall be adjusted to meet design flow conditions. Each hydronic system shall have either the ability to measure pressure across the pump, or test ports at each side of each pump.

Exceptions:

1. Pumps with pump motors of 5 hp or less.
2. When throttling results in no greater than 5% of the nameplate horsepower draw above that required if the impeller were trimmed.

503.2.9.1.3 Functional performance testing. Equipment functional performance testing shall be in accordance with Section 503.2.9.1.3.1. Functional testing of HVAC controls shall be in accordance with Section 503.2.9.1.3.2.

503.2.9.1.3.1 Equipment functional performance testing. Equipment functional performance testing shall demonstrate the correct installation and operation of components, systems, and system-to-system interfacing relationships in accordance with approved plans and specifications. This demonstration is to prove the operation, function, and maintenance serviceability for each of the commissioned systems. Testing shall include all modes of operation, including:

1. All modes as described in the Sequence of Operation.
2. Redundant or automatic back-up mode.
3. Performance of alarms, and
4. Mode of operation upon a loss of power and restored power.

Exception: Unitary or packaged HVAC equipment listed in Tables 503.2.3 (1) through (3) that do not require supply air economizers.

503.2.9.1.3.2 Controls functional performance testing. HVAC control systems shall be tested to document that control devices, components, equipment, and systems are calibrated, adjusted and operate in accordance with approved plans and specifications. Sequences of operation shall be functionally tested to document they operate in accordance with approved plans and specifications.

503.2.9.1.4 Preliminary commissioning report. A preliminary report of commissioning test procedures and results shall be completed and provided to the building owner . The report shall be identified as “Preliminary Commissioning Report” and shall identify:

1. Itemization of deficiencies found during testing required by this section which have not been corrected at the time of report preparation and the anticipated date of correction.
2. Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.
3. Climatic conditions required for performance of the deferred tests, and the anticipated date of each deferred test.

503.2.9.2 Acceptance. Buildings, or portions thereof, required to comply with this section shall not be issued a final certificate of occupancy until such time that the *code official* has received a letter of transmittal from the building owner that states they have received the Preliminary Commissioning Report as required by Section 503.2.9.1.4. At the request of the code official, a copy of the Preliminary Commissioning Report shall be made available for review.

503.2.9.3 Completion requirements. The construction documents shall require that within 90 days of system acceptance by the *code official*, the documents described in Section 503.2.9.3.1 and 503.2.9.3.2 shall be provided to the building owner or their designated representative by the mechanical contractor.

503.2.9.3.1 Drawings. Construction documents shall include as a minimum the location and performance data on each piece of equipment.

503.2.9.3.2 Manuals. An operating manual and a maintenance manual shall be in accordance with industry-accepted standards and shall include, at a minimum, the following:

1. Capacity (input and output) and required maintenance actions for each piece of equipment.
2. Operation and maintenance manuals for each piece of equipment.
3. Manufacturer’s operation manuals and maintenance manuals for each piece of equipment requiring maintenance, except equipment not furnished as part of the project. Required routine maintenance actions shall be clearly identified.
4. Names and addresses of at least one service agency.
5. HVAC controls system maintenance and calibration information, including wiring diagrams, schematics, and control sequence descriptions. Desired or field-determined setpoints shall be permanently recorded on control drawings at control devices or, for digital control systems, in programming comments.
6. A complete narrative of how each system is intended to operate, including ~~suggested~~ recommended setpoints.

503.2.9.3.3 System balancing report. A written report describing the activities and measurements completed in accordance with Section 503.2.9.1.2

503.2.9.3.4 Final Commissioning Report. A complete report of test procedures and results identified as “Final Commissioning Report” shall include:

1. Results of all Functional Performance Tests.
2. Disposition of all deficiencies found during testing, including details of corrective measures used or proposed.
3. All Functional Performance Test procedures used during the commissioning process including measurable criteria for test acceptance, provided herein for repeatability.

Exception: Deferred tests which cannot be performed at the time of report preparation due to climatic conditions.

Add a new term and definition under the second “where” beneath Table 503.2.10(1) as follows:

CFM_D – the design airflow through each applicable device from Table 503.2.10.1(2) in cubic feet per minute.

Revise Section 503.3 as follows:

503.3 Simple HVAC systems and equipment (Prescriptive). This section applies to buildings served by unitary or packaged HVAC equipment listed in Tables 503.2.3(1) through 503.2.3(5), each serving one *zone* and controlled by a single thermostat in the zone served. It also applies to two-pipe heating systems serving one or more zones, where no cooling system is installed.

~~This section does not apply to fan systems serving multiple zones, nonunitary or nonpackaged HVAC equipment and systems or hydronic or steam heating and hydronic cooling equipment and distribution systems that provide cooling or cooling and heating which are covered by Section 503.4.~~

~~**503.3.1 Economizers.** Supply air economizers shall be provided on each cooling system as shown in Table 503.3.1(1).~~

~~Economizers shall be capable of providing 100 percent outdoor air, even if additional mechanical cooling is required to meet the cooling load of the building. Systems shall provide a means to relieve excess outdoor air during economizer operation to prevent over-pressurizing the building. The relief air outlet shall be located to avoid recirculation into the building. Where a single room or space is supplied by multiple air systems, the aggregate capacity of those systems shall be used in applying this requirement.~~

~~**Exceptions:**~~

- ~~1. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1) or 503.2.3(2) and meets or exceeds the minimum cooling efficiency requirement (EER) by the percentages shown in Table 503.3.1(2).~~
- ~~2. Systems with air or evaporatively cooled condensers and which serve spaces with open case refrigeration or that require filtration equipment in order to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.~~

Each cooling system that has a fan shall include either an air or water economizer meeting the requirements of Sections 503.3.1.1 through 503.4.1.4.

Exceptions: Economizers are not required for the systems listed below.

1. Individual fan-cooling units with a supply capacity less than the minimum listed in Table 503.3.1(1).
2. Systems that require filtration equipment in order to meet the minimum ventilation requirements of Chapter 4 of the *International Mechanical Code*.
3. 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.
4. Systems that include a condenser heat recovery system required by Section 503.4.6.
5. Systems that serve *residential* spaces where the system capacity is less than five times the requirement listed in Table 503.3.1(1).
6. Systems that serve spaces whose sensible cooling load at design conditions, excluding transmission and infiltration loads, is less than or equal to transmission 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. Where the cooling *efficiency* meets or exceeds the *efficiency* requirements in Table 503.3.1(2).

**TABLE 503.3.1(1)
ECONOMIZER REQUIREMENTS**

CLIMATE ZONES	ECONOMIZER REQUIREMENT
1A, 1B, 2A, 7, 8	No requirement
2B, 3A, 3B, 3C, 4A, 4B, 4C, 5A, 5B, 5C, 6A, 6B	Economizers on all cooling systems ≥ 54,000 Btu/h ^a

For SI: 1 British thermal unit per hour = 0.293 W.

a. The total capacity of all systems without economizers shall not exceed 480,000 Btu/h per building, or 20 percent of its air economizer capacity, whichever is greater.

**TABLE 503.3.1(2)
EQUIPMENT EFFICIENCY PERFORMANCE
EXCEPTION FOR ECONOMIZERS**

CLIMATE ZONES	COOLING EQUIPMENT PERFORMANCE IMPROVEMENT (EER OR IPLV)
2B	10% Efficiency Improvement
3B	15% Efficiency Improvement
4B	20% Efficiency Improvement

503.4.1 Economizers. Supply air economizers shall be provided on each cooling system according to Table 503.3.1(1). Economizers shall be capable of operating at 100 percent outside air, even if additional mechanical cooling is required to meet the cooling load of the building.

Exceptions:

1. Systems utilizing water economizers that are capable of cooling supply air by direct or indirect evaporation or both and providing 100 percent of the expected system cooling load at outside air temperatures of 50°F (10°C) dry bulb/45°F (7°C) wet bulb and below.
2. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(1), 503.2.3(2), or 503.2.3(6) and meets or exceeds the minimum EER by the percentages shown in Table 503.3.1(2)
3. Where the cooling equipment is covered by the minimum efficiency requirements of Table 503.2.3(7) and meets or exceeds the minimum integrated part load value (IPLV) by the percentages shown in Table 503.3.1(2).

503.3.1.1 Air Economizers Air economizers shall be designed in accordance with Sections 503.3.1.1.1 through 503.3.1.1.4.

503.3.1.1.1 Design Capacity. Air economizer systems shall be capable of modulating *outdoor air* and return air dampers to provide up to 100% of the design supply air quantity as *outdoor air* for cooling.

503.3.1.1.2 Control Signal. Economizer dampers shall be capable of being sequenced with the mechanical cooling equipment and shall not be controlled by only mixed air temperature.

Exception: The use of mixed air temperature limit control shall be permitted for systems controlled from space temperature (such as single-zone systems).

503.3.1.1.3 High-Limit Shutoff. All air economizers shall be capable of automatically reducing *outdoor air* intake to the design minimum *outdoor air* quantity when *outdoor air* intake will no longer reduce cooling energy usage. High-limit shutoff control types for specific climates shall be chosen from Table 503.3.1.1.3(1). High-limit shutoff control settings for these control types shall be those listed in Table 503.3.1.1.3(2).

TABLE 503.3.1.1.3(1) HIGH-LIMIT SHUTOFF CONTROL OPTIONS FOR AIR ECONOMIZERS

<u>CLIMATE ZONES</u>	<u>ALLOWED CONTROL TYPES</u>	<u>PROHIBITED CONTROL TYPES</u>
<u>1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8</u>	<u>Fixed dry bulb</u> <u>Differential dry bulb</u> <u>Electronic enthalpy^a</u> <u>Differential enthalpy</u> <u>Dew-point and dry-bulb temperatures</u>	<u>Fixed enthalpy</u>
<u>1a, 2a, 3a, 4a</u>	<u>Fixed dry bulb</u> <u>Fixed enthalpy</u> <u>Electronic enthalpy^a</u> <u>Differential enthalpy</u> <u>Dew-point and dry-bulb temperatures</u>	<u>Differential dry bulb</u>
<u>All other climates</u>	<u>Fixed dry bulb</u> <u>Differential dry bulb</u> <u>Fixed enthalpy</u> <u>Electronic enthalpy^a</u> <u>Differential enthalpy</u> <u>Dew-point and dry-bulb temperatures</u>	-

^a Electronic enthalpy controllers are devices that use a combination of humidity and dry-bulb temperature in their switching algorithm.

Table 503.3.1.1.3(2) HIGH-LIMIT SHUTOFF CONTROL SETTING FOR AIR ECONOMIZERS

<u>DEVICE TYPE</u>	<u>CLIMATE</u>	<u>REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):</u>	
		<u>EQUATION</u>	<u>DESCRIPTION</u>
<u>Fixed dry bulb</u>	1b, 2b, 3b, 3c, 4b, 4c, 5b, 5c, 6b, 7, 8, 5a, 6a, 7a All other zones	$T_{OA} > 75^{\circ}\text{F}$ $T_{OA} > 70^{\circ}\text{F}$ $T_{OA} > 65^{\circ}\text{F}$	<u>Outdoor air temperature exceeds 75°F</u> <u>Outdoor air temperature exceeds 70°F</u> <u>Outdoor air temperature exceeds 65°F</u>
<u>Differential dry bulb</u>	1b, 2b, 3b, 3c, 4b, 4c, 5a, 5b, 5c, 6a, 6b, 7, 8	$T_{OA} > T_{RA}$	<u>Outdoor air temperature exceeds return air temperature</u>
<u>Fixed enthalpy</u>	<u>All</u>	$h_{OA} > 28 \text{ Btu/lb}^a$	<u>Outdoor air enthalpy exceeds 28 Btu/lb of dry air^a</u>
<u>Electronic Enthalpy</u>	<u>All</u>	$(T_{OA}, RH_{OA}) > A$	<u>Outdoor air temperature/RH exceeds the "A" setpoint curve^b</u>
<u>Differential enthalpy</u>	<u>All</u>	$h_{OA} > h_{RA}$	<u>Outdoor air enthalpy exceeds return air enthalpy</u>
<u>Dew-point and dry bulb temperatures</u>	<u>All</u>	$DP_{OA} > 55^{\circ}\text{F}$ or $T_{OA} > 75^{\circ}\text{F}$	<u>Outdoor air dry bulb exceeds 75°F or outside dew point exceeds 55°F (65 gr/lb)</u>

^a At altitudes substantially different than sea level, the Fixed Enthalpy limit shall be set to the enthalpy value at 75°F and 50% relative humidity. As an example, at approximately 6000 ft elevation the fixed enthalpy limit is approximately 30.7 Btu/lb.

^b Setpoint "A" corresponds to a curve on the psychrometric chart that goes through a point at approximately 75°F and 40% relative humidity and is nearly parallel to dry-bulb lines at low humidity levels and nearly parallel to enthalpy lines at high humidity levels.

503.3.1.1.4 Relief of Excess Outdoor Air. Systems shall provide a means to relieve excess outdoor air during air economizer operation to prevent over-pressurizing the building. The relief air outlet shall be located to avoid recirculation into the building.

Delete Section 503.4.1 and replace as follows:

503.4.1 Economizers. Economizer systems for complex HVAC Equipment shall be designed in accordance with Sections 503.4.1.1 through 503.4.1.4.

503.4.1.1 Design Capacity. Water economizer systems shall be capable of cooling supply air by indirect evaporation and providing up to 100% of the expected system cooling load at outdoor air temperatures of 50°F dry bulb/45° wet bulb and below.

Exception: Systems in which a water economizer is used and where dehumidification requirements cannot be met using outdoor air temperatures of 50°F dry bulb/ 45°F wet bulb must satisfy 100% of the expected system cooling load at 45°F dry bulb/40°F wet bulb.

503.4.1.2 Maximum Pressure Drop. Pre-cooling coils and water-to-water heat exchangers used as part of a water economizer system shall either have a water-side pressure drop of less than 15 ft of water or a secondary loop shall be created so that the coil or heat exchanger pressure drop is not seen by the circulating pumps when the system is in the normal cooling (non-economizer) mode.

503.4.1.3 Integrated Economizer Control. Economizer systems shall be integrated with the mechanical cooling system and be capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

Exceptions:

1. Direct expansion systems that include controls that reduce the quantity of outdoor air required to prevent coil frosting at the lowest step of compressor unloading, provided this lowest step is no greater than 25% of the total system capacity.
2. Individual direct expansion units that have a rated cooling capacity less than 54,000 Btu/h and use non-integrated economizer controls that preclude simultaneous operation of the economizer and mechanical cooling.
3. Systems in climate zones 1A, 1B, 2A, 7, 8.

503.4.1.4 Economizer Heating System Impact. HVAC system design and economizer controls shall be such that economizer operation does not increase the building heating energy use during normal operation.

Exception: Economizers on VAV systems that cause zone level heating to increase due to a reduction in supply air temperature.

Revise Section 503.4.2 as follows:

503.4.2 Variable air volume (VAV) fan control. Individual VAV fans with motors of ~~40~~ 7.5 horsepower (~~7.5~~ 5.6 kW) or greater shall be:

1. Driven by a mechanical or electrical variable speed drive;
2. Driven by a vane-axial fan with variable-pitch blades; or
- ~~23.~~ The fan motor shall have controls or devices that will result in fan motor demand of no more than 30 percent of their design wattage at 50 percent of design airflow when static pressure set point equals one-third of the total design static pressure, based on manufacturer's certified fan data.

Static pressure sensors used to control VAV fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with direct digital control. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch to ensure the static pressure can be maintained in each branch.

For systems with direct digital control of individual zone boxes reporting to the central control panel, the static pressure set point shall be reset based on the zone requiring the most pressure, i.e., the set point is reset lower until one zone damper is nearly wide open.

Revise Section 505.1 as follows:

505.1 General (Mandatory). This section covers lighting system controls, the connection of ballasts, the maximum lighting power for interior applications and minimum acceptable lighting equipment for exterior applications.

Lighting within dwelling units where ~~50~~ 75 percent or more of the permanently installed interior light fixtures are fitted with high-efficacy lamps or a minimum of 75 percent of the permanently installed lighting fixtures shall contain only high efficacy lamps.

Exception: Low-voltage lighting.

Revise Section 505.2 as follows:

505.2.1 Interior lighting controls. Each area enclosed by walls or floor-to-ceiling partitions shall have at least one manual control for the lighting serving that area. The required controls shall be located within the area served by the controls or be a remote switch that identifies the lights served and indicates their status.

Exceptions:

1. Areas designated as security or emergency areas that must be continuously lighted.
2. Lighting in stairways or corridors that are elements of the means of egress.

505.2.2 Additional controls. Each area that is required to have a manual control shall have additional controls that meet the requirements of Sections 505.2.2.1 and 505.2.2.2.

505.2.2.1 Light reduction controls. Each area that is required to have a manual control shall also allow the occupant to reduce the connected lighting load in a reasonably uniform illumination pattern by at least 50 percent. Lighting reduction shall be achieved by one of the following or other *approved* method:

1. Controlling all lamps or luminaires;
2. Dual switching of alternate rows of luminaires, alternate luminaires or alternate lamps;
3. Switching the middle lamp luminaires independently of the outer lamps; or
4. Switching each luminaire or each lamp.

Exceptions:

1. Areas that have only one luminaire.
2. Areas that are controlled by an occupant-sensing device.
3. Corridors, storerooms, restrooms or public lobbies.
4. *Sleeping unit* (see Section 505.2.3).
5. Spaces that use less than 0.6 watts per square foot (6.5 W/m²).
6. Daylight spaces complying with Section 505.2.2.2.3 Automatic Daylighting Controls

505.2.2.3 505.2.2.2 Daylight Zone Control. Daylight zones shall be provided with individual controls which control the lights independent of general area lighting. Contiguous daylight zones adjacent to vertical fenestration are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e. north, east, south, west). Daylight zones under skylights more than 15 feet from the perimeter shall be controlled separately from daylight zones adjacent to vertical fenestration.

Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

505.2.2.2 Automatic lighting shutoff. Buildings larger than 5,000 square feet (465m²) shall be equipped with an automatic control device to shut off lighting in those areas. This automatic control device shall function on either:

1. A scheduled basis, using time of day, with an independent program schedule that controls the interior lighting in areas that do not exceed 25,000 square feet (2323 m²) and are not more than one floor; or
 2. An occupant sensor that shall turn lighting off within 30 minutes of an occupant leaving a space;
- or
3. A signal from another control or alarm system that indicates the area is unoccupied.

Exception: The following shall not require an automatic control device:

1. *Sleeping unit* (see Section 505.2.3).
2. Lighting in spaces where patient care is directly provided.
3. Spaces where an automatic shutoff would endanger occupant safety or security.

505.2.2.2.1 Occupant override. Where an automatic time switch control device is installed to comply with

Section 505.2.2.2, Item 1, it shall incorporate an override switching device that:

1. Is readily accessible.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated.
4. Allows the lighting to remain on for no more than 2 hours when an override is initiated.
5. Controls an area not exceeding 5,000 square feet (465 m²).

Exceptions:

1. In malls and arcades, auditoriums, single tenant retail spaces, industrial facilities and arenas, where captive key override is utilized, override time shall be permitted to exceed 2 hours.
2. In malls and arcades, auditoriums, single tenant retail spaces, industrial facilities and arenas, the area controlled shall not exceed 20,000 square feet (1860 m²).

505.2.2.2.2 Holiday scheduling. If an automatic time switch control device is installed in accordance with Section 505.2.2.2, Item 1, it shall incorporate an automatic holiday scheduling feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.

Exception: Retail stores and associated malls, restaurants, grocery stores, places of religious worship and theaters.

505.2.2.3 Daylight zone control. Daylight zones, as defined by this code, shall be provided with individual controls that control the lights independent of general area lighting. Contiguous daylight zones adjacent to vertical fenestration are allowed to be controlled by a single controlling device provided that they do not include zones facing more than two adjacent cardinal orientations (i.e., north, east, south, west). Daylight zones under skylights more than 15 feet (4572 mm) from the perimeter shall be controlled separately from daylight zones adjacent to vertical fenestration.

Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing two or fewer light fixtures are not required to have a separate switch for general area lighting.

505.2.2.3 Automatic lighting controls. All commercial buildings shall be equipped with automatic control devices to shut off lighting in compliance with one of the following automatic control technologies:

1. Section 505.2.2.3.1 Occupancy Sensors
2. Section 505.2.2.3.2 Time Clock Controls
3. Section 505.2.2.3.3 Automatic Daylighting Controls

Any lighting control required in Sections 505.2.2.3.1, 505.2.2.3.2 and 505.2.2.3.3 shall either be manual on or shall be controlled to automatically turn the lighting on to not more than 50% power unless otherwise provided in Sections 505.2.2.3.1, 505.2.3.2 or 505.2.2.3.3.

Exception: Full automatic-on controls shall be permitted to control lighting in public corridors, stairways, restrooms, primary building entrance areas and lobbies, and areas where manual-on operation would endanger the safety or security of the room or building occupants.

505.2.2.3.1 Occupancy sensors. Occupancy sensors shall be installed in all classrooms, conference/meeting rooms, employee lunch and break rooms, private offices, restrooms, storage rooms and janitorial closets, and other spaces 300 sf. or less enclosed by ceiling height partitions. These automatic control devices shall be installed to automatically turn off lights within 30 minutes of all occupants leaving the space, except spaces with multi-scene control.

505.2.2.3.2 Time Clock Controls In areas not controlled by occupancy sensors, automatic time switch control devices shall be used. It shall incorporate an override switching device that:

1. Is readily accessible.
2. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated.
3. Is manually operated.
4. Allows the lighting to remain on for no more than 2 hours when an override is initiated.
5. Controls an area not exceeding 5,000 square feet (465 m²).

Exceptions:

1. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, where captive-key override is utilized, override time may exceed 2 hours.
2. In malls and arcades, auditoriums, single-tenant retail spaces, industrial facilities and arenas, the area controlled may not exceed 20,000 square feet (1860 m²).

505.2.2.3.3 Automatic daylighting controls. Automatic controls installed in daylight zones shall control lights in the daylit areas separately from the non-daylit areas. Controls for calibration adjustments to the lighting control device shall be readily accessible to authorized personnel. Each daylight control zone shall not exceed 2,500 square feet. Automatic daylighting controls must incorporate an automatic shut-off ability based on time or occupancy in addition to lighting power reduction controls.

Controls will automatically reduce lighting power in response to available daylight by either one of the following methods:

1. Continuous dimming using dimming ballasts and daylight-sensing automatic controls that are capable of reducing the power of general lighting in the daylit zone continuously to less than 35% of rated power at maximum light output.

2. Stepped Dimming using multi-level switching and daylight-sensing controls that are capable of reducing lighting power automatically. The system should provide a minimum of two control channels per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 30% to 50% of rated power and another control step that reduces lighting power by 65% to 100%. Stepped dimming control is not allowed in continuously occupied areas with ceiling heights of 14 feet or lower.

Exception: Daylight spaces enclosed by walls or ceiling height partitions and containing 2 or fewer luminaire are not required to have a separate switch for general area lighting.

505.2.3 Specific Application Controls **505.2.4 Specific Application Controls** Specific application controls shall be provided for the following:

1. Display/Accent Lighting—display or accent lighting shall have a separate control device.
2. Case Lighting—lighting in cases used for display purposes shall have a separate control device.
3. Hotel and Motel Guest Room Lighting—hotel and motel guest rooms and guest suites shall have a master control device at the main room entry that controls all permanently installed luminaires and switched receptacles.
4. Task Lighting—supplemental task lighting, including permanently installed under-shelf or under-cabinet lighting, shall have a control device integral to the luminaires or be controlled by a wall-mounted control device provided the control device is readily accessible and located so that the occupant can see the controlled lighting.
5. Non-visual Lighting—lighting for non-visual applications, such as plant growth and food warming, shall have a separate control device.
6. Demonstration Lighting—lighting equipment that is for sale or for demonstrations in lighting education shall have a separate control device.

Exceptions:

~~1. a., b. and d.~~ Where LED lighting is used no additional control is required for items 1, 2, or 4.

505.2.4 Functional Testing. Controls for automatic lighting systems shall be tested prior to and as a condition for issuance of an approval under Section 104.8. Testing shall ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions. The construction documents shall state the party who will conduct the required functional testing. The party responsible for the functional testing shall not be directly involved in the design or construction of the project and shall provide documentation to the *code official* certifying that the installed lighting controls meet the provisions of Section 505.

When *occupant sensors*, time switches, programmable schedule controls, *photosensors* or *daylighting controls* are installed, at a minimum, the following procedures shall be performed:

1. Confirm that the placement, sensitivity and time-out adjustments for *occupant sensors* yield acceptable performance, i.e. lights turn off only after space is vacated and do not turn on unless space is occupied.
2. Confirm that the time switches and programmable schedule controls are programmed to turn the lights off.
3. Confirm that photosensor controls reduce electric light based on the amount of usable daylight in the space as specified.

Delete Table 505.5.2 and replace as follows:

LIGHTING POWER DENSITY		
	Whole Building	Space by Space
Building Area Type^a	(W/ft²)	
Active Storage		0.8
Atrium – First Three Floors		0.6
Atrium – Each Additional Floor		0.2
AUTOMOTIVE FACILITY	0.9	
Classroom/lecture/training		1.3
Conference/Meeting/Multipurpose		1.1
Corridor/Transition		0.5
Electrical/Mechanical		1.1
Food Preparation		1.2
Inactive Storage		0.2
Lobby		1.1
Restroom		0.8
Stairway		0.6
CONVENTION CENTER	1.2	
Exhibit Space		1.3
Audience/Seating Area		0.9
COURTHOUSE	1.2	
Audience/Seating Area		0.9
Courtroom		1.9
Confinement Cells		0.9
Judges Chambers		1.3
Dressing/Locker/Fitting Room		0.6

DINING: BAR LOUNGE/LEISURE	<u>1.3</u>	
Lounge/Leisure Dining		<u>1.4</u>
DINING: CAFETERIA/FAST FOOD	<u>1.4</u>	
DINING: FAMILY	<u>1.6</u>	
Dining		<u>1.4</u>
Kitchen		<u>1.2</u>
DORMITORY	<u>1</u>	
Living Quarters		<u>1.1</u>
Bedroom		<u>0.5</u>
Study Hall		<u>1.4</u>
EXERCISE CENTER	<u>1</u>	
Dressing/Locker/Fitting Room		<u>0.6</u>
Audience/Seating Area		<u>0.3</u>
Exercise Area		<u>0.9</u>
Exercise Area/Gymnasium		<u>0.9</u>
RETAIL: SUPERMARKET	<u>1.3</u>	-
GYMNASIUM	<u>1.1</u>	-
Dressing/Locker/Fitting Room	-	<u>0.6</u>
Audience/Seating Area	-	<u>0.4</u>
Playing Area	-	<u>1.4</u>
Exercise Area	-	<u>0.9</u>
HEALTHCARE CLINIC	<u>1</u>	-
Corridors w/patient waiting, exam	-	<u>1</u>
Exam/Treatment	-	<u>1.5</u>
Emergency	-	<u>2.7</u>
Public & Staff Lounge	-	<u>0.8</u>
Hospital/Medical supplies	-	<u>1.4</u>
Hospital - Nursery	-	<u>0.6</u>
Nurse station	-	<u>1</u>
Physical therapy	-	<u>0.9</u>
Patient Room	-	<u>0.7</u>
Pharmacy	-	<u>1.2</u>
Hospital/Radiology	-	<u>0.4</u>
Operating Room	-	<u>2.2</u>
Recovery	-	<u>0.8</u>
Active storage	-	<u>0.9</u>
Laundry-Washing	-	<u>0.6</u>
HOTEL	<u>1</u>	-
Dining Area	-	<u>1.3</u>
Guest quarters	-	<u>1.1</u>
Reception/Waiting	-	<u>2.5</u>
Lobby	-	<u>1.1</u>
LIBRARY	<u>1.3</u>	
Library-Audio Visual	-	<u>0.7</u>
Stacks	-	<u>1.7</u>
Card File & Cataloguing	-	<u>1.1</u>
Reading Area	-	<u>1.2</u>
MANUFACTURING FACILITY	<u>1.3</u>	
MOTEL	<u>1</u>	-
Dining Area	-	<u>1.2</u>
Guest quarters	-	<u>1.1</u>
Reception/Waiting	-	<u>2.1</u>

MOTION PICTURE THEATER	1.2	-
Audience/Seating Area	-	1.2
Lobby	-	1
MULTI-FAMILY	0.7	
MUSEUM	1.1	-
Active Storage	-	0.8
General exhibition	-	1
Restoration	-	1.7
OFFICE	0.9	-
Enclosed	-	1
Open Plan	-	1
PARKING GARAGE	0.3	
PENITENTIARY	1.0	
PERFORMING ARTS THEATER	1.6	-
Audience/Seating Area	-	2.6
Lobby	-	3.3
Dressing/Locker/Fitting Room	-	1.1
POLICE STATIONS	1	-
FIRE STATIONS	0.8	-
Fire Station Engine Room	-	0.8
Sleeping Quarters	-	0.3
Audience/Seating Area	-	0.8
Police Station Laboratory	-	1.4
POST OFFICETS/SF	1.1	-
Sorting Area	-	1.2
Lobby	-	1
RELIGIOUS BUILDINGS	1.3	-
Lobby	-	0.6
Worship/Pulpit/Choir	-	2.4
RETAIL	1.3	-
Department Store Sales Area	-	1.3
Specialty Store Sales Area	-	1.8
Fine Merchandise Sales Area	-	2.9
Supermarket Sales Area	-	1.3
Personal Services Sales Area	-	1.3
Mass Merchandising Sales Area	-	1.3
Mall Concourse	-	1.7
SCHOOL/UNIVERSITY	1.2	-
Classroom	-	1.3
Audience	-	0.7
Dining	-	1.1
Office	-	1.1
Corridor	-	0.5
Storage	-	0.5
Laboratory	-	1.1
RETAIL: SPECIALTY b	1.6	
TOWN HALL	1.1	
TRANSPORTATION	1	
Dining Area	-	2.1
Baggage Area	-	1
Airport - Concourse	-	0.6
Terminal - Ticket Counter	-	1.5
Reception/Waiting	-	0.5

SPORTS ARENA	<u>1.1</u>	
WAREHOUSE	<u>0.6</u>	
Fine Material	-	<u>1.4</u>
Medium/Bulky Material	-	<u>0.6</u>
WORKSHOP	<u>1.4</u>	

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

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

b. Where lighting equipment is specified to be installed to highlight specific merchandise in addition to lighting equipment specified for general lighting and is switched or dimmed on circuits different from the circuits for general lighting, the smaller of the actual wattage of the lighting equipment installed specifically for merchandise, or additional lighting power as determined below shall be added to the interior lighting power determined in accordance with this line item.

Calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = ~~1000 watts +~~ (Retail Area 1 X ~~0.6~~ 0.4 W/ft²) + (Retail Area 2 X 0.6 W/ft²) + (Retail Area 3 X ~~1.4~~ 0.9 W/ft²) + (Retail Area 4 X ~~2.5~~ 1.5 W/ft²).

where:

Retail Area 1 = The floor area for all products not listed in Retail Area 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 are permitted to 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.

Add a new Section 506 as follows:

SECTION 506 **ADDITIONAL EFFICIENCY PACKAGE OPTIONS**

506.1 Requirements. Buildings shall comply with at least one of the following:

- a. 506.2 Efficient HVAC Performance Requirement
- b. 506.3 Efficient Lighting System Requirement
- c. 506.4 On-Site Supply of Renewable Energy

At the time of plan submittal, the *code official* shall be provided, by the permittee, documentation designating the intent to comply with Section 506.2, 506.3 or 506.4 in their entirety. Individual tenant spaces must comply with either 506.2 or 506.3 in their entirety unless documentation can be provided that demonstrates compliance with Section 506.4 for the entire building.

506.2 Efficient Mechanical Equipment.

Equipment shall meet the minimum efficiency requirements of Tables 506.2.(1) through 506.2.(7) in addition to the requirements in Section 503. This section shall only be used where an equipment efficiency option is available.

TABLE 506.2(1)
UNITARY AIR CONDITIONERS AND CONDENSING UNITS,
ELECTRICALLY OPERATED, EFFICIENCY REQUIREMENTS

<u>EQUIPMENT TYPE</u>	<u>SIZE CATEGORY</u>	<u>SUBCATEGORY</u> <u>OR</u> <u>RATING</u> <u>CONDITION</u>	<u>REQUIRED</u> <u>EFFICIENCY</u> ^a
<u>Air conditioners,</u> <u>Air cooled</u>	<u>< 65,000 Btu/hd</u>	<u>Split system</u>	<u>For zones 1 to 5: 15.0 SEER, 12.5 EER</u> <u>For zones 6 to 8: 14 SEER, 12 EER</u>
		<u>Single package</u>	<u>For zones 1 to 5: 15.0 SEER, 12.0 EER</u> <u>For zones 6 to 8: 14.0 SEER 11.6 EER</u>
	<u>≥ 65,000 Btu/h</u> <u>and</u> <u>< 240,000 Btu/h</u>	<u>Split system and</u> <u>single package</u>	<u>For zones 1 to 5: 12.0 EER_b, 12.4 IPLV_b</u> <u>For zones 6 to 8: 11.5 EER_b, 11.9 IPLV_b</u>
	<u>≥ 240,000 Btu/h</u> <u>and < 760,000</u> <u>Btu/h</u>	<u>Split system and</u> <u>single package</u>	<u>For zones 1 to 5: 10.8 EER_b, 12.0 IPLV_b</u> <u>For zones 6 to 8: 10.5 EER_b, 10.9 IPLV_b</u>
	<u>≥ 760,000 Btu/h</u>		<u>For zones 1 to 5: 10.2 EER_b, 11.0 IPLV_b</u> <u>For zones 6 to 8: 9.7 EER_b, 11.0 IPLV_b</u>
<u>Air conditioners,</u> <u>Water</u> <u>and evaporatively</u> <u>cooled</u>		<u>Split system and</u> <u>single package</u>	<u>14.0 EER</u>

For SI: 1 British thermal unit per hour = 0.2931 W.

a. IPLVs are only applicable to equipment with capacity modulation.

b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 506.2(2)
UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY
OPERATED, EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	REQUIRED EFFICIENCY^a
Air cooled (Cooling mode)	< 65,000 Btu/hd	Split system	For zones 1 to 5: 15.0 SEER, 12.5 EER For zones 6 to 8: 14.0 SEER, 12.0 EER
		Single package	For zones 1 to 5: 15.0 SEER, 12.0 EER For zones 6 to 8: 14.0 SEER, 11.6 EER
	≥ 65,000 Btu/h and < 240,000 Btu/h	Split system and single package	For zones 1 to 5: 12.0 SEER, 12.4 EER For zones 6 to 8: 11.5 EER ^b , 11.9 IPLV ^b
	≥ 240,000 Btu/h	Split system and single package	For zones 1 to 5: 12.0 SEER, 12.4 EER For zones 6 to 8: 10.5 EER ^b , 10.9 IPLV ^b
Water SOURCES (Cooling mode)	< 135,000 Btu/h	85°F entering water	14.0 EER
Air cooled (Heating mode)	< 65,000 Btu/hd (Cooling capacity)	Split system	For zones 1 to 5: 9.0 HSPF For zones 6 to 8: 8.5 HSPF
		Single package	For zones 1 to 5: 8.5 HSPF For zones 6 to 8: 8.0 HSPF
	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.4 COP
		17°F db/15°F wb outdoor air	2.4 COP
	≥ 135,000 Btu/h (Cooling capacity)	47°F db/43°F wb outdoor air	3.2 COP
		77°F db/15°F wb outdoor air	2.1 COP
Water SOURCES (Heating mode)	< 135,000 Btu/h (Cooling capacity)	70°F entering water	4.6 COP

For SI: °C = [(°F) - 32] / 1.8, 1 British thermal unit per hour = 0.2931 W.

db = dry-bulb temperature, °F; wb = wet-bulb temperature, °F

a. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.

b. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.

TABLE 506.2(3)
PACKAGED TERMINAL AIR CONDITIONERS AND
PACKAGED TERMINAL HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	REQUIRED EFFICIENCY^b
<u>Air conditioners</u>	<u>< 7,000 Btu / h</u>	<u>11.9 EER</u>
<u>& Heat Pumps</u> <u>(Cooling Mode)</u>	<u>7,000 Btu / h and < 10,000 Btu / h</u>	<u>11.3 EER</u>
	<u>10,000 Btu / h and < 13,000 Btu / h</u>	<u>10.7 EER</u>
	<u>> 13,000 Btu / h</u>	<u>9.5 EER</u>

a. Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY: NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches (406 mm) high and less than 42 inches (1067 mm) wide.

TABLE 506.2(4)
WARM AIR FURNACES AND COMBINATION WARM AIR FURNACES/AIR-CONDITIONING UNITS,
WARM AIR DUCT FURNACES AND UNIT HEATERS, EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	REQUIRED EFFICIENCY	TEST PROCEDURE
<u>Warm air furnaces, gas fired</u>	<u>< 225,000 Btu/h</u>	<u>—</u>	<u>For zones 1 & 2, NR.</u> <u>For zones 3 & 4 90 AFUE or 90 Et</u> <u>For zones 4-8 are 92 AFUE or 92 Et</u>	<u>DOE 10 CFR Part 430</u> <u>or ANSI Z21.47</u>
	<u>≥ 225,000 Btu/h</u>	<u>Maximum capacity</u>	<u>90% Ec note 1</u>	<u>ANSI Z21.47</u>
<u>Warm air furnaces, oil fired</u>	<u>< 225,000 Btu/h</u>	<u>—</u>	<u>For zones 1 & 2, NR.</u> <u>For zones 3 to 8 are 85 AFUE or 85 Et</u>	<u>DOE 10 CFR Part 430</u> <u>or UL 727</u>
	<u>≥ 225,000 Btu/h</u>	<u>Maximum capacity</u>	<u>85% Et, Note 1</u>	<u>UL 727</u>
<u>Warm air duct furnaces, gas fired</u>	<u>All capacities</u>	<u>Maximum capacity</u>	<u>90% Ec</u>	<u>ANSI Z83.8</u>
<u>Warm air unit heaters, gas fired</u>	<u>All capacities</u>	<u>Maximum capacity</u>	<u>90% Ec</u>	<u>ANSI Z83.8</u>
<u>Warm air unit heaters, oil fired</u>	<u>All capacities</u>	<u>Maximum capacity</u>	<u>90% Ec</u>	<u>UL 731</u>

TBD - To be decided

For SI: 1 British thermal unit per hour = 0.2931 W.

1 Units must also include an IID (intermittent ignition device), have jackets not exceeding 0.75 percent of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space. Where there two ratings units not covered by the National Appliance Energy Conservation Act of 1987 (NAECA) (3-phase power or cooling capacity greater than or equal to 65,000 Btu/h [19 kW]) shall comply with either rating.

Et = Thermal efficiency.

Ec = Combustion efficiency (100% less flue losses).

Efficient furnace fan: All fossil fuel furnaces in zones 3 to 8 shall have a furnace electricity ratio not greater than 2% and shall include a manufacturer's designation of the furnace electricity ratio.

TABLE 506.2(5)
BOILER, EFFICIENCY REQUIREMENTS

<u>EQUIPMENT TYPE</u>	<u>SIZE CATEGORY</u>	<u>TEST PROCEEDURE</u>	<u>REQUIRED EFFICIENCY</u>
<u>Gas Hot Water</u>	<u>< 300,000 Btu / h</u>	<u>DOE 10 CFR Part 430</u>	<u>90% Et</u>
	<u>> 300,000 Btu / h and > 2.5 mBtu/h</u>	<u>DOE 10 CFR Part 431</u>	<u>89% Et</u>
<u>Gas Steam</u>	<u>< 300,000 Btu / h</u>	<u>DOE 10 CFR Part 430</u>	<u>89% Et</u>
	<u>> 300,000 Btu / h</u>	<u>DOE 10 CFR Part 431</u>	<u>89% Et</u>
<u>Oil</u>	<u>< 300,000 Btu / h</u>	<u>DOE 10 CFR Part 430</u>	<u>90% Et</u>
	<u>> 300,000 Btu / h</u>	<u>DOE 10 CFR Part 431</u>	<u>89% Et</u>
<u>Et = thermal efficiency</u>			

**TABLE 506.2(6)
CHILLERS - EFFICIENCY REQUIREMENTS**

<u>EQUIPMENT TYPE</u>	<u>SIZE CATEGORY</u>	<u>REQUIRED EFFICIENCY-CHILLERS</u>		<u>OPTIONAL COMPLIANCE PATH - REQUIRED EFFICIENCY - CHILLERS WITH VSD</u>	
		<u>Full Load (KW /TON)</u>	<u>IPLV (KW /TON)</u>	<u>Full Load (KW /TON)</u>	<u>IPLV (KW /TON)</u>
<u>Air Cooled w/ Condenser</u>	<u>All</u>	<u>1.2</u>	<u>1.0</u>	<u>N/A</u>	<u>N/A</u>
<u>Air Cooled w/o Condenser</u>	<u>All</u>	<u>1.08</u>	<u>1.08</u>	<u>N/A</u>	<u>N/A</u>
<u>Water Cooled, Reciprocating</u>	<u>All</u>	<u>0.840</u>	<u>0.630</u>	<u>N/A</u>	<u>N/A</u>
<u>Water Cooled, Rotary Screw and Scroll</u>	<u>< 90 tons</u>	<u>0.780</u>	<u>0.600</u>	<u>N/A</u>	<u>N/A</u>
	³ <u>90 tons and < 150 tons</u>	<u>0.730</u>	<u>0.550</u>	<u>N/A</u>	<u>N/A</u>
	³ <u>150 tons and < 300 tons</u>	<u>0.610</u>	<u>0.510</u>	<u>N/A</u>	<u>N/A</u>
	<u>> 300 tons</u>	<u>0.600</u>	<u>0.490</u>	<u>N/A</u>	<u>N/A</u>
<u>Water Cooled, Centrifugal</u>	<u>< 150 tons</u>	<u>0.610</u>	<u>0.620</u>	<u>0.630</u>	<u>0.400</u>
	³ <u>150 tons and < 300 tons</u>	<u>0.590</u>	<u>0.560</u>	<u>0.600</u>	<u>0.400</u>
	<u>300 tons and < 600 tons</u>	<u>0.570</u>	<u>0.510</u>	<u>0.580</u>	<u>0.400</u>
	<u>> 600 tons</u>	<u>0.550</u>	<u>0.510</u>	<u>0.550</u>	<u>0.400</u>

a. Compliance with full load efficiency numbers and IPLV numbers are both required.

b. Only Chillers with Variable Speed Drives (VSD) may use the optional compliance path-for chiller efficiency.

N/A – No credit can be taken for this option

**TABLE 506.2(7)
ABSORPTION CHILLERS - EFFICIENCY REQUIREMENTS**

<u>EQUIPMENT TYPE</u>	<u>REQUIRED EFFICIENCY FULL LOAD COP (IPLV)</u>
<u>Air Cooled, Single Effect</u>	<u>0.60, allowed only in heat recovery applications</u>
<u>Water Cooled, Single Effect</u>	<u>0.70, allowed only in heat recovery applications</u>
<u>Double Effect - Direct Fired</u>	<u>1.0 (1.05)</u>
<u>Double Effect - Indirect Fired</u>	<u>1.20</u>

506.3 Efficient Lighting System. Whole Building Lighting Power Density (Watts/sf) shall meet the requirements of *Table 506.3. and automatic daylighting control requirements in Section 506.3.2.*

506.3.1 Reduced Lighting Power Density - The total interior lighting power (watts) is the sum of all interior lighting powers for all areas in the building. The interior lighting power is the floor area for the building times the value from Table 506.3.

TABLE 506.3 – REDUCED INTERIOR LIGHTING POWER

<u>BUILDING TYPE^a</u>	<u>REDUCED WHOLE BUILDING (Watts/Ft²)</u>
<u>AUTOMOTIVE FACILITY</u>	<u>0.79</u>
<u>CONVENTION CENTER</u>	<u>1.16</u>
<u>COURTHOUSE</u>	<u>1.08</u>
<u>DINING: BAR LOUNGE/LEISURE</u>	<u>1.19</u>
<u>DINING: CAFETERIA/FAST FOOD</u>	<u>1.34</u>
<u>DINING:FAMILY</u>	<u>1.50</u>
<u>DORMITORY</u>	<u>0.90</u>
<u>EXERCISE CENTER</u>	<u>0.92</u>
<u>FIRE STATIONS</u>	<u>0.74</u>
<u>GYMNASIUM</u>	<u>1.07</u>
<u>HEALTHCARE CLINIC</u>	<u>0.89</u>
<u>HOTEL</u>	<u>0.90</u>
<u>LIBRARY</u>	<u>1.00</u>
<u>MANUFACTURING FACILITY</u>	<u>1.24</u>
<u>MOTEL</u>	<u>0.90</u>
<u>MOTION PICTURE THEATER</u>	<u>1.18</u>
<u>MUSEUM</u>	<u>1.04</u>
<u>OFFICE</u>	<u>0.80</u>
<u>PERFORMING ARTS THEATER</u>	<u>1.46</u>
<u>POLICE STATIONS</u>	<u>0.89</u>
<u>POST OFFICE</u>	<u>0.98</u>
<u>RELIGIOUS BUILDINGS</u>	<u>1.18</u>
<u>RETAIL</u>	<u>1.30</u>
<u>RETAIL: SPECIALTY</u>	<u>1.40</u>
<u>RETAIL: SUPERMARKET</u>	<u>1.30</u>
<u>SCHOOL/UNIVERSITY</u>	<u>1.01</u>
<u>TOWN HALL</u>	<u>0.94</u>
<u>TRANSPORTATION</u>	<u>0.85</u>
<u>WAREHOUSE^b</u>	<u>0.60</u>
<u>WORKSHOP</u>	<u>1.20</u>

For SI: 1 foot = 304.8 mm, 1 watt per square foot = W/0.0929 m².

- a. In cases where both a general building area type and a more specific building area type are listed, the more specific building area type shall apply.
- b. At least one half of the floor area shall be in the daylight zone. Automatic daylighting controls shall be installed in daylit zones and shall meet the requirements of Section 505.2.2.2.3.

506.3.2 Automatic Daylighting Controls. Automatic daylighting controls shall be installed in all daylight zones and shall meet the requirements of Section 505.2.2.2.

506.4 On-site Supply of Renewable Energy

The building or surrounding property shall supply 3% or more of the building energy use associated with systems and equipment covered by this code through on-site renewable energy. On-site power generation using nonrenewable sources does not meet this requirement.

The code official shall be provided with an energy analysis as described in Section 507 that documents on-site renewable energy production is capable of providing at least 3% of the total estimated annual purchased energy for the building functions regulated by this code, or a calculation demonstrating that on-site renewable energy production has a nominal (maximum) rating of at least 1.75 BTUs or at least 0.50 watts per square foot of conditioned floor area.

Add the following to Chapter 6

ASTM

Standard reference number	Title	Referenced in code section number
E779-03	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization.....	502.4.1.2(3)
E1677-95 (2000)	Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls.....	502.4.1.2(2)
E2178-03	Standard Test Method for Air Permeance of Building Materials.....	502.4.1.2(1)
E2357-05	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.....	502.4.1.2(2)
ASTM C1371-04	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.....	502.2.1.1
ASTM C1549	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer....	502.2.1.1
ASTM E408-71 (02)	Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques	502.2.1.1
ASTM E1918-97	Standard Test Method for Measuring Solar Reflectance of Horizontal or Low-Sloped Surfaces in the Field.....	502.2.1.1