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I MINA'TRENTAI DOS NA LIHESLATURAN GUÅHAN
2014 (SECOND) Regular Session

CERTIFICATION OF PASSAGE OF AN ACT TO *I MAGA'LAHEN GUÅHAN*

This is to certify that **Bill No. 61-32 (COR), "AN ACT TO *ADD* A NEW § 67101.7 TO CHAPTER 67 OF TITLE 21, GUAM CODE ANNOTATED, RELATIVE TO ADOPTING THE GUAM TROPICAL ENERGY CODE (GTEC),"** was on the 1st day of February, 2014, duly and regularly passed.

Judith T. Won Pat, Ed.D.
Speaker

Attested:

Tina Rose Muña Barnes
Legislative Secretary

This Act was received by *I Maga'lahen Guåhan* this 1st day of Feb., 2014, at 10:50 o'clock P.M.

DD R.S. Menorca 4:36

Assistant Staff Officer
Maga'lahi's Office

APPROVED:

EDWARD J.B. CALVO
I Maga'lahen Guåhan

Date: _____

Public Law No. _____

I MINA'TRENTAI DOS NA LIHESLATURAN GUÅHAN
2013 (FIRST) Regular Session

Bill No. 61-32 (COR)

Introduced by: T. C. Ada
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Frank B. Aguon, Jr.
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Chris M. Dueñas
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Judith T. Won Pat, Ed.D.

AN ACT TO *ADD* A NEW § 67101.7 TO CHAPTER 67 OF TITLE 21, GUAM CODE ANNOTATED, RELATIVE TO ADOPTING THE GUAM TROPICAL ENERGY CODE (GTEC).

BE IT ENACTED BY THE PEOPLE OF GUAM:

Section 1. Legislative Findings and Intent. *I Liheslaturan Guåhan* finds that building energy codes set an energy efficiency baseline that addresses the energy-efficiency requirements for the design, materials, and equipment used in nearly all new constructions and renovations. These requirements affect the overall energy efficiency of a building and can reduce the energy needed to maintain a healthy, comfortable, and fully functioning indoor environment.

I Liheslaturan Guåhan further finds that energy codes can play a key role in reducing the island's reliance on foreign oil, and carbon emissions. Finally, current industry techniques enable construction of buildings that comply with energy codes, at minimal increase in first cost. Ultimately, building owners benefit with reduced energy bills and a comfortable healthy home or business facility.

I Liheslatura further finds that in accordance with P.L. 30-199, the Guam Building Code Council met regularly and conducted public hearings to receive input and recommendations. The product of that effort is the 2012 Guam Tropical Energy Code (GTEC), an energy conservation code applicable to Guam's tropical environment and intended for implementation in conjunction with the current Guam Building Code that was previously adopted by P.L. 30-199. The Guam Building Code Council approved the GTEC on Jan 8, 2013, and now needs Legislative ratification.

I Liheslatura finds that the 2012 GTEC should be the standard used on new construction and renovations. It is, therefore, the intent of *I Liheslatura* to adopt the Guam Tropical Energy Code into law, and to provide a six-month period before implementation in order to allow for a smooth transition.

Section 2. The existing §§ 67101.7 and 67101.8 of Chapter 67, Title 21, Guam Code Annotated, are hereby renumbered as §§ 67101.8 and 67101.9, respectively.

Section 3. A new §67101.7 of Chapter 67, Title 21, Guam Code Annotated, is hereby *added* to read:

"**§ 67101.7. Guam Tropical Energy Code Adopted.** The *Guam Tropical Energy Code*, Attachment A, is hereby adopted. This Code *shall* apply to all residential and non-residential construction as prescribed in the GTEC; however, Section 5 of this Code *shall not* be applicable to:

(a) Unconditioned Groups S & U Occupancy Buildings, or

(b) Temporary Structures, as defined by the International Building Code."

Section 4. Severability. *If* any of the provisions of this law or its application to any person or circumstance is found to be invalid or contrary to law, such invalidity *shall not* affect other provisions or applications of this law which can be given effect without the invalid provisions or application, and to this end the provisions of this law are severable.

Section 5. Effective Date. This Act *shall* become effective six (6) months from the date of enactment.

GUAM BUILDING CODE COUNCIL

c/o Guam Contractors License Board
542 N. Marine Corps Drive, Building A (DPW), Tamuning, GU 96913
contact@guambcc.org
671-649-9676

32-13-167
Office of the Speaker
Judith T. Won Pat, Ed. D.
Date 3/4/13
Time 11:24AM
Received by

March 4, 2013

The Honorable Judith T. Won Pat, Ed. D
Speaker, 32nd Guam Legislature
155 Hessler Street
Hagåtña, Guam

Re: Guam Tropical Energy Code

Hafa Adai Speaker Won Pat,

Per the mandate of P.L. 30-199, the proposed *2012 Guam Tropical Energy Code* (GTEC) is hereby transmitted for adoption as part of the *Guam Building Code*. The GTEC was developed by the Guam Building Code Council (GBCC) with input from the community, and is consistent with industry standards.

Energy codes can play a key role in reducing the island's demand of foreign oil, and reducing carbon emissions. Additionally, current industry techniques enable construction of buildings that comply with energy codes, at minimal increase in first cost. Ultimately, building owners benefit with reduced energy bills and a comfortable healthy home or business facility.

The GTEC is a set of industry based construction standards promoting energy conservation. If adopted, the GTEC will be applicable to all new residential and non-residential construction and to existing structures undergoing substantial renovation. Additionally, the GTEC is intended to promote energy conservation in a cost-effective manner. Implementation of these standards is not expected to have a significant impact in the total cost of construction.

With the support of the Guam Energy Office, the GBCC conducted community outreach and public hearings, to include information workshops for technical and non-technical stakeholders. Input was received from contractors, real estate professionals, engineers, architects, and the general public. Articles have been written about the GTEC in the local media and five Public Hearings were held on the matter. Input that was received was evaluated and incorporated, and the resulting GTEC was adopted unanimously by the GBCC on January 8, 2013.

The Guam Building Code Council (GBCC) looks forward to the timely adoption of the *2012 Guam Tropical Energy Code* (GTEC).

Sincerely,

Brent Wiese, AIA NCARB LEED AP BD+C
Chairman, Guam Building Code Council

CC: Chairman, Committee on Public Safety, Infrastructure, and Maritime Transportation

32-13-167
Office of the Speaker
Judith T. Won Pat, Ed. D.
Date 3/4/13
Time 11:24AM
Received by

2012 Guam Tropical Energy Code

Guam Building Code Council
As Approved on January 8, 2013

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DEFINITIONS

GENERAL

Scope. Unless stated otherwise, the following words and terms in this code shall have the meanings indicated in this chapter.

Interchangeability. Words used in the present tense include the future; words in the masculine gender include the feminine and neuter; the singular number includes the plural and the plural includes the singular.

Terms defined in other codes. Terms that are not defined in this code but are defined in the *International Building Code*, *International Fire Code*, *International Fuel Gas Code*, *International Mechanical Code*, *International Plumbing Code*, the *International Residential Code, or the International Energy Conservation Code* shall have the meanings ascribed to them in those codes.

Terms not defined. Terms not defined by this chapter shall have ordinarily accepted meanings such as the context implies.

GENERAL DEFINITIONS

ACCESSIBLE. Admitting close approach as a result of not being guarded by locked doors, elevation or other effective means (see "Readily *accessible*").

ADDITION. An extension or increase in the *conditioned space* floor area or height of a building or structure.

AIR BARRIER. Material(s) assembled and joined together to provide a barrier to air leakage through the building envelope. An air barrier may be a single material or a combination of materials.

ALTERATION. Any construction or renovation to an existing structure that requires a permit. Also, a change in a mechanical system that involves an extension, addition or change to the arrangement, type or purpose of the original installation that requires a permit.

APPROVED. Approval by the *code official* as a result of investigation conducted by him or her, or by reason of accepted principles or tests by nationally recognized organizations.

AUTOMATIC. Self-acting, operating by its own mechanism when actuated by some impersonal influence, as, for example, a change in current strength, pressure, temperature or mechanical configuration (see "Manual").

BASEMENT WALL. A wall 50 percent or more below grade and enclosing *conditioned space*.

BUILDING. Any structure used or intended for supporting or sheltering any use or occupancy.

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

***C*-FACTOR (THERMAL CONDUCTANCE).** The coefficient of heat transmission (surface to surface) through a building component or assembly, equal to the time rate of heat flow per unit area and the unit temperature difference between the warm side and cold side surfaces (Btu/h ft^2 x°F) [W/(m^2 xK)].

CODE OFFICIAL. The officer or other designated authority charged with the administration and enforcement of this code, or a duly authorized representative.

COMMERCIAL BUILDING. For this code, all buildings that are not included in the definition of "Residential buildings."

CONDITIONED FLOOR AREA. The horizontal projection of the floors associated with the *conditioned space*.

CONDITIONED SPACE. An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent *conditioned space*.

CURTAIN WALL. Fenestration products used to create an external nonload-bearing wall that is designed to separate the exterior and interior environments.

DAYLIGHT ZONE.
1. Under skylights. The area under skylights whose horizontal dimension, in each direction, is equal to the skylight dimension in that direction plus either the floor-to ceiling height or the dimension to a ceiling height opaque partition, or one-half the distance to adjacent skylights or vertical fenestration, whichever is least.
2. Adjacent to vertical fenestration. The area adjacent to vertical fenestration receiving daylight through the fenestration. For purposes of this definition and unless more detailed analysis is provided, the daylight *zone* depth is assumed to extend into the space a distance of 15 feet (4572 mm) or to the nearest ceiling height opaque partition, whichever is less. The daylight *zone* width is assumed to be the width of the window plus 2 feet (610 mm) on each side, or the window width plus the distance to an opaque partition, or the window width plus one-half the distance to adjacent skylight or vertical fenestration, whichever is least.

DEMAND CONTROL VENTILATION (DCV). A ventilation system capability that provides for the automatic reduction of outdoor air intake below design rates when the actual occupancy of spaces served by the system is less than design occupancy.

DUCT. A tube or conduit utilized for conveying air. The air passages of self-contained systems are not to be construed as air ducts.

DUCT SYSTEM. A continuous passageway for the transmission of air that, in addition to ducts, includes duct fittings, dampers, plenums, fans and accessory air-handling equipment and appliances.

DWELLING UNIT. A single unit providing complete independent living facilities for one or more persons, including permanent provisions for living, sleeping, eating, cooking and sanitation.

ENERGY ANALYSIS. A method for estimating the annual energy use of the *proposed design* and *standard reference design* based on estimates of energy use.

ENERGY COST. The total estimated annual cost for purchased energy for the building functions regulated by this code, including applicable demand charges.

ENERGY RECOVERY VENTILATION SYSTEM. Systems that employ air-to-air heat exchangers to recover energy from exhaust air for the purpose of preheating, precooling, humidifying or dehumidifying outdoor ventilation air prior to supplying the air to a space, either directly or as part of an HVAC system.

ENERGY SIMULATION TOOL. An *approved* software program or calculation-based methodology that projects the annual energy use of a building.

ENTRANCE DOOR. Fenestration products used for ingress, egress and access in nonresidential buildings, including, but not limited to, exterior entrances that utilize latching hardware and automatic closers and contain over 50-percent glass specifically designed to withstand heavy use and possibly abuse.

EXTERIOR WALL. Walls including both above-grade walls and basement walls.

FENESTRATION. Skylights, roof windows, vertical windows (fixed or moveable), opaque doors, glazed doors, glazed block and combination opaque/glazed doors. Fenestration includes products with glass or non-glass glazing materials.

***F*-FACTOR.** The perimeter heat loss factor for slab-on-grade floors (Btu/h xft x°F) [W/(m xK)].

HEAT CAPACITY (HC). The amount of heat necessary to raise the temperature of a given mass 1°F. Numerically, the mass expressed per unit of wall surface multiplied by the specific heat [BTU/ft^2 °F]

HEAT TRAP. An arrangement of piping and fittings, such as elbows, or a commercially available heat trap that prevents thermosyphoning of hot water during standby periods.

HIGH-EFFICACY LAMPS. Compact fluorescent lamps, 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.

HUMIDISTAT. A regulatory device, actuated by changes in humidity, used for automatic control of relative humidity.

INFILTRATION. The uncontrolled inward air leakage into a building caused by the pressure effects of wind or the effect of differences in the indoor and outdoor air density or both.

KNEE WALL (PONY WALL). A split wall with different wall types for the upper and lower portions.

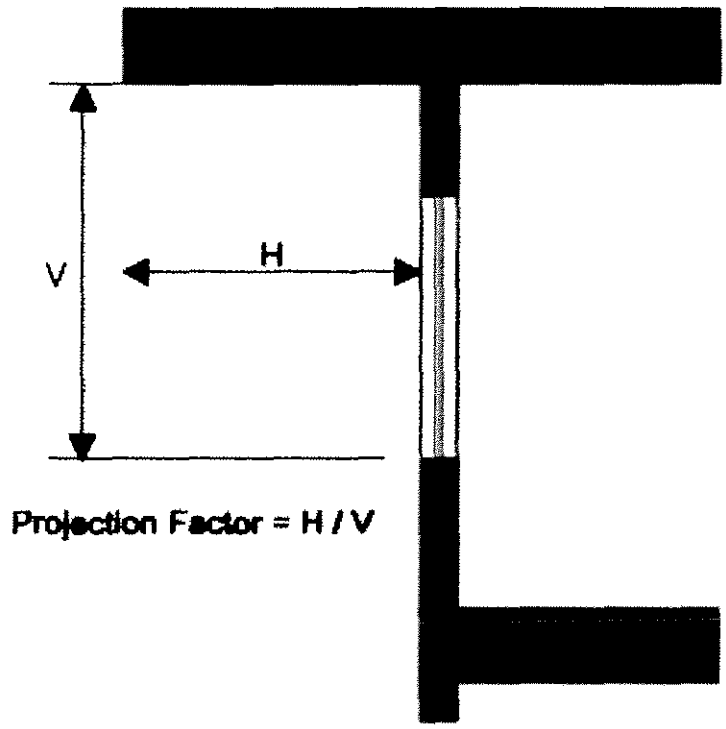
LABELED. Equipment, materials or products to which have been affixed a label, seal, symbol or other identifying mark of a nationally recognized testing laboratory, inspection agency or other organization concerned with product evaluation that maintains periodic inspection of the production of the above-labeled items and whose labeling indicates either that the equipment, material or product meets identified standards or has been tested and found suitable for a specified purpose.

LISTED. Equipment, materials, products or services included in a list published by an organization acceptable to the *code official* and concerned with evaluation of products or services that maintains periodic inspection of production of *listed* equipment or materials or periodic evaluation of services and whose listing states either that the equipment, material, product or service meets identified standards or has been tested and found suitable for a specified purpose.

LOW-RISE RESIDENTIAL. Single-family houses, multi-family structures of three stories or fewer above grade.

MANUAL. Capable of being operated by personal intervention (see "Automatic").

PROJECTION FACTOR (PF). The ratio of the horizontal depth of the external shading projection divided by the sum of the height of the fenestration and the distance from the top of the fenestration to the bottom of the farthest point of the external shading projection, in consistent units.



PROPOSED DESIGN. A description of the proposed building used to estimate annual energy use for determining compliance based on total building performance.

READILY ACCESSIBLE. Capable of being reached quickly for operation, renewal or inspection without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to portable ladders or access equipment (see "*Accessible*").

REPAIR. The reconstruction or renewal of any part of an existing building.

RESIDENTIAL BUILDING. For this code, includes R-3 buildings, as well as R-2 and R-4 buildings three stories or less in height above grade.

ROOF ASSEMBLY. The upper portion of the building envelope, including opaque areas and fenestration, that is horizontal or tilted at an angle of less than 60° from horizontal. For the purposes of determining building envelope requirements, the classifications are defined as follows:

a. Mass roof: a roof with a heat capacity exceeding 7.5 or a weight greater than 40 lb/ft^2. Concrete roofs equal to or greater than four inches are considered mass roofs.
b. Metal building roof: a roof (1) that is not in the roof with insulation entirely above deck category and (2) whose structure consists simply of metal spanning members supported by metal structural members (i.e., does not include composite concrete and metal deck construction.)
c. Other roofs: all other roofs, including wood roofs, but excluding metal building roofs.

***R*-VALUE (THERMAL RESISTANCE).** The inverse of the time rate of heat flow through a body from one of its bounding surfaces to the other surface for a unit temperature difference between the two surfaces, under steady state conditions, per unit area (h xft^2 x°F/Btu) [(m^2 xK)/W].

SERVICE WATER HEATING. Supply of hot water for purposes other than comfort heating.

SKYLIGHT. Glass or other transparent or translucent glazing material installed at a slope of 15 degrees (0.26 rad) or more from vertical. Glazing material in skylights, including unit skylights, solariums, sunrooms, roofs and sloped walls is included in this definition.

SLEEPING UNIT. A room or space in which people sleep, which can also include permanent provisions for living, eating, and either sanitation or kitchen facilities but not both. Such rooms and spaces that are also part of a dwelling unit are not *sleeping units*.

SOLAR HEAT GAIN COEFFICIENT (SHGC). The ratio of the solar heat gain entering the space through the fenestration assembly to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation which is then reradiated, conducted or convected into the space.

THERMOSTAT. An automatic control device used to maintain temperature at a fixed or adjustable set point.

***U*-FACTOR (THERMAL TRANSMITTANCE).** The coefficient of heat transmission (air to air) through a building component or assembly, equal to the time rate of heat flow per unit area and unit temperature difference between the warm side and cold side air films (Btu/h xft^2 x°F) [W/(m^2 xK)].

VENTILATION. The natural or mechanical process of supplying conditioned or unconditioned air to, or removing such air from, any space.

VENTILATION AIR. That portion of supply air that comes from outside (outdoors) plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

ZONE. A space or group of spaces within a building with heating or cooling requirements that are sufficiently similar so that desired conditions can be maintained throughout using a single controlling device.

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1. Purpose

The purpose of this code is to provide minimum design requirements to achieve energy-efficiency in buildings constructed in Guam.

2. Scope

(A) This code shall apply to all non-residential and residential construction.

(B) This code provides minimum energy-efficiency requirements for the design and construction of any of the following:

(1) new buildings,

(2) additions, alterations, renovations, or repairs to existing buildings requiring a permit,

(3) new or replacement air conditioning, water heating, and lighting equipment in existing buildings, or

(4) replacement roofing.

(C) Where this code is found in conflict with the safety, health, or environmental codes, the safety, health or environmental codes shall govern.

(D) Historic Buildings Exemption. *Any building or structure that is listed in the National Register of Historic Places or the Guam Register of Historic Places*; designated as a historic property under local designation law or survey; certified as a contributing resource with a National Register listed or locally designated historic district; or with an opinion or certification that the property is eligible to be listed on the National Register of Historic Places either individually or as a contribution building to a historic district by the State Historic Preservation Officer or the Keeper of the National Register of Historic Places, are exempted from this code, insofar as complying with the code would compromise or damage the historic character of the building.

3. Administration and Enforcement

3.01 Compliance Requirements

(A) New Buildings

(1) Low-rise residential buildings shall comply with the provisions of Section 4 through Section 6 of this code.

(2) Other buildings shall comply with either Section 4 through Section 7 of this code or the International Energy Conservation Code 2009, Chapter 5, including §506 on Total Building Performance, as amended by Section 4.03(A)(2) of this code.

(B) **Additions, alterations, renovations or repairs.** Additions, alterations, renovations or repairs to those parts of an existing building that are affected by this code, or parts thereof, building systems or portions thereof shall conform to the provisions of this code. **Unaltered portion(s) of the existing building or building system shall not be required to comply with this code.** Additions, alterations, renovations, or repairs shall not create an unsafe or hazardous condition or overload existing building systems.

Note: Major alterations to a building, where the estimated cost of construction is more than 50% of the appraised value of the building, the entire building shall comply with the provisions of this code.

Exception: The following need not comply provided the energy use of the building is not increased by any of the following:

(1) Glass only replacements in an existing sash and frame.

(2) Existing ceiling, wall or floor cavities exposed during construction provided that these cavities are filled with insulation.

(3) Construction where the existing roof, wall or floor cavities are not exposed.

(4) Alterations that replace less than 50 percent of the luminaires in a space, provided that such alterations do not increase the installed interior lighting power.

(5) Alterations that replace only the bulb and ballast within the existing luminaires in a space provided that the *alteration* does not increase the installed interior lighting power.

(C) **Change in occupancy.** Buildings undergoing a change in occupancy that would result in an increase in demand for either fossil fuel or electrical energy shall comply with this code.

(D) **Mixed occupancy.** Where a building includes both residential and other occupancies, each occupancy shall be separately considered and meet the applicable provisions for each occupancy.

(E) **Replacement Roofing.** Replacement roofing membranes shall comply with the roof requirements of Section 4.03(A)(2).

3.02 Administrative Requirements

Administrative requirements relating to permit requirements, enforcement, interpretations, claims of exemption, and calculation methods are specified by the Department of Public Works. Administrative requirements relating to rights of appeal are specified by the Guam Building Code Council.

3.03 Compliance Documents

(A) General: Plans, specifications, calculations, diagrams, reports, and other data shall constitute the compliance documents.

(B) Construction Details: Compliance documents shall show pertinent data and features of the building, equipment, and systems in sufficient detail to permit an evaluation by the Department of Public Works relative to this code.

(C) Supplemental Information: The Department of Public Works may require supplemental information necessary to verify compliance with this code, such as calculations, worksheets, compliance forms, vendor literature, or other data.

(D) Alternative method for prescriptive requirement compliance: The Energy Cost Budget Method, as defined by Chapter 11 of ASHRAE Standard 90.1-2007, may be used in place of prescriptive method outlined within this code. In such a case, evidence must be provided demonstrating that building performance is equal to or better than the energy conservation standards established within this code.

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4. Envelope

4.01 General

(A) Scope. The envelope requirements apply to all enclosed buildings, except unconditioned factories, storage spaces, and warehouses.

(B) Compliance. The building envelope shall comply with the mandatory provisions of Section 4.02 and either the prescriptive criteria of Section 4.03 or the building envelope trade-off procedures of Section 4.05. Low-rise residential buildings have the additional option of complying with the criteria for naturally ventilated buildings in Section 4.04.

4.02 Mandatory Provisions

(A) Insulation. Insulation materials shall be installed to achieve proper densities, maintain clearances, and maintain rated R-value of insulation. Exception: Insulation may be compressed at the structural support for draped applications in metal buildings.

(B) Moisture Control. The building envelope shall be designed to prevent moisture migration that leads to deterioration of the insulation or equipment and structural damage.

(C) U-factors. U-factors for opaque constructions shall be calculated using procedures consistent with the ASHRAE Fundamentals, 2009.

(D) Certification and labeling of cool roof products. The initial reflectance, aged reflectance, emittance, and the aged SRI of roofing products shall be determined by the Cool Roof Rating Council (CRRC) in accordance with the CRRC-1.

(E) Fenestration product rating. The solar heat gain coefficient (SHGC) 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. As an alternative, the center-of-glass SHGC from glass manufacturers may be used. Products lacking such a SHGC as described above shall be assigned a default SHGC from Table 4.1.

(F) Building Envelope Sealing:

(1) The building thermal envelope shall be durably sealed to limit air infiltration. The sealing methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material:

a) All joints, seams and penetrations.

b) Site-built windows, doors and skylights.

c) Openings between window and door assemblies and their respective jambs and framing.

d) Utility penetrations.

e) Dropped ceilings or chases adjacent to the thermal envelope.

f) Joints at knee walls.

g) Joints in walls and ceilings separating unconditioned spaces from conditioned spaces.

h) Behind tubs and showers on exterior walls.

i) Common walls between dwelling units.

j) Other sources of infiltration.

(2) Fenestration air leakage. Operable windows shall be capable of being tightly closed. Windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot (1.5 L/s/sq m), and swinging doors no more than 0.5 cfm per square foot (2.6 L/s/sq m), when tested according to NFRC 400 or

AAMA/WDMA/CSA101/I.S.2/A440 by an accredited, independent laboratory and listed or labeled by the manufacturer.

Exception to 4.02(F)(2): Windows, skylights and glass doors in naturally ventilated low-rise residential buildings that comply with Section 4.04.

(3) Non-Residential Building entrances enclosing conditioned space shall be revolving or self-closing doors, or be enclosed by other means as shall be approved by the Department of Public Works.

4.03 Prescriptive Building Envelope Requirements

(A) Roofs.

(1) Roofs shall meet the requirements of Table 4.2

(2) Low-slope roof membranes shall have an aged reflectance of at least 0.55 and a minimum thermal emittance of 0.75, or a minimum aged SRI of at least 64.

a) If only the new reflectance is known, the aged reflectance shall be calculated as follows:
Equation 4.03-1:

$$REFL_{Aged} = 0.60 + 0.70 \times Refl_{Initial}$$

b) If the SRI is not known, but the reflectance and emittance are known, then the SRI shall be calculated:
Equation 4.03-2:

$$SRI = -84 + 85 \times Emit + 203 \times Ref - 75 \times Refl \times Emit$$

c) Roof surfaces shall have a minimum slope of 1/4 inch per foot of run.

Exception to 4.03(A)(2)(c): Replacement roofing.

(B) Walls. Wall insulation shall meet the requirements of Table 4.3.

(C) Windows. Fenestration products shall meet the requirements of Table 4.4. The window wall ratio is limited to a maximum of 40% of the gross wall area.

(D) Skylights. Area is limited to a maximum of 3% of the gross roof area. The maximum SHGC for glass products is 0.40 and the maximum SHGC for plastic skylights is 0.35.

4.04 Prescriptive Building Envelope Requirements for Naturally Ventilated Low-Rise Residential Buildings

This section may be used as an alternative to 4.03 for low-rise residential buildings.

(A) Roofs shall meet the requirements of 4.03(A). Walls shall meet the requirements of 4.03(B). Windows shall meet the requirements of 4.03(C) and skylights shall meet the requirements of 4.03(D).

4.05 Building Envelope Trade-Off Option

A trade-off for the Mandatory Requirements shall be allowed if the envelope performance factor of the proposed building is less than or equal to the envelope performance factor of the budget building.

(A) The envelope performance factor shall be calculated using the following equations.

$$EPF_{Total} = EPF_{Roof} + EPF_{Wall} + EPF_{Fenest}$$

Where:

$$EPF_{Roof} = c_{Roof,Mass}\sum_{s=1}^{n} U_s A_s (1 - SRI)_s + c_{Roof,MtlBldg}\sum_{s=1}^{n} U_s A_s (1 - SRI)_s + c_{Roof,Other}\sum_{s=1}^{n} U_s A_s (1 - SRI)_s$$

$$EPF_{Wall} = c_{Wall,Mass}\sum_{s=1}^{n} U_s A_s + c_{Wall,MtlBldg}\sum_{s=1}^{n} U_s A_s + c_{Wall,MtlFrm}\sum_{s=1}^{n} U_s A_s + c_{Wall,Other}\sum_{s=1}^{n} U_s A_s$$

$$EPF_{Fenest} = c_{Fenest,North}\sum_{w=1}^{n} A_w SHGC_w M_w +$$

$$c_{Fenest,East}\sum_{w=1}^{n} A_w SHGC_w M_w +$$

$$c_{Fenest,South}\sum_{w=1}^{n} A_w SHGC_w M_w +$$

$$c_{Fenest,West}\sum_{w=1}^{n} A_w SHGC_w M_w +$$

$$c_{Fenest,Skylight}\sum_{s=1}^{n} A_s SHGC_s$$

Where:

EPF_{Roof}	Envelope performance factor for roofs. Other subscripts include walls and fenestration.
A_S, A_W	The area of a specific envelope component referenced by the subscript "s" or for windows the subscript "w".
$SHGC_W$	The solar heat gain coefficient for windows (w). $SHGC_S$ refers to skylights.
M_W	A multiplier for the window SHGC that depends on the projection factor of an overhang or side fin. These values are determined by the procedures in Section 4.05(B).
U_S	The U-factor for the envelope component referenced by the subscript "s".
SRI_S	The aged SRI shall be used. If the aged SRI is not known, it can be calculated from the aged reflectance and emittance using Equation 4.03-2. If the SRI is not known and cannot be calculated for a product, an SRI of 10 shall be used.
C_{Fenest}	The coefficients for use in the EPF equations are contained in

	Table 4.5.
$C_{Roof,Mass}$	A coefficient for the "Roof, Mass" class of construction. Values of "C" are taken from Table 4.5 for each class of construction.

(B) Credits for fixed shading devices (M) such as overhangs, awnings, trellises, or side fins shall be calculated using the following equations:

(overhangs) $M = 0.16 \times PF^2 + -0.61 \times PF + 1$
(side fins) $M = 0.23 \times PF^2 + -0.74 \times PF + 1$

where: PF is Projection Factor (see definitions section)

(C) The following rules shall be used to define the budget building.

(1) The budget building shall have the same building floor area, gross wall area, and gross roof area as the proposed design. If the building has both 24-hour and daytime occupancies, the distribution between these shall be the same as the proposed design.

(2) The U-factor of each envelope component shall be equal to the criteria from Section 4.03 for each class of construction.

(3) The vertical fenestration area shall be equal to the proposed design or 40% of the gross exterior wall area, whichever is less. The skylight area shall be equal to the proposed design or 3% of the gross exterior roof area, whichever is less.

(4) The SHGC of each window or skylight component shall be equal to the criteria from Section 4.03.

(5) If the roof is low-sloped or metal, the SRI shall be 64. Otherwise, the SRI shall be 27.

Table 4.1 Default Glazed Fenestration SHGC

Single Glazed		Double Glazed		
Clear	Tinted	Clear	Tinted	Glazed Block
0.8	0.7	0.7	0.6	0.6

Table 4.2 Roof Assembly

	Non-Residential		Residential	
Class	Maximum U-factor	Or Minimum Insulation:	Maximum U-factor	Or Minimum Insulation:
Mass	0.072	R-13	0.072	R-13
Metal building	0.065	R-19	0.065	R-19
Other	0.034	R-30	0.034	R-30

See definitions section for definitions of these terms.

Table 4.3 Wall Assembly

Class	All Building Types Maximum U-factor	Or Minimum Insulation
Mass	None	None
Metal building	0.113	R-13
Steel-Framed	0.124	R-13
Wood-Framed and other	0.089	R-13

A mass wall has a Heat Capacity (HC) greater than 7.0 or a weight greater than 35 lb/ft2.

Table 4.4 Window Heat Gain

Building Type	Window Wall Ratio	Un-Shaded	Partially Shaded	Well Shaded or North Facing
Nonresidential or high-rise residential	Less than 15%	No Requirement	No Requirement	No Requirement
	15% - 25%	Special Coated Glass	Tinted Glass	No Requirement
	More than 25%	Special Coated Glass	Special Coated Glass	Tinted Glass
Low-rise residential	All	No Requirement	No Requirement	No Requirement

- Window wall ratio is the ratio of the total window area of the building, measured to the outside of the frame, to the gross exterior wall area.
- A north facing window is one that faces within 22.5 degrees of true north.
- Partially shaded windows are those that are protected from direct sun for the majority of the time. Shading can be provided by overhangs, side fins, mature trees, or other devices. Qualifying overhangs shall have a projection factor greater than or equal to 0.5 and the overhang shall extend past the window jambs a distance at least equal to the overhang projection. Qualifying side fins shall have a projection factor greater than or equal to 0.5 and the side fin shall extend above the window head a distance at least equal to the side fin projection.
- Well-shaded windows are those that are more completely protected from direct sun. Shading can be provided by overhangs, side fins, mature trees, or other devices. Qualifying overhangs shall have a projection factor greater than or equal to 1.0 and the overhang shall extend past the window jambs a distance at least equal to the overhang projection. Qualifying side fins shall have a projection factor greater than or equal to 1.0 and the side fin shall extend above the window head a distance at least equal to the side fin projection.
- Tinted glass includes all glazing products with a bronze, green, gray or blue integral tint; clear glass with a coating or film; or any other glazing product that has a solar heat gain coefficient (SHGC) equal to or less than 0.61.
- Special coated glass includes glass with reflective coatings or films that have a solar heat gain coefficient (SHGC) equal to or less than 0.30.

Table 4.5 Envelope Performance Factor Coefficients		
Component, Class	Daytime	24-Hour
Roofs, Mass	1.47	3.61
Roofs, MtlBldg	15.83	25.26
Roofs, Other	2.84	3.82
Wall, Mass	2.53	6.14
Wall, MtlBldg	6.36	9.28
Wall, MtlFrm	6.36	9.28
Wall, Other	6.36	9.28
Fenest, East	53	86
Fenest, North	31	51
Fenest, South	58	98
Fenest, West	50	85
Fenest, Skylights	101	163

5. Ventilation and Air Conditioning

5.01 General

All mechanical equipment and systems serving the building's cooling, dehumidification, or ventilation needs shall meet the requirements of this section.

5.02 Applicability of Mandatory Provisions[1]

The requirements of this section apply to ventilation and cooling systems that:

(A) use unitary packaged or split-system air conditioners that are either air-cooled or evaporatively cooled,

(B) serve a single thermal zone,

(C) have a cooling capacity less than 65,000 Btu/h, and do not have a humidistat.

Ventilation and air conditioning systems that do not satisfy the above requirements shall be designed in accordance with Section 503 of the IECC 2009.

5.03 Mandatory Provisions:

[1] Aluminum or copper condenser coils which are exposed to salty and humid marine conditions typical of the climates covered by this code will quickly corrode. Corrosion leads to rapid losses in capacity, reduced efficiency, and increased energy consumption. In seaside locations especially, the operating performance of unprotected condenser coils may decrease over 50% in a single year (Source: Coatings Can Help Condensers Live Longer, Joanna Turpin, February 13, 2002, HVACR Directory). For this reason, protective coatings are recommended, although not required by the code. Many manufacturers offer protective coatings that reduce corrosion. Coatings may also be field installed, but factory applied coatings are recommended, since it is difficult to maintain quality under field conditions.

(A) Each system shall be controlled by a thermostat.

(B) Each thermostat shall be provided with setback controls that are controlled by either an automatic time clock or programmable control system.

(1) Thermostat setback capabilities. Thermostat controls shall have the capability to set back or temporarily operate the system to maintain zone temperatures up to 85°F.

(2) Automatic setback and shutdown capabilities. Automatic time clock or programmable controls shall be capable of starting and stopping the system for a seven day schedule and retaining their programming and time setting during a loss of power for at least 10 hours. Additionally, the controls shall have a manual override that allows temporary operation of the system for up to 2 hours; a manually operated timer capable of being adjusted to operate the system for up to 2 hours; or an occupancy sensor.

(3) Exceptions to 5.03(B):

a) Zones that will be operated continuously.

b) Zones with a full HVAC load demand not exceeding 6,800 Btu/h and having a readily accessible manual shutoff switch.

(C) Hotel and motel rooms shall be equipped with a mechanism that shuts off the cooling mechanism for the room when exterior doors and/or windows to the room are open.

(D) All equipment installed in the building shall have the U.S. DOE Energy Guide Label.

(E) Refrigerant suction piping on split systems shall have at least 1/2 in. cellular foam, cellular glass, or fiberglass insulation. Insulation exposed to weather shall be protected by aluminum sheet metal, painted canvas, stainless steel, or plastic cover.

(F) Duct and plenum insulation. All supply and return air ducts and plenums shall be insulated with a minimum of R-5 insulation when located in unconditioned spaces and with a minimum of R-8 insulation when located outside the building. When located within a building envelope assembly, the duct or plenum shall be separated from the building exterior or unconditioned or exempt spaces by a minimum of R-8 insulation. Supply air ducts that transport chilled air at or below 55°F (13°C) that are located in spaces that are conditioned shall be insulated with a minimum of R-5 insulation with a vapor retarder jacket.

Exception to 5.03(F): When located within equipment.

(G) Duct and plenum sealing. All joints, longitudinal and transverse seams and connections in ductwork, shall comply with the International Mechanical Code, 2009 edition.

5.04 HVAC equipment performance requirements.

Equipment shall meet the minimum efficiency requirements of Tables 503.2.3(1), 503.2.3(2), 503.2.3(3), 503.2.3(5), 503.2.3(6) and 503.2.3(7) when tested and rated in accordance with the applicable test procedure. The efficiency shall be verified through certification under an approved certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer. Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all stated requirements. Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrates that the combined efficiency of the specified components meets the requirements herein.

Exception: Water-cooled centrifugal water-chilling packages listed in Table 503.2.3(7) not designed for operation at ARHI Standard 550/590 test conditions of 44°F (7°C) leaving chilled water temperature and 85°F (29°C) entering condenser water temperature with 3 gpm/ton (0.054 l/s.kW) condenser water flow shall have maximum full load and NPLV ratings adjusted using the following equations:

Adjusted maximum full load kW/ton rating = [full load kW/ton from Table 503.2.3(7)]/K_{adj}

Adjusted maximum NPLV rating = [IPLV from Table 503.2.3(7)]/K_{adj}

where:

K_{adj} = $6.174722 - 0.303668(X) + 0.00629466(X)^2 - 0.000045780(X)^3$

X = DT_{std} + LIFT

DT_{std} = {24 + [full load kW/ton from Table 503.2.3(7)] x 6.83}/Flow

Flow = Condenser water flow (GPM)/Cooling Full Load Capacity (tons)

LIFT = CEWT = CLWT (°F)

CEWT = Full Load Condenser Entering Water Temperature (°F)

CLWT = Full Load Leaving Chilled Water Temperature (°F)

The adjusted full load and NPLV values are only applicable over the following full-load design ranges:

Minimum Leaving Chilled Water Temperature: 38°F (3.3°C)

Maximum Condenser Entering Water Temperature: 102°F (38.9°C)

Condensing Water Flow: 1 to 6 gpm/ton 0.018 to 0.1076 1/s · kW) and $X \geq 39$ and ≤ 60

Chillers designed to operate outside of these ranges or applications utilizing fluids or solutions with secondary coolants (e.g., glycol solutions or brines) with a freeze point of 27°F (-2.8°C) or lower for freeze protection are not covered by this code.

Table 503.2.3(1)
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Air conditioners, Air cooled	< 65,000 Btu/h[d]	Split system	13.0 SEER	AHRI 210/240
		Single package	13.0 SEER	
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package	11.2 EER[c]	
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package	11.0 EER[c]	AHRI 340/360
	≥240,000 Btu/h and <760,000 Btu/h	Split system and single package	10.0 EER[c] 9.7 IPLV[g]	
	≥760,000 Btu/h	Split system and single package	9.7 EER[c] 9.4 IPLV[c]	
Through-the-wall, Air cooled	<30,000 Btu/h[d]	Split system	12.0 SEER	AHRI 210/240
		Single package	12.0 SEER	

(*continued*)

Table 503.2.3(1) (*continued*)
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Air conditioners, Water and evaporatively cooled	<65,000 Btu/h	Split system and single package	12.1 EER	AHRI 210/240
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package	11.5 EER[c]	
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package	11.0 EER[c]	AHRI 340/360
	≥240,000 Btu/h	Split system and single package	11.5 EER[c]	

For SI: 1 British thermal unit per hour = 0.2931 W.
a. Chapter 6 of the 2009 International Energy Conservation Code contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. IPLVs are only applicable to equipment with capacity modulation.
c. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.
d. Single-phase air-cooled air conditioners < 65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA); SEER values are those set by NAECA.

Table 503.2.3(2)
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Air cooled, (Cooling mode)	< 65,000 Btu/h[d]	Split system	13.0 SEER	AHRI 210/240
		Single package	13.0 SEER	
	≥65,000 Btu/h and <135,000 Btu/h	Split system and single package	11.0 EER[c]	
	≥135,000 Btu/h and <240,000 Btu/h	Split system and single package	10.6 EER[c]	AHRI 340/360
	≥240,000 Btu/h	Split system and single package	9.5 EER[c] 9.2 IPLV[c]	
Through-the-wall (Air cooled, cooling mode)	<30,000 Btu/h[d]	Split system	12.0 SEER	AHRI 210/240
		Single package	12.0 SEER	
Water Source (Cooling mode)	<17,000 Btu/h	86°F entering water	11.2 EER	AHRI/ASHRAE 13256-1
	≥17,000 Btu/h and <135,000 Btu/h	86°F entering water	12.0 EER	AHRI/ASHRAE 13256-2
Groundwater Source (cooling mode)	<135,000 Btu/h	59°F entering water	16.2 EER	AHRI/ASHRAE 13256-5
Ground source (Cooling mode)	<135,000 Btu/h	77°F entering water	13.4 EER	AHRI/ASHRAE 13256-4

(*continued*)

Table 503.2.3(2) (*continued*)
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Air cooled (Heating mode)	<65,000 Btu/h[d] (Cooling capacity)	Split system	7.7 HSPF	AHRI 210/240
		Single package	7.7 HSPF	
	≥65,000 Btu/h and <135,000 Btu/h (Cooling capacity)	47°F db/43° wb Outdoor air	3.3 COP	
	≥135,000 Btu/h (Cooling capacity)	47°F db/43° wb Outdoor air	3.2 COP	AHRI 340/360
Through-the-wall (Air cooled, heating mode)	<30,000 Btu/hd	Split system	7.4 HSPF	AHRI 210/240
		Single package	7.4 HSPF	
Water source (Heating mode)	<135,000 Btu/h (Cooling capacity)	68°F entering water	4.2 COP	AHRI/ASHRAE 13256-1

(*continued*)

Table 503.2.3(2) (*continued*)
Unitary Air Conditioners and Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Groundwater source (Heating mode)	<135,000 Btu/h (Cooling capacity)	50°F entering water	3.6 COP	AHRI/ASHRAE 13256-1
Ground source (Heating mode)	<135,000 Btu/h (Cooling capacity)	32°F entering water	3.1 COP	AHRI/ASHRAE 13256-1

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. Chapter 6 of the 2009 International Energy Conservation Code contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. IPLVs and Part load rating conditions are only applicable to equipment with capacity modulation.
c. Deduct 0.2 from the required EERs and IPLVs for units with a heating section other than electric resistance heat.
d. Single-phase air-cooled air conditioners < 65,000 Btu/h are regulated by the National Appliance Energy Conservation Act of 1987 (NAECA); SEER values are those set by NAECA.

Table 503.2.3(3)
Packaged Terminal Air Conditioners and Packaged Terminal Heat Pumps

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
PTAC (Cooling mode) New Construction	All Capacities	95°F db outdoor air	12.5 - (0.213 Ÿ Cap/1000) EER	AHRI 310/380
PTAC (Cooling mode) Replacements[c]	All Capacities	95°F db outdoor air	10.9 - (0.213 Ÿ Cap/1000) EER	
PTHP (Cooling mode) New Construction	All Capacities	95°F db outdoor air	12.3 - (0.213 • Cap/1000) EER	
PTHP (Cooling mode) Replacements[c]	All Capacities	95°F db outdoor air	10.8 - (0.213 • Cap/1000) EER	
PTHP (Heating mode) New Construction	All Capacities	--	3.2 - (0.026 • Cap/1000) COP	
PTHP (Heating mode) Replacements[c]	All Capacities	--	2.9 - (0.026 • Cap/1000) 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. Chapter 6 of the 2009 International Energy Conservation Code contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7,000 Btu/h, use 7,000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.
c. Replacement units shall 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 503.2.3(5)
Boilers, Gas- and Oil-fired, Minimum Efficiency Requirements

Equipment Type[f]	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Boilers, Gas-fired	<300,000 Btu/h	Hot water	80% AFUE	DOE 10 CFR Part 430
		Steam	75% AFUE	
	≥300,000 Btu/h and ≤2,500,000 Btu/h	Minimum capacity[b]	75% E_t and 80% E_c (See Note c, d)	DOE 10 CFR Part 431
	>2,500,000 Btu/h[f]	Hot water	80% E_c (See Note c, d)	
		Steam	80% E_c (See Note c, d)	
Boilers, Oil-fired	<300,000 Btu/h	--	80% AFUE	DOE 10 CFR Part 430
	≥300,000 Btu/h and ≤2,500,000 Btu/h	Minimum capacity[b]	78% E_t and 83% E_c (See Note c, d)	DOE 10 CFR Part 431
	>2,500,000 Btu/h[a]	Hot water	83% E_c (See Note c, d)	
		Steam	83% E_c (See Note c, d)	

(*continued*)

Table 503.2.3(5) (*continued*)
Boilers, Gas- and Oil-fired, Minimum Efficiency Requirements

Equipment Type[f]	Size Category	Subcategory or Rating Condition	Minimum Efficiency[b]	Test Procedure[a]
Boilers, Oil-fired (Residual)	≥300,000 Btu/h and ≤2,500,000 Btu/h	Minimum capacity[b]	78% E_t and 83% E_c (See Note c, d)	DOE 10 CFR Part 431
	>2,500,000 Btu/h[a]	Hot water	83% E_c (See Note c, d)	
		Steam	83% E_c (See Note c, d)	

For SI: 1 British thermal unit per hour = 0.2931 W.
a. Chapter 6 of the 2009 International Energy Conservation Code contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.
b. Minimum ratings as provided for and allowed by the unit's controls.
c. E_c = Combustion efficiency (100 percent less flue losses). See reference document for detailed information.
d. E_t = Thermal efficiency. See reference document for detailed information.
e. Alternative test procedures used at the manufacturer's option are ASME PTC-4.1 for units greater than 5,000,000 Btu/h input, or ANSI Z21.13 for units greater than or equal to 300,000 Btu/h and less than or equal to 2,500,000 Btu/h input.
f. These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers, and to all packaged boilers. Minimum efficiency requirements for boilers cover all capacities of packaged boilers.

Table 503.2.3(6)
Condensing Units, Electrically Operated, Minimum Efficiency Requirements

Equipment Type	Size Category	Minimum Efficiency[b]	Test Procedure[a]
Condensing units, air cooled	≥135,000 Btu/h	10.1 EER	AHRI 365
		11.2 IPLV	
Condensing units, water or evaporatively cooled	≥135,000 Btu/h	13.1 EER	
		13.1 IPLV	

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

a. Chapter 6 of the 2009 International Energy Conservation Code contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

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

Table 503.2.3(7)
Water Chilling Packages, Efficiency Requirements[a]

Equipment Type	Size Category	Units	As of 1/1/2010		As of 1/1/2010[c]				Test Procedure[b]
					Path A		Path B		
			Full Load	IPLV	Full Load	IPLV	Full Load	IPLV	
Air-cooled chillers	<150 tons	EER	≥9.562	≥10.416	≥9.562	≥12.500	NA[d]	NA[d]	AHRI 550/590
	≥150 tons	EER			≥9.562	≥12.750	NA[d]	NA[d]	
Air-cooled without condenser, electrical operated	All capacities	EER	≥10.586	≥11.782	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements				
Water cooled, electrically operated, reciprocating	All capacities	kW/ton	≤0.837	≤0.696	Reciprocating units must comply with water cooled positive displacement efficiency requirements				
Water cooled, electrically operated, positive displacement	<75 tons	kW/ton	≤0.790	≤0.676	≤0.780	≤0.630	≤0.800	≤0.600	
	≥75 tons and <150 tons	kW/ton			≤0.775	≤0.615	≤0.790	≤0.586	
	≥150 tons and <300 tons	kW/ton	≤0.717	≤0.627	≤0.680	≤0.580	≤0.718	≤0.540	
	≥300 tons	kW/ton	≤0.639	≤0.571	≤0.620	≤0.540	≤0.639	≤0.490	

(*continued*)

Table 503.2.3(7) (*continued*)

Water Chilling Packages, Efficiency Requirements[a]

Water cooled, electrically operated, centrifugal	<150 tons	kW/ton	≤0.703	≤0.669	≤0.634	≤0.596	≤0.639	≤0.450	AHRI 550/ 590
	≥150 tons and <300 tons	kW/ton	≤0.634	≤0.596					
	≥300 tons and <600 tons	kW/ton	≤0.576	≤0.549	≤0.576	≤0.549	≤0.600	≤0.400	
	≥600 tons	kW/ton	≤0.576	≤0.549	≤0.570	≤0.539	≤0.590	≤0.400	
Air-cooled, absorption single effect	All capacities	COP	≥0.600	NR[e]	≥0.600	NR[e]	NA[d]	NA[d]	AHRI 560
Water-cooled, absorption single effect	All capacities	COP	≥0.700	NR[e]	≥0.700	NR[e]	NA[d]	NA[d]	
Absorption double effect, indirect-fired	All capacities	COP	≥1.000	≥1.050	≥1.000	≥1.050	NA[d]	NA[d]	
Absorption double effect, direct fired	All capacities	COP	≥1.000	≥1.000	≥1.000	≥1.000	NA[d]	NA[d]	

For SI: 1 ton = 3517 W, 1 British thermal unit per hour = 0.2931 W.

a. The chiller equipment requirements do not apply for chillers used in low-temperature applications where the design leaving fluid temperature is <40°F.

b. Section 12 of the 2009 International Energy Conservation Code contains a complete specification of the referenced test procedure, including the referenced year version of the test procedure.

c. Compliance with this standard can be obtained by meeting the minimum requirements of Path A or B. However, both the full load and IPLV must be met to fulfill the requirements of Path A or B.

d. NA means that this requirement is not applicable and cannot be used for compliance.

e. NR means that there are no minimum requirements for this category.

6. Service Water Heating

6.01 General

This section covers the minimum efficiency of, and controls for, service water-heating equipment and insulation of service hot water piping. New service water heating systems and equipment shall meet the requirements of this section.

6.02 Mandatory Provisions

(A) **Service water-heating equipment performance efficiency.** Water-heating equipment and hot water storage tanks shall meet the requirements of Table 601. The efficiency shall be verified through data furnished by the manufacturer or through certification under an *approved* certification program.

(B) **Temperature controls.** Service water-heating equipment shall be provided with controls to allow a setpoint of 110°F (43°C) for equipment serving dwelling units and 90°F (32°C) for equipment serving other occupancies. The outlet temperature of lavatories in public facility rest rooms shall be limited to 110°F (43°C).

(C) All water heating systems shall be certified as Energy Star compliant.

(D) Heat traps. Water-heating equipment not supplied with integral heat traps and serving noncirculating systems shall be provided with heat traps on the supply and discharge piping associated with the equipment.

(E) Pipe insulation. For automatic-circulating hot water systems, piping shall be insulated with 1 inch (25 mm) of insulation having a conductivity not exceeding 0.27 Btu per inch/h x ft^2 x °F (1.53 W per 25 mm/m^2 x K). The first 8 feet (2438 mm) of piping in noncirculating systems served by equipment without integral heat traps shall be insulated with 0.5 inch (12.7 mm) of material having a conductivity not exceeding 0.27 Btu per inch/h x ft^2 x °F (1.53 W per 25 mm/m^2 x K).

(F) Hot water system controls. Automatic-circulating hot water system pumps or heat trace shall be arranged to be conveniently turned off automatically, or manually when the hot water system is not in operation.

(G) Water Conservation. Shower heads and lavatories shall be labeled as meeting the requirements of the International Plumbing Code, 2009 edition, Section 604.4.

Table 601
Minimum Performance of Water-Heating Equipment

Equipment Type	Size Category (input)	Subcategory or Rating Condition	Performance Required[a, b]	Test Procedure
Water heaters, Electric	≤12 kW	Resistance	0.97 - 0.00132*V*, EF	DOE 10 CFR Part 430
	>12 kW	Resistance	1.73*V* + 155 SL, Btu/h	ANSI Z21.10.3
	≤24 amps and ≤250 volts	Heat pump	0.93 - 0.00132*V*, EF	DOE 10 CFR Part 430
Storage water heaters, Gas	≤75,000 Btu/h	≥20 gal	.067 - 0.0019*V*, EF	DOE 10 CFR Part 430
	>75,000 Btu/h and ≤155,000 Btu/h	<4,000 Btu/h/gal	80% E_t (Q/800 + 110$\sqrt{V}$)SL, Btu/h	ANSI Z21.10.3
	>155,000 Btu/h	<4,000 Btu/h/gal	80% E_t (Q/800 + 110$\sqrt{V}$)SL, Btu/h	
Instantaneous water heaters, Gas	>50,000 Btu/h and <200,000 Btu/h[c]	≥4,000 (Btu/h)/gal and <2 gal	0.62 - 0.0019*V*, EF	ANSI Z21.10.3
	≥200,000 Btu/h	≥4,000 Btu/h/gal and <10 gal	80% E_t	
	≥200,000 Btu/h	≥4,000 Btu/h/gal and ≥10 gal	80% E_t (Q/800 + 110$\sqrt{V}$)SL, Btu/h	
Storage water heaters, Oil	≤105,000 Btu/h	≥20 gal	0.59 - 0.0019*V*, EF	DOE 10 CFR Part 430
	>105,000 Btu/h	<4,000 Btu/h/gal	78% E_t (Q/800 + 110$\sqrt{V}$)SL, Btu/h	ANSI Z21.10.3

(*continued*)

Table 601 (continued)
Minimum Performance of Water-Heating Equipment

Equipment Type	Size Category (input)	Subcategory or Rating Condition	Performance Required[a, b]	Test Procedure
Instantaneous water heaters, Oil	≤210,000 Btu/h	≥4,000 Btu/h/gal and <2 gal	0.59 - 0.0019*V*, EF	DOE 10 CFR Part 430
	>210,000 Btu/h	≥4,000 Btu/h/gal and <10 gal	80% E_t	ANSI Z21.10.3
	>210,000 Btu/h	≥4,000 Btu/h/gal and ≥10 gal	78% E_t (Q/800 + 110√*V*)SL, Btu/h	
Hot water supply boilers, Gas and Oil	≥300,000 Btu/h and <12,500,000 Btu/h	≥4,000 Btu/h/gal and <10 gal	80% E_t	ANSI Z21.10.3
Hot water supply boilers, Gas	≥300,000 Btu/h and <12,500,000 Btu/h	≥4,000 Btu/h/gal and ≥10 gal	80% E_t (Q/800 + 110√*V*)SL, Btu/h	
Hot water supply boilers, Oil	>300,000 Btu/h and <12,500,000 Btu/h	>4,000 Btu/h/gal and >10 gal	78% E_t (Q/800 + 110√*V*)SL, Btu/h	
Pool heaters, Gas and Oil	All	--	78% E_t	ASHRAE 146
Heat pump pool heaters	All	--	4.0 COP	AHRI 1160
Unfired storage tanks	All	--	Minimum insulation requirement R-12.5 (h • Ft2 • °F)/Btu	(none)

For SI: °C=[(°F) - 32]/1.8, 1 British thermal unit per hour = 0.2931 W, 1 gallon = 3.785 L, 1 British thermal unit per hour per gallon = 0.078 W/L.

a. Energy factor (EF) and thermal efficiency (E_t) are minimum requirements. In the EF equation, *V* is the rated volume in gallons.

b. Standby loss (SL) is the maximum Btu/h based on a nominal 70°F temperature difference between stored water and ambient requirements. In the SL equation, *Q* is the nameplate input rate in Btu/h. In the SL equation for electric water heaters, *V* is the rated volume in gallons. In the SL equation for oil and gas water heaters and boilers, *V* is the rated volume in gallons.

c. Instantaneous water heaters with input rates below 200,000 Btu/h must comply with these requirements if the water heater is designated to heat water to temperatures 180°F or higher.

7. Lighting

7.01 General

Lighting systems and equipment shall comply with this Chapter. The lighting requirements in this section shall apply to:

(A) interior spaces of buildings,

(B) exterior building features, including facades, illuminated roofs, architectural features, entrances, exits, loading docks, and illuminated canopies, and

(C) building grounds for lighting that is provided through the building's electrical service.

(D) Exceptions to Section 7.01:

(1) emergency lighting that is automatically off during normal building operation and is powered by battery, generator, or other alternate power source.

(2) residential dwelling units, provided that a minimum of 50 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps. For additions or extensions, unaltered portions of the existing residential dwelling unit shall not be required to comply with this requirement.

7.02 Mandatory Provisions

(A) Lighting Control

(1) Space Control. Each space enclosed by ceiling-height partitions shall have at least one control device to independently control the general lighting within the space. Each control device shall be activated either manually by an occupant or automatically by sensing an occupant. Each control device shall:

a) control a maximum of 2,500 ft^2 for a space less than 10,000 ft^2 and a maximum of 10,000 ft^2 for a space greater than 10,000 ft^2

b) be capable of overriding the automatic shutoff control required in Section 7.02(A)(1) for no more than 2 hours, and

c) be readily accessible and located so the occupant can see the controlled lighting.

Exception to Section 7.02(A)(1)(c). The required control device may be remotely installed if required for reasons of safety or security. A

remotely located device shall have a pilot light indicator as part of or next to the control device and is clearly labeled to identify the controlled lighting.

(2) Automatic Lighting Shutoff. Interior lighting systems serving more than 5,000 ft^2 shall be equipped with an automatic control device. This automatic control device shall function on either a scheduled basis at specific programmed times or on an unscheduled basis by occupant sensors. An independent program schedule shall be provided for areas of no more than 25,000 ft^2 but not more than one floor.

Exception: lighting systems designed for 24-hour use.

(3) Daylighted Area Control. Luminaires in daylighted areas greater than 250 ft^2 shall be equipped with an independent control device that: (a) is capable of reducing the light output of the luminaires in the day lighted areas by at least 50%, and (b) controls only the luminaires located entirely within the day lighted area.

(4) Exterior Lighting Control. Lighting for all exterior applications not exempted shall be controlled by a photosensor or astronomical time switch that is capable of automatically turning off the exterior lighting when daylight is available or the lighting is not required.

(5) Additional Control. The following lighting applications shall be equipped with a control device to control such lighting independently of general lighting:

a) Display/Accent Lighting. Display or accent lighting within a 3,000 ft^2 area shall have a separate control device.

b) Case Lighting. Lighting in cases used for display purposes within a 3,000 ft^2 area shall be equipped with a separate control device.

c) 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.

d) Task Lighting. supplemental task lighting including permanently installed undershelf or undercabinet lighting shall have a control device integral to the luminaire or be controlled by a wall-mounted control device provided the control device complies with Section 7.02(A)(l)(c).

e) Nonvisual Lighting. Lighting for nonvisual applications, such as plant growth and food-warming, shall be equipped with a separate control device.

f) Demonstration Lighting. Lighting equipment that is for sale or for demonstrations in lighting education shall be equipped with a separate control device accessible only to authorized personnel.

(B) Exit Signs. Exit sign luminaire power shall not exceed 5 watts for each exposed face.

(C) Installed Interior Lighting Power. The installed interior lighting power shall include the power of all the lighting indicated on the plans and specifications. The installed interior lighting power includes all power used by the luminaires, including lamps, ballasts, current regulators, and control devices except as specifically exempted in Section 7.01.

Exception to Section 7.02(C). If two or more independently operating lighting systems in a space are controlled to prevent simultaneous user operation, the installed interior lighting power shall be based solely on the lighting system with the highest power.

(D) Luminaire Wattage. Luminaire wattage incorporated into the installed interior lighting power shall be determined in accordance with the following criteria:

(1) The wattage of incandescent luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.

(2) The wattage of luminaires containing permanently installed ballasts shall be the operating input wattage of the specified lamp/ballast combination based on values from manufacturers catalogs or values from independent testing laboratory reports.

(3) The wattage of all other miscellaneous luminaire types not described in (1) or (2) shall be the specified wattage of the luminaire.

(4) The wattage of lighting track, plug-in busway, and flexible-lighting systems that allow the addition and/or relocation of luminaires without altering the wiring of the system shall be the larger of the specified wattage of the luminaires included in the system or 30 W/lin ft. Systems with integral overload protection, such as fuses or circuit breakers, shall be rated at 100% of the maximum rated load of the limiting device.

(E) Exterior Building Grounds Lighting. Lighting for exterior building grounds luminaires which operate at greater than 100 W shall contain lamps having a minimum efficacy of 60 lm/W unless the luminaire is controlled by a motion sensor or exempt under Section 7.01.

7.03 Interior Lighting Power

(A) The installed interior lighting power for a building or a separately metered or permitted portion of a building shall be calculated in accordance with Section

7.02(D) and shall not exceed the interior lighting power allowance determined in accordance with either Section 7.03(B) or Section 7.03(C). Tradeoffs of interior lighting power allowance among portions of the building for which a different method of calculation has been used are not permitted.

(B) Building Area Method Determination of interior lighting power allowance (watts) by the building area method shall be in accordance with the following:

(1) Determine the appropriate building type from Table 7.1 and the allowed lighting power density. For building area types not listed, selection of a reasonably equivalent type shall be permitted.

(2) Determine the gross lighted floor area of the building.

(3) The interior lighting power allowance is the product of the lighted floor area of the building times the allowed lighting power density.

(4) If a building is comprised of different building area types, an allowance for each shall be computed separately. Trade-offs among building area types are permitted provided that the total installed interior lighting power does not exceed the interior lighting power allowance.

Exceptions to Section 7.03(B): The following lighting equipment and applications shall not be considered when determining the interior lighting power allowance, nor shall the wattage for such lighting be included in the installed interior lighting power identified in accordance with Section 7.02(D).

a) The connected power associated with the following lighting equipment is not included in calculating total connected lighting power.

i) Sports arena or playing field lighting.

ii) *Sleeping unit* lighting in hotels, motels, boarding houses or similar buildings.

iii) Emergency lighting automatically off during normal building operation.

iv) Lighting in spaces specifically designed for use by occupants with special lighting needs including the visually impaired and other medical and age-related issues.

v) Lighting in interior spaces that have been specifically designated as a registered historic structure.

b) Lighting equipment used for the following shall be exempt provided that it is in addition to general lighting and is controlled by an independent control device.

i) Lighting specifically designed for medical or dental procedures and lighting integral to medical equipment.

ii) Display or accent lighting that is an essential element for the function performed in galleries, museums, and monuments.

c) Lighting for theatrical purposes, including performance, stage, and film or video production.

d) Lighting for photographic processes.

e) Lighting that is integral to equipment or instrumentation and is installed by its manufacturer.

f) Lighting for plant growth or maintenance.

g) Lighting that is an integral part of advertising or directional signage.

h) Lighting integral to food warming and food preparation equipment.

i) Lighting that is for sale or lighting educational demonstration systems.

j) Lighting *approved* because of safety or emergency considerations, inclusive of exit lights.

k) Lighting integral to both open and glass-enclosed refrigerator and freezer cases.

l) Lighting in retail display windows, provided the display area is enclosed by ceiling-height partitions.

m) Furniture mounted supplemental task lighting that is controlled by automatic shutoff.

(C) Alternative Method: The interior lighting power may alternatively be calculated by using Section 7.04 Alternative Compliance Path: Space-by-Space Method.

Table 7.2 Interior Lighting Power Densities – Building Area Method			
Building Area Type	W/ft^2	Building Area Type	W/ft^2
Automotive Facility	0.9	Multi-Family	0.7
Convention Center	1.2	Museum	1.1
Court House	1.2	Office	1.0
Dining: Bar Lounge/Leisure	1.3	Parking Garage	0.3
Dining: Cafeteria/Fast Food	1.4	Penitentiary	1.0
Dining: Family	1.6	Performing Arts Theater	1.6
Dormitory	1.0	Police/Fire Station	1.0
Exercise Center	1.0	Post Office	1.1
Gymnasium	1.1	Religious Building	1.3
Health Care-Clinic	1.0	Retail	1.5
Hospital	1.2	School/University	1.2
Hotel	1.0	Sports Arena	1.1
Library	1.3	Town Hall	1.1
Manufacturing Facility	1.3	Transportation	1.0
Motel	1.0	Warehouse	0.8
Motion Picture Theater	1.2	Workshop	1.4
In cases where both general building type and a specific building area type are listed, the specific building area type shall apply. ASHRAE 90.1-2007.			

7.04 Alternative Compliance Path: Space-by-Space Method

Space-by-Space Method of Calculating Interior Lighting Power Allowance. Use the following steps to determine the interior lighting power allowance by the Space-by-Space Method:

(A) Determine the appropriate building type from Table 7.2. For building types not listed, selection of a reasonably equivalent type shall be permitted.

(B) For each space enclosed by partitions 80% or greater than ceiling height, determine the gross interior floor area by measuring to the center of the partition wall. Include the floor area of balconies or other projections. Retail spaces do not have to comply with the 80% partition height requirements.

(C) Determine the *interior lighting power allowance* by using the columns designated Space-by-Space Method in Table 7.2. Multiply the floor area(s) of the space(s) times the allowed *LPD* for the space type that most closely represents the proposed use of the space(s). The product is the *lighting power*

allowance for the space(s). For space types not listed, selection of a reasonable equivalent category shall be permitted.

(D) The interior *lighting power allowance* is the sum of *lighting power allowances* of all spaces. Trade-offs among spaces are permitted provided that the total *installed interior lighting power* does not exceed *the interior lighting power allowance*.

7.05 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 non-business hours. This additional power shall be used only for the specified *luminaires* and shall not be used for any other purpose.

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, such as chandelier-type luminaries or sconces or for highlighting art or exhibits, provided that the additional lighting power shall not exceed 1.0 W/ft^2 of such spaces.

(B) For lighting equipment installed in sales areas and specifically designed and directed to highlight merchandise, calculate the additional lighting power as follows:

Additional Interior Lighting Power Allowance = 1000 watts + (Retail Area 1 x 1.0 W/ft^2) + (Retail Area 2 x 1.7 W/ft^2) + (Retail Area 3 x 2.6 W/ft^2) + (Retail Area 4 x 4.2 W/ft^2),

where
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; and
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 Department of Public Works.

Table 7.2 Lighting Power Densities Using the Space-by-Space Method

Common Space Types[a]	*LPD*, W/ft^2	Building-Specific Space Types	*LPD*, W/ft^2
Office--Enclosed	1.1	Gymnasium/Exercise Center	
Office--Open Plan	1.1	Playing Area	1.4
Conference/Meeting/Multipurpose	1.3	Exercise Area	0.9
Classroom/Lecture/Training	1.4	Courthouse/Police Station/Penitentiary	
For Penitentiary	1.3	Courtroom	1.9
Lobby	1.3	Confinement Cells	0.9
For Hotel	1.1	Judges' Chambers	1.3
For Performing Arts Theater	3.3	Fire Stations	
For Motion Picture Theater	1.1	Engine Room	0.8
Audience/Seating Area	0.9	Sleeping Quarters	0.3
For Gymnasium	0.4	Post Office--Sorting Area	1.2
For Exercise Center	0.3	Convention Center--Exhibit Space	1.3
For Convention Center	0.7	Library	
For Penitentiary	0.7	Card File and Cataloging	1.1
For Religious Buildings	1.7	Stacks	1.7
For Sports Arena	0.4	Reading Area	1.2
For Performing Arts Theater	2.6	Hospital	
For Motion Picture Theater	1.2	Emergency	2.7
For Transportation	0.5	Recovery	0.8
Atrium--First Three Floors	0.6	Nurses' Station	1.0
Atrium--Each Additional Floor	0.2	Exam/Treatment	1.5
Lounge/Recreation	1.2	Pharmacy	1.2
For Hospital	0.8	Patient Room	0.7
Dining Area	0.9	Operating Room	2.2
For Penitentiary	1.3	Nursery	0.6
For Hotel	1.3	Medical Supply	1.4
For Motel	1.2	Physical Therapy	0.9
For Bar Lounge/Leisure Dining	1.4	Radiology	0.4
For Family Dining	2.1	Laundry--Washing	0.6
Food Preparation	1.2	Automotive--Service/Repair	0.7
Laboratory	1.4	Manufacturing	
Restrooms	0.9	Low Bay (<25 ft Floor to Ceiling Height)	1.2
Dressing/Locker/Fitting Room	0.6	High Bay (≥25 ft Floor to Ceiling Height)	1.7
Corridor/Transition	0.5	Detailed Manufacturing	2.1
For Hospital	1.0	Equipment Room	1.2
For Manufacturing Facility	0.5	Control Room	0.5
Stairs--Active	0.6	Hotel/Motel Guest Rooms	1.1
Active Storage	0.8	Dormitory--Living Quarters	1.1
For Hospital	0.9	Museum	
Inactive Storage	0.3	General Exhibition	1.0
For Museum	0.8	Restoration	1.7
Electrical/Mechanical	1.5	Bank/Office--Banking Activity Area	1.5

(*continued*)

Table 7.2 Lighting Power Densities Using the Space-by-Space Method (continued)

Common Space Types[a]	*LPD*, W/ft²	Building-Specific Space Types	*LPD*, W/ft²
Workshop	1.9	Religious Buildings	
Sales Area[b]	1.7	Worship Pulpit, Choir	2.4
		Fellowship Hall	0.9
		Retail	
		Sales Area[c]	1.7
		Mall Concourse	1.7
		Sports Arena	
		Ring Sports Area	2.7
		Court Sports Area	2.3
		Indoor Playing Field Area	1.4
		Warehouse	
		Fine Material Storage	1.4
		Medium/Bulky Material Storage	0.9
		Parking Garage--Garage Area	0.2
		Transportation	
		Airport--Concourse	0.6
		Air/Train/Bus--Baggage Area	1.0
		Terminal--Ticket Counter	1.5

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

[b]For accent lighting, see Section 9.6.2(b) of the ANSI/ASHRAE/IESNA Standard 90.1-2007 (I-P Edition)

[c]For accent lighting, see Section 9.6.3(c) of the ANSI/ASHRAE/IESNA Standard 90.1-2007 (I-P Edition)

7.06 Exterior Building Lighting Power

The total exterior lighting power allowance for all exterior building applications is the sum of the individual lighting power densities permitted in Table 7.3 plus an additional allowance of up to 5% of that sum. Trade-offs are permitted only for those elements designated as "Tradeable Surfaces" in Table 7.3 All fixtures shall comply with Section 7.02(E).

Exceptions to Section 7.06: Lighting used for the following exterior applications is exempt when equipped with a control device independent of the control of the nonexempt lighting:

(A) Specialized signal, directional, and marker lighting associated with transportation.

(B) Advertising signage or directional signage.

(C) Lighting integral to equipment or instrumentation that is installed by its manufacturer.

(D) Lighting for theatrical purposes, including performance, stage, film production, and video production.

(E) Lighting for athletic playing areas.

(F) Temporary lighting.

(G) Lighting for industrial production, material handling, transportation sites, and associated storage areas.

(H) Theme elements in theme/amusement parks.

(I) Lighting used to highlight features of public monuments and registered historic landmark structures or buildings.

Table 7.3 - Exterior Lighting Power Densities		
Tradeable Surfaces: (Lighting power densities for uncovered parking areas, building grounds, building entrances and exits, canopies and overhangs, and outdoor sales areas may be traded)	**Uncovered Parking Areas**	
	Parking lots and drives	0.15 W/ft^2
	Building Grounds	
	Walkways less than 10 feet wide	1.0 W/linear foot
	Walkways 10 feet wide or greater	0.2 W/ft^2
	Plaza areas	0.2 W/ft^2
	Special feature areas	0.2 W/ft^2
	Stairways	1.0 W/ft^2
	Building Entrances and Exits	
	Main entries	30 W/linear foot of door width
	Other doors	20 W/linear foot of door width
	Canopies and Overhangs	
	Canopies (free standing and attached overhands)	1.25 W/ft^2
	Outdoor Sales	
	Open areas (including vehicle sales lots)	0.5 W/ft^2
	Street frontage for vehicle sales lots in addition to "open area" allowance	20 W/linear foot
Non-Tradeable Surfaces: (Lighting Power density calculations for these 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 "Tradeable Surfaces" section of this table.)	**Building Facades**	0.2 W/ft^2 for each illuminated wall or surface or 5.0 W/linear foot for each illuminated wall or surface length
	Automate Teller Machines and Night Depositories	270 W per location plus 90W per additional ATM per location
	Entrances and Gatehouse Inspection Stations at Guarded Facilities	1.25 W/ft^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradeable Surfaces")
	Loading areas for law enforcement, fire, ambulance, and other emergency vehicles	0.5 W/ft^2 of uncovered area (covered areas are included in the "Canopies and Overhangs" section of "Tradeable Surfaces")
	Drive-Up Windows at Fast Food Restaurants	400 W per drive-through
	Parking near 24-hour retail entrances	800 W per main entry