REVISION RECORD FOR THE STATE OF CALIFORNIA

ERRATA

January 1, 2014

2013 Title 24, Part 6, California Code of Regulations

General Information:

1. The date of this erratum is for identification purposes only. See the History Note Appendix on the back side or accompanying page.
2. This erratum is issued by the California Building Standards Commission in order to correct nonsubstantive printing errors or omissions in California Code of Regulations, Title 24, Part 6, of the 2013 *California Energy Code*. Instructions are provided below.
3. Health and Safety Code Section 18938.5 establishes that only building standards in effect at the time of the application for a building permit may be applied to the project plans and construction. This rule applies to both adoptions of building standards for Title 24 by the California Building Standards Commission, and local adoptions and ordinances imposing building standards. An erratum to Title 24 is a nonregulatory correction because of a printing error or omission that does not differ substantively from the official adoption by the California Building Standards Commission. Accordingly, the corrected code text provided by this erratum may be applied on and after the stated effective date.
4. You may wish to retain the superseded material with this revision record so that the prior wording of any section can be easily ascertained.

Title 24, Part 6

Remove Existing Pages	Insert Buff Colored Pages
v and vi	v and vi
1 and 2	1 and 2
5 and 6	5 and 6
11 through 26	11 through 26
35 and 36	35 and 36
47 through 52	47 through 52
59 through 62	59 through 62
75 through 78	75 through 78
81 and 82	81 and 82
85 and 86	85 and 86
89 and 90	89 and 90
95 and 96	95 and 96
103 and 104	103 and 104
107 through 110	107 through 110
115 and 116	115 and 116
121 and 122	121 and 122
129 through 132	129 through 132
143 through 146	143 through 146

Item No. 5560S131

CALIFORNIA CODE OF REGULATIONS, TITLE 24

California Agency Information Contact List

Board of State & Community Corrections

www.bscc.ca.gov . . . . . (916) 445-5073
Local Adult Jail Standards
Local Juvenile Facility Standards

California Building Standards Commission

www.bsc.ca.gov . . . . . (916) 263-0916

California Energy Commission

*www.energy.ca.gov . . . . . **Energy Hotline** (800) 772-3300*
Building Efficiency Standards
Appliance Efficiency Standards
Compliance Manual/Forms

California State Lands Commission

www.slc.ca.gov . . . . . (562) 499-6312
Marine Oil Terminals

California State Library

www.library.ca.gov . . . . . (916) 654-0266

Department of Consumer Affairs:

Acupuncture Board
www.acupuncture.ca.gov . . . . . (916) 515-5200
Office Standards

Board of Pharmacy
www.pharmacy.ca.gov . . . . . (916) 574-7900
Pharmacy Standards

Bureau of Barbering and Cosmetology
www.barbercosmo.ca.gov . . . . . (916) 952-5210
Barber and Beauty Shop, and College Standards

Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation
www.bearhfti.ca.gov. . . . . (916) 999-2041
Insulation Testing Standards

Structural Pest Control Board
www.pestboard.ca.gov . . . . . (800) 737-8188
Structural Standards

Veterinary Medical Board
www.vmb.ca.gov . . . . . (916) 263-2610
Veterinary Hospital Standards

Department of Food and Agriculture

www.cdfa.ca.gov
Meat & Poultry Packing Plant Standards (916) 654-0509
Dairy Standards (916) 654-0773

Department of Housing and Community Development

www.hcd.ca.gov . . . . . (916) 445-9471
Residential- Hotels, Motels, Apartments, Single-Family Dwellings; and Permanent Structures in Mobilehome & Special Occupancy Parks
(916) 445-3338
Factory-Built Housing, Manufactured Housing & Commercial Modular
Mobilehome- Permits & Inspections
Northern Region–(916) 255-2501
Southern Region–(951) 782-4420
(916) 445-9471
Employee Housing Standards

Department of Public Health

www.dph.ca.gov. . . . . (916) 449-5661
Organized Camps Standards
Public Swimming Pools Standards

Division of the State Architect

www.dgs.ca.gov/dsa. . . . . (916) 445-8100
Access Compliance
Structural Safety
Public Schools Standards
Essential Services Building Standards
Community College Standards

State Historical Building Safety Board
Alternative Building Standards

Office of Statewide Health Planning and Development

www.oshpd.ca.gov . . . . . (916) 440-8356
Hospital Standards
Skilled Nursing Facility Standards & Clinic Standards
Permits

Office of the State Fire Marshal

osfm.fire.ca.gov . . . . . (916) 445-8200
Code Development and Analysis
Fire Safety Standards

SUBCHAPTER 1

ALL OCCUPANCIES—GENERAL PROVISIONS

SECTION 100.0
SCOPE

(a) **Buildings covered.** The provisions of Part 6, apply to all buildings:

1. That are of Occupancy Group A, B, E, F, H, M, R, S or U; and
2. For which an application for a building permit or renewal of an existing permit is filed (or is required by law to be filed) on or after the effective date of the provisions, or which are constructed by a governmental agency; and
3. That are:

   A. Unconditioned; or

   B. Indirectly or directly conditioned by mechanical heating or mechanical cooling, or process spaces; or

   C. Low-rise residential buildings that are heated with a nonmechanical heating system.

      Exception 1 to Section 100.0(a): Qualified historic buildings as regulated by the *California Historic Building Code* (Title 24, Part 8). Lighting in qualified historic buildings shall comply with the applicable requirements in Section 140.6(a)3Q.

      Exception 2 to Section 100.0(a): Building departments, at their discretion, may exempt temporary buildings, temporary outdoor lighting or temporary lighting in an unconditioned building, or structures erected in response to a natural disaster. Temporary buildings or structures shall be completely removed upon the expiration of the time limit stated in the permit.

(b) **Parts of buildings regulated.** The provisions of Part 6 apply to the building envelope, space-conditioning systems, water-heating systems, pool and spas, solar ready buildings, indoor lighting systems of buildings, outdoor lighting systems and signs located either indoors or outdoors, in buildings that are:

1. Covered by Section 100.0(a), and
2. Set forth in Table 100.0-A.

(c) **Habitable stories.**

1. All conditioned space in a story shall comply with Part 6, whether or not the story is a habitable space.
2. All unconditioned space in a story shall comply with the lighting requirements of Part 6, whether or not the story is a habitable space.

(d) **Outdoor lighting and indoor and outdoor signs.** The provisions of Part 6 apply to outdoor lighting systems and to signs located either indoors or outdoors as set forth in Table 100.0-A.

(e) **Sections applicable to particular buildings.** Table 100.0-A and this subsection list the provisions of Part 6 that are applicable to different types of buildings covered by Section 100.0(a).

1. **All buildings.** Sections 100.0 through 110.10 apply to all buildings.

   Exception to Section 100.0(e)1: Spaces or requirements not listed in Table 100.0-A.

2. **Newly constructed buildings.**

   A. **All newly constructed buildings.** Sections 110.0 through 110.10 apply to all newly constructed buildings within the scope of Section 100.0(a). In addition, newly constructed buildings shall meet the requirements of Subsections B, C, D or E, as applicable.

   B. **Nonresidential, high-rise residential and hotel/motel buildings that are mechanically heated or mechanically cooled.**

      i. **Sections applicable.** Sections 120.0 through 140.8 apply to newly constructed nonresidential buildings, high-rise residential buildings and hotels/motels that are mechanically heated or mechanically cooled.

      ii. **Compliance approaches.** In order to comply with Part 6, newly constructed nonresidential buildings, high-rise residential buildings and hotels/motels that are mechanically heated or mechanically cooled must meet the requirements of:

         a. Mandatory measures: The applicable provisions of Sections 120.0 through 130.5; and

         b. Either:

            (i) Performance approach: Section 140.1; or

            (ii) Prescriptive approach: Sections 140.2 through 140.8.

   C. **Unconditioned nonresidential buildings and process space.** Sections 110.9, 110.10, 130.0 through 130.5, 140.3(c), 140.6, 140.7 and 140.8 apply to all newly constructed unconditioned buildings and 140.3(c), 140.1 and 141.0 for process spaces within the scope of Section 100.0(a).

   D. **Low-rise residential buildings.**

      i. **Sections applicable.** Sections 150.0 through 150.1 apply to newly constructed low-rise residential buildings.

      ii. **Compliance approaches.** In order to comply with Part 6, newly constructed low-rise residential buildings must meet the requirements of:

         a. Mandatory measures: The applicable provisions of Sections 110.0 through 110.10 and 150.0; and

b. Either:

(i) Performance approach: Section 150.1(a) and (b); or

(ii) Prescriptive approach: Sections 150.1(a) and (c).

Exception 1 to Section 100.0(e)2Diib: Seasonally occupied agricultural housing limited by state or federal agency contract to occupancy not more than 180 days in any calendar year.

Exception 2 to Section 100.0(e)2Diib: Low-rise residential buildings that are heated with a wood heater or another nonmechanical heating system and that use no energy obtained from depletable sources for lighting or water heating.

E. **Covered processes.**

i. Sections applicable. Sections 110.2, 120.6 and 140.9 apply to covered processes.

ii. Compliance approaches. In order to comply with Part 6, covered processes must meet the requirements of:

a. The applicable mandatory measures in Section 120.6; and

b. Either:

(i) The performance approach requirements of Section 140.1; or

(ii) The prescriptive approach requirements of Section 140.9.

Note: If covered processes do not have prescriptive requirements, then only the applicable mandatory measures in Section 120.6 must be met.

3. **New construction in existing buildings.**

A. **Nonresidential, high-rise residential and hotel/motel buildings.** Section 141.0 applies to new construction in existing buildings that will be nonresidential, high-rise residential and hotel/motel occupancies.

TABLE 100.0-A—APPLICATION OF STANDARDS

OCCUPANCIES	APPLICATION	MANDATORY	PRESCRIPTIVE	PERFORMANCE	ADDITIONS/ ALTERATIONS
General Provisions		100.0, 100.1, 100.2, 110.0, 110.10			
Nonresidential, High-rise Residential and Hotels/Motels	General	140.0	140.2	140.1	141.0
	Envelope (conditioned)	110.6, 110.7, 110.8, 120.7	140.3		
	Envelope (unconditioned, process spaces)	N.A.	140.3(c)		
	HVAC (conditioned)	110.2, 110.5, 120.0, 120.5, 120.8	140.4		
	Water Heating	110.3, 120.3, 120.8	140.5		
	Indoor Lighting (conditioned, process spaces)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6		
	Indoor Lighting (unconditioned and parking garages)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6	N.A.	
	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7		
	Building Electrical Power	130.5	N.A.		
	Pool and Spa Systems	110.4, 150.0(p)	N.A.		N.A.
	Solar Ready Buildings	110.10	N.A.		N.A.
Covered Processes[1]	Envelope, Ventilation, Process Loads	110.2, 120.6, 120.8	140.9	140.1	120.6, 140.9
Signs	Indoor and Outdoor	130.0, 130.3	140.8	N.A.	141.0
Low-rise Residential	General	150.0	150.1(a, c)	150.1(a, b)	150.2
	Envelope (conditioned)	110.6, 110.7, 110.8, 150.0 (a-e, g[1])			
	HVAC (conditioned)	110.2, 110.5, 150.0 (h, i, m, o)			
	Water heating	110.3, 150.0 (j, n)			
	Indoor Lighting (conditioned, unconditioned and parking garages)	110.9, 130.0, 150.0(k)			
	Outdoor Lighting	110.9, 130.0, 150.0(k)			
	Pool and Spa Systems	110.4, 150.0(p)	N.A.	N.A.	N.A.
	Solar Ready Buildings	110.10	N.A.	N.A.	N.A.

1. Nonresidential, high-rise and hotel/motel buildings that contain covered processes may conform to the applicable requirements of both occupancy types listed in this table.

tice titled "Nomenclature and Definitions for Illuminating Engineering."

ANSI Z2 1.10.3 is the American National Standards Institute document titled "Gas Water Heaters, Volume III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour," 2011. (ANSI Z21.10.3-2011/CSA 4.3-2011).

ANSI Z21.13 is the American National Standards Institute document titled "Gas-Fired Low Pressure Steam and Hot Water Boilers," 2010. (ANSI Z21.13-2010/CSA 4.9-2010).

ANSI Z21.40.4A is the American National Standards Institute document titled "Addenda 1 to ANSI Z21.40.4-1996/CGA 2.94-M96, Performance Testing and Rating of Gas-Fired, Air Conditioning and Heat Pump Appliances," 1998 (ANSI Z21.40.4-1998/CGA 2.94A-M98).

ANSI Z21.47 is the American National Standards Institute document titled "Gas-Fired Central Furnaces," 2006. (ANSI Z21.47-2006/CSA 2.3-2006).

ANSI Z83.8 is the American National Standards Institute document titled "American National Standard/CSA Standard For Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces," 2009 (ANSI Z83.8-2009/CSA 2.6-2009).

APPLIANCE EFFICIENCY REGULATIONS are the regulations in Title 20, Sections 1601 et seq. of the California Code of Regulations.

APPROVED CALCULATION METHOD (See "alternative calculation methods.")

AHRI is the Air-Conditioning, Heating and Refrigeration Institute.

AHRI 210/240 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment," 2008 (ANSI/AHRI Standard 210/240-2008 with Addenda 1 and 2).

ANSI/AHRI/CSA 310/380 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Standard for Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-04)," 2004 (ANSI/AHRI/CSA Standard 310/380-2004).

AHRI 320 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Water-Source Heat Pumps," 1998 (AHRI Standard 320-1998).

AHRI 325 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Ground Water-Source Heat Pumps," 1998 (ARI Standard 325-1998).

ANSI/AHRI 340/360 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment," 2007 (ANSI/AHRI Standard 340/360-2007 with Addenda 1 and 2).

ANSI/AHRI 365 is the Air-Conditioning, Heating and Refrigeration Institute document titled, "Commercial and Industrial Unitary Air-Conditioning Condensing Units," 2009 (ANSI/AHRI Standard 365 (I-P)-2009).

ANSI/AHRI 390 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Single Package Vertical Air-Conditioners and Heat Pumps," 2003 (ANSI/AHRI Standard 390 (I-P)-2003).

ANSI/AHRI 400 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Liquid to Liquid Heat Exchangers," 2001 (ANSI/AHRI Standard 400 (I-P)-2001) with addenda 1 and 2.

ANSI/AHRI 460 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers," 2005 (ANSI/AHRI Standard 460-2005).

AHRI 550/590 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Water Chilling Packages Using the Vapor Compression Cycle," 2011 (AHRI Standard 550/590-982003(I-P)-2011).

ANSI/AHRI 560 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Absorption Water Chilling and Water Heating Packages," 2000 (ANSI/AHRI Standard 560-2000).

AHRI 680 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Residential Air Filter Equipment," 2009 (ANSI/AHRI Standard 680).

AHRI 1230 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment," 2010 (AHRI Standard 1230-2010) with Addendum 1.

ASHRAE is the American Society of Heating Refrigerating and Air-Conditioning Engineers.

ASHRAE CLIMATIC DATA FOR REGION X is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Climatic Data for Region X, Arizona, California, Hawaii and Nevada," Publication SPCDX, 1982 and "Supplement," 1994.

ASHRAE HANDBOOK, APPLICATIONS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Applications." (2011)

ASHRAE HANDBOOK, EQUIPMENT VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment." (2008)

ASHRAE HANDBOOK, FUNDAMENTALS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Fundamentals." (2009)

ASHRAE STANDARD 52.2 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size," 2007 (ANSI/ASHRAE Standard 52.2-2007 including ANSI/ASHRAE Addendum b to ANSI/ASHRAE Standard 52.2-2007).

ASHRAE STANDARD 55 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Thermal Environmental Conditions for Human Occupancy," 2010. (ASHRAE Standard 55-2010)

ASHRAE STANDARD 62.2 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings," 2010 (ANSI/ASHRAE Standard 62.2-2010 including ANSI/ASHRAE Addenda b, c, e, g, h, i and l to ANSI/ASHRAE 62.2-2010 published in the 2011 supplement, and ANSI/ASHRAE Addendum j to ANSI/ASHRAE Standard 62.2-2010 published in March, 2012, and ANSI/ASHRAE Addendum n to ANSI/ASHRAE Standard 62.2-2010 published in February, 2012).

ASHRAE STANDARD 193 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Method of Test for Determining the Airtightness of HVAC Equipment," 2010. (ANSI/ASHRAE Standard 193-2010)

ASME is the American Society of Mechanical Engineers.

ASME A112.18.1/CSA B125.1 is the American Society of Mechanical Engineers document titled "Plumbing Fixture Fittings" 2011. (ASME Standard A112.18.1-2011/CSA B125.1-11)

ASTM is the American Society for Testing and Materials International.

ASTM C 55 is the American Society for Testing and Materials document titled "Standard Specification for Concrete Brick," 2001. (ASTM C 55-01)

ASTM C 177 is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus," 1997. (ASTM C 177-97)

ASTM C 272 is the American Society for Testing and Materials document titled "Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions," 2001. (ASTM C 272-01)

ASTM C 335 is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation," 1995. (ASTM C 335-95)

ASTM C 518 is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," 2002. (ASTM C 518-02)

ASTM C 731 is the American Society for Testing and Materials document titled "Standard Test Method for Extrudability, After Package Aging of Latex Sealants," 2000. (ASTM C 731-00)

ASTM C 732 is the American Society for Testing and Materials document titled "Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants," 2001. (ASTM C 732-01)

ASTM C 836 is the American Society of Testing and Materials document titled, "Standard Specification for High Solids Content, cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course," 2005. (ASTM C 836-05)

ASTM C 1549 is the American Society for Testing and Materials document titled, "Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer," 2004. (ASTM C 1549-04)

ASTM C 1167 is the American Society for Testing and Materials document titled "Standard Specification for Clay Roof Tiles," 2011. (ASTM C 1167-11)

ASTM C 1371 is the American Society for Testing and Materials document titled "Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers," 1998. (ASTM C 1371-98)

ASTM C 1492 is the American Society for Testing and Materials document titled "Standard Specification for Concrete Roof Tile," 2009. [ASTM C 1492-03(2009)]

ASTM C 1583 is the American Society of Testing and Materials document titled, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension" Pull-off Method)," 2004. (ASTM C 1583-04)

ASTM D 448 is the American Society for Testing and Materials document entitled, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction," 2008. (ASTM D 448-08)

ASTM D 522 is the American Society of Testing and Materials document titled, "Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings," 2001. [ASTM D 522-93a (2001)]

ASTM D 822 is the American Society of Testing and Materials document titled, "Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings," 2001. (ASTM D 822-01)

ASTM D 1003 is the American Society for Testing and Materials document entitled "Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics," 2000. (ANSI/ASTM D 1003-00)

ASTM D 1653 is the American Society of Testing and Materials document entitled, "Standard Test Methods for Water Vapor Transmission of Organic Coating Films," 2003. (ASTM D 1653-03)

ASTM D 1863 is the American Society for Testing and Materials document titled, "Standard Specification for Mineral Aggregate Used on Built-Up Roofs," 2003. (ASTM D 1863-03)

ASTM D 2370 is the American Society of Testing and Materials document titled, "Standard Test Method for Tensile Properties of Organic Coatings," 2002. [ASTM D 2370-98 (2002)]

ASTM D 2824 is the American Society of Testing and Materials document titled "Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos," 2002. (ASTM D 2824-02)

EXTERIOR WALL AREA is the area of the opaque exterior surface of exterior walls.

FAÇADE is the contiguous exterior of a building surface, but not limited to fenestration products.

FACTORY-ASSEMBLED COOLING TOWERS are cool ing towers constructed from factory-assembled modules either shipped to the site in one piece or put together in the field.

FENESTRATION:

Includes the following:

ACE is an NFRC-approved calculation entity (ACE) that conducts calculations of fenestration product ratings for certification authorization using the NFRC component modeling approach and issues label certificates to Specifying Authorities for product certification authorization in accordance with NFRC requirements.

ALTERATION is any change to an existing building's exterior fenestration product that is not a repair (see Fenestration Repair) that:

i. Replaces existing fenestration in an existing wall or roof with no net area added; or
ii. Replaces existing fenestration and adds new net area in the existing wall or roof; or
iii. Adds a new window that increases the net fenestration area to an existing wall or roof.

ALTERED COMPONENT is a new fenestration component that has undergone an alteration other than a repair and is subject to all applicable standards requirements.

BAY WINDOW is a combination assembly which is composed of three or more individual windows either joined side by side or installed within opaque assemblies and which projects away from the wall on which it is installed. Center windows, if used, are parallel to the wall on which the bay is installed, the end panels or two side windows, are angled with respect to the center window. Common angles are 30° and 45°, although other angles may be employed.

CMA (component modeling approach) is a fenestration product certification program from the National Fenestration Rating Council (NFRC) that enables energy-related performance ratings for nonresidential fenestration products, including the thermal performance *U*-factor, solar heat gain coefficient, and visible transmittance.

CMAST (component modeling approach software tool) is an NFRC approved software that allows a user to create a fenestration product "virtually" and generate its energy-related performance ratings, including the thermal performance *U*-factor, solar heat gain coefficient, and visible transmittance.

CURTAIN WALL/STOREFRONT is an external nonbearing wall intended to separate the exterior nonconditioned and interior conditioned spaces. It also consists of any combination of framing materials, fixed glazing, opaque glazing, operable windows or other in-fill materials.

DOOR is a fenestration product in an exterior door having a glazed area of 50 percent or greater of the area of the door.

DUAL-GLAZED GREENHOUSE WINDOWS is a double glass pane separated by an air or other gas space that adds conditioned volume but not conditioned floor area to a building.

DYNAMIC GLAZING SYSTEMS are glazing systems that have the ability to reversibly change their performance properties, including *U*-factor, Solar Heat Gain Coefficient (SHGC) and/or Visible Transmittance (VT) between well-defined end points. These may include, but are not limited to, chromogenic glazing systems and integrated shading systems (defined below). Dynamic Glazing systems do not include internally mounted or externally mounted shading devices that attach to the window framing/glazing that may or may not be removable.

CHROMOGENIC GLAZING is a class of switchable glazing that includes active materials (e.g., electrochromic) and passive materials (e.g., photochromic and thermochromic) permanently integrated into the glazing assembly. Their primary function is to switch reversibly from a high transmission state to a low transmission state with associated changes in VT and SHGC.

INTEGRATED SHADING SYSTEM is a class of fenestration products including an active layer: e.g., shades, louvers, blinds or other materials permanently integrated between two or more glazing layers. The *U*-factor and/or SHGC and VT of the insulating glass assembly can be altered by reversibly changing the enclosed active layer.

FENESTRATION AREA for windows is the total window rough opening area that includes the fenestration and fenestration frame components in the exterior walls and roofs.

FENESTRATION PRODUCT is any transparent or translucent material plus any sash, frame, mullions and dividers, in the facade of a building, including, but not limited to, windows, sliding glass doors, French doors, skylights, curtain walls, dynamic glazing, garden windows and glass block.

FENESTRATION REPAIR is the reconstruction or renewal for the purpose of maintenance of any fenestration product, component or system and shall not increase the preexisting energy consumption of the repaired fenestration product, component, system or equipment. Replacement of any component, system or equipment for which there are requirements in the Standards are considered an alteration (see Fenestration, Alterations) and not a repair and is subject to the requirements of Part 6 of the Standards.

FIELD-FABRICATED is a fenestration product 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. Field fabricated does not include site-built fenestration.

FIN is an opaque surface, oriented vertically and projecting outward horizontally from an exterior vertical surface.

FIN OFFSET is the horizontal distance from the edge of exposed exterior glazing at the jamb of a window to the fin.

FIN PROJECTION is the horizontal distance, measured outward horizontally, from the surface of exposed exterior glazing at the jamb of a window to the outward edge of a fin.

FIXED is fenestration that is not designed to be opened or closed.

FIELD ERECTED COOLING TOWERS are cooling towers which are custom designed for a specific application and which cannot be delivered to a project site in the form of factory assembled modules due to their size, configuration, or materials of construction.

FIREPLACE is a hearth and fire chamber, or similar prepared place, in which a fire may be made and which is built in conjunction with a flue or chimney, including but not limited to factory-built fireplaces, masonry fireplaces, and masonry heaters as further clarified in the CBC.

FLOOR/SOFFIT TYPE is a type of floor/soffit assembly having a specific heat capacity, framing type and *U*-factor.

FLUID COOLER is a fan-powered heat rejection device that includes a water or glycol circuit connected by a closed circulation loop to a waterliquid-cooled refrigerant condenser, and may be either evaporative-cooled, or air-cooled, or a combination of the two.

FLUX is the rate of energy flow per unit area.

FOOD PREPARATION EQUIPMENT is cooking equipment intended for commercial use, including coffee machines, espresso coffee makers, conductive cookers, food warmers including heated food servers, fryers, griddles, nut warmers, ovens, popcorn makers, steam kettles, ranges and cooking appliances for use in commercial kitchens, restaurants or other business establishments where food is dispensed.

FREEZER is a space designed to be capable of operation at less than 28°F.

GAS COOLING EQUIPMENT is cooling equipment that produces chilled water or cold air using natural gas or liquefied petroleum gas as the primary energy source.

GAS HEATING SYSTEM is a system that uses natural gas or liquefied petroleum gas as a fuel to heat a conditioned space.

GAS LOG is a self-contained, free-standing, open-flame, gas-burning appliance consisting of a metal frame or base supporting simulated logs, and designed for installation only in a vented fireplace.

GLAZED DOOR is an exterior door having a glazed area of 50 percent or greater of the area of the door.

GLAZING (See "fenestration product.")

GLOBAL WARMING POTENTIAL (GWP) is the radiative forcing impact of one mass-based unit of a given greenhouse gas relative to an equivalent unit of carbon dioxide over a given period of time.

GLOBAL WARMING POTENTIAL VALUE (GWP Value) is the 100-year GWP value published by the Intergovernmental Panel on Climate Change (IPCC) in either its Second Assessment Report (SAR) (IPCC, 1995), or its Fourth Assessment A-3 Report (AR4) (IPCC, 2007). Both the 1995 IPCC SAR values and the 2007 IPCC AR4 values are published in table 2.14 of the 2007 IPCC AR4. The SAR GWP values are found in column "SAR (100-yr)" of Table 2.14.; the AR4 GWP values are found in column "100 yr" of Table 2.14."

GOVERNMENTAL AGENCY is any public agency or subdivision thereof, including, but not limited to, any agency of the state, a county, a city, a district, an association of governments or a joint power agency.

GREENHOUSE or GARDEN WINDOW is a window unit that consists of a three-dimensional, five-sided structure generally protruding from the wall in which it is installed. Operating sash may or may not be included.

GROSS EXTERIOR ROOF AREA is the sum of the skylight area and the exterior roof/ceiling area.

GROSS EXTERIOR WALL AREA is the sum of the window area, door area and exterior wall area.

HABITABLE SPACE is space in a building for living, sleeping, eating or cooking. Bathrooms, toilets, hallways, storage areas, closets or utility rooms and similar areas are not considered habitable spaces.

HABITABLE STORY is a story that contains space in which humans may work or live in reasonable comfort, and that has at least 50 percent of its volume above grade.

HEAT CAPACITY (HC) or thermal capacity is the measurable physical quantity that characterizes the amount of heat required to change a substance's temperature by a given amount.

HEAT PUMP is an appliance that consists of one or more assemblies; that uses an indoor conditioning coil, a compressor, and a refrigerant-to-outdoor air heat exchanger to provide air heating; and that may also provide air cooling, dehumidifying, humidifying, circulating, or air cleaning.

HEATED SLAB FLOOR is a concrete floor either on-grade, raised, or a lightweight concrete slab topping. Heating is provided by a system placed within or under the slab and is sometimes referred to as a radiant slab floor.

HEATING EQUIPMENT is equipment used to provide mechanical heating for a room or rooms in a building.

HEATING SEASONAL PERFORMANCE FACTOR (HSPF) is the total heating output of a central air-conditioning heat pump (in Btu) during its normal use period for heating divided by the total electrical energy input (in watt-hours) during the same period, as determined using the applicable test method in the Appliance Efficiency Regulations.

HI is the Hydronics Institute of the Gas Appliance Manufacturers Association (GAMA).

HI HTG BOILER STANDARD is the Hydronics Institute document entitled "Testing and Rating Standard for Rating Boilers," 1989.

HIGH-RISE RESIDENTIAL BUILDING is a building, other than a hotel/motel, of occupancy Group R-2 or R-4 with four or more habitable stories.

HOTEL/MOTEL is a building or buildings that has six or more guest rooms or a lobby serving six or more guest rooms, where the guest rooms are intended or designed to be used, or which are used, rented or hired out to be occupied, or which are occupied for sleeping purposes by guests, and all conditioned spaces within the same building envelope. Hotel/motel also

includes all conditioned spaces which are (1) on the same property as the hotel/motel, (2) served by the same central heating, ventilation and air-conditioning system as the hotel/motel, and (3) integrally related to the functioning of the hotel/motel as such, including, but not limited to, exhibition facilities, meeting and conference facilities, food service facilities, lobbies and laundries.

HVAC SYSTEM is a space- conditioning system or a ventilation system.

IES HB (See "IES Lighting Handbook.")

IES LIGHTING HANDBOOK is the Illuminating Engineering Society document titled "The IES Lighting Handbook: Reference and Applications, Tenth Edition." (2011)

IES LM-79-08 is the Illuminating Engineering Society document titled, "IES Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products."

IES TM-15-11 is the Illuminating Engineering Society document titled, "Luminaire Classification Systems for Outdoor Luminaires."

INFILTRATION is uncontrolled inward air leakage from outside a building or unconditioned space, including leakage through cracks and interstices, around windows and doors, and through any other exterior or demising partition or pipe or duct penetration. See AIR BARRIER.

INTEGRATED ENERGY EFFICIENCY RATIO (IEER) is a single-number cooling part-load efficiency figure of merit calculated per the method described in ANSI/AHRI Standard 340/360/1230. This metric replaces the IPLV for ducted and non-ducted units.

INTEGRATED PART-LOAD VALUE (IPLV) is a single-number cooling part-load efficiency figure of merit calculated per the method described in ANSI/AHRI Standard 550/590 for use with chillers.

ISO STANDARD 17025 is the International Organization for Standardization document titled "General Criteria for the Competence of Testing and Calibration Laboratories," 2005. (ANS/ISO/IEC Standard 17025:2005)

ISO 13256-1 is the International Organization for Standardization document titled "Water-source heat pumps—Testing and rating for performance—Part 1: Water-to-air and brine-to-air heat pumps," 1998.

ISO 13256-2 is the International Organization for Standardization document titled "Water-source heat pumps—Testing and rating for performance—Part 1: Water-to-water and brine-to-water heat pumps," 1998.

LANGELIER SATURATION INDEX (LSI) is expressed as the difference between the actual system pH and the saturation pH. LSI indicates whether water will precipitate, dissolve or be in equilibrium with calcium carbonate, and is a function of hardness, alkalinity, conductivity, pH and temperature.

LARGEST NET CAPACITY INCREMENT is the largest increase in capacity when switching between combinations of base compressors that is expected to occur under the compressed air system control scheme.

LIGHTING definitions:

Accent lighting is directional lighting designed to highlight or spotlight objects. It can be recessed, surface mounted or mounted to a pendant, stem or track.

Chandelier is a ceiling-mounted, close-to-ceiling or suspended decorative luminaire that uses glass, crystal, ornamental metals or other decorative material.

Compact fluorescent lamp is a fluorescent lamp less than 9 inches maximum overall length (M.O.L.) with a T5 or smaller diameter glass tube that is folded, bent or bridged.

Decorative (lighting/luminaire) is lighting or luminaires installed only for aesthetic purposes and that does not serve as display lighting or general lighting.

Display lighting is lighting that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance. Types of display lighting include:

Floor: supplementary lighting required to highlight features, such as merchandise on a clothing rack, which is not displayed against a wall.

Wall: supplementary lighting required to highlight features, such as merchandise on a shelf, which is displayed on perimeter walls.

Window: lighting of objects such as merchandise, goods and artifacts, in a show window, to be viewed from the outside of a space through a window.

Case: lighting of small art objects, artifacts or valuable collections which involves customer inspection of very fine detail from outside of a glass enclosed display case.

General lighting is installed electric lighting that provides a uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect, exclusive of daylighting, and also known as ambient lighting.

GU-24 is the designation of a lamp holder and socket configuration, based on a coding system by the International Energy Consortium, where "G" indicates the broad type of two or more projecting contacts, such as pins or posts, "U" distinguishes between lamp and holder designs of similar type but that are not interchangeable due to electrical or mechanical requirements, and "24" indicates 24 millimeters center to center spacing of the electrical contact posts.

Illuminance is the incident luminous flux density on a differential element of surface located at a point and oriented in a particular direction, expressed in lumens per unit area.

Illumination is light incident on a surface of body, or the general condition of being illuminated.

Lamp is an electrical appliance that produces optical radiation for the purpose of visual illumination, designed with a base to provide an electrical connection between the lamp and a luminaire, and designed to be installed into a luminaire by means of a lamp-holder integral to the luminaire.

Landscape lighting is a type of outdoor lighting that is recessed into or mounted on the ground, paving or raised deck, which is mounted less than 42 inches above grade or

mounted onto trees or trellises, and that is intended to be aimed only at landscape features.

Lantern is an outdoor luminaire that uses an electric lamp to replicate the appearance of a pre-electric lantern, which used a flame to generate light.

Light is the luminous equivalent of power and is properly called luminous flux.

Lighting, or illumination, is the application of light to achieve some practical or aesthetic effect.

Light emitting diode (LED) definitions used in Part 6 are in Section 6.8 of ANSI/IES RP-16-10.

Low voltage is less than 90 volts.

Lumen maintenance is a strategy used to provide a precise, constant level of lighting from a lighting system regardless of the age of the lamps or the maintenance of the luminaires.

Luminaire is a complete lighting unit consisting of lamp(s) and the parts that distribute the light, position and protect the lamp(s), and connect the lamp(s) to the power supply.

Luminance is a measure of the light emitting power of a surface, in a particular direction, per unit apparent area.

Luminous flux is visually evaluated radiant flux and defines "light" for purposes of lighting design and illuminating engineering.

Marquee lighting is a permanent lighting system consisting of one or more rows of many small lamps, including light emitting diodes (LEDs), or fiber optic lighting, attached to a canopy.

Ornamental lighting for compliance with Part 6 is the following:

Luminaires installed outdoor which are rated for 100 watts or less that are post-top luminaires, lanterns, pendant luminaires, chandeliers and marquee lighting.

Decorative luminaires installed indoor that are chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels.

Pendant is a mounting method in which the luminaire is suspended from above.

Permanently installed lighting consists of luminaires that are affixed to land, within the meaning of Civil Code Sections 658 and 660, except as provided below. Permanently installed luminaires may be mounted inside or outside of a building or site. Permanently installed luminaires may have either plug-in or hardwired connections for electric power. Examples include track and flexible lighting systems; lighting attached to walls, ceilings, columns, inside or outside of permanently installed cabinets, internally illuminated cabinets, mounted on poles, in trees, or in the ground; attached to ceiling fans and integral to exhaust fans. Permanently installed lighting does not include portable lighting or lighting that is installed by the manufacturer in exhaust hoods for cooking equipment, refrigerated cases, food preparation equipment, and scientific and industrial equipment.

Portable lighting is lighting, with plug-in connections for electric power, that is: table and freestanding floor lamps; attached to modular furniture; workstation task luminaires; luminaires attached to workstation panels; attached to movable displays; or attached to other personal property.

Post top luminaire is an outdoor luminaire that is mounted directly on top of a lamp-post.

Precision lighting is task lighting for commercial or industrial work that illuminates low contrast, finely detailed, or fast moving objects.

Radiant power is the time-rate-flow of radiant energy.

Radiant energy is the electromagnetic or photonic radiant energy from a source.

Sconce is a wall mounted decorative accent luminaire.

Source (light) is the general term used to reference a source of light. It can refer variously to an electric lamp, a light emitting diode (LED), an entire luminaire with lamp and optical control, or fenestration for daylighting.

Special effects lighting is lighting installed to give off luminance instead of providing illuminance, which does not serve as general, task or display lighting.

Task lighting is lighting that is not general lighting and that specifically illuminates a location where a task is performed.

Temporary lighting is a lighting installation, with plug-in connections, that does not persist beyond 60 consecutive days or more than 120 days per year.

Track lighting is a system that includes luminaires and a track, rails or cables that both mount the system and deliver electric power. Track lighting includes the following types:

Line-voltage track lighting is equipped with luminaires that, use line-voltage lamps or that are equipped with integral transformers at each luminaire.

Low-voltage track lighting is equipped with remote transformers for use with low-voltage equipment along the entire length of track.

Track-mounted luminaires are luminaires designed to be attached at any point along a track lighting system. Track-mounted luminaires may be line-voltage or low-voltage.

Tuning is the ability to set maximum light levels at a lower level than full lighting power.

LIGHTING CONTROLS consist of the following:

Astronomical time-switch control is an automatic time-switch control that controlls lighting based on the time of day and astronomical events such as sunset and sunrise, accounting for geographic location and calendar date.

Automatic daylight control uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the luminous flux of the electric lighting system in response.

Automatic multilevel daylight control adjusts the luminous flux of the electric lighting system in either a series of steps or by continuous dimming in response to available daylight. This kind of control uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the electric lighting levels in response.

Automatic time switch control controls lighting based on the time of day.

Captive-key override is a type of lighting control in which the key that activates the override cannot be released when the lights are in the on position.

Countdown timer switch turns lighting or other loads ON when activated using one or more selectable count-down time periods and then automatically turns lighting or other loads OFF when the selected time period had elapsed.

Dimmer varies the luminous flux of the electric lighting system by changing the power delivered to that lighting system.

Dimmer, full-range (Also known as a continuous dimmer) varies the luminous flux of the electric lighting system over a continuous range from the device's maximum light output to the device's minimum light output without visually apparent abrupt changes in light level between the various steps.

Dimmer, stepped varies the luminous flux of the electric lighting system in one or more predetermined discrete steps between maximum light output and OFF with changes in light level between adjacent steps being visually apparent.

Lighting control, self-contained is a unitary lighting control module that requires no additional components to be a fully functional lighting control.

Lighting control system requires two or more components to be installed in the building to provide all of the functionality required to make up a fully functional and compliant lighting control.

Multilevel astronomical time switch is an astronomical time switch control that reduces lighting power in multiple steps.

Multilevel lighting control reduces power going to a lighting system in multiple steps.

Multiscene programmable control allows for two or more predefined lighting settings, in addition to all-OFF, for two or more groups of luminaires to suit multiple activities in the space.

Occupant sensing controls automatically control levels of illumination, allow for manual operation and consist of the following types:

Motion sensor is used outdoors, automatically turns lights OFF after an area is vacated of occupants, and automatically turns the lights ON when the area is occupied.

Occupant sensor is used indoors and automatically turns lights OFF after an area is vacated of occupants and is capable of automatically turning the lighting load ON when an area is occupied.

Partial-ON occupant/motion sensor automatically turns lights OFF after an area is vacated of occupants and is capable of automatically or manually turning ON part of the lighting load when an area is occupied.

Partial-OFF occupant/motion sensor automatically turns OFF part of the lighting load after an area is vacated of occupants and is capable of automatically turning ON the lighting load when an area is occupied.

Vacancy sensor automatically turns lights OFF after an area is vacated of occupants but requires lights to be turned ON manually.

Part-night outdoor lighting control is a time or occupancy-based lighting control device or system that is programmed to reduces or turns off the lighting power to an outdoor luminaire for a portion of the night.

Photo control automatically turns lights ON and OFF, or automatically adjusts lighting levels, in response to the amount of daylight that is available. A Photo control may also be one component of a field assembled lighting system, the component having the capability to provide a signal proportional to the amount of daylight to a Lighting Control System to continuously dim or brighten the electric lights in response.

Track lighting integral current limiter consists of a current limiter integral to the end-feed housing of a manufactured line-voltage track lighting system.

Track lighting supplementary overcurrent protection panel is a panelboard containing supplementary overcurrent protection devices as defined in Article 100 of the *California Electrical Code*, and used only with line voltage track lighting.

LISTED is in accordance with Article 100 of the *California Electrical Code*.

LOW-GWP REFRIGERANT is a compound used as a heat transfer fluid or gas that is: (A) any compound or blend of compounds, with a GWP Value less than 150; and (B) U.S. EPA Significant New Alternatives Policy (SNAP)-approved; and (C) not an ozone depleting substance as defined in Title 40 of the Code of Federal Regulations, Part 82, §82.3 (as amended March 10, 2009).

LOW-RISE RESIDENTIAL BUILDING is a building, other than a hotel/motel that is Occupancy Group:

R-2, multi-family, with three stories or less; or

R-3, single family; or

U-building, located on a residential site.

LPG is liquefied petroleum gas.

MAKEUP AIR is outdoor air that is intentionally conveyed by openings or ducts into the building from the outside; is supplied to the vicinity of an exhaust hood; and replaces air, vapor and contaminants being exhausted by the exhaust hood. Makeup air is generally filtered and fan-forced, and it may be heated or cooled. Makeup air may be delivered through openings or ducts integral to the exhaust hood.

MANUAL is capable of being operated by personal intervention.

MANUFACTURED DEVICE is any heating, cooling, ventilation, lighting, water heating, refrigeration, cooking, plumbing fitting, insulation, door, fenestration product, or any other appliance, device, equipment, or system subject to Sections 110.0 through 110.9 of Part 6.

MANUFACTURED or KNOCKED DOWN PRODUCT is a fenestration product constructed of materials that are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product. Knocked down or partially assembled products may be sold as a fenestration product when provided with temporary and permanent labels as described in Section 10-111, or as a site-built fenestration product when not provided with temporary and permanent labels as described in Section 10-111.

MECHANICAL COOLING is lowering the temperature within a space using refrigerant compressors or absorbers, desiccant dehumidifiers or other systems that require energy from depletable sources to directly condition the space. In nonresidential, high-rise residential and hotel/motel buildings, cooling of a space by direct or indirect evaporation of water alone is not considered mechanical cooling.

MECHANICAL HEATING is raising the temperature within a space using electric resistance heaters, fossil fuel burners, heat pumps or other systems that require energy from depletable sources to directly condition the space.

MERV is the minimum efficiency reporting value as determined by ASHRAE Standard 52.2 Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.

METAL BUILDING is a complete integrated set of mutually dependent components and assemblies that form a building, which consists of a steel-framed superstructure and metal skin. This does not include structural glass or metal panels such as in a curtainwall system.

MICROCHANNEL CONDENSER is an air-cooled condenser for refrigeration systems which utilizes multiple small parallel gas flow passages in a flat configuration with fin surfaces bonded between the parallel gas passages.

MINISPLIT AIR CONDITIONERS AND HEAT PUMPS are air conditioner or heat pump systems that have a single outdoor section and one or more indoor sections. The indoor sections cycle on and off in unison in response to a single indoor thermostat.

MODELING ASSUMPTIONS are the conditions (such as weather conditions, thermostat settings and schedules, internal gain schedules, etc.) that are used for calculating a building's annual energy consumption as specified in the Alternative Calculation Methods (ACM) Approval Manuals.

MULTIPLE-SPLIT AIR CONDITIONERS AND HEAT PUMPS are air conditioner or heat pump systems that have two or more indoor sections. The indoor sections operate independently and can be used to condition multiple zones in response to multiple indoor thermostats.

MULTIPLE ZONE SYSTEM is an air distribution system that supplies air to more than one space conditioning zone, each of which has one or more devices (such as dampers, cooling coils and heating coils) that regulate airflow, cooling or heating capacity to the zone.

NET EXHAUST FLOW RATE is the exhaust flow rate for a hood, minus any internal discharge makeup air flow rate.

NEWLY CONDITIONED SPACE is any space being converted from unconditioned to directly conditioned or indirectly conditioned space. Newly conditioned space must comply with the requirements for an addition. See Section 141.0 for nonresidential occupancies and Section 150.2 for residential occupancies.

NEWLY CONSTRUCTED BUILDING is a building that has never been used or occupied for any purpose.

NONDUCTED SYSTEM is an air conditioner or heat pump that is permanently installed; directly heats or cools air within the conditioned space; and uses one or more indoor coils that are mounted on walls or ceilings within the conditioned space. The system may be of a modular design that allows for combining multiple outdoor coils and compressors to create one unified system.

NFRC 100 is the National Fenestration Rating Council document titled "NFRC 100: Procedure for Determining Fenestration Product *U*-factors." (2011; NFRC 100 includes procedures for site fenestration formerly included in a separate document, NFRC 100-SB).

NFRC 200 is the National Fenestration Rating Council document titled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (2011).

NFRC 202 is the National Fenestration Rating Council document titled "NFRC 202: Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence." (2011).

NFRC 203 is the National Fenestration Rating Council document titled "NFRC 203: Procedure for Determining Visible Transmittance of Tubular Daylighting Devices." (2012).

NFRC 400 is the National Fenestration Rating Council document titled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (2010).

NONRESIDENTIAL BUILDING is any building which is identified in the California Building Code Table; Description of Occupancy as Group A, B, E, F, H, M, or S; and is a U; as defined by Part2 of Title24 of the California Code or Regulation.

Note: Requirements for high-rise residential buildings and hotels/ motels are included in the nonresidential sections of Part 6.

NONRESIDENTIAL BUILDING OCCUPANCY TYPES are building types in which a minimum of 90 percent of the building floor area functions as one of the following, which do not qualify as any other Building Occupancy Types more specifically defined in Section 100.1, and which do not have a combined total of more than 10 percent of the area functioning

of any Nonresidential Function Areas specifically defined in Section 100.1:

Auditorium building is a public building in which a minimum of 90 percent of the building floor area are rooms with fixed seating that are primarily used for public meetings or gatherings.

Classroom building is a building for an educational institution in which a minimum of 90 percent of the building floor area are classrooms or educational laboratories.

Commercial and industrial storage building is a building for which a minimum or 90 percent of the building floor area is used for storing items.

Convention center building is a building in which a minimum of 90 percent of the building floor area are rooms for meetings and conventions which have neither fixed seating nor fixed staging.

Financial institution building is a building in which a minimum of 90 percent of the building floor area are rooms used for an institution which collects funds from the public and places them in financial assets such as deposits, loans, and bonds.

General commercial and industrial work building is a building in which a minimum of 90 percent of the building floor area are rooms for performing a craft, assembly or manufacturing operation.

Grocery store building is a building in which a minimum of 90 percent of the building floor area is sales floor for the sale of foodstuffs.

Library building is a building in which a minimum of 90 percent of the building floor area are rooms used as a repository of literary materials kept for reading or reference, such as books, periodicals, newspapers, pamphlets and prints.

Medical buildings and clinic buildings are non "I" occupancy buildings in which a minimum of 90 percent of the building floor area are rooms where medical or clinical care is provided, does not provide overnight patient care, and is used to provide physical and mental care through medical, dental or psychological examination and treatment.

Office building is a building of CBC Group B Occupancy in which a minimum of 90 percent of the building floor area are rooms in which business, clerical or professional activities are conducted.

Parking garage building is a building in which a minimum of 90 percent of the building floor area is for the purpose of parking vehicles, which consists of at least a roof over the parking area enclosed with walls on all sides. The building includes areas for vehicle maneuvering to reach designated parking spaces. If the roof of a parking structure is also used for parking, the section without an overhead roof is considered an outdoor parking lot instead of a parking garage.

Religious facility building is a building in which a minimum of 90 percent of the floor area in the building floor area are rooms for assembly of people to worship.

Restaurant building is a building in which a minimum of 90 percent of the building floor area are rooms in which food and drink are prepared and served to customers in return for money.

School building is a building in which a minimum of 90 percent of the building floor area is used for an educational institution, but in which less than 90 percent of the building floor area is classrooms or educational laboratories and may include an auditorium, gymnasium, kitchen, library, multi-purpose room, cafeteria, student union or workroom. A maintenance or storage building is not a school building.

Theater building is a building in which a minimum of 90 percent of the building floor area are rooms having tiers of rising seats or steps for the viewing of motion pictures, or dramatic performances, lectures, musical events and similar live performances.

NONRESIDENTIAL COMPLIANCE MANUAL is the manual developed by the Commission, under Section 25402.1 (e) of the Public Resources Code, to aid designers, builders and contractors in meeting the energy efficiency requirements for nonresidential, high-rise residential and hotel/motel buildings.

NONRESIDENTIAL FUNCTION AREAS are those areas, rooms, and spaces within Nonresidential Buildings that fall within the following particular definitions and are defined according to the most specific definition.

Aisle way is the passage or walkway between storage racks permanently anchored to the floor in a Commercial or Industrial Storage Building, where the racks are used to store materials such as goods and merchandise.

Atrium is a large-volume indoor space created by openings between two or more stories but is not used for an enclosed stairway, elevator hoistway, escalator opening or utility shaft for plumbing, electrical, air-conditioning or other equipment.

Auditorium room is a room with fixed seats used for public meetings or gatherings.

Auto repair bay is a room or area used to repair automotive equipment and/or vehicles.

Beauty salon is a room or area in which the primary activity is manicures, pedicures, facials, or the cutting or styling of hair.

Civic meeting place is a space in a government building designed or used for public debate, discussion or public meetings of governmental bodies.

Classroom, lecture, training, vocational room is a room or area where an audience or class receives instruction.

Commercial and industrial storage area is a room or area used for storing of items such as goods and merchandise.

Commercial and industrial storage area (refrigerated) is a room or area used for storing items where mechanical refrigeration is used to maintain the space temperature at 55°F or less.

Convention, conference, multipurpose and meeting centers are rooms or areas that are designed or used for meetings, conventions or events, and that have neither fixed seating nor fixed staging.

Corridor is a passageway or route into which compartments or rooms open.

Dining is a room or area where meals that are served to the customers will be consumed.

Electrical/mechanical/telephone room is a room in which the building's electrical switchbox or control panels, telephone switchbox, and/or HVAC controls or equipment is located.

Exercise center or gymnasium is a room or area equipped for gymnastics, exercise equipment or indoor athletic activities.

Exhibit, museum area is a room or area in a museum that has for its primary purpose exhibitions, having neither fixed seating nor fixed staging. An exhibit does not include a gallery or other place where art is for sale. An exhibit does not include a lobby, conference room or other occupancies where the primary function is not exhibitions.

Financial transaction area is a room or area used by an institution that collects funds from the public and places them in financial assets such as deposits, loans and bonds, and includes tellers, work stations and customers' waiting areas; to complete financial transactions. Financial transaction areas do not include private offices, hallways, restrooms or other support areas.

General commercial and industrial work area is a room or area in which an art, craft, assembly or manufacturing operation is performed. Lighting installed in these areas is classified as follows:

High bay: Where the luminaires are 25 feet or more above the floor.

Low bay: Where the luminaires are less than 25 feet above the floor.

Precision: Where visual tasks of small size or fine detail such as electronic assembly, fine woodworking, metal lathe operation, fine hand painting and finishing, egg processing operations or tasks of similar visual difficulty are performed.

Grocery sales area is a room or area that has as its primary purpose the sale of foodstuffs requiring additional preparation prior to consumption.

Hotel function area is a hotel room or area such as a hotel ballroom, meeting room, exhibit hall or conference room, together with prefunction areas and other spaces ancillary to its function.

Kitchen/food preparation is a room or area with cooking facilities or an area where food is prepared.

Laboratory, scientific is a room or area where research, experiments and measurement in medical and physical sciences are performed requiring examination of fine details. The area may include workbenches, countertops, scientific instruments and associated floor spaces. Scientific laboratory does not refer to film, computer and other laboratories where scientific experiments are not performed.

Laundry is a room or area primarily designed or used for laundering activities.

Library area is a room or area primarily designed or used as a repository for literary materials such as books, periodicals, newspapers, pamphlets and prints, kept for reading or reference.

Reading area is a room or area in a library containing tables, chairs or desks for patrons to use for the purpose of reading books and other reference documents. Library reading areas include reading, circulation and checkout areas. Reading areas do not include private offices, meeting, photocopy or other rooms not used specifically for reading by library patrons.

Stack area is a room or area in a library with grouping of shelving sections. Stack aisles include pedestrian paths located in stack areas.

Lobby

Hotel is the contiguous area in a hotel/motel between the main entrance and the front desk, including reception, waiting and seating areas.

Main entry is the contiguous area in buildings other than hotel/motel that is directly located by the main entrance of the building through which persons must pass, including any ancillary reception, waiting and seating areas.

Locker or dressing room is a room or area for changing clothing, sometimes equipped with lockers.

Lounge is a room or area in a public place such as a hotel, airport, club or bar designated for people to sit, wait and relax.

Mall is a roofed or covered common pedestrian area within a mall building that serves as access for two or more tenants.

Medical and clinical care area is a non "I" occupancy room or area in a building that does not provide overnight patient care and that is used to provide physical and mental care through medical, dental or psychological examination and treatment, including, but not limited to, laboratories and treatment spaces.

Museum is a room or area in which the primary function is the care of exhibit of works of artistic, historical or scientific value. A museum does not include a gallery or other place where art is for sale. A museum does not include a lobby, conference room or other occupancies where the primary function is not the care or exhibit of works of artistic, historical or scientific value.

Office area is a room or area in a building of CBC Group B Occupancy in which business, clerical or professional activities are conducted.

Open area is a warehouse facility term describing a large unobstructed area that is typically used for the handling and temporary storage of goods.

Parking garage areas include the following:

Parking areas are the areas of a Parking Garage used for the purpose of parking and maneuvering of vehicles on a single floor. Parking areas include sloping floors of a parking garage. Parking areas do not include Daylight Transition Zones, Dedicated Ramps, or the roof of a Parking Garage, which may be present in a Parking Garage.

Daylight transition zone in a Parking Garage is the interior path of travel for vehicles to enter a parking garage as needed to transition from exterior daylight levels to interior light levels. Daylight Transition Zones only include the path of vehicular travel and do not include adjacent Parking Areas.

Dedicated ramps in parking garages are driveways specifically for the purpose of moving vehicles between floors of a parking garage and which have no adjacent parking. Dedicated ramps do not include sloping floors of a parking structure, which are considered Parking Areas.

Religious worship area is a room or area in which the primary function is for an assembly of people to worship. Religious worship does not include classrooms, offices or other areas in which the primary function is not for an assembly of people to worship.

Restroom is a room providing personal facilities such as toilets and washbasins.

Retail merchandise sales area is a room or area in which the primary activity is the sale of merchandise.

Server room is a room smaller than 500 square feet, within a larger building, in which networking equipment and Information Technology (IT) server equipment is housed, and a minimum of five IT servers are installed in frame racks.

Server aisle is an aisle of racks of Information Technology (IT) server equipment in a Server Room. While networking equipment may also be housed on these racks, it is largely a room to manage server equipment.

Stairs is a series of steps providing passage for persons from one level of a building to another, including escalators.

Stairwell is a vertical shaft in which stairs are located.

Support area is a room or area used as a passageway, utility room, storage space or other type of space associated with or secondary to the function of an occupancy that is listed in these regulations.

Tenant lease area is a room or area in a building intended for lease for which a specific tenant is not identified at the time of building permit application.

Theater areas include the following:

Motion picture theater is an assembly room or area with tiers of rising seats or steps for the showing of motion pictures.

Performance theater is an assembly room or area with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events and similar live performances.

Transportation function area is the ticketing area, waiting area, baggage handling areas, concourse in an airport terminal, bus or rail terminal or station, subway or transit station, or a marine terminal.

Videoconferencing studio is a room with permanently installed videoconferencing cameras, audio equipment and playback equipment for both audio-based and video-based two-way communication between local and remote sites.

Vocational area is a room or area used to provide training in a special skill to be pursued as a trade.

Waiting area is an area other than a hotel lobby or main entry lobby normally provided with seating and used for people waiting.

Wholesale showroom is a room or area where samples of merchandise are displayed.

NONSTANDARD PART LOAD VALUE (NPLV) is a single-number part-load efficiency figure of merit for chillers referenced to conditions other than IPLV conditions. (See "integrated part load value.")

NORTH-FACING (See "orientation.")

OCCUPANT SENSOR, LIGHTING is a device that automatically turns lights off soon after an area is vacated. The term occupant sensor applies to a device that controls indoor lighting systems. When the device is used to control outdoor lighting systems, it is termed a motion sensor. The device also may be called an occupancy sensor, occupant-sensing device or vacancy sensor.

OCCUPIABLE SPACE is any enclosed space inside the pressure boundary and intended for human activities, including, but not limited to, all habitable spaces, toilets, closets, halls, storage and utility areas, and laundry areas.

OPEN COOLING TOWER is an open, or direct contact, cooling tower which exposes water directly to the cooling atmosphere, thereby transferring the source heat load from the water directly to the air by a combination of heat and mass transfer.

OPERABLE FENESTRATION is designed to be opened or closed.

ORIENTATION, CARDINAL is one of the four principal directional indicators, north, east, south and west, which are marked on a compass. Also called cardinal directions.

ORIENTATION, EAST-FACING is oriented to within 45 degrees of true east, including 45°00'00" south of east (SE), but excluding 45°00'00" north of east (NE).

ORIENTATION, NORTH-FACING is oriented to within 45 degrees of true north, including 45°00'00" east of north (NE), but excluding 45°00'00"west of north (NW).

ORIENTATION, SOUTH-FACING is oriented to within 45 degrees of true south including 45°00'00" west of south (SW), but excluding 45°00'00" east of south (SE).

ORIENTATION, WEST-FACING is oriented to within 45 degrees of true west, including 45°00'00" north of due west (NW), but excluding 45°00'00" south of west (SW).

OUTDOOR AIR (Outside air) is air taken from outdoors and not previously circulated in the building.

OUTDOOR LIGHTING is electrical lighting used to illuminate outdoor areas.

OUTDOOR AREAS are areas external to a building. These include but are not limited to the following areas:

Building entrance way is the external area of any operable doorway in or out of a building, including overhead doors. These areas serve any doorway, set of doors (including elevator doors such as in parking garages), turnstile, vestibule or other form of portal that is ordinarily used to gain access to the building by its users and occupants. Where buildings have separate one-way doors to enter and to leave, this also includes any area serving any doors ordinarily used to leave the building.

Building facade is the exterior surfaces of a building, not including horizontal roofing, signs and surfaces not visible from any public accessible viewing location.

Canopy is a permanent structure, other than a parking garage area, consisting of a roof and supporting building elements, with the area beneath at least partially open to the elements. A canopy may be freestanding or attached to surrounding structures. A canopy roof may serve as the floor of a structure above.

Carport is a covered, open-sided structure designed or used primarily for the purpose of parking vehicles, having a roof over the parking area. Typically, carports are free-standing or projected from the side of the building and are only two or fewer car lengths deep. A Carport is not a Garage.

Hardscape is the area of an improvement to a site that is paved or has other structural features such as curbs, plazas, entries, parking lots, site roadways, driveways, walkways, sidewalks, bikeways, water features and pools, storage or service yards, loading docks, amphitheaters, outdoor sales lots, and private monuments and statuary.

Outdoor sales frontage is the portion of the perimeter of an outdoor sales area immediately adjacent to a street, road or public sidewalk.

Outdoor sales lot is an uncovered paved area used exclusively for the display of vehicles, equipment or other merchandise for sale. All internal and adjacent access drives, walkway areas, employee and customer parking areas, vehicle service or storage areas are not outdoor sales lot areas, but are considered hardscape.

Parking lot is an uncovered area for the purpose of parking vehicles. Parking lot is a type of hardscape.

Paved area is an area that is paved with concrete, asphalt, stone, brick, gravel or other improved wearing surface, including the curb.

Principal viewing location is anywhere along the adjacent highway, street, road or sidewalk running parallel to an outdoor sales frontage.

Public monuments are statuary, buildings, structures and/or hardscape on public land.

Sales canopy is a canopy specifically to cover and protect an outdoor sales area.

Stairways and Ramps. Stairways are one or more flights of stairs with the necessary landings and platforms connecting them to form a continuous and uninterrupted passage from one level to another. An exterior stairway is open on at least one side, except for required structural columns, beams, handrails and guards. The adjoining open areas shall be either yards, courts or public ways. The other sides of the exterior stairway need not be open. Ramps are walking surfaces with a slope steeper than 5 percent.

Vehicle service station is a gasoline, natural gas, diesel or other fuel dispensing station.

OUTDOOR LIGHTING ZONE is a geographic area designated by the California Energy Commission in accordance with Part 1, Section 10-114, that determines requirements for outdoor lighting, including lighting power densities and specific control, equipment or performance requirements. Lighting zones are numbered LZ1, LZ2, LZ3 and LZ4.

OVERHANG is a contiguous opaque surface, oriented horizontally and projecting outward horizontally from an exterior vertical surface.

OVERHANG OFFSET is the vertical distance from the edge of exposed exterior glazing at the head of a window to the overhang.

OVERHANG PROJECTION is the horizontal distance, measured outward horizontally from the surface of exposed exterior glazing at the head of a window to the outward edge of an overhang.

PART 1 means Part 1 of Title 24 of the California Code of Regulations.

PART 6 means Part 6 of Title 24 of the California Code of Regulations.

PART-LOAD OPERATION occurs when a system or device is operating below its maximum rated capacity.

PARTICLE SIZE EFFICIENCY is the fraction (percentage) of particles that are captured on air filter equipment as determined during rating tests conducted in accordance with ASHRAE Standard 52.2 or AHRI Standard 680. Particle Size Efficiency is measured in three particle size ranges: 0.3-1.0, 1.0-3.0, 3.0-10 microns.

POOLS, ANSI/NSPI-5 is the American National Standards Institute and National Spa and Pool Institute document entitled "American National Standard for Residential Inground Swimming Pools," 2003 (ANSI/NSPI-5 2003).

POOLS, AUXILIARY POOL LOADS are features or devices that circulate pool water in addition to that required for pool filtration, including, but not limited to, solar pool heating systems, filter backwashing, pool cleaners, waterfalls, fountains and spas.

POOLS, BACKWASH VALVE is a diverter valve designed to backwash filters located between the circulation pump and the filter, including, but not limited to, slide, push-pull, multiport and full-flow valves.

POOLS, MULTISPEED PUMP is a pump capable of operating at two (2) or more speeds and includes two-speed and variable-speed pumps.

POOLS, NSF/ANSI 50 is the NSF International (formerly National Sanitation Foundation) Standard and American National Standards Institute document entitled "Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs," 2005 (NSF/ANSI 50 – 2005).

POOLS, RESIDENTIAL are permanently installed residential in-ground swimming pools intended for use by a single-family home for noncommercial purposes and with dimensions as defined in ANSI/NSPI-5.

PRESSURE BOUNDARY is the primary air enclosure boundary separating indoor and outdoor air. For example, a volume that has more leakage to the outside than to the conditioned space would be considered outside the pressure boundary. Exposed earth in a crawlspace or basement shall not be considered part of the pressure boundary.

PRIMARY AIRFLOW is the airflow (cfm or L/s) supplied to the zone from the air-handling unit at which the outdoor air intake is located. It includes outdoor intake air and recirculated air from that air-handling unit but does not include air transferred or air recirculated to the zone by other means.

PRIMARY STORAGE is compressed air storage located upstream of the distribution system and any pressure flow regulators.

PROCESS is an activity or treatment that is not related to the space conditioning, lighting, service water heating or ventilating of a building as it relates to human occupancy.

PROCESS BOILER is a type of boiler with a capacity (rated maximum input) of 300,000 Btus per hour (Btu/h) or more that serves a process.

PROCESS, COVERED are processes that are regulated under Part 6, which include but are not limited to computer rooms, laboratory exhaust, garage exhaust, commercial kitchen ventilation, refrigerator warehouses, supermarket refrigeration systems, compressed air systems, process cooling towers and process boilers.

PROCESS, EXEMPT is a process that is not a covered process.

PROCESS LOAD is a load resulting from a process.

PROCESS LOAD, COVERED is the energy consumption of and/or the heat generated by a piece of equipment or device that is part of a covered process.

PROCESS LOAD, EXEMPT is the energy consumption of and/or the heat generated by a piece of equipment or device that is part of an exempt process.

PROCESS SPACE is a space that is thermostatically controlled to maintain a process environment temperature less than 55°F or to maintain a process environment temperature greater than 90°F for the whole space that the system serves, or that is a space with a space-conditioning system designed and controlled to be incapable of operating at temperatures above 55°F or incapable of operating at temperatures below 90°F at design conditions.

PROPOSED DESIGN BUILDING ENERGY USE is the predicted energy use of proposed building derived from application of the building energy use modeling rules described in the Alternative Calculation Method (ACM) Approval Manual.

PUBLIC AREAS are spaces generally open to the public at large, customers or congregation members, or similar spaces where occupants need to be prevented from controlling lights for safety, security or business reasons.

***R*-VALUE** is the measure of the thermal resistance of insulation or any material or building component expressed in ft^2-hr-°F/Btu.

RADIANT BARRIER is a highly reflective, low emitting material installed at the underside surface of the roof deck and the inside surface of gable ends or other exterior vertical surfaces in attics to reduce solar heat gain.

RAISED FLOOR is a floor (partition) over a crawl space, or an unconditioned space, or ambient air.

READILY ACCESSIBLE is capable of being reached quickly for operation, repair or inspection, without requiring climbing or removing obstacles, or resorting to access equipment.

RECOOL is the cooling of air that has been previously heated by space-conditioning equipment or systems serving the same building.

RECOVERED ENERGY is energy used in a building that (1) is recovered from space conditioning, service water heating, lighting, or process equipment after the energy has performed its original function; (2) provides space conditioning, service water heating, or lighting; and (3) would otherwise be wasted.

REFERENCE APPENDICES is the support document for the Building Energy Efficiency Standards and the ACM Approval Manuals. The document consists of three sections: the Reference Joint Appendices (JA), the Reference Residential Appendices (RA) and the Reference Nonresidential Appendices (NA).

REFLECTANCE, SOLAR is the ratio of the reflected solar flux to the incident solar flux.

REFRIGERATED CASE is a manufactured commercial refrigerator or freezer, including but not limited to display cases, reach-in cabinets, meat cases, and frozen food and soda fountain units.

REFRIGERATED SPACE is a space constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55°F or less.

REFRIGERATED WAREHOUSE is a building or a space greater than or equal to 3,000 square feet constructed for storage or handling of products, where mechanical refrigeration is used to maintain the space temperature at 55°F or less.

REHEAT is the heating of air that has been previously cooled by cooling equipment or supplied by an economizer.

RELATIVE SOLAR HEAT GAIN is the ratio of solar heat gain through a fenestration product (corrected for external shading) 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.

RELOCATABLE PUBLIC SCHOOL BUILDING is a relocatable building as defined by Title 24, Part 1, Section 4-314, which is subject to Title 24, Part 1, Chapter 4, Group 1.

REPAIR is the reconstruction or renewal for the purpose of maintenance of any component, system or equipment of an existing building. Repairs shall not increase the preexisting energy consumption of the repaired component, system or

equipment. Replacement of any component, system or equipment for which there are requirements in the Standards is considered an alteration and not a repair.

REPLACEMENT AIR is air that is used to replace air removed from a building through an exhaust system. Replacement air may be derived from one or more of the following: makeup air, portions of supply air, transfer air or infiltration air.

SUPPLY AIR is air entering a space from an air-conditioning, heating or ventilating system for the purpose of comfort conditioning. Supply air is generally filtered, fan-forced, and heated, cooled, humidified or dehumidified as necessary to maintain specified temperature and humidity conditions.

TRANSFER AIR is air transferred, whether actively by fans or passively by pressure differentials, from one room to another within a building through openings in the room envelope.

INFILTRATION AIR is outdoor air that enters a building or space through openings in the building or space envelope due to negative pressure in the space or building relative to the exterior of the building envelope.

RESIDENTIAL BUILDING (See "high-rise residential building" and "low-rise residential building.")

RESIDENTIAL COMPLIANCE MANUAL is the manual developed by the Commission, under Section 25402.1 of the Public Resources Code, to aid designers, builders and contractors in meeting energy efficiency standards for low-rise residential buildings.

RESIDENTIAL SPACE TYPE is one of the following:

Bathroom is a room or area containing a sink used for personal hygiene, toilet, shower or a tub.

Closet is a nonhabitable room used for the storage of linens, household supplies, clothing, nonperishable food or similar uses, and which is not a hallway or passageway.

Garage is a nonhabitable building or portion of building, attached to or detached from a residential dwelling unit, in which motor vehicles are parked.

Kitchen is a room or area used for cooking, food storage and preparation and washing dishes, including associated counter tops and cabinets, refrigerator, stove, ovens and floor area.

Laundry is a nonhabitable room or space which contains plumbing and electrical connections for a washing machine or clothes dryer.

Storage building is a nonhabitable detached building used for the storage of tools, garden equipment or miscellaneous items.

Utility room is a nonhabitable room or building which contains only HVAC, plumbing, or electrical controls or equipment; and which is not a bathroom, closet, garage or laundry room.

ROOF is the outside cover of a building or structure including the structural supports, decking and top layer that is exposed to the outside with a slope less than 60 degrees from the horizontal.

ROOF, LOW-SLOPED is a roof that has a ratio of rise to run of 2:12 or less (9.5 degrees from the horizontal).

ROOF, STEEP-SLOPED is a roof that has a ratio of rise to run of greater than 2:12 (9.5 degrees from the horizontal).

ROOFING PRODUCT is the top layer of the roof that is exposed to the outside, which has properties including but not limited to solar reflectance, thermal emittance and mass.

ROOF RECOVER BOARD is a rigid type board installed directly below a low-sloped roof membrane, with or without above deck thermal insulation, to: (a) improve a roof system's compressive strength, (b) physically separate the roof membrane from the thermal insulation, or (c) physically separate a new roof covering from an underlying roof membrane as part of a roof overlay project.

RUNOUT is piping that is no more than 12 feet long and that connects to a fixture or an individual terminal unit.

SATURATED CONDENSING TEMPERATURE (also known as CONDENSING TEMPERATURE) is: (a) for single component and azeotropic refrigerants, the saturation temperature corresponding to the refrigerant pressure at the condenser entrance, or (b) for zeotropic refrigerants, the arithmetic average of the Dew Point and Bubble Point temperatures corresponding to the refrigerant pressure at the condenser entrance.

SCIENTIFIC EQUIPMENT is measurement, testing or metering equipment used for scientific research or investigation, including but not limited to manufactured cabinets, carts and racks.

SEASONAL ENERGY EFFICIENCY RATIO (SEER) is the total cooling output of an air conditioner in Btu during its normal usage period for cooling divided by the total electrical energy input in watt-hours during the same period, as determined using the applicable test method in the Appliance Efficiency Regulations.

SERVICE WATER HEATING is heating of water for sanitary purposes for human occupancy, other than for comfort heating.

SHADING is the protection from heat gains because of direct solar radiation by permanently attached exterior devices or building elements, interior shading devices, glazing material or adherent materials.

SHADING COEFFICIENT(SC) is the ratio of the solar heat gain through a fenestration product to the solar heat gain through an unshaded $^1/_8$-inch-thick clear double strength glass under the same set of conditions. For nonresidential, high-rise residential and hotel/motel buildings, this shall exclude the effects of mullions, frames, sashes, and interior and exterior shading devices.

SIGN definitions include the following:

Electronic message center (EMC) is a pixilated image producing electronically controlled sign formed by any light source. Bare lamps used to create linear lighting ani-

mation sequences through the use of chaser circuits, also known as "chaser lights" are not considered an EMC.

Illuminated face is a side of a sign that has the message on it. For an exit sign it is the side that has the word "EXIT" on it.

Sign, cabinet is an internally illuminated sign consisting of frame and face, with a continuous translucent message panel, also referred to as a panel sign.

Sign, channel letter is an internally illuminated sign with multiple components, each built in the shape of an individual three-dimensional letter or symbol that are each independently illuminated, with a separate translucent panel over the light source for each element.

Sign, double-faced is a sign with two parallel opposing faces.

Sign, externally illuminated is any sign or a billboard that is lit by a light source that is external to the sign directed towards and shining on the face of the sign.

Sign, internally illuminated is a sign that is illuminated by a light source that is contained inside the sign where the message area is luminous, including cabinet signs and channel letter signs.

Sign, traffic is a sign for traffic direction, warning and roadway identification.

Sign, unfiltered is a sign where the viewer perceives the light source directly as the message, without any colored filter between the viewer and the light source, including neon, cold cathode and LED signs.

SINGLE FAMILY RESIDENCE is a building that is of Occupancy Group R-3.

SINGLE PACKAGE VERTICAL AIR CONDITIONER (SPVAC) is a type of air-cooled small or large commercial package air-conditioning and heating equipment; factory assembled as a single package having its major components arranged vertically, which is an encased combination of cooling and optional heating components; is intended for exterior mounting on, adjacent interior to, or through an outside wall; and is powered by single or three-phase current. It may contain separate indoor grille, outdoor louvers, various ventilation options, indoor free air discharge, ductwork, wall plenum or sleeve. Heating components may include electrical resistance, steam, hot water, gas, or no heat but may not include reverse cycle refrigeration as a heating means.

SINGLE PACKAGE VERTICAL HEAT PUMP (SPVHP) is an SPVAC that utilizes reverse cycle refrigeration as its primary heat source, with secondary supplemental heating by means of electrical resistance, steam, hot water or gas.

SINGLE ZONE SYSTEM is an air distribution system that supplies air to one thermal zone.

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 that are manufactured with the intention of being assembled at the construction site. These include storefront systems, curtain walls and atrium roof systems.

SITE SOLAR ENERGY is thermal, chemical or electrical energy derived from direct conversion of incident solar radiation at the building site.

SKYLIGHT is fenestration installed on a roof less than 60 degrees from the horizontal.

SKYLIGHT AREA is the area of the rough opening for the skylight.

SKYLIGHT TYPE is one of the following three types of skylights: glass mounted on a curb, glass not mounted on a curb, or plastic (assumed to be mounted on a curb).

SMACNA is the Sheet Metal and Air-conditioning Contractors National Association.

SMACNA HVAC DUCT CONSTRUCTION STANDARDS is the Sheet Metal Contractors' National Association document "HVAC Duct Construction Standards Metal and Flexible - 3rd Edition," 2006 (2006 ANSI/SMACNA- 006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition).

SMACNA RESIDENTIAL COMFORT SYSTEM INSTALLATION STANDARDS MANUAL is the Sheet Metal Contractors' National Association document entitled "Residential Comfort System Installation Standards Manual, Seventh Edition." (1998)

SOCIAL SERVICES BUILDING is a space where public assistance and social services are provided to individuals or families.

SOLAR HEAT GAIN COEFFICIENT (SHGC) is the ratio of the solar heat gain entering the space through the fenestration area 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.

SOLAR REFLECTANCE INDEX (SRI) is a measure of the roof's ability to reject solar heat which includes both reflectance and emittance.

SOLAR SAVINGS FRACTION (SSF) is the fraction of domestic hot water demand provided by a solar water-heating system.

SOLAR ZONE is a section of the roof designated and reserved for the future installation of a solar electric or solar thermal system.

SOUTH-FACING (See "orientation.")

SPA is a vessel that contains heated water in which humans can immerse themselves, is not a pool, and is not a bathtub.

SPACE-CONDITIONING SYSTEM is a system that provides heating or cooling within or associated with conditioned spaces in a building, and may incorporate use of components such as chillers/compressors, fluid distribution systems (e.g., air ducts, water piping, refrigerant piping), pumps, air handlers, cooling and heating coils, air or water cooled condensers, economizers, terminal units, and associated controls.

SPANDRAL is opaque glazing material most often used to conceal building elements between floors of a building so they

cannot be seen from the exterior, also known as "opaque in-fill systems."

STANDARD DESIGN BUILDING is a building that complies with the mandatory and prescriptive requirements in the Title 24 Building Energy Efficiency Standards by using the building energy modeling rules described in the Alternative Calculation Method (ACM) Reference Manual.

STORAGE, COLD is a storage area within a refrigerated warehouse where space temperatures are maintained at or above 32°F.

STORAGE, FROZEN is a storage area within a refrigerated warehouse where the space temperatures are maintained below 32°F.

TENANT SPACE is a portion of a building occupied by a tenant.

THERMAL MASS is solid or liquid material used to store heat for later heating use or for reducing cooling requirements.

THERMAL RESISTANCE (R) is a measurement of the resistance over time of a material or building component to the passage of heat in $(hr \times ft^2 \times °F)/Btu$.

THERMOSTATIC EXPANSION VALVE (TXV) is a refrigerant metering valve, installed in an air conditioner or heat pump, which controls the flow of liquid refrigerant entering the evaporator in response to the superheat of the gas leaving it.

TIME DEPENDENT VALUATION (TDV) ENERGY is the time varying energy caused to be used by the building to provide space conditioning and water heating and for specified buildings lighting. TDV energy accounts for the energy used at the building site and consumed in producing and in delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses.

TINTED GLASS is colored glass by incorporation of a mineral admixture resulting in a degree of tinting. Any tinting reduces both visible and radiant transmittance.

TOTAL HEAT OF REJECTION (THR) is the heat rejected by refrigeration system compressors at design conditions, consisting of the design cooling capacity plus the heat of compression added by the compressors.

TOWNHOUSE is a single-family dwelling unit constructed in a group of three or more attached units in which each unit extends from the foundation to roof and with open space on at least two sides.

TRANSFER AIR is air transferred, whether actively by fans or passively by pressure differentials, from one room to another within a building through openings in the room envelope.

TRIM COMPRESSOR is a compressor that is designated for part-load operation, handling the short-term variable trim load of end uses, in addition to the fully loaded base compressors.

***U*-FACTOR** is the overall coefficient of thermal transmittance of a fenestration, wall, floor, roof or ceiling component in $Btu/(hr \times ft^2 \times °F)$, including air film resistance at both surfaces.

UL is the Underwriters Laboratories.

UL 727 is the Underwriters Laboratories document entitled "Standard for Oil-Fired Central Furnaces," 2006.

UL 731 is the Underwriters Laboratories document entitled "Standard for Oil-Fired Unit Heaters," 2006 with revisions 1 through 7.

UL 1574 is the Underwriters Laboratories document entitled "Track Lighting Systems," 2000.

UNCONDITIONED SPACE is enclosed space within a building that is not directly conditioned or indirectly conditioned.

UNIT INTERIOR MASS CAPACITY (UIMC) is the amount of effective heat capacity per unit of thermal mass, taking into account the type of mass material, thickness, specific heat, density and surface area.

USDOE 10 CFR 430 is the regulation issued by Department of Energy and available in the Code of Federal Regulation -Title 10, Chapter II, Subchapter D, Part 430 – Energy Conservation Program for Consumer Products. Relevant testing methodologies are specified in "Appendix N to subpart B of Part 430 – Uniform test method for measuring the energy consumption of furnaces and boilers."

USDOE 10 CFR 431 is the regulation issued by Department of Energy and available in the Code of Federal Regulation -Title 10, Chapter II, Subchapter D, Part 431 - Energy Conservation Program for Certain Commercial and Industrial equipment. Relevant testing methodologies are specified in "Subpart E to Part 431 – Uniform test method for the measurement of energy efficiency of commercial packaged boilers."

VAPOR RETARDER CLASS is a measure of the ability of a material or assembly to limit the amount of moisture that passes through the material or assembly meeting Section 202 of the *California Building Code.*

VARIABLE AIR VOLUME (VAV) SYSTEM is a space-conditioning system that maintains comfort levels by varying the volume of supply air to the zones served.

VENDING MACHINE is a machine for vending and dispensing refrigerated or nonrefrigerated food and beverages or general merchandise.

VERTICAL GLAZING (See "window.")

VERY VALUABLE MERCHANDISE are rare or precious objects, including, but not limited to, jewelry, coins, small art objects, crystal, ceramics or silver, the selling of which involves customer inspection of very fine detail from outside of a locked case.

VISIBLE TRANSMITTANCE (VT) is the ratio (expressed as a decimal) of visible light that is transmitted through a glazing fenestration. The higher the VT rating, the more light is allowed through a window.

WALL TYPE is a type of wall assembly having a specific heat capacity, framing type and *U*-factor.

WATER BALANCE IN EVAPORATIVE COOLING TOWERS. The water balance of a cooling tower is:

$M = E + B$, where:

M = makeup water (from the mains water supply)

E = losses due to evaporation

B = losses due to blowdown

WEST-FACING (See "orientation.")

WINDOW is fenestration that is not a skylight and that is an assembled unit consisting of a frame and sash componenet holding one or more pieces of glazing.

WINDOW AREA is the area of the surface of a window, plus the area of the frame, sash and mullions.

WINDOW FILM is a fenestration attachment product that consists of a flexible adhesive-backed ploymer film, which may be applied to the interior or exterior surface of an existing glazing system.

WINDOW WALL RATIO is the ratio of the window area to the gross exterior wall area.

WOOD HEATER is an enclosed wood-burning appliance used for space heating and/or domestic water heating.

WOOD STOVE (See "wood heater.")

ZONE, CRITICAL is a zone serving a process where reset of the zone temperature setpoint during a demand shed event might disrupt the process, including but not limited to data centers, telecom and private branch exchange (PBX) rooms, and laboratories.

ZONE, NONCRITICAL is a zone that is not a critical zone.

ZONE, SPACE-CONDITIONING, is a space or group of spaces within a building with sufficiently similar comfort conditioning requirements so that comfort conditions, as specified in Section 140.4(b)3 or 150.0(h), as applicable, can be maintained throughout the zone by a single controlling device.

SECTION 100.2 CALCULATION OF TIME DEPENDENT VALUATION (TDV) ENERGY

Time Dependent Valuation (TDV) energy shall be used to compare proposed designs to their energy budget when using the performance compliance approach. TDV energy is calculated by multiplying the site energy use (electricity kWh, natural gas therms, or fuel oil or LPG gallons) for each energy type times the applicable TDV multiplier. TDV multipliers vary for each hour of the year and by energy type (electricity, natural gas or propane), by climate zone and by building type (low-rise residential or nonresidential, high-rise residential or hotel/motel). TDV multipliers are summarized in Reference Joint Appendix JA3. TDV multipliers for propane shall be used for all energy obtained from depletable sources other than electricity and natural gas.

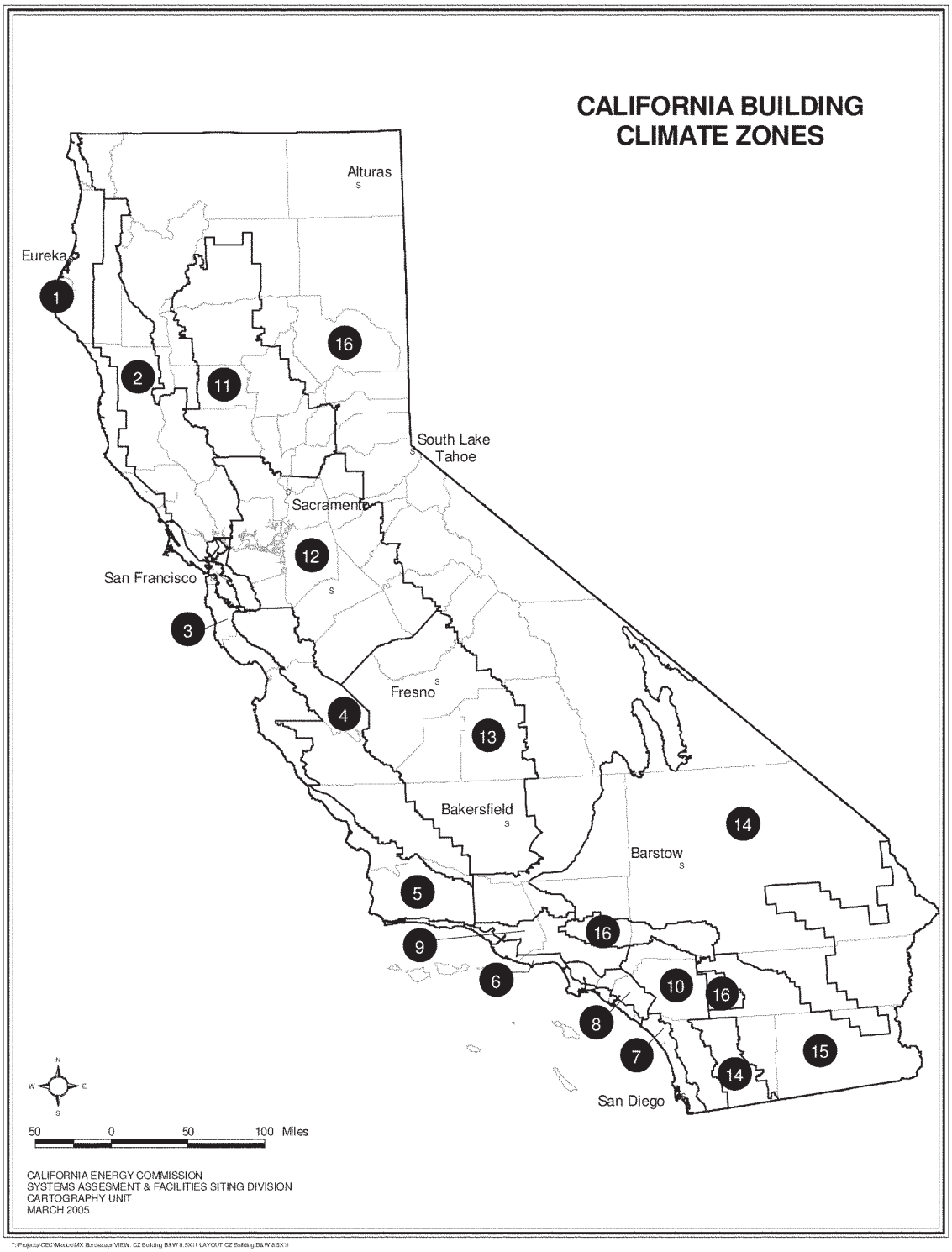

FIGURE 100.1-A CALIFORNIA CLIMATE ZONES

Climate Zones for Residential and Nonresidential Occupancies

TABLE 110.2-J
WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES, AND UNIT HEATERS[c,f]

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION[b]	MINIMUM EFFICIENCY[d,e]	TEST PROCEDURE[a]
Warm-Air furnace, gas-fired	< 225,000 Btu/h	Maximum capacity	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,000 Btu/h	Maximum capacity	80% E_t	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air furnace, oil-fired	< 225,000 Btu/h	Maximum capacity	78% AFUE or 80% E_t	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,000 Btu/h	Maximum capacity	81% E_t	Section 42, Combustion, UL 727
Warm-Air duct furnaces, gas-fired	All capacities	Maximum capacity	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air unit heaters, gas-fired	All capacities	Maximum capacity	80% E_c	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air unit heaters, oil-fired	All capacities	Maximum capacity	80% E_c	Section 40, Combustion, UL 731

a. Applicable test procedure and reference year are provided under the definitions.
b. Compliance of multiple firing rate units shall be at maximum firing rate.
c. Combustion units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.
d. E_t = thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75% 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.
e. E_c = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.
f. As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.

TABLE 110.2-K
GAS- AND OIL-FIRED BOILERS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SUBCATEGORY	SIZE CATEGORY (INPUT)	MINIMUM EFFICIENCY[b,c]	TEST PROCEDURE[a]
Boiler, hot water	Gas-Fired	< 300,000 Btu/h	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	80% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	82% E_c	
	Oil-Fired	< 300,000 Btu/h	84% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	82% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	84% E_c	
Boiler, steam	Gas-Fired	< 300,000 Btu/h	80% AFUE	DOE 10 CFR Part 430
	Gas-Fired all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	79% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	79% E_t	DOE 10 CFR Part 431
	Gas-Fired, natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	77% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	77% E_t	DOE 10 CFR Part 431
	Oil-Fired	< 300,000 Btu/h	82% AFUE	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h[d]	81% E_t	DOE 10 CFR Part 431
		> 2,500,000 Btu/h[e]	81% E_t	DOE 10 CFR Part 431

a. Applicable test procedure and reference year are provided under the definitions.
b. E_c = combustion efficiency (100% less flue losses). See reference document for detailed information.
c. E_t = thermal efficiency. See test procedure for detailed information.
d. Maximum capacity—minimum and maximum ratings as provided for and allowed by the unit's controls.
e. Included oil-fired (residual).

SECTION 110.3
MANDATORY REQUIREMENTS FOR SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT

(a) **Certification by manufacturers.** Any service water-heating system or equipment may be installed only if the manufacturer has certified that the system or equipment complies with all of the requirements of this subsection for that system or equipment.

1. **Temperature controls for service water-heating systems.** Service water-heating systems shall be equipped with automatic temperature controls capable of adjustment from the lowest to the highest acceptable temperature settings for the intended use as listed in Table 3, Chapter 50 of the ASHRAE Handbook, HVAC Applications Volume.

   Exception to Section 110.3(a)1: Residential occupancies.

(b) **Efficiency.** Equipment shall meet the applicable requirements of the Appliance Efficiency Regulations as required by Section 110.1, subject to the following:

1. If more than one standard is listed in the Appliance Efficiency Regulations, the equipment shall meet all the standards listed; and
2. If more than one test method is listed in the Appliance Efficiency Regulations, the equipment shall comply with the applicable standard when tested with each test method; and
3. Where equipment can serve more than one function, such as both heating and cooling, or both space heating and water heating, it shall comply with all the requirements applicable to each function; and
4. Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.

(c) **Installation.** Any service water-heating system or equipment may be installed only if the system or equipment complies with all of the applicable requirements of this subsection for the system or equipment.

1. **Outlet temperature controls.** On systems that have a total capacity greater than 167,000 Btu/hr, outlets that require higher than service water temperatures as listed in the ASHRAE Handbook, Applications Volume, shall have separate remote heaters, heat exchangers or boosters to supply the outlet with the higher temperature.
2. **Controls for hot water distribution systems.** Service hot water systems with circulating pumps or with electrical heat trace systems shall be capable of automatically turning off the system.
3. **Temperature controls for public lavatories.** The controls shall limit the outlet temperature to 110°F.
4. **Insulation.** Unfired service water heater storage tanks and backup tanks for solar water-heating systems shall have:

   A. External insulation with an installed *R*-value of at least R-12; or

   B. Internal and external insulation with a combined *R*-value of at least R-16; or

   C. The heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.

5. **Water heating recirculation loops serving multiple dwelling units, high-rise residential, hotel/motel and nonresidential occupancies.** A water heating recirculation loop is a type of hot water distribution system that reduces the time needed to deliver hot water to fixtures that are distant from the water heater, boiler or other water heating equipment. The recirculation loop is comprised of a supply portion, connected to branches that serve multiple dwelling units, guest rooms, or fixtures and a return portion that completes the loop back to the water heating equipment. A water heating recirculation loop shall meet the following requirements:

   A. **Air release valve or vertical pump installation.** An automatic air release valve shall be installed on the recirculation loop piping on the inlet side of the recirculation pump and no more than 4 feet from the pump. This valve shall be mounted on top of a vertical riser at least 12" in length and shall be accessible for replacement and repair. Alternatively, the pump shall be installed on a vertical section of the return line.

   B. **Recirculation loop backflow prevention.** A check valve or similar device shall be located between the recirculation pump and the water heating equipment to prevent water from flowing backwards though the recirculation loop.

   C. **Equipment for pump priming.** A hose bibb shall be installed between the pump and the water heating equipment. An isolation valve shall be installed between the hose bibb and the water heating equipment. This hose bibb is used for bleeding air out of the pump after pump replacement.

   D. **Pump isolation valves.** Isolation valves shall be installed on both sides of the pump. These valves may be part of the flange that attaches the pump to the pipe. One of the isolation valves may be the same isolation valve as in item C.

   E. **Cold water supply and recirculation loop connection to hot water storage tank.** Storage water heaters and boilers shall be plumbed in accordance with the manufacturer's specifications The cold water piping and the recirculation loop piping shall not be connected to the hot water storage tank drain port.

   F. **Cold water supply backflow prevention.** A check valve shall be installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply line. The system shall comply with the expansion tank requirements as described in the *California Plumbing Code* Section 608.3.

SUBCHAPTER 3

NONRESIDENTIAL, HIGH-RISE RESIDENTIAL HOTEL/MOTEL OCCUPANCIES, AND COVERED PROCESSES—MANDATORY REQUIREMENTS

SECTION 120.0 GENERAL

Sections 120.1 through 120.9 establish requirements for the design and installation of building envelopes, ventilation, space-conditioning and service water-heating systems and equipment in nonresidential, high-rise residential and hotel/motel buildings as well as covered processes that are subject to Title 24, Part 6. All such buildings and covered processes shall comply with the applicable provisions of Sections 120.1 through 120.9.

SECTION 120.1 REQUIREMENTS FOR VENTILATION

All nonresidential, high-rise residential and hotel/motel occupancies shall comply with the requirements of Sections 120.1(a) through 120.1(e).

(a) **General requirements.**

1. All enclosed spaces in a building shall be ventilated in accordance with the requirements of this section and the *California Building Code*.

   Exception to Section 120.1(a)1: Refrigerated warehouses and other spaces or buildings that are not normally used for human occupancy and work.

2. The outdoor air-ventilation rate and air-distribution assumptions made in the design of the ventilating system shall be clearly identified on the plans required by Section 10-103 of Title 24, Part 1.

(b) **Design requirements for minimum quantities of outdoor air.** Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:

1. **Natural ventilation.**

   A. Naturally ventilated spaces shall be permanently open to and within 20 feet of operable wall or roof openings to the outdoors, the openable area of which is not less than 5 percent of the conditioned floor area of the naturally ventilated space. Where openings are covered with louvers or otherwise obstructed, openable area shall be based on the free unobstructed area through the opening.

      Exception to Section 120.1(b)1A: Naturally ventilated spaces in high-rise residential dwelling units and hotel/motel guest rooms shall be open to and within 25 feet of operable wall or roof openings to the outdoors.

   B. The means to open required operable openings shall be readily accessible to building occupants whenever the space is occupied.

2. **Mechanical ventilation.** Each space that is not naturally ventilated under Item 1 above shall be ventilated with a mechanical system capable of providing an outdoor air rate no less than the larger of:

   A. The conditioned floor area of the space times the applicable ventilation rate from Table 120.1-A; or

   B. 15 cfm per person times the expected number of occupants. For meeting the requirement in Section 120.1(b)2B for spaces without fixed seating, the expected number of occupants shall be either the expected number specified by the building designer or one half of the maximum occupant load assumed for egress purposes in the *California Building Code*, whichever is greater. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the *California Building Code*.

      Exception to Section 120.1(b)2: Transfer air. The rate of outdoor air required by Section 120.1(b)2 may be provided with air transferred from other ventilated spaces if:

      A. None of the spaces from which air is transferred have any unusual sources of indoor air contaminants; and

      B. The outdoor air that is supplied to all spaces combined is sufficient to meet the requirements of Section 120.1(b)2 for each space individually.

(c) **Operation and control requirements for minimum quantities of outdoor air.**

1. **Times of occupancy.** The minimum rate of outdoor air required by Section 120.1(b)2 shall be supplied to each space at all times when the space is usually occupied.

   Exception 1 to Section 120.1(c)1: Demand control ventilation. In intermittently occupied spaces that do not have processes or operations that generate dusts, fumes, mists, vapors or gasses and are not provided with local exhaust ventilation (such as indoor operation of internal combustion engines or areas designated for unvented food service preparation), the rate of outdoor air may be reduced if the ventilation system serving the space is controlled by a demand control ventilation device complying with Section 120.1(c)4 or by an occupant sensor ventilation control device complying with Section 120.1(c)5.

   Exception 2 to Section 120.1(c)1: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(b)2 for up to 30 minutes at a time if the average

rate for each hour is equal to or greater than the required ventilation rate.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 120.1(b)2 or three complete air changes shall be supplied to the entire building during the one-hour period immediately before the building is normally occupied.
3. **Required demand control ventilation.** HVAC systems with the following characteristics shall have demand ventilation controls complying with Section 120.1(c)4:
   A. They have an air economizer; and
   B. They serve a space with a design occupant density, or a maximum occupant load factor for egress purposes in the *California Building Code*, greater than or equal to 25 people per 1,000 square feet (40 square feet or less per person); and
   C. They are either:
      i. Single zone systems with any controls; or
      ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level.

      Exception 1 to Section 120.1(c)3: Classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1,000 square feet per Section 120.1(b)2B, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.

      Exception 2 to Section 120.1(c)3: Where space exhaust is greater than the design ventilation rate specified in Section 120.1(b)2B minus 0.2 cfm per square foot of conditioned area.

      Exception 3 to Section 120.1(c)3: Spaces that have processes or operations that generate dusts, fumes, mists, vapors or gases and are not provided with local exhaust ventilation, such as indoor operation of internal combustion engines or areas designated for unvented food service preparation, or beauty salons shall not install demand control ventilation.

      Exception 4 to Section 120.1(c)3: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people per Section 120.1(b)2B.

      Exception 5 to Section 120.1(c)3: Spaces with an area of less than 1,500 square feet complying with Section 120.1(c)5.
4. **Demand control ventilation devices.**
   A. For each system with demand control ventilation, CO_2 sensors shall be installed in each room that meets the criteria of Section 120.1(c)3 with no less than one sensor per 10,000 square feet of floor space. When a zone or a space is served by more than one sensor, a signal from any sensor indicating that CO_2 is near or at the setpoint within a space shall trigger an increase in ventilation to the space;
   B. CO_2 sensors shall be located in the room between 3 ft and 6 ft above the floor or at the anticipated height of the occupants heads;
   C. Demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 ppm plus the outdoor air CO_2 concentration in all rooms with CO_2 sensors;

      Exception to Section 120.1(c)4C: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 120.1(b)2 regardless of CO_2 concentration.

   D. Outdoor air CO_2 concentration shall be determined by one of the following:
      i. CO_2 concentration shall be assumed to be 400 ppm without any direct measurement; or
      ii. CO_2 concentration shall be dynamically measured using a CO_2 sensor located within 4 ft of the outdoor air intake.
   E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in Table 120.1-A times the conditioned floor area for spaces with CO_2 sensors, plus the rate required by Section 120.1(b)2 for other spaces served by the system, or the exhaust air rate, whichever is greater.
   F. CO_2 sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section 120.1(b)(2) to the zone serviced by the sensor at all times that the zone is occupied.
   G. The CO_2 sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.
5. Occupant sensor ventilation control devices. When occupancy sensor ventilation devices are required by Section 120.2(e)3 or when meeting Exception 5 to Section 120.1(c)3, occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present in accordance with the following:
   A. Occupant sensors shall meet the requirements in Section 110.9(b)4 and shall have suitable coverage and placement to detect occupants in the entire space ventilated. Occupant sensors controlling lighting may be used for ventilation as long as the ventilation signal is independent of daylighting, manual lighting overrides or manual control of lighting. When a

single zone damper or a single zone system serves multiple rooms, there shall be an occupancy sensor in each room and the zone is not considered vacant until all rooms in the zone are vacant.

B. One hour prior to normal scheduled occupancy, the occupancy sensor ventilation control shall allow pre-occupancy purge as described in Section 120.1(c)2.

C. Within 30 minutes after being vacant for all rooms served by a zone damper on a multiple zone system, and the space temperature is between the heating and cooling setpoints, then no outside air is required and supply air shall be zero.

D. Within 30 minutes after being vacant for all rooms served by a single zone system, the single zone system shall cycle off the supply fan when the space temperature is between the heating and cooling setpoints.

E. In spaces equipped with an occupant sensor, when vacant during hours of expected occupancy and the occupied ventilation rate required by Section 120.1(b)2 is not provided, then the system or zone controls shall cycle or operate to maintain the average outdoor air rate over an averaging period of 120 minutes equal to 25 percent of the rate listed in Table 120.1-A.

Exception to Section 120.1(c)5. If demand control ventilation is implemented as required by Section 120.1(4).

(d) **Ducting for zonal heating and cooling units.** Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit, which then supplies the air to a space in order to meet the requirements of Section 120.1(b)2, the outdoor air shall be ducted to discharge either:

1. Within 5 feet of the unit; or
2. Within 15 feet of the unit, substantially toward the unit, and at a velocity not less than 500 feet per minute.

(e) **Design and control requirements for quantities of outdoor air.**

1. All mechanical ventilation and space-conditioning systems shall be designed with and have installed ductwork, dampers and controls to allow outside air rates to be operated at the larger of (1) the minimum levels specified in Section 120.1(b)1; or 2 the rate required for make-up of exhaust systems that are required for an exempt or covered process, for control of odors, or for the removal of contaminants within the space.
2. All variable air volume mechanical ventilation and space-conditioning systems shall include dynamic controls that maintain measured outside air ventilation rates within 10 percent of the required outside air ventilation rate at both full and reduced supply airflow conditions. Fixed minimum damper position is not considered to be dynamic and is not an allowed control strategy.
3. Measured outdoor air rates of constant volume mechanical ventilation and space-conditioning systems shall be within 10 percent of the required outside air rate.

TABLE 120.1-A
MINIMUM VENTILATION RATES

TYPE OF USE	CFM PER SQUARE FOOT OF CONDITIONED FLOOR AREA
Auto repair workshops	1.50
Barber shops	0.40
Bars, cocktail lounges and casinos	0.2
Beauty shops	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Ventilation rates specified by the *California Building Code*
Hotel guest rooms (less than 500 ft^2)	30 cfm/guest room
Hotel guest rooms (500 ft^2 or greater)	0.15
Retail stores	0.20
All others	0.15

SECTION 120.2
REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS

Space-conditioning systems shall be installed with controls that comply with the applicable requirements of Subsections (a) through (i).

(a) **Thermostatic controls for each zone.** The supply of heating and cooling energy to each space-conditioning zone or dwelling unit shall be controlled by an individual thermostatic control that responds to temperature within the zone and that meets the applicable requirements of Section 120.2(b).

Exception to Section 120.2(a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if:

1. All zones are also served by an interior cooling system;
2. The perimeter system is designed solely to offset envelope heat losses or gains;
3. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and
4. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

(b) **Criteria for zonal thermostatic controls.** The individual thermostatic controls required by Section 120.2(a) shall meet the following requirements as applicable:

1. Where used to control comfort heating, the thermostatic controls shall be capable of being set, locally or remotely, down to 55°F or lower.

2. Where used to control comfort cooling, the thermostatic controls shall be capable of being set, locally or remotely, up to 85°F or higher.
3. Where used to control both comfort heating and comfort cooling, the thermostatic controls shall meet items 1 and 2 and shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

   Exception to Section 120.2(b)3: Systems with thermostats that require manual changeover between heating and cooling modes.

4. Thermostatic controls for all unitary single zone, air conditioners, heat pumps and furnaces, shall comply with the requirements of Section 110.2(c) and Reference Joint Appendix JA5 or, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section 120.2(h).

   Exception 1 to Section 120.2(b)4: Systems serving exempt process loads that must have constant temperatures to prevent degradation of materials, a process, plants or animals.

   Exception 2 to Section 120.2(b)4: Gravity gas wall heaters, gravity floor heaters, gravity room heaters, noncentral electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners and room airconditioner heat pumps.

(c) **Hotel/motel guest room and high-rise residential dwelling unit thermostats.**

1. Hotel/motel guest room thermostats shall:
   A. Have numeric temperature setpoints in °F and °C; and
   B. Have setpoint stops, which are accessible only to authorized personnel, such that guest room occupants cannot adjust the setpoint more than ±5°F (±3°C); and
   C. Meet the requirements of Section 150.0(i).

      Exception to Section 120.2(c)1: Thermostats that are integrated into the room heating and cooling equipment.

2. High-rise residential dwelling unit thermostats shall meet the requirements of Section 150.0(i).

(d) **Heat pump controls.** All heat pumps with supplementary electric resistance heaters shall be installed with controls that comply with Section 110.2(b).

(e) **Shut-off and reset controls for space-conditioning systems.** Each space-conditioning system shall be installed with controls that comply with the following:

1. The control shall be capable of automatically shutting off the system during periods of nonuse and shall have:
   A. An automatic time switch control device complying with Section 110.9(c), with an accessible manual override that allows operation of the system for up to 4 hours; or
   B. An occupancy sensor; or
   C. A 4-hour timer that can be manually operated.

      Exception to Section 120.2(e)1: Mechanical systems serving retail stores and associated malls, restaurants, grocery stores, churches and theaters equipped with 7-day programmable timers.

2. The control shall automatically restart and temporarily operate the system as required to maintain:
   A. A setback heating thermostat setpoint if the system provides mechanical heating; and

      Exception to Section 120.2(e)2A: Thermostat setback controls are not required in nonresidential buildings in areas where the Winter Median of Extremes outdoor air temperature determined in accordance with Section 140.4(b)4 is greater than 32°F.

   B. A setup cooling thermostat setpoint if the system provides mechanical cooling.

      Exception to Section 120.2(e)2B: Thermostat setup controls are not required in nonresidential buildings in areas where the Summer Design Dry Bulb 0.5 percent temperature determined in accordance with Section 140.4(b)4 is less than 100°F.

3. Multipurpose room less than 1,000 ft^2, classrooms greater than 750 ft^2 and conference, convention, auditorium and meeting center rooms greater than 750 ft^2 that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following during unoccupied periods:
   A. Automatically set up the operating cooling temperature set point by 2°F or more and set back the operating heating temperature set point by 2°F or more; and
   B. Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.

      Exception 1 to Sections 120.2(e)1, 2, 3: Where it can be demonstrated to the satisfaction of the enforcing agency that the system serves an area that must operate continuously.

      Exception 2 to Sections 120.2(e)1, 2, 3: Where it can be demonstrated to the satisfaction of the enforcing agency that shutdown, setback and setup will not result in a decrease in overall building source energy use.

      Exception 3 to Sections 120.2(e)1, 2, 3: Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

      Exception 4 to Sections 120.2(e) 1 and 2: Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

      Exception 5 to Section 120.2(e)3: If demand control ventilation is implemented as required by Sections 120.1(c)3 and 120.0(c)4.

4. Hotel and motel guest rooms shall have captive card key controls, occupancy sensing controls or automatic con-

trols such that, no longer than 30 minutes after the guest room has been vacated, setpoints are set up at least +5°F (+3°C) in cooling mode and set down at least -5°F (-3°C) in heating mode.

(f) **Dampers for air supply and exhaust equipment.** Outdoor air supply and exhaust equipment shall be installed with dampers that automatically close upon fan shutdown.

Exception 1 to Section 120.2(f): Where it can be demonstrated to the satisfaction of the enforcing agency that the equipment serves an area that must operate continuously.

Exception 2 to Section 120.2(f): Gravity and other nonelectrical equipment that has readily accessible manual damper controls.

Exception 3 to Section 120.2(f): At combustion air intakes and shaft vents.

Exception 4 to Section 120.2(f): Where prohibited by other provisions of law.

(g) **Isolation area devices.** Each space-conditioning system serving multiple zones with a combined conditioned floor area of more than 25,000 square feet shall be designed, installed and controlled to serve isolation areas.

1. Each zone, or any combination of zones not exceeding 25,000 square feet, shall be a separate isolation area.
2. Each isolation area shall be provided with isolation devices, such as valves or dampers, that allow the supply of heating or cooling to be reduced or shut off independently of other isolation areas.
3. Each isolation area shall be controlled by a device meeting the requirements of Section 120.2(e)1.

   Exception to Section 120.2(g):A zone need not be isolated if it can be demonstrated to the satisfaction of the enforcement agency that the zone must be heated or cooled continuously.

(h) **Automatic demand shed controls.** HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for noncritical zones as follows:

1. The controls shall have a capability to remotely set up the operating cooling temperature set points by four degrees or more in all noncritical zones on signal from a centralized contact or software point within an Energy Management Control System (EMCS).
2. The controls shall have a capability to remotely set down the operating heating temperature set points by four degrees or more in all noncritical zones on signal from a centralized contact or software point within an EMCS.
3. The controls shall have capabilities to remotely reset the temperatures in all noncritical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
4. The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.
5. The controls shall have the following features:

   A. Disabled. Disabled by authorized facility operators; and

   B. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and

   C. Automatic demand shed control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in Subsections 120.2(h)1 and 120.2(h)2, for noncritical zones during the demand response period.

(i) **Economizer fault detection and diagnostics (FDD).** All newly installed air-cooled unitary direct-expansion units, equipped with an economizer and mechanical cooling capacity at AHRI conditions of greater than or equal to 54,000 Btu/hr, shall include a fault detection and diagnostics (FDD) system in accordance with Subsections 120.2(i)2. through 120.2(i)9. Air-cooled unitary direct expansion units include packaged, split-systems, heat pumps and variable refrigerant flow (VRF), where the VRF capacity is defined by that of the condensing unit.

1. The following temperature sensors shall be permanently installed to monitor system operation: outside air, supply air, and when required for differential economizer operation a return air sensor, and
2. Temperature sensors shall have an accuracy of ±2°F over the range of 40°F to 80°F; and
3. Refrigerant pressure sensors, if used, shall have an accuracy of ±3 percent of full scale; and
4. The controller shall have the capability of displaying the value of each sensor; and
5. The controller shall provide system status by indicating the following conditions:

   A. Free cooling available

   B. Economizer enabled

   C. Compressor enabled

   D. Heating enabled

   E. Mixed-air low limit cycle active

6. The unit controller shall manually initiate each operating mode so that the operation of compressors, economizers, fans and heating system can be independently tested and verified; and
7. Faults shall be reported to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats; and
8. The FDD system shall detect the following faults:

   A. Air temperature sensor failure/fault

   B. Not economizing when it should

   C. Economizing when it should not

   D. Damper not modulating

   E. Excess outdoor air

9. The FDD System shall be certified by the Energy Commission as meeting requirements of Subsections 120.2(i)1 through 120.2(i)8 in accordance with Section 100(h).

SECTION 120.3
REQUIREMENTS FOR PIPE INSULATION

The piping for all space-conditioning and service water-heating systems with fluid temperatures listed in Table 120.3-A shall have the amount of insulation specified in Subsection (a) or (b). Insulation conductivity shall be determined in accordance with ASTM C 335 at the mean temperature listed in Table 120.3-A, and shall be rounded to the nearest $^1/_{100}$ Btu-inch per hour per square foot per °F.

Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, including but not limited to, the following:

Insulation exposed to weather shall be suitable for outdoor service by either being rated by the manufacturer for outdoor use or by being covered, e.g., protected by aluminum, sheet metal, painted canvas or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), all penetrations and joints of which shall be sealed.

Exception 1 to Section 120.3: Factory-installed piping within space-conditioning equipment certified under Section 111 or 112.

Exception 2 to Section 120.3: Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

Exception 3 to Section 120.3: Gas piping, cold domestic water piping, condensate drains, roof drains, vents or waste piping.

Exception 4 to Section 120.3: Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

Exception 5 to Section 120.3: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing.

(a) For insulation with a conductivity in the range shown in Table 120.3-A for the applicable fluid temperature range, the insulation shall have the applicable thickness shown in Table 120.3-A.

(b) For insulation with a conductivity outside the range shown in Table 120.3-A for the applicable fluid temperature range, the insulation shall have a minimum thickness as calculated:

INSULATION THICKNESS EQUATION

$$T = PR\left[\left(1+\frac{t}{PR}\right)^{\frac{K}{k}} - 1\right]$$

where:

T = minimum insulation thickness for material with conductivity K, inches.

PR = pipe actual outside radius, inches.

t = insulation thickness from Table 120.3-A, inches.

K = conductivity of alternate material at the mean rating temperature indicated in Table 120.3-A for the applicable fluid temperature range, in Btu-inch per hour per square foot per °F.

k = The lower value of the conductivity range listed in Table 120.3-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

TABLE 120.3-A
PIPE INSULATION THICKNESS

FLUID TEMPERATURE RANGE, (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)				
			< 1	1 to < 1.5	1.5 to < 4	4 to < 8	8 and larger
			INSULATION THICKNESS REQUIRED (in inches)				
Space heating, hot water systems (steam, steam condensate and hot water) and service water heating systems							
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0
251-350	0.29-0.31	200	3.0	4.0	4.5	4.5	4.5
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)							
40-60	0.21-0.27	75	0.5	0.5	1.0	1.0	1.0

3. Newly installed process boilers with an input capacity of 5 MMBtu/h (5,000,000 Btu/h) to 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent. Combustion air volume shall be controlled with respect to firing rate or measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.
4. Newly installed process boilers with an input capacity greater than 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 3.0 percent by volume on a dry basis over firing rates of 20 to 100 percent. Combustion air volume shall be controlled with respect to measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

(e) **Mandatory requirements for compressed air systems.**

All new compressed air systems, and all additions or alterations of compressed air systems where the total combined online horsepower (hp) of the compressor(s) is 25 horsepower or more shall meet the requirements of Subsections 1 through 3. These requirements apply to the compressors and related controls that provide compressed air and do not apply to any equipment or controls that use or process the compressed air.

Exception to Section 120.6(e): Alterations of existing compressed air systems that include one or more centrifugal compressors.

1. **Trim compressor and storage.** The compressed air system shall be equipped with an appropriately sized trim compressor and primary storage to provide acceptable performance across the range of the system and to avoid control gaps. The compressed air system shall comply with Subsection A or B below.
   A. The compressed air system shall include one or more variable speed drive (VSD) compressors. For systems with more than one compressor, the total combined capacity of the VSD compressor(s) acting as trim compressors must be at least 1.25 times the largest net capacity increment between combinations of compressors. The compressed air system shall include primary storage of at least one gallon per actual cubic feet per minute (acfm) of the largest trim compressor; or
   B. The compressed air system shall include a compressor or set of compressors with total effective trim capacity at least the size of the largest net capacity increment between combinations of compressors, or the size of the smallest compressor, whichever is larger. The total effective trim capacity of single compressor systems shall cover at least the range from 70 to 100 percent of rated capacity. The effective trim capacity of a compressor is the size of the continuous operational range where the specific power of the compressor (kW/100 acfm) is within 15 percent of the specific power at its most efficient operating point. The total effective trim capacity of the system is the sum of the effective trim capacity of the trim compressors. The system shall include primary storage of at least 2 gallons per acfm of the largest trim compressor.

Exception 1 to Section 120.6(e)1: Compressed air systems in existing facilities that are adding or replacing less than 50 percent of the online capacity of the system.

Exception 2 to Section 120.6(e)1: Compressed air systems that have been approved by the Energy Commission Executive Director as having demonstrated that the system serves loads for which typical air demand fluctuates less than 10 percent.

2. **Controls.** Compressed air systems with more than one compressor online, having a combined horsepower rating of more than 100 hp, must operate with a controller that is able to choose the most energy efficient combination of compressors within the system based on the current air demand as measured by a sensor.
3. **Compressed air system acceptance.** Before an occupancy permit is granted for a compressed air system subject to Section 120.6(e), the following equipment and systems shall be certified as meeting the acceptance requirements for code compliance, as specified by the Reference Nonresidential Appendix NA7. A certificate of acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA 7.13.

SECTION 120.7
MANDATORY INSULATION REQUIREMENTS

Any newly constructed nonresidential and high-rise residential and hotel/motel buildings shall meet the minimum requirements in this section.

(a) **Roof/Ceiling insulation.** The opaque portions of the roof/ceiling that separates conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 and 2 below:

1. **Metal building.** The weighted average *U*-factor of the roof assembly shall not exceed 0.098.
2. **Wood framed and others.** The weighted average *U*-factor of the roof assembly shall not exceed 0.075.

(b) **Wall insulation.** The opaque portions of walls that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 6 below:

1. **Metal building.** The weighted average *U*-factor of the wall assembly shall not exceed 0.113.
2. **Metal framed.** The weighted average *U*-factor of the wall assembly shall not exceed 0.105.
3. **Light mass walls.** A 6-inch or greater hollow core concrete masonry unit shall have a *U*-factor not to exceed 0.440.
4. **Heavy mass walls.** An 8-inch or greater hollow core concrete masonry unit shall have a *U*-factor not to exceed 0.690.

5. **Wood framed and others.** The weighted average *U*-factor of the wall assembly shall not exceed 0.110.
6. **Spandrel panels and glass curtain wall.** The weighted average *U*-factor of the glass spandrel panels and glass curtain wall assembly shall not exceed 0.280.

(c) **Floor and soffit insulation.** The opaque portions of floors and soffits that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 and 2 below:

1. **Raised mass floors.** Shall have a minimum of 3 inches of lightweight concrete over a metal deck, or the weighted average *U*-factor of the floor assembly shall not exceed 0.269.
2. **Other floors.** The weighted average *U*-factor of the floor assembly shall not exceed 0.071.
3. **Heated slab floor.** A heated slab floor shall be insulated to meet the requirements of Section 110.8(g).

SECTION 120.8
BUILDING COMMISSIONING

For all new nonresidential buildings, the subsections of 120.8 (a) through (i) for building commissioning shall be included in the design and construction processes of the building project to verify that the building energy systems and components meet the owner's or owner representative's project requirements.. All building systems and components covered by Sections 110.0, 120.0, 130.0 and 140.0 shall be included in the scope of the commissioning requirements in this section, excluding covered processes. For buildings less than 10,000 ft^2, only the design review requirements in Sections 120.8(d) and 120.8(e) shall be completed.

(a) **Summary of commissioning requirements.** The following items shall be completed:

1. Owner's or owner representative's project requirements;
2. Basis of design;
3. Design phase design review;
4. Commissioning measures shown in the construction documents;
5. Commissioning plan;
6. Functional performance testing;
7. Documentation and training; and
8. Commissioning report.

(b) **Owner's or owner representative's project requirements (OPR).** The energy-related expectations and requirements of the building shall be documented before the design phase of the project begins. This documentation shall include the following:

1. Energy efficiency goals;
2. Ventilation requirements;
3. Project program, including facility functions and hours of operation, and need for after hours operation; and
4. Equipment and systems expectations.

Exception to Section 120.8(b): Buildings less than 10,000 ft^2.

(c) **Basis of design (BOD).** A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project, and updated as necessary during the design and construction phases. The basis of design document shall cover the following systems:

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls; and
3. Water heating systems and controls; and
4. Covered processes.

Exception to Section 120.8(c): Buildings less than 10,000 square feet.

(d) **Design phase design review.**

1. **Design reviewer requirements.** For buildings less than 10,000 square feet, design phase design review may be completed by the design engineer. Buildings between 10,000 and 50,000 square feet require completion of the design review checklist by either an engineer in-house to the design firm but not associated with the building project, or a third party design engineer. For buildings larger than 50,000 square feet or for buildings with complex mechanical systems, an independent, review of these documents by a third party design engineer is required.
2. **Design review.** During the schematic design phase of the building project, the owner or owner's representative, design team and design reviewer must meet to discuss the project scope, schedule and how the design reviewer will coordinate with the project team. The building owner or owner's representative shall include the design review checklist compliance form in the certificate of compliance documentation (see Section 10-103).
3. **Construction documents design review.** The construction documents design review compliance form lists the items that shall be checked by the design reviewer during the construction document review. The completed form shall be returned to the owner and design team for review and sign-off. The building owner or owner's representative shall include this construction documents design review compliance form in the certificate of compliance documentation (see Section 10-103).

(e) **Commissioning measures shown in the construction documents.** Include commissioning measures or requirements in the construction documents (plans and specifications). Commissioning measures or requirements should be clear, detailed and complete to clarify the commissioning process. These requirements should include the list of systems and assemblies commissioned, testing scope, roles and responsibilities of contractors, requirements for meetings, management of issues, the commissioning schedule, operations and maintenance manual development and of training, and checklist and test form development, execution and documentation. Include, for information only, roles of noncontractor parties.

(f) **Commissioning plan.** Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the

design phase of the building project. The commissioning plan shall include the following:

1. General project information; and
2. Commissioning goals; and
3. Systems to be commissioned; and
4. Plans to test systems and components, which shall include:
   A. An explanation of the original design intent; and
   B. Equipment and systems to be tested, including the extent of tests; and
   C. Functions to be tested; and
   D. Conditions under which the test shall be performed; and
   E. Measurable criteria for acceptable performance; and
   F. Commissioning team information; and
   G. Commissioning process activities, schedules and responsibilities. Plans for the completion of commissioning requirements listed in Sections 120.8(g) through 120.8(i) shall be included.

Exception to Section 120.8(f): Buildings less than 10,000 square feet.

(g) **Functional performance testing.** Functional performance tests shall demonstrate the correct installation and operation of each component, system and system-to-system interface in accordance with the acceptance test requirements in Sections 120.5, 120.6, 130.4 and 140.9. Functional performance testing reports shall contain information addressing each of the building components tested, the testing methods utilized, and include any readings and adjustments made.

Exception to Section 120.8(g): Buildings less than 10,000 square feet.

(h) **Documentation and training.** A systems manual and systems operations training shall be completed.

1. **Systems manual.** Documentation of the operational aspects of the building shall be completed within the systems manual and delivered to the building owner or representative and facilities operator. The systems manual shall include the following:
   A. Site information, including facility description, history and current requirements; and
   B. Site contact information; and
   C. Instructions for basic operations and maintenance, including general site operating procedures, basic troubleshooting, recommended maintenance requirements, and a site events log; and
   D. Description of major systems; and
   E. Site equipment inventory and maintenance notes; and
   F. A copy of all special inspection verifications required by the enforcing agency or the standards.
2. **Systems operations training.** The training of the appropriate maintenance staff for each equipment type or system shall be documented in the commissioning report. Training materials shall include the following:
   A. System and equipment overview (i.e., what the equipment is, what it does and with what other systems or equipment it interfaces)
   B. Review and demonstration of operation, servicing and preventive maintenance procedures
   C. Review of the information in the systems manual
   D. Review of the record drawings on the systems and equipment

Exception to Section 120.8(h): Buildings less than 10,000 square feet.

(i) **Commissioning report.** A complete report of commissioning process activities undertaken through the design, construction and reporting recommendations for post-construction phases of the building project shall be completed and provided to the owner or representative.

Exception to Section 120.8(i): Buildings less than 10,000 square feet.

SECTION 120.9
MANDATORY REQUIREMENTS FOR COMMERCIAL BOILERS

(a) Combustion air positive shut-off shall be provided on all newly installed boilers as follows:

1. All boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
2. All boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).

(b) Boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:

1. The fan motor shall be driven by a variable speed drive, or.
2. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.

(c) Newly installed boilers with an input capacity 5 MMBtu/h (5,000,000 Btu/h) and greater shall maintain excess (stackgas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 to 100 percent. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

Exception to Section 120.9(c): Boilers with steady state full-load thermal efficiency 85 percent or higher.

SUBCHAPTER 5

NONRESIDENTIAL, HIGH-RISE RESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR ACHIEVING ENERGY EFFICIENCY

SECTION 140.0 PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

Nonresidential, high-rise residential and hotel/motel buildings shall meet all of the following:

(a)The requirements of Sections 100.0 through 110.10 applicable to the building project (mandatory measures).

(b)The requirements of Sections 120.0 through 130.5 (mandatory measures).

(c)Either the performance compliance approach (energy budgets) in Section 140.1 or the prescriptive compliance approach in Section 140.2 for the climate zone in which the building will be located. Climate zones are shown in Figure 100.1-A.

NOTE: The Commission periodically updates, publishes and makes available to interested persons and local enforcement agencies precise descriptions of the climate zones, which is available by zip code boundaries depicted in the Reference Joint Appendices along with a list of the communities in each zone.

SECTION 140.1 PERFORMANCE APPROACH: ENERGY BUDGETS

A building complies with the performance approach if the energy budget calculated for the proposed design building under Subsection (b) is no greater than the energy budget calculated for the standard design building under Subsection (a).

(a) **Energy budget for the standard design building.** The energy budget for a proposed building is determined by applying the mandatory and prescriptive requirements to the proposed design building. The energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation, service water heating and covered process loads.

(b) **Energy budget for the proposed design building.** The energy budget for a proposed design building is determined by calculating the TDV energy for the proposed design building. The energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation and service water heating and covered process loads.

(c) **Calculation of energy budget.** The TDV energy for both the standard design building and the proposed design building shall be computed by compliance software certified for this use by the Commission. The processes for compliance software approval by the Commission are documented in the Nonresidential ACM Approval Manual.

SECTION 140.2 PRESCRIPTIVE APPROACH

In order to comply with the prescriptive approach under this section, a building shall be designed with and shall have constructed and installed:

(a) A building envelope that complies with Section 140.3(a) or (b) and for applicable buildings Section 140.3(c);

(b) A space-conditioning system that complies with Section 140.4;

(c) A service water-heating system that complies with Section 140.5;

(d) A lighting system that complies with Section 140.6;

(e) An outdoor lighting system that complies with Section 140.7;

(f) Interior and exterior signs that comply with Section 140.8; and

(g) Covered processes that comply with Section 140.9.

SECTION 140.3 PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

A building complies with this section by being designed with and having constructed and installed either (1) envelope components that comply with each of the requirements in Subsection (a) for each individual component, and the requirements of Subsection (c) where they apply; or (2) an envelope that complies with the overall requirements in Subsection (b) and the requirements of Subsection (c) where they apply.

(a) **Envelope component approach.**

1. **Exterior roofs and ceilings.** Exterior roofs and ceilings shall comply with each of the applicable requirements in this subsection:
   A. **Roofing products.** Shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i through ii:
      i. Nonresidential buildings:
         a. Low-sloped roofs in climate zones 1 through 16 shall have:
            1. A minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75; or
            2. A minimum solar reflectance index (SRI) of 75.

         Exception 1 to Section 140.3(a)1Aia: Wood-framed roofs in climate zones 3 and 5 are exempt from the requirements of Section

140.3(a)1Aia if the roof assembly has a *U*-factor of 0.039 or lower.

Exception 2 to Section 140.3(a)1Aia: Metal building roofs in climate zones 3 and 5 are exempt from the requirements of Section 140.3(a)1Aia if the roof assembly has a *U*-factor of 0.048 or lower.

Exception 3 to Section 140.3(a)1Aia: Roof constructions that have thermal mass with a weight of at least 25 lb/ft² over the roof membrane are exempt from the requirements of Section 140.3(a)1Aia.

Exception 4 to Section 140.3(a)1Aia: An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling *U*-factor in Table 140.3 is not exceeded.

b. Steep-sloped roofs in climate zones 1 through 16 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

ii. High-rise residential buildings and hotels and motels:

a. Low-sloped roofs in Climate Zones 9, 10, 11, 13, 14 and 15 shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.

Exception to Section 140.3(a)1Aiia: Roof constructions that have thermal mass with a weight of at least 25 lb/ft² over the roof membrane.

b. Steep-sloped roofs in climate zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

Exception to Section 140.3(a)1A: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

B. **Roof insulation.**

Roofs shall have an overall assembly *U*-factor no greater than the applicable value in Table 140.3-B, C or D, and where required by Section 110.8(e), insulation shall be placed in direct contact with a continuous roof or drywall ceiling.

2. **Exterior walls.** Exterior walls shall have an overall assembly *U*-factor no greater than the applicable value in Table 140.3-B, C or D.
3. **Demising walls.** Demising walls shall meet the requirements of Section 110.8(f).
4. **Exterior floors and soffits.** Exterior floors and soffits shall have an overall assembly *U*-factor no greater than the applicable value in Table 140.3-B, C or D.
5. **Fenestration.** Vertical windows shall:

A. Have (1) a west-facing area no greater than 40 percent of the gross west-facing exterior wall area, or 6 feet times the west-facing display perimeter, whichever is greater; and (2) a total area no greater than 40 percent of the gross exterior wall area, or 6 feet times the display perimeter, whichever is greater; and

Exception to Section 140.3(a)5A: Window area in demising walls is not counted as part of the window area for this requirement. Demising wall area is not counted as part of the gross exterior wall area or display perimeter for this requirement.

B. Have an area-weighted average *U*-factor no greater than the applicable value in Table 140.3-B, C or D.

Exception to Section 140.3(a)5B: For vertical fenestration containing chromogenic type glazing:

i. The lower-rated labeled *U*-factor shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and

ii. Chromogenic glazing shall be considered separately from other fenestration; and

TABLE 140.3
ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE

NONRESIDENTIAL					
Aged Solar Reflectance	Metal Building Climate Zone 1-16 *U*-factor	Wood framed and Other Climate Zone 1 & 5 *U*-factor	Wood Framed and Other Climate Zone 2-4, 9-16 *U*-factor	Wood Framed and Other, Climate Zone 6 *U*-factor	Wood Framed and Other Climate Zone 7 & 8 *U*-factor
0.62-0.60	0.061	0.045	0.036	0.065	0.059
0.59-0.55	0.054	0.041	0.034	0.058	0.053
0.54-0.50	0.049	0.038	0.032	0.052	0.048
0.49-0.45	0.047	0.035	0.030	0.047	0.044
0.44-0.40	0.043	0.033	0.028	0.043	0.040
0.39-0.35	0.039	0.031	0.027	0.039	0.037
0.34-0.30	0.035	0.029	0.025	0.037	0.035
0.29-0.25	0.033	0.027	0.024	0.034	0.032

iii. Area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.

C. Have an area-weighted average relative solar heat gain coefficient, RSHGC, excluding the effects of interior shading, no greater than the applicable value in Table 140.3-B, C or D.

For purposes of this paragraph, the relative solar heat gain coefficient, RSHGC, of a vertical windows is:

i. the solar heat gain coefficient of the windows; or

ii. relative solar heat gain as calculated by Equation 140.3-A, if the window has an overhang that extends beyond each side of the window jamb by a distance equal to the overhang's horizontal projection.

Exception 1 to Section 143(a)5C: An area-weighted average relative solar heat gain of 0.56 or less shall be used for windows:

a. that are in the first story of exterior walls that form a display perimeter; and

b. for which codes restrict the use of overhangs to shade the windows.

Exception 2 to Section 140.3(a)5C: For vertical fenestration containing chromogenic type glazing:

i. the lower-rate labeled RSHGC shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity to demonstrate compliance with this section; and

ii. chromogenic glazing shall be considered separately from other fenestration; and

iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.

D. Have an area-weighted average visible transmittance (VT), no less than the applicable value in Table 140.33-B, and C, or Equation 140.3-B, as applicable.

Exception 1 to Section 140.3(a)5D: When the fenestration's primary and secondary sidelit daylit zones are completely overlapped by one or more skylit daylit zones, then the fenestration need not comply with Section 140.3(a)5D.

Exception 2 to Section 140.3(a)5D: If the fenestration's visible transmittance is not within the scope of NFRC 200, ASTM E 972 or Equation 140.3-B, then the VT shall be calculated according to Reference Nonresidential Appendix NA6.

Exception 3 to Section 140.3(a)5D: For vertical fenestration containing chromogenic type glazing:

i. the higher-rate labeled VT shall be used with automatic controls to modulate the amount of light transmitted into the space in multiple steps in response to daylight levels or solar intensity; and

ii. chromogenic glazing shall be considered separately from other fenestration; and

iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.

EQUATION 140.3-A
RELATIVE SOLAR HEAT GAIN,COEFFICIENT, RSHGC

$$RSHG = SHGC_{win} \times \left[1 + \frac{aH}{V} + b\left(\frac{H}{V}\right)^2\right]$$

where:

$RSHG$ = relative solar heat gain.
$SHGC_{win}$ = solar heat gain coefficient of the window.
H = horizontal projection of the overhang from the surface of the window in feet, but no greater than V.
V = vertical distance from the window sill to the bottom of the overhang, in feet.
a = -0.41 for north-facing windows, -1.22 for south-facing windows and -0.92 for east- and west-facing windows.
b = 0.20 for north-facing windows, 0.66 for south-facing windows and 0.35 for east- and west-facing windows.

EQUATION 140.3-B
VERTICAL FENESTRATION MINIMUM *VT*

$$VT = 0.11 \geq WWR$$

where:

WWR = Window wall ratio, the ratio of (i) the total window area of the entire building to (ii) the total gross exterior wall area of the entire building. If the WWR is greater than 0.40, then 0.40 shall be used as the value for WWR in Equation 140.3-B.
VT = Visible transmittance of framed window.

6. **Skylights.** Skylights shall:

A. Have an area no greater than 5 percent of the gross exterior roof area (SRR); and

Exception to Section 140.3(a)6A: Atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

B. Have an area-weighted performance rating *U*-factor no greater than the applicable value in Table 140.3-B, C or D.

Exception to Section 140.3(a)6B: For skylights containing chromogenic type glazing:

i. the lower-rate labeled *U*-factor shall be used with automatic controls to modulate the

amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and

ii. chromogenic glazing shall be considered separately from other skylights; and

iii. area-weighted averaging with other skylights that is not chromogenic shall not be permitted.

C. Have an area-weighted performance rating solar heat gain coefficient no greater than the applicable value in Table 140.3-B, C or D.

Exception to Section 140.3(a)6C: For skylights containing chromogenic type glazing:

i. the lower-rated labeled SHGC shall be used to demonstrate compliance with this section; and

ii. chromogenic glazing shall be considered separately from other skylights; and

iii. area-weighted averaging with other skylights that is not chromogenic shall not be permitted.

D. Have an area-weighted performance rating VT no less than the applicable value in Table 140.3-B or C; and

Exception to Section 140.3(a)6D: For skylights containing chromogenic type glazing:

i. the higher-rate labeled VT shall be used to demonstrate compliance with this section; and

ii. chromogenic glazing shall be considered separately from other skylights; and

iii. area-weighted averaging with other skylights that are not chromogenic shall not be permitted.

E. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D 1003 or other test method approved by the Energy Commission.

7. **Exterior doors.** All exterior doors that separate conditioned space from unconditioned space or from ambient air shall have a *U*-factor not greater than the applicable value in Table 140.3-B, C or D. Doors that are more than one-half glass in area are considered glazed doors.

8. **Relocatable public school buildings.** In complying with Sections 140.3(a)1 to 7 shall meet the following:

A. Relocatable public school buildings shall comply with Table 140.3-B for a specific climate zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use only in a specific climate zone; or

B. Relocatable public school buildings shall comply with Table 140.3-D for any climate zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use in any climate zone; and

C. The manufacturer or builder of a relocatable public school building shall certify that components of the building comply with requirements of this section by:

i. The placement of two (2) metal identification labels on the building, one mechanically fastened and visible from the exterior and the other mechanically fastened to the interior frame above the ceiling at the end of the module, both labels stating (in addition to any other information by the Division of the State Architect or other law) "Complies with Title 24, Part 6 for all climate zones;" and

ii. Identification of the location of the two labels on the plans submitted to the enforcing agency.

9. **Air barrier.** To meet the requirement of Table 140.3-B, all buildings shall have a continuous air barrier that is designed and constructed to control air leakage into, and out of, the building's conditioned space. The air barrier shall be sealed at all joints for its entire length and shall be composed of:

A. Materials that have an air permeance not exceeding 0.004 cfm/ft^2, under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/m^2 at 75 pa), when tested in accordance with ASTM E 2178; or

Exception to Section 140.3(a)9A: Materials in Table 140.3-A shall be deemed to comply with Section 140.3(a)9A, provided all joints are sealed and all of the materials are installed as air barriers in accordance with the manufacturer's instructions.

B. Assemblies of materials and components that have an average air leakage not exceeding 0.04 cfm/ft^2, under a pressure differential of 0.3 in. w.g (1.57 psf) (0.2 L/m^2 at 75 pa), when tested in accordance with ASTM E 2357, ASTM E 1677, ASTM E 1680 or ASTM E 283; or

Exception to Section 140.3(a)9B: The following materials shall be deemed to comply with Section 140.3(a)9B if all joints are sealed and all of the materials are installed as air barriers in accordance with the manufacturer's instructions:

1. Concrete masonry walls that have at least two coatings of paint or at least two coatings of sealer coating.

2. Concrete masonry walls with integral rigid board insulation.

3. Structurally insulated panels.

4. Portland cement or Portland sand parge, or stucco, or a gypsum plaster, each with min. $^1/_2$ inches thickness.

TABLE 140.3-C
PRESCRIPTIVE ENVELOPE CRITERIA FOR HIGH-RES BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

				Climate Zone														
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
ENVELOPE	Maximum *U*-factor	Roofs/ Ceilings	Metal building	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
			Wood framed and other	0.034	0.028	0.039	0.028	0.039	0.039	0.039	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
		Walls	Metal building	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057
			Metal-Framed	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105
			Mass light[1]	.170	0.170	0.170	0.170	0.170	0.227	0.227	0.227	0.196	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass heavy[1]	0.160	0.160	0.160	0.184	0.211	0.690	0.690	0.690	0.690	0.690	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-Framed and other	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042
		Floors/ Soffits	Mass	0.045	0.045	0.058	0.058	0.058	0.069	0.092	0.092	0.092	0.669	0.058	0.058	0.058	0.045	0.058	0.037
			Other	0.034	0.034	0.039	0.039	0.039	0.039	0.071	0.039	0.039	0.039	0.039	0.039	0.039	0.034	0.039	0.034
	Roofing Products	Low-sloped	Aged solar reflectance	NR	NR	NR	NR	NR	NR	NR	NR	0.55	0.55	0.55	NR	0.55	0.55	0.55	NR
			Thermal emittance	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	NR	0.75	0.75	0.75	NR
		Steep-sloped	Aged solar reflectance	NR	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal emittance	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0. 75	0.75	0.75	0.75	0.75	0.75	NR
	Exterior Doors, Maximum *U*-factor		Nonswinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
			Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

1. Light mass walls are walls with a heat capacity of at least 7.0 Btu/ft^2-ºF and less than 15.0 Btu/ft^2-ºF. Heavy mass walls are walls with a heat capacity of at least 15.0 Btu/ft^2-ºF.

				ALL CLIMATE ZONES				
					Fixed Window	Operable Window	Curtainwall or Storefront	Glazed Doors
ENVELOPE	FENESTRATION	Vertical	Area-Weighted performance rating	Max *U*-factor	0.36	0.46	0.41	0.45
				Max RSHGC	0.25	0.22	0.26	0.23
			Area-Weighted performance rating	Min VT	0.42	0.32	0.46	0.17
			Maximum WWR%	40%				
					Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
		Skylights	Area-Weighted performance rating	Max *U*-factor	0.58	0.46	0.88	
				Max SHGC	0.25	0.25	NR	
			Area-Weighted performance rating	Min VT	0.49	0.49	0.64	
			Maximum SRR%	5%				

TABLE 140.3-D
PRESCRIPTIVE ENVELOPE CRITERIA FOR RELOCATABLE PUBLIC SCHOOL BUILDINGS FOR USE IN ALL CLIMATE ZONES

Roofs/Ceilings		
Roofs of metal buildings	Maximum *U*-factor 0.048	
Roofs of all nonmetal buildings	Maximum *U*-factor 0.039	
Roofing Products – Aged Reflectance/Emittance		
Low-sloped/low-sloped	0.63/0.75	
Steep-sloped/steep-sloped	0.20/0.75	
Walls		
Walls of wood frame buildings	Maximum *U*-factor 0.059	
Walls of metal frame buildings	Maximum *U*-factor 0.062	
Walls of metal buildings	Maximum *U*-factor 0.057	
Walls of mass/7.0 ≤ HC, any building	Maximum *U*-factor 0.170	
All other walls	Maximum *U*-factor 0.059	
Floors and soffits of all buildings	Maximum *U*-factor 0.048	
Windows of All Buildings		
U-factor	Maximum *U*-factor 0.47	
RSHGC	Maximum RSHGC 0.26	
Glazed Doors, All Buildings		
Max average weighted *U*-factor	0.45	
Max average weighted RSHGC	0.23	
Exterior Door, All Buildings		
Nonswinging doors	Maximum *U*-factor 0.50	
Swinging doors	Maximum *U*-factor 0.70	
Skylights		
Glass with curb	Maximum *U*-factor 0.99	
Glass without curb	Maximum *U*-factor 0.57	
Plastic with curb	Maximum *U*-factor 0.87	
Glass skylights	0-2% SRR	Maximum SHGC 0.46
	2.1-5% SRR	Maximum SHGC 0.36
Plastic skylights	0-2% SRR	Maximum SHGC 0.69
	2.1-5% SRR	Maximum SHGC 0.57

(c) **Minimum daylighting requirement for large enclosed spaces.** In climate zones 2 through 15, conditioned enclosed spaces, and unconditioned enclosed spaces that are greater than 5,000 ft^2 and that are directly under a roof with ceiling heights greater than 15 feet, shall meet the following requirements:

1. A combined total of at least 75 percent of the floor area, as determined in building floor plan (drawings) view, shall be within one or more of the following:
   A. Primary sidelit daylit zone in accordance with Section 130.1(d)1B, or
   B. Skylit daylit zone in accordance with Section 130.1(d)1A.
2. All skylit daylit zones and primary sidelit daylit zones shall be shown on building plans.
3. General lighting in daylit zones shall be controlled in accordance with Section 130.1(d).
4. Skylights shall:
   A. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, tested according to ASTM D 1003 (notwithstanding its scope) or other test method approved by the Commission; and
   B. If the space is conditioned, meet the requirements in Section 140.3(a)6.

Exception 1 to Section 140.3(c): Auditoriums, churches, movie theaters, museums and refrigerated warehouses.

Exception 2 to Section 140.3(c): In buildings with unfinished interiors, future enclosed spaces for which there are plans to have:

A. A floor area of less than or equal to 5,000 square feet of floor area, or

B. Ceiling heights of less than or equal to 15 feet.

This exception shall not be used for S-1 or S-2 (storage), or for F-1 or F-2 (factory) occupancies.

Exception 3 to Section 140.3(c): Enclosed spaces having a designed general lighting system with a lighting power density less than 0.5 watts per square foot.

SECTION 140.4
PRESCRIPTIVE REQUIREMENTS FOR SPACE-CONDITIONING SYSTEMS

A building complies with this section by being designed with and having constructed and installed a space-conditioning system that meets the applicable requirements of Subsections (a) through (m).

(a) **Sizing and equipment selection.** Mechanical heating and mechanical cooling equipment shall be the smallest size, within the available options of the desired equipment line, necessary to meet the design heating and cooling loads of the building, as calculated according to Subsection (b).

Exception 1 to Section 140.4(a): Where it can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building TDV energy use.

Exception 2 to Section 140.4(a): Standby equipment with controls that allow the standby equipment to operate only when the primary equipment is not operating.

Exception 3 to Section 140.4(a): Multiple units of the same equipment type, such as multiple chillers and boilers, having combined capacities exceeding the design load, if they have controls that sequence or otherwise optimally control the operation of each unit based on load.

(b) **Calculations.** In making equipment sizing calculations under Subsection (a), all of the following rules shall apply:

1. **Methodology.** The methodologies, computer programs, inputs and assumptions approved by the Commission shall be used.
2. **Heating and cooling loads.** Heating and cooling system design loads shall be determined in accordance with the procedures described in the ASHRAE Handbook, Fundamentals Volume or as specified in a method approved by the Commission.

TABLE 140.4-A
ECONOMIZER TRADE-OFF TABLE FOR COOLING SYSTEMS

CLIMATE ZONE	EFFICIENCY IMPROVEMENT[a]
1	70%
2	65%
3	65%
4	65%
5	70%
6	30%
7	30%
8	30%
9	30%
10	30%
11	30%
12	30%
13	30%
14	30%
15	30%
16	70%

a. If a unit is rated with an IPLV, IEER or SEER, then to eliminate the required air or water economizer, the applicable minimum cooling efficiency of the HVAC unit must be increased by the percentage shown. If the HVAC unit is only rated with a full load metric, such as EER or COP cooling, then that metric must be increased by the percentage shown.

Exception 5 to Section 140.4(e)1: Fan systems primarily serving computer room(s). See Section 140.9(a) for computer room economizer requirements.

2. If an economizer is required by Section 140.4(e)1, it shall be:

   A. Designed and equipped with controls so that economizer operation does not increase the building heating energy use during normal operation; and

   Exception to Section 140.4(e)2A: Systems that provide 75 percent of the annual energy used for mechanical heating from site-recovered energy or a site-solar energy source.

   B. Capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.

3. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then it shall be a type listed in, and shall have high limit shut-off controls complying with Table 140.4-B.

4. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then the air economizer, and all return air dampers on any individual cooling fan system that has a total mechanical cooling capacity over 54,000 Btu/hr, shall have the following features:

   A. **Warranty.** 5-year manufacturer warranty of economizer assembly.

   B. **Damper reliability testing.** Suppliers of economizers shall certify that the economizer assembly, including but not limited to outdoor air damper, return air damper, drive linkage and actuator, have been tested and are able to open and close against the rated airflow and pressure of the system after 60,000 damper opening and closing cycles.

   C. **Damper leakage.** Economizer and return dampers shall be certified in accordance with AMCA Standard 500 to have a maximum leakage rate of 10 cfm/sf at 1.0 in. w.g. when tested.

   D. **Adjustable setpoint.** If the high-limit control is fixed dry bulb or fixed enthalpy ± fixed dry bulb, then the control shall have an adjustable setpoint.

TABLE 140.4-B
AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

DEVICE TYPE[a]	CLIMATE ZONES	REQUIRED HIGH LIMIT (ECONOMIZER OFF WHEN):	
		Equation[b]	Description
Fixed dry bulb	1, 3, 5, 11-16	$T_{OA} > 75°F$	Outdoor air temperature exceeds 75°F
	2, 4, 10	$T_{OA} > 73°F$	Outdoor air temperature exceeds 73°F
	6, 8, 9	$T_{OA} > 71°F$	Outdoor air temperature exceeds 71°F
	7	$T_{OA} > 69°F$	Outdoor air temperature exceeds 69°F
Differential dry bulb	1, 3, 5, 11-16	$T_{OA} > T_{RA}°F$	Outdoor air temperature exceeds return air temperature
	2, 4, 10	$T_{OA} > T_{RA}-2°F$	Outdoor air temperature exceeds return air temperature minus 2°F
	6, 8, 9	$T_{OA} > T_{RA}-4°F$	Outdoor air temperature exceeds return air temperature minus 4°F
	7	$T_{OA} > T_{RA}-6°F$	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy[c] + Fixed dry bulb	All	$h_{OA} > 28$ Btu/lb[c] or $T_{OA} > 75°F$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air[c] or Outdoor air temperature exceeds 75°F

a. Only the high limit control devices listed are allowed to be used and at the setpoints listed. Others such as Dew Point, Fixed Enthalpy, Electronic Enthalpy, and Differential Enthalpy Controls may not be used in any climate zone for compliance with Section 140.4(e)1 unless approval for use is provided by the Energy Commission Executive Director.

b. Devices with selectable (rather than adjustable) setpoints shall be capable of being set to within 2°F and 2 Btu/lb of the setpoint listed.

c. At altitudes substantially different than sea level, the Fixed Enthalpy limit value shall be set to the enthalpy value at 75°F and 50% relative humidity. As an example, at approximately 6,000 foot elevation, the fixed enthalpy limit is approximately 30.7 Btu/lb.

E. **Sensor accuracy.** Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies.

i. Drybulb and wetbulb temperatures accurate to ±2°F over the range of 40°F to 80°F.

ii. Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb.

iii. Relative humidity (RH) accurate to ±5 percent over the range of 20 percent to 80 percent RH.

F. **Sensor calibration data.** Data used for control of the economizer shall be plotted on a sensor performance curve.

G. **Sensor high limit control.** Sensors used for the high limit control shall be located to prevent false readings, including but not limited to being properly shielded from direct sunlight.

H. **Relief air system.** Relief air systems shall be capable of providing 100 percent outside air without over-pressurizing the building.

5. Systems that include an air economizer to meet Section 140.4(e)1 shall include the following:

A. Unit controls shall have mechanical capacity controls interlocked with economizer controls such that the economizer is at 100 percent open position when mechanical cooling is on and does not begin to close until the leaving air temperature is less than 45°F.

B. Direct Expansion (DX) units that control the capacity of the mechanical cooling directly based on occupied space temperature shall have a minimum of two stages of mechanical cooling capacity, per the following effective dates:

i. ≥ 75,000 Btu/hr – Effective 1/1/2014

ii. ≥ 65,000 Btu/hr – Effective 1/1/2016

C. Effective 1/1/2014, DX units not within the scope of Section 140.4(e)5.B, such as those that control space temperature by modulating the airflow to the space, shall (i) comply with the requirements in Table 140.4-C, and (ii) shall have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling capacity.

TABLE 140.4-C
DIRECT EXPANSION (DX) UNIT REQUIREMENTS FOR COOLING STAGES AND COMPRESSOR DISPLACEMENT

COOLING CAPACITY	MINIMUM NUMBER OF MECHANICAL COOLING STAGES	MINIMUM COMPRESSOR DISPLACEMENT
= 65,000 Btu/h and < 240,000 Btu/h	3 stages	= 35% full load
= 240,000 Btu/h	4 stages	= 25% full load

(f) **Supply air temperature reset controls.** Space-conditioning systems supplying heated or cooled air to multiple zones shall include controls that automatically reset supply air temperatures. Air distribution systems serving zones that are likely to have constant loads, such as interior zones, shall be designed for the air flows resulting from the fully reset supply air temperature. Supply air temperature reset controls shall be:

1. In response to representative building loads or to outdoor air temperature; and
2. At least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

Exception 1 to Section 140.4(f): Systems that meet the requirements of Section 140.4(d), without using Exception 1 or 2 to that section.

Exception 2 to Section 140.4(f): Where supply-air temperature reset would increase overall building energy use.

Exception 3 to Section 140.4(f): Systems supplying zones in which specific humidity levels are required to satisfy exempt process loads. Computer Rooms or other spaces with only IT equipment may not use this exception.

(g) **Electric resistance heating.** Electric resistance heating systems shall not be used for space heating.

Exception 1 to Section 140.4(g): Where an electric resistance heating system supplements a heating system in which at least 60 percent of the annual energy requirement is supplied by site-solar or recovered energy.

Exception 2 to Section 140.4(g): Where an electric resistance heating system supplements a heat pump heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load calculated in accordance with Section 140.4(a) at the design outdoor temperature specified in Section 140.4(b)4.

Exception 3 to Section 140.4(g): Where the total capacity of all electric resistance heating systems serving the entire building is less than 10 percent of the total design output capacity of all heating equipment serving the entire building.

Exception 4 to Section 140.4(g): Where the total capacity of all electric resistance heating systems serving the building, excluding those allowed under Exception 2, is no more than 3 kW.

Exception 5 to Section 140.4(g): Where an electric resistance heating system serves an entire building that is not a high-rise residential or hotel/motel building; and has a conditioned floor area no greater than 5,000 square feet; and has no mechanical cooling; and is in an area where natural gas is not currently available and an extension of a natural gas system is impractical, as determined by the natural gas utility.

(h) **Heat rejection systems.**

1. **Scope.** Section 140.4(h) applies to heat rejection equipment used in comfort cooling systems, such as air-cooled condensers, open cooling towers, closed-circuit cooling towers and evaporative condensers.
2. **Fan speed control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two thirds of full speed or less, and shall have controls that automatically change the fan speed to con-

section if it complies with the applicable requirements of Sections 110.1, 110.3 and 120.3.

(b) **High-rise residential and hotel/motel occupancies.** A service water-heating system installed in high-rise residential or hotel/motel buildings complies with this section if it meets the requirements of Section 150.1(c)8.

SECTION 140.6 PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

A building complies with this section if:

i. The calculation of actual indoor lighting power density of all proposed building areas combined, calculated under Subsection (a) is no greater than the density calculation of allowed indoor lighting power density, specific methodologies calculated under Subsection (c); and

ii. The calculation of allowed indoor lighting power density, general rules comply with Subsection (b); and

iii. General lighting complies with the automatic daylighting controls in secondary daylit zone requirements in Subsection (d).

(a) **Calculation of actual indoor lighting power density.** The actual indoor lighting power density of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through 3 of this subsection and the requirements of Subdivision 4 of this subsection.

Exception to Section 140.6(a). Up to 0.3 watts per square foot of portable lighting for office areas shall not be required to be included in the calculation of actual indoor lighting power density.

1. **Two interlocked lighting systems.** No more than two lighting systems may be used for an area, and if there are two they must be interlocked. Where there are two interlocked lighting systems, the watts of the lower wattage system may be excluded from the actual indoor lighting power density if:

   A. An installation certificate detailing compliance with Section 140.6(a)1 is submitted in accordance with Sections 10-103 and 130.4; and

   B. The area or areas served by the interlocking systems is an auditorium, a convention center, a conference room, a multipurpose room or a theater; and

   C. The two lighting systems are interlocked with a nonprogrammable double-throw switch to prevent simultaneous operation of both systems.

   For compliance with Part 6 a nonprogrammable double-throw switch is an electrical switch commonly called a "single pole double throw" or "three-way" switch that is wired as a selector switch allowing one of two loads to be enabled. It can be a line voltage switch or a low voltage switch selecting between two relays. It cannot be overridden or changed in any manner that would permit both loads to operate simultaneously.

2. **Reduction of wattage through controls.** In calculating actual indoor lighting power density, the installed watts of a luminaire providing general lighting in an area listed in Table 140.6-A may be reduced by the product of (i) the number of watts controlled as described in Table 140.6-A, times (ii) the applicable power adjustment factor (PAF), if all of the following conditions are met:

   A. An installation certificate is submitted in accordance with Section 130.4(b), and

   B. Luminaires and controls meet the applicable requirements of Section 110.9, and Sections 130.0 through 130.5; and

   C. The controlled lighting is permanently installed general lighting systems and the controls are permanently installed nonresidential-rated lighting controls. (Thus, for example, portable lighting, portable lighting controls and residential rated lighting controls shall not qualify for PAFs.)

   When used for determining PAFs for general lighting in offices, furniture mounted luminaires that comply with all of the following conditions shall qualify as permanently installed general lighting systems:

   i. The furniture mounted luminaires shall be permanently installed no later than the time of building permit inspection; and

   ii. The furniture mounted luminaires shall be permanently hardwired; and

   iii. The furniture mounted lighting system shall be designed to provide indirect general lighting; and

   iv. Before multiplying the installed watts of the furniture mounted luminaire by the applicable PAF, 0.3 watts per square foot of the area illuminated by the furniture mounted luminaires shall be subtracted from installed watts of the furniture mounted luminaires; and

   v. The lighting control for the furniture mounted luminaire complies with all other applicable requirements in Section 140.6(a)2.

   D. At least 50 percent of the light output of the controlled luminaire is within the applicable area listed in Table 140.6-A. Luminaires on lighting tracks shall be within the applicable area in order to qualify for a PAF.

   E. Only one PAF from Table 140.6-A may be used for each qualifying luminaire. PAFs shall not be added together unless allowed in Table 140.6-A.

   F. Only lighting wattage directly controlled in accordance with Section 140.6(a)2 shall be used to reduce the calculated actual indoor lighting power densities as allowed by Section 140.6(a)2. If only a portion of

the wattage in a luminaire is controlled in accordance with Section 140.6(a)2, then only that portion of controlled wattage may be reduced in calculating actual indoor lighting power density.

G. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multilevel, and automatic lighting controls required in Section 130.1, and in addition to any other lighting controls required by any provision of Part 6. PAFs shall not be available for lighting controls required by Part 6.

Exception to Section 140.6(a)2G: Lighting controls designed and installed for the sole purpose of compliance with Section 130.1(b)3 may be used to qualify for a PAF, provided the lighting controls are designed and installed in addition to all manual, and automatic lighting controls otherwise required in Section 130.1.

H. To qualify for the PAF for a partial-ON occupant sensing control in Table 140.6-A, a partial-on occupant sensing control shall meet all of the following requirements:

i. The control shall automatically deactivate all of the lighting power in the area within 30 minutes after the room has been vacated; and

ii. The first stage shall automatically activate between 30-70 percent of the lighting power in the area and may be a switching or dimming system; and

iii. The second stage shall require manual activation of the alternate set of lights, and this manual-ON requirements shall not be capable of conversion from manual-ON to automatic-ON functionality via manual switches or dip switches; and

iv. Switches shall be located in accordance with Section 130.1(a) and shall allow occupants to manually do all of the following regardless of the sensor status: activate the alternate set of lights in accordance with Item (iii); activate 100 percent of the lighting power; and deactivate all of the lights.

I. To qualify for the PAF for an occupant sensing control controlling the general lighting in large open plan office areas above workstations, in accordance with Table 140.6-A, the following requirements shall be met:

i. The open plan office area shall be greater than 250 square feet; and

ii. This PAF shall be available only in office areas which contain workstations; and

iii. Controlled luminaires shall only be those that provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with Section 140.6(a)2 and provide general lighting directly above the controlled area; and

iv. Qualifying luminaires shall be controlled by occupant sensing controls that meet all of the following requirements, as applicable:

a. Infrared sensors shall be equipped by the manufacturer, of fitted in the field by the installer, with lenses or shrouds to prevent them from being triggered by movement outside of the controlled area.

b. Ultrasonic sensors shall be tuned to reduce their sensitivity to prevent them from being triggered by movements outside of the controlled area.

c. All other sensors shall be installed and adjusted as necessary to prevent them from being triggered by movements outside of the controlled area.

J. To qualify for the PAF for a manual dimming system PAF or a multiscene programmable dimming system PAF in Table 140.6-A, the lighting shall be controlled with a control that can be manually operated by the user.

K. To qualify for the PAF for a demand responsive control in Table 140.6-A, a demand responsive control shall meet all of the following requirements:

i. The building shall be 10,000 square feet or smaller; and

ii. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal; and

iii. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in Table 130.1-A; and

iv. Spaces that are nonhabitable shall not be used to comply with this requirement, and spaces with a lighting power density of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.

L. To qualify for the PAF for combined manual dimming plus partial-ON occupant sensing control in Table 140.6-A, (i) the lighting controls shall comply with the applicable requirements in Section 140.6(a)2J; and (ii) the lighting shall be controlled with a dimmer control that can be manually operated, or with a multiscene programmable control that can be manually operated.

3. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from actual indoor lighting power density. (Indoor lighting not listed below shall comply with all applicable nonresidential indoor lighting requirements in Part 6.):

A. In theme parks: lighting for themes and special effects;

B. Studio lighting for film or photography, provided that these lighting systems are in addition to and separately switched from a general lighting system;

I. Determine additional allowed power for wall display lighting according to column 3 of Table 140.6-D for each primary function area as follows:

i. Additional wall display lighting power shall not be available when using Section 140.6(c)3H for determining the allowed indoor lighting power density allotment for general lighting for the area.

ii. Floor displays shall not qualify for wall display allowances.

iii. Qualifying wall lighting shall:

a. Be mounted within 10 feet of the wall having the wall display. When track lighting is used for wall display, and where portions of that lighting track are more than 10 feet from the wall and other portions are within 10 feet of the wall, portions of track more than 10 feet from the wall shall not be used for the wall display allowance.

b. Be a lighting system type appropriate for wall lighting. Lighting systems appropriate for wall lighting are lighting track adjacent to the wall, wall-washer luminaires, luminaires behind a wall valance or wall cove, or accent light. (Accent luminaires are adjustable or fixed luminaires with PAR, R, MR, AR or other directional lamp types.)

iv. Additional allowed power for wall display lighting is available only for lighting that illuminates walls having wall displays. The length of display walls shall include the length of the perimeter walls, including but not limited to closable openings and permanent full height interior partitions. Permanent full height interior partitions are those that (I) extend from the floor to no more than 2 feet of the ceiling or are taller than ten feet, and (II) are permanently anchored to the floor, provided, however, that neither. commercial industrial stacks nor industrial storage stacks are permanent full height interior partitions.

v. The wall display mounting height multiplier is the applicable factor from Table 140.6-E. Mounting height is the distance from the finished floor to the bottom of the luminaire. Wall display lighting with varying mounting heights shall be separately determined under Item vi.

vi. The additional allowed power for wall display lighting shall be the smaller of:

a. The product of wall display power determined in accordance with Table 140.6-D, times the wall display lengths determined in accordance with Item iv, times the mounting height multiplier determined in accordance with Item v; or

b. The actual power used for the wall display lighting systems.

J. Determine additional allowed power for floor display lighting and task lighting as follows:

i. Neither additional allowed power for floor display lighting nor additional allowed power for task lighting shall be available when using Section 140.6(c)3H for determining allowed indoor lighting power density allotment for general lighting.

ii. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.

iii. Lighting internal to display cases shall be counted as floor display lighting in accordance with Section 140.6(c)3J; or very valuable display case lighting in accordance with Section 140.6(c)3Liii and iv.

iv. Additional allowed power for floor display lighting, and additional allowed power for task lighting, may be used by qualifying floor display lighting systems, qualifying task lighting systems, or a combination of both. For floor areas qualifying for both floor display and task lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.

v. Qualifying floor display lighting shall:

a. Be mounted no closer than 2 feet to a wall.

b. Consist of only (I) directional lighting types, such as PAR, R, MR, AR; or (II) lighting employing optics providing directional display light from nondirectional lamps.

c. If track lighting is used, shall be only track heads that are classified as direction lighting types.

vi. Qualifying task lighting shall:

a. Be located immediately adjacent to and capable of illuminating the task for which it is installed.

b. Be of a type different from the general lighting system.

c. Be separately switched from the general lighting system.

vii. If there are illuminated floor displays, floor display lighting power shall be used only if allowed by column 4 of Table 140.6-D.

viii. Additional allowed power for a combination of floor display lighting and task lighting shall be available only for (I) floors having floor displays; or (II) floors not having floor displays but having tasks having illuminance recommendations that appear in the Tenth Edition of the *IES Lighting Handbook*, and that are higher than the general lighting level in Column 2 of Table 140.6-D. The square footage of floor display or the square foot-

age of task areas shall be determined in accordance with Section 140.6(c)3C and D, except that any floor area designed to not have floor displays or tasks, such as floor areas designated as a path of egress, shall not be included for the floor display allowance.

ix. For floor display lighting where the bottom of the luminaire is 12 feet or higher above the finished floor, the wattage allowed in Column 4 of Table 140.6-D may be increased by multiplying the floor display lighting power allowance by the appropriate factor from Table 140.6-E

Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire. Wall display lighting with varying mounting heights shall be separately determined under Item x.

x. The additional allowed power for floor display lighting for each applicable area shall be the smaller of:

a. The product of allowed floor display and task lighting power determined in accordance with Section 140.6(c)3Jvii times the floor square footage determined in accordance with Section 140.6(c)3Jviii times the height multiplier if appropriate in accordance with Section 140.6(c)3Jix; or

b. The actual power used for the floor display lighting systems.

K. Determine additional allowed power for ornamental/special effects lighting as follows:

i. Additional allowed power for ornamental/special effects lighting shall not be available when using Section 140.6(c)3H for determining general lighting power density allowances.

ii. Qualifying ornamental lighting includes luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels, when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.

iii. Additional lighting power for ornamental/special effects lighting shall be used only if allowed by Column 5 of Table 140.6-D.

iv. Additional lighting power for ornamental/special effects lighting shall be used only in areas having ornamental/special effects lighting. The square footage of the floor area shall be determined in accordance with Section 140.6(c)3C and D, and it shall not include floor areas not having ornamental/special effects lighting.

v. The additional allowed power power for ornamental/special effects lighting for each applicable area shall be the smaller of:

a. The product of the allowed ornamental/special effects lighting power determined in accordance with Section 140.6(c)3Kiii, times floor square footage determined in accordance with Section 140.6(c)3Kiv; or

b. The actual power of allowed ornamental/special effects lighting.

L. Determine additional allowed power for very valuable display case lighting as follows:

i. Additional allowed power for very valuable display case lighting shall not be available when using Section 140.6(c)3H for determining general lighting power density allowances.

ii. Additional allowed power for very valuable display case lighting shall be available only for display cases in appropriate function areas in retail merchandise sales, museum and religious worship.

iii. To qualify for additional allowed power for very valuable display case lighting, a case shall contain jewelry, coins, fine china, fine crystal, precious stones, silver, small art objects and artifacts, and/or valuable collections the display of which involves customer inspection of very fine detail from outside of a locked case.

iv. Qualifying lighting includes internal display case lighting or external lighting employing highly directional luminaires specifically designed to illuminate the case or inspection area without spill light, and shall not be fluorescent lighting unless installed inside of a display case.

v. If there is qualifying very valuable display case lighting in accordance with Section 140.6(c)3Liii, the smallest of the following separate lighting power for display cases presenting very valuable display items is permitted:

a. The product of the area of the primary function and 0.8 watt per square foot; or

b. The product of the area of the display case and 12 watts per square foot; or

c. The actual power of lighting for very valuable displays.

SECTION 140.8
REQUIREMENTS FOR SIGNS

This section applies to all internally illuminated and externally illuminated signs, unfiltered light emitting diodes (LEDs) and unfiltered neon, both indoor and outdoor. Each sign shall comply with either subsection (a) or (b), as applicable.

(a) **Maximum allowed lighting power.**

1. For internally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 12 watts per square foot. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power.
2. For externally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 2.3 watts per square foot. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more luminaires, shall be used.
3. Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with Section 140.8(b).

(b) **Alternate lighting sources.** The sign shall comply if it is equipped only with one or more of the following light sources:

1. High pressure sodium lamps; or
2. Metal halide lamps that are:
   A. Pulse start or ceramic served by a ballast that has a minimum efficiency of 88 percent or greater, or
   B. Pulse start that are 320 watts or smaller, are not 250 watt or 175 watt lamps, and are served by a ballast that has a minimum efficiency of 80 percent.

   Ballast efficiency is the measured output wattage to the lamp divided by the measured operating input wattage when tested according to ANSI C82.6-2005.
3. Neon or cold cathode lamps with transformer or power supply efficiency greater than or equal to the following:
   A. A minimum efficiency of 75 percent when the transformer or power supply rated output current is less than 50 mA; or
   B. A minimum efficiency of 68 percent when the transformer or power supply rated output current is 50 mA or greater.

   The ratio of the output wattage to the input wattage is at 100 percent tubing load.
4. Fluorescent lighting systems meeting one of the following requirements:
   A. Use only lamps with a minimum color rendering index (CRI) of 80; or
   B. Use only electronic ballasts with a fundamental output frequency not less than 20 kHz.
5. Light emitting diodes (LEDs) with a power supply having an efficiency of 80 percent or greater; or

   Exception to Section 140.8(b)5: Single voltage external power supplies that are designed to convert 120 volt AC input into lower voltage DC or AC output, and have a nameplate output power less than or equal to 250 watts, shall comply with the applicable requirements of the appliance efficiency regulations (Title 20).
6. Compact fluorescent lamps that do not contain a medium screw base sockets (E24/E26).

Exception 1 to Section 140.8: Unfiltered incandescent lamps that are not part of an electronic message center (EMC), an internally illuminated sign or an externally illuminated sign.

Exception 2 to Section 140.8: Exit signs. Exit signs shall meet the requirements of the appliance efficiency regulations.

Exception 3 to Section 140.8: Traffic Signs. Traffic signs shall meet the requirements of the appliance efficiency regulations.

SECTION 140.9
PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

(a) **Prescriptive requirements for computer rooms.**

A computer room complies with this section by being designed with and having constructed and installed a cooling system that meets the requirements of Subsections 1 through 6.

1. **Economizers.** Each individual cooling system primarily serving computer room(s) shall include either:
   A. An integrated air economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 55°F dry-bulb/50°F wet-bulb and below; or
   B. An integrated water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 40°F dry-bulb/35°F wet-bulb and below.

   Exception 1 to Section 140.9(a)1: Individual computer rooms under 5 tons in a building that does not have any economizers.

   Exception 2 to Section 140.9(a)1: New cooling systems serving an existing computer room in an existing building up to a total of 50 tons of new cooling equipment per building.

   Exception 3 to Section 140.9(a)1: New cooling systems serving a new computer room in an existing building up to a total of 20 tons of new cooling equipment per building.

   Exception 4 to Section 140.9(a)1: A computer room may be served by a fan system without an economizer if it is also served by a fan system with an economizer that also serves noncomputer room(s), provided that all of the following are met:

   i. The economizer system is sized to meet the design cooling load of the computer room(s)

when the noncomputer room(s) are at 50 percent of their design load; and

ii. The economizer system has the ability to serve only the computer room(s), e.g., shut off flow to noncomputer rooms when unoccupied; and

iii. The noneconomizer system does not operate when the outside air drybulb temperatures is below 60°F and, the cooling load of the noncomputer room(s) served by the economizer system is less than 50 percent of design load.

2. **Reheat.** Each computer room zone shall have controls that prevent reheating, recooling and simultaneous provisions of heating and cooling to the same zone, such as mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by cooling equipment or by economizer systems.
3. **Humidification.** Nonadiabatic humidification (e.g., steam, infrared) is prohibited. Only adiabatic humidification (e.g., direct evaporative, ultrasonic) is permitted.
4. **Power consumption of fans**. The total fan power at design conditions of each fan system shall not exceed 27 W/kBtu·h of net sensible cooling capacity.
5. **Fan control.** Each unitary air conditioner with mechanical cooling capacity exceeding 60,000 Btu/hr and each chilled water fan system shall be designed to vary the airflow rate as a function of actual load and shall have controls and/or devices (such as two-speed or variable speed control) that will result in fan motor demand of no more than 50 percent of design wattage at 66 percent of design fan speed.
6. **Containment.** Computer rooms with air-cooled computers in racks and with a design load exceeding 175 kW/room shall include air barriers such that there is no significant air path for computer discharge air to recirculate back to computer inlets without passing through a cooling system.

   Exception 1 to Section 140.9(a)6: Expansions of existing computer rooms.

   Exception 2 to Section 140.9(a)6: Computer racks with a design load less than 1 kW/rack.

   Exception 3 to Section 140.9(a)6: Equivalent energy performance based on computational fluid dynamics or other analysis.

(b) **Prescriptive requirements for commercial kitchens.**

1. **Kitchen exhaust systems.**

   A. Replacement air introduced directly into the hood cavity of kitchen exhaust hoods shall not exceed 10 percent of the hood exhaust airflow rate.

   B. For kitchen/dining facilities having total Type I and Type II kitchen hood exhaust airflow rates greater than 5,000 cfm, each Type I hood shall have an exhaust rate that complies with Table 140.9-A. If a single hood or hood section is installed over appliances with different duty ratings, then the maximum allowable flow rate for the hood or hood section shall not exceed the Table 140.9-A values for the highest appliance duty rating under the hood or hood section. Refer to ASHRAE Standard 154-2011 for definitions of hood type, appliance duty and next exhaust flow rate.

   Exception 1 to Section 140.9(b)1.B: 75 percent of the total Type I and Type II exhaust replacement air is transfer air that would otherwise be exhausted.

   Exception 2 to Section 140.9(b)1.B: Existing hoods not being replaced as part of an addition or alteration.

TABLE 140.9-A
MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH

TYPE OF HOOD	LIGHT DUTY EQUIPMENT	MEDIUM DUTY EQUIPMENT	HEAVY DUTY EQUIPMENT	EXTRA HEAVY DUTY EQUIPMENT
Wall-mounted canopy	140	210	280	385
Single island	280	350	420	490
Double island	175	210	280	385
Eyebrow	175	175	Not allowed	Not allowed
Backshelf/ passover	210	210	280	Not allowed

2. **Kitchen ventilation.**

   A. Mechanically cooled or heated makeup air delivered to any space with a kitchen hood shall not exceed the greater of:

      i. The supply flow required to meet the space heating and cooling load; or

      ii. The hood exhaust flow minus the available transfer air from adjacent spaces. Available transfer air is that portion of outdoor ventilation air serving adjacent spaces not required to satisfy other exhaust needs, such as restrooms, not required to maintain pressurization of adjacent spaces, and that would otherwise be relieved from the building.

      Exception to Section 140.9(b)2.A: Existing kitchen makeup air units not being replaced as part of an addition or alteration.

   B. A kitchen/dining facility having a total Type I and Type II kitchen hood exhaust airflow rate greater than 5,000 cfm shall have one of the following:

      i. At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or

SUBCHAPTER 6

NONRESIDENTIAL, HIGH-RISE RESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES—ADDITIONS, ALTERATIONS AND REPAIRS

SECTION 141.0
ADDITIONS, ALTERATIONS AND REPAIRS TO EXISTING BUILDINGS THAT WILL BE NONRESIDENTIAL, HIGH-RISE RESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES AND TO EXISTING OUTDOOR LIGHTING FOR THESE OCCUPANCIES AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

Covered process requirements for additions, alterations and repairs to existing buildings are covered in Section 141.1.

(a) **Additions.** Additions shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The envelope and lighting of the addition, any newly installed space-conditioning system or water-heating system serving the addition, any addition to an outdoor lighting system and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 through 130.5 and Sections 140.2 through 140.9.
2. **Performance approach.**

A. The envelope and indoor lighting of the addition, and any newly installed space conditioning system or water heating system serving the addition, shall meet the applicable requirements of Sections 110.0 through 130.5; and

B. Either:

i. The addition alone shall comply with Section 140.1; or

ii. Existing plus addition plus alteration. The standard design for existing plus addition, plus alteration energy use is the combination of the existing building's unaltered components to remain, existing building altered components that are the more efficient, in TDV energy, of either the existing conditions, or the requirements of Section 141.0(b)2, plus the proposed addition's energy use meeting the requirements of Section 140.1. The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered component's energy features, plus the proposed energy features of the addition.

Exception 1 to Section 141.0(a): When heating, cooling or service water heating to an addition are provided by expanding existing systems, the existing systems and equipment need not comply with Sections 110.0 through 120.9 or Sections 140.4 through 140.5.

Exception 2 to Section 141.0(a): Where an existing system with electric reheat is expanded by adding variable air volume (VAV) boxes to serve an addition, total electric reheat capacity may be expanded so that the total capacity does not exceed 150 percent of the existing installed electric heating capacity in any one permit, and the system need not comply with Section 140.4(g). Additional electric reheat capacity in excess of 150 percent of the existing installed electric heating capacity may be added subject to the requirements of the Section 140.4(g).

Exception 3 to Section 141.0(a): Duct sealing. When ducts are extended from an existing duct system to serve the addition, the existing duct system and the extended ducts shall meet the applicable requirements specified in Section 141.0(b)2D.

Exception 4 to Section 141.0(a): Additions that increase the area of the roof by 2,000 square feet or less are exempt from the requirements of Section 110.10.

(b) **Alterations.** Alterations to existing nonresidential, high-rise residential or hotel/motel buildings, relocatable public school buildings or alterations in conjunction with a change in building occupancy to a nonresidential, high-rise residential or hotel/motel occupancy are not subject to Subsection (a) shall meet Item 1, and either Item 2 or 3 below:

1. **Mandatory insulation requirements for roofs, walls and floors.** Altered components in a nonresidential, high-rise residential, or hotel/motel building shall meet the minimum requirements in this section.

A. **Roof/ceiling insulation.** The opaque portions of the roof/ceiling that separate conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Section 141.0(b)2Biii.

B. **Wall insulation.** For the altered opaque portion of walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 4 below:

1. **Metal building.** A minimum of R-13 insulation between framing members, or the weighted average *U*-factor of the wall assembly shall not exceed U-0.113.
2. **Metal framed.** A minimum of R-13 insulation between framing members, or the weighted average *U*-factor of the wall assembly shall not exceed U-0.217.
3. **Wood framed and others.** A minimum of R-11 insulation between framing members, or the weighted average *U*-factor of the wall assembly shall not exceed U-0.110.

4. **Spandrel panels and glass curtain walls.** A minimum of R-4, or the weighted average *U*-factor of the wall assembly shall not exceed U-0.280.

   Exception to Section 141.0(b)1B: Light and heavy mass walls.

C. **Floor insulation.** For the altered portion of raised floors that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

1. **Raised framed floors.** A minimum of R-11 insulation between framing members, or the weighted average *U*-factor of the floor assembly shall not exceed the *U*-factor of U-0.071.
2. **Raised mass floors in high-rise residential and hotel/motel guest rooms.** A minimum of R-6 insulation, or the weighted average *U*-factor of the floor assembly shall not exceed the *U*-factor of U-0.111.
3. **Raised mass floors in other occupancies.** No minimum *U*-factor requirement.

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting and water heating systems, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 120.0 through 120.6, and Sections 120.8 through 130.5; and

   Exception to Section 141.0(b)2: The requirements of Section 120.1(i) shall not apply to alterations of spaceconditioning systems or components.

   A. Fenestration alterations other than repairs and those subject to Section 141.0(b)2 shall meet the applicable requirements below:

      i. For all nonresidential, high-rise residential, and hotel/motel occupancies, when fenestration is altered or where there are alterations that do not increase the fenestration area, all altered fenestration shall meet the requirements of Table 141.0-A. When new fenestration area is added to alterations it shall meet the requirements of Table 140.3-B, C or D.

         Exception to Section 141.0(b)2Ai: The RSHG and visible transmittance (VT) requirement of Table 141.0-A shall not apply when:

         1. 150 square feet or less of an entire building's fenestration is replaced, or
         2. 50 square feet or less of fenestration area is added, or
         3. 50 square feet or less of skylight is added.

   B. Existing roofs being replaced, recovered or recoated, of a nonresidential, high-rise residential, and hotels/motels shall meet the requirements of Section 110.8(i). Roofs with more than 50 percent of the roof area or more than 2,000 square feet of roof, whichever is less, is being altered the requirements of i through iii below apply:

      i. Roofing products. Nonresidential buildings:

         a. Low-sloped roofs in Climate Zones 1 through 16 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75, or a minimum SRI of 75.
         b. Steep-sloped roofs in Climate Zones 1 through 16 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

            Exception to Section 141.0(b)2Bia: An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling *U*-factor in Table 141.0-B is not exceeded.

      ii. Roofing products. High-rise residential buildings and hotels and motels:

         a. Low-sloped roofs in Climate Zones 10, 11, 13, 14 and 15 shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.
         b. Steep-sloped roofs Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

      Exception 1 to Sections 141.0(b)2Bi and ii: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

      Exception 2 to Sections 141.0(b)2Bi and ii: Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft² are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

TABLE 141.0-A
ALTERED WINDOW MAXIMUM *U*-FACTOR AND MINIMUM RSHGC

CLIMATE ZONE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
U-factor	0.47	0.47	0.58	0.47	0.58	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47	0.47
RSHGC	0.41	0.31	0.41	0.31	0.41	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.41
VT	See Table 140.3-B, C and D for all climate zones															

iii. For nonresidential buildings, high-rise residential buildings and hotels/motels, when roofs are exposed to the roof deck or to the roof recover boards and meets Section 141.0(b)2Bia and iia the exposed area shall be insulated to the levels specified in Table 141.0-C.

Exception to Section 141.0(b)2Biii:

a. Existing roofs that are insulated with at least R-7 insulation or that have a *U*-factor lower than 0.089 are not required to meet the *R*-value requirement of Table 141.0-C.

b. If mechanical equipment is located on the roof and will not be disconnected and lifted as part of the roof replacement, insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing.

c. If adding the required insulation will reduce the base flashing height to less than 8 inches (203 mm) at penthouse or parapet walls, the insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing, provided that the conditions in Subsections i through iv apply:

i. The penthouse or parapet walls are finished with an exterior cladding material other than the roofing covering membrane material; and

ii. The penthouse or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain a base flashing height of 8 inches (203 mm); and

iii. For nonresidential buildings, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for climate zones 2 and 10 through 16, and less than 100 square feet per linear foot for climate zones 1 and 3 though 9; and

iv. For high-rise residential buildings, hotels or motels, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for all climate zones.

v. Tapered insulation may be used which has a thermal resistance less than that prescribed in Table 141.0-C at the drains and other low points, provided that the thickness of insulation is increased at the high points of the roof so that the average thermal resistance equals or exceeds the value that is specified in Table 141.0-C.

TABLE 141.0-B
ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE

NONRESIDENTIAL		
Aged Solar Reflectance	Climate Zone 1, 3-9 *U*-factor	Climate Zone 2, 10-16 *U*-factor
0.62- 0.60	0.075	0.052
0.59-0.55	0.066	0.048
0.54-0.50	0.060	0.044
0.49-0.45	0.055	0.041
0.44-0.40	0.051	0.039
0.39-0.35	0.047	0.037
0.34-0.30	0.044	0.035
0.29-0.25	0.042	0.034

TABLE 141.0-C
INSULATION REQUIREMENTS FOR ROOF ALTERATIONS

	NONRESIDENTIAL		HIGH-RISE RESIDENTIAL AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS	
Climate Zone	Continuous Insulation *R*-value	*U*-factor	Continuous Insulation *R*-value	*U*-factor
1	R-8	0.082	R-14	0.055
2	R-14	0.055	R-14	0.055
3-9	R-8	0.082	R-14	0.055
10-16	R-14	0.055	R-14	0.055

C. **New or replacement space-conditioning systems or components** other than new or replacement space-conditioning system ducts shall meet the requirements of Section 140.4 applicable to the systems or components being altered.

Exception 1 to Section 141.0(b)2C: Subsection (b)2C does not apply to replacements of equivalent or lower capacity electric resistance space heaters for high rise residential apartment units.

Exception 2 to Section 141.0(b)2C: Subsection (b)2C does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

D. **Altered duct systems.** When new or replacement space-conditioning system ducts are installed to serve an existing building, the new ducts shall meet the requirements of Section 120.4. If the space conditioning system meets the criteria of Section 140.4(l)1, 2 and 3, the duct system shall be sealed as confirmed through field verification and diagnostic testing in accordance with the procedures for duct sealing of an existing duct system as specified in Reference Nonresidential Appendix NA2, to meet one of the following requirements:

i. If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to, or less than 6 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1.

Entirely new or replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the building's existing duct system (e.g., registers, grilles, boots, air handler, coil, plenums, duct material) if the reused parts are accessible and can be sealed to prevent leakage.

ii. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

a. The measured duct leakage shall be equal to or less than 15 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1; or

b. If it is not possible to comply with the duct leakage criterion in Subsection 141.0(b)2Diia, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test performed by a certified HERS Rater utilizing the methods specified in Reference Nonresidential Appendix NA2.1.4.2.2.

Exception to Section 141.0(b)2Dii: Duct sealing. Existing duct systems that are extended, which are constructed insulated or sealed with asbestos are exempt from the requirements of subsection 141.0(b)2Dii.

E. **Altered space-conditioning systems.** When a space conditioning system is altered by the installation or replacement of space-conditioning system equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil:

i. For all altered units where the existing thermostat does not comply with Reference Joint Appendix JA5, the existing thermostat shall be replaced with a thermostat that complies with Reference Joint Appendix JA5. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a thermostat that complies with Reference Joint Appendix JA5; and

ii. The duct system that is connected to the new or replaced space-conditioning system equipment, shall be sealed, if the duct system meets the criteria of Sections 140.4(l)1, 2 and 3, as confirmed through field verification and diagnostic testing in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Nonresidential Appendix NA2, and conforming to the applicable leakage compliance criteria in Section 141.0(b)2D.

Exception 1 to Section 141.0(b)2Eii: Duct sealing. Buildings altered so that the duct system no longer meets the criteria of Section 144(l)1, 2 and 3 are exempt from the requirements of Subsection 141.0(b)2Eii.

Exception 2 to Section 141.0(b)2Eii: Duct sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Nonresidential Appendix NA2 are exempt from the requirements of Subsection 141.0(b)2Eii.

Exception 3 to Section 141.0(b)2Eii: Duct sealing. Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection 141.0(b)2Eii.

F. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 110.9, 130.0, 130.1, 130.2, 130.4, 130.5, 140.3(c), 140.6 and 140.7.

G. When the requirements of Section 130.1(d) are triggered by the addition of skylights to an existing building and the lighting system is not recircuited, the daylighting control need not meet the multilevel requirements in Section 130.1(d).

SUBCHAPTER 7

LOW-RISE RESIDENTIAL BUILDINGS— MANDATORY FEATURES AND DEVICES

SECTION 150.0 MANDATORY FEATURES AND DEVICES

Any newly constructed low-rise residential building shall meet the requirements of this section.

(a) **Ceiling and rafter roof insulation.** The opaque portions of ceilings separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Item1 or 2 below:

1. Ceilings and rafter roofs shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-30 or greater for the insulation alone. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage.

   Exception to Section 150.0(a)1: Insulation of rafter roofs in an alteration shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater.
2. The weighted average *U*-factor shall not exceed 0.031 that would result from installing R-30 insulation between wood-framing members.

(b) **Loose-fill insulation.** When loose-fill insulation is installed, the minimum installed weight per square foot shall conform with the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled *R*-value.

(c) **Wall insulation.** Insulation installed in opaque portions of above grade framed walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1, 2 or 3 below:

1. Walls shall be insulated between framing members with insulation having an installed thermal resistance of not less than R-13 in 2×4 inch framing or the *U*-factor shall not exceed U-0.102 that results from installing R-13 in a 2×4 inch wood framed assembly; and

   Exception to Section 150.0(c)1: Existing walls already insulated to an installed thermal resistance of R-11 or greater.
2. Walls shall be insulated between framing members with insulation having an installed thermal resistance of not less than R-19 in framing of 2×6 inch or greater, or the *U*-factor shall not exceed the U-0.074 that results from installing R-19 in a 2×6 inch or greater wood framed assembly; and
3. Bay window roofs and floors shall be insulated to meet the wall insulation requirements of Table 150.1-A.

(d) **Raised-floor insulation.** Raised floors separating conditioned space from unconditioned space or ambient air shall meet the requirements of Items 1 or 2 below:

1. Floors shall be insulated between wood-framing members with insulation having an installed thermal resistance of R-19 or greater.
2. The weighted average *U*-factor of floor assemblies shall not exceed 0.037 that would result from installing R-19 insulation between wood-framing members and accounting for the effects of framing members.

   Exception to Section 150.0(d): A building with a controlled ventilation or unvented crawlspace may omit raised floor insulation if all of the following are met:

   i. The foundation walls are insulated to meet the wall insulation minimums as shown in Table 150.1-A; and

   ii. A Class I or Class II vapor retarder is placed over the entire floor of the crawl space; and

   iii. Vents between the crawlspace and outside air are fitted with automatically operated louvers that are temperature actuated; and

   iv. The requirements in Reference Residential Appendix RA4.5.1.

(e) **Installation of fireplaces, decorative gas appliances and gas logs.**

1. If a masonry or factory-built fireplace is installed, it shall have the following:

   A. Closable metal or glass doors covering the entire opening of the firebox; and

   B. A combustion air intake to draw air from the outside of the building, which is at least 6 square inches in area and is equipped with a readily accessible, operable and tight-fitting damper or combustion-air control device; and

   Exception to Section 150.0(e)1B: An outside combustion-air intake is not required if the fireplace will be installed over concrete slab flooring and the fireplace will not be located on an exterior wall.

   C. A flue damper with a readily accessible control.

   Exception to Section 150.0(e)1C: When a gas log, log lighter or decorative gas appliance is installed in a fireplace, the flue damper shall be blocked open if required by the CMC or the manufacturer's installation instructions.

2. Continuous burning pilot lights and the use of indoor air for cooling a firebox jacket, when that indoor air is vented to the outside of the building, are prohibited.

(f) **Reserved.**

(g) **Vapor retarder.**

1. In Climate Zones 14 and 16 a Class II vapor retarder shall be installed on the conditioned space side of all insulation in all exterior walls, vented attics and unvented attics with air-permeable insulation; and
2. In Climate Zones 1-16 with unvented crawl spaces the earth floor of the crawl space shall be covered with a Class I or Class II vapor retarder; or
3. In a building having a controlled ventilation crawl space, a Class I or Class II vapor retarder shall be placed over the earth floor of the crawl space to reduce moisture entry and protect insulation from condensation, as specified in the exception to Section 150.0(d).

(h) **Space-conditioning equipment.**

1. **Building cooling and heating loads.** Building heating and cooling loads shall be determined using a method based on any one of the following:
   A. The ASHRAE Handbook, Equipment Volume, Applications Volume and Fundamentals Volume; or
   B. The SMACNA Residential Comfort System Installation Standards Manual; or
   C. The ACCA Manual J.

The cooling and heating loads are two of the criteria that shall be used for equipment sizing and selection.

Note: Heating systems are required to have a minimum heating capacity adequate to meet the minimum requirements of the CBC. The furnace output capacity and other specifications are published in the Commission's directory of certified equipment or other directories approved by the Commission.

2. **Design conditions.** For the purpose of sizing the space-conditioning (HVAC) system, the indoor design temperatures shall be 68°F for heating and 75°F for cooling. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X. The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values. The outdoor design temperatures for cooling shall be no greater than the 1.0 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.
3. **Outdoor condensing units.**
   A. **Clearances.** Installed air conditioner and heat pump outdoor condensing units shall have a clearance of at least five (5) feet (1.5 meters) from the outlet of any dryer vent.
4. **Central forced-air heating furnaces.**
   A. **Temperature rise.** Central forced-air heating furnace installations shall be configured to operate in conformance with the furnace manufacturer's maximum inlet-to-outlet temperature rise specifications.

(i) **Thermostats.** Heating systems shall be equipped with thermostats that meet the requirements of Section 110.2(c).

(j) **Water system piping and insulation for piping tanks and cooling systems lines.**

1. **Storage tank insulation.**
   A. Storage gas water heaters with an energy factor equal to or less than the federal minimum standards shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater.
   B. Unfired hot water tanks, such as storage tanks and backup storage tanks for solar water-heating systems, shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater or have internal insulation of at least R-16 and a label on the exterior of the tank showing the insulation *R*-value.
2. **Water piping and cooling system line insulation thickness and conductivity.** Piping shall be insulated to the thicknesses as follows:
   A. All domestic hot water system piping conditions listed below, whether buried or unburied, must be insulated and the insulation thickness shall be selected based on the conductivity range in Table 120.3-A and the insulation level shall be selected from the fluid temperature range based on the thickness requirements in Table 120.3-A:
      i. The first 5 feet (1.5 meters) of hot and cold water pipes from the storage tank.
      ii. All piping with a nominal diameter of $^{3}/_{4}$ inch (19 millimeter) or larger.
      iii. All piping associated with a domestic hot water recirculation system regardless of the pipe diameter.
      iv. Piping from the heating source to storage tank or between tanks.
      v. Piping buried below grade.
      vi. All hot water pipes from the heating source to the kitchen fixtures.
   B. In addition to insulation requirements, all domestic hot water pipes that are buried below grade must be installed in a water proof and noncrushable casing or sleeve that allows for installation, removal, and replacement of the enclosed pipe and insulation.
   C. Pipe for cooling system lines shall be insulated as specified in Subsection A. Piping for steam and hydronic heating systems or hot water systems with pressure above 15 psig (103 kPa) shall meet the requirements in Table 120.3-A.

Exception 1 to Section 150.0(j)2: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

Exception 2 to Section 150.0(j)2: Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents or waste piping.

adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

E. Drawbands used with flexible duct.

i. Drawbands shall be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.

ii. Drawbands shall have a minimum tensile strength rating of 150 pounds.

iii. Drawbands shall be tightened as recommended by the manufacturer with an adjustable tensioning tool.

F. Aerosol-sealant closures.

i. Aerosol sealants shall meet the requirements of UL 723, and be applied according to manufacturer specifications.

ii. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.

4. **Duct insulation *R*-value ratings.** All duct insulation product *R*-values shall be based on insulation only (excluding air films, vapor retarder or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C 518 or ASTM C 177, incorporated herein by reference, and certified pursuant to Section 110.8.

5. **Duct insulation thickness.** The installed thickness of duct insulation used to determine its *R*-value shall be determined as follows:

A. For duct board, duct liner and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.

B. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.

C. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.

6. **Duct labeling.** Insulated flexible duct products installed to meet this requirement shall include labels, in maximum intervals of 3 feet, showing the thermal performance *R*-value for the duct insulation itself (excluding air films, vapor retarders or other duct components), based on the tests in Section 150.0(m)4 and the installed thickness determined by Section 150.0(m)5C.

7. **Backdraft dampers.** All fan systems, regardless of volumetric capacity, that exchange air between the building conditioned space and the outside of the building shall be provided with backdraft or automatic dampers to prevent unintended air leakage through the fan system when the fan system is not operating.

8. **Gravity ventilation dampers.** All gravity ventilating systems that serve conditioned space shall be provided with either automatic or readily accessible, manually operated dampers in all openings to the outside except combustion inlet and outlet air openings and elevator shaft vents.

9. **Protection of insulation.** Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance and wind, but not limited to the following: Insulation exposed to weather shall be suitable for outdoor service, e.g., protected by aluminum, sheet metal, painted canvas or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

10. **Porous inner core flex duct.** Flexible ducts having porous inner cores shall not be used.

11. **Duct system sealing and leakage testing.** When space conditioning systems utilize forced air duct systems to supply conditioned air to an occupiable space, the ducts shall be sealed, as confirmed through field verification and diagnostic testing, in accordance with all applicable procedures specified in Reference Residential Appendix RA3.1, and the leakage compliance criteria specified in Reference Residential Appendix Table RA3.1-2, and conforming to one of the following subsections A, B, or C as applicable:

A. For single-family dwellings and townhouses with the air-handling unit installed and the ducts connected directly to the air handler, the total leakage of the duct system shall not exceed 6 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.

B. For single-family dwellings and townhouses at the rough-in stage of construction prior to installation of the dwelling's interior finishing:

i. Air-handling unit installed.

If the air-handling unit is installed and the ducts are connected directly to the air handler, the total leakage of the duct system shall not exceed 6 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Sections RA3.1.4.3.2, RA3.1.4.3.2.1 and RA3.1.4.3.3.

ii. Air-handling unit not yet installed.

If the air-handling unit is not yet installed, the total leakage of the duct system shall not exceed 4 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Sections RA3.1.4.3.2, RA3.1.4.3.2.2 and RA3.1.4.3.3.

C. For multifamily dwellings with the air-handling unit installed and the ducts connected directly to the air handler, regardless of duct system location,

i. The total leakage of the duct system shall not exceed 12 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1, or

ii. The duct system leakage to outside shall not exceed 6 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

12. **Air filtration.** Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length and through a thermal conditioning component, except evaporative coolers, shall be provided with air filter devices in accordance with the following:

A. **System design and installation.**

i. The system shall be designed to ensure that all recirculated air and all outdoor air supplied to the occupiable space is filtered before passing through the system's thermal conditioning components.

ii. The system shall be designed to accommodate the clean-filter pressure drop imposed by the system air filter device(s). The design airflow rate and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter device shall be determined.

iii. All system air filter devices shall be located and installed in such a manner as to allow access and regular service by the system owner.

iv. All system air filter device locations shall be labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop as determined according to subsection ii above. The labels shall be permanently affixed to the air filter device readily legible, and visible to a person replacing the air filter media.

B. **Air filter media efficiency.** The system shall be provided with air filter media having a designated efficiency equal to or greater than MERV 6 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 3.0–10 μm range when tested in accordance with AHRI Standard 680.

C. **Air filter media pressure drop.** The system shall be provided with air-filter media that conforms to the maximum allowable clean-filter pressure drop determined according to Section 150.0(m)12Aii, as rated using AHRI Standard 680, for the applicable design airflow rate(s) for the system air filter device(s). If the alternative to 150.0(m)13B is utilized for compliance, the design clean-filter pressure drop for the system air filter media shall conform to the requirements given in Table 150.0-C or 150.0-D.

D. **Air filter media product labeling.** The system shall be provided with air filter media that has been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections 150.0(m)12B and 150.0(m)12C.

13. **Duct system sizing and air filter grille sizing.** Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall:

A. Have a hole for the placement of a static pressure probe (HSPP), or a permanently installed static pressure probe (PSPP) in the supply plenum downstream of the air conditioning evaporator coil. The size, location, and labeling of the HSPP or PSPP shall conform to the requirements specified in Reference Residential Appendix RA3.3.1.1 as confirmed by field verification and diagnostic testing; and

Exception to 150.0(m)13A: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.3-1 shall not be required to provide holes as described in Figure RA3.3-1.

B. Demonstrate, in every control mode, airflow greater than or equal to 350 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

Alternative to Section 150.0(m)13B: Standard ducted systems (systems without zoning dampers) may comply by meeting the applicable requirements in Table 150.0-C or 150.0-D as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Sections RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in Tables 150.0-C and 150.0-D.

Exception to Section 150.0(m)13B: Multispeed compressor systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

14. **Reserved.**

15. **Zonally controlled central forced air systems.** Zonally controlled central forced air cooling systems shall be capable of simultaneously delivering, in every zonal control mode, an airflow from the dwelling, through the air handler fan and delivered to the dwelling, of greater than or equal to 350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

Exception to 150.0(m)15: Multispeed compressor systems or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach set forth in Section 150.1(b) shall demonstrate compliance for airflow (cfm/ton) and fan efficacy (Watt/cfm) by operating the

tion area includes skylights tilted in any direction when the pitch is less than 1:12.

4. **Shading.** Where Table 150.1-A requires a maximum solar heat gain coefficient (SHGC), the requirements shall be met by one of the following:
   A. Complying with the required SHGC pursuant to Section 150.1(c)3A, or
   B. An exterior operable shading louver or other exterior shading device that meets the required SHGC; or
   C. A combination of Items A and B to achieve the same performance as achieved in Section 150.1(c)3A.
   D. For south-facing glazing only, optimal overhangs shall be installed so that the south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21.
   E. Exterior shading devices must be permanently secured with attachments or fasteners that are not intended for removal.

   Exception to Section 150.1(c)4E: Where the *California Building Code* (CBC) requires emergency egress or where compliance would conflict with health and safety regulations.
5. **Reserved.**
6. **Heating system type.** Heating system types shall be installed as required in Table 150.1-A.
7. **Space heating and space cooling.** All space heating and space cooling equipment shall comply with minimum appliance efficiency regulations as specified in Sections 110.0 through 110.2 and meet all applicable requirements of Sections 150.0 and 150.1(c)7.

   Additionally, all systems shall comply with the following requirements, as applicable:

   A. **Refrigerant charge.** When refrigerant charge verification or charge indicator display is shown as required by Table 150.1-A.

      i. Air-cooled air conditioners and air-source heat pumps (including but not limited to ducted split systems, ducted packaged systems, and mini-split systems) shall shall comply with the following requirements if the procedures are applicable to the system:

         a. Have measurement access holes (MAH), installed according to the specifications in Reference Residential Appendix RA3.2.2.3 as verified by field verification and diagnostic testing; and correct refrigerant charge shall be confirmed through field verification and diagnostic testing in accordance with applicable procedures specified in the Reference Residential Appendix Section RA3.2.2 or RA1; or

         b. Be equipped with a charge indicator display (CID) device that provides a clearly visible indication to the occupant when the air conditioner fails to meet the required system operating parameters specified in the applicable section of Reference Joint Appendix JA6 for the installed CID technology. The CID indication shall be constantly visible and within one foot of the air conditioner's thermostat. CID installations shall be confirmed by field verification and diagnostic testing utilizing the procedures specified in Reference Residential Appendix RA3.4.2.

         Exception to Section 150.1(c)7Aia: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.2-1, shall not be required to provide holes as described in Figure RA3.2-1. <

         Exception to Section 150.1(c)7Ai: When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 to verify the refrigerant charge, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5 and shall be capable of receiving and responding to demand response signals prior to final approval of the building permit by the enforcing agency. <

      ii. Air-cooled air conditioners or air-source heat pumps (including but not limited to packaged systems and minisplit systems) that cannot comply with the requirements of Section 150.1(c)7Aia or 150.1(c)7Aib shall conform to the following requirement:

         a. Correct refrigerant charge shall be confirmed by the system installer utilizing the weigh-in charging procedure specified in Reference Residential Appendix RA3.2.3.1, as confirmed through field verification by a HERS Rater according to the procedure specified in Reference Residential Appendix RA3.2.3.2.

         Exception to Section 150.1(c)7A: Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to confirm refrigerant charge through field verification and diagnostic testing. The installer of these packaged systems shall submit certificate of installation documentation that certifies the system is a packaged system for which the correct refrigerant charge has been

verified by the system manufacturer prior to shipment from the factory.

8. **Domestic water-heating-systems.** Water-heating-systems shall meet the requirements of either A, B, C or D.

   A. For systems serving individual dwelling units, a single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, and that meets the tank insulation requirements of Section 150.0(j) and the requirements of Sections 111 and 113 shall be installed. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps shall be used.

   B. For systems serving individual dwelling units, a single gas or propane instantaneous water heater with an input of 75,000 Btu per hour or less and no storage tank, and that meets the requirements of Sections 110.1 and 110.3 shall be installed. For recirculation distribution systems, only demand recirculation systems with manual control pumps shall be used.

   C. For systems serving multiple dwelling units, a central water heating system that includes the following components shall be installed:

      i. Gas or propane water heaters, boilers or other water heating equipment that meet the minimum efficiency requirements of Sections 110.1 and 110.3; and

      ii. A water heating recirculation loop that meets the requirements of Sections 110.3(c)2 and 110.3(c)5 and is equipped with an automatic control system that controls the recirculation pump operation based on measurement of hot water demand and hot water return temperature and has two recirculation loops each serving half of the building; and

      Exception to Section 150.1(c)8Cii: Buildings with eight or fewer dwelling units are exempt from the requirement for two recirculation loops.

      iii. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.20 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.35 in Climate Zones 10 through 16. The solar savings fraction shall be determined using a calculation method approved by the Commission.

   D. For systems serving individual dwelling units, an electric-resistance storage or instantaneous water heater may be installed as the main water heating source only if natural gas is unavailable, the water heater is located within the building envelope, and a solar water-heating system meeting the installation criteria specified in the Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.50 is installed. The solar savings fraction shall be determined using a calculation method approved by the Commission. Recirculation pumps shall not be used.

9. **Space-conditioning ducts.** All ducts shall either be in directly conditioned space as confirmed by field verification and diagnostic testing in accordance with Reference Residential Appendix RA3.1.4.3.8 or be insulated to a minimum installed level as specified by Table 150.1-A. All ducts shall meet all applicable mandatory requirements of Section 150.0(m).

Note: Requirements for duct insulation in Table 150.1-A do not apply to buildings with space conditioning systems that do not have ducts.

10. **Central fan integrated ventilation systems.** Central forced air system fans used in central fan integrated ventilation systems shall demonstrate, in air distribution mode, an air-handling unit fan efficacy less than or equal to 0.58 W/CFM as confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix RA3.3.

11. **Roofing products.** All roofing products shall meet the requirements of Section 110.8 and the applicable requirements of Subsection A or B:

    A. Low-rise residential buildings with steep-sloped roofs in climate zones 10 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

    B. Low-rise residential buildings with low-sloped roofs, in climate zones 13 and 15 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75 or a minimum SRI of 0.75.

       Exception 1 to Section 150.1(c)11: Building integrated photovoltaic panels and building integrated solar thermal panels are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

       Exception 2 to Section 150.1(c)11: Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft^2 are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

12. **Ventilation cooling.** Single-family homes shall comply with the whole house fan (WHF) requirements shown in Table 150.1-A. When a WHF is required, comply with subsections a through c below:

    A. Have installed one or more WHFs whose total air flow CFM as listed in the CEC Directory is at least 2 CFM/ft^2 of conditioned floor area; and

    B. Have at least 1 square foot of attic vent free area for each 375 CFM of rated whole house fan air flow CFM; and

    C. Provide homeowners who have WHFs with a one page "How to operate your whole house fan" informational sheet.

13. **HVAC system bypass ducts.** Unless otherwise specified on the certificate of compliance, bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow shall not be used. All zonally controlled forced air systems shall be verified by a HERS Rater utilizing the procedure in Reference Residential Appendix Section RA3.1.4.6 to confirm compliance with Section 150.1(c)13.

TABLE 150.1-A
COMPONENT PACKAGE A-STANDARD BUILDING DESIGN

					CLIMATE ZONES														
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BUILDING ENVELOPE	INSULATION[1]	ROOFS/CEILINGS			U 0.025 R-38	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.031 R-30	U 0.025 R-38	U 0.025 R-38	U 0.025 R-38	U 0.025 R-38	U 0.025 R-38	U 0.025 R-38
		Walls	Above grade	2×4 Framed[2]	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5	U 0.065 R-15+4 or R-13+5
				Mass Wall Interior[3]	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.059 R-17
				Mass Wall Exterior[3]	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.125 R-8.0	U 0.070 R-13
			Below grade	Below Grade Interior[3]	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.070 R-13	U 0.066 R-15
				Below Grade Exterior[3]	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.200 R-5.0	U 0.053 R-19
		Floors	Slab perimeter		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.058 R-7.0
			Raised		U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19	U 0.037 R-19
			Concrete raised		U 0.092 R-8.0	U 0.092 R-8.0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.269 R-0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0	U 0.092 R-8.0	U 0.138 R-4.0	U 0.092 R-8.0
		RADIANT BARRIER			NR	REQ	REQ	REQ	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	ROOFING PRODUCTS	Low-sloped		Aged solar reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
				Thermal emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
		Steep-sloped		Aged solar reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
				Thermal emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
	FENESTRATION	Maximum *U*-factor[4]			0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
		Maximum SHGC[5]			NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Maximum total area			20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum west facing area			NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%
HVAC SYSTEM[a]		Space Heating	Electric-resistance allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
			If gas, AFUE =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
			If heat pump, HSPF[7,6] =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
		Space Cooling	SEER =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
			Refrigerant charge verification or charge indicator display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
			Whole house fan[7]		NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	NR
		Central System Air Handlers[8]	Central fan integrated ventilation system fan efficacy		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
		Ducts	Duct insulation		R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-8	R-6	R-6	R-8	R-8	R-8
WATER HEATING		All Buildings			System Shall meet Section 150.1(c)[8]															

continued

ASTM E 408-71 (2008) Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques (2008)

ASTM E 972-96 (2007) Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight

ASTM E 1980-01 Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces

ASTM E 2178-03 Standard Test Method for Air Permeance of Building Materials

ASTM E 2357-05 Standard Test Method for Determining Air Leakage of Air Barrier Assemblies

ASTM E 779-03 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization

ASTM E 1677-95 (2000) Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls

Available from: ASTM International
100 Barr Harbor Drive West
Conshohocken, PA 19428-2959
(610) 832-9500

CALIFORNIA BUILDING STANDARDS COMMISSION

California Electrical Code

California Plumbing Code

California Mechanical Code

California Building Code

Available from: California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833-2936
(916) 263-0916
www.bsc.ca.gov

CALIFORNIA ENERGY COMMISSION

Appliance Efficiency Regulations

Nonresidential Alternative Calculation Method (ACM) Manual

Nonresidential Compliance Manual

Residential Alternative Calculation Method (ACM) Manual

Residential Compliance Manual

New Solar Homes Partnership Guidebook, currently adopted by the Energy Commission

Available from: California Energy Commission
1516 Ninth Street
Sacramento, CA 95814
(916) 654-5106 or
(800) 772-3300 (in California)
www.energy.ca.gov/title24

CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS

Standards for Insulating Material

Available from: California Department of Consumer Affairs
Bureau of Home Furnishings and Thermal Insulation
3485 Orange Grove Avenue
North Highlands, CA 95660
(916) 574-2041

CODE OF FEDERAL REGULATIONS

21 Code of Federal Regulations, Section 1002.12 (1996)

47 Code of Federal Regulations, Parts 2 and 15 (1996)

Available from: Department of Energy
Washington, D.C. 20585

COOLING TECHNOLOGY INSTITUTE

CTI ATC-105-00 Acceptance Test Code for Water Cooling Towers (2000)

CTI STD-201-02 Standard for the Certification of Water-Cooling Tower Thermal Performance (2004)

Available from: Cooling Technology Institute
2611 FM 1960 West, Suite A101
Houston, Texas 77068-3730

PO Box 73383
Houston, TX 77273-3383
(281) 583-4087

COOL ROOF RATING COUNCIL

CRRC-1 Product Rating Program Manual (2007)

Available from: Cool Roof Rating Council
1610 Harrison Street
Oakland, CA 94612
(866) 465-2523
www.coolroofs.org

HYDRONICS INSTITUTE

HI Heating Boiler Standard 86, 6th Edition (1989)

Available from: Hydronics Institute
35 Russo Place, P.O. Box 218
Berkeley Heights, New Jersey 07922
(908) 464-8200

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA

The IESNA Lighting Handbook, Ninth Edition (2000)

Available from: IESNA
120 Wall Street, 17th Floor
New York, NY 10005-4001
(212) 248-5000
Email: iesna@iesna.org

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

California Mechanical Code

Available from: International Association of Plumbing and Mechanical Officials
4755 E. Philadelphia St.
Ontario, CA 91761
(800) 85-IAPMO (854-2766)
www.iapmo.org

INTERNATIONAL CODE COUNCIL

California Building Code

Available from: International Code Council
Los Angeles District Office
5360 South Workman Mill Road
Whittier, CA 90601-2298
(888) 422-7233
www.iccsafe.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO-13256-1 Water-Source Heat Pumps-Testing and Rating for Performance-Part 1: Water-to-Air and Brine-to-Air Heat Pumps (1998)

Available from: ISO
1, rue de Varembe
Case postale 56
CH-1211
Geneve 20, Switzerland

NATIONAL FENESTRATION RATING COUNCIL

NFRC 100 Procedure for Determining Fenestration Product *U*-factors (2011)

NFRC 200 Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence (2011)

NFRC 202 Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence (2011)

Note: This technical document has yet not been fully approved by NFRC. If this document is not approved before the Building Energy Standards effective date it will be removed.

NFRC 203 Procedure for Determining Visible Transmittance of Tubular Daylighting Devices (2012)

Note: This technical document has yet not been fully approved by NFRC. If this document is not approved before the Building Energy Standards effective date it will be removed.

NFRC 400 Procedure for Determining Fenestration Product Air Leakage (2010)

Available from: National Fenestration Rating Council
8484 Georgia Ave.
Silver Spring, MD 20910
(301) 589-1776
www.NFRC.org and Email: info@nfrc.org

NSF INTERNATIONAL (formerly National Sanitation Foundation)

NSF/ANSI 50 2005 Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs (2005)

Available from: NSF International
PO Box 130140
Ann Arbor, MI 48113
(735) 769-8010

SHEET METAL AND AIR-CONDITIONING CONTRACTORS NATIONAL ASSOCIATION

Residential Comfort System Installation Standards Manual (1998)

Available from: Sheet Metal and Air-Conditioning Contractors National Association (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1209
(703) 803-2980
ww.smacna.org

UNDERWRITERS LABORATORIES

UL 181 Standard for Safety for Factory-made Air Ducts and Connectors (1996)

UL 181A Standard for Safety for Closure Systems for Use with Rigid Air Ducts and Air Connectors (1994)

UL 18IB Standard for Safety for Closure Systems for Use with Flexible Air Ducts and Air Connectors (1995)

UL 723 Standard for Test for Surface Burning Characteristics of Building Materials (1996)

UL 727 Standard for Oil-Fired Central Furnaces (1994)

UL 731 Standard for Oil-Fired Unit Heaters (1995)

UL 1598 Standard for Luminaires (2000)

Available from: Underwriters Laboratories
333 Pfingsten Road
Northbrook, IL 60062-2096
(847) 272-8800

HISTORY NOTE APPENDIX

CALIFORNIA ENERGY CODE

(Title 24, Part 6, California Code of Regulations)

For prior history, see History Note Appendix to the 2010 *California Energy Code*, effective January 1, 2011.

1. The 2007 building energy efficiency standards were brought forward unamended into the 2010 *California Energy Code,* effective with other parts of Title 24 on January 1, 2008.

2. (CEC 01/07)Update of 2007 building energy efficiency standards in response to AB 32 (Nuñez, Chap. 488, Stats. of 2006) and SB 1 (Murray, Chap. 132, Stats. of 2006), approved by the California Building Standards Commission on September 11, 2008; filed with the Secretary of State September 12, 2008, published January 1, 2009; effective August 1, 2009.

3. (CEC 01/12) Update of 2010 building energy efficiency standards to repeal, amend and add sections of the standards to, among other things, increase the efficient use of energy and water in buildings and further the State's policy goals of achieving zero net energy consumption of energy by buildings. Approved by the California Building Standards Commission on January 24, 2013; filed with the Secretary of State February 12, 2013 and effective January 1, 2014.

4. Errata to correct editorial errors within the preface and Chapter 1 of this code. Effective January 1, 2014.

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