REVISION RECORD
FOR THE STATE OF CALIFORNIA

ERRATA

January 1, 2023

2022 Title 24, Part 6, California Energy Code

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 2022 *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 You may wish to retain the superseded material with this revision record so that the prior wording of any section can be easily ascertained.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
1 through 6	1 through 6
15 and 16	15 and 16
19 through 36	19 through 36
41 and 42	41 and 42
59 and 60	59 and 60
63 through 66	63 through 66
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151 through 160	151 through 160
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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, I, 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, or process spaces.

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.

Exception 3 to Section 100.0(a): Buildings in Occupancy Group I-3 and I-4.

(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, electrical power distribution 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 110.12 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 110.12 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 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 and hotels/motels that are mechanically heated or mechanically cooled.

ii. **Compliance approaches.** In order to comply with Part 6, newly constructed nonresidential 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 140.10.

C. **Unconditioned nonresidential buildings and process space.** Sections 110.9, 110.10, 120.6, 130.0 through 130.5, 140.3(c), 140.6, 140.7 and 140.8 apply to all newly constructed unconditioned buildings and 140.1, and 140.3(c), for process spaces within the scope of Section 100.0(a).

D. **Single-family buildings.**

i. **Sections applicable.** Sections 150.0 through 150.1 apply to newly constructed single-family buildings.

ii. **Compliance approaches.** In order to comply with Part 6, newly constructed single-family 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: Sections 150.1(a) and (b); or

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

Exception 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.

TABLE 100.0-A—APPLICATION OF STANDARDS

OCCUPANCIES	APPLICATION	MANDATORY	PRESCRIPTIVE	PERFORMANCE	ADDITIONS/ ALTERATIONS
All Buildings	General	100.0, 100.1, 100.2, 110.0	100.0, 100.1, 100.2, 110.0	100.0, 100.1, 100.2, 110.0	100.0, 100.1, 100.2, 110.0
Nonresidential and Hotels/ Motels	General	120.0	140.0, 140.2	140.0, 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, 120.1, 120.2, 120.3, 120.4, 120.5, 120.8	140.4		
	Water Heating	110.3, 120.3, 120.8, 120.9	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		
	Electrical Power Distribution	110.11, 130.5	N.A.		
	Pool and Spa Systems	110.4, 110.5, 150.0(p)			
	Solar Ready Buildings	110.10			141.0(a)
	Solar PV and Battery Storage Systems	N.A.	141.10	140.0, 140.1	N.A.
Covered Processes[1]	Envelope, Ventilation, Process Loads	110.2, 120.6	140.9	140.1	120.6, 140.9, 141.1
Signs	Indoor and Outdoor	110.9, 130.0, 130.3	140.8	N.A.	141.0, 141.0(b)2H
Single-family	General	150.0	150.1(a), (c)	150.1(a), (b)	150.2(a), (b)
	Envelope (conditioned)	110.6, 110.7, 110.8, 150(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g), 150.0(q)			
	HVAC (conditioned)	110.2, 110.5, 150.0(h), 150.0(i), 150.0(j), 150.0(m), 150.0(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.	
	Solar Ready Buildings	110.10	N.A.	N.A.	N.A.
	Electric Ready	150.0(s), 150.0(t), 150.0(u), 150.0(v)	N.A.	N.A.	N.A.
	Solar PV Systems	N.A.	150.0(c)14	150.1(a), (b)	N.A.
Multifamily	General	160.0	170.2	170.1	180.0
	HVAC (conditioned)	110.6, 110.7, 110.8, 160.1	170.1(a)		
	Ventilation and Indoor Air Quality	160.2	N.A.		
	HVAC (conditioned)	110.2, 110.5, 160.3	170.2(c)		
	Water Heating	110.3, 160.4	170.2(d)		
	Indoor Lighting	110.9, 160.5	170.2(e)		
	Outdoor Lighting	110.9, 160.5	170.2(e)		
	Electrical Power Distribution	110.11, 160.6	N.A.	N.A.	
	Pool and Spa Systems	110.4, 110.5, 160.7			
	Solar Ready Buildings	110.10, 160.8			
	Electric Ready	160.9			N.A.
	Solar PV and Battery Storage Systems	N.A.	170.2(f), (g), (h)	170.1	N.A.

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

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8 and 25943, *Public Resources Code*.

E. **Multifamily Buildings**.

i. Sections applicable. Sections 160.0 through 170.2 apply to newly constructed multifamily buildings.

ii. Compliance approaches. In order to comply with Part 6, newly constructed multifamily buildings must meet the requirements of:

a. Mandatory measures: The applicable provisions of Sections 110.0 through 110.10, and 160.0; and

b. Either:

(i) Performance approach: Section 170.1; or

(ii) Prescriptive approach: Section 170.2(a) through (f).

F. **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 (additions, alterations and repairs).**

A. **Nonresidential and hotel/motel buildings.** Section 141.0 applies to new construction in existing nonresidential, high-rise residential and hotel/motel buildings. New construction in existing buildings includes additions, alterations and repairs. Section 141.0 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specify which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specified in Section 141.0 apply to the occupancy after the alterations.

B. **Single-family buildings.** Section 150.2 applies to new construction in existing single-family buildings. New construction in existing buildings includes additions, alterations and repairs. Section 150.2 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specifies which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specified in Section 150.2 apply to the occupancy after the alterations.

C. **Multifamily buildings.** Section 180.0 applies to new construction in existing multifamily buildings. New construction in existing buildings includes additions, alterations and repairs. Section 180.0 specifies requirements that uniquely apply to additions, alterations or repairs to existing buildings, and specifies which requirements in other sections also apply. For alterations that change the occupancy classification of the building, the requirements specified in Section 180.0 apply to the occupancy after the alterations.

4. **Installation of insulation in existing buildings.** Section 110.8(d) applies to buildings in which insulation is being installed in existing attics, or on existing water heaters or existing space conditioning ducts.

5. **Outdoor lighting.** Sections 110.9, 130.0, 130.2, 130.4, 140.7, and 150.0 apply to newly constructed outdoor lighting systems, and Section 141.0 applies to outdoor lighting that is either added or altered.

6. **Signs.** Sections 130.0, 130.3 and 140.8 apply to newly constructed signs located either indoors or outdoors, and Section 141.0 applies to sign alterations located either indoors or outdoors.

(f) **Mixed occupancy.** When a building is designed and constructed for more than one type of occupancy (residential and nonresidential), the space for each occupancy shall meet the provisions of Part 6 applicable to that occupancy.

Exception 1 to Section 100.0(f): If one occupancy constitutes at least 80 percent of the conditioned floor area of the building, the entire building envelope, HVAC and water heating may be designed to comply with the provisions of Part 6 applicable to that occupancy, provided that the applicable lighting requirements in Sections 140.6 through 140.8, 150.0(k), or 160.5 and 170.2(e) are met for each occupancy and space, and mandatory measures in Sections 110.0 through 130.5, 150.0, and 160.0 through 160.9 are met for each occupancy and space.

Exception 2 to Section 100.0(f): If one occupancy constitutes at least 90 percent of the combined conditioned plus unconditioned floor area of the building, the entire building indoor lighting may be designed to comply with only the lighting provisions of Part 6 applicable to that occupancy.

(g) **Administrative requirements.** Administrative requirements relating to permit requirements, enforcement by the Commission, locally adopted energy standards, interpretations, claims of exemption, approved calculation methods, rights of appeal, and certification and labeling requirements of fenestration products and roofing products are specified in California Code of Regulations, Title 24, Part 1, Sections 10-101 to 10-114.

(h) **Certification requirements for manufactured equipment, products and devices.** Part 6 limits the installation of manufactured equipment, products and devices to those that have been certified as specified by Sections 110.0 and 110.1.

Requirements for manufactured equipment, products, and devices, when not specified in Title 24 Part 6, are specified in California Code of Regulations, Title 20, Sections 1601–1609.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code*.

SECTION 100.1
DEFINITIONS AND RULES OF CONSTRUCTION

(a) **Rules of Construction.**

1. Where the context requires, the singular includes the plural and the plural includes the singular.
2. The use of "and" in a conjunctive provision means that all elements in the provision must be complied with or must exist to make the provision applicable. Where compliance with one or more elements suffices, or where existence of one or more elements makes the provision applicable, "or" (rather than "and/or") is used.
3. "Shall" is mandatory and "may" is permissive.

(b) **Definitions.** Terms, phrases, words and their derivatives in Part 6 shall be defined as specified in Section 100.1. Terms, phrases, words and their derivatives not found in Section 100.1 shall be defined as specified in the "Definitions" chapters of Title 24, Parts 1 through 5 of the California Code of Regulations. Where terms, phrases, words and their derivatives are not defined in any of the references above, they shall be defined as specified in *Webster's Third New International Dictionary of the English Language, Unabridged* (1961 edition, through the 2002 addenda), unless the context requires otherwise.

AAMA/WDMA/CSA 101/I.S.2/A440-17 are the American Architectural Manufacturers Association/Window and Door Manufacturers Association/Canadian Standards Association document titled "North American Fenestration Standard/ Specification for windows, doors, and skylights" (2017).

ACCA is the Air Conditioning Contractors of America.

ACCA MANUAL J is the Air Conditioning Contractors of America document titled "Manual J-Residential Load Calculation," (ANSI/ACCA 2 Manual J – 2016).

ACCEPTANCE REQUIREMENTS FOR CODE COMPLIANCE is a description of test procedures in the Reference Nonresidential Appendices that includes equipment and systems to be tested, functions to be tested, conditions under which the test shall be performed, the scope of the tests, results to be obtained and measurable criteria for acceptable performance.

ACCESSIBLE is having access thereto, but which first may require removal or opening of access panels, doors or similar obstructions.

ADDITION is any change to a building that increases conditioned floor area and conditioned volume. See also, "newly conditioned space." Addition is also any change that increases the floor area and volume of an unconditioned building of an occupancy group or type regulated by Part 6. Addition is also any change that increases the illuminated area of an outdoor lighting application regulated by Part 6.

ADIABATIC PAD is a material located before the heat transfer surface of an adiabatic condenser, which precools the ambient air by becoming fully wetted during precool mode operation.

AGRICULTURAL BUILDING is a structure designed and constructed to house farm implements, hay, grain, poultry, livestock or other horticultural products. It is not a structure that is a place of human habitation, a place of employment where agricultural products are processed, treated or packaged, or a place used by the public.

AHAM is the Association of Home Appliance Manufacturers.

AHAM HRH-2 is the Association of Home Appliance Manufacturers document titled "Residential Kitchen Range Hood Performance Test Procedures," 2020 (AHAM HRH-2).

AHAM RKRH-CPPG is the Association of Home Appliance Manufacturers document titled "Residential Kitchen Range Hood Certification Program Procedural Guide," 2020 (version 3).

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," 2017 (AHRI Standard 210/240-2017 with Addenda 1).

AHRI 310/380 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Packaged Terminal Air-Conditioners and Heat Pumps (CSA-C744-17)," 2004 (AHRI 310/380-2017).

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," 2019 (AHRI Standard 340/360 (I-P)-2019).

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

AHRI 400 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Liquid to Liquid Heat Exchangers," 2015 (ANSI/AHRI Standard 400 (I-P)-2015).

AHRI 430 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Central Station Air-handling Unit Supply Fans," 2020 (AHRI Standard 430 (I-P)-2020).

AHRI 440 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Fan-coil Units," 2019 (AHRI Standard 440 (I-P)-2019).

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 and Heat Pump Water-heating Packages Using the Vapor Compression Cycle," 2020 (AHRI Standard 550/590 (I-P)-2020).

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

AHRI 680 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Residential Air Filter Equipment," 2017 (AHRI Standard 680-2017).

AHRI 920 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Direct Expansion-Dedicated Outdoor Air System Units," 2020 (AHRI Standard 920 (I-P)-2020).

AHRI 1060 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment," 2018 (AHRI Standard 1060 (I-P)-2018).

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," 2014 (AHRI Standard 1230-2014) with Addendum 1.

AHRI 1360 is the Air-Conditioning, Heating and Refrigeration Institute document titled "Performance Rating of Computer and Data Processing Room Air Conditioners," 2017 (AHRI Standard 1360 (I-P)-2017).

AIR, AVAILABLE TRANSFER is that portion of total outdoor ventilation air that is not required to satisfy other exhaust needs or to maintain pressurization of other spaces and that is transferable according to Section 120.1(g).

AIR, INFILTRATION 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.

AIR, MAKEUP, or COMPENSATING OUTDOOR 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.

AIR, REPLACEMENT 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.

AIR, SUPPLY 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.

AIR, TRANSFER 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.

AIR BARRIER is a combination of interconnected materials and assemblies joined and sealed together to provide a continuous barrier to air leakage through the building envelope that separates conditioned from unconditioned space, or that separates adjoining conditioned spaces of different occupancies or uses.

AIR CONDITIONER is an appliance that supplies cooled and dehumidified air to a space for the purpose of cooling objects within the space.

AIR CURTAIN UNIT means equipment providing a directionally controlled stream of air moving across the entire height and width of an opening that reduces the infiltration or transfer of air from one side of the opening.

AIR FILTER, AIR FILTER EQUIPMENT, or **AIR FILTER DEVICE** is air-cleaning equipment used for removing particulate matter from the air.

AIR FILTER MEDIA is the part of the air filter equipment which is the actual particulate removing agent.

AIR-COOLED AIR CONDITIONER is an air conditioner using an air-cooled condenser.

AIR-HANDLING UNIT or **AIR HANDLER** is a blower or fan that distributes supply air to a room, space or area.

AIR-SOURCE HEAT PUMP is an appliance that consists of one or more factory-made assemblies that includes an indoor conditioning coil, a compressor and a refrigerant-to-air heat exchanger, and that provides heating and cooling functions.

AIR-TO-AIR HEAT EXCHANGER is a device which will reduce the heat losses or gains that occur when a building is mechanically ventilated, by transferring heat between the conditioned air being exhausted and outside air being supplied.

ALTERATION is any change to a building's water-heating system, space-conditioning system, lighting system, electrical power distribution system, or envelope that is not an addition. Alteration is also any change that is regulated by Part 6 to an outdoor lighting system that is not an addition. Alteration is also any change that is regulated by Part 6 to signs located either indoors or outdoors. Alteration is also any change that is regulated by Part 6 to a covered process that is not an addition. (See also "fenestration alteration".)

ALTERED COMPONENT is a component that has undergone an alteration.

ALTERNATING CURRENT-OUTPUT UNINTERRUPTIBLE POWER SUPPLY (AC-OUTPUT UPS) is a combination of converters, switches and energy storage devices, such as batteries, constituting a power system for maintaining continuity of load power in case of input power

failure. Input power failure occurs when voltage and frequency are outside rated steady-state and transient tolerance bands or when distortion or interruptions are outside the limits specified for the uninterruptible power supply. An AC-output UPS is an uninterruptible power supply that supplies power with a continuous flow of electric charge that periodically reverses direction.

ALTERNATIVE CALCULATION METHODS (ACM) are compliance software, or alternative component packages, or exceptional methods approved by the Commission under Section 10-109. ACMs are also referred to as Compliance Software.

ALTERNATIVE CALCULATION METHODS (ACM) APPROVAL MANUAL are the documents establishing the requirements for Energy Commission approval of Compliance Software used to demonstrate compliance with the Building Energy Efficiency Standards for Residential and Nonresidential Buildings currently adopted by the Energy Commission.

AMCA is the Air Movement and Control Association.

ANNUAL FUEL UTILIZATION EFFICIENCY (AFUE) is a measure of the percentage of heat from the combustion of gas or oil which is transferred to the space being heated during a year, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

ANNUNCIATED is a type of visual signaling device that indicates the on, off, or other status of a load.

ANSI is the American National Standards Institute.

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/AMCA 208 is the Air Movement and Control Association document titled "Calculation of the Fan Energy Index," 2018 (ANSI/AMCA 208-18).

ANSI/AMCA 210 is the Air Movement and Control Association document titled "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating," 2016 (ANSI/AMCA 210-16).

ANSI/AMCA STANDARD 500-D is the American National Standards Institute / Air Movement and Control Association document titled "Laboratory Methods of Testing Dampers for Rating," 2018 (ANSI/AMCA 500-D-2018).

ANSI/ASABE S640 is the American National Standards Institute/American Society of Agricultural and Biological Engineers document titled "Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)," 2017 (ANSI/ASABE S640 JUL2017).

ANSI/ASSPE Z9.5 is the American National Standards Institute document titled "Laboratory Ventilation," 2012 (ANSI/AIHA/ASSPE Z9.5-2012).

ANSI C82.6 is the American National Standards Institute document titled "AMERICAN NATIONAL STANDARD FOR LAMP BALLASTS—Ballasts for High-Intensity Discharge Lamps—Methods of Measurement," 2020 (ANSI C82.6-2015 (R2020)).

ANSI/CTA-2045-B is the American National Standards Institute document titled "Modular Communications Interface for Energy Management," 2021 (ANSI/CTA-2045-B-2021).

ANSI/NEMA WD 6 is the National Electrical Manufacturers Association Document titled "American National Standard for Wiring Devices—Dimensional Specification," 2016 (ANSI/NEMA WD 6-2016).

ANSI Z21.40.4a is the American National Standards Institute document titled "Performance Testing and Rating of Gas-Fired, Air Conditioning and Heat Pump Appliances," 2017 (ANSI Z21.40.4a-1996 (R2017)/CGA 2.94a-M96 (R2017)).

ANSI Z21.47 is the American National Standards Institute document titled "Gas-Fired Central Furnaces," 2021 (ANSI Z21.47-2021/CSA 2.3-2021).

ANSI Z83.8 is the American National Standards Institute document titled "Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces," 2016 (ANSI Z83.8-2016/CSA 2.6-2016 (R2021)).

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.")

ASCE 7-16 is the American Society of Civil Engineers Standard 7-16.

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" (I-P) (2019).

ASHRAE HANDBOOK, FUNDAMENTALS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "ASHRAE Handbook: Fundamentals" (I-P) (2017).

ASHRAE HANDBOOK, SYSTEMS AND 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" (I-P) (2020).

ASHRAE STANDARD 52.2 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Method of Testing General Ventilation Air-

FAN ELECTRICAL INPUT POWER (FAN kWdesign) is the electrical input power in kilowatts required to operate an individual fan or fan array at design conditions. It includes the power consumption of motor controllers, if present.

FAN ENERGY INDEX (FEI) is the ratio of the electric input power of a reference fan to the electric input power of the actual fan as calculated per ANSI/AMCA 208-18 at fan system design conditions.

FAN NAMEPLATE ELECTRICAL INPUT POWER (kW) is the nominal electrical input power rating stamped on a fan assembly nameplate.

FAN SYSTEM includes all the fans that contribute to the movement of air through a point of a common duct, plenum or cabinet.

FAN SYSTEM, COMPLEX means a fan system that combines a single-cabinet fan system with other supply fans, exhaust fans or both.

FAN SYSTEM, EXHAUST/RELIEF is a fan system dedicated to the removal of air from interior spaces to the outdoors.

FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV) is a fan system that serves three or more space-conditioning zones where airflow to each zone is individually controlled based on heating, cooling and/or ventilation requirements, indoor fan airflow varies as a function of load, and the sum of the minimum zone airflows for each zone is 40 percent or less of the fan system design conditions.

FAN SYSTEM, RETURN is a fan system dedicated to removing air from interior spaces where some or all of the air is to be recirculated except during economizer operation.

FAN SYSTEM, SINGLE-CABINET is a fan system where a single fan, a single-fan array, a single set of fans operating in parallel, or fans or fan arrays in series and embedded in the same cabinet both supply air to a space and recirculate the air.

FAN SYSTEM, SUPPLY-ONLY is a fan system that provides supply air to interior spaces and does not recirculate the air.

FAN SYSTEM, TRANSFER is a fan system that exclusively moves air from one occupied space to another.

FAN SYSTEM AIRFLOW (cfm) is the sum of the airflow of all fans with fan electrical input power greater than 1 kW at fan system design conditions, excluding the airflow that passes through downstream fans with fan input power less than 1 kW.

FAN SYSTEM DESIGN CONDITIONS are operating conditions that can be expected to occur during normal system operation that result in the highest supply airflow rate to or from the conditioned spaces served by the fan system.

FAN SYSTEM ELECTRICAL INPUT POWER (Fan $kW_{design,system}$) is the sum of the fan electrical input power (Fan kW_{design}) in kilowatts of all fans that are required to operate at fan system design conditions to supply air from the heating or cooling source to the conditioned spaces, return it to the source, exhaust it to the outdoors or transfer it to another space.

FENESTRATION: Includes the following:

ACE is an NFRC-Approved Calculation Entity 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.

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.

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.

CLERESTORY FENESTRATION is fenestration installed above a roofline greater than or equal to 60 degrees from the horizontal, or any portion of exterior vertical glazing greater than 8 feet per floor above the finished floor of a space.

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.

Note: Window wall is also included as part of the curtain wall/storefront fenestration category.

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 perfor-

mance 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.

FENESTRATION 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.

FENESTRATION AREA is the rough opening area of any fenestration product.

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, glazed doors, skylights, curtain walls, dynamic glazing, garden windows, glass block and glazing used in greenhouses.

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, alteration) 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.

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.

HORIZONTAL SLATS, when referring to a daylighting device, is a set of adjacent surfaces located directly adjacent to vertical fenestration, oriented horizontally and projecting horizontally from its interior or exterior vertical surface.

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.

LIGHT SHELF is an adjacent, opaque surfaced daylighting device located at the sill of clerestory glazing, oriented horizontally and projecting horizontally from an interior or exterior vertical surface.

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.

NFRC 100 is the National Fenestration Rating Council document titled "Procedure for Determining Fenestration Product *U*-factors," (2020) (ANSI/NFRC 100-2020).

NFRC 200 is the National Fenestration Rating Council document titled "Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence," (2020) (ANSI/NFRC 200-2020).

NFRC 202 is the National Fenestration Rating Council document titled "Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence," (2020) (ANSI/NFRC 202-2020).

NFRC 203 is the National Fenestration Rating Council document titled "Procedure for Determining Visible Transmittance of Tubular Daylighting Devices," (2020) (ANSI/NFRC 203-2020).

NFRC 400 is the National Fenestration Rating Council document titled "Procedure for Determining Fenestration Product Air Leakage," (2020) (ANSI/NFRC 400-2020).

OPERABLE SHADING DEVICE is a device at the interior or exterior of a building or integral with a fenestration product, which is capable of being operated, either manually or automatically, to adjust the amount of solar radiation admitted to the interior of the building.

efficiency (MRE) ratings required for DX-DOAS units, expressed in lb of moisture/kWh.

IES LM-79-19 is an American National Standard authored by the Illuminating Engineering Society and titled "Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products," (2019) (ANSI/IES LM-79-19).

IES LS-1-20 is an American National Standard authored by the Illuminating Engineering Society and titled "Lighting Science: Nomenclature and Definitions for Illuminating Engineering," 2020 (ANSI/IES LS-1-20).

IES TM-15-20 is an American National Standard authored by the Illuminating Engineering Society and titled "Technical Memorandum: Luminaire Classification System for Outdoor Luminaires," (2020) (ANSI/IES TM-15-20).

INDOOR GROWING is a type of CEH space in a building with a Skylight Roof Ratio less than 50 percent. Growing plants in a warehouse with or without skylights is an example of indoor growing.

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.

INFORMATION TECHNOLOGY EQUIPMENT (ITE) includes computers, data storage, servers and network/communication equipment located in a computer room.

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

INTEGRATED HVAC SYSTEM is an HVAC system designed to handle both sensible and latent heat removal. Integrated HVAC systems may include, but are not limited to: HVAC systems with a sensible heat ratio of 0.65 or less and the capability of providing cooling, dedicated outdoor air systems, single package air conditioners with at least one refrigerant circuit providing hot gas reheat, and dehumidifiers modified to allow external heat rejection.

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

ISO 5801 is the International Organization for Standardization document titled "Fans—Performance testing using standardized airways," 2017 (ISO 5801:2017).

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," 2012 [ANSI/AHRI/ASHRAE ISO 13256-1:1998 (RA 2012)].

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," 2012 [ANSI/AHRI/ASHRAE ISO 13256-2-01 (R2012)].

ISO 17025 is the International Organization for Standardization document titled "General Criteria for the Competence of Testing and Calibration Laboratories," 2017 (ISO/IEC 17025:2017).

ITE DESIGN LOAD is the combined power of all the ITE loads for which the ITE cooling system is designed.

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 to emphasize a particular object or surface feature, or to draw attention to a part of the field of view. It can be recessed, surface mounted or mounted to a pendant, stem or track, and can be display lighting. It shall not provide general lighting.

Astronomical time-switch control is a lighting control that controls 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 adjusts the luminous flux of the electric lighting system either in 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 scheduling control is a time-based lighting control that is capable of being programmed to reduce or turn off lighting power for a portion of the night and to turn off lighting power for the day.

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.

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

Color Rendering Index (CRI) is a measure of the degree of color shift that objects undergo when illuminated by the lighting source as compared with the color of the same objects when illuminated by a reference source of comparable color temperature. CRI is calculated according to CIE 13.3.

Colored light source is a light source designed and marketed as a colored light source and not designed or marketed for general lighting applications with either of the following characteristics maintained throughout all modes of operation including color changing operation:

(1) A Color Rendering Index (CRI) less than 40, as determined according to the method set forth in CIE Publication 13.3; or

(2) A Correlated Color Temperature as measured with ANSI/IES LM-66-20 or ANSI/IES LM-79-19 (as appropriate) and calculated with CIE 15, which does not have a corresponding nominal CCT designation in ANSI C78.377-2017.

Compact fluorescent lamp is a fluorescent lamp with a small-diameter glass tube (T5 or smaller) that is folded, bent or bridged to create a long discharge path in a small volume. The lamp designs generally include an amalgam and a cold chamber, or a cold spot, to control the mercury vapor pressure and light output. The lamp designs generally include an amalgam and a cold chamber, or a cold spot, to control the mercury vapor pressure and light output.

Correlated Color Temperature (CCT) is the absolute temperature of a blackbody whose chromaticity most nearly resembles that of the light source.

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

Daylight continuous dimming controls are continuous dimming controls that vary the luminous flux in response to available daylight.

Decorative (lighting/luminaires) is lighting or luminaires installed only for aesthetic purposes and that does not serve as display lighting or general lighting. Decorative luminaires are chandeliers, sconces, lanterns, neon or cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels not providing general lighting or task lighting.

Dimmer is a device used to control the intensity of light emitted by a luminaire by controlling the voltage or current available to it.

Dimmer, continuous means a dimmer that 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, forward phase cut varies the luminous flux of the electric lighting system in which a portion of the alternating current voltage waveform supplying to the light source is removed.

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.

Display lighting, case is lighting that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance of small art objects, artifacts or valuable collections that involve customer inspection of very fine detail from outside of a glass enclosed display case.

Display lighting, floor is supplementary lighting that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance required to highlight features, such as merchandise on a clothing rack or sculpture or free standing of artwork, not displayed against a wall.

Display lighting, wall is supplementary lighting that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance required to highlight features, such as merchandise on a shelf or wall-mounted artwork, displayed on perimeter walls.

Display lighting, window is lighting that provides a higher level of illuminance to a specific area than the level of surrounding ambient illuminance of objects such as merchandise, goods and artifacts, in a show window, to be viewed from the outside of a space through a window.

Driver, when used in relation to solid state lighting, is a device that uses semiconductors to control and supply dc power for LED starting and operation.

Enclosed luminaires are luminaires which contain enclosed lamp compartments where ventilation openings are less than 3 square inches per lamp in the lamp compartment as defined by UL 1598.

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 area density of the luminous flux incident at a point on a surface.

Illumination is commonly used in a qualitative sense to designate the act of illuminating or the state of being illuminated.

Inseparable Solid State Lighting (SSL) Luminaire is a luminaire featuring solid state lighting components such as LEDs, light engines and/or driver components which cannot be easily removed or replaced by the end user, thus requiring replacement of the entire luminaire. Removal of

solid state lighting components may require the cutting of wires, use of a soldering iron, or damage to or destruction of the luminaire. If solid state lighting components are not removable without destruction to the luminaire, the luminaire is deemed inseparable.

Institutional tuning is the process of adjusting the maximum light output of lighting systems to support visual needs or save energy. Institutional tuning differs from personal tuning in that the control strategy is implemented at the institutional rather than the individual user level, and maximum light level adjustments are available only to authorized personnel.

Integrated LED lamp is an integrated assembly composed of light emitting diode (LED) packages (components) or LED arrays (modules), as well as an LED driver, an ANSI standard base, and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a corresponding ANSI standard lamp-holder (socket). (ANSI/IES LS-1-20)

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. A lamp is not a luminaire and is not an LED retrofit kit.

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.

LED driver is a device composed of a power source and light emitting diode (LED) control circuitry designed to operate an LED package (component), an LED array (module) or an LED lamp. An LED driver is a power source that adjusts the voltage or current to LEDs, ranging in complexity from a resistor to a constant voltage or constant current power supply. An LED driver is also known and referred to as lamp control gear.

LED light engine is an integrated assembly composed of light emitting diode (LED) packages (components) or LED arrays (modules), as well as an LED driver and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit through a custom connector compatible with the LED luminaire for which it was designed. It does not use an ANSI standard base.

LED retrofit kit is a solid state lighting product intended to replace existing light sources and systems, including incandescent and fluorescent light sources, in previously installed luminaires that already comply with safety standards. These kits replace the existing light source and related electrical components, and are classified or certified to UL 1598C. They may employ an ANSI standard lamp base, either integral or connected to the retrofit by wire leads. LED retrofit kit does not include self-ballasted lamps.

Light is a form of radiant energy that is capable of exciting the retina and producing a visual sensation. The visible portion of the electromagnetic spectrum extends from about 380 to about 770 nanometers.

Lighting, or illumination, is commonly used in a qualitative or general sense to designate the act of illuminating or the state of being illuminated.

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 the functionality required to make up a fully functional and compliant lighting control.

Light emitting diode (LED) is a p-n junction semiconductor device that emits incoherent optical radiation when forward-biased. The optical emission may be in the ultraviolet, visible or infrared wavelength regions.

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 is less than 90 volts.

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

Luminaire is a complete lighting unit consisting of a light source such as a lamp or lamps, together with the parts that distribute the light, to position and protect the light source, and to connect the light source to the power supply.

Luminaire alteration is adding luminaires, removing and reinstalling luminaires, or combined replacement of lamps and ballasts or drivers. Luminaire alterations do not include repairs, such as replacing lamps only, ballasts or drivers only, diffusers, shades or luminaire covers.

Luminance is the luminous intensity of the source or surface divided by the area of the source or surface seen by the observer.

Luminous efficacy is a measure of the luminous efficiency of a light source. It is the quotient of the total luminous flux emitted by the total light source power input, expressed in lm/W.

Luminous flux is the time rate of flow of radiant energy, evaluated in terms of a standardized visual response.

Luminous maintenance (often referred to as “lumen flux maintenance” or “lumen maintenance”) is the remaining luminous flux output, typically expressed as a percentage of initial luminous flux output, at any selected elapsed operating time. Luminous maintenance is the converse of luminous flux depreciation (or “lumen depreciation”).

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

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.

Narrow band spectrum is a limited range of wavelengths (nm) concentric to a dominant peak wavelength in the visible spectrum. The limited range of wavelength shall be within 20 nm on either side of the peak wavelength at 50 percent of the peak wavelength's relative spectral power, and within 75 nm on either side of the peak wavelength at 10 percent of the peak wavelength's relative spectral power.

NEMA LSD 57 is the National Electrical Manufacturers Association document titled "Polyurethane Foam Application: Lighting Equipment," 2018 (NEMA LSD 57-2018).

NEMA SSL 7A is the National Electrical Manufacturers Association document titled "Phase Cut Dimming for Solid State Lighting: Basic Compatibility," 2015 (NEMA SSL 7A-2015).

Non-integrated LED lamp is an assembly composed of a light emitting diode (LED) array (module) or LED packages (components), and an ANSI standard base. The device is intended to connect to the LED driver of an LED luminaire through an ANSI standard lamp-holder (socket). The device cannot be connected directly to the branch circuit. (ANSI/IES LS-1-20)

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

Motion sensing control is used outdoors, automatically reduces lighting power or turns lights OFF after an area is vacated of occupants, and automatically turns the lights ON when the area is occupied.

Occupant sensing control is used indoors, automatically reduces lighting power or 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 or motion sensing control 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 or motion sensing control automatically dims the lighting or turns OFF part of the lighting load after an area is vacated of occupants, and is capable of automatically turning ON the lighting load or restoring it to full when an area is occupied.

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

One-to-one alteration is either replacement of whole luminaires one for one, in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire, or when components of a luminaire are modified without replacing the entire luminaire.

Ornamental lighting/Luminaires are lighting or luminaires installed outdoors that are rated for 50 watts or less that are post-top luminaires, lanterns, pendant luminaires, chandeliers and marquee lighting, not providing general lighting or task lighting.

Pendant luminaire (Suspended luminaire) is a luminaire that is hung from a ceiling by supports.

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.

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 dim or brighten the electric lights in response.

Portable lighting is lighting equipment designed for manual portability, 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 energy is energy travelling in the form of electromagnetic waves. It is measured in units of energy such as joules or kilowatt hours.

Radiant power is the time rate of flow of radiant energy. It is expressed preferably in watts.

Recessed luminaire is a luminaire that is mounted in the ceiling or behind a wall or other surface with the opening of the luminaire flush with the surface.

Sconce is a wall mounted decorative accent luminaire.

Security cameras are any operational camera used to enhance the safety and security within a general hardscape area.

Shut-off controls are any lighting control capable of automatically shutting OFF the lighting in a space when the space is typically unoccupied.

Solid State Lighting (SSL) is a family of light sources that includes: semiconductor light emitting diodes (LEDs); and organic light emitting diodes (OLEDs).

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 directed to a specific surface or area, providing illumination for visual tasks. Task lighting is not general lighting.

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 lighting equipment system consisting of an electrified power channel (track) and removable luminaires (lamp holders; track heads) that can be mechanically attached anywhere along the power channel. The luminaires can be repositioned and re-aimed as desired. Track lighting includes the following types:

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.

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.

Tunable lighting are light sources with the ability to alter their luminous flux and/or spectral power distribution. Tunable lighting includes the following types:

Color tunable light source is capable of emitting highly saturated light of varying hues, as well as white light, for example by varying the relative intensity of individual emitters within the light source.

Dim-to-warm (also known as warm dim) light source is capable of simultaneously decreasing its correlated color temperature as its light output decreases, typically resembling the change in color temperature of an incandescent lamp as it dims.

Tunable white light source is capable of adjusting its correlated color temperature while maintaining its relative light output and capable of adjusting its light output while maintaining its correlated color temperature.

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, 2017).

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

R-2, multifamily, with three habitable stories or less; or

R-3, single family; or

U-building, located on a residential site.

LPG is liquefied petroleum gas.

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.

MECHANICAL COOLING is lowering the temperature within a space using refrigerant compressors or absorbers, desiccant dehumidifiers or other systems that require energy to directly condition the space. Systems that are solely energy recovery ventilation (ERV) or heat recovery ventilation (HRV) are not considered mechanical cooling. In nonresidential, multifamily buildings 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 to directly condition the space. Systems that only use solar energy or heat recovery as the heat source are not mechanical heating systems.

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.

MULTIFAMILY BUILDING is any of the following:

A building of Occupancy Group R-2, other than a hotel/motel building or timeshare property,

A building of Occupancy Group R-3 that is a nontransient congregate residence, other than boarding houses of more than 6 guests and alcohol or drug abuse recovery homes of more than 6 guests, or

A building of Occupancy Group R-4.

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.

NATURAL GAS AVAILABILITY. For newly constructed buildings, natural gas is available if a gas service line can be connected to the site without a gas main extension. For addition and alteration, natural gas is available if a gas service line is connected to the existing building.

NEEA is the Northwest Energy Efficiency Alliance.

NEEA ADVANCED WATER HEATER SPECIFICATION is the Northwest Energy Efficiency Alliance (NEEA) specification version 7.0 for heat pump water heaters.

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

NET SENSIBLE COEFFICIENT OF PERFORMANCE (COP) is defined by AHRI 1360 and includes all indoor unit power and air-cooled condenser/condensing unit power for air-cooled units and includes all indoor unit power and the power allowance for pump and heat rejection as described in the Heat Rejection/Cooling Fluid Standard Rating Conditions table of AHRI 1360 for water, glycol and chilled water units.

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.

NONRESIDENTIAL BUILDING is any building which is identified in the *California Building Code* Table; Description of Occupancy as Group A, B, E, F, H, I, M, or S, and is a U; as defined by Part 2 of Title 24 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:

Assembly building is a building with meeting halls in which people gather for civic, social, or recreational activities. These include civic centers, convention centers and auditoriums.

Commercial and industrial storage building is a building with building floor areas used for storing items.

Financial institution building is a building with floor areas used by an institution which collects funds from the public and places them in financial assets such as deposits, loans, and bonds.

Grocery store building is a building with building floor areas used for the display and sale of food.

Gymnasium building is a building with building floor areas used for physical exercises and recreational sport events and activities.

Industrial/manufacturing facility building is a building with building floor areas used for performing a craft, assembly or manufacturing operation.

Library building is a building with building floor areas used for repository of literary materials and for reading reference, such as books, periodicals, newspapers, pamphlets and prints.

Motion picture theater building is a building with building floor areas used for showing motion pictures to audiences.

Museum building is a building with building floor areas in which objects of historical, scientific, artistic or cultural interests are curated, treated, preserved, exhibited and stored.

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

Parking garage building is a building with building floor areas used for parking vehicles, and 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.

Performance arts theater building is a building with building floor areas used for showing performing arts that include plays, music or dance to audiences.

Religious facility building is a building with building floor areas used for assembly of people to worship.

Restaurant building is a building with building floor areas in which food and drink are prepared and served to customers in return for money.

Retail store building is a building with building floor areas used for the display and sale of merchandise except food.

School building is a building used by an educational institution. The building floor area can include classrooms or educational laboratories and may include an auditorium, gymnasium, kitchen, library, multipurpose room, cafeteria, student union or workroom. A maintenance or storage building is not a school building.

Sports arena building is a building with building floor areas used for public viewing of sporting events and activities. Sports arenas are classified according to the number of spectators they are able to accommodate, as follows:

Class I Facility is used for competition play for 5,000 or more spectators.

Class II Facility is used for competition play for up to 5,000 spectators.

Class III Facility is used for competition play for up to 2,000 spectators.

Class IV Facility is normally used for recreational play and there is limited or no provision for spectators.

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.

Audience seating area is a room or area with fixed seats for public meetings or gatherings.

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

Auto repair/maintenance area is an area used to repair or maintain automotive equipment and/or vehicles.

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

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

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

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 area are rooms or areas that are designed or used for meetings, conventions or events, and that have neither fixed seating nor fixed staging.

Copy room is a room or area used for copying, scanning, or binding documents.

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

Dining areas include the following:

Bar/lounge is a room or area where wait staff serve patrons with liquor, cocktails, wine and beer in a relaxed atmosphere, usually with tables and chairs.

Cafeteria/fast food is a room or area where customers pick up their food at a counter and there is little or no wait staff or table service.

Family dining is a room or area where wait staff serve patrons with meals in a casual atmosphere.

Fine dining is a room or area where wait staff serve patrons with meals in an elegant and formal atmosphere.

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

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.

Healthcare facilities may have a room or area as follows:

Exam/treatment room is a room or area 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 laboratories and treatment spaces.

Imaging room is a diagnostic room and area for application and review of results from imaging technologies including x-ray, ultrasound, computerized tomography (CT) and magnetic resonance imaging (MRI).

Medical supply room is a room or area used for storing medical supplies.

Nursery is a room or area for providing medical care for newly born infants.

Nurse's station is a room or area where health care staff work when not directly interacting with patients.

Operating room is a room or area where surgical operations are carried out in a sterile environment. This category also applies to veterinary operating rooms.

Patient room is a room or area that is occupied by one or more patients during a stay in a healthcare facility or hospital.

Physical therapy room is a room or area for providing physical therapy treatment.

Recovery room is a room or area that is equipped with apparatus for meeting postoperative emergencies and in which surgical patients are kept during the immediate postoperative period for care and recovery from anesthesia.

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 area is a room or area with cooking facilities or where food is prepared.

Laboratory, scientific area 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 area 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, main entry is the contiguous area in buildings including 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 room is a room or area for changing clothing, sometimes equipped with lockers.

Lounge/breakroom or waiting area is a room or area in which people 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.

Manufacturing, 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.

Multipurpose room is a room that can be used for multipurpose activities such as meetings, instructional activities and social gatherings. Multipurpose rooms are typically found in offices, schools, convention centers, and assisted living facilities.

Museum areas include the following:

Exhibit/display 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.

Restoration room is a room or area in which the primary function is the care of works of artistic, historical or scientific value. A restoration does not include a gallery or other place where art is for sale. A restoration 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.

Parking garage areas include the following:

Daylight adaptation zone in a parking garage is the interior path of travel for vehicles adjacent to the entrance or exit of a parking garage as needed for visual adaptation to transition from exterior daylight levels to interior light levels. Daylight adaptation zones only include the path of vehicular travel and do not include adjacent parking areas.

Parking zones and ramps in a parking garage are used for the purpose of parking and maneuvering of vehicles. Parking areas include sloping floors of a parking garage, ramps and driveways specifically for the purpose of moving vehicles between floors of a parking garage. Parking areas and ramps do not include daylight adaptation zones or the roof of a parking garage, which may be present in a parking garage.

Pharmacy area is a room or area where medicinal drugs are dispensed and sold, usually in a retail store.

Playing area for sports arena is an area where sports are played in front an audience.

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 sales areas include the following:

Fitting room is a room or area where the retail customers try out clothing before purchasing.

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

Retail merchandise sales 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.

Storage, commercial and industrial area includes the following:

Shipping & Handling is a room or areas used for packing, wrapping, labeling and shipping out goods, merchandise and materials.

Warehouse is a room or areas used for storing of items such as goods, merchandise and materials.

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 rows of seats for the showing of motion pictures.

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

Transportation function areas include the following:

Baggage area is a room or area in a transportation facility such as an airport where the travelers reclaim their baggage.

Ticketing area is a room or area in a transportation facility such as an airport or a train station where travelers purchase tickets, check in baggage, or inquire about travel information.

Videoconferencing studio is a room or area 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.

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.")

OCCUPANCY is the purpose for which a building or part thereof is used or intended to be used.

OCCUPANCY, HUMAN is any occupancy that is intended primarily for human activities.

OCCUPANCY GROUP is a classification of occupancy defined in Chapter 3 of the CBC (Title 24, Part 2).

OCCUPANCY TYPE is a description of occupancy that is more specific than occupancy group and that relates to determining the amount of lighting, ventilation, or other services needed for that portion of the building.

OCCUPIABLE SPACE is any enclosed space that is intended for human occupancy, including all habitable spaces as well as bathrooms, toilets, closets, halls, storage and utility areas, laundry areas, and similar areas. (See also "habitable space.")

OCCUPIED STANDBY MODE is when a zone is scheduled to be occupied and an occupant sensor indicates zero population within the zone.

ONLINE CAPACITY is the total combined capacity in actual cubic feet per minute of compressed air at a given pressure from all online compressors.

ONLINE COMPRESSORS are all the compressors that are physically connected to compressed air piping and are available to serve peak load. Online compressors do not include back up compressors whose only purpose is to be available when an online compressor fails.

OPEN COOLING TOWER, or OPEN-CIRCUIT 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.

OPENADR 2.0a is the OpenADR Alliance document titled "OpenADR 2.0 Profile Specification A Profile," 2011.

OPENADR 2.0b is the OpenADR Alliance document titled "OpenADR 2.0 Profile Specification B Profile," 2015.

OPERABLE FENESTRATION is designed to be opened or closed.

OPTIMUM START CONTROLS are controls that are designed to automatically adjust the start time of a space-conditioning system each day with the intent of bringing the space to desired occupied temperature levels at the beginning of scheduled occupancy.

OPTIMUM STOP CONTROLS are controls that are designed to setup or setback thermostat setpoints before scheduled unoccupied periods based upon the thermal lag and acceptable drift in space temperature that is within comfort limits.

OSHPD is the California Office of Statewide Health Planning and Development.

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

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

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 is electrical lighting used to illuminate outdoor areas.

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 LZ0, LZ1, LZ2, LZ3 and LZ4.

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

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.

PHOTOSYNTHETIC PHOTON EFFICACY (PPE) is photosynthetic photon flux divided by input electric power in units of micromoles per second per watt, or micromoles per joule as defined by ANSI/ASABE S640.

PHOTOSYNTHETIC PHOTON FLUX (PPF) is the rate of flow of photons between 400 to 700 nanometers in wavelength from a radiation source as defined by ANSI/ASABE S640.

POOLS, ANSI/APSP/ICC-5 is the American National Standards Institute and National Spa and Pool Institute document entitled "American National Standard for Residential Inground Swimming Pools," 2011 (ANSI/APSP/ICC-5 2011) with Addenda A.

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 or more speeds and includes two-speed and variable-speed pumps.

POOLS, NSF/ANSI/CAN 50 is the NSF International (formerly National Sanitation Foundation) Standard and American National Standards Institute document entitled "Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs, and Other Recreational Water Facilities," 2020 (NSF/ANSI/CAN 50—2020).

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 is a process that is regulated under Part 6, Sections 120.6 and 140.9, which includes computer rooms, data centers, elevators, escalators and moving walkways, laboratories, enclosed parking garages, commercial kitchens, refrigerated warehouses, commercial refrigeration, compressed air systems, process boilers and controlled environment horticultural spaces.

PROCESS, EXEMPT is a process that is not a covered process regulated under Part 6.

PROCESS LOAD is an energy load resulting from a process.

PROCESS SPACE is a nonresidential space that is designed to be 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 is a building that is simulated by Commission-approved compliance software to determine the energy consumption resulting from all of the characteristics and energy consuming features that are actually proposed for a building, as specified by 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.

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.

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.

RESNET 380 is the Residential Energy Services Network document titled "Standard for Testing Airtightness of Building Enclosures, Dwelling Unit, and Sleeping Unit Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems," 2019 (ANSI/RESNET/ICC 380-2019).

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 less than 2:12 (9.5 degrees from the horizontal).

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

ROOF RECOVER is the process of installing an additional roof covering over a prepared existing roof covering without removing the existing roof covering.

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.

ROOF REPLACEMENT is the process of removing the existing roof covering, repairing any damaged substrate and installing a new roof covering.

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.

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

SAE J1772 is the SAE International document titled "SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler" (SAE J1772_201710).

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.

SEAL CLASS A is a ductwork sealing category that requires sealing all transverse joints, longitudinal seams and duct wall penetrations. Duct wall penetrations are openings made by pipes, conduit, tie rods or wires. Longitudinal seams are joints oriented in the direction of airflow. Transverse joints are connections of two duct sections oriented perpendicular to airflow. Openings for rotating shafts shall be sealed with bushings or other devices that seal off air leakage. All connections shall be sealed, including but not limited to spin-ins, taps, other branch connections, access doors, access panels and duct connections to equipment. Sealing that would void product listings is not required. All duct pressure class ratings shall be designated in the design documents.

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.

SEASONAL ENERGY EFFICIENCY RATIO 2 (SEER2) is the SEER metric for residential central air conditioners and heat pumps effective January 1, 2023, as created by the U.S. Department of Energy "ISSUANCE 2016-11-30 Energy Conservation Program: Test Procedures for Central Air Conditioners and Heat Pumps, Final Rule."

SENSIBLE ENERGY RECOVERY RATIO is a ratio of the change in the dry-bulb temperature of the outdoor air supply to the difference in dry-bulb temperature between the outdoor air and entering exhaust airflow, with no adjustment to account for that portion of the dry-bulb temperature change in the leaving supply airflow that is the result of leakage of entering exhaust airflow rather than heat exchange between the airstreams.

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.

SIDELIT DAYLIT ZONE, PRIMARY is the area in plan view directly adjacent to each vertical glazing, one window head height deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

SIDELIT DAYLIT ZONE, SECONDARY is the area in plan view directly adjacent to each vertical glazing, two window head heights deep into the area, and window width plus 0.5 times window head height wide on each side of the rough opening of the window, minus any area on a plan beyond a permanent obstruction that is 6 feet or taller as measured from the floor.

SIGN definitions include the following:

Electronic message center (EMC) is a pixelated image producing electronically controlled sign formed by any light source. Bare lamps used to create linear lighting animation 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 BUILDING is any of the following:

A residential building of Occupancy Group R-3 with two or fewer dwelling units,

A building of Occupancy Group R-3, other than a multi-family building or hotel/motel building,

A townhouse,

A building of Occupancy Group R-3.1 or

A building of Occupancy Group U when located on a residential site.

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 controlled by a single thermostat.

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).

SKYLIT DAYLIT ZONE is the rough area in plan view under each skylight, plus 0.7 times the average ceiling height in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than one-half of the distance from the floor to the bottom of the skylight. The bottom of the skylight is measured from the bottom of the skylight well for skylights having wells, or the bottom of the skylight if no skylight well exists. For the purpose of determining the skylit daylit zone, the geometric shape of the skylit daylit zone shall be identical to the plan view geometric shape of the rough opening of the skylight; for example, for a rectangular skylight the skylit daylit zone plan area shall be rectangular, and for a circular skylight the skylit daylit zone plan area shall be circular. For skylight located in an atrium, the skylit daylit zone shall include the floor area directly under the atrium, and the area of the top floor that is directly under the skylight, plus 0.7 times the average ceiling height of the top floor, in each direction from the edge of the rough opening of the skylight, minus any area on a plan beyond a permanent obstruction that is taller than one-half of the distance from the top floor to the bottom of the skylight.

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 is the Sheet Metal Contractors' National Association document entitled "Residential Comfort System Installation Standards, Eighth Edition," (2016).

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

SOLAR ELECTRIC GENERATION SYSTEM or PHOTOVOLTAIC SYSTEM is the complete set of all components for converting sunlight into electricity through the photovoltaic process, including the array of panels, inverter(s) and the balance of system components required to enable the system to effectively deliver power to reduce a building's consumption of electricity from the utility grid.

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 mechanical heating or mechanical 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.

STANDARD DESIGN BUILDING is a building that is automatically simulated by Commission-approved compliance software to establish the energy budget that is the maxi-

mum energy consumption allowed by a proposed design building to comply with the Title 24 Building Energy Efficiency Standards. The standard design building is simulated using the same location and having the same characteristics of the proposed design building, but assuming minimal compliance with the mandatory and prescriptive requirements that are applicable to the proposed building, as specified by the Alternative Calculation Methods Approval 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 with a high overall heat capacity to store energy for heating or 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 × ft^2 × °F)/Btu.

THERMOSTAT is an automatic control device or system used to maintain temperature at a fixed or adjustable setpoint.

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.

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.

TRANSCRITICAL CO_2 REFRIGERATION SYSTEM is a type of refrigeration system that uses CO_2 as the refrigerant where the ultimate heat rejection to ambient air can take place above the critical point.

SUBCRITICAL MODE is a system operating condition for a refrigeration system wherein the refrigerant pressure and temperature leaving the compressor is such that the refrigerant is below the critical point. Typically used in reference to CO_2 refrigeration systems.

TRANSCRITICAL MODE is a system operating condition for a refrigeration system wherein the refrigerant pressure and temperature leaving the compressor is such that the refrigerant is at or above the critical point. Typically used in reference to CO_2 refrigeration systems.

TRANSIENT is the occupancy for not more than 30 days of a dwelling unit or sleeping unit.

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 × ft^2 × °F), including air film resistance at both surfaces.

UL is the Underwriters Laboratories.

UL 181 is the Underwriters Laboratories document titled "Standard for Safety for Factory-Made Air Ducts and Air Connectors," 2017 (UL 181).

UL 181A is the Underwriters Laboratories document titled "Standard for Safety for Closure Systems for Use with Rigid Air Ducts," 2017 (UL 181A).

UL 181B is the Underwriters Laboratories document titled "Standard for Safety for Closure Systems for Use with Flexible Air Ducts and Air Connectors," 2017 (UL 181B).

UL 723 is the Underwriters Laboratories document titled "Standard for Safety for Test for Surface Burning Characteristics," 2018 (UL 723).

UL 727 is the Underwriters Laboratories document entitled "Standard for Safety for Oil-Fired Central Furnaces," 2018 (UL 727).

UL 731 is the Underwriters Laboratories document entitled "Standard for Safety for Oil-Fired Unit Heaters," 2018 (UL 731).

UL 1077 is the Underwriters Laboratories document titled "Standard for Safety for Supplementary Protectors for Use in Electrical Equipment," 2016 (UL 1077).

UL 1574 is the Underwriters Laboratories document entitled "Standard for Safety for Track Lighting Systems," 2020 (UL 1574).

UL 1598 is the Underwriters Laboratories document entitled "Standard for Safety for Luminaires," 2021 (UL 1598).

UL 1741 is the Underwriters Laboratories document titled "Standard for Safety for Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources," 2021 (UL 1741).

UL 1973 is the Underwriters Laboratories document titled "Standard for Safety for Batteries for Use in Stationary, Vehicle Auxiliary Power and Light Electric Rail (LER) Applications," 2018 (ANSI/CAN/UL-1973:2018).

UL 2108 is the Underwriters Laboratories document titled "Standard for Safety for Low Voltage Lighting Systems," 2019 (UL 2108).

UL 8750 is the Underwriters Laboratories document titled "Standards for Safety for Light Emitting Diode (LED) Equipment for Use in Lighting Products," 2021 (UL 8750).

UL 9540 is the Underwriters Laboratories document titled "Standard for Safety for Energy Storage Systems and Equipment," 2020 (ANSI/CAN/UL 9540:2021).

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

UNIFORM ENERGY FACTOR (UEF) of a water heater is a measure of overall water heater efficiency, as determined using the applicable test method in the Appliance Efficiency Regulations.

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 applicable appendices.

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.

VENTILATION SYSTEM, BALANCED is a mechanical device intended to remove air from buildings, and simultaneously replace it with outdoor air.

VENTILATION SYSTEM, CENTRAL FAN INTEGRATED, or CFI is a ventilation system configuration in which the ventilation ductwork is connected to the duct system of a dwelling unit space-conditioning system to enable distribution of ventilation air to the dwelling unit while the space-conditioning system air handling unit is operating.

VENTILATION SYSTEM, ENERGY RECOVERY, or ERV is a mechanical device intended to remove air from buildings, simultaneously replace it with outdoor air, and in the process transfer heat from the warmer to the colder of the simultaneous airflows and transfer moisture from the most humid to least humid of the simultaneous airflows.

VENTILATION SYSTEM, EXHAUST is a mechanical device intended to remove air from buildings, causing outdoor air to enter by ventilation inlets or normal leakage paths through the building envelope.

VENTILATION SYSTEM, HEAT RECOVERY, or HRV is a mechanical device intended to remove air from buildings, simultaneously replace it with outdoor air, and in the process transfer heat from the warmer to the colder of the simultaneous airflows.

VENTILATION SYSTEM, SUPPLY is a mechanical device intended to bring outdoor air into buildings, causing indoor air to flow out of the building through ventilation relief outlets or normal leakage paths through the building envelope.

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.

VIRTUAL END NODE (VEN) is an interface with a demand responsive control system that accepts signals transmitted through OpenADR, consistent with the specifications in OpenADR 2.0a or 2.0b.

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

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

WOOD STOVE (See "wood heater.")

ZONAL describes characterized by or relating to a zone or zones.

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 computer rooms, 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, nat-

ural 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.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8 and 25943, *Public Resources Code*.

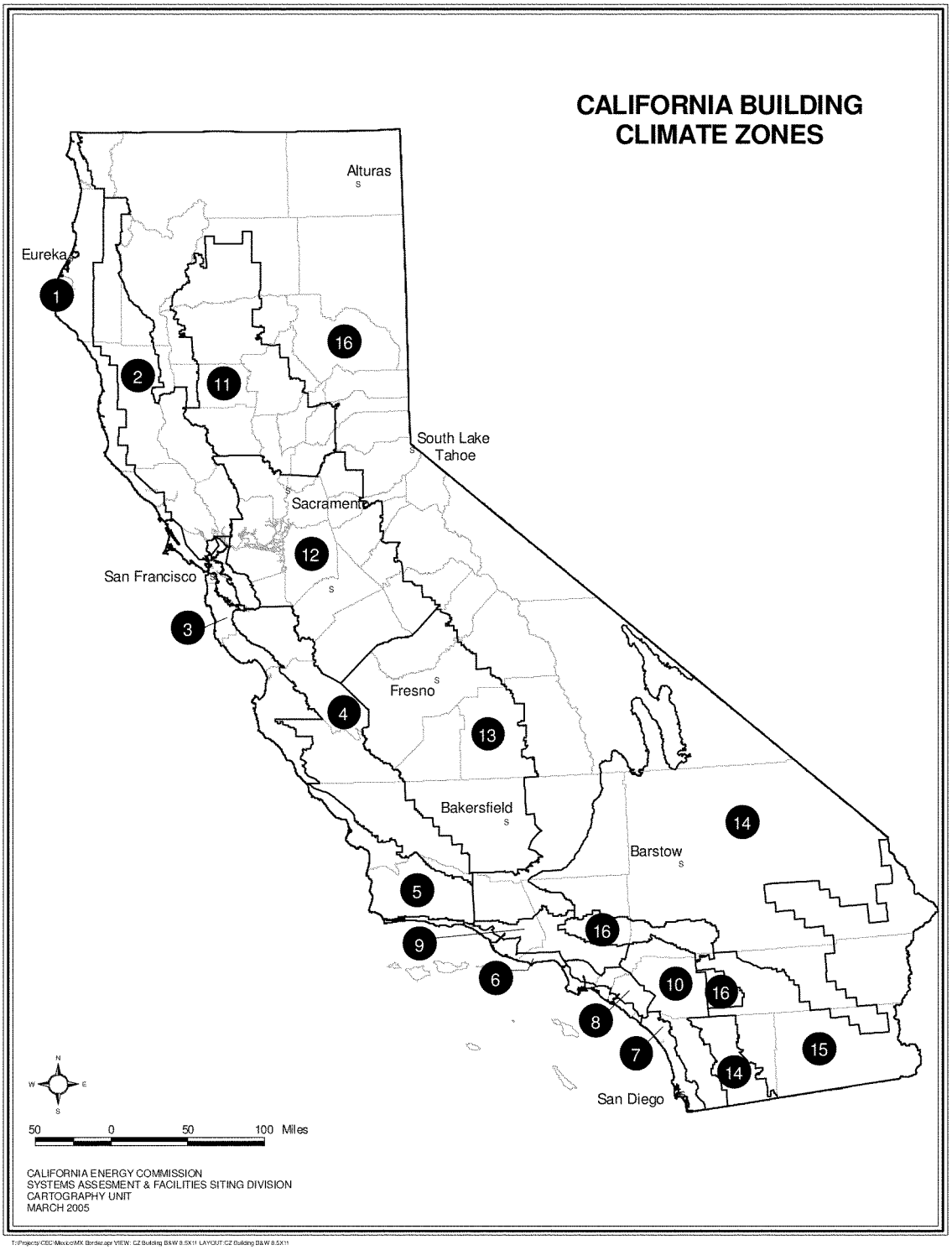

FIGURE 100.1-A CALIFORNIA CLIMATE ZONES
Climate Zones for Residential and Nonresidential Occupancies

TABLE 110.2-B
HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	EFFICIENCY[a]	TEST PROCEDURE[b]
Air cooled (cooling mode), both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h		11.0 EER 14.1 IEER	AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h		10.6 EER 13.5 IEER	
	≥ 240,000 Btu/h		9.5 EER 12.5 IEER	
Water source (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	86ºF entering water	13.0 EER	ISO-13256-1
Groundwater source (cooling mode)	< 135,000 Btu/h	59ºF entering water	18.0 EER	ISO-13256-1
Ground source (cooling mode)	< 135,000 Btu/h	77ºF entering water	14.1 EER	ISO-13256-1
Water source water-to-water (cooling mode)	< 135,000 Btu/h	86ºF entering water	10.6 EER	ISO-13256-2
Groundwater source water-to-water (cooling mode)	< 135,000 Btu/h	59ºF entering water	16.3 EER	ISO-13256-2
Ground source brine-to-water (cooling mode)	< 135,000 Btu/h	77ºF entering water	12.1 EER	ISO-13256-2
Air cooled (heating mode) Split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h (cooling capacity)	47°F db/43°F wb outdoor air	3.4 COP	AHRI 340/360
		17°F db/15°F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h and < 240,000 Btu/h (cooling capacity)	47°F db/43°F wb outdoor air	3.3 COP	
	≥ 240,000 Btu/h and < 760,000 Btu/h		3.2 COP	
	≥ 135,000 Btu/h (cooling capacity)	17°F db/15°F wb outdoor air	2.05 COP	
Water source (heating mode)	< 135,000 Btu/h (cooling capacity)	68ºF entering water	4.3 COP	ISO-13256-1
	≥ 135,000 Btu/h and < 240,000 Btu/h	68ºF entering water	2.90 COP	ISO-13256-1
Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)	50ºF entering water	3.7 COP	ISO-13256-1
Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)	32ºF entering water	3.2 COP	ISO-13256-1
Water source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	68ºF entering water	3.7 COP	ISO-13256-2
Groundwater source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	50ºF entering water	3.1 COP	ISO-13256-2
Ground source brine-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	32ºF entering water	2.5 COP	ISO-13256-2

a. Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.
b. Applicable test procedure and reference year are provided under the definitions.

TABLE 110.2-C
AIR-COOLED GAS-ENGINE HEAT PUMPS

EQUIPMENT TYPE	SIZE CATEGORY	SUBCATEGORY OR RATING CONDITION	EFFICIENCY	TEST PROCEDURE[a]
Air-cooled gas-engine heat pump (cooling mode)	All capacities	95°F db outdoor air	0.60 COP	ANSI Z21.40.4A
Air-cooled gas-engine heat pump (heating mode)	All capacities	47°F db/43°F wb outdoor air	0.72 COP	ANSI Z21.40.4A

a. Applicable test procedure and reference year are provided under the definitions.

TABLE 110.2-D
WATER CHILLING PACKAGES—MINIMUM EFFICIENCY REQUIREMENTS[a, b]

EQUIPMENT TYPE	SIZE CATEGORY	PATH A EFFICIENCY[a, b]	PATH B EFFICIENCY[a, b]	TEST PROCEDURE[c]
Air cooled, with condenser electrically operated	< 150 tons	≥ 10.100 EER ≥ 13.700 IPLV	≥ 9.700 EER ≥ 15.800 IPLV	AHRI 550/590
	≥ 150 tons	≥ 10.100 EER ≥ 14.000 IPLV	≥ 9.700 EER ≥ 16.100 IPLV	
Air cooled, without condenser electrically operated	All capacities	Air-cooled chillers without condensers must be rated with matching condensers and comply with the air-cooled chiller efficiency requirements.		AHRI 550/590
Water cooled, electrically operated reciprocating	All capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
Water cooled, electrically operated, positive displacement	< 75 tons	≤ 0.750 kW/ton ≤ 0.600 IPLV	≤ 0.780 kW/ton ≤ 0.500 IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	≤ 0.720 kW/ton ≤ 0.560 IPLV	≤ 0.750 kW/ton ≤ 0.490 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.660 kW/ton ≤ 0.540 IPLV	≤ 0.680 kW/ton ≤ 0.440 IPLV	
	≥ 300 tons and < 300 tons	≤ 0.610 kW/ton ≤ 0.520 IPLV	≤ 0.625 kW/ton ≤ 0.410 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Water cooled, electrically operated, centrifugal	> 150 ton	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.695 kW/ton ≤ 0.440 IPLV	
	≥ 150 tons and < 300 tons	≤ 0.610 kW/ton ≤ 0.550 IPLV	≤ 0.635 kW/ton ≤ 0.400 IPLV	
	≥ 300 tons and < 400 tons	≤ 0.560 kW/ton ≤ 0.520 IPLV	≤ 0.595 kW/ton ≤ 0.390 IPLV	
	≥ 400 tons and < 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
	≥ 600 tons	≤ 0.560 kW/ton ≤ 0.500 IPLV	≤ 0.585 kW/ton ≤ 0.380 IPLV	
Air cooled absorption single effect	All capacities	≥ 0.600 COP	N.A.[d]	AHRI 560
Water cooled absorption single effect	All capacities	≥ 0.700 COP	N.A.[d]	
Absorption double effect, indirect-fired	All capacities	≥ 1.000 COP ≥ 1.050 IPLV	N.A.[d]	
Absorption double effect, direct-fired	All capacities	≥ 1.000 COP ≥ 1.000 IPLV	N.A.[d]	
Water cooled gas engine driven chiller	All capacities	≥ 1.2 COP ≥ 2.0 IPLV	N.A.[d]	ANSI Z21.40.4

a. No requirements for:
- Centrifugal chillers with design leaving evaporator temperature < 36°F; or
- Positive displacement chillers with design leaving fluid temperature ≤ 32°F; or
- Absorption chillers with design leaving fluid temperature < 40°F.

b. Must meet the minimum requirements of Path A or Path B. However, both the full load (COP) and IPLV must be met to fulfill the requirements of the applicable path.

c. See Section 100.1 for definitions.

d. N.A. means not applicable.

SECTION 110.8
MANDATORY REQUIREMENTS FOR INSULATION, ROOFING PRODUCTS AND RADIANT BARRIERS

(a) **Insulation certification by manufacturers.** All insulation shall be certified by Department of Consumer Affairs, Bureau of Household Goods and Services that the insulation conductive thermal performance is approved pursuant to the California Code of Regulations, Title 24, Part 12, Chapters 12 – 13, Article 3, "Standards for Insulating Material."

(b) **Installation of urea formaldehyde foam insulation.** Urea formaldehyde foam insulation may be applied or installed only if:

1. It is installed in exterior side walls; and
2. A 4-mil-thick plastic polyethylene vapor retarder or equivalent plastic sheathing vapor retarder is installed between the urea formaldehyde foam insulation and the interior space in all applications.

(c) **Flamespread rating of insulation.** All insulating material shall be installed in compliance with the flamespread rating and smoke density requirements of the CBC.

(d) **Installation of insulation in existing buildings.** Insulation installed in an existing attic, or on an existing duct or water heater, shall comply with the applicable requirements of Subsections 1, 2 and 3 below. If a contractor installs the insulation, the contractor shall certify to the customer, in writing, that the insulation meets the applicable requirements of Subsections 1, 2 and 3 below.

1. **Attics.** If insulation is installed in the existing attic of a low-rise residential building, the *R*-value of the total amount of insulation (after addition of insulation to the amount, if any, already in the attic) shall meet the requirements of Section 150.0(a) for single-family buildings and Section 180.2(a)1 for multifamily buildings three habitable stories or fewer.

   Exception to Section 110.8(d)1: Where the accessible space in the attic is not large enough to accommodate the required *R*-value, the entire accessible space shall be filled with insulation, provided such installation does not violate Section 1202.2 of Title 24, Part 2 or Section 806 of Title 24, Part 2.5.

2. **Water heaters.** If external insulation is installed on an existing unfired water storage tank or on an existing back-up tank for a solar water-heating system, it shall have an *R*-value of at least R-3.5, or 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.
3. **Ducts.** If insulation is installed on an existing space-conditioning duct, it shall comply with Section 605.0 of the CMC.

(e) **Reserved.**

(f) **Reserved.**

(g) **Insulation requirements for heated slab floors.** Heated slab floors shall be insulated according to the requirements in Table 110.8-A.

1. Insulation materials in ground contact must:
   A. Comply with the certification requirements of Section 110.8(a); and
   B. Have a water absorption rate for the insulation material alone without facings that is no greater than 0.3 percent when tested in accordance with Test Method A – 24 Hour-Immersion of ASTM C272.
   C. Water vapor permeance no greater than 2.0 perm/inch when tested in accordance with ASTM E96.
2. Insulation installation must:
   A. Be covered with a solid guard that protects against damage from ultraviolet radiation, moisture, landscaping operation, equipment maintenance and wind; and
   B. Include a rigid plate, which penetrates the slab and blocks the insulation from acting as a conduit for insects from the ground to the structure above the foundation.

(h) **Wet insulation systems.** When insulation is installed on roofs above the roofing membrane or layer used to seal the roof from water penetration, the effective *R*-value of the insulation shall be as specified in Reference Joint Appendix JA4.

TABLE 110.8-A
SLAB INSULATION REQUIREMENTS FOR HEATED SLAB-ON-GRADE

INSULATION LOCATION	INSULATION ORIENTATION	INSTALLATION REQUIREMENTS	CLIMATE ZONE	INSULATION *R*-VALUE
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16 inches or to the frost line, whichever is greater. Insulation may stop at the top of the footing where this is less than the required depth. For below grade slabs, vertical insulation shall be extended from the top of the foundation wall to the bottom of the foundation (or the top of the footing) or to the frost line, whichever is greater.	1–15	5
			16	10
Between heated slab and outside foundation wall	Vertical and horizontal	Vertical insulation from top of slab at inside edge of outside wall down to the top of the horizontal insulation. Horizontal insulation from the outside edge of the vertical insulation extending 4 feet toward the center of the slab in a direction normal to the outside of the building in plan view.	1–15	5
			16	10 vertical and 7 horizontal

(i) **Roofing products solar reflectance and thermal emittance.**

1. In order to meet the requirements of Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1I or 150.2(b)2, a roofing product's thermal emittance and an aged solar reflectance shall be certified and labeled according to the requirements of Section 10-113.

   Exception 1 to Section 110.8(i)1: Roofing products that are not certified according to Section 10-113 shall assume the following default aged solar reflectance/thermal emittance values:

   A. For asphalt shingles: 0.08/0.75

   B. For all other roofing products: 0.10/0.75

2. If CRRC testing for an aged solar-reflectance is not available for any roofing products, the aged value shall be derived from the CRRC initial value using the equation $\rho_{aged} = [0.2 + \beta[\rho_{initial} - 0.2]$, where $\rho_{initial}$ = the initial solar reflectance and soiling resistance β is listed by product type in Table 110.8-B.

TABLE 110.8-B
VALUES OF SOILING RESISTANCE β BY PRODUCT TYPE

PRODUCT TYPE	CRRC PRODUCT CATEGORY	β
Field-Applied coating	Field-Applied coating	0.65
Other	Not a field-applied coating	0.70

3. Solar Reflectance Index (SRI), calculated as specified by ASTM E1980-01, may be used as an alternative to thermal emittance and an aged solar reflectance when complying with the requirements of Sections 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1I or 150.2(b)2. SRI calculations shall be based on moderate wind velocity of 2–6 meters per second. The SRI shall be calculated based on the aged solar reflectance value of the roofing products.

4. Liquid applied roof coatings applied to low-sloped roofs in the field as the top surface of a roof covering shall:

   A. Be applied across the entire roof surface to meet the dry mil thickness or coverage recommended by the coating manufacturer, taking into consideration the substrate on which the coating is applied; and

   B. Meet the minimum performance requirements listed in Table 110.8-C or the minimum performance requirements of ASTM C836, D3468, D6083 or D6694, whichever are appropriate to the coating material.

      Exception 1 to Section 110.8(i)4B: Aluminum-pigmented asphalt roof coatings shall meet the requirements of ASTM D2824 and be installed as specified by ASTM D3805.

      Exception 2 to Section 110.8(i)4B: Cement-based roof coatings shall contain a minimum of 20 percent cement and shall meet the requirements of ASTM C1583, ASTM D822 and ASTM D5870.

(j) **Radiant barrier.** A radiant barrier shall have an emittance of 0.05 or less, tested in accordance with ASTM C1371 or ASTM E408, and shall be certified to the Department of Consumer Affairs as required by Title 24, Part 12, Chapter 12-13, Standards for Insulating Material.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, and 25943, *Public Resources Code.*

SECTION 110.9
MANDATORY REQUIREMENTS FOR LIGHTING CONTROLS

(a) **All lighting control devices and systems and all light sources** subject to the requirements of Section 110.9 shall meet the following requirements:

1. Shall be installed only if the lighting control or light source complies with all of the applicable requirements of Section 110.9.

TABLE 110.8-C
MINIMUM PERFORMANCE REQUIREMENTS FOR LIQUID APPLIED ROOF COATINGS

PHYSICAL PROPERTY	ASTM TEST PROCEDURE	REQUIREMENT
Initial percent elongation (break)	D2370	Minimum 200% @ 73°F (23°C)
Initial percent elongation (break) or initial flexibility	D2370 D522, Test B	Minimum 60% @ 0°F (-18°C) Minimum pass 1″ mandrel @ 0°F (-18°C)
Initial tensile strength (maximum stress)	D2370	Minimum 100 psi (1.38 MPa) @ 73°F (23°C)
Initial tensile strength (maximum stress) or initial flexibility	D2370 D522, Test B	Minimum 200 psi (2.76 MPa) @ 0°F (-18°C) Minimum pass 1″ mandrel @ 0°F (-18°C)
Final percent elongation (break) after accelerated weathering 1000 h	D2370	Minimum 100% @ 73°F (23°C)
Final percent elongation (break) after accelerated weathering 100 h or Flexibility after accelerated weathering 100 h	D2370 D522, Test B	Minimum 40% @ 0°F (-18°C) Minimum pass 1″ mandrel @ 0°F (-18°C)
Permeance	D1653	Maximum 50 perms
Accelerated weathering 1000 h	D4798	No cracking or checking[1]

1. Any cracking or checking visible to the eye fails the test procedure.

reserved space shall be permanently marked as "For Future Solar Electric".

Note: Authority: Sections 25213, 25218, 25218.5, 25402, 25402.1, and 25605, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, 25605, and 25943, *Public Resources Code.*

SECTION 110.11 MANDATORY REQUIREMENTS FOR ELECTRICAL POWER DISTRIBUTION SYSTEM

Certification by Manufacturers. Any electrical power distribution system equipment listed in this section may be installed only if the manufacture has certified to the Commission that the equipment complies with all the applicable requirements of this section.

(a) **Low-voltage dry-type distribution transformer** shall be certified by the Manufacturer as required by the Title 20 Appliance Efficiency Regulations.

EXCEPTION to Section 110.11(a):

1. autotransformer;
2. drive (isolation) transformer;
3. grounding transformer;
4. machine-tool (control) transformer;
5. nonventilated transformer;
6. rectifier transformer;
7. regulating transformer;
8. sealed transformer;
9. special-impedance transformer;
10. testing transformer;
11. transformer with tap range of 20 percent or more;
12. uninterruptible power supply transformer; or
13. welding transformer.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, and 25943, *Public Resources Code.*

SECTION 110.12 MANDATORY REQUIREMENTS FOR DEMAND MANAGEMENT

Buildings, other than healthcare facilities, that install or are required to install demand responsive controls shall comply with the applicable demand responsive control requirements of Sections 110.12(a) through 110.12(e).

(a) **Demand responsive controls.**

1. All demand responsive controls shall be either:
   A. A certified OpenADR 2.0a or OpenADR 2.0b Virtual End Node (VEN), as specified under Clause 11, Conformance, in the applicable OpenADR 2.0 Specification; or
   B. Certified by the manufacturer as being capable of responding to a demand response signal from a certified OpenADR 2.0b Virtual End Node by automatically implementing the control functions requested by the Virtual End Node for the equipment it controls.
2. All demand responsive controls shall be capable of communicating with the VEN using a wired or wireless bidirectional communication pathway.
3. **Reserved.**
4. When communications are disabled or unavailable, all demand responsive controls shall continue to perform all other control functions provided by the control.
5. Demand responsive control thermostats shall comply with Reference Joint Appendix 5 (JA5), Technical Specifications for Occupant Controlled Smart Thermostats.

(b) **Demand Responsive Zonal HVAC Controls.** Nonresidential 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 increase the operating cooling temperature set points by 4 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 decrease the operating heating temperature set points by 4 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 increase, decrease, 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 Sections 110.12(b)1 and 110.12(b)2, for noncritical zones during the demand response period.

(c) **Demand Responsive Lighting Controls.** Buildings with nonresidential lighting systems having a total

installed lighting power of 4,000 watts or greater that are subject to the requirements of Section 130.1(b) shall install controls that are capable of automatically reducing lighting power in response to a Demand Response Signal.

1. For compliance testing, the lighting controls shall demonstrate a 15-percent or greater reduction in lighting power as described in NA7.6.3. The controls may provide additional demand responsive functions or abilities.
2. For buildings where demand response controls are required, demand responsive controls shall control the general lighting that is subject to the requirements of Section 130.1(b) and may control additional lighting.
3. General lighting shall be reduced in a manner consistent with the uniform level of illumination requirements in Table 130.1-A.

Exception to Section 110.12(c): Spaces where a health or life safety statute, ordinance, or regulation does not permit the general lighting to be reduced are not required to install demand responsive controls and do not count toward the 4,000-watt threshold.

(d) **Demand Responsive Electronic Message Center Control.** Controls for electronic message centers greater than 15 kW shall be capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.

Exception to Section 110.12(d): Electronic message centers that are not permitted by a health or life safety statute, ordinance, or regulation to be reduced.

(e) **Demand Responsive Controlled Receptacles.** Controlled receptacles in buildings shall be capable of automatically turning off all loads connected to the receptacle in response to a demand response signal.

Exception 1 to Section 110.12(e): Buildings not required to have demand responsive lighting controls.

Exception 2 to Section 110.12(e): Spaces where a health or life safety statute, ordinance or regulation does not permit the receptacles to be automatically controlled.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code.*

(d) **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(c) shall be supplied to each space at all times when the space is usually occupied.

   Exception 1 to Section 120.1(d)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(d)4 or by an occupant sensor ventilation control device complying with Section 120.1(d)5.

   Exception 2 to Section 120.1(d)1: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(c) 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(c) 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.** Demand ventilation controls complying with Section 120.1(d)4 are required for a space with a design occupant density, or a maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1,000 square feet (40 square feet or less per person) if the ventilation system serving the space has one or more of the following:

   A. an air economizer; or

   B. modulating outside air control; or

   C. design outdoor airflow rate > 3,000 cfm

   Exception 1 to Section 120.1(d)3: Where space exhaust is greater than the design ventilation rate specified in Section 120.1(c)3 minus 0.2 cfm per square foot of conditioned area.

   Exception 2 to Section 120.1(d)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, daycare sickrooms, science labs, barber shops or beauty and nail salons shall not install demand control ventilation.

   Exception 3 to Section 120.1(d)3: Spaces with an area of less than 150 square feet, or a design occupancy of less than 10 people as specified by Section 120.1(c)3.

4. **Demand control ventilation devices.**

   A. For each system with demand control ventilation (DCV), CO_2 sensors shall be installed in each room that meets the criteria of Section 120.1(d)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 the zone or space, shall trigger an increase in ventilation.

   B. CO_2 sensors shall be located in the room between 3 feet and 6 feet 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(d)4C: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 120.1(c)3 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 feet 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 for DCV, times the conditioned floor area for spaces with CO_2 sensors, plus the rate required by Section 120.1(c)3 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(c)3 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.** Occupant sensing or ventilation controls are required for space-conditioning zones that are both permitted to have their ventilation air reduced to zero while in occupied-standby mode per Table 120.1-A and required to install occupant sensors to comply with Section 130.1(c)5, 6 and 7. Occupant sensor ventilation control devices used to reduce the rate of outdoor air flow when occupants are not present shall comply with the following:

   A. Occupant sensors shall have suitable coverage and placement to detect occupants in the entire space ventilated. In 20 minutes or less after no occupancy is detected by any sensors covering the room, occupant sensing controls shall indicate a room is vacant.

B. When occupant sensors controlling lighting are also used for ventilation, the ventilation signal shall be independent of daylighting, manual lighting overrides or manual control of lighting.

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

D. One hour prior to normal scheduled occupancy, the occupant sensor ventilation control shall allow preoccupancy purge as described in Section 120.1(d)2.

E. When the zone is scheduled to be occupied and occupant sensing controls in all rooms and areas served by the zone indicate the spaces are unoccupied, the zone shall be placed in occupied-standby mode.

F. In 5 minutes or less after entering occupied-standby mode, mechanical ventilation to the zone shall be shut off until the space becomes occupied or until ventilation is needed to provide space heating or conditioning. When mechanical ventilation is shut off to the zone, the ventilation system serving the zone shall reduce the system outside air rate by the amount of outside air required for the zone.

G. Where the system providing space conditioning also provides ventilation to the zone, in 5 minutes or less after entering occupied-standby mode, space-conditioning zone setpoints shall be reset in accordance with Section 120.2(e)3.

(e) **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(c)3, 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.

(f) **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 that allow design minimum outside air rates to be operated at no less than the larger of (1) the minimum levels specified in Section 120.1(c)3; 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 are capable of maintaining measured outside air ventilation rates within 10 percent of the design minimum 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. All mechanical ventilation and space-conditioning systems shall be tested to confirm their ability to operate within 10 percent of the design minimum outside air rate.

(g) **Air classification and recirculation limitations.** Air classification and recirculation limitations of air shall be based on the air classification as listed in Table 120.1-A or Table 120.1-C, and in accordance with the requirements of Sections 120.1(g)1 through 4.

Note: Air class definitions are taken directly from ASHRAE 62.1 and are duplicated here for convenience.

1. **Class 1 Air** is air with low contaminant concentration, low sensory-irritation intensity or inoffensive odor. Recirculation or transfer of Class 1 air to any space shall be permitted; [ASHRAE 62.1:5.16.3.1]
2. **Class 2 Air** is air with moderate contaminant concentration, mild sensory-irritation intensity or mildly offensive odors (Class 2 air also includes air that is not necessarily harmful or objectionable but that is inappropriate for transfer or recirculation to spaces used for different purposes). Recirculation or transfer of Class 2 air shall be permitted in accordance with Sections 120.1(g)2A through 120.1(g)2E:
   A. Recirculation of Class 2 air within the space of origin shall be permitted [ASHRAE 62.1:5.16.3.2.1];
   B. Recirculation or transfer of Class 2 to other Class 2 or Class 3 spaces shall be permitted, provided that the other spaces are used for the same or similar purpose or task and involve the same or similar pollutant sources as the Class 2 space [ASHRAE 62.1:5.16.3.2.2]; or
   C. Transfer of Class 2 air to toilet rooms [ASHRAE 62.1:5.16.3.2.3]; or
   D. Recirculation or transfer of Class 2 air to Class 4 spaces [ASHRAE 62.1:5.16.3.2.4]; or
   E. Class 2 air shall not be recirculated or transferred to Class 1 spaces. [ASHRAE 62.1:5.16.3.2.5]

      Exception to Section 120.1(g)2E: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device is permitted. Recirculated Class 2 air shall not exceed 10 percent of the outdoor air intake flow.
3. **Class 3 Air** is air with significant contaminant concentration, significant sensory-irritation intensity or offensive odor. Recirculation or transfer of Class 3 air shall be permitted in accordance with Section 120.1(g)3A and B:
   A. Recirculation of Class 3 air within the space of origin shall be permitted. [ASHRAE 62.1:5.16.3.3.1]
   B. Class 3 air shall not be recirculated or transferred to any other space. [ASHRAE 62.1:5.16.3.3.2].

      Exception to Section 120.1(g)3B: When using any energy recovery device, recirculation from leakage, carryover, or transfer from the exhaust side of the energy recovery device is permitted. Recirculated Class 3 air shall not exceed 5 percent of the outdoor air intake flow.
4. **Class 4 Air** is air with highly objectionable fumes or gases or with potentially dangerous particles, bioaerosols, or gases at concentrations high enough to be considered as harmful. Class 4 air shall not be recirculated

TABLE 120.1-C – AIRSTREAMS OR SOURCES
[ASHRAE 62.1:TABLE 5.16.1]

DESCRIPTION	AIR CLASS
Diazo printing equipment discharge	4
Commercial kitchen grease hoods	4
Commercial kitchen hoods other than grease	3
Laboratory hoods	4[a]
Hydraulic elevator machine room	2

a. Air Class 4 unless determined otherwise by the Environmental Health and Safety professional responsible to the owner or to the owner's designee.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, and 25943, *Public Resources Code.*

SECTION 120.2
REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS

Nonresidential and hotel/motel buildings shall comply with the applicable requirements of Sections 120.2(a) through 120.2(k).

(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). An energy management control system (EMCS) may be installed to comply with the requirements of one or more thermostatic controls if it complies with all applicable requirements for each thermostatic control.

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; and
2. The perimeter system is designed solely to offset envelope heat losses or gains; and
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 1 to Section 120.2(b)3: Systems with thermostats that require manual changeover between heating and cooling modes.

   Exception 2 to Section 120.2(b)3: Systems serving healthcare facilities.
4. Thermostatic controls for all single zone, air conditioners and heat pumps shall comply with the requirements of Sections 110.2(c) and 110.12(a) and, if equipped with DDC to the Zone level, with the Automatic Demand Shed Controls of Section 110.12(b).

   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: Package terminal air conditioners, package terminal heat pumps, room air conditioners and room air conditioner heat pumps.

   Exception 3 to Section 120.2(b)4: Systems serving healthcare facilities.

(c) **Hotel/motel guest room 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 110.2(c).

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

(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 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)3 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)3 is less than 100°F.

3. **Occupant sensing zone controls.** Where the system providing space conditioning also provides the ventilation required by Section 120.1 and includes occupant sensor ventilation control as specified in Section 120.1(d)5, the occupant sensing zone controls shall additionally comply with the following:

   A. In 5 minutes or less after entering occupied-standby mode as described in Section 120.1(d).

      i. 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; or

      ii. For multiple zone systems with Direct Digital Controls (DDC) to the zone level, setup the operating cooling temperature setpoint by 0.5°F or more and setback the operating heating temperature setpoint by 0.5°F or more.

   B. In 5 minutes or less after entering occupied-standby mode, mechanical ventilation to the zone shall remain off whenever the space temperature is between the active heating and cooling setpoints.

      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: Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

      Exception 3 to Sections 120.2(e) 1 and 2: Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

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

   Exception to Section 120.2(e): Systems serving healthcare facilities.

(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): Equipment that serves an area that must operate continuously.

Exception 2 to Section 120.2(f): Gravity and other non-electrical 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): Zones designed to be conditioned continuously.

(h) **Automatic demand shed controls.** See Section 110.12 for requirements for automatic demand shed controls.

(i) **Economizer fault detection and diagnostics (FDD).** All newly installed air handlers with a mechanical cooling capacity over 33,000 Btu/hr and an installed air economizer shall include a stand-alone or integrated Fault Detection and Diagnostics (FDD) system in accordance with Subsections 120.2(i)1 through 120.2(i)8.

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. The controller shall have the capability of displaying the value of each sensor; and
4. The controller shall provide system status by indicating the following conditions:

   A. Free cooling available;

   B. Economizer enabled;

   C. Compressor enabled;

   D. Heating enabled, if the system is capable of heating; and

   E. Mixed-air low limit cycle active.

5. The unit controller shall allow manual initiation of each operating mode so that the operation of cooling systems, economizers, fans and heating system can be independently tested and verified; and
6. Faults shall be reported in one of the following ways:
   A. Reported to an Energy Management Control System regularly monitored by facility personnel.
   B. Annunciated locally on one or more zone thermostats, or a device within five (5) feet of zone thermostat(s), clearly visible, at eye level, and meeting the following requirements:
      i. On the thermostat, device, or an adjacent written sign, display instructions to contact appropriate building personnel or an HVAC technician; and
      ii. In buildings with multiple tenants, the annunciation shall either be within property management offices or in a common space accessible by the property or building manager.
   C. Reported to a fault management application which automatically provides notification of the fault to a remote HVAC service provider.
7. 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; and
   E. Excess outdoor air.
8. The FDD System shall be certified by the Energy Commission as meeting requirements of Subsections 120.2(i)1 through 120.2(i)7 in accordance with Section 110.0 and JA6.3.

Exception to Section 120.2(i)8: FDD algorithms based in direct digital control systems are not required to be certified to the Energy Commission.

(j) **Direct Digital Controls (DDC)**. Direct Digital Controls to the zone shall be provided as specified by Table 120.2-A. The provided DDC system shall meet the control logic requirements of Sections 120.1(d), 110.12(a) and 110.12(b), and be capable of the following:

The provided DDC system shall meet the control logic requirements of Sections 110.12(a), 110.12(b) and 120.1(d) and be capable of the following:

1. Monitoring zone and system demand for fan pressure, pump pressure, heating and cooling;
2. Transferring zone and system demand information from zones to air distribution system controllers and from air distribution systems to heating and cooling plant controllers;
3. Automatically detecting the zones and systems that may be excessively driving the reset logic and generate an alarm or other indication to the system operator;
4. Readily allow operator removal of zone(s) from the reset algorithm;
5. For new buildings, trending and graphically displaying input and output points; and
6. Resetting heating and cooling setpoints in all noncritical zones upon receipt of a signal from a centralized contact or software point as described in Section 110.12(b).

(k) **Optimum start/stop controls.** Space conditioning systems with DDC to the zone level shall have optimum start/stop controls. The control algorithm shall, as a minimum, be a function of the difference between space temperature and occupied setpoint, the outdoor air temperature, and the

TABLE 120.2-A
DDC APPLICATIONS AND QUALIFICATIONS

BUILDING STATUS	APPLICATIONS	QUALIFICATIONS
Newly Constructed Buildings	Air handling system and all zones served by the system	Individual systems supplying more than three zones and with design heating or cooling capacity of 300 kBtu/h and larger
	Chilled water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design cooling capacity of 300 kBtu/h (87.9 kW) and larger
	Hot water plant and all coils and terminal units served by the system	Individual plants supplying more than three zones and with design heating capacity of 300 kBtu/h (87.9 kW) and larger
Additions or Alterations	Zone terminal unit such as VAV box	Where existing zones served by the same air handling, chilled water, or hot water systems that have DDC
	Air handling system or fan coil	Where existing air handling system(s) and fan coil(s) served by the same chilled or hot water plant have DDC
	New air handling system and all new zones served by the system	Individual systems with design heating or cooling capacity of 300 kBtu/h and larger and supplying more than three zones and more than 75 percent of zones are new
	New or upgraded chilled water plant	Where all chillers are new and plant design cooling capacity is 300 kBtu/h (87.9 kW) and larger
	New or upgraded hot water plant	Where all boilers are new and plant design heating capacity is 300 kBtu/h (87.9 kW) and larger

amount of time prior to scheduled occupancy. Mass radiant floor slab systems shall incorporate floor temperature onto the optimum start algorithm.

Exception to Section 120.2(k): Systems that must operate continuously.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, and 25943, *Public Resources Code.*

SECTION 120.3
REQUIREMENTS FOR PIPE INSULATION

Nonresidential and hotel/motel buildings shall comply with the applicable requirements of Sections 120.3(a) through 120.3(c).

(a) **General requirements.** The piping conditions listed below for space-conditioning and service water-heating systems with fluid normal operating temperatures listed in Table 120.3-A, shall have at least the amount of insulation specified in Subsection (c):

1. **Space cooling systems.** All refrigerant suction, chilled water, and brine fluid distribution systems.
2. **Space heating systems.** All refrigerant, steam, steam condensate and hot water fluid distribution systems.
3. **Service water-heating systems.**
   A. Recirculating system piping, including the supply and return piping to the water heater.
   B. The first 8 feet of hot and cold outlet piping, including piping between a storage tank and a heat trap, for a nonrecirculating storage system.
   C. Pipes that are externally heated.

Insulation conductivity shall be determined in accordance with ASTM C335 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. Fluid distribution systems include all elements that are in series with the fluid flow, such as pipes, pumps, valves, strainers, coil u-bends, and air separators, but not including elements that are not in series with the fluid flow, such as expansion tanks, fill lines, chemical feeders, and drains.

Exception to Section 120.3(a)2: Heat pump refrigerant vapor line shall be installed with a minimum of 0.5-inch-thick or R-3.0 insulation for nonresidential buildings and 0.75-inch-thick or R-6.0 insulation for residential buildings. No insulation is required on the refrigerant liquid line.

(b) **Insulation protection.** Pipe insulation shall be protected from damage due to sunlight, moisture, equipment maintenance and wind. Protection shall, at minimum, include the following:

1. Pipe insulation exposed to weather shall be protected by a cover suitable for outdoor service. The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be used to provide this protection.
2. Pipe insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include, or be protected by, a Class I or Class II vapor retarder. All penetrations and joints shall be sealed.
3. Pipe insulation buried below grade must be installed in a water proof and noncrushable casing or sleeve.

(c) **Insulation thickness**

1. 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 minimum thickness or *R*-value shown in Table 120.3-A.
2. 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 *R*-value shown in Table 120.3-A or thickness as calculated:

MINIMUM 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.

Exception 1 to Section 120.3: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

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

Exception 4 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.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code.*

Exception 1 to Section 120.6(a)4B: Condensing units with a total compressor horsepower less than 100 HP.

Exception 2 to Section 120.6(a)4B: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling/freezing of products (space with design cooling capacities of greater than 240 Btu/hr-ft^2), or process refrigeration cooling for other than a refrigerated space.

C. The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to:

i. The design drybulb temperature plus 20°F for systems serving freezers;

ii. The design drybulb temperature plus 30°F for systems serving coolers.

Exception 1 to Section 120.6(a)4C: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling/freezing of products [space with design cooling capacities of greater than 240 Btu/hr-ft^2 (2 tons per 100 ft^2)], or process refrigeration cooling for other than a refrigerated space.

D. All condenser fans for air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air or water fluid coolers or cooling towers shall be continuously variable speed, with system shall control the speed of all fans serving a common condenser high side controlled in unison.

E. The minimum condensing temperature setpoint shall be less than or equal to 70°F for systems utilizing air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air or water-cooled fluid coolers or cooling towers for heat rejection.

F. Condensing temperature reset. The condensing temperature set point of systems served by air-cooled condensers shall be reset in response to ambient drybulb temperature. The condensing temperature set point of systems served by evaporative-cooled condensers or water-cooled condensers (via cooling towers or fluid coolers) shall be reset in response to ambient wetbulb temperatures. The condensing temperature set point for systems served by adiabatic condensers shall be reset in response to ambient drybulb temperature while operating in dry mode.

Exception 1 to Section 120.6(a)4F: Condensing temperature control strategies approved by the Executive Director that have been demonstrated to provide at least equal energy savings.

Exception 2 to Section 120.6(a)4F: Systems served by adiabatic condensers in Climate Zones 1, 3, 5, 12, 14 and 16.

G. Fan-powered condensers shall meet the condenser efficiency requirements listed in Table 120.6-B. Condenser efficiency is defined as the total heat of rejection (THR) capacity divided by all electrical input power including fan power at 100 percent fan speed, and power of spray pumps for evaporative condensers.

Exception to Section 120.6(a)4G: Adiabatic condensers with ammonia as refrigerant.

H. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

Exception to Section 120.6(a)4H: Micro-channel condensers.

Exception to Section 120.6(a)4: Transcritical CO_2 refrigeration systems.

5. **Compressors.** Compressor systems utilized in refrigerated warehouses shall conform to the following:

A. Compressors serving refrigeration systems that are not transcritical CO_2 shall be designed to operate at a minimum condensing temperature of 70°F or less.

TABLE 120.6-B
FAN-POWERED CONDENSERS – MINIMUM EFFICIENCY REQUIREMENTS

CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM EFFICIENCY	RATING CONDITION
Outdoor evaporative cooled with THR Capacity > 8,000 MBH	All	350 Btuh/Watt	100°F saturated condensing temperature (SCT), 70°F outdoor wetbulb temperature
Outdoor evaporative cooled with THR Capacity < 8,000 MBH and indoor evaporative cooled	All	160 Btuh/Watt	
Outdoor air cooled	Ammonia	75 Btuh/Watt	105°F saturated condensing temperature (SCT), 95°F outdoor drybulb temperature
	Halocarbon	65 Btuh/Watt	
Adiabatic dry mode	Halocarbon	45 Btuh/Watt	105°F saturated condensing temperature (SCT), 95°F outdoor drybulb temperature
Indoor air cooled	All	Exempt	

B. Compressors for transcritical CO_2 refrigeration systems shall be designed to operate at a minimum condensing temperature of 60°F or less.

Exception to Section 120.6(a)5B: Compressors with a design saturated suction temperature greater than or equal to 30°F shall be designed to operate at a minimum condensing temperature of 70°F or less.

C. New open-drive screw compressors in new refrigeration systems with a design saturated suction temperature (SST) of 28°F or lower that discharges to the system condenser pressure shall control compressor speed in response to the refrigeration load.

Exception 1 to Section 120.6(a)5C: Refrigeration plants with more than one dedicated compressor per suction group.

Exception 2 to Section 120.6(a)5C: Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling/freezing of products [space with design cooling capacities of greater than 240 Btu/hr-ft^2 (2 tons per 100 ft^2)], or process refrigeration cooling for other than a refrigerated space.

D. New screw compressors with nominal electric motor power greater than 150 HP shall include the ability to automatically vary the compressor volume ratio (Vi) in response to operating pressures.

6. **Infiltration barriers.** Passageways between freezers and higher-temperature spaces, and passageways between coolers and nonrefrigerated spaces, shall have an infiltration barrier consisting of strip curtains, an automatically-closing door or an air curtain designed by the manufacturer for use in the passageway and temperature for which it is applied.

Exception 1 to Section 120.6(a)6: Openings with less than 16 square feet of opening area.

Exception 2 to Section 120.6(a)6: Dock doorways for trailers.

7. **Refrigerated warehouse acceptance.** Before an occupancy permit is granted for a new refrigerated warehouse, or before a new refrigeration system serving a refrigerated warehouse is operated for normal use, 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:

A. Electric resistance underslab heating systems shall be tested in accordance with NA7.10.1.

B. Evaporators fan motor controls shall be tested in accordance with NA7.10.2.

C. Evaporative condensers shall be tested in accordance with NA7.10.3.1.

D. Air-Cooled condensers shall be tested in accordance with NA7.10.3.2.

E. Adiabatic condensers shall be tested in accordance with NA7.10.3.3.

F. Variable speed compressors shall be tested in accordance with NA7.10.4.

G. Transcritical CO_2 refrigeration systems shall be tested in accordance with NA7.20.1.

8. **Transcritical CO_2 gas coolers.** New fan-powered gas coolers on all new transcritical CO_2 refrigeration systems shall conform to the following:

A. Air-cooled gas coolers are prohibited in Climate Zones 9 through 15.

B. Design leaving gas temperature for air-cooled gas coolers shall be less than or equal to the design dry-bulb temperature plus 6°F.

Exception to Section 120.6(a)8B: Design leaving gas temperature for air-cooled gas coolers in Climate Zones 2, 4 and 8 shall be less than or equal to the design dry-bulb temperature plus 8°F.

C. Design leaving gas temperature for adiabatic gas coolers necessary to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to the design dry-bulb temperature plus 15°F.

D. All gas cooler fans shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.

E. While operating below the critical point, the gas cooler pressure shall be controlled in accordance with Section 120.6(a)4F.

F. While operating above the critical point, the gas cooler pressure setpoint shall be reset based on ambient conditions such that the system efficiency is maximized.

G. The minimum condensing temperature setpoint shall be less than or equal to 60°F for systems utilizing air-cooled gas coolers, evaporative-cooled gas coolers, adiabatic gas coolers, air or water-cooled fluid coolers or cooling towers for heat rejection.

Exception to Section 120.6(a)8G: Transcritical CO_2 refrigeration systems with a design intermediate saturated suction temperature greater than or equal to 30°F shall have a minimum condensing temperature setpoint of 70°F or less.

H. Fan-powered gas coolers shall meet the gas cooler efficiency requirements listed in Table 120.6-C. Gas cooler efficiency is defined as the Total Heat of Rejection (THR) capacity divided by all electrical input power (fan power at 100 percent fan speed).

9. **Automatic door closers.** Doors designed for the passage of people that are between freezers and higher-temperature spaces, or between coolers and nonrefrigerated spaces, shall have automatic door closers.

TABLE 120.6-C
TRANSCRITICAL CO_2 FAN-POWERED GAS COOLERS—
MINIMUM EFFICIENCY REQUIREMENTS

CONDENSER TYPE	REFRIGERANT TYPE	MINIMUM EFFICIENCY	RATING CONDITION
Outdoor air cooled	Transcritical CO_2	160 Btuh/watt	1400 psig, 100°F outlet gas temperature, 90°F outdoor dry-bulb temperature
Adiabatic dry mode	Transcritical CO_2	90 Btuh/watt	1100 psig, 100°F outlet gas temperature, 90°F outdoor dry-bulb temperature

(b) **Mandatory requirements for commercial refrigeration.**

Retail food or beverage stores with 8,000 square feet or more of conditioned floor area, and that utilize either refrigerated display cases, or walk-in coolers or freezers shall meet all applicable state and federal appliance and equipment standards consistent with Section 110.0 and 110.1 or, for equipment not subject to such standards, the requirements of Subsections 1 through 4.

1. **Condensers serving refrigeration systems.** Fan-powered condensers shall conform to the following requirements:

   A. All condenser fans for air-cooled condensers, evaporative-cooled condensers, adiabatic condensers, gas coolers, air- or water-cooled fluid coolers or cooling towers shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.

   B. The refrigeration system condenser controls for systems with air-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature.

   C. The refrigeration system condenser controls for systems with evaporative-cooled condensers shall use variable-setpoint control logic to reset the condensing temperature setpoint in response to ambient wetbulb temperature.

   D. The refrigeration system condenser controls for systems with adiabatic condensers shall use variable setpoint control logic to reset the condensing temperature setpoint in response to ambient drybulb temperature while operating in dry mode.

      Exception 1 to Section 120.6(b)1B, C and D: Condensing temperature control strategies approved by the executive director that have been demonstrated to provide equal energy savings.

      Exception 2 to Section 120.6(b)1D: Systems served by adiabatic condensers in Climate Zone 16.

   E. The saturated condensing temperature necessary for adiabatic condensers to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to:

      i. The design drybulb temperature plus 20°F for systems serving freezers;

      ii. The design drybulb temperature plus 30°F for systems serving coolers.

   F. The minimum condensing temperature setpoint shall be less than or equal to 70°F.

   G. Fan-powered condensers shall meet the specific efficiency requirements listed in Table 120.6-D.

TABLE 120.6-D
FAN-POWERED CONDENSERS—
SPECIFIC EFFICIENCY REQUIREMENTS

CONDENSER TYPE	MINIMUM SPECIFIC EFFICIENCY[a]	RATING CONDITION
Evaporative cooled	160 Btuh/Watt	100°F saturated condensing temperature (SCT), 70°F outdoor wetbulb temperature
Air cooled	160 Btuh/Watt	105°F saturated condensing temperature (SCT), 95°F outdoor drybulb temperature
Adiabatic dry mode	45 Btu/W (halocarbon)	105°F saturated condensing temperature (SCT), 95°F outdoor drybulb temperature

a. See Section 100.1 for definition of condenser specific efficiency.

Exception 1 to Section 120.6(b)1G: Condensers with a total heat rejection capacity of less than 150,000 Btuh at the specific efficiency rating condition.

Exception 2 to Section 120.6(b)1G: Stores located in Climate Zone 1.

Exception 3 to Section 120.6(b)1G: Existing condensers that are reused for an addition or alteration.

   H. Air-cooled condensers shall have a fin density no greater than 10 fins per inch.

      Exception 1 to Section 120.6(b)1H: Microchannel condensers.

      Exception 2 to Section 120.6(b)1H: Existing condensers that are reused for an addition or alteration.

      Exception to Section 120.6(b)1B, 1C, 1D, 1E, 1F, 1G: Transcritical CO_2 refrigeration systems.

      Exception to Section 120.6(b)1: New condensers replacing existing condensers when the attached compressor system total heat of rejection does not increase and less than 25 percent of both the attached compressors and the attached display cases are new.

2. **Compressor systems.** Refrigeration compressor systems and condensing units shall conform to the following requirements:

   A. Compressors and multiple-compressor suction groups shall include control systems that use floating suction pressure logic to reset the target saturated suction temperature based on the temperature requirements of the attached refrigeration display cases or walk-ins.

      Exception 1 to Section 120.6(b)2A: Single compressor systems that do not have continuously variable capacity capability.

      Exception 2 to Section 120.6(b)2A: Suction groups that have a design saturated suction temperature of 30°F or higher, or suction groups that comprise the high stage of a two-stage or cascade system or that primarily serve chillers for secondary cooling fluids.

   B. Liquid subcooling shall be provided for all low temperature compressor systems with a design cooling capacity equal or greater than 100,000 Btu/hr with a design saturated suction temperature of -10°F or lower, with the subcooled liquid temperature maintained continuously at 50°F or less at the exit of the subcooler, using compressor economizer port(s) or a separate medium or high temperature suction group operating at a saturated suction temperature of 18°F or higher.

      Exception 1 to Section 120.6(b)2B: Low temperature cascade systems that condense into another refrigeration system rather than condensing to ambient temperature.

      Exception 2 to Section 120.6(b)2B: Transcritical CO_2 refrigeration systems.

   C. Compressors for transcritical CO_2 refrigeration systems shall be designed to operate at a minimum condensing temperature of 60°F or less.

      Exception to Section 120.6(b)2C: Compressors with a design saturated suction temperature greater than or equal to 30°F shall be designed to operate at a minimum condensing temperature of 70°F or less.

   Exception to Section 120.6(b)2: Existing compressor systems that are reused for an addition or alteration.

3. **Refrigerated display cases.** Lighting in refrigerated display cases, and lights on glass doors installed on walk-in coolers and freezers shall be controlled by one of the following:

   A. Automatic time switch controls to turn off lights during nonbusiness hours. Timed overrides for any line-up or walk-in case may only be used to turn the lights on for up to one hour. Manual overrides shall time-out automatically to turn the lights off after one hour.

   B. Motion sensor controls on each case that reduce display case lighting power by at least 50 percent within 30 minutes after the area near the case is vacated.

4. **Refrigeration heat recovery.**

   A. HVAC systems shall utilize heat recovery from refrigeration system(s) for space heating, using no less than 25 percent of the sum of the design total heat of rejection of all refrigeration systems that have individual total heat of rejection values of 150,000 Btu/h or greater at design conditions.

      Exception 1 to Section 120.6(b)4A: Stores located in Climate Zone 15.

      Exception 2 to Section 120.6(b)4A: HVAC systems or refrigeration systems that are reused for an addition or alteration.

      Exception 3 to Section 120.6(b)4A: Stores where the design total heat of rejection of all refrigeration systems is less than or equal to 500,000 Btu/h.

   B. The increase in hydrofluorocarbon refrigerant charge associated with refrigeration heat recovery equipment and piping shall be no greater than 0.35 lbs per 1,000 Btu/h of heat recovery heating capacity.

5. **Transcritical CO_2 gas coolers**. New fan-powered gas coolers on all new transcritical CO_2 refrigeration systems shall conform to the following:

   A. Air-cooled gas coolers are prohibited in Climate Zones 10 through 15.

   B. Design leaving gas temperature for air-cooled gas coolers shall be less than or equal to the design dry-bulb temperature plus 6°F.

   C. Design leaving gas temperature for adiabatic gas coolers necessary to reject the design total heat of rejection of a refrigeration system assuming dry mode performance shall be less than or equal to the design dry-bulb temperature plus 15°F.

   D. All gas cooler fans shall be continuously variable speed, with the speed of all fans serving a common condenser high side controlled in unison.

   E. While operating below the critical point, the gas cooler pressure shall be controlled in accordance with Section 120.6(b)1A.

   F. While operating above the critical point, the gas cooler pressure setpoint shall be reset based on ambient conditions such that the system efficiency is maximized.

   G. The minimum condensing temperature setpoint shall be less than or equal to 60°F for air-cooled gas coolers, evaporative-cooled gas coolers, adiabatic gas coolers, air or water-cooled fluid coolers or cooling towers.

      Exception to Section 120.6(b)5G: Transcritical CO_2 refrigeration systems with a design intermediate saturated suction temperature greater than or equal to 30°F shall have a minimum condensing temperature setpoint of 70°F or less.

   H. Fan-powered gas coolers shall meet the condenser efficiency requirements listed in Table 120.6-E. Gas cooler efficiency is defined as the total heat of rejection (THR) capacity divided by all electrical input power (fan power at 100-percent fan speed).

case for less than 30 minutes, with no perceptible drop in pressure.

If dial gauges are used for conducting this test, these gauges must conform with *California Plumbing Code* Sections 318.3, 318.4 and 318.5.

Piping less than or equal to 50 adjoining feet in length shall be pressurized and inspected. Connections shall be tested with a noncorrosive leak-detecting fluid or other leak-detecting methods at the discretion of the authority having jurisdiction.

5. **Pipe sizing.** Compressed air piping greater than 50 adjoining feet in length shall be designed and installed to minimize frictional losses in the distribution network. These piping installations shall meet the requirements of Section 120.6(e)5A and either Section 120.6(e)5B or 120.6(e)5C:
   A. Service line piping shall have inner diameters greater than or equal to ¾ inch. Service line piping are pipes that deliver compressed air from distribution piping to end uses.
   B. Piping section average velocity. Compressor room interconnection and main header piping shall be sized so that at coincident peak flow conditions, the average velocity in the segment of pipe is no greater than 20 ft/sec. Compressor room interconnection and main header piping are the pipes that deliver compressed air from the compressor outlets to the inlet to the distribution piping. Each segment of distribution and service piping shall be sized so that at coincident peak flow conditions, the average velocity in the segment of pipe is no greater than 30 ft/sec. Distribution piping are pipes that deliver compressed air from the compressor room interconnection piping or main header piping to the service line piping.
   C. Piping total pressure drop. Piping shall be designed such that piping frictional pressure loss at coincident peak loads is less than 5 percent of operating pressure between the compressor and end use or end use regulator.
6. **Compressed air system acceptance.** Before an occupancy permit is granted for a compressed air system subject to Section 120.6(e), the 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.

(f) **Mandatory requirements for elevators.** Elevators shall meet the following requirements:

1. The light power density for the luminaires inside the elevator cab shall be no greater than 0.6 watts per square foot.

   Exception to Section 120.6(f)1: Interior signal lighting and interior display lighting are not included in the calculation of lighting power density.
2. Elevator cab ventilation fans for cabs without space conditioning shall not exceed 0.33 watts per cfm as measured at maximum speed.
3. When the elevator cab is stopped and unoccupied with doors closed for over 15 minutes, the cab interior lighting and ventilation fans shall be switched off until elevator cab operation resumes.
4. Lighting and ventilation shall remain operational in the event that the elevator cabin gets stuck when passengers are in the cabin.
5. Elevator Lighting and Ventilation Control Acceptance. Before an occupancy permit is granted for elevators subject to 120.6(f), the following equipment and systems shall be certified as meeting the Acceptance Requirement 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 NA7.14.

   Exception to Section 120.6(f): Elevators located in healthcare facilities.

(g) **Mandatory requirements for escalators and moving walkways**.

1. Escalators and moving walkways located in airports, hotels, and transportation function areas shall automatically slow to the minimum permitted speed in accordance with ASME A17.1/CSA B44 when not conveying passengers.
2. Escalators and Moving Walkways Acceptance. Before an occupancy permit is granted for escalators and moving walkways subject to 120.6(g), the following equipment and systems shall be certified as meeting the Acceptance Requirement 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 NA7.15.

(h) **Mandatory requirements for controlled environment horticulture (CEH) spaces.**

1. **Indoor growing, dehumidification.** Dehumidification equipment shall be one of the following:
   A. Dehumidifiers subject to regulation under federal appliance standards tested in accordance with 10 CFR 430.23(z) and Appendix X or X1 to Subpart B of 10 CFR Part 430 as applicable, and complying with 10 CFR 430.32(v)2;
   B. Integrated HVAC system with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat;
   C. Chilled water system with on-site heat recovery designed to fulfill at least 75 percent of the annual energy for dehumidification reheat; or

D. Solid or liquid desiccant dehumidification system for system designs that require dew point of 50°F or less.

2. **Indoor growing, horticultural lighting.** In a building with CEH spaces and with more than 40 kW of aggregate horticultural lighting load, the electric lighting systems used for plant growth and plant maintenance shall meet all of the following requirements:

   A. The horticultural lighting systems shall have a photosynthetic photon efficacy (PPE) rated in accordance with ANSI/ASABE S640 for wavelengths from 400 to 700 nanometers and meet one of the following requirements:

      i. Integrated, nonserviceable luminaires shall have a rated PPE of at least 1.9 micromoles per joule; or

      ii. Luminaires with removable or serviceable lamps shall have lamps with a rated PPE of at least 1.9 micromoles per joule.

   B. Time-switch lighting controls shall be installed and comply with Section 110.9(b)1, Section 130.4(a)4 and applicable sections of NA7.6.2.

   C. Multilevel lighting controls shall be installed and comply with Section 130.1(b).

3. **Indoor growing, electrical power distribution systems.** Electrical power distribution systems serving CEH spaces shall be designed so that a measurement device is capable of monitoring the electrical energy usage of aggregate horticultural lighting load.

4. **Conditioned greenhouses, building envelope.** Conditioned greenhouses shall meet the following requirements:

   A. Opaque wall and opaque roof assembly shall meet the requirements of Section 120.7; and

   B. Nonopaque envelopes shall have two or more glazings separated by either air or gas fill.

5. **Conditioned greenhouses, space-conditioning systems.** Space-conditioning systems used for plant production shall comply with all applicable requirements.

6. **Greenhouses, horticultural lighting.** In a greenhouse with more than 40 kW of aggregate horticultural lighting load, the electric lighting system used for plant growth and plant maintenance shall meet the following requirements:

   A. The horticultural lighting systems shall have a photosynthetic photon efficacy (PPE) rated in accordance with ANSI/ASABE S640 for wavelengths from 400 to 700 nanometers and meet one of the following requirements:

      i. Integrated, nonserviceable luminaires shall have a rated PPE of at least 1.7 micromoles per joule; or

      ii. Luminaires with removable or serviceable lamps shall have lamps with a rated PPE of at least 1.7 micromoles per joule.

   B. Time-switch lighting controls shall be installed and comply with Section 110.9(b)1, Section 130.4(a)4 and applicable sections of Reference Nonresidential Appendix NA7.6.2.

   C. Multilevel lighting controls shall be installed and comply with Section 130.1(b).

(i) **Mandatory requirements for steam traps.** Steam traps in new industrial facilities and new steam traps added to support new, nonreplacement, process equipment in existing industrial facilities where the installed steam trap operating pressure, which is the steam pressure entering the steam trap during normal design operating conditions, is greater than 15 psig and the total combined connected boiler input rating is greater than 5 million Btu/hr shall meet the following requirements:

1. **Central steam trap fault detection and diagnostics monitoring.** Steam trap systems shall be equipped with a central steam trap monitoring system that:

   A. Provides a status update of all steam trap fault detection sensors at no greater than 8-hour intervals.

   B. Automatically displays an alarm that identifies which steam trap has a fault once the system has detected a fault.

2. **Steam trap fault detection.** Steam traps shall be equipped with automatic fault detection sensors that shall communicate their operational state to the central steam trap monitoring system as described in Section 120.6(i)1.

3. **Steam trap strainer installation.** Steam traps shall either:

   A. Be equipped with an integral strainer and blow-off valve; or

   B. Be installed downstream within 3 feet of a strainer and blow-off valve.

4. **Steam trap system acceptance.** Before an occupancy permit is granted for steam trap systems subject to Section 120.6(i), the equipment and systems shall be certified as meeting the Acceptance Requirement for Code Compliance, as specified by the Reference Nonresidential Appendix NA7.19. A Certificate of Acceptance shall be submitted to the enforcement agency that certifies that the equipment and systems meet the acceptance requirements specified in NA7.19.

Exception 1 to Section 120.6(i): Steam traps where steam is diverted to a steam system of lower pressure for use when the steam trap fails open.

(j) **Mandatory requirements for computer rooms.** Space-conditioning systems serving a computer room shall meet the following requirements:

1. **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

management control system, interlocked lighting system, lighting power adjustment factor, or additional wattage available for a videoconference studio, in accordance with the following requirements, as applicable:

1. Certification that when a lighting control system is installed to comply with lighting control requirements in Part 6 it complies with the applicable requirements of Section 110.9; and complies with Reference Nonresidential Appendix NA7.7.1.
2. Certification that when an energy management control system is installed to function as a lighting control required by Part 6 it functionally meets all applicable requirements for each application for which it is installed, in accordance with Sections 110.9, 130.0 through 130.5, 140.6 through 150.0, and 150.2; and complies with Reference Nonresidential Appendix NA7.7.2.
3. **Reserved.**
4. **Reserved.**
5. Certification that interlocked lighting systems used to serve an approved area comply with Section 140.6(a)1; and comply with Reference Nonresidential Appendix NA7.7.4.
6. Certification that lighting controls installed to earn a lighting power adjustment factor (PAF) comply with Section 140.6(a)2; and comply with Reference Nonresidential Appendix NA7.7.5.
7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)2Gvii; and complies with Reference Nonresidential Appendix NA7.7.6.

(c) When certification is required by Title 24, Part 1, Section 10-103.1, the acceptance testing specified by Section 130.4 shall be performed by a certified lighting controls acceptance test technician (CLCATT). If the CLCATT is operating as an employee, the CLCATT shall be employed by a certified lighting controls acceptance test employer. The CLCATT shall disclose on the Certificate of Acceptance a valid CLCATT certification identification number issued by an approved acceptance test technician certification provider. The CLCATT shall complete all certificate of acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.

Note: Authority cited: Sections 25402, 25402.1 and 25213, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code*.

SECTION 130.5
ELECTRICAL POWER DISTRIBUTION SYSTEMS

Nonresidential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.5(a) through 130.5(e).

(a) **Service electrical metering.** Each electrical service or feeder shall have a permanently installed metering system which measures electrical energy use in accordance with Table 130.5-A.

Exception 1 to Section 130.5(a): Service or feeder for which the utility company provides a metering system that indicates instantaneous kW demand and kWh for a utility-defined period.

Exception 2 to Section 130.5(a): Electrical power distribution systems subject to *California Electrical Code* Article 517.

(b) **Separation of electrical circuits for electrical energy monitoring.** Electrical power distribution systems shall be designed so that measurement devices can monitor the electrical energy usage of load types according to Table 130.5-B.

Exception 1 to Section 130.5(b): For each separate load type, up to 10 percent of the connected load may be of any type.

Exception 2 to Section 130.5(b): Electrical power distribution systems subject to *California Electrical Code* Article 517.

(c) **Voltage drop.** The maximum combined voltage drop on both installed feeder conductors and branch circuit conductors to the farthest connected load or outlet shall not exceed 5 percent.

Exception to Section 130.5(c): Voltage drop permitted by *California Electrical Code* Sections 647.4, 695.6 and 695.7.

(d) **Circuit controls for 120-volt receptacles and controlled receptacles.** In all buildings, both controlled and uncontrolled 120 volt receptacles shall be provided in office areas, lobbies, conference rooms, kitchen areas in office spaces and copy rooms. Additionally, hotel/motel guest rooms shall comply with Section 130.5(d)4. Controlled receptacles shall meet the following requirements, as applicable:

1. Install a control capable of automatically shutting OFF the controlled receptacles when the space is typically unoccupied, either at the receptacle or circuit level. When an automatic time switch control is installed it shall incorporate an override control that allows the controlled receptacle to remain ON for no more than 2 hours when an override is initiated and an automatic holiday “shut-OFF” feature that turns OFF all loads for at least 24 hours and then resumes the normally scheduled operation. Countdown timer switches shall not be used to comply with the automatic time switch control requirements; and
2. Install at least one controlled receptacle within 6 feet from each uncontrolled receptacle or install a splitwired receptacle with at least one controlled and one uncontrolled receptacle. Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle shall be installed at each workstation; and
3. Provide a permanent and durable marking for controlled receptacles or circuits to differentiate them from uncontrolled receptacles or circuits; and

4. For hotel and motel guest rooms, install controlled receptacles for at least one-half of the 120-volt receptacles in each guestroom. Electric circuits serving controlled receptacles in guestrooms shall have captive card key controls, occupant sensing controls, or automatic controls so the power is switched OFF no longer than 30 minutes after the guestroom has been vacated.

NOTE: A hardwired power strip controlled by an occupant sensing control may be used to comply with Section 130.5(d). Plug-in strips and other plug-in devices shall not be used to comply with the requirements of Section 130.5(d).

Exception 1 to Section 130.5(d): Receptacles that are only for the following purposes:

i. Receptacles specifically for refrigerators and water dispensers in kitchen area.

ii. Receptacles located a minimum of six feet above the floor that are specifically for clocks.

iii. Receptacles for network copiers, fax machines, A/V and data equipment other than personal computers in copy rooms.

iv. Receptacles on circuits rated more than 20 amperes.

TABLE 130.5-A
MINIMUM REQUIREMENTS FOR METERING OF ELECTRICAL LOAD

METERING FUNCTIONALITY	ELECTRICAL SERVICES RATED 50 kVA OR LESS	ELECTRICAL SERVICES RATED MORE THAN 50 kVA AND LESS THAN OR EQUAL TO 250 kVA	ELECTRICAL SERVICES RATED MORE THAN 250 kVA AND LESS THAN OR EQUAL TO 1000 kVA	ELECTRICAL SERVICES RATED MORE THAN 1000 kVA
Instantaneous (at the time) kW demand	Required	Required	Required	Required
Historical peak demand (kW)	Not required	Not required	Required	Required
Tracking kWh for a user-definable period	Required	Required	Required	Required
kWh per rate period	Not required	Not required	Not required	Required

TABLE 130.5-B
MINIMUM REQUIREMENTS FOR SEPARATION OF ELECTRICAL LOAD

ELECTRICAL LOAD TYPE	ELECTRICAL SERVICES RATED 50 kVA OR LESS	ELECTRICAL SERVICES RATED MORE THAN 50 kVA AND LESS THAN OR EQUAL TO 250 kVA	ELECTRICAL SERVICES RATED MORE THAN 250 kVA AND LESS THAN OR EQUAL TO 1000 kVA	ELECTRICAL SERVICES RATED MORE THAN 1000 kVA
Lighting including exit and egress lighting and exterior lighting	Not required	All lighting in aggregate	All lighting disaggregated by floor, type or area	All lighting disaggregated by floor, type or area
HVAC systems and components including chillers, fans, heaters, furnaces, package units, cooling towers and circulation pumps associated with HVAC	Not required	All HVAC in aggregate	All HVAC in aggregate and each HVAC load rated at least 50 kVA	All HVAC in aggregate and each HVAC load rated at least 50 kVA
Domestic and service water system pumps and related systems and components	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Plug load including appliances rated less than 25 kVA	Not required	All plug load in aggregate Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area Groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf	All plug load separated by floor, type or area All groups of plug loads exceeding 25 kVA connected load in an area less than 5000 sf
Elevators, escalators, moving walks and transit systems	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Other individual non-HVAC loads or appliances rated 25 kVA or greater	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Industrial and commercial load centers 25 kVA or greater, including theatrical lighting installations and commercial kitchens	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Renewable power source (net or total)	Each group	Each group	Each group	Each group
Loads associated with renewable power source	Not required	All loads in aggregate	All loads in aggregate	All loads in aggregate
Charging stations for electric vehicles	All loads in aggregate	All loads in aggregate	All loads in aggregate	All loads in aggregate

SUBCHAPTER 5

NONRESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR ACHIEVING ENERGY EFFICIENCY

SECTION 140.0 PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

Nonresidential and hotel/motel buildings shall comply with all of the following:

(a) The requirements of Sections 100.0 through 110.12 applicable to the building project (mandatory measures for all buildings).

(b) The requirements of Sections 120.0 through 130.5 (mandatory measures for nonresidential and hotel/motel buildings).

(c) Either the performance compliance approach (energy budgets) specified in Section 140.1 or the prescriptive compliance approach specified 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 to Section 140.0(c): 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.

Note to Section 140.0: The requirements of Sections 140.1 through 140.10 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 140.1 through 140.10 also apply to additions or alterations to existing buildings.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code.*

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 the Standard Design Building is determined by applying the mandatory and prescriptive requirements to the proposed design building. The energy budget is the sum of the source energy and TDV energy for space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage systems, 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 source energy and TDV energy for the proposed design building. The energy budget is the sum of the source energy and TDV energy for space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage systems, and service water heating and covered process loads.

Exception to Section 140.1(b). A community shared solar electric generation system, or other renewable electric generation system, and/or community shared battery storage system, that provides dedicated power, utility energy reduction credits or payments for energy bill reductions to the permitted building and is approved by the Energy Commission as specified in Title 24, Part 1, Section 10-115, may offset part or all of the solar electric generation system or battery storage system TDV energy required to comply with the standards, as calculated according to methods established by the Commission in the Nonresidential ACM Reference Manual.

(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 ACM Approval Manual.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code.*

SECTION 140.2 PRESCRIPTIVE APPROACH

To comply using the prescriptive approach a building shall be designed with and shall have constructed and installed systems and components meeting the applicable requirements of Sections 140.3 through 140.10.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, *Public Resources Code.*

SECTION 140.3 PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

A building complies with this section by being designed with and constructed to meet all prescriptive requirements in Subsection (a) and the requirements of Subsection (c) and (d) where they apply.

(a) **Envelope component requirements.**

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 0.034 or lower.

Exception2 to Section 140.3(a)1Aia: Roof constructions with a weight of at least 25 lb/ft^2 over the roof membrane are exempt from the requirements of Section 140.3(a)1Aia.

Exception 3 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:

1. in Climate Zones 1 and 3 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

2. in Climate Zones 2 and 4 through 16 shall have a minimum aged solar reflectance of 0.25 and a minimum thermal emittance of 0.80, or a minimum SRI of 23.

ii. Guest rooms of hotel and motel buildings:

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 with a weight of at least 25 lb/ft^2 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 and 120.7(a)3, insulation shall be placed in direct contact with a roof or drywall ceiling.

TABLE 140.3
ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE—NONRESIDENTIAL BUILDINGS

Aged Solar Reflectance	Metal Building Climate Zone 1-16 *U*-factor	Wood Framed and Other Climate Zones 6-8 *U*-factor	Wood Framed and Other All Other Climate Zones *U*-factor
0.62-0.56	0.038	0.045	0.032
0.55-0.46	0.035	0.042	0.030
0.45-0.36	0.033	0.039	0.029
0.35-0.25	0.031	0.037	0.028

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 120.7(b)7. Vertical windows in demising walls between conditioned and unconditioned spaces shall have an area-weighted average U-factor no greater than the applicable value in Table 140.3-B, C or D.

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. **Exterior Windows.** Vertical windows in exterior walls shall:

A. Percent window area shall be limited in accordance with the applicable requirements of i and ii below:

i. 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;

ii. 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

NOTE: Demising walls are not exterior walls, and therefore demising wall area is not part of the gross exterior wall area or display perimeter and windows in demising walls are not part of the window area.

Exception to Section 140.3(a)5A: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

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

Exception 1 to Section 140.3(a)5B: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

Exception 2 to Section 140.3(a)5B: For vertical windows 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 glazing; and

iii. Area-weighted averaging with other glazing 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 window is:

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

ii. Relative solar heat gain coefficient is calculated using Equation 140.3-A, if the window has an overhang or exterior horizontal slats that extend beyond each side of the window jamb by a distance equal to the overhang's horizontal projection.

Exception 1 to Section 140.3(a)5C: An area-weighted average relative solar heat gain coefficient 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 glazing 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; and

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

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

Exception 3 to Section 140.3(a)5C: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

NOTE: Demising walls are not exterior walls, and therefore windows in demising walls are not subject to SHGC requirements.

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

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

Exception 2 to Section 140.3(a)5D: If the window's VT is not within the scope of NFRC 200, or ASTM E972, then the VT shall be calculated according to Reference Nonresidential Appendix NA6.

Exception 3 to Section 140.3(a)5D: For vertical windows 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 glazing; and

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

Exception 4 to Section 140.3(a)5D: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

NOTE: Demising walls are not exterior walls, and therefore windows in demising walls are not subject to VT requirements.

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

$$RSHGC = SHGC \times \{1 + a \times (2.72^{-PF} - 1) \times [\sin(b \times Az) + c]\}$$

where:

	a	b	c
Overhang	0.150	0.008727	5.67
Exterior Horizonal Slat	0.144	0.008727	5.13

$RSHGC$ = Relative solar heat gain coefficient.

$SHGC$ = Solar heat gain coefficient of the vertical fenestration.

Az = Azimuth of the vertical fenestration in degrees.

PF = Projection factor as calculated by Equation 140.3-C.

EQUATION 140.3-B
VERTICAL FENESTRATION MINIMUM VT

$$VT \geq 0.11/WWR$$

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 Skylight Roof Ratio (SRR); and

Exception 1 to Section 140.3(a)6A: Buildings with atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

Exception 2 to Section 140.3(a)6A: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

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

Exception 1 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 glazing; and

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

Exception 2 to Section 140.3(a)6B: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

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 1 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 glazing; and

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

Exception 2 to Section 140.3(a)6C: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

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

Exception 1 to Section 140.3(a)6D: For skylights containing chromogenic type glazing:

i. the higher-rated 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 glazing; and

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

Exception 2 to Section 140.3(a)6D: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

E. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D1003 or other test method approved by the Energy Commission.

Exception 1 to Section 140.3(a)6E: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or automated baffles or the geometry of the skylight and light well.

Exception 2 to Section 140.3(a)6E: Conditioned greenhouses. The requirements of Section 120.6(h)4 apply.

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-quarter 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.

Exception to Section 140.3(a)9: Relocatable public school buildings.

A. Design. Construction documents shall include air barrier boundaries, interconnections and penetrations, and associated square foot calculations for all sides of the air barrier.

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

1. **Heating and cooling loads.** Heating and cooling system design loads shall be determined in accordance with the procedures described in Subsection A or B below:
   A. For systems serving hotel/motel buildings, and nonresidential buildings other than healthcare facilities, the method in the 2017 ASHRAE Handbook, Fundamentals shall be used or as specified in a method approved by the Commission.
   B. For system serving healthcare facilities the method in the *California Mechanical Code* shall be used.
2. **Indoor design conditions.** Indoor design temperature and humidity conditions for comfort applications shall be determined in accordance with Subsection A or B below:
   A. For systems serving hotel/motel buildings, and nonresidential buildings other than healthcare facilities, ASHRAE Standard 55 or the 2017 ASHRAE Handbook, Fundamentals Volume, except that winter humidification and summer dehumidification shall not be required.
   B. For systems serving healthcare facilities the method in the *California Mechanical Code* shall be used.
3. **Outdoor design conditions.** Outdoor design conditions shall be selected in accordance with Subsection A or B below:
   A. For systems serving hotel/motel buildings, and nonresidential buildings other than healthcare facilities the design conditions from Reference Joint Appendix JA2 shall be used, which is based on data from the ASHRAE Climatic Data for Region X. Heating design temperatures shall be no lower than the Heating Winter Median of Extremes values. Cooling design temperatures shall be no greater than the 0.5 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.
   B. For system serving healthcare facilities the method in Section 320.0 of the *California Mechanical Code* shall be used.

   Exception to Section 140.4(b)3: Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent cooling design wet bulb values.
4. **Ventilation.** Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section 120.1(c)3.
5. **Envelope.** Envelope heating and cooling loads shall be calculated using envelope characteristics, including square footage, thermal conductance, Solar Heat Gain Coefficient or shading coefficient, and air leakage, consistent with the proposed design.
6. **Lighting.** Lighting heating and cooling loads shall be based on actual design lighting levels or power densities as specified in Section 140.6.
7. **People.** Occupant density shall be based on the expected occupancy of the building and shall be the same as determined under Section 120.1(c)3A, if used. Sensible and latent heat gains shall be as listed in the 2017 ASHRAE Handbook, Fundamentals, Chapter 18.
8. **Process loads.** Loads caused by a process shall be based upon actual information on the intended use of the building.
9. **Miscellaneous equipment.** Equipment loads other than process loads shall be calculated using design data compiled from one or more of the following sources:
   A. Actual information based on the intended use of the building; or
   B. Published data from manufacturer's technical publications or from technical societies, such as the ASHRAE Handbook, Applications Volume; or
   C. Other data based on the designer's experience of expected loads and occupancy patterns.
10. **Internal heat gains.** Internal heat gains may be ignored for heating load calculations.
11. **Safety factor.** Calculated design loads based on 140.4(b)1 through 10 may be increased by up to 10 percent to account for unexpected loads or changes in space usage.
12. **Other loads.** Loads such as warm-up or cool-down shall be calculated from principles based on the thermal capacity of the building and its contents, the degree of setback, and desired recovery time; or may be assumed to be no more than 30 percent for heating and 10 percent for cooling of the steady-state design loads. In addition, the steady-state load may include a safety factor in accordance with Section 140.4(b)11.

(c) **Fan systems.** Each fan system moving air into, out of or between conditioned spaces or circulating air for the purpose of conditioning air within a space shall meet the requirements of Items 1, 2 and 3 below.

1. **Fan power budget.** For each fan system that includes at least one fan or fan array with fan electrical input power ≥ 1 kW, fan system electrical input power (Fan $kW_{design,system}$) determined per Section 140.4(c)1(B) at the fan system design airflow shall not exceed Fan kW_{budget} as calculated per Section 140.4(c)1(A).
   A. **Calculation of fan power budget (Fan kW_{budget}).** For each fan system:
      i. Determine the fan system airflow and choose the appropriate table(s) for fan power allowance.
         a. For single-cabinet fan systems, use the fan system airflow and the power allowances in both Table 140.4-A and Table 140.4-B.
         b. For supply-only fan systems, use the fan system airflow and power allowances in Table 140.4-A.

c. For relief fan systems, use the design relief airflow and the power allowances in Table 140.4-B.

d. For exhaust, return and transfer fan systems, use the fan system airflow and the power allowances in Table 140.4-B.

e. For complex fan systems, separately calculate the fan power allowance for the supply and return/exhaust systems and sum them. For the supply airflow, use supply airflow at the fan system design conditions, and the power allowances in Table 140.4-A. For the return exhaust airflow, use return/exhaust airflow at the fan system design conditions, and the power allowances in Table 140.4-B.

ii. For each fan system determine the components included in the fan system and sum the fan power allowances of those components. All fan systems shall include the system base allowance. If, for a given component, only a portion of the fan system airflow passes through the component, calculate the fan power allowance for that component per Equation 140.4-A:

EQUATION 140.4-A FAN POWER ALLOWANCE

$$FPA_{adj} = \frac{Q_{comp}}{Q_{sys}} \times FPA_{comp}$$

Where

FPA_{adj} = The corrected fan power allowance for the component in W/cfm.

Q_{comp} = The airflow through component in cfm.

Q_{sys} = The fan system airflow in cfm.

FPA_{comp} = The fan power allowance of the component from Table 140.4A or Table 140.4B.

iii. Multiply the fan system airflow by the sum of the fan power allowances for the fan system.

iv. Divide by 1000 to convert to Fan kW_{budget}.

v. For building sites at elevations greater than 3,000 feet, multiply Fan kW_{budget} by the correction factor in Table 140.4-C.

B. Determining fan system electrical input power (Fan $kW_{design,system}$). Fan $kW_{design,system}$ is the sum of Fan kW_{design} for each fan or fan array included in the fan system with Fan kWdesign ≥ 1 kW. If variable speed drives are used, their efficiency losses shall be included. Fan input power shall be calculated with two times the clean filter pressure drop, which is the mean of the clean filter pressure drop and design final filter pressure drop. The Fan kW_{design} for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a fan system:

i. Use the default Fan kW_{design} in Table 140.4-D for one or more of the fans. This method cannot be used for complex fan systems.

ii. Use the Fan kW_{design} at fan system design conditions provided by the manufacturer of the fan, fan array, or equipment that includes the fan or fan array calculated per a test procedure included in USDOE 10 CFR Part 430, USDOE 10 CFR Part 431, ANSI/AMCA Standard 208-2018, ANSI/AMCA Standard 210-2016, AHRI Standard 430-2020, AHRI Standard 440-2019 or ISO 5801-2017.

iii. Use the Fan kW_{design} provided by the manufacturer, calculated at fan system design conditions per one of the methods listed in Section 5.3 of ANSI/AMCA 208-2018.

iv. Determine the Fan kW_{design} by using the maximum electrical input power provided on the motor nameplate.

2. **Variable air volume (VAV) systems.**

A. Static pressure sensor location. Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section 140.4(c)2B. If this results in the sensor being located downstream of any major duct split, multiple sensors shall be installed in each major branch with fan capacity controlled to satisfy the sensor furthest below its setpoint; and

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

3. **Fractional HVAC motors for fans.** HVAC motors for fans that are less than 1 hp and $^1/_{12}$ hp or greater shall be electronically-commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

Exception 1 to Section 140.4(c)3: Motors in fan-coils and terminal units that operate only when providing heating to the space served.

Exception 2 to Section 140.4(c)3: Motors in space conditioning equipment certified under Section 110.1 or 110.2.

Exception to Section 140.4(c): Fan system power caused solely by process loads.

TABLE 140.4-G
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.

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 for 60,000 damper opening and closing cycles.

iii. **Damper leakage.** Economizer outdoor air and return air dampers shall have a maximum leakage rate of 10 cfm/sf at 250 Pascals (1.0 in. of water) when tested in accordance with AMCA Standard 500-D. The economizer outside air and return air damper leakage rates shall be certified to the Energy Commission in accordance with Section 110.0.

iv. **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.

v. **Sensor accuracy.** Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies.

1. Drybulb and wetbulb temperatures accurate to ±2°F over the range of 40°F to 80°F;
2. Enthalpy accurate to ±3 Btu/lb over the range of 20 Btu/lb to 36 Btu/lb;
3. Relative humidity (RH) accurate to ±5 percent over the range of 20 percent to 80 percent RH;

vi. **Sensor calibration data.** Data used for control of the economizer shall be plotted on a sensor performance curve.

vii. **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.

viii. **Relief air system.** Relief air systems shall be capable of providing 100 percent outside air without over-pressurizing the building.

E. The space-conditioning system shall include the following:

i. 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.

ii. Direct Expansion (DX) units greater than 65,000 Btu/hr 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.

iii. DX units not within the scope of Section 140.4(e)2Eii shall comply with the requirements in Table 140.4-H, and have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means except at the lowest stage of mechanical cooling capacity.

TABLE 140.4-H
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

3. Systems that include a water economizer to meet Section 140.4(e)1 shall include the following:

   A. Maximum pressure drop. Precooling coils and water-to-water heat exchangers used as part of a water economizer shall either have a waterside pressure drop of less than 15 feet of water, or a secondary loop shall be installed so that the coil or heat exchanger pressure drop is not contributing to pressure drop when the system is in the normal cooling (non-economizer) mode.

   B. Economizer systems shall be integrated with the mechanical cooling system so that they are capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load. Controls shall 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.

(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 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)1, without using Exception 1 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 process loads. Computer rooms or other spaces with only IT equipment may not use this exception.

Exception 4 to Section 140.4(f): Systems serving healthcare facilities.

(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 entire 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 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.

Exception 6 to Section 140.4(g): Heating systems serving as emergency backup to gas heating equipment.

(h) **Heat rejection systems.** Heat rejection equipment used in comfort cooling systems, such as air-cooled condensers, open cooling towers, closed-circuit cooling towers and evaporative condensers shall include the following:

1. **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 control the leaving fluid temperature or condensing temperature or pressure of the heat rejection device.

   Exception 1 to Section 140.4(h)1: Heat rejection devices included as an integral part of the equipment listed in Tables 110.2-A through 110.2-N.

   Exception 2 to Section 140.4(h)1: Condenser fans serving multiple refrigerant circuits.

   Exception 3 to Section 140.4(h)1: Condenser fans serving flooded condensers.

   Exception 4 to Section 140.4(h)1: Up to one third of the fans on a condenser or tower with multiple fans where the lead fans comply with the speed control requirement.

2. **Tower flow turndown.** Open cooling towers configured with multiple condenser water pumps shall be designed so that all cells can be run in parallel with the larger of:

   A. The flow that is produced by the smallest pump, or

   B. 50 percent of the design flow for the cell.

3. **Limitation on centrifugal fan cooling towers.** Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply and 75°F outdoor wet-bulb temperature shall use propeller fans and shall not use centrifugal fans.

   Exception 1 to Section 140.4(h)3: Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability.

   Exception 2 to Section 140.4(h)3: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, Table 110.2-F.

4. **Multiple cell heat rejection equipment.** Multiple cell heat rejection equipment with variable speed fan drives shall:
   A. Operate the maximum number of fans allowed that comply with the manufacturer's requirements for all system components, and
   B. Control all operating fans to the same speed. Minimum fan speed shall comply with the minimum allowable speed of the fan drive as specified by the manufacturer's recommendation. Staging of fans is allowed once the fans are at their minimum operating speed.
5. **Cooling tower efficiency.** Axial fan, open-circuit cooling towers serving condenser water loops for chilled water plants with a total of 900 gpm or greater, shall have a rated efficiency of no less than 60 gpm/hp when rated in accordance with the conditions as listed in Table 110.2-F.

   Exception 1 to Section 140.4(h)5: Replacement of existing cooling towers that are inside an existing building or on an existing roof.

   Exception 2 to Section 140.4(h)5: Cooling towers serving buildings in Climate Zone 1 or 16.

(i) **Minimum chiller efficiency.** Chillers shall meet or exceed Path B from Table 110.2-D.

Exception 1 to Section 140.4(i): Chillers with electrical service > 600V.

Exception 2 to Section 140.4(i): Chillers attached to a heat recovery system with a design heat recovery capacity > 40 percent of the design chiller cooling capacity.

Exception 3 to Section 140.4(i): Chillers used to charge thermal energy storage systems where the charging temperature is < 40°F.

Exception 4 to Section 140.4(i): In buildings with more than three chillers, only three chillers are required to meet the Path B efficiencies.

(j) **Limitation of air-cooled chillers.** Chilled water plants shall not have more than 300 tons provided by air-cooled chillers.

Exception 1 to Section 140.4(j): Where the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled chillers.

Exception 2 to Section 140.4(j): Chillers that are used to charge a thermal energy storage system with a design temperature of less than 40°F (4°C).

Exception 3 to Section 140.4(j): Systems serving healthcare facilities.

(k) **Hydronic system measures.**

1. **Hydronic variable flow systems.** HVAC chilled and hot water pumping shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to no more than the larger of: a) 50 percent or less of the design flow rate; or b) the minimum flow required by the equipment manufacturer for the proper operation of equipment served by the system.

   Exception 1 to Section 140.4(k)1: Systems that include no more than three control valves.

   Exception 2 to Section 140.4(k)1: Systems having a total pump system power less than or equal to 1.5 hp.
2. **Chiller isolation.** When a chilled water system includes more than one chiller, provisions shall be made so that flow through any chiller is automatically shut off when that chiller is shut off while still maintaining flow through other operating chiller(s). Chillers that are piped in series for the purpose of increased temperature differential shall be considered as one chiller.
3. **Boiler isolation.** When a hot water plant includes more than one boiler, provisions shall be made so that flow through any boiler is automatically shut off when that boiler is shut off while still maintaining flow through other operating boiler(s).
4. **Chilled and hot water temperature reset controls.** Systems with a design capacity exceeding 500,000 Btu/hr supplying chilled or heated water shall include controls that automatically reset supply water temperatures as a function of representative building loads or outside air temperature.

   Exception 1 to Section 140.4(k)4: Hydronic systems that use variable flow to reduce pumping energy in accordance with 140.4(k)1.

   Exception 2 to Section 140.4(k)4: Systems serving healthcare facilities.
5. **Water-cooled air conditioner and hydronic heat pump systems.** Water circulation systems serving water-cooled air conditioners, hydronic heat pumps, or both that have total pump system power exceeding 5 hp shall have flow controls that meet the requirements of Section 140.4(k)6. Each such air conditioner or heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.
6. **Variable flow controls.**
   A. Variable speed drives. Individual pumps serving variable flow systems and having a motor horsepower exceeding 5 hp shall have controls or devices (such as variable speed control) that will result in pump motor demand of no more than 30 percent of design wattage at 50 percent of design water flow. The pumps shall be controlled as a function of required differential pressure.
   B. Pressure sensor location and setpoint.
      i. For systems without direct digital control of individual coils reporting to the central control panel, differential pressure shall be measured at the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.
      ii. For systems with direct digital control of individual coils with a central control panel, the static pressure setpoint shall be reset based on the valve requiring the most pressure, and the setpoint shall be no less than 80 percent open. Pressure sensors may be mounted anywhere.

Exception 1 to Section 140.4(k)6: Heating hot water systems.

Exception 2 to Section 140.4(k)6: Condenser water systems serving only water-cooled chillers.

7. **Hydronic heat pump (WLHP) controls.** Hydronic heat pumps connected to a common heat pump water loop with central devices for heat rejection and heat addition shall have controls that are capable of providing a heat pump water supply temperature dead band of at least 20°F between initiation of heat rejection and heat addition by the central devices.

   Exception to Section 140.4(k)7: Where a system loop temperature optimization controller is used to determine the most efficient operating temperature based on real-time conditions of demand and capacity, dead bands of less than 20°F shall be allowed.

8. **High capacity space heating gas boiler systems.** In Climate Zones 1 through 6, 9 through 14, and 16, gas hot water boiler systems for space heating with a total system input of at least 1 MMBtu/h but no more than 10 MMBtu/h shall meet all of the following requirements.

   A. **Boiler system efficiency.** Gas hot water boilers shall have a minimum thermal efficiency of 90 percent. Systems with multiple boilers can meet this requirement if the space-heating input provided by equipment with thermal efficiencies above and below 90 percent has an input capacity-weighted average thermal efficiency of at least 90 percent. For boilers federally regulated by combustion efficiency, the calculation for the input capacity-weighted average thermal efficiency shall use the combustion efficiency value.

   B. **Hot water distribution design.** The hot water distribution system shall be designed to comply with Items i and ii.

      i. Coils and other heat exchangers shall be selected so that at design conditions the hot water return temperature entering the boilers is 120°F or less.

      ii. Under all operating conditions, the water temperature entering the boiler is 120°F or less or the flow rate of supply hot water that recirculates directly into the return system, such as by three-way valves or minimum flow bypass controls, shall be no greater than 20 percent of the design flow of the operating boilers.

   Exception 1 to Section 140.4(k)8: Where 25 percent of the annual space heating requirement is provided by on-site renewable energy, site-recovered energy or heat recovery chillers.

   Exception 2 to Section 140.4(k)8: Space heating boilers installed in individual dwelling units.

   Exception 3 to Section 140.4(k)8: Where 50 percent or more of the design heating load is served using perimeter convective heating, radiant ceiling panels or both.

   Exception 4 to Section 140.4(k)8: Individual gas boilers with input capacity less than 300,000 Btu/h shall not be included in the calculations of the total system input or total system efficiency.

(l) **Reserved.**

(m) **Fan control.** Each cooling system listed in Table 140.4-I shall be designed to vary the indoor fan airflow as a function of load and shall comply with the following requirements:

1. DX and chilled water cooling systems that control the capacity of the mechanical cooling directly based on occupied space temperature shall (i) have a minimum of two stages of fan control with no more than 66 percent speed when operating on stage 1; and (ii) draw no more than 40 percent of the fan power at full fan speed, when operating at 66 percent speed.
2. All other systems, including but not limited to DX cooling systems and chilled water systems that control the space temperature by modulating the airflow to the space, shall have proportional fan control such that at 50 percent air flow the power draw is no more than 30 percent of the fan power at full fan speed.
3. Systems that include an air side economizer to meet Section 140.4(e)1 shall have a minimum of two speeds of fan control during economizer operation.

Exception 1 to Section 140.4(m): Modulating fan control is not required for chilled water systems with all fan motors < 1 HP, or for evaporative systems with all fan motors < 1 HP, if the systems are not used to provide ventilation air and all indoor fans cycle with the load.

Exception 2 to Section 140.4(m): Systems serving healthcare facilities.

TABLE 140.4-I
FAN CONTROL SYSTEMS

COOLING SYSTEM TYPE	FAN MOTOR SIZE	COOLING CAPACITY
DX cooling	Any	≥ 65,000 Btu/hr
Chilled water and evaporative	≥ 1/4 HP	Any

(n) **Mechanical system shut-off.** Any directly conditioned space with operable wall or roof openings to the outdoors shall be provided with interlock controls that disable or reset the temperature setpoint to 55°F for mechanical heating and disable or reset the temperature setpoint to 90°F for mechanical cooling to that space when any such opening is open for more than 5 minutes.

Exception 1 to Section 140.4(n): Interlocks are not required on doors with automatic closing devices.

Exception 2 to Section 140.4(n): Any space without a thermostatic control (thermostat or a space temperature sensor used to control heating or cooling to the space).

Exception 3 to Section 140.4(n): Healthcare facilities.

ages out to an input capacity-weighted average of at least 90 percent.

Exception 1 to Section 140.5(c): If 25 percent of the annual service water-heating requirement is provided by site-solar energy or site-recovered energy.

Exception 2 to Section 140.5(c): Water heaters installed in individual dwelling units.

Exception 3 to Section 140.5(c): Individual gas water heaters with input capacity at or below 100,000 Btu/h shall not be included in the calculations of the total system input or total system efficiency.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, and 25943, *Public Resources Code.*

SECTION 140.6 PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

A building complies with this section if:

i. The calculation of adjusted indoor lighting power of all proposed building areas combined, calculated under Subsection (a) is no greater than the calculation of allowed indoor lighting power, specific methodologies calculated under Subsection (c); and

ii. The calculation of allowed indoor lighting power, general rules comply with Subsection (b).

The prescriptive limits on indoor lighting power are the smaller of the adjusted and allowed indoor lighting power values determined in accordance with Item i.

(a) **Calculation of adjusted indoor lighting power.** The adjusted indoor lighting power 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 4 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.

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 adjusted 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 adjusted indoor lighting power, 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.

   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, 0.2 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 installed watts as allowed by Section 140.6(a)2 for calculating the Adjusted Indoor Lighting Power. 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 adjusted indoor lighting power.

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.

H. To qualify for the PAF for daylight continuous dimming plus OFF control, the daylight control and controlled luminaires shall comply with Section 130.1(d), 130.4(a)3 and 130.4(a)7, and the daylight control shall be continuous dimming and shall additionally turn lights completely OFF when the daylight available in the daylit zone is greater than 150 percent of the illuminance received from the general lighting system at full power. The PAF shall apply to the luminaires in the primary sidelit daylit zone, secondary sidelit daylit zone and skylit daylit zone.

I. To qualify for the PAF for an occupant sensing control controlling the general lighting in large office areas above workstations, in accordance with Table 140.6-A, the following requirements shall be met:

i. The 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 an Institutional Tuning in Table 140.6-A, the tuned lighting system shall comply with all of the following requirements:

i. The lighting controls shall limit the maximum output or maximum power draw of the controlled lighting to 85 percent or less of full light output or full power draw; and

ii. The means of setting the limit is accessible only to authorized personnel; and

iii. The setting of the limit is verified by the acceptance test required by Section 130.4(a)7; and

iv. The construction documents specify which lighting systems shall have their maximum light output or maximum power draw set to no greater than 85 percent of full light output or full power draw.

K. To qualify for the PAF for a demand responsive control in Table 140.6-A, the general lighting wattage receiving the PAF shall not be within the scope of Section 110.12(c) and a demand responsive control shall meet all of the following requirements:

i. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal; and

ii. General lighting shall be reduced in a manner consistent with uniform level of illumination requirements in Table 130.1-A.

L. To qualify for the PAFs for clerestory fenestration, horizontal slats, or light shelves in Table 140.6-A, the daylighting design shall meet the requirements in Section 140.3(d). The PAFs shall only apply to lighting in a primary or secondary sidelit daylit zone where continuous dimming daylighting controls meeting the requirements of Section 130.1(d) are installed.

3. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from adjusted indoor lighting power. (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

D. If the area category method is used for an area, the tailored method may not be used for that area. If the tailored method is used for an area, the area category method may not be used for that area.

4. Allowed indoor lighting power allotments for all lighting power allotments other than general lighting shall be restricted as follows:

A. When using the area category method, allowed indoor lighting power allotments for specialized task work; precision commercial and industrial work; white board or chalk board; accent, display and feature; decorative; or videoconferencing studio; may not be increased as a result of, or otherwise traded off against, decreasing any other allotment; and

B. When using the tailored method, allowed indoor lighting power allotments for wall display; floor display and task; decorative/special effect; or very valuable display case; may not be increased, or otherwise traded between any of the separate allotments.

(c) **Calculation of allowed indoor lighting power: specific methodologies.** The allowed indoor lighting power for each building type, or each primary function area shall be calculated using only one of the methods in Subsection 1, 2 or 3 below as applicable.

1. **Complete building method.** Requirements for using the complete building method include all of the following:

A. The complete building method shall be used only for building types, as defined in Section 100.1, that are specifically listed in Table 140.6-B. (For example, retail and wholesale stores, hotel/motel, and high-rise residential buildings shall not use this method.)

B. The complete building method shall be used only on projects involving:

i. Entire buildings with one type of use occupancy; or

ii. Mixed occupancy buildings where one type of use makes up at least 90 percent of the entire building (in which case, when applying the complete building method, it shall be assumed that the primary use is 100 percent of the building); or

iii. A tenant space where one type of use makes up at least 90 percent of the entire tenant space (in which case, when applying the complete building method, it shall be assumed that the primary use is 100 percent of the tenant space).

C. The complete building method shall be used only when the applicant is applying for a lighting permit and submits plans and specifications for the entire building or the entire tenant space.

D. Under the complete building method, the allowed indoor lighting power allotment is the lighting power density value times the floor area of the entire building.

E. For buildings including a parking garage plus another type of use listed in Table 140.6-B, the parking garage portion of the building and other type of use portion of the building shall each separately use the Complete Building Method.

2. **Area category method.** Requirements for using the area category method include all of the following:

A. The area category method shall be used only for primary function areas, as defined in Section 100.1, that are listed in Table 140.6-C. For primary function areas not listed, selection of a reasonably equivalent type shall be permitted.

B. Primary function areas in Table 140.6-C shall not apply to a complete building. Each primary function area shall be determined as a separate area.

C. For purposes of compliance with Section 140.6(c)2, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Table 146.0-C.

D. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in primary function area.

E. If at the time of permitting for a newly constructed building, a tenant is not identified for a multitenant area, a maximum of 0.4 watts per square foot shall be allowed for the lighting in each area in which a tenant has not been identified. The area shall be classified as unleased tenant area.

F. Under the area category method, the allowed indoor lighting power for each primary function area is the lighting power density value in Table 140.6-C times the square feet of the primary function area. The total allowed indoor lighting power density for the building is the sum of all allowed indoor lighting powers densities for all areas in the building.

G. In addition to the allowed indoor lighting power calculated according to Sections 140.6(c)2A through F, the building may add additional lighting power allowances for qualifying lighting systems as specified in the Qualifying Lighting Systems column in Table 140.6-C under the following conditions:

i. Only primary function areas having a lighting system as specified in the Qualifying Lighting Systems column in Table 140.6-C and in accordance with the corresponding footnote of the table shall qualify for the additional lighting power allowances; and

ii. The additional lighting power allowances shall be used only if the plans clearly identify all applicable task areas and the lighting equipment designed to illuminate these tasks; and

iii. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for the additional lighting power allowances; and

iv. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

v. The additional lighting power allowances shall not be used when using the complete building method, or when the tailored method is used for any area in the building; and

vi. The additional lighting power allowed is the smaller of:

a. the lighting power density listed in the "Allowed Additional Lighting LPD" column in Table 140.6-C, times the square feet of the primary function, or

b. the adjusted indoor lighting power of the applicable lighting; and

vii. In addition to meeting Sections 140.6(c)2Gi through vi, additional lighting power for videoconferencing as specified in Table 140.6-C shall be allowed in a videoconferencing studio, as defined in Section 100.1, provided the following conditions are met:

a. A completed and signed installation certificate is prepared and submitted in accordance with Section 130.4(b), specifically detailing compliance with the applicable requirements of Section 140.6(c)2Gvii; and

b. The 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; and

c. General lighting is switched in accordance with Table 130.1-A; and

d. Wall wash lighting is separately switched from the general lighting system; and

e. All of the lighting in the studio, including general lighting and additional lighting power allowed by Section 140.6(c)2Gvii is controlled by a multiscene programmable control system (also known as a scene preset control system).

3. **Tailored method.** Requirements for using the tailored method include all of the following:

A. The tailored method shall be used only for primary function areas listed in Table 140.6-D, as defined in Section 100.1.

B. Allowed indoor lighting power allotments for general lighting shall be determined according to Section 140.6(c)3F, as applicable.

C. For compliance with Section 140.6(c)3, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Table 140.6-D.

D. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a primary function area.

E. In addition to the allowed indoor lighting power allotments for general lighting calculated according to Sections 140.6(c)3F, as applicable, the building may add additional lighting power allowances for wall display lighting, floor display lighting and task lighting, decorative/special effects lighting, and very valuable display cases lighting according to Sections 140.6(c)3G through J.

F. Determine allowed indoor lighting power allotments for general lighting for primary function areas listed in Table 140.6-D as follows:

i. Use the General Illumination Level (Lux) listed in Column 2 of Table 140.6-D to determine the allowed general lighting power density allotments for the area.

ii. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in Table 140.6-F.

iii. Find the allowed general lighting power density allotments in Table 140.6-G that is applicable to the general illuminance level (Lux) from Column 2 of Table 140.6-D (as described in Item i) and the RCR determined in accordance with Table 140.6-F (as described in Item ii).

iv. Determine the square feet of the area in accordance with Section 140.6(c)3C and D.

v. Multiply the allowed lighting power density allotment, as determined in accordance with Item iii by the square feet of each primary function area, as determined in accordance with Item iv. The product is the allowed indoor lighting power allotment for general lighting for the area.

G. 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. Floor displays shall not qualify for wall display allowances.

ii. 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

mum average efficiency for alternating current-output UPS shall meet or exceed calculation and testing requirements identified in ENERGY STAR Program Requirements for Uninterruptible Power Supplies (UPSs) – Eligibility Criteria Version 2.0.

where:

P is the rated output power in watts (W).

E_{MOD} is an allowance of 0.004 for modular UPSs applicable in the commercial 1,500–10,000 W range.

ln is the natural logarithm.

The requirement shall be rounded to the third decimal place for certification and reporting.

Exception to Section 140.9(a)4: Alternating current-output UPS that utilizes standardized NEMA 1-15P or NEMA 5-15P input plug, as specified in ANSI/NEMA WD-6-2016.

(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-C. 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)1B: 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)1B: Existing hoods not being replaced as part of an addition or alteration.

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)2A: 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

ii. Demand ventilation system(s) on at least 75 percent of the exhaust air. Such systems shall:

a. Include controls necessary to modulate airflow in response to appliance operation and to maintain full capture and containment of

TABLE 140.9-B
ALTERNATING CURRENT-OUTPUT UNINTERRUPTIBLE POWER SUPPLY MINIMUM AVERAGE EFFICIENCY

	VOLTAGE AND FREQUENCY DEPENDENT	VOLTAGE INDEPENDENT	VOLTAGE AND FREQUENCY INDEPENDENT
$P < 350$ W	$5.71 \times 10^{-5} \times P + 0.962$	$5.71 \times 10^{-5} \times P + 0.964$	$0.011 \times \ln(P) + 0.824$
350 W $< P <$1,500 W	0.982	0.984	$0.011 \times \ln(P) + 0.824$
1,500 W $< P <$10,000 W	$0.981 - E_{MOD}$	$0.980 - E_{MOD}$	$0.0145 \times \ln(P) + 0.800 - E_{MOD}$
$P >$10,000 W	0.970	0.940	$0.0058 \times \ln(P) + 0.886$

TABLE 140.9-C
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

smoke, effluent and combustion products during cooking and idle; and

b. Include failsafe controls that result in full flow upon cooking sensor failure; and

c. Include an adjustable timed override to allow occupants the ability to temporarily override the system to full flow; and

d. Be capable of reducing exhaust and replacement air system airflow rates to the larger of:

(i) 50 percent of the total design exhaust and replacement air system airflow rates; or

(ii) The ventilation rate required as specified by Section 120.1(c)3.

iii. Listed energy recovery devices with a sensible heat recovery effectiveness of not less than 40 percent on at least 50 percent of the total exhaust airflow; or

iv. A minimum of 75 percent of makeup air volume that is:

a. Unheated or heated to no more than 60°F; and

b. Uncooled or cooled without the use of mechanical cooling.

Exception to Section 140.9(b)2B: Existing hoods not being replaced as part of an addition or alteration.

3. **Kitchen exhaust system acceptance.** Before an occupancy permit is granted for a commercial kitchen subject to Section 140.9(b), 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 NA7.11.

Exception to Section 140.9(b): healthcare facilities.

(c) **Prescriptive requirements for laboratory and factory exhaust systems.**

1. Airflow reduction requirements. For buildings with laboratory exhaust systems where the minimum circulation rate to comply with code or accreditation standards is 10 ACH or less, the design exhaust airflow shall be capable of reducing zone exhaust and makeup airflow rates to the regulated minimum circulation rate, or the minimum required to maintain pressurization requirements, whichever is larger. Variable exhaust and makeup airflow shall be coordinated to achieve the required space pressurization at varied levels of demand and fan system capacity.

Exception 1 to Section 140.9(c)1: Laboratory exhaust systems serving zones where constant volume is required by the authority having jurisdiction, facility environmental health & safety department or other applicable code.

Exception 2 to Section 140.9(c)1: New zones on an existing constant volume exhaust system.

2. **Exhaust System Transfer Air.** Conditioned supply air delivered to any space with mechanical exhaust shall comply with the requirements of Section 140.4(o).

3. **Fan System Power Consumption.** All newly installed fan exhaust systems serving a laboratory or factory greater than 10,000 cfm shall meet Subsection A and either B, C, or D:

A. System shall meet all discharge requirements in ANSI Z9.5-2012.

B. The exhaust fan system power shall not exceed 0.85 watts per cfm of exhaust air for systems with air filtration, scrubbers, or other air treatment devices. For all other exhaust fan systems the system power shall not exceed 0.65 watts per cfm of exhaust air. Exhaust fan system power equals the sum of the power of all fans in the exhaust system that are required to operate at normal occupied design conditions in order to exhaust air from the conditioned space to the outdoors. Exhaust air does not include entrained air, but does include all exhaust air from fume hoods, hazardous exhaust flows, or other manifolded exhaust streams.

Exception to Section 140.9(c)3B: Laboratory exhaust systems where applicable local, state, or federal exhaust treatment requirements specify installation of air treatment devices that cause more than 1 in. of water pressure drop.

C. The volume flow rate at the stack shall vary based on the measured 5-minute averaged wind speed and wind direction obtained from a calibrated local anemometer.

i. At least one sonic anemometer or at least two anemometers of other types shall be installed in a location that experiences similar wind conditions to the free stream environment above the exhaust stacks and be at a height that is outside the wake region of nearby structures.

ii. Look-up tables shall be used to define the required exhaust volume flow rate, as a function of at least eight wind speeds and eight wind directions, to maintain downwind concentrations below health and odor limits, as defined by the 2018 American Conference of Governmental Industrial Hygienists Threshold Limit Values and Biological Exposure Indices, for all contaminants, or as defined by applicable local, state, or federal jurisdictions, if more stringent.

iii. Wind speed/direction sensors shall be certified by the manufacturer to be accurate within plus or minus 40 fpm (0.2 m/s) and 5.0 degrees when measured at sea level and 25°C, factory calibrated, and certified by

SUBCHAPTER 6

NONRESIDENTIAL AND HOTEL/MOTEL OCCUPANCIES—ADDITIONS, ALTERATIONS AND REPAIRS

SECTION 141.0
ADDITIONS, ALTERATIONS AND REPAIRS TO EXISTING NONRESIDENTIAL AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

Additions, alterations, and repairs to existing nonresidential and hotel/motel buildings, existing outdoor lighting for these occupancies, and internally and externally illuminated signs, shall meet the requirements specified in Sections 100.0 through 110.10, and 120.0 through 130.5 that are applicable to the building project, and either the performance compliance approach (energy budgets) in Section 141.0(a)2 (for additions) or 141.0(b) 3 (for alterations), or the prescriptive compliance approach in Section 141.0(a)1 (for additions) or 141.0(b)2 (for alterations), for the Climate Zone in which the building is located. Climate zones are shown in Figure 100.1-A.

Covered process requirements for additions, alterations and repairs to existing nonresidential and hotel/motel buildings are specified in Section 141.1.

Exception to Section 141.0: Alterations to healthcare facilities are not required to comply with this Section.

NOTES:

1. For alterations that change the occupancy classification of the building, the requirements specified in Section 141.0(b) apply to the occupancy after the alterations.
2. Relocation or moving of a relocatable public school building is not, by itself, considered an alteration for the purposes of Title 24, Part 6.

(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, electrical power distribution system, or water-heating system; 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 120.7, 120.9 through 130.5 and 140.2 through 140.9.
2. **Performance approach.**
   A. The envelope and indoor lighting in the conditioned space of the addition, and any newly installed space-conditioning system, electrical power distribution system, or water-heating system, shall meet the applicable requirements of Sections 110.0 through 120.7, 120.9 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 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.

Exception 5 to Section 141.0(a): A gas hot water boiler system with a total system input of at least 1 MMBtu/h but no more than 10 MMBtu/h added to an existing building is exempt from the requirements of Section 140.4(k)8.

Exception 6 to Section 141.0(a): A gas service water-heating system with a total system input of at least 1 MMBtu/h added to an existing building is exempt from the requirements of Section 140.5(c).

Exception 7 to Section 141.0(a): Section 140.4(a)2 shall not apply to new space-conditioning systems or components.

(b) **Alterations.** Alterations to components of existing nonresidential, hotel/motel, or relocatable public school buildings, including alterations made in conjunction with a change in building occupancy to a nonresidential, high-rise residential or hotel/motel occupancy shall meet Item 1, and either Item 2 or 3 below:

1. **Mandatory requirements.** Altered components in a nonresidential 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)2Bii.
   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 area-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 area-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 area-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 area-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 area-weighted average *U*-factor of the floor assembly shall not exceed the *U*-factor of U-0.071.
      2. **Raised mass floors in hotel/motel guest rooms.** A minimum of R-6 insulation, or the area-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.
   D. **Fan energy index:** New fan systems serving an existing building shall meet the requirements of Section 120.10.
2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, electrical power distribution 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 120.9 through 130.5.

   Exception to Section 141.0(b)2: The requirements of Section 120.2(i) shall not apply to alterations of space-conditioning systems or components.

   A. Fenestration alterations other than repair and those subject to Section 141.0(b)2 shall meet the requirements below:
      i. Vertical fenestration alterations shall meet the requirements in Table 141.0-A.
      ii. Added vertical fenestration shall meet the requirements of Table 140.3-B, C or D.
      iii. All altered or newly installed skylights shall meet the requirements of Table 140.3-B, C or D.

      Exception 1 to Section 141.0(b)2Ai: In an alteration, where 150 square feet or less of the entire building's vertical fenestration is replaced, RSHGC and VT requirements of Table 141.0-A shall not apply.

      Exception 2 to Section 141.0(b)2Aii: In an alteration, where 50 square feet or less of vertical fenestration is added, RSHGC and VT requirements of Table 140.3-B, C or D shall not apply.

      Exception 3 to Section 141.0(b)2Aiii: In an alteration, where 50 square feet or less of skylight is added, SHGC and VT requirements of Table 140.3-B, C or D shall not apply.

   NOTE: Glass replaced in an existing sash and frame or sashes replaced in an existing frame are considered repairs. In these cases, Section 141.0(c) requires that the replacement be at least equivalent to the original in performance.

TABLE 141.0-A
ALTERED VERTICAL FENESTRATION MAXIMUM *U*-FACTOR AND MAXIMUM 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															

B. Existing roofs of a nonresidential or hotel/motel building being replaced, recovered or recoated, as defined in Section 100.1(b) and Title 24, Part 2, Chapter 2, shall meet the requirements of Section 110.8(i). When roofs with more than 50 percent of the roof area or more than 2,000 square feet of roof, whichever is less, are being altered the requirements of i and ii apply:

i. Roofing products shall comply with requirements in Section 140.3(a)1A.

Exception 1 to Section 141.0(b)2Bi: An aged solar reflectance less than 0.63 is allowed for low-sloped roofs provided the maximum roof/ceiling *U*-factor in Table 141.0-B is not exceeded.

Exception 2 to Section 141.0(b)2Bi: 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 3 to Section 141.0(b)2Bi: Roof constructions with a weight of at least 25 lb/ft^2 are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

ii. **Roof/ceiling insulation.** For low-sloped roofs, the area of the roof recover or roof replacement shall be insulated to the level specified in Table 141.0-C.

Exception 1 to Section 141.0(b)2Bii: Roof recovers with new R-10 insulation added above deck do not need to be insulated to the level specified in Table 141.0-C.

Exception 2 to Section 141.0(b)2Bii: When existing mechanical equipment located on the roof will not be disconnected and lifted, insulation added is the greater of R-10 or the maximum installed thickness that will allow the distance between the height of the roof membrane surface and the top of the base flashing to remain in accordance with the manufacturer's instructions.

Exception 3 to Section 141.0(b)2Bii: At the drains and other low points, tapered insulation with a thermal resistance less than that prescribed in Table 141.0-C may be used, provided that insulation thickness is increased at the high points of the roof so that the average thermal resistance equals or exceeds the value specified in Table 141.0-C.

Exception 4 to Section 141.0(b)2Bii: The area of the roof recoat is not required to be insulated.

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. Additional fan power allowances are available when determining the fan power budget (Fan kW_{budget}) as specified in Table 141.0-D. These values can be added to the fan power allowance values in Table 140.4-A and Table 140.4-B.

Exception 1 to Section 141.0(b)2C: Section 140.4(a)2 shall not apply to new or replacement space-conditioning systems or components.

TABLE 141.0-B
ROOF/CEILING INSULATION TRADEOFF FOR LOW-SLOPED AGED SOLAR REFLECTANCE

NONRESIDENTIAL		
Aged Solar Reflectance	Climate Zones 6, 7 and 8 *U*-factor	All Other Climate Zones *U*-factor
0.62–0.60	0.043	0.035
0.59–0.55	0.041	0.034
0.54–0.50	0.038	0.031
0.49–0.45	0.034	0.029
0.44–0.40	0.032	0.028
0.39–0.35	0.029	0.026
0.34–0.30	0.028	0.025
0.29–0.25	0.026	0.024

TABLE 141.0-C
INSULATION REQUIREMENTS FOR ROOF ALTERATIONS

Climate Zone	Continuous Insulation *R*-value	*U*-factor
1–5, 9–16	R-23	0.037, with at least R-10 above deck
6–8	R-17	0.047, with at least R-10 above deck

TABLE 141.0-D
ADDITIONAL FAN POWER ALLOWANCES

AIRFLOW	MULTI-ZONE VAV SYSTEMS[1] ≤5,000 cfm	MULTI-ZONE VAV SYSTEMS[1] >5,000 and ≤10,000 cfm	MULTI-ZONE VAV SYSTEMS[1] >10,000 cfm	ALL OTHER FAN SYSTEMS ≤5,000 cfm	ALL OTHER FAN SYSTEMS >5,000 and ≤10,000 cfm	ALL OTHER FAN SYSTEMS >10,000 cfm
Supply Fan System Additional Allowance	0.135	0.114	0.105	0.139	0.12	0.107
Supply Fan System Additional Allowance in Unit with Adapter Curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/Relief/Return/Transfer Fan System Additional Allowance	0.07	0.061	0.054	0.07	0.062	0.055
Exhaust/Relief/Return/Transfer Fan System Additional Allowance in Unit with Adapter Curb	0.016	0.017	0.022	0.000	0.000	0.000

1. See FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV) for the definition of a multi-zone VAV system.

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.

Exception 3 to Section 141.0(b)2C. Section 140.4(n) is not applicable to new or replacement space-conditioning systems.

Exception 4 to Section 141.0(b)2C: Section 140.4(e) is applicable to systems, other than single package air-cooled commercial unitary air conditioners and heat pumps, with cooling capacity less than 54,000 Btu/h.

Exception 5 to Section 141.0(b)2C: A new or replacement gas hot water boiler system with a total system input of at least 1 MMBtu/h but no more than 10 MMBtu/h need not comply with the requirements of Section 140.4(k)8.

D. **Altered duct systems.** New or replacement space-conditioning system ducts installed to serve an existing building shall meet the requirements of Section 120.4 (a) through (f) and meet i, ii or iii below:

i. Entirely new or complete replacement duct systems installed as part of an alteration shall be leakage tested in accordance with Section 120.4(g). This applies to replacement duct systems installed as part of an alteration that are constructed of at least 75 percent new duct material. Up to 25 percent of that alteration may consist of reused parts from the building's existing duct system (including registers, grilles, boots, air handlers, coils, plenums and ducts) 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 and the combined new and existing duct system meets the criteria in Subsections 1, 2, 3 and 4 below, the duct system shall be sealed to a leakage rate not to exceed 15 percent of the nominal air handler airflow rate as confirmed through HERS field verification and diagnostic testing, in accordance with the applicable procedures in Reference Nonresidential Appendix NA7.5.3:

1. The duct system does not serve a healthcare facility;
2. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system;
3. The space-conditioning system serves less than 5,000 square feet of conditioned floor area; and
4. The combined surface area of the ducts located outdoors or in unconditioned space is more than 25 percent of the total surface area of the entire duct system.

Exception 1 to Section 141.0(b)2Dii: When it is not possible to achieve the duct leakage criteria in Section 141.0(b)2Dii, 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 2 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.

iii. If new ducts installed as part of an alteration are exempt from leakage testing according to Section 141.0(b)2Di or 141.0(b)2Dii, then the new ducts shall meet the duct leakage testing requirements of CMC Section 603.9.2.

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 the requirements for

demand responsive controls specified in Section 110.12, the existing thermostat shall be replaced with a demand responsive thermostat that complies with Section 110.12. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a demand responsive thermostat that complies with Section 110.12; and

ii. The duct system that is connected to the new or replaced space-conditioning system equipment shall be sealed in accordance with Section 141.0(b)2Dii.

Exception 1 to Section 141.0(b)2Eii: Duct sealing. Buildings altered so that the duct system no longer meets the criteria of Section 141.0(b)2Dii.

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 Reference Nonresidential Appendix NA2.

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, 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).

H. New internally and externally illuminated signs shall meet the requirements of Sections 110.9, 130.3 and 140.8.

I. **Altered indoor lighting systems.** Alterations to indoor lighting systems that include 10% or more of the luminaires serving an enclosed space shall meet the requirements of i, ii, or iii below:

i. The alteration shall comply with the indoor lighting power requirements specified in Section 140.6 and the lighting control requirements specified in Table 141.0-F;

ii. The alteration shall not exceed 80% of the indoor lighting power requirements specified in Section 140.6, and shall comply with the lighting control requirements specified in Table 141.0-F; or

iii. The alteration shall be a one-for-one luminaire alteration within a building or tenant space of 5,000 square feet or less, the total wattage of the altered luminaires shall be at least 40% lower compared to their total pre-alteration wattage, and the alteration shall comply with the lighting control requirements specified in Table 141.0-F.

Alterations to indoor lighting systems shall not prevent the operation of existing, unaltered controls, and shall not alter controls to remove functions specified in Section 130.1.

Alterations to lighting wiring are considered alterations to the lighting system. Alterations to indoor lighting systems are not required to separate existing general, floor, wall, display, or decorative lighting on shared circuits or controls. New or completely replaced lighting circuits shall comply with the control separation requirements of Section 130.1(a)3 and 130.1(c)1D.

Exception 1 to Section 141.0(b)2I: Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded as specified in Section 140.6(a)3.

Exception 2 to Section 141.0(b)2I: Any enclosed space with only one luminaire.

Exception 3 to Section 141.0(b)2I: Any alteration that would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.

Exception 4 to Section 141.0(b)2I: Acceptance testing requirements of Section 130.4 are not required for alterations where lighting controls are added to control 20 or fewer luminaires.

Exception 5 to Section 141.0(b)2I: Any alteration limited to adding lighting controls or replacing lamps, ballasts, or drivers.

Exception 6 to Section 141.0(b)2I: One-for-one luminaire alteration of up to 50 luminaires either per complete floor of the building or per complete tenant space, per annum.

J. **Reserved.**

K. **Reserved.**

L. Alterations to existing outdoor lighting systems in a lighting application listed in Table 140.7-A or 140.7-B shall meet the applicable requirements of Sections 130.0, 130.2(b) and 130.4, and:

i. In alterations that increase the connected lighting load, the added or altered luminaires shall meet the applicable requirements of Section 130.2(c) and the requirements of Section 140.7 for general hardscape lighting or for the specific lighting applications containing the alterations; and

ii. In alterations that do not increase the connected lighting load, where 10 percent or more of the existing luminaires are replaced in a general hardscape or a specific lighting application, the alterations shall meet the following requirements:

a. In parking lots and outdoor sales lots where the bottom of the luminaire is mounted 24

feet or less above the ground, the replacement luminaires shall comply with Section 130.2(c)1 AND Section 130.2(c)3;

b. For parking lots and outdoor sales lots where the bottom of the luminaire is mounted greater than 24 feet above the ground and for all other lighting applications, the replacement luminaires shall comply with Section 130.2(c)1 and either comply with Section 130.2(c)2 or be controlled by lighting control systems, including motion sensors, that automatically reduce lighting power by at least 40 percent in response to the area being vacated of occupants; and

Exception to Section 141.0(b)2Lii: Alterations where fewer than five existing luminaires are replaced.

iii. In alterations that do not increase the connected lighting load, where 50 percent or more of the existing luminaires are replaced in general hardscape or a specific application, the replacement luminaires shall meet the requirements of Subsection ii above and the requirements of Section 140.7 for general hardscape lighting or specific lighting applications containing the alterations.

Exception 1 to Section 141.0(b)2Liii: Alterations where the replacement luminaires have at least 40 percent lower power consumption compared to the original luminaires are not required to comply with the lighting power allowances of Section 140.7.

Exception 2 to Section 141.0(b)2Liii: Alterations where fewer than five existing luminaires are replaced.

Exception to Section 141.0(b)2L: Acceptance testing requirements of Section 130.4 are not required for alterations where controls are added to 20 or fewer luminaires.

M. Alterations to existing internally and externally illuminated signs that increase the connected lighting load, replace and rewire more than 50 percent of the ballasts, or relocate the sign to a different location on the same site or on a different site shall meet the requirements of Section 140.8.

Exception to Section 141.0(b)2M: Replacement of parts of an existing sign, including replacing lamps, the sign face or ballasts, that do not require rewiring or that are done at a time other than when the sign is relocated, is not an alteration subject to the requirements of Section 141.0(b)2M.

N. Service water-heating systems shall meet the requirements of Sections 140.5(a)2 and b, except for the solar water heating requirements.

O. A building shell for which interior walls or ceilings are installed for the first time shall meet the requirements of Section 140.3(c).

P. **Electrical power distribution systems.** Alterations to electrical power distribution systems shall meet the applicable requirements of Section 130.5 as follows:

i. Service electrical metering. New or replacement electrical service equipment shall meet the requirements of Section 130.5(a) applicable to the electrical power distribution system altered.

ii. Separation of electrical circuits for electrical energy monitoring. For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of Section 130.5(b).

iii. Voltage drop. Alterations of feeders and branch circuits where the alteration includes addition, modification, or replacement of both feeders and branch circuits, the altered circuits shall meet the requirements of Section 130.5(c).

Exception to Section 141.0(b)2Piii: Voltage drop permitted by *California Electrical Code* Sections 647.4, 695.6 and 695.7.

iv. Circuit controls for 120-volt receptacles and controlled receptacles. For entirely new or complete replacement of electrical power distribution systems, the entire system shall meet the applicable requirements of Sections 130.5(d) and 130.5(e).

Q. Existing building envelope wall where 25 percent or more of the wall area is being altered must comply with Section 140.3(a)9. Where the building is tested in accordance with the procedures for whole building air leakage in NA2.4 and the tested leakage rate exceeds 0.4 cfm/ft^2 of building shell at 75 pascals, a visual inspection and diagnostic evaluation shall be done in accordance with NA2.4.7 and all observed leaks shall be sealed where such sealing can be made without destruction of existing building components.

Exception to Section 141.0(b)2Q: Healthcare facilities.

R. **Exterior doors.** Alterations that add exterior door area shall meet the *U*-factor requirements of Section 140.3(a)7.

3. **Performance approach.**

A. The altered envelope, space-conditioning system, lighting and water heating components, 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 120.9 through 130.5.

Exception 1 to Section 141.0(b)3A: Window films. Applied window films installed as part of an alteration complies with the *U*-factor, RSHGC and VT requirements of Table 141.0-E.

Exception 2 to Section 141.0(b)3A: The requirements of Section 120.2(i) shall not apply to alterations of space-conditioning systems or components.

B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements of Section 141.0(b)2. For components not being altered, the standard design shall be based on the unaltered existing conditions such that the standard and proposed designs for these components are identical.

C. When the third party verification option is specified, all components proposed for alteration, for which the additional credit is taken, must be verified. The Executive Director shall determine the qualifications required by the third party inspector.

D. The proposed design shall be based on the actual values of the altered components.

Notes to Section 141.0(b)3:

1. If an existing component must be replaced with a new component, that component is considered an altered component for the purpose of determining the energy budget and must therefore meet the requirements of Section 141.0(b)3.
2. The standard design assumes the same geometry and orientation as the proposed design.
3. The "existing efficiency level" modeling rules, including situations where nameplate data is not available, are described in the *Nonresidential ACM Reference Manual.*

Exception 1 to Section 141.0(b): When heating, cooling or service water heating for an alteration are provided by expanding existing systems, the existing systems and equipment need not comply with Sections 110.0 through 120.9 and Section 140.4 or 140.5.

Exception 2 to Section 141.0(b): When existing heating, cooling or service water heating systems or components are moved within a building, the existing systems or components need not comply with Sections 110.0 through 120.9 and Section 140.4 or 140.5.

Exception 3 to Section 141.0(b): Where an existing system with electric reheat is expanded when adding variable air volume (VAV) boxes to serve an alteration, total electric reheat capacity may be expanded not to exceed 20 percent of the existing installed electric capacity in any one permit and the system need not comply with Section 140.4(g). Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of Section 140.4(g).

Exception 4 to Section 141.0(b): The requirements of Section 120.2(i) shall not apply to alterations of space-conditioning systems or components.

TABLE 141.0-E
THE STANDARD DESIGN FOR AN ALTERED COMPONENT

ALTERED COMPONENT	STANDARD DESIGN WITHOUT THIRD-PARTY VERIFICATION OF EXISTING CONDITIONS SHALL BE BASED ON	STANDARD DESIGN WITH THIRD-PARTY VERIFICATION OF EXISTING CONDITIONS SHALL BE BASED ON
Roof/ceiling insulation, wall insulation, and floor/ soffit insulation	The requirements of Section 141.0(b)1 and 141.0(b)2Bii.	
Fenestration The allowed glass area shall be the smaller of a. or b. below: a. The proposed glass area: or b. The larger of: 1. The existing glass area that remains; or 2. The area allowed in Section 140.3(a)5A.	The *U*-factor and RSHGC requirements of Table 141.0-A.	The existing *U*-factor and RSHGC levels.
Space-conditioning system equipment and ducts	The requirements of Section 141.0(b)2C, 141.0(b)2Di or 141.0(b)2Dii, and Section 141.0(b)2E.	
Window film	The *U*-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Tables 110.6-A and 110.6-B.
Service water heating systems	The requirements of Section 140.5 without solar water heating requirements.	
Roofing products	The requirements of Section 141.0(b)2B.	
Lighting system	The requirements of Sections 141.0(b)2F through 141.0(b)2K.	
All other measures	The proposed efficiency levels.	

TABLE 141.0-F
CONTROL REQUIREMENTS FOR INDOOR LIGHTING SYSTEM ALTERATIONS

CONTROL SPECIFICATIONS		PROJECTS COMPLYING WITH SECTION 141.0(B)2Ii	PROJECTS COMPLYING WITH SECTION 141.0(B)2Iii OR 141.0(B)2Iiii
Manual Area Controls	130.1(a)1	Required	Required
	130.1(a)2	Required	Required
	130.1(a)3	Only required for new or completely replaced circuits	Only required for new or completely replaced circuits
Multi-Level Controls	130.1(b)	Required	Not Required
Automatic Shut Off Controls	130.1(c)1	Required; 130.1(c)1D only required for new or completely replaced circuits	Required; 130.1(c)1D only required for new or completely replaced circuits
	130.1(c)2	Required	Required
	130.1(c)3	Required	Required
	130.1(c)4	Required	Required
	130.1(c)5	Required	Required
	130.1(c)6	Required	Required; except for 130.1(c)6D
	130.1(c)7	Required	Required
	130.1(c)8	Required	Required
Daylighting Controls	130.1(d)	Required	Not Required
Demand Responsive Controls	110.12(a) and 110.12(c)	Required	Not Required

(c) **Repairs.** Repairs shall not increase the preexisting energy consumption of the repaired component, system or equipment.

(d) **Alternate method of compliance.** Any addition, alteration or repair may comply with the requirements of Title 24, Part 6 by meeting the applicable requirements for the entire building.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, 25910, and 25943, *Public Resources Code*.

SECTION 141.1
REQUIREMENTS FOR COVERED PROCESSES IN ADDITIONS, ALTERATIONS TO EXISTING NONRESIDENTIAL AND HOTEL/MOTEL BUILDINGS

Covered processes in additions or alterations to existing buildings that will be nonresidential and hotel/motel occupancies shall comply with the applicable Subsections of Section 120.6 and 140.9.

(a) **Lab and Process Facility Exhaust Systems.** All newly installed fan systems for a laboratory or process facility exhaust system greater than 10,000 cfm shall meet the requirements of Section 140.9(c).

(b) **Computer Rooms.** All newly installed computer room cooling systems and uninterruptible power supply systems in additions/alterations shall meet the requirements of Sections 120.6(j), 140.9(a)2 and 140.9(a)4 and comply with Item 1 below.

1. **Economizers.** Each individual cooling system primarily serving computer rooms in an existing building shall include either:
   A. An integrated air economizer capable of partial cooling when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load up to 80°F room supply air temperature at outside air temperatures of 55°F dry-bulb and below or 50°F wet-bulb and below, and be equipped with a fault detection and diagnostic system as specified by Section 120.2(i); or
   B. An integrated water economizer capable of partial cooling when additional mechanical cooling is required and capable of providing 100 percent of the expected system cooling load up to 80°F room supply air temperature at outside air temperatures of 40°F dry-bulb and below or 35°F wet-bulb and below.

   Exception 1 to Section 141.1(b)1: Individual computer rooms with an ITE design load under 5 tons (18 kW) in a building that does not have any economizers.

   Exception 2 to Section 141.1(b)1: New cooling systems serving an existing computer room in an existing building with an ITE design load up to a total of 50 tons (176 kW).

Exception 3 to Section 141.1(b)1: New cooling systems serving a new computer room in an existing building with an ITE design load up to a total of 20 tons (70 kW).

(c) **Controlled Environment Horticulture Spaces.**

1. Indoor growing, space-conditioning systems and dehumidification. All newly installed heating, ventilation, air conditioning systems or dehumidification systems in buildings with indoor growing shall meet the applicable requirements of Sections 120.6(h)1 and 120.6(h)2.
2. Greenhouses, building envelope and space-conditioning systems. A greenhouse being converted to a conditioned greenhouse or additions to a conditioned greenhouse shall meet the requirements of Sections 120.6(h)4 and 120.6(h)5.
3. Indoor growing and greenhouses, horticultural lighting. When alterations to horticultural lighting systems increase lighting wattage or include adding, replacing or altering 10 percent or more of the horticultural luminaires serving an enclosed space, the newly installed, replaced or altered lighting shall meet the requirements of Section 120.6(h)3 for indoor growing or Section 120.6(h)7 for greenhouses.

   Exception to Section 141.1(c)3: Any alteration limited to adding lighting controls or replacing lamps, ballasts or drivers.

NOTE: For alterations that change the occupancy classification of the building, the requirements of Section 141.1 apply to the occupancy that will exist after the alterations.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code.* Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.8, and 25943, *Public Resources Code.*

SUBCHAPTER 7

SINGLE-FAMILY RESIDENTIAL BUILDINGS—MANDATORY FEATURES AND DEVICES

SECTION 150.0 MANDATORY FEATURES AND DEVICES

Single-family residential buildings shall comply with the applicable requirements of Sections 150(a) through 150.0(v).

NOTE: The requirements of Sections 150.0(a) through 150.0(r) apply to newly constructed buildings. Sections 150.2(a) and 150.2(b) specify which requirements of Sections 150.0(a) through 150.0(r) also apply to additions or alterations.

(a) **Roof deck, ceiling and rafter roof insulation.** The opaque portions of roof decks separating attic spaces from ambient air, and ceilings or rafter roofs separating conditioned spaces from unconditioned spaces or ambient air, shall meet the requirements of Items 1 through 4 below:

1. In Climate Zones 4 and 8 through 16, roof decks in newly constructed attic systems shall be insulated to achieve an area-weighted average *U*-factor not exceeding U-0.184.

   Exception to Section 150.0(a)1:

   i. The space-conditioning system air handler and ducts are located entirely in conditioned space below the ceiling separating the occupiable space from the attic; or

   ii. The space-conditioning system air handler is located in unconditioned space and has 12 linear feet or less of supply duct, including the length of the air handler and the plenum, located in unconditioned space, with all other portions of the supply ducts located in conditioned space below the ceiling separating the occupiable space from the attic.

2. Ceilings and rafter roofs shall be insulated to achieve an area-weighted average *U*-factor not exceeding U-0.043 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-22 or greater for the insulation alone. For vented attics, the mandatory insulation shall be installed at the ceiling level; for unvented attics, the mandatory insulation shall be placed at either ceiling or roof level; and

   Exception to Section 150.0(a)2: Ceilings and rafter roofs in an alteration shall be insulated to achieve an area-weighted average U-factor not exceeding 0.054 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater.

3. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage; and

4. Insulation shall be installed in direct contact with a roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 110.7, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling.

(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.** Opaque portions of above grade walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the following requirements:

1. 2 × 4 inch framing shall have an overall assembly *U*-factor not exceeding U-0.102.

   Exception to Section 150.0(c)1: Existing walls already insulated to a *U*-factor not exceeding U-0.110 or already insulated between framing members with insulation having an installed thermal resistance of R-11 or greater.

2. 2 × 6 inch or greater framing shall have an overall assembly *U*-factor not exceeding U-0.071.

3. Opaque nonframed assemblies shall have an overall assembly *U*-factor not exceeding U-0.102.

4. Bay or bow window roofs and floors shall be insulated to meet the wall insulation requirements of Table 150.1-A.

5. Masonry walls shall be insulated to meet the wall insulation requirements of Table 150.1-A.

6. In wood framed assemblies, compliance with U-factors may be demonstrated by installing wall insulation with an R-value of 13 in 2x4 assemblies, and 20 in 2x6 assemblies.

(d) **Raised-floor insulation.** Raised floors separating conditioned space from unconditioned space or ambient air shall have an overall assembly *U*-factor not exceeding U-0.037. In a wood framed assembly, compliance with the U-factor may be demonstrated by installing insulation with an *R*-value of 19 or greater.

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.** If a masonry or factory-built fireplace is installed, it shall comply with Section 110.5, Section 4.503 of Part 11, and shall have the following:

1. Closable metal or glass doors covering the entire opening of the firebox; and
2. 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)2: 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.
3. A flue damper with a readily accessible control.

   Exception to Section 150.0(e)3: 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.

(f) **Slab edge insulation.** Material used for slab edge insulation shall meet the following minimum specifications:

1. Water absorption rate for the insulation material alone without facings no greater than 0.3 percent when tested in accordance with Test Method A – 24-Hour-Immersion of ASTM C272.
2. Water vapor permeance no greater than 2.0 perm/inch when tested in accordance with ASTM E96.
3. Concrete slab perimeter insulation shall be protected from physical damage and ultraviolet light deterioration.
4. Insulation for a heated slab floor shall meet the requirements of Section 110.8(g).

(g) **Vapor retarder.**

1. In Climate Zones 1–16, the earth floor of unvented crawl space shall be covered with a Class I or Class II vapor retarder. This requirement shall also apply to controlled ventilation crawl space for buildings complying with the Exception to Section 150.0(d).
2. In Climate Zones 14 and 16, a Class I or 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.

(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.
   B. **Liquid line drier.** Installed air conditioner and heat pump systems shall be equipped with liquid line filter driers if required, as specified by manufacturer's instructions.
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.** All heating or cooling systems, including heat pumps, not controlled by a central energy management control system (EMCS) shall have a setback thermostat, as specified in Section 110.2(c).

(j) **Insulation for piping and tanks.**

1. **Water piping, solar water-heating system piping, and space-conditioning system line insulation thickness and conductivity.** Piping shall be insulated as follows:
   A. All domestic hot water piping shall be insulated as specified in Section 609.11 of the *California Plumbing Code*.
   B. Piping for space-conditioning systems, solar water-heating system collector loop, and distribution piping for steam and hydronic heating system shall meet the requirements of Section 120.3(a).

   Exception 1 to Section 150.0(j)1: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

   Exception 2 to Section 150.0(j)1: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the

v. Filter racks or grilles shall use gaskets, sealing or other means to close gaps around inserted filters to and prevent air from bypassing the filter.

C. **Air filter efficiency.** The system shall be provided with air filter(s) having a designated efficiency equal to or greater than MERV 13 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30-1.0 μm range, and equal to or greater than 85 percent in the 1.0-3.0 μm range when tested in accordance with AHRI Standard 680.

D. **Air filter pressure drop.** All system shall be provided with air-filter(s) that conforms to the applicable maximum allowable clean-filter pressure drop specified in Subsections i, ii, iii, or iv below, when tested using ASHRAE Standard 52.2, or as rated using AHRI Standard 680, for the applicable design airflow rate(s) for the system air filter(s).

i. The maximum allowable clean-filter pressure drop shall be determined by the system design for the nominal two-inch minimum depth air filter required by Section 150.0(m)12Biia, or

ii. A maximum of 25 PA (0.1 inches water) clean-filter pressure drop shall be allowed for a nominal one-inch depth air filter sized according to Section 150.0(m)12Biib, or

iii. For systems specified in 150.0(m)12Aii, and 150.0(m)12Aiii, the maximum allowable clean filter pressure drop shall be determined by the system design.

iv. If Exception 1 to Section 150.0(m)13B or D is utilized for compliance with cooling system airflow rate and fan efficacy requirements, the clean-filter pressure drop for the system air filter shall conform to the requirements given in Table 150.0-B or 150.0-C.

E. **Air filter product labeling.** Systems described in 150.0(m)12)Ai shall be equipped with air filters that have been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections 150.0(m)12C and 150.0(m)12D.

13. **Space conditioning system airflow rate and fan efficacy.** Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall:

A. **Static pressure probe.** 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. **Single zone central forced air systems.** 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 the maximum W/CFM specified in Subsections i or ii below. The airflow rate and fan efficacy requirements in this section shall be confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

i. 0.45 W/CFM for gas furnace air-handling units.

ii. 0.58 W/CFM for air-handling units that are not gas furnaces.

C. **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 the maximum W/CFM specified in Subsections i or ii below. The airflow rate and fan efficacy requirements in this section shall be confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

i. 0.45 W/CFM for gas furnace air-handling units.

ii. 0.58 W/CFM for air-handling units that are not gas furnaces.

D. **Small duct high velocity forced air systems.** Demonstrate, in every control mode, airflow greater than or equal to 250 CFM per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.62 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

Exception 1 to Section 150.0(m)13B and D: Standard ducted systems (without zoning dampers) may comply by meeting the applicable requirements in Table 150.0-B or 150.0-C 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 specified by Section 150.0(m)12Div for the system air filter(s) shall conform to the requirements given in Tables 150.0-B and 150.0-C.

Exception 2 to Section 150.0(m)13B and D: Multi-speed 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.

Exception 3 to Section 150.0(m)13B: Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value 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.

Exception 1 to Section 150.0(m)13C: Multispeed or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach, shall demonstrate compliance with the airflow (cfm/ton) and fan efficacy (Watt/cfm) requirements of Section 150.0(m)13C by operating the system at maximum compressor capacity and system fan speed with all zones calling for conditioning, rather than in every zonal control mode.

Exception 2 to Section 150.0(m)13C: Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value 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.

(n) **Water heating system.**

1. Systems using gas or propane water heaters to serve individual dwelling units shall designate a space at least 2.5 feet by 2.5 feet wide and 7 feet tall suitable for the future installation of a heat pump water heater (HPWH) by meeting either A or B below. All electrical components shall be installed in accordance with the *California Electrical Code:*
   A. If the designated space is within 3 feet from the water heater, then this space shall include the following:
      i. A dedicated 125 volt, 20 amp electrical receptacle that is connected to the electric panel with a 120/240 volt 3 conductor, 10 AWG copper branch circuit, within 3 feet from the water heater and accessible to the water heater with no obstructions; and
      ii. Both ends of the unused conductor shall be labeled with the word "spare" and be electrically isolated; and
      iii. A reserved single pole circuit breaker space in the electrical panel adjacent to the circuit breaker for the branch circuit in A above and labeled with the words "Future 240V Use"; and
      iv. A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance.
   B. If the designated space is more than 3 feet from the water heater, then this space shall include the following:
      i. A dedicated 240 volt branch circuit shall be installed within 3 feet from the designated space. The branch circuit shall be rated at 30 amps minimum. The blank cover shall be identified as "240V ready"; and
      ii. The main electrical service panel shall have a reserved space to allow for the installation of a double pole circuit breaker for a future HPWH installation. The reserved space shall be permanently marked as "For Future 240V use"; and
      iii. Either a dedicated cold water supply, or the cold water supply shall pass through the designated HPWH location just before reaching the gas or propane water heater; and
      iv. The hot water supply pipe coming out of the gas or propane water heater shall be routed first through the designated HPWH location before serving any fixtures; and
      v. The hot and cold water piping at the designated HPWH location shall be exposed and readily accessible for future installation of an HPWH; and
      vi. A condensate drain that is no more than 2 inches higher than the base of the installed water heater, and allows natural draining without pump assistance.
2. Water heating recirculation loops serving multiple dwelling units shall meet the requirements of Section 110.3(c)4.
3. Solar water-heating systems and collectors shall be certified and rated by the Solar Rating and Certification Corporation (SRCC), the International Association of Plumbing and Mechanical Officials, Research and Testing (IAPMO R&T), or by a listing agency that is approved by the executive director.
4. Instantaneous water heaters with an input rating greater than 6.8 kBTU/hr (2kW) shall meet the requirements of Section 110.3(c)6.

(o) **Requirements for ventilation and indoor air quality.** All dwelling units shall meet the requirements of ASHRAE Standard 62.2. Ventilation and Acceptable Indoor Air Quality in Residential Buildings subject to the amendments specified in Section 150.0(o)1 below. All dwelling units shall comply with Section 150.0(o)2 below.

Exception to Section 150.0(o): The following sections of ASHRAE 62.2 shall not be required for compliance: Section 4.1.1, Section 4.1.2, Section 4.1.4, Section 4.3, Section 4.6, Section 5, Section 6.1.1, Section 6.5.2 and Normative Appendix A.

1. Amendments to ASHRAE 62.2 requirements.
   A. **Window operation.** Window operation is not a permissible method of providing the dwelling unit ventilation airflow specified in Section 150.0(o)1C below. <
   B. **Central fan integrated (CFI) ventilation systems.** CFI ventilation systems shall meet the following requirements.
      i. **Continuous operation prohibition.** Continuous operation of a dwelling unit's central forced air

tilation fan's inlet terminals/grilles or outlet terminals/grilles in accordance with the procedures in Reference Residential Appendix RA3.7.

b. As an alternative to performing an airflow measurement of the system as installed in the dwelling unit, compliance may be demonstrated by installing an exhaust fan and duct system that conforms to the specifications of Table 150.0-H. Visual inspection shall verify the installed system conforms to the requirements of Table 150.0-H.

When using Table 150.0-H for demonstrating compliance, the airflow rating shall be greater than or equal to the value required by Section 150.0(o)1G at a static pressure greater than or equal to 0.25 in. of water (62.5 Pa). When a vented range hood utilizes a capture efficiency rating to demonstrate compliance with Section 150.0(o)1Giiib, a static pressure greater than or equal to 0.25 in. of water at the rating point shall not be required, and the airflow listed in the approved directory corresponding to the compliant capture efficiency rating point shall be applied to Table 150.0-H for determining compliance.

Use of Table 150.0-H is limited to ventilation systems that conform to all of the following three specifications:

1. Total duct length is less than or equal to 25 ft (8 m),
2. Duct system has no more than three elbows, and
3. Duct system has exterior termination fitting with a hydraulic diameter greater than or equal to the minimum duct diameter and not less than the hydraulic diameter of the fan outlet.

vi. **Sound ratings for local mechanical exhaust.** Local mechanical exhaust systems shall be rated for sound in accordance with Section 7.2 of ASHRAE 62.2 at no less than the minimum airflow rate required by Section 150.0(o)1G.

Exception to Section 150.0(o)1Gvi: Kitchen range hoods may be rated for sound at no less than 100 cfm at a static pressure determined at working speed as specified in HVI 916 section 7.2.

H. **Airflow measurement of whole-dwelling unit ventilation.** The airflow required by Section 150.0(o)1C is the quantity of outdoor ventilation air supplied or indoor air exhausted by the mechanical ventilation system as installed and shall be measured by using a flow hood, flow grid or other airflow measuring device at the mechanical ventilation fan's inlet terminals/grilles or outlet terminals/grilles in accordance with the procedures in Reference Residential Appendix RA3.7. Balanced mechanical ventilation system airflow shall be the average of the supply fan and exhaust fan flows.

I. **Sound ratings for whole-dwelling unit ventilation systems.** Whole-dwelling unit ventilation systems shall be rated for sound in accordance with Section 7.2 of ASHRAE 62.2 at no less than the minimum airflow rate required by Section 150.0(o)1C.

J. **Label for whole-dwelling unit ventilation system on-off control.** Compliance with ASHRAE 62.2 Section 4.4 (Control and Operation) shall require manual ON-OFF control switches associated with whole-dwelling unit ventilation systems to have a label clearly displaying the following text, or equivalent text: "This switch controls the indoor air quality ventilation for the home. Leave switch in the 'on' position at all times unless the outdoor air quality is very poor."

K. **Combustion air and compensating outdoor air or makeup air.**

i. All dwelling units shall conform to the applicable requirements specified in *California Mechanical Code* Chapter 7, Combustion Air.

ii. All dwelling units shall conform to the requirements in ASHRAE 62.2 Section 6.4, Combustion and Solid-Fuel-Burning Appliances.

2. **Field verification and diagnostic testing.**

A. **Whole-dwelling unit ventilation airflow performance.** The whole-dwelling unit ventilation airflow required by Section 150.0(o)1C shall be confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.7. Balanced mechanical ventilation system airflow shall be the average of the supply fan and exhaust fan flows. Ventilation airflow of systems with multiple operating modes shall be tested in all modes designed to comply with the required ventilation airflows.

B. **Kitchen local mechanical exhaust—vented range hoods**. Vented range hoods installed to comply with local mechanical exhaust requirements specified in Section 150.0(o)1G shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.7.4.3 to confirm the model is rated by HVI or AHAM to comply with the following requirements:

i. The minimum ventilation airflow rate as specified by Section 150.0(o)1G, or alternatively the minimum capture efficiency as specified by Section 150.0(o)1G.

ii The maximum sound rating as specified in Section 150.0(o)1Gvi.

C. **Heat recovery ventilation (HRV) and energy recovery ventilation (ERV) system fan efficacy.** Systems with heat or energy recovery serving a single dwelling unit shall have a fan efficacy of ≤1.0 W/cfm as confirmed by HERS field verification in accordance with Reference Appendix RA3.7.4.4.

(p) **Pool systems and equipment installation.** Any residential pool system or equipment installed shall comply with the applicable requirements of Section 110.4, as well as the requirements listed in this section.

1. **Pump sizing and flow rate.**
   A. All installed pumps and pump motors subject to State or federal appliance standards shall be listed in the Commission's directory of certified equipment and shall comply with the Appliance Efficiency Regulations.
   B. All pump flow rates shall be calculated using the following system equation:

      $H = C \times F^2$

      where:

      H is the total system head in feet of water.

      F is the flow rate in gallons per minute (gpm).

      C is a coefficient based on the volume of the pool:

      0.0167 for pools less than or equal to 17,000 gallons.

      0.0082 for pools greater than 17,000 gallons.
   C. Filtration pumps shall be sized, or if programmable shall be programmed, so that the filtration flow rate is not greater than the rate needed to turn over the pool water volume in 6 hours or 36 gpm, whichever is greater; and
   D. Pump motors used for filtration shall meet the applicable federal standard in 10 CFR 431.465; and
   E. Each auxiliary pool load shall be served by either separate pumps, or the system shall be served by a multispeed pump; and

      Exception to Section 150.0(p)1E: Pumps if less than 1 hp may be single speed.
   F. Multispeed pumps shall have controls which default to the filtration flow rate when no auxiliary pool loads are operating; and
   G. For multispeed pumps, the controls shall default to the filtration flow rate setting within 24 hours and shall have an override capability for servicing.
2. **System piping.**
   A. A length of straight pipe that is greater than or equal to at least 4 pipe diameters shall be installed before the pump; and
   B. Pool piping shall be sized so that the velocity of the water at maximum flow for auxiliary pool loads does not exceed 8 feet per second in the return line and 6 feet per second in the suction line; and
   C. All elbows shall be sweep elbows or of an elbow-type that has a pressure drop of less than the pressure drop of straight pipe with a length of 30 pipe diameters.
3. **Filters.** Filters shall be at least the size specified in NSF/ANSI 50 for public pool intended applications.
4. **Valves.** Minimum diameter of backwash valves shall be 2 inches or the diameter of the return pipe, whichever is greater.

(q) **Fenestration products.** Fenestration separating conditioned space from unconditioned space or outdoors shall meet the requirements of either Item 1 or 2 below:

1. Fenestration, including skylight products, must have a maximum *U*-factor of 0.45.

   Exception 1 to Section 150.0(q)1: Up to 10 square feet of fenestration area or 0.5 percent of the conditioned floor area, whichever is greater, is exempt from the maximum *U*-factor requirement.

   Exception 2 to Section 150.0(q)1: For dual-glazed greenhouse or garden windows, up to 30 square feet of fenestration area is exempt from the maximum *U*-factor requirement.
2. The area-weighted average *U*-factor of all fenestration, including skylight products shall not exceed 0.45.

(r) **Solar ready buildings.** shall meet the requirements of Section 110.10 applicable to the building project.

(s) **Energy storage systems (ESS) ready.** All single-family residences that include one or two dwelling units shall meet the following. All electrical components shall be installed in accordance with the *California Electrical Code*:

1. At least one of the following shall be provided:
   A. ESS ready interconnection equipment with a minimum backed-up capacity of 60 amps and a minimum of four ESS-supplied branch circuits, or
   B. A dedicated raceway from the main service to a panelboard (subpanel) that supplies the branch circuits in Section 150.0(s)(2). All branch circuits are permitted to be supplied by the main service panel prior to the installation of an ESS. The trade size of the raceway shall be not less than 1 inch. The panelboard that supplies the branch circuits (subpanel) must be labeled "Subpanel shall include all backed-up load circuits."
2. A minimum of four branch circuits shall be identified and have their source of supply collocated at a single panelboard suitable to be supplied by the ESS. At least one circuit shall supply the refrigerator, one lighting circuit shall be located near the primary egress and at least one circuit shall supply a sleeping room receptacle outlet.
3. The main panelboard shall have a minimum busbar rating of 225 amps.
4. Sufficient space shall be reserved to allow future installation of a system isolation equipment/transfer switch within 3 feet of the main panelboard. Raceways shall be installed between the panelboard and the system isolation equipment/transfer switch location to allow the connection of backup power source.

SUBCHAPTER 8

SINGLE-FAMILY RESIDENTIAL BUILDINGS—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

SECTION 150.1 PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR SINGLE-FAMILY RESIDENTIAL BUILDINGS

(a) **Basic requirements.** Single-family residential buildings shall meet all of the following:

1. The applicable requirements of Sections 110.0 through 110.10.
2. The applicable requirements of Section 150.0 (mandatory features).
3. Either the performance standards or the prescriptive standards set forth in this section for the climate zone in which the building is located. Climate zones are shown in Reference Joint Appendix JA2–Weather/Climate Data.

   Exception to Section 150.1(a)3: If a single contiguous subdivision or tract falls in more than one climate zone, all buildings in the subdivision or tract may be designed to meet the performance or prescriptive standards for the climate zone that contains 50 percent or more of the dwelling units.

   Note: The Commission periodically updates, publishes, and makes available to interested persons and local enforcement agencies precise descriptions of the climate zones, as specified in Reference Joint Appendix JA2–Weather/Climate Data.

Note: The requirements of Sections 150.0(a) through 150.0(r) apply to newly constructed buildings and Sections 150.2(a) and 150.2(b) specifies changes to the requirements of Sections 150.1(a) through 150.1(c) that apply to additions or alterations.

(b) **Performance standards.** A building complies with the performance standards if the energy consumption calculated for the proposed design building is no greater than the energy budget calculated for the standard design building using Commission-certified compliance software as specified by the Alternative Calculation Methods Approval Manual.

1. **Newly constructed buildings.** The Energy Budget for newly constructed buildings is expressed in terms of the Energy Design Ratings, which are based on source energy and time-dependent valuation (TDV) energy. The Energy Design Rating 1 (EDR1) is based on source energy. The Energy Design Rating 2 (EDR2) is based on TDV energy and has two components, the Energy Efficiency Design Rating, and the Solar Electric Generation and Demand Flexibility Design Rating. The total Energy Design Rating shall account for both the Energy Efficiency Design Rating and the Solar Electric Generation and Demand Flexibility Design Rating. The proposed building shall separately comply with the Source Energy Design Rating, Energy Efficiency Design Rating and Total Energy Design Rating.

   Exception to Section 150.1(b)1. A community shared solar electric generation system, or other renewable electric generation system, or community shared battery storage system, which provides dedicated power, utility energy reduction credits, or payments for energy bill reductions to the permitted building and is approved by the Energy Commission as specified in Title 24, Part 1, Section 10-115, may offset part or all of the solar electric generation system and demand flexibility Energy Design Rating required to comply with the Standards, as calculated according to methods established by the Commission in the Residential ACM Reference Manual.

2. **Additions and alterations to existing buildings.** The energy budget for additions and alterations is expressed in terms of TDV energy.
3. **Compliance demonstration requirements for performance standards.**
   A. **Certificate of compliance and application for a building permit.** The application for a building permit shall include documentation pursuant to Sections 10-103(a)1 and 10-103(a)2 which demonstrates, using an approved calculation method, that the building has been designed so that its Energy Efficiency Design Rating and the total EDR meets or exceeds the standard design EDR for the applicable climate zone.

   Exception to Section 150.1(b)3A Multiple orientation: A permit applicant may demonstrate compliance with the energy budget requirements of Section 150.1(a) and (b) for any orientation of the same building model if the documentation demonstrates that the building model with its proposed designs and features would comply in each of the four cardinal orientations.

   B. **Field verification.** When performance of installed features, materials, components, manufactured devices or systems above the minimum specified in Section 150.1(c) is necessary for the building to comply with Section 150.1(b), or is necessary to achieve a more stringent local ordinance, field verification shall be performed in accordance with the applicable requirements in the following subsections, and the results of the verification(s) shall be documented on applicable certificates of installation pursuant to Section 10-103(a)3 and applicable certificates of verification pursuant to Section 10-103(a)5.

      i. **EER/EER2/SEER/SEER2/CEER/HSPF/HSPF2 Rating.** When performance compliance requires

installation of a space-conditioning system with a rating that is greater than the minimum rating required by Table 150.1-A or specified for the standard design, the installed system shall be field verified in accordance with the procedures specified in the applicable sections of Reference Residential Appendix RA3.4.

ii. **Variable capacity heat pump (VCHP) compliance option.** When performance compliance requires installation of a heat pump system that meets all the requirements of the VCHP compliance option specified in the ACM Reference Manual, the system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.4.4.3.

iii. **Low leakage air handler.** When performance compliance requires installation of a low leakage air-handling unit, the installed air-handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

iv. **Reserved.**

v. **Heat pump—rated heating capacity.** When performance compliance requires installation of a heat pump system, the heating capacity values at 47°F and 17°F shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.

vi. **Whole-house fan.** When performance compliance requires installation of a whole-house fan, the whole-house fan ventilation airflow rate and fan efficacy shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.9.

vii. **Central fan ventilation cooling system.** When performance compliance requires installation of a central fan ventilation cooling system, the installed system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.3.4.

viii. **Building enclosure air leakage.** When performance compliance requires a building enclosure leakage rate that is lower than the standard design, the building enclosure shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.8.

ix. **Quality Insulation Installation (QII).** When performance compliance requires field verification of QII, the building insulation system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.5.

(c) **Prescriptive standards/component packages.** Buildings that comply with the prescriptive standards shall be designed, constructed and equipped to meet all of the requirements for the appropriate climate zone shown in Table 150.1-A. In Table 150.1-A, an NA (not allowed) means that feature is not permitted in a particular climate zone and an NR (no requirement) means that there is no prescriptive requirement for that feature in a particular climate zone. Installed components shall meet the following requirements:

1. **Insulation.**

A. Roof and ceiling insulation shall be installed in a ventilated attic with an *R*-value equal to or greater than that shown in Table 150.1-A meeting Option ii or iii below.

i. Option A: **Reserved.**

ii. Option B: A minimum *R*-value of insulation installed between the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9A; or

iii. Option C: A minimum *R*-value of ceiling insulation located between the attic and the conditioned space when meeting Section 150.1(c)9B.

Note: Low-rise residential single-family buildings with the ducts and air handler located in the conditioned space, as specified by Section 150.1(c)9B, need only comply with insulation requirements of Option C.

B. **Walls.**

i. Framed exterior walls shall be insulated such that the exterior wall has an assembly *U*-factor equal to or less than that shown in Table 150.1-A. The *U*-factors shown are maximum *U*-factors for the exterior wall assembly.

ii. Mass walls above grade and below grade shall be insulated such that the wall has an assembly *U*-factor equal to or less than that shown in Table 150.1-A, or walls shall be insulated with continuous insulation that has an *R*-value equal to or greater than that shown in Table 150.1-A. "Interior" denotes continuous insulation installed on the inside surface of the wall, and "exterior" denotes continuous insulation installed on the outside surface of the wall.

iii. Other unframed exterior walls, excluding mass walls, shall meet the requirements for framed walls shown in Table 150.1-A.

C. Raised floors shall be insulated such that the floor assembly has an assembly *U*-factor equal to or less than shown in Table 150.1-A, or shall be insulated between wood framing with insulation having an *R*-value equal to or greater than that shown in Table 150.1-A.

Exception to Section 150.1(c)1C: Raised-floor insulation may be omitted if the foundation walls are insulated to meet the wall insulation minimums shown in Table 150.1-A, and a vapor retarder is placed over the entire floor of the crawl space, and the vents are fitted with automatically operated louvers, and the requirements of Reference Residential Appendix RA4.5.1 are met.

D. Slab floor perimeter insulation shall be installed with a *U*-factor equal to or less than, or *R*-value equal to or greater than, shown in Table 150.1-A. The minimum depth of concrete-slab floor perimeter insulation shall be 16 inches or the depth of the footing of the building, whichever is less.

Exception to Section 150.1(c)1: The insulation requirements of Table 150.1-A may also be met by ceiling, roof deck, wall, or floor assemblies that meet the required maximum *U*-factors using a *U*-factor calculation method that considers the thermal effects of all elements of the assembly and is approved by the executive director.

E. All buildings shall comply with the quality insulation installation (QII) requirements shown in Table 150.1-A. When QII is required, insulation installation shall meet the criteria specified in Reference Appendix RA3.5.

2. **Radiant barrier.** A radiant barrier required in Table 150.1-A shall meet the requirements specified in Section 110.8(j), and shall meet the installation criteria specified in the Reference Residential Appendix RA4.

3. **Fenestration.**

A. Installed fenestration products, including glazed doors, shall have an area-weighted average *U*-factor and Solar Heat Gain Coefficient (SHGC) meeting the applicable fenestration value in Table 150.1-A and shall be determined in accordance with Sections 110.6(a)2 and 110.6(a)3.

Exception 1 to Section 150.1(c)3A: For each dwelling unit, up to 3 square feet of new glazing area installed in doors and up to 3 square feet of new tubular skylights area with dual-pane diffusers shall not be required to meet the *U*-factor and SHGC requirements of Table 150.1-A.

Exception 2 to Section 150.1(c)3A: For each dwelling unit up to 16 square feet of new skylight area with a maximum *U*-factor of 0.55 and a maximum SHGC of 0.30.

Exception 3 to Section 150.1(c)3A: For fenestration containing chromogenic type glazing:

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

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

iii. Area-weighted averaging with other fenestration that is not chromatic shall not be permitted and shall be determined in accordance with Section 110.6(a).

Exception 4 to Section 150.1(c)3A: For dwelling units containing unrated site-built fenestration that meets the maximum area restriction, the *U*-factor and SHGC can be determined in accordance with the Nonresidential Reference Appendix NA6 or use default values in Table 110.6-A and Table 110.6-B.

B. The maximum total fenestration area shall not exceed the percentage of conditioned floor area CFA as indicated in Table 150.1-A. Total fenestration includes skylights and west-facing glazing.

C. The maximum west-facing fenestration area shall not exceed the percentage of conditioned floor area as indicated in Table 150.1-A. West-facing fenestration 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 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. **Doors.** Installed swinging door products separating conditioned space from outside or adjacent unconditioned space, but not including glazed door products, shall have an area-weighted average U-factor no greater than the applicable door value in Table 150.1-A and shall be determined in accordance with Section 110.6(a)2. Glazed door products are treated as fenestration products in Sections 150.1(c)3 and 150.1(c)4.

Exception to Section 150.1(c)5: Swinging doors between the garage and conditioned space that are required to have fire protection are not required to meet the applicable door value in Table 150.1-A.

6. **Heating system type.** Heating system types shall be installed as required in Table 150.1-A. For Climate Zones 3, 4, 13 and 14, the space-conditioning system shall be a heat pump, or shall meet the performance compliance requirements of Section 150.1(b)1.

Exception to Section 150.1(c)6: A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed 2 kW or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.

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)7A.

   A. **Refrigerant charge.** When refrigerant charge verification or fault indicator display is shown as required by Table 150.1-A, the system shall comply with either Section 150.1(c)7Ai or 150.1(c)7Aii:

      i. Air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, small duct high velocity systems, and mini-split systems, shall comply with Subsections a, b and c, unless the system is of a type that cannot be verified using the specified procedures:

         a. Have measurement access holes (MAH), installed according to the specifications in Reference Residential Appendix Section RA3.2.2.3; and

            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.

         b. System airflow rate in accordance with Subsection I or II shall be confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix Section RA3. 3 or an approved alternative procedure as specified by Section RA1; and

            I. For small duct high velocity systems the system airflow rate shall be greater than or equal to 250 cfm per ton; or

            II. For all other air-cooled air conditioner or air-source heat pump systems the system airflow rate shall be greater than or equal to 350 cfm per ton.

            Exception to Section 150.1(c)7Aib: Standard ducted systems without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in Table 150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12D for the system air filter device(s) shall conform to the requirements given in Tables 150.0-B and 150.0-C.

         c. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable:

            I. The installer and rater shall perform the standard charge procedure as specified by Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified by Section RA1; or

            II. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

            III. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the Section RA3.2.2 standard charge verification procedure and Section RA3.3 airflow rate verification procedure or approved alternatives in Section RA1. The HERS Rater shall verify the charge using Sections RA3.2.2 and RA3.3 or approved alternatives in Section RA1.

            Exception 1 to Section 150.1(c)7Aic: When the outdoor temperature is less than 55°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 Section 110.12. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.1(c)7Aib.

      ii. Air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted packaged systems, small duct high-velocity systems and mini-split systems, which are of a type that cannot comply with the requirements of Section 150.1(c)7Ai shall comply with Subsections a and b, as applicable.

         I. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.2.3.2.; and

         II. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.1(c)7Aib provided the system is of a type that can be verified using the procedures in Section RA3.3 or an approved alternative procedure in Section RA1.

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 have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirements in Section 150.1(c)7Aib, provided that the system is of a type that can be verified using the procedure specified in Section RA3.3 or an approved alternative in Section RA1.

8. **Domestic water-heating systems.** Water-heating systems shall meet the requirements of A, B or C, or shall meet the performance compliance requirements of Section 150.1(b)1. For recirculation distribution systems, only demand recirculation systems with manual on/off control as specified in the Reference Appendix RA4.4.9 shall be used:

   A. A single 240 volt heat pump water heater (HPWH). The storage tank shall be located in the garage or conditioned space. In addition, meet the following:

      i. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.6 in Climate Zones 1 and 16; and

      ii. A drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9 in Climate Zone 16.

   B. A single 240 volt HPWH that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. In addition, for Climate Zone 16, a drain water heat recovery system that is field verified as specified in Reference Appendix RA3.6.9 and the storage tank shall be located in the garage or conditioned space.

   C. A solar water-heating system with electric backup meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum annual solar savings fraction of 0.7.

   Exception 1 to Section 150.1(c)8: For Climate Zones 3, 4, 13 and 14, a gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank may be installed.

   NOTE: The space-conditioning system shall be a heat pump as specified in Section 150.1(c)6.

   Exception 2 to Section 150.1(c)8: An instantaneous electric water heater with point of use distribution as specified in RA4.4.5 may be installed for new dwelling units with a conditioned floor area of 500 square feet or less.

   Exception 3 to Section 150.1(c)8A and B: A 120V HPWH may be installed in place of a 240V HPWH for new dwelling unit with one bedroom or fewer.

9. **Space conditioning distribution systems.** All space-conditioning systems shall meet all applicable requirements of A or B below:

   A. High performance attics. Air handlers or ducts are allowed to be in ventilated attic spaces when the roof and ceiling insulation level meet Option B in Table 150.1-A. Duct insulation levels shall meet the requirements in Table 150.1-A.

   B. Duct and air handlers located in conditioned space. Duct systems and air handlers of HVAC systems shall be located in conditioned space, and confirmed by field verification and diagnostic testing to meet the criterion of Reference Residential Appendix Section RA3.1.4.3.8. Duct insulation levels shall meet the requirements in Table 150.1-A.

   Note: Gas heating appliances installed in conditioned spaces must meet the combustion air requirements of the *California Mechanical Code* Chapter 7, as applicable.

10. **Central fan integrated ventilation systems.** Central forced air system fans used to provide outside air shall have an air-handling unit fan efficacy less than or equal to the maximum W/cfm specified in A, B or C. The airflow rate and fan efficacy requirements in this section shall be confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix RA3.3. Central fan integrated ventilation systems shall be certified to the Energy Commission as intermittent ventilation systems as specified in Reference Residential Appendix RA3.7.4.2.

    A. 0.45 W/cfm for gas furnace air-handling units.

    B. 0.58 W/cfm for air-handling units that are not gas furnaces.

    C. 0.62 W/cfm for small-duct high-velocity air-handling units.

    Exception to Section 150.1(c)10A: Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value 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.

11. **Roofing products.** All roofing products shall meet the requirements of Section 110.8 and the applicable requirements of Subsection A or B:

    A. Single-family 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. Single-family 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 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 aged solar reflectance and thermal emittance or SRI.

Exception 2 to Section 150.1(c)11: Roof constructions with a weight of at least 25 lb/ft^2 are exempt from the minimum requirements for aged 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, B and C below.

    A. Have installed one or more WHFs whose total airflow cfm is equal to or greater than 1.5 cfm/ft^2 of conditioned floor area. Airflow cfm for WHFs shall be determined based on the airflow listed in the Home Ventilating Institute Certified Products Directory.

    B. Have at least 1 square foot of attic vent free area for each 750 cfm of rated whole-house fan airflow cfm, or if the manufacturer has specified a greater free vent area, the manufacturer's free vent area specifications.

    Exception to Section 150.1(c)12B: WHFs that are directly vented to the outside.

    C. Provide homeowners who have WHFs with a one page "How to operate your whole-house fan" informational sheet.

    Exception to Section 150.1(c)12: New dwelling units with a conditioned floor area of 500 square feet or less shall not be required to comply with the WHF requirements.

13. **HVAC system bypass ducts.** Bypass ducts that deliver conditioned supply air directly to the space-conditioning system return duct airflow shall not be used.

14. **Photovoltaic requirements.** All single-family residential buildings shall have a newly installed photovoltaic (PV) system or newly installed PV modules meeting the minimum qualification requirements specified in Joint Appendix JA11. The annual electrical output of the PV system shall be no less than the smaller of a PV system size determined using Equation 150.1-C, or the maximum PV system size that can be installed on the building's solar access roof area (SARA).

    A. SARA includes the area of the building's roof space capable of structurally supporting a PV system, and the area of all roof space on covered parking areas, carports and all other newly constructed structures on the site that are compatible with supporting a PV system per Title 24, Part 2, Section 1511.2.

    B. SARA does NOT include:

        i. Any roof area that has less than 70 percent annual solar access. Annual solar access is determined by dividing the total annual solar insolation, accounting for shading obstructions, by the total annual solar insolation if the same areas were unshaded by obstructions. For steep slope roofs, only shading from existing permanent natural or manmade obstructions that are external to the dwelling, including but not limited to trees, hills, and adjacent structures, shall be considered for annual solar access calculations. For low slope roofs, all obstructions, including those that are external to the dwelling unit, and obstructions that are part of the building design and elevation features shall be considered for the annual solar access calculations.

        ii. Occupied roof areas as specified by CBC Section 503.1.4.

        iii. Roof area that is otherwise not available due to compliance with other building code requirements if confirmed by the Executive Director.

EQUATION 150.1-C
ANNUAL PHOTOVOLTAIC ELECTRICAL OUTPUT

$$kW_{PV} = (CFA \times A)/1000 + (N_{DU} \times B)$$

where:

kW_{PV} = kW_{dc} size of the PV system.

CFA = Conditioned floor area.

N_{DU} = Number of dwelling units.

A = CFA adjustment factor from Table 150.1-C.

B = Dwelling unit adjustment factor from Table 150.1-C.

Exception 1 to Section 150.1(c)14: For steep slope roofs, SARA shall not consider roof areas with a northerly azimuth that lies between 300 degrees and 90 degrees from true north. No PV system is required if the SARA is less than 80 contiguous square feet.

Exception 2 to Section 150.1(c)14: No PV system is required when the minimum PV system size specified by Section 150.1(c)14 is less than 1.8 kW_{dc}.

Exception 3 to Section 150.1(c)14: Buildings with enforcement-authority-approved roof designs, where the enforcement authority determines it is not possible for the PV system, including panels, modules and components and supports and attachments to the roof structure, to meet the requirements of the American Society of Civil Engineers (ASCE), Standard 7-16, Chapter 7, Snow Loads.

Exception 4 to Section 150.1(c)14: For buildings that are approved by the local planning department prior to January 1, 2020 with mandatory conditions for approval:

a. Shading from roof designs and configurations for steep-sloped roofs, which are required by the mandatory conditions for approval, shall be considered for the annual solar access calculations; and

b. Roof areas that are not allowed by the mandatory conditions for approval to have PVs shall not be considered in determining the SARA.

Exception 5 to Section 150.1(c)14: PV system sizes determined using Equation 150.1-C may be reduced by 25 percent if installed in conjunction with a battery storage system. The battery storage system shall meet the qualification requirements specified in Joint Appendix JA12 and have a minimum usable capacity of 7.5 kWh.

SUBCHAPTER 9

SINGLE-FAMILY RESIDENTIAL BUILDINGS—ADDITIONS AND ALTERATIONS TO EXISTING RESIDENTIAL BUILDINGS

SECTION 150.2
ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS TO EXISTING SINGLE-FAMILY RESIDENTIAL BUILDINGS

(a) **Additions.** Additions to existing single-family residential buildings shall meet the requirements of Sections 110.0 through 110.9; Sections 150.0(a) through (n), (p) and (q); and either Section 150.2(a)1 or 2.

Exception 1 to Section 150.2(a): Additions of 300 square feet or less are exempt from the roofing requirements of Section 150.1(c)11.

Exception 2 to Section 150.2(a): Existing inaccessible piping shall not require insulation as defined under Section 150.0(j)1.

Exception 3 to Section 150.2(a): Space-conditioning system. When heating or cooling will be extended to an addition from the existing system(s), the existing heating and cooling equipment need not comply with Part 6. The heating system capacity must be adequate to meet the minimum requirements of CBC Section 1204.1.

Exception 4 to Section 150.2(a): Space-conditioning system ducts. When any length of duct is extended from an existing duct system to serve the addition, the existing duct system and the extended duct shall meet the applicable requirements specified in Section 150.2(b)1Di and 150.2(b)1Dii.

Exception 5 to Section 150.2(a): Additions 1,000 square feet or less are exempt from the ventilation cooling requirements of Section 150.1(c)12.

Exception 6 to Section 150.2(a): Photovoltaic systems, as specified in Section 150.1(c)14, are not required for additions.

Exception 7 to Section 150.2(a): Space heating system. A new or replacement space heating system serving an addition may be a heat pump or gas heating system.

1. **Prescriptive approach.** Additions to existing buildings shall meet the following additional requirements:
   A. Additions that are greater than 700 square feet shall meet the requirements of Section 150.1(c), with the following modifications:
      i. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2 × 4 framing and R-21 in a 2 × 6 framing.
      ii. The maximum allowed fenestration area shall be the greater of 175 square feet or 20 percent of the addition floor area, and the maximum allowed west-facing fenestration area shall be the greater of 70 square feet or the requirements of Section 150.1(c).
      iii. When existing siding of a wood-framed wall is not being removed or replaced, cavity insulation of R-15 in a 2 × 4 framing and R-21 in a 2 × 6 framing shall be installed and continuous insulation is not required.
      iv. Additions that consist of the conversion of existing spaces from unconditioned to conditioned space shall not be required to perform the following as part of QII:
         a. Existing window and door headers shall not be required to be insulated.
         b. Air sealing shall not be required when the existing air barrier is not being removed or replaced.
   B. Additions that are 700 square feet or less shall meet the requirements of Section 150.1(c), with the following modifications:
      i. Roof and ceiling insulation in a ventilated attic shall meet one of the following requirements:
         a. In Climate Zones 1, 2, 4, and 8 through 16, achieve an overall assembly *U*-factor not exceeding 0.025. In wood framed assemblies, compliance with *U*-factors may be demonstrated by installing insulation with an *R*-value of R-38 or greater.
         b. In Climate Zones 3, and 5 through 7, achieve an overall assembly *U*-factor not exceeding 0.031. In wood framed assemblies, compliance with *U*-factors may be demonstrated by installing insulation with an *R*-value of R-30 or greater.
      ii. Radiant barriers shall be installed in Climate Zones 2-15.
      iii. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2 × 4 framing and R-21 in a 2 × 6 framing.
      iv. In Climate Zones 2, 4 and 6-15; the maximum allowed west-facing fenestration area shall not be greater than 60 square feet; and shall also comply with either a or b below:
         a. For additions that are 700 square feet or less but greater than 400 square feet, the maximum allowed fenestration area limit is the greater of 120 square feet or 25 percent of the conditioned floor area of the addition.
         b. For additions that are 400 square feet or less, the maximum allowed fenestration area is

the greater of 75 square feet or 30 percent of the conditioned floor area of the addition.

v. Quality Insulation Installation (QII) requirements of Section 150.1(c)1E do not apply.

vi. When existing siding of a wood-framed wall is not being removed or replaced, cavity insulation of R-15 in a 2 × 4 framing and R-21 in a 2 × 6 framing shall be installed and continuous insulation is not required.

Exception to Section 150.2(a)1B: Insulation in an enclosed rafter ceiling shall meet the requirements of Section 150.0.

C. **Mechanical ventilation for indoor air quality.** Additions to existing buildings shall comply with Section 150.0(o) subject to the requirements specified in Subsections i and ii below.

i. **Whole-dwelling unit mechanical ventilation.**

a. Dwelling units that meet the conditions in Subsection 1 or 2 below shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F.

1. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by less than or equal to 1000 square feet.

2. Junior accessory dwelling units (JADU) that are additions to an existing building.

b. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling unit conditioned floor area plus the addition conditioned floor area.

c. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

ii. **Local mechanical exhaust.** Additions to existing buildings shall comply with all applicable requirements specified in Sections 150.0(o)1G and 150.0(o)2.

D. **Water heater.** When a second water heater is installed as part of the addition, one of the following types of water heaters shall be installed:

i. A single heat pump water heater. The storage tank shall not be located outdoors and shall be placed on an incompressible, rigid insulated surface with a minimum thermal resistance of R-10. The water heater shall be installed with a communication interface that either meets the requirements of Section 110.12(a) or has an ANSI/CTA-2045-B communication port; or

ii. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher; or

iii. A gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank; or

iv. For additions that are 500 square feet or less, an instantaneous electric water heater with point of use distribution as specified in RA4.4.5; or

v. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item i, ii, iii or iv.

2. **Performance approach.** Performance calculations shall meet the requirements of Section 150.1(a) through (c), pursuant to the applicable requirements in Items A, B and C below.

A. **For additions alone.** The addition complies if the addition alone meets the energy budgets as specified in Section 150.1(b).

B. **Existing plus alteration plus addition.** The standard design for existing plus alteration plus addition 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 150.2(b)2; plus the proposed addition's energy use meeting the requirements of Section 150.2(a)1. The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered components' energy features, plus the proposed energy features of the addition.

Exception to Section 150.2(a)2B: Existing structures with a minimum R-11 insulation in framed walls showing compliance with Section 150.2(a)2 are exempt from showing compliance with Section 150.0(c).

C. **Mechanical ventilation for indoor air quality.** Additions to existing buildings shall comply with Section 150.0(o) subject to the requirements specified in Subsections i and ii below.

i. **Whole-dwelling unit mechanical ventilation.**

a. Dwelling units that meet the conditions in Subsection 1 or 2 below shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F.

1. Additions to an existing dwelling unit that increase the conditioned floor area of the

existing dwelling unit by less than or equal to 1000 square feet.

2. Junior accessory dwelling units (JADU) that are additions to an existing building.

b. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling unit conditioned floor area plus the addition conditioned floor area.

c. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

ii. **Local mechanical exhaust.** Additions to existing buildings shall comply with all applicable requirements specified in Sections 150.0(o)1G and 150.0(o)2.

(b) **Alterations.** Alterations to existing single-family residential buildings or alterations in conjunction with a change in building occupancy to a single-family residential occupancy shall meet either Item 1 or 2 below.

1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9, all applicable requirements of Sections 150.0(a) through (l), 150.0(m)1 through 150.0 (m)10, and 150.0(p) through (q); and

A. **Added fenestration.** Alterations that add vertical fenestration and skylight area shall meet the total fenestration area and west facing fenestration area, *U*-factor, and solar heat gain coefficient requirements of Section 150.1(c) and Table 150.1-A.

Exception 1 to Section 150.2(b)1A: Alterations that add fenestration area of up to 75 square feet shall not be required to meet the total fenestration area and west-facing fenestration area requirements of Section 150.1(c)3B and C.

Exception 2 to Section 150.2(b)1A: Alterations that add up to 16 square feet of new skylight area with a maximum *U*-factor of 0.55 and a maximum SHGC of 0.30 area shall not be required to meet the total fenestration area and west-facing fenestration area requirements of Sections 150.1(c)3B and C.

B. **Replacement fenestration.** New manufactured fenestration products installed to replace existing fenestration products of the same total area shall meet the U-factor and Solar Heat Gain Coefficient requirements of Sections 150.1(c)3A, and 150.1(c)4.

Exception 1 to Section 150.2(b)1B: Replacement of vertical fenestration no greater than 75 square feet with a *U*-factor no greater than 0.40 in Climate Zones 1–16, and a SHGC value no greater than 0.35 in Climate Zones 2, 4 and 6–15.

Exception 2 to Section 150.2(b)1B: Replaced skylights must meet a *U*-factor no greater than 0.55, and a SHGC value no greater than 0.30.

Note: Glass replaced in an existing sash and frame or sashes replaced in an existing frame are considered repairs, provided that the replacement is at least equivalent to the original in performance.

C. **Entirely new or complete replacement space-conditioning systems** installed as part of an alteration, shall include all the system heating or cooling equipment, including but not limited to: condensing unit, cooling or heating coil, and air handler for split systems; or complete replacement of a packaged unit; plus entirely new or replacement duct system [Section 150.2(b)1Diia]. Entirely new or complete replacement space-conditioning systems shall meet the requirements of Sections 150.0(h), 150.0(i), 150.0(j)1, 150.0(j)2, 150.0(m)1 through 150.0(m)10, 150.0(m)12, 150.0(m)13, 150.1(c)7, 150.2(b)1G and Table 150.2-A.

D. **Altered duct systems—duct sealing.** In all climate zones, when more than 25 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of Subsections i and ii below. Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in garage spaces, the system shall comply with Subsection 150.2(b)1Diic regardless of the length of any new or replacement space-conditioning ducts installed in the garage space.

i. New ducts located in unconditioned space shall meet the applicable requirements of Sections 150.0(m)1 through 150.0(m)10, and the duct insulation requirements of Table 150.2-A; and

TABLE 150.2-A
DUCT INSULATION *R*-VALUE

Climate Zone	3, 5 through 7	1, 2, 4, 8 through 16
Duct *R*-Value	R-6	R-8

ii. The altered duct system, regardless of location, shall be sealed as confirmed through field verification and diagnostic testing in accordance with all applicable procedures for duct sealing of altered existing duct systems as specified in Reference Residential Appendix Section RA3.1, utilizing the leakage compliance criteria specified in Subsection a or b below.

a. **Entirely new or complete replacement duct system.** If the new ducts form an entirely new or complete replacement duct system directly connected to the air handler, the duct system

measured leakage shall be equal to or less than 5 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.

Entirely new or complete replacement duct systems installed as part of an alteration is constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air handler, coil, plenums, duct material; if the reused parts are accessible and can be sealed to prevent leakage.

Entirely new or complete replacement duct systems shall also conform to the requirements of Sections 150.0(m)12 and 150.0(m)13. If the air handler and ducts are located within a vented attic, the requirements of Section 150.2(b)1J shall also be met.

b. **Extension of an existing duct system.** If the new ducts are an extension of an existing duct system serving single-family dwellings, the combined new and existing duct system shall meet one of the following requirements:

I. The measured duct leakage shall be equal to or less than 10 percent of system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

II. The measured duct leakage to outside shall be equal to or less than 7 percent of system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

III. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1DiibI or 150.2(b)1DiibII, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

Exception to Section 150.2(b)1Diib: Duct sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

c. **Altered ducts and duct system components in garage spaces.** When new or replacement space-conditioning ducts, air-handling units, cooling or heating coils, or plenums are located in a garage space, compliance with either I or II below is required.

I. The measured system duct leakage shall be less than or equal to 6 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

II. All accessible leaks located in the garage space shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

E. **Altered space-conditioning system—duct sealing.** In all climate zones, when a space-conditioning system serving a single-family dwelling 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, the duct system that is connected to the altered space-conditioning system equipment shall be sealed, 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 Residential Appendix RA3.1, and the leakage compliance criteria specified in Subsection i, ii, or iii below. Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in garage spaces, the system shall comply with Section 150.2(b)1Diic regardless of the length of any new or replacement space-conditioning ducts installed in the garage space.

i. The measured duct leakage shall be equal to or less than 10 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix RA3.1.4.3.1; or

ii. The measured duct leakage to outside shall be equal to or less than 7 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

iii. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Ei or 150.2(b)1Eii, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix Section RA3.1.4.3.5.

Exception 1 to Section 150.2(b)1E: 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 Residential Appendix RA3.1.

Exception 2 to Section 150.2(b)1E: Duct sealing. Duct systems with less than 40 linear feet as determined by visual inspection.

Exception 3 to Section 150.2(b)1E: Duct sealing. Existing duct systems constructed, insulated or sealed with asbestos.

F. **Altered space-conditioning system—mechanical cooling.** When a space-conditioning system is an air conditioner or heat pump that is altered by the installation or replacement of refrigerant-containing system components such as the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping, the altered system shall comply with the following requirements:

i. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).

ii. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14 and 15, air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high-velocity air systems, and minisplit systems shall comply with Subsections a and b, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of Section 150.2(b)1Fii shall comply with Section 150.2(b)1Fiii.

Exception to Section 150.2(b)1Fii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiia, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1. >

a. Minimum system airflow rate shall comply with the applicable Subsection I or II below as confirmed through field verification and diagnostic testing in accordance with the procedures specified in Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified in Section RA1.

1. Small duct high-velocity systems shall demonstrate a minimum system airflow rate greater than or equal to 250 cfm per ton of nominal cooling capacity; or

2. All other air-cooled air conditioner or air-source heat pump systems shall demonstrate a minimum system airflow rate greater than or equal to 300 cfm per ton of nominal cooling capacity; and

Exception 1 to Section 150.2(b)1Fiia: Systems unable to comply with the minimum airflow rate requirement shall demonstrate compliance using the procedures in Section RA3.3.3.1.5; and the system's thermostat shall conform to the specifications in Section 110.12.

Exception 2 to Section 150.2(b)1Fiia: Entirely new or complete replacement space-conditioning systems, as specified by Section 150.2(b)1C, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in Table 150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section 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-B and 150.0-C.

b. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable.

1. The installer and rater shall perform the standard charge verification procedure as specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1; or

2. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

3. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1, provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1. <

Exception to Section 150.2(b)1Fiib: When the outdoor temperature is less than 55°F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix

Section RA3.2.3.1 to demonstrate compliance, 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 Section 110.12. Ducted systems shall comply with the minimum system airflow rate requirements in Section 150.2(b)1Fiia.

iii. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14 and 15, air-cooled air conditioners or air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high-velocity, and minisplit systems, which are of a type that cannot comply with the requirements of 150.2(b)1Fiib shall comply with Subsections a and b, as applicable.

a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix RA3.2.3.2; and

b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.2(b)1Fiia provided the system is of a type that can be verified using the procedures in Section RA3.3 or an approved alternative procedure in Section RA1.

Exception to Section 150.2(b)1Fiii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiiib, provided that the system is of a type that can be verified using the procedure specified in Section RA3.3 or an approved alternative in Section RA1.

G. **Altered space-heating system.** Altered or replacement space-heating systems shall not use electric resistance as the primary heat source.

Exception 1 to Section 150.2(b)1G: Nonducted electric resistance space heating systems, if the existing space heating system is electric resistance.

Exception 2 to Section 150.2(b)1G: Ducted electric resistance space heating systems, if the existing space heating system is electric resistance and a ducted space cooling system is not being replaced or installed.

Exception 3 to Section 150.2(b)1G: Electric resistance space heating systems, if the existing space heating system is electric resistance and the building is located in Climate Zone 7 or 15.

H. **Water-heating system.** Altered or replacement service water-heating systems or components shall meet the applicable requirements below:

i. **Pipe insulation.** For newly installed and existing accessible piping, the insulation requirements of Section 150.0(j)1 shall be met.

ii. **Distribution system.** For recirculation distribution systems: serving individual dwelling units, only demand recirculation systems with manual on/off control as specified in the Reference Appendix RA4.4.9 shall be installed.

iii. **Water heating system.** The water heating system shall meet one of the following:

a. A natural gas or propane water-heating system; or

b. A single heat pump water heater. The storage tank shall not be located outdoors and be placed on an incompressible, rigid insulated surface with a minimum thermal resistance of R-10. The water heater shall be installed with a communication interface that either meets the requirements of Section 110.12(a) or has an ANSI/CTA-2045-B communication port; or

c. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher; or

d. If the existing water heater is an electric resistance water heater, a consumer electric water heater; or

e. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item a above; or if no natural gas is connected to the existing water heater location, a water-heating system determined by the executive director to use no more energy than the one specified in Item d above.

I. **Roofs.** Replacements of the exterior surface of existing roofs, including adding a new surface layer on top of the existing exterior surface, shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i and ii where more than 50 percent of the roof is being replaced.

i. **Steep-sloped roofs.** Steep-sloped roofs shall meet the following:

New roofing products in Climate Zones 4 and 8 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 Section 150.2(b)1Ii: The following shall be considered equivalent to Subsection i:

a. Buildings with ceiling assemblies with a *U*-factor lower than or equal to 0.025 or that are insulated with at least R-38 ceiling insulation; or

b. Buildings with a radiant barrier in the attic, where the radiant barrier is not installed directly above spaced sheathing, meeting the requirements of Section 150.1(c)2; or

c. In Climate Zones 2, 4, 9, 10, 12 and 14, buildings that have no ducts in the attic; or

d. Buildings with R-2 or greater continuous insulation above or below the roof deck.

Exception 2 to Section 150.2(b)1Ii: Roof area covered by building integrated photovoltaic panels or building integrated solar thermal panels is not required to meet minimum requirements for aged solar reflectance, thermal emittance or SRI.

Exception 3 to Section 150.2(b)1Ii: Roof constructions with a weight of at least 25 lb/ft^2 are exempt from minimum requirements for aged solar reflectance and thermal emittance, or SRI.

ii. **Low-sloped roofs.** Low-sloped roofs shall meet the following:

a. New roofing products in Climate Zones 4 and 6 through 15 shall have an aged solar reflectance equal to or greater than 0.63 and a thermal emittance equal or greater than 0.75, or a minimum SRI of 75.

Exception 1 to Section 150.2(b)1Iia: The aged solar reflectance can be met by using insulation at the roof deck specified in Table 150.2-B.

TABLE 150.2-B
AGED SOLAR REFLECTANCE INSULATION TRADE-OFF TABLE

MINIMUM AGED SOLAR REFLECTANCE	ROOF DECK CONTINUOUS INSULATION *R*-VALUE (Climate Zones 6–7)	ROOF DECK CONTINUOUS INSULATION *R*-VALUE (Climate Zones 2, 4 and 8–15)
0.60	2	16
0.55	4	18
0.50	6	20
0.45	8	22
No requirement	10	24

Exception 2 to Section 150.2(b)1Iia: Roof area covered by building integrated photovoltaic panels or building integrated solar thermal panels is not required to meet the minimum requirements for aged solar reflectance, thermal emittance or SRI.

Exception 3 to Section 150.2(b)1Iia: Roof constructions with a weight of at least 25 lb/ft^2 are exempt from the minimum requirements for aged solar reflectance and thermal emittance, or SRI.

b. Roofs shall be insulated to the levels specified in Table 150.2-C.

TABLE 150.2-C
INSULATION REQUIREMENTS FOR ROOF ALTERATIONS

CLIMATE ZONE	CONTINUOUS INSULATION *R*-VALUE	ROOF ASSEMBLY *U*-FACTOR
3, 5–7	N.A.	N.A.
1, 2, 4, 8–16	R-14	0.039

Exception 1 to Section 150.2(b)1Iiib: Existing roofs with R-10 or greater continuous insulation above or below the roof deck; or

Exception 2 to Section 150.2(b)1Iiib: Existing roofs with an assembly *U*-factor of 0.056 or less or that are insulated with at least R-19 insulation between the roof rafters and in contact with the roof deck in Climate Zones 1, 2, 4, and 8 through 10; or

Exception 3 to Section 150.2(b)1Iiib: The continuous insulation requirements of Table 150.2-C may be reduced to R-4 where the following conditions are met:

i. Mechanical equipment is located on the roof and will not be temporarily disconnected and lifted as part of the roof replacement and the addition of insulation required by Table 150.2-C would reduce the height from the roof surface to the top of the base flashing to less than that set forth in the manufacturer's installation instructions as per *California Residential Code* Section R900; or

ii. Replaced roofing abuts sidewall or parapet walls and the addition of insulation required by Table 150.2-C would reduce the height from the roof surface to the top of the base flashing to less than that set forth in the manufacturer's installation instructions as per *California Residential Code* Section R900, provided that the following conditions apply:

1. The sidewall or parapet walls are finished with an exterior cladding material other than the roof covering membrane material; and

2. The sidewall or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain the minimum base flashing height; and

3. The ratio of the replaced roof area to the linear dimension of affected sidewall or parapet walls is less than 25 square feet per linear foot; or

Exception 4 to Section 150.2(b)1Iiib: The continuous insulation requirements per Table 150.2-C may be reduced where increasing the thickness of above deck insulation would reduce the flashing around an existing exterior wall opening below what is permitted by the fenestration or door manufacturer's installation instructions, or registered design professional's approved flashing design, as per *California Residential Code* Section R703.4, or by *California Residential Code* Section R905.2.8.3.

Exception 5 to Section 150.2(b)1Biib: Tapered insulation with thermal resistance less than prescribed at the drains and other low points may be used 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 required value.

J. **Ceiling.** Vented attics shall meet the following:

i. In Climate Zones 1 through 4, 6, and 8 through 16 insulation shall be installed to achieve a weighted U-factor of 0.020 or insulation installed at the ceiling level shall result in an insulated thermal resistance of R-49 or greater for the insulation alone; and

Exception to Section 150.2(b)1Ji: In Climate Zones 1, 3 and 6, dwelling units with at least R-19 existing insulation installed at the ceiling level.

ii. In Climate Zones 2, 4, and 8 through 16, air seal all accessible areas of the ceiling plane between the attic and the conditioned space in accordance with Section 110.7; and

Exception 1 to Section 150.2(b)1Jii: Dwelling units with at least R-19 existing insulation installed at the ceiling level.

Exception 2 to Section 150.2(b)1Jii: Dwelling units with atmospherically vented space-heating or water-heating combustion appliances located inside the pressure boundary of the dwelling unit.

iii. In Climate Zones 1 through 4 and 8 through 16, recessed downlight luminaires in the ceiling shall be covered with insulation to the same depth as the rest of the ceiling. Luminaires not rated for insulation contact must be replaced or retrofitted with a fireproof cover that allows for insulation to be installed directly over the cover; and

Exception 1 to Section 150.2(b)1Jiii: In Climate Zones 1 through 4 and 8 through 10, dwelling units with at least R-19 existing insulation installed at the ceiling level.

iv. Attic ventilation shall comply with the *California Building Code* requirements.

Exception 1 to Section 150.2(b)1J: Dwelling units with at least R-38 existing insulation installed at the ceiling level.

Exception 2 to Section 150.2(b)1J: Dwelling units where the alteration would directly cause the disturbance of asbestos.

Exception 3 to Section 150.2(b)1J: Dwelling units with knob and tube wiring located in the vented attic.

Exception 4 to Section 150.2(b)1J: Where the accessible space in the attic is not large enough to accommodate the required *R*-value, the entire accessible space shall be filled with insulation provided such installation does not violate Section 806.3 of Title 24, Part 2.5.

Exception 5 to Section 150.2(b)1J: Where the attic space above the altered dwelling unit is shared with other dwelling units and the requirements of Section 150.2(b)1J are not triggered for the other dwelling units.

K. **Lighting.** The altered lighting system shall meet the lighting requirements of Section 150.0(k). The altered luminaires shall meet the luminaire efficacy requirements of Section 150.0(k) and Table 150.0-A. Where existing screw-base sockets are present in ceiling-recessed luminaires, removal of these sockets is not required provided that new JA8-compliant trim kits or lamps designed for use with recessed downlights or luminaires are installed.

L. **Mechanical ventilation for indoor air quality—entirely new or complete replacement ventilation systems.** Entirely new or complete replacement ventilation systems shall comply with all applicable requirements in Section 150.0(o). An entirely new or complete replacement ventilation system includes a new ventilation fan component and an entirely new duct system. An entirely new or complete replacement duct system is constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air filtration devices and duct material, if the reused parts are accessible and can be sealed to prevent leakage.

M. **Mechanical ventilation for indoor air quality—altered ventilation systems.** Altered ventilation system components or newly installed ventilation equipment serving the alteration shall comply with Section 150.0(o) as applicable subject to the requirements specified in Subsections i and ii below.

i. **Whole-dwelling unit mechanical ventilation.**

a. **Whole-dwelling unit airflow.** If the whole-dwelling ventilation fan is altered or replaced,

then one of the following Subsections 1 or 2 shall be used for compliance as applicable.

1. Dwellings that were required by a previous building permit to comply with the whole-dwelling unit airflow requirements in Section 150.0(o) shall meet or exceed the whole-dwelling unit mechanical ventilation airflow specified in Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F as confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.7.
2. Dwellings that were not required by a previous building permit to have a whole-dwelling unit ventilation system shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Section 150.0(o)1C, 150.0(o)1E or 150.0(o)1F.

b. **Replacement ventilation fans.** Whole-dwelling unit replacement ventilation fans shall be rated for airflow and sound in accordance with the requirements of ASHRAE 62.2 Sections 7.1 and 7.2. Additionally, when conformance to a specified whole-dwelling unit airflow rate is required for compliance, the replacement fans shall be rated at no less than the airflow rate required for compliance.

c. **Air filters.** If the air filtration device for a whole-dwelling unit ventilation system is altered or replaced, then one of the following Subsections 1 or 2 shall be used for compliance as applicable.

1. Dwellings that were required by a previous building permit to comply with the ventilation system air filtration requirements in Section 150.0(m)12 shall comply with the air filtration requirements in Section 150.0(m)12.
2. Dwellings that were not required by a previous building permit to comply with the ventilation system air filtration requirements in Section 150.0(m)12 shall not be required to comply with the air filtration requirements specified in Section 150.0(m)12.

ii. **Local mechanical exhaust.**

a. **Bathroom local mechanical exhaust.** Altered bathroom local mechanical exhaust systems shall comply with the applicable requirements specified in Section 150.0(o)1G.

b. **Kitchen local mechanical exhaust.** If the kitchen local ventilation fan is altered or replaced, then one of the following Subsections 1, 2 or 3 shall be used for compliance as applicable.

1. Dwellings that were required by a previous building permit to comply with the kitchen local exhaust requirements in Section 150.0(o)1G shall meet or exceed the applicable airflow or capture efficiency requirements in Section 150.0(o)1G.
2. Dwellings that were required by a previous building permit to install a vented kitchen range hood or other kitchen exhaust fan shall install a replacement fan that meets or exceeds the airflow required by the previous building permit, or 100 cfm, whichever is greater.
3. Dwellings that were not required to have a kitchen local ventilation exhaust system according to the conditions in either Subsection 1 or 2 above shall not be required to comply with the requirements of Section 150.0(o)1G.

c. **Replacement ventilation fans.** New or replacement local mechanical exhaust fans shall be rated for airflow and sound in accordance with the requirements of ASHRAE 62.2 Section 7.1 and Title 24, Part 6 Section 150.0(o)1Gvi. Additionally, when compliance with a specified exhaust airflow rate is required, the replacement fan shall be rated at no less than the airflow rate required for compliance.

N. **Exterior doors.** Alterations that add exterior door area shall meet the *U*-factor requirement of Section 150.1(c)5.

2. **Performance approach.** The altered component(s) and any newly installed equipment serving the alteration shall meet the applicable requirements of Subsections A, B, and C below.

A. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (l), Sections 150.0(m)1 through 150.0 (m)10, and Sections 150.0(p) through (q). Entirely new or complete replacement mechanical ventilation systems, as these terms are used in Section 150.2(b)1L, shall comply with the requirements in Section 150.2(b)1L. Altered mechanical ventilation systems shall comply with the requirements of Section 150.2(b)1M. Entirely new or complete replacement space-conditioning systems, and entirely new or complete replacement duct systems, as these terms are used in Sections 150.2(b)1C and 150.2(b)1Diia, shall comply with the requirements of Sections 150.0(m)12 and 150.0(m)13.

B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in Table 150.2-D. For components not being altered, the standard design shall be based on the existing conditions. When the third party verification option is specified as a requirement, all components proposed for alteration for which the additional credit is taken must be verified.

C. The proposed design shall be based on the actual values of the altered components.

Notes to Section 150.2(b)2:

1. If an existing component must be replaced with a new component, that component is considered an altered component for the purpose of determining the standard design altered component energy budget and must meet the requirements of Section 150.2(b)2B.
2. The standard design shall assume the same geometry and orientation as the proposed design.
3. The "existing efficiency level" modeling rules, including situations where nameplate data are not available, are described in the Residential ACM Approval Manual.

Exception 1 to Section 150.2(b): Any dual- glazed greenhouse or/garden window installed as part of an alteration complies with the *U*-factor requirements in Section 150.1(c)3.

Exception 2 to Section 150.2(b): Where the space in the attic or rafter area is not large enough to accommodate the required *R*-value, the entire space shall be filled with insulation, provided such installation does not violate Section 1203.2 of Title 24, Part 2.

(c) **Whole building.** Any addition or alteration may comply with the requirements of Title 24, Part 6 by meeting the requirements for the entire building.

Note: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, 25910, and 25943, *Public Resources Code*.

TABLE 150.2-D
STANDARD DESIGN FOR AN ALTERED COMPONENT

ALTERED COMPONENT	STANDARD DESIGN WITHOUT THIRD PARTY VERIFICATION OF EXISTING CONDITIONS SHALL BE BASED ON	STANDARD DESIGN WITH THIRD-PARTY VERIFICATION OF EXISTING CONDITIONS SHALL BE BASED ON
Ceiling insulation, wall insulation, and raised-floor insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation *R*-value
Fenestration	The *U*-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.	If the proposed *U*-factor is ≤ 0.40 and SHGC value is ≤ 0.35, the standard design shall be based on the existing *U*-factor and SHGC values as verified. Otherwise, the standard design shall be based on the *U*-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.
Window film	The *U*-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Tables 110.6-A and 110.6-B.
Doors	The *U*-factor of 0.20. The door area shall be the door area of the existing building.	If the proposed *U*-factor is < 0.20, the standard design shall be based on the existing *U*-factor value as verified. Otherwise, the standard design shall be based on the *U*-factor of 0.20. The door area shall be the door area of the existing building.
Space-heating and space-cooling equipment	Table 150.1-A for equipment efficiency requirements; Section 150.2(b)1C for entirely new or complete replacement systems; Section 150.2(b)1F for refrigerant charge verification requirements.	The existing efficiency levels.
Air distribution system – duct sealing	The requirements of Sections 150.2(b)1D and 150.2(b)1E	
Air distribution system – duct insulation	The proposed efficiency levels.	The existing efficiency levels.
Water heating systems	The requirements of Section 150.2(b)1Hii.	The existing efficiency levels.
Roofing products	The requirements of Section 150.2(b)1I.	
All other measures	The proposed efficiency levels.	The existing efficiency levels.

(b) **Attached dwelling units.** Attached dwelling units shall comply with the requirements of Subsections 1 and 2 below.

1. **Air filtration.**

A. System types specified in Subsections i, ii and iii shall be provided with air filters in accordance with Sections 160.2(b)1B, 160.2(b)1C and 160.2(b)1D. System types specified in Subsection i shall also comply with Section 160.2(b)1E.

i. Mechanical space-conditioning systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length.

ii. Mechanical supply-only ventilation systems and makeup air systems that provide outside air to an occupiable space.

iii. The supply side of mechanical balanced ventilation systems, including heat recovery ventilation systems, and energy recovery ventilation systems that provide outside air to an occupiable space.

B. **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 are filtered before passing through any system's thermal conditioning components.

Exception to Section 160.2(b)1Bi: For heat recovery ventilators and energy recovery ventilators, the location of the filters required by Section 160.2(b)1 may be downstream of a system thermal conditioning component, provided the system is equipped with ancillary filtration upstream of the system's thermal conditioning component.

ii. All systems shall be designed to accommodate the clean-filter pressure drop imposed by the system air filter(s). The design airflow rate, and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter, shall be determined and reported on labels according to Subsection iv below.

Systems specified in Section 160.2(b)1Ai shall be equipped with air filters that meet either Subsection a or b below:

a. Nominal 2-inch minimum depth filter(s) shall be sized by the system designer, or

b. Nominal 1-inch minimum depth filter(s) shall be allowed if the filter(s) are sized according to Equation 160.2-A, based on a maximum face velocity of 150 ft per minute and according to the maximum allowable clean-filter pressure drop specified in Section 160.2(b)1Dii.

$$A_{face} = Q_{filter} / V_{face} \qquad \textbf{(Equation 160.2-A)}$$

where:

A_{face} = air filter face area, the product of air filter nominal length × nominal width, ft^2.

Q_{filter} = design airflow rate for the air filter, ft^3/min

V_{face} = air filter face velocity ≤ 150 ft/min

iii. All system air filters shall be located and installed in such a manner as to be accessible for regular service by the system owner.

iv. All system air filter installation locations shall be labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop. The labels shall be permanently affixed to the air filter installation location, readily legible and visible to a person replacing the air filter.

v. Filter racks or grilles shall use gaskets, sealing or other means to close gaps around inserted filters and prevent air from bypassing the filter.

C. **Air filter efficiency.** The system shall be provided with air filters having a designated efficiency equal to or greater than MERV 13 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50 percent in the 0.30–1.0 μm range, and equal to or greater than 85 percent in the 1.0–3.0 μm range when tested in accordance with AHRI Standard 680.

D. **Air filter pressure drop.** All systems shall be provided with air filters that conform to the applicable maximum allowable clean-filter pressure drop specified in Subsection i, ii, iii or iv below, when tested using ASHRAE Standard 52.2, or as rated using AHRI Standard 680, for the applicable design airflow rates for the system air filters.

i. The maximum allowable clean-filter pressure drop shall be determined by the system design for the nominal 2-inch minimum depth air filter required by Section 160.2(b)1Biia, or

ii. A maximum of 25 Pa (0.1 inches water) clean-filter pressure drop shall be allowed for a nominal 1-inch depth air filter sized according to Section 160.2(b)1Biib, or

iii. For systems specified in Sections 160.2(b)1Aii and 160.2(b)1Aiii, the maximum allowable clean filter pressure drop shall be determined by the system design.

iv. If Exception 1 to Section 160.3(b)5Lii or iv is utilized for compliance with cooling system airflow rate and fan efficacy requirements, the clean-filter pressure drop for the system air filter shall conform to the requirements given in Table 160.3-A or 160.3-B.

E. **Air filter product labeling.** Systems described in Section 160.2(b)1Ai shall be equipped with air filters that have been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections 160.2(b)1C and 160.2(b)1D.

Exception to Section 160.2(b)1: Evaporative coolers are exempt from the air filtration requirements in Section 160.2(b)1.

2. **Ventilation and indoor air quality for attached dwelling units**. All attached dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Residential Buildings subject to the amendments specified in Section 160.2(b)2A below. All dwelling units shall comply with Section 160.2(b)2B below.

   Exception to Section 160.2(b)2 The following sections of ASHRAE 62.2 shall not be required for compliance: Section 4.1.1, Section 4.1.2, Section 4.1.4, Section 4.3, Section 4.6, Section 5, Section 6.1.1, Section 6.5.2 and Normative Appendix A.

   A. Amendments to ASHRAE 62.2 requirements.

      i. **Window operation**. Window operation is not a permissible method of providing the dwelling unit ventilation airflow specified in Subsection iv or v below.

      ii. **Central fan integrated (CFI) ventilation systems**.

         a. Continuous operation prohibition. Continuous operation of a dwelling unit's central forced air system air handlers used in CFI ventilation systems is not a permissible method of providing the whole-dwelling unit ventilation airflow required by Section 160.2(b)2Aiv.

            Exception to Section 160.2(b)2Aiia: The Energy Commission may approve continuous operation of central fan integrated ventilation systems pursuant to Section 10-109(h).

         b. Outdoor air damper(s). A motorized damper(s) shall be installed on the connected ventilation duct(s) of CFI systems that prevents all airflow into or out of the space-conditioning duct system when the damper(s) is closed.

         c. Damper control. The required motorized damper(s) shall be controlled to be in an opened position when outdoor air ventilation is required for compliance, and shall be in the closed position when ventilation air is not required. The damper(s) shall be closed whenever the space-conditioning system air handling unit is not operating. If the outdoor airflow for the CFI ventilation system is fan-powered, then the outdoor air fan shall not operate when the required motorized damper(s) on the outdoor air ventilation duct(s) is closed.

         d. Variable ventilation. CFI ventilation systems shall incorporate controls that track outdoor air ventilation run time, and either open or close the required motorized damper(s) depending on whether or not outdoor air ventilation is required for compliance with Section 160.2(b)2Aiv. During periods when comfort conditioning is not called for by the space-conditioning thermostat, the CFI ventilation system controls shall operate the space-conditioning system central fan and outdoor air damper(s) when necessary to ensure compliance with the minimum outdoor air ventilation required by Section 160.2(b)2Aiv in accordance with applicable variable mechanical ventilation methods specified in ASHRAE 62.2 Section 4.5.

      iii. **Air filtration.** Air filtration shall conform to the specifications in Section 160.2(b)1. Compliance with ASHRAE 62.2 Sections 6.7 (Minimum Filtration) and 6.7.1 (Filter Pressure Drop) shall not be required.

      iv. **Whole-dwelling unit mechanical ventilation**. Multifamily attached dwelling units shall comply with Subsections a and b below.

         a. Mechanical ventilation airflow shall be provided at rates greater than or equal to the value determined in accordance with Equation 160.2-B.

            Total Required Ventilation Rate [ASHRAE 62.2:4.1.1]:

            $$Q_{tot} = 0.03A_{floor} + 7.5(N_{br} + 1)$$ **(Equation 160.2-B)**

            where:

            Q_{tot} = total required ventilation rate, cfm.

            A_{floor} = dwelling-unit floor area, ft^2.

            N_{br} = number of bedrooms (not to be less than 1).

         b. All dwelling units in a multifamily building shall use the same whole-dwelling unit ventilation system type. The system type installed throughout the building shall be only one of the following three types: supply, exhaust or balanced. The dwelling unit shall comply with one of the following Subsections 1 or 2 below.

            1. **Balanced ventilation**. A balanced ventilation system shall provide the required whole-dwelling-unit ventilation airflow. Systems with heat recovery or energy recovery that serve a single dwelling unit shall have a fan efficacy of ≤1.0 W/cfm; or

            2. **Supply or exhaust ventilation with compartmentalization testing**. Continuously operating supply ventilation systems or continuously operating exhaust ventilation systems shall be allowed to be used to provide the required whole-dwelling unit ventilation airflow only if the dwelling unit envelope leakage is less than or equal to 0.3 cubic feet per minute at 50 Pa (0.2 inch water) per ft^2 of dwelling unit envelope surface area as confirmed by HERS field verification and diagnostic testing in accordance with the procedures specified in Reference Appendix RA3.8 or NA2.3 as applicable.

dwelling unit, 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. Air handler airflow for calculation of duct leakage rate compliance targets shall be determined according to methods specified in Reference Residential Appendix RA3.1.4.2.

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 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 air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

Exception 1 to Section 160.3(b)5K: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four habitable stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

Exception 2 to Section 160.3(b)5K: Multifamily dwelling units in buildings four habitable stories and greater in Climate Zones 1, 3, 5 and 7.

L. **System airflow rate and fan efficacy.** Space-conditioning systems that utilize forced air ducts to supply cooling to an individual dwelling unit shall:

i. **Static pressure probe.** 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 Section 160.3(b)5Li: 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.

ii. **Single zone central forced air systems.** 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 the maximum W/cfm specified in Subsection a or b below. The airflow rate and fan efficacy requirements in this section shall be confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

a. 0.45 W/cfm for gas furnace air-handling units.

b. 0.58 W/cfm for air-handling units that are not gas furnaces.

Exception 1 to Section 160.3(b)5Lii: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in Table 160.3-A or 160.3-B 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 specified by Section 160.2(b)1Div for the system air filter(s) shall conform to the requirements given in Table 160.3-A or 160.3-B.

Exception 2 to Section 160.3(b)5Lii: Multi-speed compressor systems or variable speed compressor systems shall verify airflow (cfm/ton) and fan efficacy (watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

Exception 3 to Section 160.3(b)5Lii: Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value 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.

iii. **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 the maximum W/cfm specified in Subsection a or b below. The airflow rate and fan efficacy requirements in this section shall be confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

a. 0.45 W/cfm for gas furnace air-handling units.

b. 0.58 W/cfm for air-handling units that are not gas furnaces.

Exception 1 to Section 160.3(b)5Liii: Multi-speed or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach, shall demonstrate compliance with the airflow (cfm/ton) and fan efficacy (watt/cfm) requirements of Section 160.3(b)5Liii by operating the system at maximum compressor capacity

and system fan speed with all zones calling for conditioning, rather than in every zonal control mode.

Exception 2 to Section 160.3(b)5Liii: Gas furnace air-handling units manufactured prior to July 3, 2019 shall comply with a fan efficacy value 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.

iv. **Small duct high velocity forced air systems.** Demonstrate, in every control mode, airflow greater than or equal to 250 cfm per ton of nominal cooling capacity through the return grilles, and an air-handling unit fan efficacy less than or equal to 0.62 W/cfm as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.

Exception 1 to Section 160.3(b)5Liv: Standard ducted systems without zoning dampers may comply by meeting the applicable requirements in Table 160.3-A or 160.3-B 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 specified by Section 160.2(b)1Div for the system air filter(s) shall conform to the requirements given in Table 160.3-A or 160.3-B.

Exception 2 to Section 160.3(b)5Liv: Multi-speed compressor systems or variable speed compressor systems shall verify airflow (cfm/ton) and fan efficacy (watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

Exception 1 to Section 160.3(b)5L: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four habitable stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

Exception 2 to Section 160.3(b)5L: Multifamily dwelling units in buildings four habitable stories and greater in Climate Zone 1.

6. Piping for space-conditioning systems, solar water-heating system collector loop, and distribution piping for steam and hydronic heating system shall meet the requirements of Section 160.3(c)1.

(c) **Fluid distribution systems; common area space-conditioning systems.** Multifamily buildings shall comply with the applicable requirements of Section 160.3(a)1. Multifamily common areas shall comply with the applicable requirements of Sections 160.3(a)2A through 160.3(a)2J.

1. **Pipe insulation**. Multifamily buildings shall comply with the applicable requirements of Sections 160.3(c)1A through 160.3(c)1D.

A. **General requirements.** The piping conditions listed below for space-conditioning systems with fluid normal operating temperatures listed in Table 160.3-D shall have at least the amount of insulation specified in Section 160.3(c)1D:

i. **Space cooling systems.** All refrigerant suction, chilled water and brine fluid distribution systems.

ii. **Space heating systems.** All refrigerant, steam, steam condensate and hot water fluid distribution systems.

Exception to Section 160.3(c)1Aii: Heat pumps refrigerant vapor line shall be installed with a minimum of 0.75-inch-thick or R-6.0 insulation. No insulation is required on the refrigerant liquid line.

B. Insulation conductivity shall be determined in accordance with ASTM C335 at the mean temperature listed in Table 160.3-D, and shall be rounded to the nearest $^{1}/_{100}$ Btu-inch per hour per square foot per °F. Fluid distribution systems include all elements that are in series with the fluid flow, such as pipes, pumps, valves, strainers, coil u-bends and air separators, but not including elements that are not in series with the fluid flow, such as expansion tanks, fill lines, chemical feeders and drains.

C. **Insulation protection.** Pipe insulation shall be protected from damage due to sunlight, moisture, equipment maintenance and wind. Protection shall, at minimum, include the following:

i. Pipe insulation exposed to weather shall be protected by a cover suitable for outdoor service. The cover shall be water retardant and provide shielding from solar radiation that can cause degradation of the material. Adhesive tape shall not be used to provide this protection.

ii. Pipe insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include, or be protected by, a Class I or Class II vapor retarder. All penetrations and joints shall be sealed.

iii. Pipe insulation buried below grade must be installed in a waterproof and noncrushable casing or sleeve.

D. **Insulation thickness.**

i. For insulation with a conductivity in the range shown in Table 160.3-D for the applicable fluid temperature range, the insulation shall have the applicable minimum thickness or *R*-value shown in Table 160.3-D.

ii. For insulation with a conductivity outside the range shown in Table 160.3-D for the applicable fluid temperature range, the insulation shall have

SUBCHAPTER 11

MULTIFAMILY BUILDINGS—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

SECTION 170.0 GENERAL

Multifamily buildings shall comply with the applicable requirements of Sections 170.0 through 170.2. Sections 170.0 through 170.2 apply to dwelling units and common use areas in multifamily buildings. Nonresidential occupancies in mixed occupancy buildings shall comply with nonresidential requirements in Sections 120, 130, 140 and 141.

(a) Multifamily buildings shall meet all of the following:

1. The applicable requirements of Sections 110.0 through 110.10.
2. The applicable requirements of Section 160.0 (mandatory features).
3. Either the performance standards Section 170.1 or the prescriptive standards Section 170.2 set forth in this subchapter for the climate zone in which the building is located. Climate zones are shown in Reference Joint Appendix JA2—Weather/Climate Data.

   Exception to Section 170.0 (a)3: If a single development falls in more than one climate zone, all buildings in the subdivision or tract may be designed to meet the performance or prescriptive standards for the climate zone that contains 50 percent or more of the dwelling units.

   NOTE: The Commission periodically updates, publishes and makes available to interested persons and local enforcement agencies precise descriptions of the climate zones, as specified in Reference Joint Appendix JA2—Weather/Climate Data.

   NOTE: The requirements of Sections 170.1(a) through 170.2(e) apply to newly constructed buildings and Sections 180.1 and 180.2 specify changes to the requirements of Sections 170.1(a) through 170.2(e) that apply to additions or alterations.

   NOTE: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8 and 25943, *Public Resources Code*.

SECTION 170.1 PERFORMANCE APPROACH

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 the standard design building is expressed in terms of source energy and time-dependent valuation (TDV) energy, and they are determined by applying the mandatory and prescriptive requirements to the proposed design building. The source energy budget and the TDV energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage system, service water heating and covered process loads.

(b) **Energy budget for the proposed design building**. The energy budget for a proposed design building is expressed in terms of source energy and time-dependent valuation (TDV) energy, and they are determined by calculating the source energy and TDV energy for the proposed design building. The source energy budget and the TDV energy budget is the sum of the energy for space-conditioning, indoor lighting, mechanical ventilation, photovoltaic (PV) and battery storage system, and service water heating and covered process loads. The proposed building shall separately comply with the source energy budget and the TDV energy budget.

Exception to Section 170.1(b): A community shared solar electric generation system, or other renewable electric generation system, and/or community shared battery storage system, that provides dedicated power, utility energy reduction credits or payments for energy bill reductions to the permitted building and is approved by the Energy Commission as specified in Title 24, Part 1, Section 10-115, may offset part or all of the solar electric generation system or battery storage system TDV energy required to comply with the standards, as calculated according to methods established by the Commission in the Nonresidential ACM Reference Manual.

(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 ACM Approval Manual.

(d) **Compliance demonstration requirements for performance standards.**

1. Certificate of Compliance and Application for a Building Permit. The application for a building permit shall include documentation pursuant to Sections 10-103(a)1 and 10-103(a)2 that demonstrates, using an approved calculation method, that the building has been designed so that its source energy budget and TDV energy budget do not exceed the standard design for the applicable climate zone.
2. Field verification of individual dwelling unit systems. When performance of installed features, materials, components, manufactured devices or systems above the minimum specified in Section 170.2 is necessary for the building to comply with Section 170.1, or is necessary to achieve a more stringent local ordinance,

field verification shall be performed in accordance with the applicable requirements in the following subsections, and the results of the verification(s) shall be documented on applicable Certificates of Installation pursuant to Section 10-103(a)3 and applicable Certificates of Verification pursuant to Section 10-103(a)5.

A. EER/EER2/SEER/SEER2/CEER/HSPF/HSPF2 Rating. When performance compliance requires installation of a space-conditioning system with a rating that is greater than the minimum rating required by Table 170.2-K or specified for the standard design, the installed system shall be field verified in accordance with the procedures specified in the applicable sections of Reference Residential Appendix RA3.

B. Variable capacity heat pump (VCHP) compliance option. When performance compliance requires installation of a heat pump system that meets all the requirements of the VCHP compliance option specified in the ACM Reference Manual, the system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.4.4.3.

C. Low leakage air handler. When performance compliance requires installation of a low leakage air-handling unit, the installed air handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

D. Reserved.

E. Heat pump—rated heating capacity. When performance compliance requires installation of a heat pump system, the heating capacity values at 47°F and 17°F shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.2.

F. Whole-house fan. When performance compliance requires installation of a whole-house fan, the whole-house fan ventilation airflow rate and fan efficacy shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.9.

G. Central fan ventilation cooling system. When performance compliance requires installation of a central fan ventilation cooling system, the installed system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.3.4.

H. Dwelling unit enclosure air leakage. When performance compliance requires a building enclosure leakage rate that is lower than the standard design, the building enclosure shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.8.

I. Quality insulation installation (QII). When performance compliance requires field verification of QII, the building insulation system shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.5.

J. Precooling. When performance compliance requires field verification of the installation and programming of a precooling thermostat, it shall be field verified in accordance with the procedures in Reference Residential Appendix RA3.4.5.

NOTE: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8 and 25943, *Public Resources Code*.

SECTION 170.2
PRESCRIPTIVE APPROACH

Multifamily buildings, including both dwelling units and common use areas, that comply with the prescriptive standards shall be designed, constructed and equipped to meet all of the requirements for the appropriate climate zone shown in Table 170.2-A. In Table 170.2-A, NA (not allowed) means that feature is not permitted in a particular climate zone and NR (no requirement) means that there is no prescriptive requirement for that feature in a particular climate zone. Installed components shall meet the following requirements:

(a) **Envelope component requirements**.

1. **Exterior roofs and ceilings**. Exterior roofs and ceilings shall comply with each of the applicable requirements in this subsection:

   A. Roofing products. All roofing products shall meet the requirements of Section 110.8 and the applicable minimum aged solar reflectance and thermal emittance requirements of Table 170.2-A.

   Exception 1 to Section 170.2(a)1A: 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 170.2(a)1A: Roof constructions with a weight of at least 25 lb/ft² are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

   B. Roof insulation. roofs shall have an overall assembly *U*-factor no greater than the applicable value in Table 170.2-A, meeting i, ii, iii or iv below. Where required by Sections 110.8 and 160.1(a), insulation shall be placed in direct contact with a continuous roof or drywall ceiling.

      i. Option A: Reserved.

      ii. Option B: A minimum *R*-value of insulation installed between the roof rafters in contact with the roof deck and an additional layer of ceiling insulation located between the attic and the conditioned space when meeting Section 170.2(c)3Biia; or

iii. Option C: A minimum *R*-value of ceiling insulation located between the attic and the conditioned space when meeting Section 170.2(c)3Biib.

iv. Option D: A minimum *U*-factor for roof assemblies above conditioned space without attic space.

C. Radiant barrier. A radiant barrier required in Table 170.2-A shall meet the requirements specified in Section 110.8(j), and shall meet the installation criteria specified in Reference Residential Appendix RA4**.**

2. **Wall insulation.**

A. Exterior walls shall have an overall assembly *U*-factor no greater than the applicable value in Table 170.2-A.

B. Demising walls shall meet the requirements of Section 160.1(b)7. Vertical windows in demising walls between conditioned and unconditioned spaces shall have an area-weighted average *U*-factor no greater than the applicable value in Table 170.2-A.

3. **Fenestration.**

A. Vertical fenestration and glazed doors in exterior walls shall comply with Subsections i, ii and iii:

i. Percent fenestration area shall be limited in accordance with the applicable requirements of a and b below:

a. A total fenestration area no greater than 20 percent of the conditioned floor area; and

b. A total fenestration area no greater than 40 percent of the gross exterior wall area.

NOTE: Demising walls are not exterior walls, and therefore demising wall area is not part of the gross exterior wall area, and fenestration in demising walls is not part of the fenestration area limitation.

ii. Fenestration properties. Installed fenestration products, including glazed doors, shall have an area-weighted average *U*-factor, relative solar heat gain coefficient (RSHGC) and visual transmittance (VT) meeting the applicable fenestration values in Table 170.2-A and shall be determined in accordance with Sections 110.6(a)2 and 110.6(a)3.

Vertical fenestration in demising walls between conditioned and unconditioned spaces is only required to comply with the area-weighted average *U*-factor requirement in Table 170.2-A.

Exception 1 to Section 170.2(a)3Aii: For each dwelling unit, up to 3 square feet of new glazing area installed in doors shall not be required to meet the *U*-factor and RSHGC requirements of Table 170.2-A.

Exception 2 to Section 170.2(a)3Aii: For fenestration containing chromogenic type glazing:

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

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

c. Area-weighted averaging with other fenestration that is not chromatic shall not be permitted and shall be determined in accordance with Section 110.6(a).

Exception 3 to Section 170.2(a)3Aii: For dwelling units containing unrated site-built fenestration that meets the maximum area restriction, the *U*-factor and SHGC can be determined in accordance with Nonresidential Reference Appendix NA6 or using default values in Table 110.6-A and Table 110.6-B.

Exception 4 to Section 170.2(a)3Aii: Fenestration in dwelling units of buildings that are three habitable stories or fewer in Climate Zones 1, 3, 5 and 16 is not required to comply with the RSHGC requirements.

Exception 5 to Section 170.2(a)3Aii: Fenestration in dwelling units of buildings that are three habitable stories or fewer is not required to comply with the VT requirements.

iii. Shading. Where Table 170.2-A requires a maximum RSHGC, the requirements shall be met with an area-weighted average RSHGC excluding the effects of interior shading, no greater than the applicable value in Table 170.2-A.

For the purposes of this paragraph, the RSHGC of a vertical window is:

a. The solar heat gain coefficient of the window; or

b. Relative solar heat gain coefficient is calculated using Equation 170.2-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 170.2(a)3Aiiib: An area-weighted average relative solar heat gain coefficient of 0.56 or less shall be used for windows:

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

II. For which codes restrict the use of overhangs to shade the windows.

Exception 2 to Section 170.2(a)3Aiiib: For vertical glazing 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; and

II. chromogenic glazing shall be considered separately from other glazing; and

III. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

NOTE: Demising walls are not exterior walls, and therefore fenestration in demising walls is not subject to SHGC requirements.

$$RSHGC = SHGC \times [1 + a \times (2.72^{-PF} - 1) \times (\sin(b \times Az) + c)]$$ **(Equation 170.2-A)**

where:

	a	b	c
Overhang	0.150	0.008727	5.67
Exterior Horizontal Slat	0.144	0.008727	5.13

RSHGC = Relative solar heat gain coefficient.

SHGC = Solar heat gain coefficient of the vertical fenestration.

Az = Azimuth of the vertical fenestration in degrees.

PF = Projection factor as calculated by Equation 140.3-D.

iv. Vertical fenestration shall have an area-weighted average visible transmittance (VT) no less than the applicable value in Table 170.2-A, or Equation 170.2-B, as applicable.

Exception 1 to Section 170.2(a)3Aiv: When the window's primary and secondary sidelit daylit zones are completely overlapped by one or more skylit daylit zones, then the window need not comply with Section 170.2(a)3Aivw.

Exception 2 to Section 170.2(a)3Aiv: If the window's VT is not within the scope of NFRC 200 or ASTM E972, then the VT shall be calculated according to Reference Nonresidential Appendix NA6.

Exception 3 to Section 170.2(a)3Aiv: For vertical windows containing chromogenic type glazing:

a. The higher rated 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;

b. Chromogenic glazing shall be considered separately from other glazing; and

c. Area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

Exception 4 to Section 170.2(a)3Aiv: Fenestration in dwelling units of buildings that are three habitable stories or fewer is not required to comply with the VT requirements.

NOTE: Demising walls are not exterior walls, and therefore windows in demising walls are not subject to VT requirements.

$$VT \geq 0.11/WWR$$ **(Equation 170.2-B)**

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 170.2-B.

VT = Visible transmittance of framed window.

B. **Skylights shall:**

i. Have an area no greater than 5 percent of the gross exterior roof area Skylight Roof Ratio (SRR); and

Exception 1 to Section 170.2(a)3Bi: Buildings with an atrium over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

ii. Have an area-weighted performance rating *U*-factor no greater than the applicable value in Table 170.2-A.

Exception 2 to Section 170.2(a)3Bii: For each dwelling unit up to 16 square feet of new skylight area with a maximum U-factor of 0.55 and a maximum SHGC of 0.30.

iii. Solar heat gain coefficient. Have an area-weighted performance rating solar heat gain coefficient no greater than the applicable value in Table 170.2-A.

Exception to Sections 170.2(a)3Bii and 170.2(a)3Biii: For skylights containing chromogenic type glazing:

a. the lower-rated labeled SHGC 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

b. chromogenic glazing shall be considered separately from other glazing; and

c. area-weighted averaging with other glazing that is not chromogenic shall not be permitted.

iv. Haze value. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D1003 or other test method approved by the Energy Commission.

Exception to Section 170.2(a)3Biv: Skylights designed and installed to exclude direct sunlight entering the occupied space by the use of fixed or

C. HVAC system bypass ducts. Bypass ducts that deliver conditioned supply air directly to the space-conditioning system return duct airflow shall not be used.

4. Common use area 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 O.

A. Fan systems. Each fan system moving air into, out of, or between spaces or circulating air for the purpose of conditioning air within a space shall meet the requirements of Items i, ii and iii below.

i. Fan power budget. For each fan system that includes at least one fan or fan array with fan electrical input power ≥ 1 kW, fan system electrical input power (Fan $kW_{design,system}$) determined per Section 170.2(c)4Aib at the fan system design airflow shall not exceed Fan kW_{budget} as calculated per Section 170.2(c)4Aia.

a. Calculation of fan power budget (Fan kW_{budget}). For each fan system:

I. Determine the fan system airflow and choose the appropriate table(s) for fan power allowance.

A. For single-cabinet fan systems, use the fan system airflow and the power allowances in both Tables 170.2-B and Table 170.2-C.

B. For supply-only fan systems, use the fan system airflow and power allowances in Table 170.2-B.

C. For relief fan systems, use the design relief airflow and the power allowances in Table 170.2-C.

D. For exhaust, return and transfer fan systems, use the fan system airflow and the power allowances in Table 170.2-C.

E. For complex fan systems, separately calculate the fan power allowance for the supply and return/exhaust systems and sum them. For the supply airflow, use supply airflow at the fan system design conditions, and the power allowances in Table 170.2-B. For the return/exhaust airflow, use return/exhaust airflow at the fan system design conditions, and the power allowances in Table 170.2-C.

II. For each fan system, determine the components included in the fan system and sum the fan power allowances of those components. All fan systems shall include the system base allowance. If, for a given component, only a portion of the fan system airflow passes through the component, calculate the fan power allowance for that component per this equation:

$$FPA_{adj} = \frac{Q_{comp}}{Q_{sys}} \times FPA_{comp}$$

where:

FPA_{adj} = The correct/ed fan power allowance for the component in W/cfm.

Q_{comp} = The airflow through component in cfm.

Q_{sys} = The fan system airflow in cfm.

FPA_{comp} = The fan power allowance of the component from Table 170.2-B or Table 170.2-C.

III. Multiply the fan system airflow by the sum of the fan power allowances for the fan system.

IV. Divide by 1000 to convert to Fan kW_{budget}.

V. For building sites at elevations greater than 3,000 feet, multiply Fan kW_{budget} by the correction factor in Table 170.2-D.

b. Determining fan system electrical input power (Fan $kW_{design,system}$). Fan $kW_{design,system}$ is the sum of Fan kW_{design} for each fan or fan array included in the fan system with Fan $kW_{design} \geq 1$ kW. If variable speed drives are used, their efficiency losses shall be included. Fan input power shall be calculated with two times the clean filter pressure drop, which is the mean of the clean filter pressure drop and design final filter pressure drop. The Fan kW_{design} for each fan or fan array shall be determined using one of the following methods. There is no requirement to use the same method for all fans in a fan system:

I. Use the default Fan kW_{design} in Table 170.2-E-1 for one or more of the fans. This method cannot be used for complex fan systems.

II. Use the Fan kW_{design} at fan system design conditions provided by the manufacturer of the fan, fan array, or equipment that includes the fan or fan array calculated per a test procedure included in USDOE 10 CFR Part 430, USDOE 10 CFR Part 431, ANSI/AMCA Standard 208-2018, ANSI/AMCA Standard 210-2016, AHRI Standard 430-2020, AHRI Standard 440-2019 or ISO 5801-2017.

III. Use the Fan kW_{design} provided by the manufacturer, calculated at fan system design

conditions per one of the methods listed in Section 5.3 of ANSI/AMCA 208-2018.

IV. Determine the Fan kW_{design} by using the maximum electrical input power provided on the motor nameplate.

ii. VAV systems.

a. Static pressure sensor location. Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller setpoint is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with Section 170.2(c)4Aiib. If this results in the sensor being located downstream of any major duct split, multiple sensors shall be installed in each major branch with fan capacity controlled to satisfy the sensor furthest below its setpoint; and

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

iii. Fractional HVAC motors for fans. HVAC motors for fans that are less than 1 hp and $^1/_{12}$ hp or greater shall be electronically commutated motors or shall have a minimum motor efficiency of 70 percent when rated in accordance with NEMA Standard MG 1-2006 at full load rating conditions. These motors shall also have the means to adjust motor speed for either balancing or remote control. Belt-driven fans may use sheave adjustments for airflow balancing in lieu of a varying motor speed.

Exception 1 to Section 170.2(c)4Aiii: Motors in fan-coils and terminal units that operate only when providing heating to the space served.

Exception 2 to Section 170.2(c)4Aiii: Motors in space-conditioning equipment certified under Section 110.1 or 110.2.

Exception 1 to 170.2(c)4A: Fan system power caused solely by process loads.

B. **Space-conditioning zone controls.** Each space-conditioning zone shall have controls designed in accordance with i or ii:

i. Each space-conditioning zone shall have controls that prevent:

a. Reheating; and

b. Recooling; and

c. 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; or

ii. Zones served by variable air-volume systems that are designed and controlled to reduce, to a minimum, the volume of reheated, recooled or mixed air are allowed only if the controls meet all of the following requirements:

a. For each zone with direct digital controls (DDC), the volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of:

I. 50 percent of the peak primary airflow; or

II. The design zone outdoor airflow rate as specified by Section 160.2(c)3.

b. The volume of primary air in the deadband shall not exceed the design zone outdoor airflow rate as specified by Section 160.2(c)3.

c. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95ºF while the airflow is maintained at the deadband flow rate.

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

e. For each zone without DDC, the volume of primary air that is reheated, recooled or mixed air supply shall not exceed the larger of the following:

I. 30 percent of the peak primary airflow; or

II. The design zone outdoor airflow rate as specified by Section 160.2(c)3.

Exception 1 to Section 170.2(c)4B: Zones with special pressurization relationships or cross-contamination control needs.

Exception 2 to Section 170.2(c)4B: Zones served by space-conditioning systems in which at least 75 percent of the energy for reheating, or providing warm air in mixing systems, is provided from a site-recovered or site-solar energy source.

Exception 3 to Section 170.2(c)4B: Zones in which specific humidity levels are required to satisfy exempt process loads. Computer rooms or other spaces where the only process load is from IT equipment may not use this exception.

Exception 4 to Section 170.2(c)4B: Zones with a peak supply-air quantity of 300 cfm or less.

TABLE 170.2-E-1
DEFAULT VALUES FOR FAN KW_{DESIGN} BASED ON MOTOR NAMEPLATE HP

MOTOR NAMEPLATE HP	DEFAULT FAN KW_{DESIGN} WITH VARIABLE SPEED DRIVE (FAN KW_{DESIGN})	DEFAULT FAN KW_{DESIGN} WITHOUT VARIABLE SPEED DRIVE (FAN KW_{DESIGN})
<1	0.96	0.89
≥1 and <1.5	1.38	1.29
≥1.5 and <2	1.84	1.72
≥2 and <3	2.73	2.57
≥3 and <5	4.38	4.17
≥5 and <7.5	6.43	6.15
≥7.5 and <10	8.46	8.13
≥10 and <15	12.47	12.03
≥15 and <20	16.55	16.04
≥20 and <25	20.58	19.92
≥25 and <30	24.59	23.77
≥30 and <40	32.74	31.70
≥40 and <50	40.71	39.46
≥50 and <60	48.50	47.10
≥60 and <75	60.45	58.87
≥75 and ≤100	80.40	78.17

1. This table cannot be used for motor nameplate horsepower values greater than 100.
2. This table is to be used only with motors with a service factor ≤1.15. If the service factor is not provided, this table may not be used.

C. **Economizers**.

i. Each cooling air handler that has a design total mechanical cooling capacity over 33,000 Btu/hr, or chilled-water cooling systems without a fan or that use induced airflow that has a cooling capacity greater than the systems listed in Table 170.2-E-2, shall include either:

a. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside air; or

b. A water economizer capable of providing 100 percent of the expected system cooling load, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

Exception 1 to Section 170.2(c)4Ci: Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

Exception 2 to Section 170.2(c)4Ci: Where the use of outdoor air for cooling will affect other systems, such as humidification or dehumidification, so as to increase overall building TDV energy use.

Exception 3 to Section 170.2(c)4Ci: Systems serving dwelling units.

Exception 4 to Section 170.2(c)4Ci: Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in Table 170.2-F.

Exception 5 to Section 170.2(c)4Ci: Fan systems primarily serving computer rooms. See Section 140.9(a) for computer room economizer requirements.

TABLE 170.2-E-2
CHILLED WATER SYSTEM COOLING CAPACITY

CLIMATE ZONES	TOTAL BUILDING CHILLED WATER SYSTEM CAPACITY, MINUS CAPACITY OF THE COOLING UNITS WITH AIR ECONOMIZERS	
	Building Water-Cooled Chilled Water System	Air-Cooled Chilled Water Systems or District Chilled Water Systems
15	≥960,000 Btu/h (280 kW)	≥1,250,000 Btu/h (365 kW)
1–14	≥720,000 Btu/h (210 kW)	≥940,000 Btu/h (275 kW)
16	≥1,320,000 Btu/h (385 kW)	≥1,720,000 Bu/h (505 kW)

TABLE 170.2-F
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 annualized or part-load metric, then to eliminate the required economizer, only the annualized or part-load minimum cooling efficiency of the unit must be increased by the percentage shown. If the unit is only rated with a full load metric, like EER or COP cooling, then that metric must be increased by the percentage shown. To determine the efficiency required to eliminate economizer, when the unit equipment efficiency is rated with an energy-input divided by work-output metric, the metric shall first be converted to COP prior to multiplying by the efficiency improvement percentage and then converted back to the rated metric.

ii. If an economizer is required by Section 170.2(c)4Ci, and an air economizer is used to meet the requirement, then 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 170.2(c)4Ciia: 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.

c. Designed and equipped with a device type and high limit shut off complying with Table 170.2-G.

iii. The air economizer and all air dampers 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, has been tested and is able to open and close against the rated airflow and pressure of the system for 60,000 damper opening and closing cycles.

TABLE 170.2-G
AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

DEVICE TYPE[a]	CLIMATE ZONES	REQUIRED HIGH LIMIT (Economizer Off When):	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
Fixed Dry Bulb	2, 4, 10	$T_{OA} > 73°F$	Outdoor air temperature exceeds 73°F
Fixed Dry Bulb	6, 8, 9	$T_{OA} > 71°F$	Outdoor air temperature exceeds 71°F
Fixed Dry Bulb	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
Differential Dry Bulb	2, 4, 10	$T_{OA} > T_{RA}–2°F$	Outdoor air temperature exceeds return air temperature minus 2°F
Differential Dry Bulb	6, 8, 9	$T_{OA} > T_{RA}–4°F$	Outdoor air temperature exceeds return air temperature minus 4°F
Differential Dry Bulb	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 170.2(c)4Ci 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.

are within the thermostat deadband to provide destratification and air mixing in the space.

iv. The DOAS supply air shall be delivered directly to the occupied space or downstream of the terminal heating or cooling coils.

Exception 1 to Section 170.2(c)4Niv: Active chilled beam systems.

Exception 2 to Section 170.2(c)4Niv: Sensible only cooling terminal units with pressure-independent variable-airflow regulating devices limiting the DOAS supply air to the greater of latent load or minimum ventilation requirements.

Exception 3 to Section 170.2(c)4Niv: Terminal heating or cooling units that comply with the low fan power allowance requirements in Exception 6 to Section 170.2(c)4Niii.

v. DOAS with mechanical cooling providing ventilation to multiple zones and operating in conjunction with zone heating and cooling systems shall not use heating or heat recovery to warm supply air above 60°F when representative building loads or outdoor air temperature indicate that the majority of zones require cooling.

vi. DOAS with a total fan system power less than 1 kW shall not exceed a total combined fan power of 1.0 W/cfm. DOAS with fan power greater than or equal to 1 kW shall meet the requirements of Section 170.2(c)4A.

O. **Exhaust air heat recovery.** Fan systems designed to operate to the criteria listed in either Table 170.2-I or Table 170.2-J shall include an exhaust air heat recovery system that meets the following:

i. A sensible energy recovery ratio of at least 60 percent or an enthalpy recovery ratio of at least 50 percent for both heating and cooling design conditions.

ii. Energy recovery bypass or control to disable energy recovery and to directly economize with ventilation air based on outdoor air temperature limits specified in Table 170.2-G. For energy recovery systems where the transfer of energy cannot be stopped, bypass shall prevent the total airflow rate of either outdoor air or exhaust air through the energy recovery exchanger from exceeding 10 percent of the full design airflow rate.

iii. For a DOAS unit and a separate independent space-conditioning system meeting the requirements of Section 170.2(c)4Nia, the design supply fan airflow rate shall be the total airflow of only the DOAS unit.

Exception to Section 170.2(c)4Oii: DOAS units with the capability to shut off when a separate independent space-conditioning system meets the economizer requirements specified by Section 170.2(c)4Cia is economizing.

Exception 1 to Section 170.2(c)4O: Systems meeting Section 140.9(c) prescriptive requirements for laboratory and factory exhaust systems.

Exception 2 to Section 170.2(c)4O: Systems serving spaces that are not cooled and that are heated to less than 60°F.

Exception 3 to Section 170.2(c)4O: Where more than 60 percent of the outdoor air heating energy is provided from site-recovered energy in Climate Zone 16.

Exception 4 to Section 170.2(c)4O: Sensible recovery ratio requirements at heating design conditions are exempted for Climate Zone 15.

Exception 5 to Section 170.2(c)4O: Sensible recovery ratio requirements at cooling design conditions are exempted for Climate Zone 1.

Exception 6 to Section 170.2(c)4O: Where the sum of the airflow rates exhausted and relieved within 20 feet of each other is less than 75 percent of the design outdoor airflow rate, excluding exhaust air that is either:

i. used for another energy recovery system;

ii. not allowed by the *California Mechanical Code* (Title 24, Part 4) for use in energy recovery systems with leakage potential; or

iii. of Class 4 as specified in Section 160.2(c)8.

Exception 7 to Section 170.2(c)4O: Systems expected to operate less than 20 hours per week.

(d) **Water-heating systems.** Water-heating systems shall meet the requirements of either 1, 2, 3 or 4.

For recirculation distribution systems serving individual dwelling units, only demand recirculation systems with manual on/off control as specified in the Reference Appendix RA4.4.9 shall be used. Recirculation system serving multiple dwelling units shall meet the requirements of Sections 110.3(c)2 and 110.3(c)5, and shall be capable of automatically controlling the recirculation pump operation based on measurement of hot water demand and hot water return temperature:

1. For systems serving individual dwelling units, the water-heating system shall meet the requirement of either A, B or C, or shall meet the performance compliance requirements of Section 170.1:

A. A single 240 volt heat pump water heater. In addition, meet the following:

i. A compact hot water distribution system as specified in Reference Appendix RA4.4.6 in Climate Zones 1 and 16; and

ii. A drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9 in Climate Zone 16.

B. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher. In addition, for Climate Zone 16, a drain water heat recovery system that is field verified as specified in Reference Appendix RA3.6.9.

C. A gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank.

2. For heat pump water-heating systems serving multiple dwelling units, the water-heating system shall be installed according to the manufacturer's design and installation guidelines and meet the following requirements:

A. The hot water return from the recirculation loop shall connect to a recirculation loop tank and shall not directly connect to the primary heat pump water heater inlet or the primary thermal storage tanks.

B. The fuel source for the recirculation loop tank shall be electricity if auxiliary heating is needed. The recirculation loop heater shall be capable of multi-pass water-heating operation.

C. For systems with single pass primary heat pump water heater, the primary thermal storage tanks shall be piped in series if multiple tanks are used. For systems with multi-pass primary heat pump water heater, the primary thermal storage tanks shall be piped in parallel if multiple tanks are used.

D. The primary storage tank temperature setpoint shall be at least 135°F.

E. The recirculation loop tank temperature setpoint shall be at least 10°F lower than the primary thermal storage tank temperature setpoint such that hot water from the recirculation loop tank is used for the temperature maintenance load before engaging the recirculation loop tank heater.

F. The minimum heat pump water heater compressor cut-off temperature shall be equal to or lower than 40°F ambient air temperature.

G. A recirculation system.

Exception to Section 170.2(d)2G: Buildings with eight or fewer dwelling units.

H. Design documentation shall be provided in accordance with JA14.4.

3. For gas or propane systems serving multiple dwelling units, a central water-heating system that includes the following components shall be installed:

A. For Climate Zones 1 through 9, gas service water-heating systems with a total installed gas water-heating input capacity of 1 MMBtu/h or greater shall have gas service water-heating equipment with a minimum thermal efficiency of 90 percent. Multiple units are allowed to meet this requirement with an input capacity-weighted average of at least 90 percent.

Exception 1 to Section 170.2(d)3A: Individual gas water heaters with input capacity at or below 100,000 Btu/h shall not be included in the calculations of the total system input or total system efficiency.

Exception 2 to Section 170.2(d)3A: If 25 percent of the annual water-heating requirement is provided by site-solar energy or site-recovered energy.

B. A recirculation system.

Exception to Section 170.2(d)3B: Buildings with eight or fewer dwelling units.

C. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of either i or ii below:

i. 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; or

ii. A minimum solar savings fraction of 0.15 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.30 in Climate Zones 10 through 16. In addition, a drain water heat recovery system that is field verified as specified in the Reference Appendix RA3.6.9.

4. A water-heating system serving multiple dwelling units determined by the Executive Director to use no more energy than the one specified in Subsection 1, 2 or 3 above.

(e) **Lighting.** Dwelling unit lighting shall meet the applicable mandatory requirements of Section 160.5(a). Common use area lighting shall meet the following requirements:

Exception to Section 170.2(e): Common use areas providing shared provisions for living, eating, cooking or sanitation to dwelling units that would otherwise lack these provisions may instead comply with Section 160.5(a).

1. **Interior common use area lighting.** A building complies with Section 170.2(e)1 if:

A. The calculation of adjusted indoor lighting power of all proposed building areas combined, calculated under Subsection 170.2(e)2, is no greater than the calculation of allowed indoor lighting power, specific methodologies calculated under Subsection 170.2(e)4; and

B. The calculation of allowed indoor lighting power, general rules comply with Subsection 170.2(e)3.

The prescriptive limits on indoor lighting power are the smaller of the actual and allowed indoor lighting power values determined in accordance with Item i.

or less shall have a luminaire aperture no wider than 8 inches.

b. Color changing. Qualifying tunable-white luminaires shall be capable of a color change greater than or equal to 2000 Kelvin correlated color temperature (CCT). Qualifying dim-to-warm luminaires shall be capable of color change greater than or equal to 500 Kelvin CCT.

c. Controls. Qualifying luminaires shall be connected to controls that allow color changing of the luminaires.

iii. Tailored Method Display Lighting Mounting Height Lighting Power Adjustment. For wall display luminaires or floor display luminaires meeting the Tailored Method described in Sections 170.2(e)1Ciig and h and where the bottom of luminaires are 10 feet 7 inches and greater above the finished floor, the adjusted indoor lighting power of these luminaires shall be calculated by multiplying their maximum rated wattage and the appropriate mounting height adjustment factor from Table 170.2-O. Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire. General lighting shall not qualify for a mounting height multiplier.

3. **Calculation of allowed indoor lighting power: general rules.**

A. The allowed indoor lighting power allotment for conditioned areas shall be calculated separately from the allowed lighting power allotment for unconditioned areas. Each allotment is applicable solely to the area to which it applies, and there shall be no trade-offs between conditioned and unconditioned area allotments.

B. The allowed indoor lighting power allotment shall be calculated separately from the allowed outdoor lighting power allotment. Each allotment is applicable solely to the area to which it applies, and there shall be no trade-offs between the separate indoor and outdoor allotments.

C. The allowed indoor lighting power allotment for general lighting shall be calculated as follows:

i. The Area Category Method, as described in Section 170.2(e)1Ci, shall be used either by itself for all common use areas in the building, or when some areas in the building use the Tailored Method described in Section 170.2(e)1Cii. Under the Area Category Method (either by itself or in conjunction with the Tailored Method), as described more fully in Section 170.2(e)1Ci, and subject to the adjustments listed there, the allowed indoor lighting power allotment for general lighting shall be calculated for each area in the building as follows:

a. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in Table 170.2-M (or Table 170.2-N if the Tailored Method is used for that area).

b. For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in Table 170.2-M (or Table 170.2-N if the Tailored Method is used for that area).

The allowed indoor lighting power allotment for general lighting for one area for which the Area Category Method was used may be increased up to the amount that the allowed indoor lighting power allotment for general lighting for another area using the Area Category Method or Tailored Method is decreased, except that such increases and decreases shall not be made between conditioned and unconditioned space.

D. The tailored method, as described in Section 170.2(e)1Cii, shall be used either by itself for all areas in the building, or when some areas in the building use the Area Category Method described in Section 170.2(e)1Ci. Under the Tailored Method (either by itself or in conjunction with the Area Category Method) as described more fully in Section 170.2(e)1Cii, and subject to the adjustments listed there, allowed indoor lighting power allotment for general lighting shall be calculated for each area in the building as follows:

i. For conditioned areas, by multiplying the conditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in Table 170.2-N (or Table 170.2-M if the Area Category Method is used for that area);

ii. For unconditioned areas, by multiplying the unconditioned square feet of the area times the applicable allotment of watts per square foot for the area shown in Table 170.2-L (or Table 170.2-M if the Area Category Method is used for that area).

E. The allowed indoor lighting power allotment for general lighting for one area for which the Tailored Method was used may be increased up to the amount that the allowed indoor lighting power for general lighting for another area is decreased, but only if the Tailored Method or Area Category Method was used for the other area, except that such increases and decreases shall not be made between conditioned and unconditioned space.

F. If the Area Category Method is used for an area, the Tailored Method may not be used for that area. If the Tailored Method is used for an area, the Area Category Method may not be used for that area.

4. **Calculation of allowed indoor lighting power: specific methodologies.** The allowed indoor lighting power for each common use primary function area shall

be calculated using only one of the methods in Subsection i, ii or iii below as applicable.

A. Area Category Method. Requirements for using the Area Category Method include all of the following:

i. The Area Category Method shall be used only for primary function areas, as defined in Section 100.1, that are listed in Table 170.2-M. For primary function areas not listed, selection of a reasonably equivalent type shall be permitted.

ii. For purposes of compliance with Section 170.2(e)1Ci, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Table 170.2-M.

iii. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a primary function area.

iv. The allowed indoor lighting power for each primary function area is the Lighting Power Density value in Table 170.2-M times the square feet of the primary function area. The total allowed indoor lighting power for the building is the sum of all allowed indoor lighting power for all areas in the building.

v. In addition to the allowed indoor lighting power calculated according to Sections 170.2(e)1Cia through f, the building may add additional lighting power allowances for qualifying lighting systems as specified in the Qualifying Lighting Systems column in Table 170.2-M under the following conditions:

a. Only primary function areas having a lighting system as specified in the Qualifying Lighting Systems column in Table 170.2-M and in accordance with the corresponding footnote of the table shall qualify for the additional lighting power allowances; and

b. The additional lighting power allowances shall be used only if the plans clearly identify all applicable task areas and the lighting equipment designed to illuminate these tasks; and

c. Tasks that are performed less than 2 hours per day or poor quality tasks that can be improved are not eligible for the additional lighting power allowances; and

d. The additional lighting power allowances shall not utilize any type of luminaires that are used for general lighting in the building; and

e. The additional lighting power allowances shall not be used when using the Complete Building Method, or when the Tailored Method is used for any area in the building; and

f. The additional lighting power allowed is the smaller of:

I. the lighting power density listed in the "Allowed Additional Lighting LPD" column in Table 170.2-M, times the square feet of the primary function, or

II. the adjusted indoor lighting power of the applicable lighting; and

B. Tailored Method. Requirements for using the Tailored Method include all of the following:

i. The Tailored Method shall be used only for primary function areas listed in Table 170.2-N as defined in Section 100.1.

ii. Allowed indoor lighting power allotments for general lighting shall be determined according to Section 170.2(e)1Ciif, as applicable.

iii. For compliance with Section 170.2(e)1Cii, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Table 170.2-N.

iv. Where areas are bounded or separated by interior partitions, the floor area occupied by those interior partitions may be included in a primary function area.

v. In addition to the allowed indoor lighting power allotments for general lighting calculated according to Section 170.2(e)1Ciif, as applicable, the building may add additional lighting power allowances for wall display lighting, task lighting and decorative/special effects lighting, according to Sections 170.20(e)1Ciig through j.

vi. Determine allowed indoor lighting power allotments for general lighting for primary function areas listed in Table 170.2-N as follows:

a. Use the general illumination level (lux) listed in column 2 of Table 170.2-N to determine the allowed general lighting power density allotments for the area.

b. Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in Table 170.2-P.

c. Find the allowed general lighting power density allotment in Table 170.2-Q that is applicable to the general illuminance level (lux) from column 2 of Table 170.2-N (as described in Item i) and the RCR determined in accordance with Table 170.2-P (as described in Item ii).

d. Determine the square feet of the area in accordance with Sections 170.2(e)1Ciic and d.

e. Multiply the allowed lighting power density allotment, as determined in accordance with Item iii by the square feet of each primary function area, as determined in accordance with Item iv. The product is the allowed

SUBCHAPTER 12

MULTIFAMILY BUILDINGS—ADDITIONS, ALTERATIONS AND REPAIRS TO EXISTING MULTIFAMILY BUILDINGS

SECTION 180.0 GENERAL

Additions, alterations and repairs to existing attached dwelling units and common use areas in multifamily buildings, existing outdoor lighting for these occupancies, and internally and externally illuminated signs shall meet the requirements specified in Sections 100.0 through 110.10, 160.1, and 160.3 through 170.2 that are applicable to the building project, and either the performance compliance approach (energy budgets) in Section 180.1(b) (for additions) or 180.2(c) (for alterations), or the prescriptive compliance approach in Section 180.1(a) (for additions) or 180.2(b) (for alterations), for the climate zone in which the building is located. Climate zones are shown in Figure 100.1-A.

Covered process requirements for additions, alterations and repairs to existing multifamily buildings are specified in Section 141.1.

Nonresidential occupancies in mixed occupancy buildings shall comply with nonresidential requirements in Sections 120.0 through 141.1.

NOTE: For alterations that change the occupancy classification of the building, the requirements specified in Section 180.2 apply to the occupancy after the alterations.

NOTE: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8 and 25943, *Public Resources Code*.

SECTION 180.1 ADDITIONS

Additions to existing multifamily buildings shall meet the applicable requirements of Sections 110.0 through 110.9; Sections 160.0, 160.1, and 160.2(c) and (d); Sections 160.3 through 160.7; and either Section 180.1(a) or 180.1(b).

Exception 2 to Section 180.1: Additions of 300 square feet or less are exempt from the roofing product requirements of Section 170.2(a)1A.

Exception 3 to Section 180.1: Existing inaccessible piping shall not require insulation as defined under Section 160.4(f)2Aiii.

Exception 4 to Section 180.1: Space-conditioning system. When heating or cooling will be extended to an addition from the existing system(s), the existing heating and cooling equipment need not comply with Part 6. The heating system capacity must be adequate to meet the minimum requirements of CBC Section 1204.1.

Exception 5 to Section 180.1: Space-conditioning system ducts. When any length of 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 Sections 180.2(b)2Ai and 180.2(b)2Aii.

Exception 6 to Section 180.1: Photovoltaic and battery storage systems, as specified in Sections 170.2(f) through 170.2(h), are not required for additions.

Exception 7 to Section 180.1: Dwelling unit space heating system. New or replacement space heating systems serving an addition may be a heat pump or gas heating system.

(a) **Prescriptive approach.** The envelope and lighting of the addition; any newly installed space-conditioning or ventilation system, electrical power distribution system, or water-heating system; 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 110.12; 160.0, 160.1, and 160.2(c) and (d); and 160.3 through 170.2.

1. **Envelope.**
   A. Additions that are greater than 700 square feet shall meet the requirements of Section 170.2(a), with the following modifications:
      i. Framed walls extension. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing.
      ii. The maximum allowed fenestration area shall be the greater of 175 square feet or 20 percent of the addition floor area.
      iii. When existing siding of a wood-framed wall is not being removed or replaced, cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing shall be installed and continuous insulation is not required.
      iv. Additions that consist of the conversion of existing spaces from unconditioned to conditioned space shall not be required to perform the air sealing part of QII when the existing air barrier is not being removed or replaced.
   B. Additions that are 700 square feet or less shall meet the requirements of Section 170.2(a), with the following modifications.
      i. Roof and ceiling insulation in a ventilated attic shall meet one of the following requirements:
         a. In Climate Zones 1, 2, 4, and 8 through 16, achieve an overall assembly *U*-factor not exceeding 0.025. In wood framed assemblies, compliance with *U*-factors may be demonstrated by installing insulation with an *R*-value of R-38 or greater.

b. In Climate Zones 3 and 5 through 7, achieve an overall assembly *U*-factor not exceeding 0.031. In wood framed assemblies, compliance with *U*-factors may be demonstrated by installing insulation with an *R*-value of R-30 or greater.

ii. Radiant barrier. For buildings three habitable stories or less, radiant barriers shall be installed in attics with exposed attic deck undersides in Climate Zones 2–15.

iii. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 framing and R-21 in a 2x6 framing; and

iv. Fenestration products must meet the *U*-factor, RSGHC and VT requirements of Table 180.2-B.

v. Quality insulation installation (QII) requirements of Section 170.2(a)6 do not apply.

Exception to Section 180.1(a)1B: Insulation in an enclosed rafter ceiling shall meet the requirements of Section 160.1(a).

Exception to Section 180.1(a)1: Additions that increase the area of the roof by 2,000 square feet or less are exempt from the solar ready requirements of Section 160.8.

2. **Mechanical ventilation for indoor air quality.** Additions to existing buildings shall comply with Section 160.2 subject to the requirements specified in Subsections A and B below. When HERS field verification and diagnostic testing are required by Section 180.1(a)2, buildings with three habitable stories or fewer shall use the applicable procedures in the Residential Appendices, and buildings with four or more habitable stories shall use the applicable procedures in Nonresidential Appendices NA1 and NA2.

A. **Whole-dwelling unit mechanical ventilation**.

i. Dwelling units that meet the conditions in Subsection a or b below shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Section 160.2(b)2Aiv or 160.2(b)2Av.

a. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by less than or equal to 1,000 square feet.

b. Junior accessory dwelling units (JADU) that are additions to an existing building.

ii. Additions to an existing dwelling unit that increase conditioned floor area by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Section 160.2(b)2Aiv or 160.2(b)2Av, as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprising the existing dwelling unit conditioned floor area plus the addition conditioned floor area.

iii. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Section 160.2(b)2Aiv or 160.2(b)2Av as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

B. **Local mechanical exhaust**. Additions to existing buildings shall comply with all applicable requirements specified in Sections 160.2(b)2Avi and 160.2(b)2B.

3. **Water heater.** When additional water-heating equipment is installed to serve a dwelling unit as part of the addition, one of the following types of water heaters shall be installed:

A. A water-heating system that meets the requirements of Section 170.2(d); or

B. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item A above.

(b) **Performance approach.** Performance calculations shall meet the requirements of Sections 170.0 through 170.2(a), pursuant to the applicable requirements in Items 1, 2 and 3 below.

1. **For additions alone.** The addition complies if the addition alone meets the energy budgets as specified in Section 170.1.

2. **Existing plus alteration plus addition.** The standard design for existing plus alteration plus addition 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 180.2(c); plus the proposed addition's energy use meeting the requirements of Section 180.1(a). The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered components' energy features, plus the proposed energy features of the addition.

Exception to Section 180.1(b)2: Existing structures with a minimum R-11 insulation in framed walls showing compliance with Section 180.1(b) are exempt from showing compliance with Section 160.1(b).

3. **Mechanical ventilation for indoor air quality**. Additions to existing buildings shall comply with Section 160.2 subject to the requirements specified in Subsections A and B below. When HERS field verification and diagnostic testing are required by Section 180.1(b)3, buildings with three habitable stories or fewer shall use the applicable procedures in the Residential Appendices, and buildings with four or more habitable stories shall use the applicable procedures in Nonresidential Appendices NA1 and NA2.

A. **Whole-dwelling unit mechanical ventilation**.

i. Dwelling units that meet the conditions in Subsection a or b below shall not be required to comply with the whole-dwelling unit ventilation airflow specified in Section 160.2(b)2Aiv or 160.2(b)2Av.

a. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by less than or equal to 1000 square feet.

b. Junior accessory dwelling units (JADU) that are additions to an existing building.

ii. Additions to an existing dwelling unit that increase the conditioned floor area of the existing dwelling unit by more than 1,000 square feet shall have mechanical ventilation airflow in accordance with Section 160.2(b)2Aiv or 160.2(b)2Av as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprising the existing dwelling unit conditioned floor area plus the addition conditioned floor area.

iii. New dwelling units that are additions to an existing building shall have mechanical ventilation airflow provided in accordance with Section 160.2(b)2Aiv or 160.2(b)2Av as applicable. The mechanical ventilation airflow rate shall be based on the conditioned floor area of the new dwelling unit.

B. **Local mechanical exhaust**. Additions to existing buildings shall comply with all applicable requirements specified in Sections 160.2(b)2Avi and 160.2(b)2B.

NOTE: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, *Public Resources Code*. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8 and 25943, *Public Resources Code*.

SECTION 180.2
ALTERATIONS

Alterations to components of existing multifamily buildings, including alterations made in conjunction with a change in building occupancy to a multifamily occupancy, shall meet Item (a), and either Item (b) or (c) below:

Exception 1 to Section 180.2: When heating, cooling or service water heating for an alteration is provided by expanding existing systems, the existing systems and equipment need not comply with Sections 110.0 through 110.10; Sections 160.0 through 160.7; and Section 170.2(c) or 170.2(d).

Exception 2 to Section 180.2: When existing heating, cooling or service water-heating systems or components are moved within a building, the existing systems or components need not comply with Sections 110.0 through 110.10; Sections 160.0 through 160.7; and Section 170.2(c) or 170.2(d).

Exception 3 to Section 180.2: Where an existing system with electric reheat is expanded when adding variable air volume (VAV) boxes to serve an alteration, total electric reheat capacity may be expanded not to exceed 20 percent of the existing installed electric capacity in any one permit and the system need not comply with Section 170.2(b)4E. Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of Section 170.2(b)4E.

Exception 4 to Section 180.2: The requirements of Section 160.3(a)2H shall not apply to alterations of space-conditioning systems or components.

(a) **Mandatory requirements.** Altered components in a multifamily building shall meet the minimum requirements in this section.

1. **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 180.2(b)1B.
2. **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 A through D below:
   A. **Metal building.** A minimum of R-13 insulation between framing members, or the area-weighted average *U*-factor of the wall assembly shall not exceed U-0.113.
   B. **Metal framed.** A minimum of R-13 insulation between framing members, or the area-weighted average *U*-factor of the wall assembly shall not exceed U-0.217.
   C. **Wood framed and others.** A minimum of R-11 insulation between framing members, or the area-weighted average *U*-factor of the wall assembly shall not exceed U-0.110.
   D. **Spandrel panels and curtain walls.** A minimum of R-4, or the area-weighted average *U*-factor of the wall assembly shall not exceed U-0.280.

   Exception to Section 180.2(a)2: Light and heavy mass walls.
3. **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 A and B below:
   A. **Raised framed floors.** A minimum of R-11 insulation between framing members, or the area-weighted average *U*-factor of the floor assembly shall not exceed U-0.071.
   B. **Raised mass floors.** A minimum of R-6 insulation, or the area-weighted average *U*-factor of the floor assembly shall not exceed U-0.111.

(b) **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall

meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Sections 160.0, 160.1, 160.2(c) and (d), 160.3(a) through 160.3(b)5J, 160.3(b)6, 160.3(c) and 160.5; and

1. **Envelope.**

A. **Roof alterations**. Existing roofs being replaced, recovered or recoated of a multifamily building shall meet the requirements of Section 110.8(i). For roofs with more than 50 percent of the roof area or more than 2,000 square feet of roof, whichever is less, being altered, the requirements of i and iii below apply:

i. Low-sloped roofs in Climate Zones 2, 4, and 6 through 15 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75, or a minimum SRI of 75.

Exception to Section 180.2(b)1Ai: The aged solar reflectance requirement can be met by using insulation at the roof deck specified in Table 180.2-A.

TABLE 180.2-A
ROOF/CEILING INSULATION TRADEOFF FOR LOW-SLOPED AGED SOLAR REFLECTANCE

MINIMUM AGED SOLAR REFLECTANCE	ROOF DECK CONTINUOUS INSULATION *R*-VALUE (Climate Zones 6–7)	ROOF DECK CONTINUOUS INSULATION *R*-VALUE (Climate Zones 2, 4, 8–15)
0.60	2	16
0.55	4	18
0.50	6	20
0.45	8	22
No requirement	10	24

ii. Steep-sloped roofs in Climate Zones 4 and 8 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 180.2(b)1Aii: The following shall be considered equivalent to Subsection ii:

a. Buildings with ceiling assemblies with a *U*-factor lower than or equal to 0.025 or that are insulated with at least R-38 ceiling insulation in an attic; or

b. Buildings with a radiant barrier in the attic, where the radiant barrier is not installed directly above spaced sheathing, meeting the requirements of Section 170.2(a)1C; or

c. Buildings that have no ducts in the attic in Climate Zones 2, 4, 9, 10, 12 and 14; or

d. Buildings with R-2 or greater continuous insulation above or below the roof deck.

Exception 1 to Sections 180.2(b)1Ai and ii: Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels is not required to meet the minimum requirements for solar reflectance, thermal emittance or SRI.

Exception 2 to Sections 180.2(b)1Ai and ii: Roof constructions with a weight of at least 25 lb/ft² are not required to meet the minimum requirements for solar reflectance, thermal emittance or SRI.

iii. For low-sloped roofs, the area of the roof recover or roof replacement shall be insulated to R-14 continuous insulation or a *U*-factor of 0.039 in Climate Zones 1, 2, 4, and 8 through 16.

Exception 1 to Section 180.2(b)1Aiii: Roof recovers with new R-10 insulation added above deck do not need to be insulated to meet R-14.

Exception 2 to Section 180.2(b)1Aiii: When existing mechanical equipment located on the roof will not be disconnected and lifted, insulation added may be limited to the greater of R-10 or the maximum installed thickness that will allow the distance between the height of the roof membrane surface to the top of the base flashing to remain in accordance with the manufacturer's instructions.

Exception 3 to Section 180.2(b)1Aiii: At the drains and other low points, tapered insulation with a thermal resistance less than R-14 may be used, provided that insulation thickness is increased at the high points of the roof so that the average thermal resistance equals or exceeds R-14.

Exception 4 to Section 180.2(b)1Aiii: The area of the roof recoat is not required to be insulated.

B. **Roof/ceiling insulation**.

i. **Attic roof**. Vented attics shall meet the following:

a. In Climate Zones 1 through 4 and 8 through 16, insulation shall be installed to achieve a weighted *U*-factor of 0.020 or insulation installed at the ceiling level shall result in an installed thermal resistance of R-49 or greater for the insulation alone; and

Exception to Section 180.2(b)1Bia: In Climate Zones 1, 3, 4 and 9, dwelling units with at least R-19 existing insulation installed at the ceiling level.

b. In Climate Zones 2 and 11 through 16, air seal all accessible areas of the ceiling plane between the attic and the conditioned space in accordance with Section 110.7; and

Exception 1 to Section 180.2(b)1Bib: Dwelling units with at least R-19 existing insulation installed at the ceiling level.

Exception 2 to Section 180.2(b)1Bib: Dwelling units with atmospherically vented space heating or water-heating combustion appliances located inside the pressure boundary of the dwelling unit.

TABLE 180.2-B
ALTERED FENESTRATION MAXIMUM *U*-FACTOR AND MAXIMUM SHGC

CLIMATE ZONE		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Curtainwall/Storefront/Window Wall and Glazed Doors[1]	*U*-factor	0.38	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.38
Curtainwall/Storefront/Window Wall and Glazed Doors[1]	RSHGC	0.35	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.25
Curtainwall/Storefront/ Window Wall and Glazed Doors[1]	VT[2]	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
NAFS 2017 Performance Class AW Window – Fixed[1]	*U*-factor	0.38	0.38	0.38	0.38	0.38	0.47	0.47	0.41	0.41	0.38	0.38	0.38	0.38	0.38	0.38	0.38
NAFS 2017 Performance Class AW Window – Fixed[1]	RSHGC	0.35	0.25	0.25	0.25	0.25	0.31	0.31	0.26	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25
NAFS 2017 Performance Class AW Window – Fixed[1]	VT[2]	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
NAFS 2017 Performance Class AW Window – Operable[1]	*U*-factor	0.43	0.43	0.43	0.43	0.43	0.47	0.47	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
NAFS 2017 Performance Class AW Window – Operable[1]	RSHGC	0.35	0.24	0.24	0.24	0.24	0.31	0.31	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
NAFS 2017 Performance Class AW Window – Operable[1]	VT[2]	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
All Other Windows and Glazed Doors[1]	*U*-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.34	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
All Other Windows and Glazed Doors[1]	RSHGC	0.35	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Skylights, 3 Habitable Stories and Fewer	*U*-factor	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30
Skylights, 3 Habitable Stories and Fewer	RSHGC	NA	0.23	NA	0.23	NA	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.30	NA
Skylights, 4 Habitable Stories and Greater	*U*-factor	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Skylights, 4 Habitable Stories and Greater	RSHGC	0.35	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Skylights, 4 Habitable Stories and Greater	VT[2]	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49

1. For fenestration installed in buildings with three or fewer habitable stories, there is no SHGC requirement in Climate Zones 1, 3, 5 and 16.
2. Minimum VT requirements to not apply to multifamily buildings 3 habitable stories or fewer.

c. In Climate Zones 1 through 4 and 8 through 16, recessed downlight luminaires in the ceiling shall be covered with insulation to the same depth as the rest of the ceiling. Luminaires not rated for insulation contact must be replaced or fitted with a fireproof cover that allows for insulation to be installed directly over the cover; and

   Exception to Section 180.2(b)1Bic: In Climate Zones 1 through 4 and 8 through 10, dwelling units with at least R-19 existing insulation installed at the ceiling level.

d. Attic ventilation shall comply with the *California Building Code* requirements.

   Exception 1 to Section 180.2(b)1Bi: Dwelling units with at least R-38 existing insulation installed at the ceiling level.

   Exception 2 to Section 180.2(b)1Bi: Dwelling units where the alteration would directly cause the disturbance of asbestos, unless the alteration is made in conjunction with asbestos abatement.

   Exception 3 to Section 180.2(b)1Bi: Dwelling units with knob and tube wiring located in the vented attic.

   Exception 4 to Section 180.2(b)1Bi: Where the accessible space in the attic is not large enough to accommodate the required *R*-value, the entire accessible space shall be filled with insulation, provided such installation does not violate Section 806.3 of Title 24, Part 2.5.

   Exception 5 to Section 180.2(b)1Bi: Where the attic space above the altered dwelling unit is shared with other dwelling units and the requirements of Section 180.2(b)1Bi are not triggered for the other dwelling units.

Fenestration alterations other than repair shall meet the requirements below:

NOTE: Glass replaced in an existing sash and frame or sashes replaced in an existing frame are

considered repairs. In these cases, Section 180.2(b) requires that the replacement be at least equivalent to the original in performance.

i. Fenestration products installed to replace existing fenestration products of the same total area shall meet either a or b:

a. The maximum *U*-factor, RSHGC and VT requirements of Table 180.2-B, or

b. The area-weighted *U*-factor and RSHGC of Table 170.2-A.

Exception 1 to Section 180.2(b)1Ci: In an alteration, where 150 square feet or less of the entire building's vertical fenestration is replaced, RSHGC and VT requirements of Table 180.2-B shall not apply.

ii. Alterations that add fenestration and skylight area shall meet the total fenestration area requirements of Section 170.2(a) and the *U*-factor, RSHGC and VT requirements of Table 180.2-B.

Exception 1 to Section 180.2(b)1Cii: Alterations that add fenestration area of up to 50 square feet shall not be required to meet the total fenestration area requirements of Sections 170.2(a), nor the *U*-factor, RSHGC and VT requirements of Table 180.2-B.

Exception 2 to Section 180.2(b)1Cii: Alterations that add up to 16 square feet of new skylight area per dwelling unit with a maximum *U*-factor of 0.55 and a maximum RSHGC of 0.30 shall not be required to meet the total fenestration area requirements of Section 170.2(a)3.

D. **Exterior doors.** Alterations that add exterior door area shall meet the *U*-factor requirement of Section 170.2(a)4.

2. **Space-conditioning systems**.

A. Space-conditioning systems serving dwelling units.

i. **Entirely new or complete replacement space-conditioning systems** installed as part of an alteration shall include all the system heating or cooling equipment, including but not limited to: condensing unit, cooling or heating coil, and air handler for split systems; or complete replacement of a packaged unit; plus entirely new or replacement duct system [Section 180.2(b)2Aiib]. Entirely new or complete replacement space-conditioning systems shall meet the requirements of Sections 160.2(a)1, 160.3(a)1, 160.3(b)1 through 3, 160.3(b)5, 160.3(b)6, 160.3(c)1, 170.2(c)3B and 180.2(b)2Av, and Table 180.2-C.

ii. **Altered duct systems—duct sealing:** In all climate zones, when more than 25 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of Subsections a and b below. New ducts located in unconditioned space shall meet the applicable requirements of Sections 160.3(b)5A through J and the duct insulation requirements of Table 180.2-C, and

a. The altered duct system, regardless of location, shall be sealed as confirmed through field verification and diagnostic testing in accordance with all applicable procedures for duct sealing of altered existing duct systems as specified in Reference Residential Appendix RA3.1, utilizing the leakage compliance criteria specified in Subsection I or II below.

TABLE 180.2-C
DUCT INSULATION *R*-VALUE

Climate Zone	3, 5 through 7	1, 2, 4, 8 through 16
Duct *R*-Value	R-6	R-8

I. Entirely new or complete replacement duct system. If the new ducts form an entirely new or complete replacement duct system directly connected to the air handler, the duct system shall meet one of the following requirements:

A. The total leakage of the duct system shall not exceed 12 percent of the air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1, or

B. The duct system leakage to outside shall not exceed 6 percent of the air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.

Entirely new or complete replacement duct systems installed as part of an alteration are constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air handler, coil, plenums and duct material, if the reused parts are accessible and can be sealed to prevent leakage.

Entirely new or complete replacement duct systems shall also conform to the requirements of Sections 160.2(a)1 and 160.3(b)5L. If the air handler and ducts are located within a vented attic, the requirements of Section 180.2(b)1Bi shall also be met.

II. Extension of an existing duct system. If the new ducts are an extension of an existing duct system serving multifamily dwell-

ings, 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 air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

B. The measured duct leakage to outside shall be equal to or less than 10 percent of air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

C. If it is not possible to meet the duct sealing requirements of either Section 180.2(b)2AiicI or II then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

Exception to Section 180.2(b)2AiiaII: duct sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

Exception 1 to 180.2(b)2Aii: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

iii. **Altered space-conditioning system—duct sealing.** In all climate zones, when a space-conditioning system serving a multifamily dwelling 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, the duct system that is connected to the altered space-conditioning system equipment shall be sealed, 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 Residential Appendix RA3.1 and the leakage compliance criteria specified in Subsection a, b or c below.

a. The measured duct leakage shall be equal to or less than 15 percent of air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

b. The measured duct leakage to outside shall be equal to or less than 10 percent of air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or

c. If it is not possible to meet the duct sealing requirements of either Section 180.2(b)2Aiiia or b, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

Exception 1 to Section 180.2(b)2Aiii: **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 Reference Residential Appendix RA3.1.

Exception 2 to Section 180.2(b)2Aiii: duct sealing. Duct systems with less than 40 linear feet as determined by visual inspection.

Exception 3 to Section 180.2(b)2Aiii: duct sealing. Existing duct systems constructed, insulated or sealed with asbestos.

Exception 4 to Section 180.2(b)2Aiii: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

iv. **Altered space-conditioning system mechanical cooling.** When a space-conditioning system is an air conditioner or heat pump that is altered by the installation or replacement of refrigerant-containing system components such as the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping, the altered system shall comply with the following requirements:

a. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).

b. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14 and 15, air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high velocity air systems, and minisplit systems, shall comply with Subsections I and II, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of Section 180.2(b)2Aivb shall comply with Section 180.2(b)2Aivc.

Exception to Section 180.2(b)2Aivb: Entirely new or complete replacement packaged systems for which the manufacturer has

verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with the minimum system airflow rate requirement in Section 180.2(b)2AivbI, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1.

I. The minimum system airflow rate shall comply with the applicable Subsection A or B below as confirmed through field verification and diagnostic testing in accordance with the procedures specified in Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified in Section RA1.

A. Small duct high velocity systems shall demonstrate a minimum system airflow rate greater than or equal to 250 cfm per ton of nominal cooling capacity; or

B. All other air-cooled air conditioner or air-source heat pump systems shall demonstrate a minimum system airflow rate greater than or equal to 300 cfm per ton of nominal cooling capacity.

Exception 1 to Section 180.2(b)2AivbI: Systems unable to comply with the minimum airflow rate requirement shall demonstrate compliance using the procedures in Section RA3.3.3.1.5, and the system's thermostat shall conform to the specifications in Section 110.12.

Exception 2 to Section 180.2(b)2AivbI: Entirely new or complete replacement space-conditioning systems, as specified by Section 180.2(b)2Ai, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in Table 160.3-A or 160.3-B 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 160.2(a)1C for the system air filter device(s) shall conform to the requirements given in Tables 160.3-A and 160.3-B.

II. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable.

A. The installer and rater shall perform the standard charge verification procedure as specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1; or

B. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or

C. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1, provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

Exception 1 to Section 180.2(b)2AivbII: When the outdoor temperature is less than 55°F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 to demonstrate compliance, 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 Section 110.12. Ducted systems shall comply with the minimum system airflow rate requirements in Section 180.2(b)2AivbI.

Exception 2 to Section 180.2(b)2Aivb: The HERS Rater field verification and HERS Provider data registry requirements of Reference Residential Appendix RA2 and RA3 are not required for multifamily dwelling units in buildings four stories and greater. The installer shall certify that diagnostic testing was performed in accordance with the applicable procedures.

v. **Altered space-heating system.** Altered or replacement space-heating systems shall not use electric resistance as the primary heat source.

Exception 1 to Section 180.2(b)2Av: Nonducted electric resistance space heating systems, if the existing space heating system is electric resistance.

Exception 2 to Section 180.2(b)2Av: Ducted electric resistance space heating systems, if the existing space heating system is electric resistance and a ducted space cooling system is not being replaced or installed.

Exception 3 to Section 180.2(b)2Av: Electric resistance space heating systems, if the existing space heating system is electric resistance in Climate Zone 6, 7, 8 or 15.

b. **Common use area space-conditioning systems.**

i. New or replacement space-conditioning systems or components other than new or replacement space-conditioning system ducts shall meet the requirements of Sections 170.2(c)1, 2 and 4, applicable to the systems or components being altered. For compliance with Section 170.2(c)4A, additional fan power adjustment credits are available as specified in Table 180.2-D.

Exception 1 to Section 180.2(b)2Bi: Section 180.2(b)2Av does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

Exception 2 to Section 180.2(b)2Bi: Section 170.2(c)4L is not applicable to new or replacement space-conditioning systems.

Exception 3 to Section 180.2(b)2Bi: Section 170.2(c)4Ci is applicable to systems, other than single package air-cooled commercial unitary air conditioners and heat pumps, with cooling capacity less than 54,000 Btu/h.

ii. **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 160.3(c)2 and meet a or b below:

a. Reserved.

b. Entirely new or replacement duct systems installed as part of an alteration shall be leakage-tested in accordance with Section 160.2(c)2H. 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, including registers, grilles, boots, air handlers, coils, plenums and ducts, if the reused parts are accessible and can be sealed to prevent leakage.

Exception 1 to Section 180.2(b)2Biib: When it is not possible to achieve the duct leakage criteria in Section 180.2(b)2Biib, 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 NA2.1.4.2.2a.

Exception 2 to Section 180.2(b)2Biib: Duct sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos, are exempt from the requirements of subsection 180.2(b)2Biib.

c. If the new ducts are an extension of an existing duct system, the combined new and existing duct system meets the criteria in Subsections I, II and III below. The duct system shall be sealed to a leakage rate not to exceed 15 percent of the nominal air handler airflow rate as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures in Reference Nonresidential Appendices NA1 and NA2:

I. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system; and

II. The space-conditioning system serves less than 5,000 square feet of conditioned floor area; and

TABLE 180.2-D
FAN POWER LIMITATION PRESSURE DROP ADJUSTMENT

AIRFLOW	MULTI-ZONE VAV SYSTEMS[1] ≤5,000 cfm	MULTI-ZONE VAV SYSTEMS[1] >5,000 AND ≤10,000 cfm	MULTI-ZONE VAV SYSTEMS[1] >10,000 cfm	ALL OTHER FAN SYSTEMS ≤5,000 cfm	ALL OTHER FAN SYSTEMS >5,000 AND ≤10,000 cfm	ALL OTHER FAN SYSTEMS >10,000 cfm
Supply Fan System Additional Allowance	0.135	0.114	0.105	0.139	0.12	0.107
Supply Fan System Additional Allowance in Unit with Adapter Curb	0.033	0.033	0.043	0.000	0.000	0.000
Exhaust/Relief/Return/Transfer Fan System Additional Allowance	0.07	0.061	0.054	0.07	0.062	0.055
Exhaust/Relief/Return/Transfer Fan System Additional Allowance in Unit with Adapter Curb	0.016	0.017	0.022	0.000	0.000	0.000

1. See FAN SYSTEM, MULTI-ZONE VARIABLE AIR VOLUME (VAV) for the definition of a multi-zone VAV system.

III. The combined surface area of the ducts located in the following spaces is more than 25 percent of the total surface area of the entire duct system:

A. Outdoors;

B. In a space directly under a roof that

i. Has a *U*-factor greater than the *U*-factor of the ceiling, or if the roof does not meet the requirements of Section 170.2(a)1B, or

ii. Has fixed vents or openings to the outside or unconditioned spaces; or

C. In an unconditioned crawl space; or

D. In other unconditioned spaces.

iii. **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:

a. For all altered units where the existing thermostat does not comply with the requirements for demand responsive controls specified in Section 110.12, the existing thermostat shall be replaced with a demand responsive thermostat that complies with Section 110.12. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a demand responsive thermostat that complies with Section 110.12; and

b. 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 Section 170.2(c)4Ji, 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 180.2(b)2Bii.

Exception 1 to Section 180.2(b)2Biiib: duct sealing. Buildings altered so that the duct system no longer meets the criteria of Section 170.2(c)4Ji are exempt from the requirements of Subsection 180.2(b)2Biiib.

Exception 2 to Section 180.2(b)2Biiib: 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 180.2(b)2Biiib.

Exception 3 to Section 180.2(b)2Biiib: duct sealing. Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection 180.2(b)2Biiib.

3. **Hot water systems**. Altered or replacement water-heating systems or components serving individual dwelling units shall meet the applicable requirements below:

A. **Pipe insulation.** For newly installed piping and existing accessible piping, the insulation requirements of Section 160.4(f) shall be met.

B. **Distribution system.** For recirculation distribution system serving individual dwelling units, only demand recirculation systems with manual on/off control as specified in Reference Appendix RA4.4.9 shall be installed.

C. **Water-heating system.** The water-heating system shall meet one of the following:

i. A natural gas or propane water-heating system; or

ii. A single heat pump water heater. The storage tank shall not be located outdoors and shall be placed on an incompressible, rigid insulated surface with a minimum thermal resistance of R-10. The water heater shall be installed with a communication interface that either meets the requirements of Section 110.12(a) or has an ANSI/CTA-2045-B communication port; or

iii. A single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher; or

iv. If the existing water heater is an electric resistance water heater, a consumer electric water heater.

v. A water-heating system determined by the Executive Director to use no more energy than the one specified in Sections 180.2(b)3Ci through iii above; or if no natural gas is connected to the existing water heater location, a water-heating system determined by the Executive Director to use no more energy than the one specified in Section 180.2(b)3Civ above.

4. **Lighting.**

A. **Dwelling unit lighting.** The altered lighting system shall meet the lighting requirements of Section 160.5(a). The altered luminaires shall meet the luminaire efficacy requirements of Section 160.5(a) and Table 160.5-A. Where existing screw base sockets are present in ceiling-recessed luminaires, removal of these sockets is not required, provided that new JA8 compliant trim kits or lamps designed for use with recessed downlights or luminaires are installed.

APPENDIX 1-A

STANDARDS AND DOCUMENTS REFERENCED IN THE ENERGY CODE

The following documents are incorporated by reference to the extent they are referenced in the Energy Code.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE

AHRI 210/240-2017 Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment (2017 with Addendum 1)

AHRI 310/380-2017 Packaged Terminal Air-Conditioners and Heat Pumps (2017)

AHRI 340/360 (I-P)-2019 Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment (2019)

ANSI/AHRI 365 (I-P)-2009 Performance Rating of Commercial and Industrial Unitary Air-Conditioning Condensing Units (2009)

ANSI/AHRI 390-2003 Performance Rating of Single Package Vertical Air Conditioners and Heat Pumps (2003)

ANSI/AHRI 400 (I-P)-2015 Performance Rating of Liquid to Liquid Heat Exchangers (2015)

AHRI 430 (I-P)-2020 Performance Rating of Central Station Air-handling Unit Supply Fans (2020)

AHRI 440 (I-P)-2019 Performance Rating of Fan-coil Units (2019)

ANSI/AHRI 460-2005 Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (2005)

AHRI 550/590 (I-P)-2020 Performance Rating of Water-Chilling and Heat Pump Water-heating Packages Using the Vapor Compression Cycle (2020)

AHRI 560-2000 Absorption Water Chilling and Water Heating Packages (2000)

AHRI 680 (I-P)-2017 Performance Rating of Residential Air Filter Equipment (2017)

AHRI 920 (I-P)-2020 Performance Rating of Direct Expansion-Dedicated Outdoor Air System Units (2020)

AHRI 1060 (I-P)-2018 Performance Rating of Air-to-Air Exchangers for Energy Recovery Ventilation Equipment (2018)

AHRI 1230-2014 Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment (w/Addendum 1)

AHRI 1360 (I-P)-2017 Performance Rating of Computer and Data Processing Room Air Conditioners (2017)

Available from: Air-Conditioning, Heating and Refrigeration Institute
2311 Wilson Blvd., Suite 400
Arlington, VA 22203
(703) 524-8800

AIR-CONDITIONING CONTRACTORS OF AMERICA

ANSI/ACCA 2 Manual J-2016 Manual J—Residential Load Calculation, Eighth Edition (2016)

Available from: Air-Conditioning Contractors of America, Inc.
2800 Shirlington Road, Suite 300
Arlington, VA 22206
(703) 575-4477
www.acca.org

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

CANADIAN STANDARDS ASSOCIATION

WINDOW AND DOOR MANUFACTURERS ASSOCIATION

AAMA/WDMA/CSA 101/I.S.2/A440-17 North American Fenestration Standard/Specification for Windows, Doors, and Skylights (2017)

Available from: AAMA
1827 Walden Office Square, Suite 550
Schaumburg, IL 60173-4268
(847) 303-5664
www.aamanet.org

CSA
5060 Spectrum Way, Suite 100
Mississauga, ON, Canada L4W 5N6
(800) 463-6727
www.csagroup.org

WDMA
2025 M Street, NW, Suite 800
Washington, DC 20036-3309
(202) 367-1157
www.wdma.com

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS

2021 TLVs and BEIs
Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices

Available from: ACGIH
1330 Kemper Meadow Drive
Cincinnati, Ohio 45240
(513) 742-2020
www.acgih.org

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI/AMCA 208-18
Calculation of the Fan Energy Index (2018)

ANSI/AMCA 210-16
Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating (2016)

ANSI/AMCA 500-D-18
Laboratory Methods Of Testing Dampers For Rating (2018)

ANSI/ASABE S640 JUL2017
Quantities and Units of Electromagnetic Radiation for Plants (Photosynthetic Organisms)

ANSI/ASSP Z9.5-2012
Laboratory Ventilation (2012)

ANSI/CTA-2045-B2021
Modular Communications Interface for Energy Management (2018)

ANSI C82.6-2015 (R2020)
American National Standard for Lamp Ballasts—Ballasts for High-Intensity Discharge Lamps—Methods of Measurement (2020)

ANSI/NEMA WD 6-2016
American National Standard for Wiring Devices—Dimensional Specifications (2016)

ANSI Z21.40.4a-1998 (R2017)/CGA 2.94a-M98 (R2017)
Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances (2017)

ANSI Z21.47-2021/CSA 2.3:21
Gas-Fired Central Furnaces (2021)

ANSI Z83.8-2016/CSA 2.6-2016 (R2021)
Gas Unit Heaters, Gas Packaged Heaters, Gas Utility Heaters and Gas-Fired Duct Furnaces (2016)

Available from: American National Standards Institute
25 West 43rd Street, 4th floor
New York, NY 10036
(212) 642-4900

ANSI/APSP/ICC-5-2011
American National Standard For Residential Inground Swimming Pools (2011 w/Addendum A)

Available from: Association of Pool & Spa Professionals
2111 Eisenhower Ave.
Alexandria, VA 22314
(703) 838-0083

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (NATIONAL PUBLICATIONS)

ANSI/ASHRAE Standard 52.2-2017
Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size (2017)

ANSI/ASHRAE Standard 55-2020
Thermal Environment Conditions for Human Occupancy (2020)

ANSI/ASHRAE Standard 62.1-2019
Ventilation for Acceptable Indoor Air Quality (2019)

ANSI/ASHRAE Standard 62.2-2019
Ventilation and Acceptable Indoor Air Quality in Residential Buildings (2019)

ANSI/ASHRAE Standard 84-2020
Method of Testing Air-to-Air Heat/ Energy Exchangers (2020)

ANSI/ASHRAE/IES Standards 90.1-2019
Energy Standards for Buildings Except Low-Rise Residential Buildings (2019)

ANSI/ASHRAE Standard 154-2016
Ventilation for Commercial Cooking Operations (2016)

ANSI/ASHRAE 193-2010 (RA2014)
Method of Test for Determining the Airtightness of HVAC Equipment (RA2014)

ASHRAE Handbooks

HVAC Applications (I-P) (2019)

HVAC Systems and Equipment (I-P) (2020)

Fundamentals (I-P) (2017)

Available from: American Society of Heating, Refrigerating and Air-Conditioning Engineers
(ASHRAE)
1791 Tullie Circle N.E.
Atlanta, GA 30329
www.ashrae.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (REGIONAL PUBLICATION)

ASHRAE Climatic Data for Region X Arizona, California, Hawaii, Nevada, Publication SPCDX, 1982, ISBN #20002196 and Supplement, 1994, ISBN #20002596

Available from: Order Desk
Building News
10801 National Boulevard
Los Angeles, CA 90064
(800) 873-6397 or (310) 474-7771
www.bnibooks.com/

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME A17.1-2019/CSA B44:19
Safety Code for Elevators and Escalators (2019)

ASME A112.18.1-2018/CSA B125.1-18
Plumbing Supply Fittings

Available from: ASME
Two Park Avenue
New York, NY 10016-5990
(800) 843-2763
http://www.asme.org/

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS

AHAM HRH-2-2020 Residential Kitchen Range Hood Performance Test Procedures (2020)

AHAM RKRH-CPPG-2020
Residential Kitchen Range Hood Certification Program Procedural Guide (2020) Version 3.0

Available from: Association of Home Appliance Manufacturers
1111 19th Street, NW, Suite 402
Washington, DC 20036
(202) 872-5955
www.aham.org

AMERICAN SOCIETY FOR TESTING AND MATERIALS/ASTM INTERNATIONAL

ASTM C55-17 Standard Specification for Concrete Building Brick (2017)

ASTM C177-19 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus (2019)

ASTM C272/C272M-18
Standard Test Method for Water Absorption of Core Materials for Sandwich Constructions (2018)

ASTM C335/C335M-17
Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation (2017)

ASTM C518-17 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus (2017)

ASTM C731-15 Standard Test Method for Extrudability, After Package Aging, of Latex Sealants (2015)

ASTM C732-17 Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants (2017)

ASTM C836/C836M-18
Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course (2018)

ASTM C1167-11 (2017)
Standard Specification for Clay Roof Tiles (2017)

ASTM C1371-15 Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers (2015)

ASTM C1492-03 (2016)
Standard Specification for Concrete Roof Tile (2016)

ASTM C1549-16 Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer (2016)

ASTM C1583/C1583M-20
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) (2020)

ASTM D448-12 (2017)
Standard Classification for Sizes of Aggregate for Road and Bridge Construction (2017)

ASTM D522/D522M-17
Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (2017)

ASTM D822/D822M-13 (2018)
Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings (2018)

ASTM D1003-21 Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics (2021)

ASTM D1653-21 Standard Test Methods for Water Vapor Transmission of Organic Coating Films (2021)

ASTM D1863/D1863M-05 (2018) Standard Specification for Mineral Aggregate Used on Built-Up Roofs (2018)

ASTM D2202-00 (2019) Standard Test Method for Slump of Sealants (2019)

ASTM D2370-16 Standard Test Method for Tensile Properties of Organic Coatings (2016)

ASTM D2824/D2824M-18 Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered and Fibered without Asbestos (2018)

ASTM D3468/D3468M-99 (2020) Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing (2020)

ASTM D3805/D3805M-16 Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings (2016)

ASTM D4798/D4798M-11 (2021) Standard Practice for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method) (2021)

ASTM D5870-16 Standard Practice for Calculating Property Retention Index of Plastics (2016)

ASTM D6083/D6083M-21 Standard Specification for Liquid-Applied Acrylic Coating Used in Roofing (2021)

ASTM D6694/D6694M-15 Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing Systems (2015)

ASTM E96/E96M-16 Standard Test Methods for Water Vapor Transmission of Materials (2016)

ASTM E283/E283M-19 Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen (2019)

ASTM E408-13 (2019) Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques (2019)

ASTM E779-19 Standard Test Method for Determining Air Leakage Rate by Fan Pressurization (2019)

ASTM E903-20 Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres (2020)

ASTM E972-96 (2021) Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight (2021)

ASTM E1175-87 (2015) Standard Test Method for Determining Solar or Photopic Reflectance, Transmittance, and Absorptance of Materials Using a Large Diameter Integrating Sphere (2015)

ASTM E1677-19 Standard Specification for Air Barrier (AB) Material or Assemblies for Low-Rise Framed Building Walls (2019)

ASTM E1680-16 Standard Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems (2016)

ASTM E1918-16 Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field (2016)

ASTM E1980-11 (2019) Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces (2019)

ASTM E2178-21 Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials (2021)

ASTM E2357-18 Standard Test Method for Determining Air Leakage Rate of Air Barrier Assemblies (2018)

ASTM E3087-18 Standard Test Method for Measuring Capture Efficiency of Domestic Range Hoods (2018)

Available from: ASTM International
100 Barr Harbor Drive West
Conshohocken, PA 19428-2959
(800) 262-1373 or (610) 832-9500

ASSOCIATION OF HOME APPLIANCE MANUFACTURERS

AHAM HRH-2-2020 Residential Kitchen Range Hood Performance Test Procedures (2020)

AHAM RKRH-CPPG-2020 Residential Kitchen Range Hood Certification Program Procedural Guide (2020) Version 3.0

Available from: Association of Home Appliance Manufacturers
1111 19th Street, NW, Suite 402
Washington, DC 20036
(202) 872-5955
www.aham.org

CALIFORNIA HISTORICAL BUILDING CODE

2022 California Building Code
2022 California Electrical Code
2022 California Fire Code
2022 California Mechanical Code
2022 California Plumbing 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

Alternative Calculation Method (ACM) Manual

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 Household Goods and Services
4244 South Market Court, Suite D
Sacramento, California 95834-1243
(916) 999-2041

CERTIFYING ORGANIZATION

CIE 13.3-1995 Method of Measuring and Specifying Colour Rendering Properties of Light Sources (1995)

CIE 015-2018 Technical Report: Colorimetry (2018)

COOLING TECHNOLOGY INSTITUTE

CTI ATC-105 (19) Acceptance Test Code for Cooling Towers (2019)

CTI ATC-105DS (18) Acceptance Test Code for Dry Fluid Coolers (2018)

CTI ATC-105S (11) Acceptance Test Code for Closed-Circuit Cooling Towers (2011)

CTI ATC-106 (11) Acceptance Test Code for Mechanical Draft Evaporative Vapor Condensers (2011)

CTI STD-201 RS (17) Standard for the Certification of Water-Cooling Tower Thermal Performance (2017)

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 (2021)

Available from: Cool Roof Rating Council
2435 N. Lombard Street
Portland, OR 97217
(866) 465-2523
www.coolroofs.org

HOME VENTILATING INSTITUTE

HVI Publication 915-2020 HVI Loudness Testing and Rating Procedure (2020)

HVI Publication 916-2020 HVI Airflow Test Procedure (2020)

HVI Publication 920-2020 HVI Product Performance Certification Procedure Including Verification and Challenge (2020)

Available from: Home Ventilating Institute
1740 Dell Range Blvd.,
Suite H, PMB 450
Cheyenne, WY 82009
(855) 484-8368
www.hvi.org

ILLUMINATING ENGINEERING SOCIETY

The IES Lighting Library™

ANSI/IES LM-79-19 Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products (2019)

ANSI/IES LS-1-20 Lighting Science: Nomenclature and Definitions for Illuminating Engineering (2020)

ANSI/IES TM-15-20 Technical Memorandum: Luminaire Classification System for Outdoor Luminaires (2020)

Available from: Illuminating Engineering Society
120 Wall Street, 17th Floor
New York, NY 10005-4026
(212) 248-5000
www.ies.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
Western Regional Office
3060 Saturn St.
Brea, CA 92821
(888) 422-7233
www.iccsafe.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO 5801:2017 Fans—Performance testing using standardized airways (2017)

ISO 13256-1:1998 (RA 2012) Water-Source Heat Pumps—Testing and Rating for Performance—Part 1: Water-to-Air and Brine-to-Air Heat Pumps (2012)

ISO 13256-2:1998 (RA 2012) Water-Source Heat pumps—Testing and rating for Performance—Part 2: Water-to-Water and Brine-to-Water Heat Pumps (2012)

ISO/IEC 17025:2017 General Criteria for the Competence of Testing and Calibration Laboratories (2017)

Available from: ISO
Chemin de Blandonnet 8
CP 401
1214 Vernier
Geneva, Switzerland

INTERNATIONAL WINDOW FILM ASSOCIATION

Architectural Visual Inspection Standard Window Film (reendorsed 2018)

Available from: International Window Film Association
P.O. Box 3871
Martinsville, VA 24115-3871
276-666-4932

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA LSD 57-2018 Polyurethane Foam Application: Lighting Equipment (2018)

NEMA SSL 7A-2015 Phase Cut Dimming for Solid State Lighting: Basic Compatibility (2015)

Available from: 1300 North 17th Street, Suite 1752
Rosslyn, VA 22209
708-841-3200
www.nema.org

NATIONAL FENESTRATION RATING COUNCIL

ANSI/NFRC 100-2020 Procedure for Determining Fenestration Product *U*-factors (2020)

ANSI/NFRC 200-2020 Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence (2020)

ANSI/NFRC 202-2020 Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence (2020)

ANSI/NFRC 203-2020 Procedure for Determining Visible Transmittance of Tubular Daylighting Devices (2020)

ANSI/NFRC 400-2020 Procedure for Determining Fenestration Product Air Leakage (2020)

Available from: National Fenestration Rating Council
6035 Ivy Lane, Suite 140
Greenbelt, MD 20770
(301) 589-1776
www.NFRC.org
Email: info@nfrc.org

NSF INTERNATIONAL (FORMERLY NATIONAL SANITATION FOUNDATION)

NSF/ANSI/CAN 50-2020 Equipment and Chemicals for Swimming Pools, Spas, Hot Tubs, and Other Recreational Water Facilities (2020)

Available from: NSF International
PO Box 130140
Ann Arbor, MI 48113
(735) 769-8010

RESIDENTIAL ENERGY SERVICES NETWORK

ANSI/RESNET/ICC 380-2019 Standard for Testing Airtightness of Building Enclosures, Dwelling Unit, and Sleeping Unit Enclosures, Airtightness of Heating and Cooling Air Distribution Systems, and Airflow of Mechanical Ventilation Systems (2019)

Available from: Residential Energy Services Network, Inc. (RESNET)
P.O. Box 4561
Oceanside, CA 92052-4561
http://resnet.us/

HISTORY NOTE APPENDIX

2022 California Energy Code
California Code of Regulations, Title 24, Part 6

HISTORY:

For prior code history, see the History Note Appendix to the *California Energy Code,* 2019 Triennial Edition, effective January 1, 2020.

1. (CEC 04/21)—Repeal the 2019 adoption of the *California Energy Code*, CCR Title 24, Part 6 and adopt the 2022 *California Energy Code,* effective on January 1, 2023.
2. Erratum to correct editorial errors in Subchapters 1–14, effective January 1, 2023.

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