

File No. 160948

Committee Item No. 5

Board Item No. 16

## COMMITTEE/BOARD OF SUPERVISORS

### AGENDA PACKET CONTENTS LIST

Committee: Land Use and Transportation

Date October 31, 2016

Board of Supervisors Meeting

Date November 15, 2016

#### Cmte Board

<input type="checkbox"/>	<input type="checkbox"/>	Motion
<input type="checkbox"/>	<input type="checkbox"/>	Resolution
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Ordinance
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Legislative Digest
<input type="checkbox"/>	<input type="checkbox"/>	Budget and Legislative Analyst Report
<input type="checkbox"/>	<input type="checkbox"/>	Youth Commission Report
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Introduction Form
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Department/Agency Cover Letter and/or Report
<input type="checkbox"/>	<input type="checkbox"/>	Memorandum of Understanding (MOU)
<input type="checkbox"/>	<input type="checkbox"/>	Grant Information Form
<input type="checkbox"/>	<input type="checkbox"/>	Grant Budget
<input type="checkbox"/>	<input type="checkbox"/>	Subcontract Budget
<input type="checkbox"/>	<input type="checkbox"/>	Contract/Agreement
<input type="checkbox"/>	<input type="checkbox"/>	Form 126 - Ethics Commission
<input type="checkbox"/>	<input type="checkbox"/>	Award Letter
<input type="checkbox"/>	<input type="checkbox"/>	Application
<input type="checkbox"/>	<input type="checkbox"/>	Form 700
<input type="checkbox"/>	<input type="checkbox"/>	Vacancy Notice
<input type="checkbox"/>	<input type="checkbox"/>	Information Sheet
<input type="checkbox"/>	<input type="checkbox"/>	Public Correspondence

OTHER (Use back side if additional space is needed)

<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	CEQA Determination
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Findings
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	Corrections List
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2016 State Code
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	2016 National Code
<input type="checkbox"/>	<input type="checkbox"/>	
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Completed by: Alisa Somera

Date October 27, 2016

Completed by: Alisa Somera 4775

Date November 1, 2016

[Green Building Code - Repeal of Existing 2013 Code and Enactment of 2016 Edition]

Ordinance repealing the 2013 Green Building Code in its entirety and enacting a 2016 Green Building Code consisting of the 2016 California Green Building Standards Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

NOTE: **Unchanged Code text and uncodified text** are in plain Arial font.  
**Additions to Codes** are in single-underline italics Times New Roman font.  
**Deletions to Codes** are in ~~striketrough italics Times New Roman font~~.  
**Board amendment additions** are in double-underlined Arial font.  
**Board amendment deletions** are in ~~striketrough Arial font~~.  
**Asterisks (\* \* \* \*)** indicate the omission of unchanged Code subsections or parts of tables.

Be it ordained by the People of the City and County of San Francisco:

Section 1. Environmental Findings. The Planning Department has determined that the actions contemplated in this ordinance comply with the California Environmental Quality Act (California Public Resources Code Sections 21000 et seq.). Said determination is on file with the Clerk of the Board of Supervisors in File No. 160948 and is incorporated herein by reference. The Board affirms this determination.

Section 2. General Findings.

(a) The State of California adopts a new California Building Standards Code every three years (the "triennial State Code") with supplements published in intervening years. The triennial State Code goes into effect throughout the State of California 180 days after its

1 publication by the California Building Standards Commission or at a later date established by  
2 the Commission.

3 (b) The California Building Standards Code is contained in Title 24 of the California  
4 Code of Regulations. It consists of 12 Parts based upon model codes that are amended by  
5 the State agencies with jurisdiction over the subject matter. The California Green Building  
6 Standards Code is Part 11 of Title 24 of the California Code of Regulations. The 2016  
7 California Green Building Standards Code will go into effect throughout California on January  
8 1, 2017.

9 (c) Local jurisdictions must enforce the California Building Standards Code but they  
10 may also enact more restrictive building standards that are reasonably necessary because of  
11 local conditions caused by climate, geology, or topography. Local amendments may be made  
12 to a triennial State Code and also throughout the intervening years. However, local  
13 amendments previously adopted are not automatically applicable to a new triennial State  
14 Code. Rather, they must be re-enacted with the required findings of local conditions,  
15 expressly made applicable to the new triennial State Code, and with an operative date no  
16 earlier than the effective date of the new State Code.

17 (d) As in past triennial State Code adoption cycles, by this ordinance the Board of  
18 Supervisors repeals the 2013 San Francisco Green Building Code in its entirety, enacts the  
19 2016 San Francisco Green Building Code, and re-enacts the existing local amendments and  
20 expressly makes them applicable to the 2016 California Green Building Standards Code.

21 (e) Pursuant to Charter Section D3.750-5, the Building Inspection Commission  
22 considered and approved San Francisco's amendments to the 2016 California Green Building  
23 Standards Code at a duly noticed public hearing that was held on August 17, 2016.

24  
25 Section 3. Findings regarding Local Conditions.

1 (a) California Health and Safety Code Sections 17958.7 and 18941.5 provide that  
2 before making any changes or modifications to the California Green Building Code and any  
3 other applicable provisions published by the California Building Standards Commission, the  
4 governing body must make an express finding that each such change or modification is  
5 reasonably necessary because of specified local conditions. The local amendments together  
6 with the required findings must be filed with the California Building Standards Commission  
7 before the local changes or modifications can go into effect.

8 (b) The City and County of San Francisco is unique among California communities  
9 with respect to local climatic, geological, topographical, and other conditions. A specific list of  
10 findings that support San Francisco's modifications to the 2016 California Green Building  
11 Standards Code, with a section-by-section correlation of each modification with a specific  
12 numbered finding, are contained in Exhibit A entitled "Standard Findings for San Francisco  
13 Building Standards Code Amendments."

14 (c) Pursuant to California Health and Safety Code Sections 17958.7 and 18941.5,  
15 the Board of Supervisors finds and determines that the local conditions described in Exhibit A  
16 constitute a general summary of the most significant local conditions giving rise to the need  
17 for modification of the 2016 California Green Building Standards Code provisions published by  
18 the California Building Standards Commission. The Board of Supervisors further finds and  
19 determines that the proposed modifications are reasonably necessary based upon the local  
20 conditions set forth in Exhibit A.

21  
22 Section 4. Findings Required by California Public Resources Code and Title 24 of the  
23 California Code of Regulations.

24 (a) Public Resources Code Section 25402.1(h)(2) and Section 10-106 of the  
25 California Code of Regulations, Title 24, Part 1, Locally Adopted Energy Standards, authorize



1 a local jurisdiction to adopt and enforce more restrictive local energy standards, provided that  
2 the local jurisdiction makes a determination that the local standards are cost effective and will  
3 save more energy than the current Statewide standards and provided further that the local  
4 jurisdiction files an application for approval with the California Energy Commission together  
5 with documentation supporting the cost-effectiveness determination. Local energy standards  
6 may take effect only after the California Energy Commission has reviewed and formally  
7 approved them.

8 (b) Local energy standards previously adopted are not automatically applicable to a  
9 new triennial State Code. Rather, they must be re-enacted with a new cost-effectiveness  
10 study and determination based on the new State standards, and be re-approved by the  
11 California Energy Commission.

12 (c) Based upon the findings of a cost-effectiveness study performed on the more  
13 restrictive local standards contained in the City's proposed 2016 San Francisco Green  
14 Building Code, the Board of Supervisors hereby determines that these local energy standards  
15 are cost effective and will save more energy than the standards contained in the 2016  
16 California Green Building Standards Code. A copy of the cost-effectiveness study is on file  
17 with the Clerk of the Board of Supervisors in File No. 160948.

18  
19 Section 5. Repeal of 2013 San Francisco Green Building Code and Enactment of the  
20 2016 San Francisco Green Building Code.

21 (a) The 2013 San Francisco Green Building Code is hereby repealed in its entirety.  
22 The San Francisco Green Building Code being repealed was enacted on November 5, 2013,  
23 by Ordinance No. 259-13, with an operative date of January 1, 2014. It was amended by  
24 Ordinance No. 071-16. These ordinances are available on the website of the Board of  
25 Supervisors.

1 (b) The 2016 San Francisco Green Building Code is hereby enacted. It consists of  
2 the 2016 California Green Building Standards Code and San Francisco's existing local  
3 amendments, which are re-enacted and expressly made applicable to the 2016 California  
4 Green Building Standards Code. Copies of the 2016 California Green Building Standards  
5 Code and the stand-alone San Francisco amendments are declared to be part of Board File  
6 No. 160948 and are incorporated into this ordinance by reference as though fully set forth.  
7 Additions to the 2016 California Green Building Standards Code are shown in bold underlined  
8 type; deletions are shown with bold strikethrough type.

9  
10 Section 6. Continuance of Actions Under Prior Code. Nothing contained in this  
11 ordinance shall be construed as abating any action now pending under or by virtue of any  
12 ordinance of the City and County of San Francisco hereby repealed, nor shall this ordinance  
13 be construed as discontinuing, abating, modifying or altering any penalties accruing, or to  
14 accrue, or as waiving any right of the City under any such ordinance.

15  
16 Section 7. Severability. If any section, subsection, sentence, clause, or phrase of this  
17 ordinance is, for any reason, held to be invalid, such decision shall not affect the validity of the  
18 remaining portions of this ordinance. The Board of Supervisors hereby declares that it would  
19 have passed this ordinance, and each section, subsection, sentence, clause, or phrase of this  
20 Ordinance, irrespective of the fact that any one or more sections, subsections, sentences,  
21 clauses, or phrases be declared invalid.

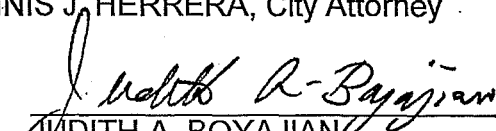
22  
23 Section 8. Effective and Operative Dates. This ordinance shall become effective 30  
24 days after enactment. Enactment occurs when the Mayor signs the ordinance, the Mayor  
25 returns the ordinance unsigned or does not sign the ordinance within ten days of receiving it,

1 or the Board of Supervisors overrides the Mayor's veto of the ordinance. This ordinance shall  
2 take effect and be in full force on and after either January 1, 2017 or its effective date if the  
3 effective date is later.

4  
5 Section 9. Directions to Clerk. Upon final passage of this ordinance, the Clerk of the  
6 Board of Supervisors is hereby directed to transmit this ordinance with the Exhibit A  
7 attachment and the San Francisco modifications to the 2016 California Green Building  
8 Standards Code to the California Building Standards Commission pursuant to the applicable  
9 provisions of State law.

10  
11 APPROVED AS TO FORM:  
12 DENNIS J. HERRERA, City Attorney

13 By:

  
14 JUDITH A. BOYAJIAN  
Deputy City Attorney

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## **LEGISLATIVE DIGEST**

[Green Building Code - Repeal of Existing 2013 Code and Enactment of 2016 Edition]

**Ordinance repealing the 2013 Green Building Code in its entirety and enacting a 2016 Green Building Code consisting of the 2016 California Green Building Standards Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.**

### **Existing Law**

The Green Building Code enhances the design and construction of buildings through the use of building concepts having a reduced negative impact or positive environmental impact. The Code encourages sustainable construction practices in the categories of: planning and design, energy efficiency, water efficiency and conservation, material conservation and resource efficiency, and environmental quality. The current San Francisco Green Building Code consists of the 2013 California Green Building Standards Code and San Francisco's local amendments to the 2013 California Green Building Standards Code ("San Francisco Amendments").

### **Amendments to Current Law**

On January 1, 2017, a 2016 California Green Building Standards Code (also known as CalGreen) will go into effect throughout the State. The San Francisco Amendments to the 2013 California Code must be re-enacted and made applicable to the 2016 California Code. Therefore, as in past State Code adoption cycles, San Francisco will repeal its existing Green Building Code in its entirety and adopt a new Green Building Code consisting of the 2016 California Green Building Standards Code and San Francisco's local amendments to the 2013 California Green Building Standards Code ("San Francisco Amendments"). The San Francisco Amendments to the 2013 California Green Building Standards Code will be carried forward and made applicable to the 2016 California Green Building Standards Code with no or only minor technical changes..

The San Francisco Amendments are not integrated into the text of the California Codes but rather are separately printed in a stand-alone document. Therefore, the user must consult both texts in order to determine the complete code requirement. In the San Francisco Amendments, additions to the 2016 California Green Building Standards Code are shown in bold type; deletions are shown with strikethrough.

### Background Information

The State of California adopts a new California Building Standards Code every three years (the "triennial State Code") with supplements published in intervening years. The triennial State Code goes into effect throughout the State 180 days after its publication by the California Building Standards Commission or at a later date established by the Commission. In the current triennial State Code adoption cycle, the California Building Standards Code will go into effect on January 1, 2017. The California Building Standards Code is contained in Title 24 of the California Code of Regulations, and consists of several parts that are based upon model codes with amendments made by the State agencies with jurisdiction over the subject matter. The California Green Building Standards Code is Part 11 of Title 24 of the California Code of Regulations.

Local jurisdictions must enforce the California Building Standards Code but they may also enact more restrictive building standards that are reasonably necessary because of local conditions caused by climate, geology, or topography. Local amendments may be made to a triennial State Code and also throughout the intervening years. However, local amendments previously adopted are not automatically applicable to a new triennial State Code. Rather, they must be re-enacted with the required findings of local conditions, expressly made applicable to the new triennial State Code, and with an operative date no earlier than the effective date of the new State Code.

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BOARD of SUPERVISORS



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San Francisco 94102-4689  
Tel. No. 554-5184  
Fax No. 554-5163  
TDD/TTY No. 554-5227

October 6, 2016

Lisa Gibson  
Acting Environmental Review Officer  
Planning Department  
1650 Mission Street, Ste. 400  
San Francisco, CA 94103

Dear Ms. Gibson:

On September 6, 2016, Building Inspection Commission introduced the following proposed legislations:

**File No. 160944**

Ordinance repealing the 2013 Building Code in its entirety and enacting a 2016 Building Code consisting of the 2016 California Building Code and the 2016 California Residential Code, as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160945**

Ordinance adding the provisions of the 2016 California Residential Code with local amendments into various chapters of the 2016 San Francisco Building Code, and adding Chapter 36 to the Building Code to serve as a directory of where such provisions may be found; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160946**

Ordinance repealing the 2013 Electrical Code in its entirety and enacting a 2016 Electrical Code consisting of the 2016 California Electrical Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160947**

Ordinance enacting a 2016 San Francisco Existing Building Code consisting of the 2016 California Existing Building Code with San Francisco amendments; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160948**

Ordinance repealing the 2013 Green Building Code in its entirety and enacting a 2016 Green Building Code consisting of the 2016 California Green Building Standards Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160949**

Ordinance repealing the 2013 Mechanical Code in its entirety and enacting a 2016 Mechanical Code consisting of the 2016 California Mechanical Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160950**

Ordinance repealing the 2013 Plumbing Code in its entirety and enacting a 2016 Plumbing Code consisting of the 2016 California Plumbing Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

This legislation is being transmitted to you for environmental review.

Angela Calvillo, Clerk of the Board

 By: Alisa Somera, Legislative Deputy Director  
Land Use and Transportation Committee

Not defined as a project under CEQA Guidelines  
Sections 15378 and 15060(c)(2) because they do not  
result in a physical change in the environment.

Attachment

c: Joy Navarrete, Environmental Planning  
Jeanie Poling, Environmental Planning

Joy  
Navarrete

Digitally signed by Joy Navarrete  
DN: cn=Joy Navarrete, o=Planning,  
ou=Environmental Planning,  
email=joy.navarrete@sf.gov.org,  
c=US  
Date: 2016.10.20 15:09:12 -0700

# **Proposed 2016 San Francisco Building/Existing Building/Electrical/Plumbing/Mechanical/Green Building Code Amendment Correction List**

<b>PROPOSED 2016 SAN FRANCISCO BUILDING CODE AMENDMENTS CORRECTIONS</b>	
<b>Section No.</b>	<b>Correction</b>
102A.3.1	Duplicated text and section number have been deleted.
202	Story, First in Section 202 has been deleted.
406.3	Section number of 406.3 and a typo in the text have been corrected
1012.2	Exception number in Section 1012.2 has been corrected.
1016.2	Item number has been corrected.
1207	Section numbers in 1207 has been corrected.
<b>Finding Table Section No.</b>	<b>Correction</b>
102A.4.1	Section 102A.4.1 has been deleted in the Finding Table.
102A.4.2	Section 102A.4.2 has been deleted in the Finding Table.
102A.7.1	Section 102A.7.1 has been deleted in the Finding Table.
102A.7.2	Section 102A.7.2 has been deleted in the Finding Table.
102A.7.3	Section 102A.7.3 has been deleted in the Finding Table.
102A.10	Section 102A.10 has been deleted in the Finding Table.
103A.5	Section 103A.5 has been added to the Finding Table.
106A.1.14	Section 106A.1.14 has been added to the Finding Table.
106A.3.1	Section 106A.3.1 has been added to the Finding Table.
1011.5.5.1	Section 1011A.5.5.1 has been added to the Finding Table.
Chapter 11D	Chapter 11D has been added to the Finding Table.
1207	Section 1207 has been corrected in the Finding Table.
1312A.1	A typo in Section 1312A.1 has been corrected.
1510.10	Section 1510.10 has been corrected.
1705.1.1	Section 1705.1.1 has been added to the Finding Table.
<b>PROPOSED 2016 SAN FRANCISCO EXISTING BUILDING CODE AMENDMENTS CORRECTIONS</b>	
<b>Section No.</b>	<b>Correction</b>
301.2.1	The reference in this section has been corrected to Section 403.
407.4.1	Section 407.4.1 has been corrected.
<b>Finding Table Section No.</b>	<b>Correction</b>
326.4.1	Section 326.4.1 has been added to the Finding Table.
326.4.2	Section 326.4.2 has been added to the Finding Table.
404D.2.1	Section 404D.2.1 has been added to the Finding Table.
Table 4D-A	Table 4D-A has been added to the Finding Table.



Table 403E	Table 403E has been added to the Finding Table.
<b>PROPOSED 2016 SAN FRANCISCO PLUMBING CODE AMENDMENTS CORRECTIONS</b>	
<b>Section No.</b>	<b>Correction</b>
1101.2.3	The reference has been corrected to 1101.2.2
<b>Finding Table Section No.</b>	
603.3	Section 603.3 has been added in the Finding Table.
<b>PROPOSED 2016 SAN FRANCISCO ELECTRICAL CODE AMENDMENTS CORRECTIONS</b>	
<b>Section No.</b>	<b>Correction</b>
89.117. (A)	A parenthesis on the left side has been added.
230.43	Section 230.43 has been corrected by deleting the word "general" in the State language
230.71	Section 230.71 has been corrected by deleting the old San Francisco amendment.
330.12	Section 330.12 has been corrected by changing "Revise Item (1)"
411.5	A comma has been added in the text.
700.16	Change to "Revise the first paragraph of this section as follows".
760.46	Editor's Note has been deleted.
<b>Finding Table Section No.</b>	
210.5(C)(1)(a)	Section 210.5(C)(1)(a) has been corrected in the Finding Table.
215.12(C)(a)	Section 215.12(C)(a) has been corrected in the Finding Table.
330.12	Section 330.12 has been added in the Finding Table.
355.10(A)	Section 355.10(A) has been corrected in the Finding Table.
<b>PROPOSED 2016 SAN FRANCISCO MECHANICAL CODE AMENDMENTS CORRECTIONS</b>	
<b>Finding Table Section No.</b>	<b>Correction</b>
101.2	Section 101.2 has been deleted in the Finding Table.
<b>PROPOSED 2016 SAN FRANCISCO GREEN BUILDING CODE AMENDMENTS CORRECTIONS</b>	
<b>Section No.</b>	<b>Correction</b>
Chapter 4	The title of Chapter 4 has been corrected.
Chapter 5	The title of Chapter 5 has been corrected.
<b>Finding Table Section No.</b>	
	<b>Correction</b>

4.201.1	Section 4.201.1 in the Finding Table has been deleted.
5.101.1	Section 5.101.1 in the Finding Table has been deleted.
5.201.1.2	Section 5.201.1.2 has been added to the Finding Table.

## 2016 San Francisco Green Building Code Findings

Section #	Finding #	Section #	Finding #	Section #	Finding #
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### CHAPTER 1

Section #	Finding #	Section #	Finding #	Section #	Finding #
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101.2	9	101.6.1	9	101.11	9
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101.3.1	9	101.7	9		

### CHAPTER 2

Section #	Finding #	Section #	Finding #	Section #	Finding #
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### CHAPTER 3

Section #	Finding #	Section #	Finding #	Section #	Finding #
301.1	9				
302.1	9				
303.1.1.1	9				

### CHAPTER 4

Section #	Finding #	Section #	Finding #	Section #	Finding #
4.101.1	9	4.103.2.3	14,15	TABLE 4.104.A	12,14,15
4.103.1	9	4.103.2.4	7,11	4.104.2	9
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4.103.1.2	7,11	4.103.3	9	4.105.1	12,14,15
4.103.2	9	4.103.3.1	5,7,11,12,13, 14,15,16,17	4.105.1.1	12,14,15
4.103.2.1	5,7,11,12,13, 14,15,16,17	4.103.3.2	4,5,17	4.105.1.2	12,14,15
		4.104.1	12,14,15	4.201.2	12

### CHAPTER 5

Section #	Finding #	Section #	Finding #	Section #	Finding #
5.101.1	9	5.103.1.9	5,8,14,15,16	5.104.1	14,15
5.103.1	9	5.103.1.10	9	Table 5.104.A	14,15
5.103.1.1	5,7,11,12,13, 14,15,16,17	5.103.3	9	5.104.2	9
5.103.1.2	11,13,17	5.103.3.1	5,7,11,12,13, 14,15,16,17	5.105.1	14,15

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5.103.1.3	14,15	5.103.3.2	5,8,14,15,16	5.105.1.1	14,15
5.103.1.4	12	5.103.4	9	5.105.1.2	14,15
5.103.1.6	7,11	5.103.4.1	5,7,11,12,13, 14,15,16,17	5.201.1.2	3, 5, 14
5.103.1.7	9	5.103.4.2	5,8,14,15,16		
5.103.1.8	5,8,14,15,16				

**CHAPTER 6  
NO S.F. AMENDMENTS**

**CHAPTER 7**

<b>Section #</b>	<b>Finding #</b>	<b>Section #</b>	<b>Finding #</b>	<b>Section #</b>	<b>Finding #</b>
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702.2	9				

# PROPOSED SAN FRANCISCO GREEN BUILDING CODE AMENDMENTS 2016 Edition

## Chapter 1 ADMINISTRATION

### SECTION 101 – GENERAL

*Revise this section as follows:*

101.1 Title. These regulations shall be known as the California **San Francisco** Green Building Standards Code and may be cited as such and will be referred to herein as "this code". ~~It is intended that it shall also be known as the CALGreen Code.~~ The California **San Francisco** Green Building Standards Code consists of **the combination of** ~~is Part 11 of twelve parts~~ of the official compilation and publication of the adoption, amendment and repeal of building regulations to the California Code of Regulations, Title 24, ~~also referred to as and Chapter 13C of San Francisco Building Inspection Commission Amendments to the California Building Standards Code.~~

*Revise this section as follows:*

101.2 Purpose. The purpose of this ~~code chapter~~ is to ~~improve public~~ **promote the health, safety and general welfare of San Francisco residents, workers, and visitors by minimizing waste of energy, water, and other resources in the construction and operation of buildings in the City and County of San Francisco and by providing a healthy indoor environment.** The green building practices required by this chapter will also further the goal of reducing the greenhouse gas emissions in the City and County of San Francisco to 25 percent below 1990 levels by the year 2017, as stated in Board of Supervisors Resolution No. 158-02 and San Francisco Environment Code Chapter 9. ~~enhancing the design and construction of buildings through the use of building concepts having a reduced negative impact, or positive environmental impact and encouraging sustainable construction practices in the following categories:~~

- ~~1. Planning and design.~~
- ~~2. Energy efficiency.~~
- ~~3. Water efficiency and conservation.~~
- ~~4. Material conservation and resource efficiency.~~
- ~~5. Environmental quality.~~

*Revise this section as follows:*

101.3 Scope. The provisions of this code shall apply to the planning, design, operation, construction, use and occupancy of every newly constructed building or structure, unless otherwise indicated in this code, **as well as alterations to existing buildings throughout the State of California. the City and County of San Francisco.**

~~It is not the intent that~~ **While this code substitute or be identified as meeting references green building programs, the City and County of San Francisco does not confer certification requirements of under any green building program.**

*Revise this section as follows:*

101.3.1 ~~State-regulated~~ **Regulated** buildings, structures and applications. Provisions of this code shall apply to the following buildings, structures, and applications regulated by state agencies as specified in Sections 103 through 106 of California Green Building Standards Code Title 24 Part 11, ~~except where modified by local ordinance with supplemental requirements applicable to occupancy types A, B, I, M, E and R as defined by California Building Code Title 24 Section 302 (2013 2016) as amended pursuant to Section 101.7.~~ When adopted by a state agency, the provisions of this code shall be enforced by the appropriate enforcing agency, but only to the extent of authority granted to such agency by statute.

*Revise this section as follows:*

101.4 Appendices. ~~Provisions contained in the appendices of this code are not mandatory unless specifically adopted by a State agency or adopted by a city, county, or city and county in compliance with Health and Safety Code Sections 18930 and 18941.5, respectively, for Building Standards Law; Health and Safety Code Section 17950 for State Housing Law; and Health and Safety Code Section 13869.7 for Fire Protection Districts. See Section 101.7 of this code. [Reserved]~~

*Revise this section as follows:*

101.6.1 Differences. In the event of any differences between these building standards and the standard reference documents, the text of these building standards **this Chapter** shall govern. ~~In the event a local amendment to this code results in differences between these building standards and the amendment, the text of the amendment shall govern.~~

*Revise this section as follows:*

101.6.3 Conflicts. When the requirements of this code conflict with the requirements of any other part of the California Building Standards Code, Title 24, ~~the most restrictive requirement shall prevail. any provision contained elsewhere in the San Francisco Municipal Code, or any regulation or requirement adopted by the Public Utilities Commission or other City agency under its Charter authority, the most restrictive requirement shall prevail.~~

*Revise this section as follows:*

101.7 ~~City, county, or city and county amendments, additions or and deletions. This code is intended to set mandatory minimum Green Building Standards and includes optional tiers that may, at the discretion of any city, county or city and county, be applied. This code includes the amendments, deletions, and additions to California green building requirements which maintain stricter local green building standards.~~

*Revise this section as follows:*

101.10 ~~Mandatory requirements.~~ This code contains both mandatory and voluntary green building measures. ~~Mandatory and voluntary measures are identified in the appropriate application checklist contained in this code.~~ **Equivalency.** Wherever reference is made to the LEED® or GreenPoint Rated systems, a comparable equivalent rating system may be used if approved by the Director. The applicable LEED®, GreenPoint Rated or equivalent versions of performance standards for applications subject to this chapter are:

**LEED v4 for Interior Design and Construction (LEED v4 ID+C)**

**LEED v4 for Building Design and Construction (LEED v4 BD+C)**

**LEED v4 for Homes Design and Construction**

**GreenPoint Rated (GPR) Single Family New Home Construction -v7.0**

**GreenPoint Rated (GPR) Multifamily New Home Construction -v7.0**

**GreenPoint Rated (GPR) Existing Multifamily -v1.0**

Wherever specific LEED prerequisites or credits are cited, such references are to LEED v4 BD+C. More recent LEED and GreenPoint Rated versions may be used, provided the credits and points achieved are as or at least as stringent as LEED v4 BD+C or GPR v7.0.

Wherever the LEED or GreenPoint Rated systems include a minimum energy or other performance requirement, the permit applicant may choose to meet the minimum performance requirements with an alternative equivalent method approved by the Director.

Compliance with any of these requirements may be verified and/or certified by any means, including third-party review or equivalent requirements verified via other rating systems, as approved by the Director.

*Revise this section as follows:*

101.11 Effective use of this code. The following steps may be used to establish which provisions of this code are applicable to a specific occupancy:

1. Establish the type of occupancy.
2. Verify which state agency has authority for the established occupancy by reviewing the authorities list in Sections 103 through 106.
- ~~2.~~ 3. Once the appropriate agency has been identified, ~~find~~ **Find** the section which covers the established occupancy.
- ~~3.~~ 4. The Matrix Adoption Tables at the beginning of Chapters 4 and 5 ~~Identify~~ **Identify** the mandatory green building measures necessary to meet the minimum requirements of this code for the established occupancy in Sections 4 and 5.
5. Voluntary tier measures are contained in Appendix Chapters A4 and A5. A Checklist containing each green building measure, both required and voluntary is provided at the end of each appendix chapter. Each measure listed in the application checklist has a section number which correlates to a section where more information about the specific measure is available.
6. The Application Checklist identifies which measures are required by this code and allows users to check off which voluntary items have been selected to meet voluntary tier levels if desired or mandated by a city, county, or city and county.
4. Administrative Bulletin 93, provided by the Department of Building Inspection, summarizes how the requirements of San Francisco Green Building Code and relevant local requirements may be

met. Appendices to Administrative Bulletin 93 include tabular summaries of required measures, and provide submittal forms.

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## Chapter 2

# DEFINITIONS

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### SECTION 202 – DEFINITIONS

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*Add and amend the following definitions:*

**GREENPOINT RATED, GREENPOINTS and GREENPOINTS CHECKLIST.** The residential green building rating system and checklist and certification methodology of the non-profit organization Build It Green.

**HIGH-RISE RESIDENTIAL BUILDING.** For the purposes of ~~this code~~ CalGreen, a building that is of Occupancy Group R and is four stories or greater.

**HISTORICAL RESOURCE.** A property that meets the terms of the definitions in Section 21084.1 of the CEQA Statute (The California Environmental Quality Act [Public Resources Code Section 21084.1]) and Section 15064.5 of the CEQA Guidelines, as determined by the San Francisco Planning Department.

**LARGE COMMERCIAL BUILDING.** A commercial building or addition of Group B, M, A, ~~or I,~~ or E, occupancy that is 25,000 gross square feet or more.

**LEED® and LEED® Checklist.** The Leadership in Energy and Environment Design rating system, certification methodology, and checklist of the United States Green Building Council (USGBC).

**LOW-RISE RESIDENTIAL BUILDING.** For the purposes of ~~CalGreen~~ ~~this code~~, a building that is of Occupancy Group R and is three stories or less or that is a one or two family dwelling or townhouse.

**MAJOR ALTERATIONS.** Alterations where interior finishes are removed and significant upgrades to structural and mechanical, electrical and/or plumbing systems are proposed where areas of such construction are 25,000 gross square feet or more in Group B, M or R occupancies of existing buildings.

**NEWLY CONSTRUCTED (or NEW CONSTRUCTION).** A newly constructed building (or new construction) is a building that has never before been used or occupied for any purpose and does not include additions, alterations or repairs.

**NEW LARGE COMMERCIAL INTERIORS.** First-time tenant improvements where areas of such construction are over 25,000 gross square feet or more in Group B or M occupancy areas of existing buildings.



**NONRESIDENTIAL COMPLIANCE MANUAL.** The document published by the California Energy Commission to aid in compliance and enforcement of the Title 24 California Building Energy Standards, for buildings of nonresidential occupancy and high-rise residential buildings.

**RESIDENTIAL COMPLIANCE MANUAL.** The document published by the California Energy Commission to aid in compliance and enforcement of the Title 24 California Building Energy Standards, for low-rise residential buildings.

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## Chapter 3

# GREEN BUILDING

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### SECTION 301 – GENERAL

*Revise this section as follows:*

301.1 Scope. Buildings in the City and County of San Francisco shall be designed to include the green building measures specified as mandatory in the application checklists contained in this code. Voluntary green building measures are also included in under the application checklists and may be included **California Green Building Standards Code (CalGreen)**, in the design and construction of structures covered by this code but are not required unless adopted by a city, county or city and county as specified in Section 101.7

Additional green building requirements established by the City and County of San Francisco are mandatory for:

- (1) Newly constructed Group R occupancy buildings,
- (2) Newly constructed buildings of Group B, M, A, and I occupancies that are 25,000 gross square feet or more,
- (3) New first-time build-outs of commercial interiors that are 25,000 gross square feet or more in buildings of Group B or M occupancies, and
- (4) Major alterations that are 25,000 gross square feet or more in existing buildings of Group B, M or R occupancies, where interior finishes are removed and significant upgrades to structural and mechanical, electrical and/or plumbing systems are proposed.

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### SECTION 302 – MIXED OCCUPANCY BUILDINGS

*Revise this section as follows:*

302.1 Mixed occupancy buildings. In mixed occupancy buildings, each portion of a building shall comply with the specific green building **California Title 24 Part 11** required measures applicable to each specific occupancy. However, to fulfill any additional local green building requirements, the project sponsor may apply a single required green building standard to the entire building.

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### SECTION 303 – PHASED PROJECTS

*Add the following section:*

**303.1.1.1 Maintenance of required features.** Any structure subject to this chapter shall maintain the green building features required herein, or equivalent, regardless of subsequent alterations, additions, or changes of use, unless subject to subsequent or more stringent requirements.

*Modify the following section:*

## **SECTION 304 – VOLUNTARY TIERS**

**This section not applicable in San Francisco.**

**304.1 Purpose.** Voluntary tiers are intended to further encourage building practices that improve public health, safety and general welfare by promoting the use of building concepts which minimize the building's impact on the environment and promote a more sustainable design.

**304.1.1 Tiers.** The provisions of Divisions A4.6 and A5.6 outline means, in the form of voluntary tiers, of achieving enhanced construction levels by incorporating additional measures for residential and nonresidential new construction. Voluntary tiers may be adopted by local governments and, when adopted, enforced by local enforcing agencies. Buildings complying with tiers specified for each occupancy contain additional prerequisite and elective green building measures necessary to meet the threshold of each tier. See section 101.7 of this code for procedures and requirements related to local amendments, additions or deletions, including changes to energy standards.

[ BSC] Where there are practical difficulties involved in complying with the threshold levels of a tier, the enforcing agency may grant modifications for individual cases. The enforcing agency shall first find that a special individual reason makes the strict letter of the tier impractical and that modification is in conformance with the intent and purpose of the measure. The details of any action granting modification shall be recorded and entered in the files of the enforcing agency.

*Modify the following section:*

## **SECTION 305 [OSHPD 1] – CALGREEN TIER 1 AND CALGREEN TIER 2**

**This section not applicable in San Francisco.**

**305.1 CALGreen Tier 1 and CALGreen Tier 2 buildings** contain voluntary green building measures necessary to meet the threshold of each level.

**305.1.1 CALGREEN Tier 1.** To achieve CALGreen Tier 1, buildings must comply with the latest edition of "Savings By Design, Healthcare Modeling Procedures" found online at <http://www.energysoft.com/ep/2007SBDHPProcedures.pdf>

**305.1.2 CALGREEN Tier 2.** To achieve CALGreen Tier 2, buildings must exceed the latest edition of "Savings By Design, Healthcare Modeling Procedures" by a minimum of 15%.

*Modify the following section:*

## **SECTION 306 [DSA-SS] – VOLUNTARY MEASURES**

**This section not applicable in San Francisco.**

**306.1 Purpose.** Voluntary measures are intended to further encourage building practices that improve public health, safety and general welfare by promoting the use of building concepts which minimize the building's impact on the environment, promote a more sustainable design, and high performance educational facilities.

**306.1.1** The provisions of Appendix A5 outline means of achieving enhanced construction levels by incorporating additional measures.

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## **Chapter 4**

# **RESIDENTIAL MANDATORY MEASURES**

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### **Division 4.1**

## **PLANNING AND DESIGN**

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### **SECTION 4.101 – GENERAL**

*Modify the following section:*

**4.101.1 Scope.** The provisions of this division outline planning, design and development methods that include environmentally responsible site selection, building design, building siting and development to protect, restore, enhance the environmental quality of the site, and respect the integrity of adjacent properties, and promote the health, safety and welfare of San Francisco residents.

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*Replace the following section:*

### **SECTION 4.103 – REQUIREMENTS FOR GROUP R OCCUPANCY BUILDINGS**

#### **4.103.1 New low-rise residential buildings.**

##### **4.103.1.1 Rating requirements**

New residential buildings must be GreenPoint Rated and applicants must submit documentation demonstrating that a minimum of 75 GreenPoints from the GreenPoints Single Family New Construction Checklist or the GreenPoints Multifamily New Construction Checklist will be achieved. Alternatively, this rating requirement may be met by obtaining LEED Silver certification.

##### **4.103.1.2 Stormwater management**

Projects subject to this section shall meet the San Francisco Public Utilities Commission stormwater management requirements.

#### **4.103.2 New high-rise residential buildings**

##### **4.103.2.1 Rating requirement**

Permit applicants must submit documentation to achieve LEED® “Silver” certification. Alternatively, this rating requirement may be met by obtaining the GreenPoint Rated designation and submitting documentation demonstrating that a minimum of 75 GreenPoints from the GreenPoint Rated Multifamily New Construction checklist will be achieved.

#### 4.103.2.2 [Reserved]

4.103.2.3 Construction debris management. Permit applicants must submit documentation verifying the diversion of a minimum 75 percent of the projects construction and demolition debris. The waste management plan necessary to meet this requirement shall be updated as necessary and shall be accessible during construction for examination by the Department of Building Inspection. Permit applicants must also meet the requirements of San Francisco Environment Code Chapter 14 and San Francisco Building Code Chapter 13B (Construction and Demolition Debris Recovery Program.)

4.103.2.4 Stormwater management. Projects subject to this section shall meet the San Francisco Public Utilities Commission stormwater management requirements.

4.103.2.4.1 Construction activity stormwater pollution prevention. All projects, whether greater or lesser than one acre, must develop and implement construction activity pollution prevention and site run-off controls adopted by the San Francisco Public Utilities Commission.

### 4.103.3 MAJOR ALTERATIONS TO EXISTING GROUP R OCCUPANCY BUILDINGS

#### 4.103.3.1 RATING REQUIREMENT

Permit applicants must submit documentation to achieve a LEED® Gold rating. Alternatively, this rating requirement may be met by obtaining the GreenPoint Rated designation and submitting documentation demonstrating that a minimum of 75 GreenPoints from the GreenPoint Rated Multifamily checklist will be achieved. Major alterations applying to less than 80% of the building’s gross floor area may alternately obtain the GreenPoint Rated Elements designation and submit documentation demonstrating that 49 points from the GreenPoint Rated Multifamily checklist have been achieved.

#### 4.103.3.2 LOW-EMITTING MATERIALS

Alterations utilizing LEED must submit documentation verifying that low-emitting materials are used, subject to on-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials wherever applicable: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

Alterations utilizing GreenPoint Rated must submit documentation to verify the use of low-emitting materials meeting the GreenPoint Rated Multifamily New Homes measures for low-emitting coatings, adhesives and sealants, and carpet systems.

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*Replace the following section:*

## SECTION 4.104 – HISTORIC PRESERVATION

4.104.1 On-site retention of historical features. For alterations of buildings determined to be historical resources, after demonstrating compliance with all applicable codes, including the 2013

2016 California Building Energy Efficiency Standards (Title 24, Part 6) and the 2013 2016 California Historical Building Code (Title 24, Part 8), the minimum points or credits required under this chapter shall be reduced for retention and in-situ reuse or restoration of certain character defining features, as described in Table 4.104A. Retention includes the rehabilitation and repair of character-defining features that conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.

TABLE 4.104.A

SIGNIFICANT HISTORICAL ARCHITECTURAL FEATURES	PERCENT RETAINED*	ADJUSTMENT TO MINIMUM LEED POINT REQUIREMENT	ADJUSTMENT TO MINIMUM GREENPOINTS REQUIREMENT
Windows @ principal façade(s)	100%	4	15
Other windows	At least 50%	1	3
Other windows	100%	2	6
Exterior doors @ principal façade(s)	100%	1	3
Siding or wall finish @ principal façade(s)	100%	1	4
Trim & casing @ wall openings on principal façade(s)	100%	1	3
Roof cornices or decorative eaves visible from right-of-way	100%	1	3
Sub-cornices, belt courses, water tables, and running trim visible from right-of-way	100%	1	3
Character-defining elements of significant interior spaces	100%	4	15

Other exterior ornamentation (e.g. cartouches, corbels, quoins, etc.) visible from right-of-way	80%	1	3
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**4.104.2. Adjustment to Green Credit for Retention of Historic Features. Where the historical resource is a portion of the total project, the LEED or GreenPoint Rated requirement shall be adjusted to equal the percentage of gross floor area of the historical resource compared to the total project gross floor area.**

*Replace the following section:*

## **SECTION 4.105 – DEMOLITION OF EXISTING STRUCTURES**

**4.105.1 Adjustments to Rating Requirements for Building Demolition and Density.** Applications subject to the San Francisco Green Building Code, whereby construction of a new building is proposed within five years of the demolition of a building on the site, where such demolition occurred after the effective date of the Green Building Ordinance - November 3, 2008 - the sustainability requirements for new buildings pursuant to the San Francisco Green Building Code shall be increased as follows:

**4.105.1.1 LEED® Projects.** For projects attaining a LEED® certification:

- (1) Where the building demolished was an historical resource, the required points shall be increased by 10 points.
- (2) Where the building demolished was not an historical resource, the required points shall be increased by 6 additional points.
- (3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 5 additional points.

**4.105.1.2 GreenPoint Rated Projects.** For projects attaining GreenPoint Rated:

- (1) Where the building demolished was an historical resource, the required points shall be increased by 25 additional points.
- (2) Where the building demolished was not an historical resource, the required points shall be increased by 20 additional points.
- (3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 17 additional points.

## **Division 4.2 ENERGY EFFICIENCY**

## **SECTION 4.201– GENERAL**

*Add the following section:*

### **4.201.2. RENEWABLE ENERGY AND BETTER ROOFS**

**(a) Newly constructed Group R occupancy buildings of 10 occupied floors or less and that apply for a building permit on or after January 1, 2017 shall install solar photovoltaic systems and/or solar thermal systems in the solar zone required by California Code of Regulations (CCR), Title 24, Part 6 Section 110.10.**

**(b) The minimum solar zone area for the project shall be calculated under Title 24, Part 6, Section 110.10(b) through (e), as applicable, and Residential Compliance Manual Chapter 7 or Nonresidential Compliance Manual Chapter 9, as applicable, except as provided below.**

**(1) For single family residences, Exceptions 3 and 5 to Title 24, Part 6, Section 110.10(b)1A may be applied in the calculation of the minimum solar zone area. Exceptions 1, 2, 4, 6, and 7 may not be applied in the calculation.**

**(2) For Group R Occupancy buildings other than single family residences, Exceptions 3 and 5 to Title 24, Part 6, Section 110.10(b)1B may be applied in the calculation of the minimum solar zone area. Exceptions 1, 2, and 4 may not be applied in the calculation.**

**(3) Buildings with a calculated minimum solar zone area of less than 150 contiguous square feet due to limited solar access under Exception 5 to Title 24, Part 6, Section 110.10(b)1A or Exception 3 to Title 24, Part 6, Section 110.10(b)1B are exempt from the solar energy requirements in this Section 4.201.2.**

**(c) The sum of the areas occupied by solar photovoltaic collectors and/or solar thermal collectors must be equal to or greater than the solar zone area. The solar zone shall be located on the roof or overhang of the building, or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project. Solar photovoltaic systems and solar thermal systems shall be installed in accord with: all applicable State code requirements, including access, pathway, smoke ventilation, and spacing requirements specified in CCR Title 24, Part 9; all applicable local code requirements; manufacturer's specifications; and the following performance requirements:**

**(1) Solar photovoltaic systems: The total nameplate capacity of photovoltaic collectors shall be at least 10 Watts<sub>DC</sub> per square foot of roof area allocated to the photovoltaic collectors.**

**(2) Solar thermal systems: Single family residential solar domestic water heating systems shall be OG-300 System Certified by either the Solar Rating and Certification Corporation (SRCC) or the International Association of Plumbing and Mechanical Officials (IAPMO). Solar thermal systems installed in all Group R occupancy buildings other than single family residences shall use collectors with OG-100 Collector Certification by SRCC or IAPMO, shall be designed to generate annually at least 100 kBtu per square foot of roof area allocated to the solar thermal**

collectors. Systems with at least 500 square feet of collector area shall include a Btu meter installed on either the collector loop or potable water side of the solar thermal system.

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# Chapter 5

## NONRESIDENTIAL MANDATORY MEASURES

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### Division 5.1

### PLANNING AND DESIGN

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#### SECTION 5.101 –GENERAL

*Modify the section as follows:*

5.101.1 Scope. The provisions of this chapter outline planning, design and development methods that include environmentally responsible site selection, building design, building siting and development to protect, restore, and enhance the environmental quality of the site, and respect the integrity of adjacent properties, and promote the health, safety and welfare of San Francisco residents.

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*Replace the following section:*

#### SECTION 5.103 – REQUIREMENTS FOR GROUP A, B, I, E and M BUILDINGS

##### 5.103.1 New Large Commercial Buildings.

5.103.1.1 Rating requirement. Permit applicants must submit documentation to achieve LEED "Gold" certification.

5.103.1.2 Indoor water use reduction. Permit applicants must submit documentation verifying that project meets maximum prescriptive fixture flow rates in accordance with the California Plumbing Code. The project must also achieve the LEED WE Prerequisite Indoor Water Use Reduction (WEp2) and a minimum 30 percent reduction in the use of indoor potable water, as calculated to meet the LEED WE credit Indoor Water Use Reduction (WEc2).

5.103.1.3 Construction waste management. Permit applicants must submit documentation verifying the diversion of a minimum 75 percent of the project's construction and demolition waste, as calculated to meet LEED MR Prerequisite Construction and Demolition Waste Management Planning and LEED MR Credit Construction and Demolition Waste Management. Permit applicants must also meet the requirements of San Francisco Environment Code Chapter 14 and San Francisco Building Code Chapter 13B (Construction and Demolition Debris Recovery Program.) The waste management plan necessary to meet this requirement shall be updated as necessary and shall be accessible during construction for examination by the Department of Building Inspection.

5.103.1.4 Commissioning. Permit applicants must submit documentation verifying that the facility has been or will meet the criteria necessary to achieve CALGreen section 5.410.2 and Option 1 of LEED EA credit (Enhanced Commissioning), in addition to LEED EA Prerequisite (Fundamental Commissioning) and Verification.

**5.103.1.6 Stormwater management.** Projects subject to this section shall meet the San Francisco Public Utilities Commission stormwater management requirements. All new building projects must develop and implement an Erosion and Sediment Control Plan or Stormwater Pollution Prevention Plan and implement site run-off controls adopted by the San Francisco Public Utilities Commission as applicable.

**5.103.1.7 Energy performance.** [Reserved]

**5.103.1.8 Temporary ventilation and IAQ management during construction.** Permit applicants must submit documentation verifying that an Indoor Air Quality Management Plan is prepared and implemented which meets LEED EQ Credit Construction Indoor Air Quality Management and Title 24 Part 11 Sections 5.504.1 and 5.504.3.

**5.103.1.9 Low-Emitting Materials.** Permit applicants must submit documentation verifying that low-emitting materials are used, subject to on-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials wherever applicable: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

**5.103.1.10 CALGreen mandatory measures.** The following measures are mandatory in California for new non-residential buildings. Optionally, similar LEED credits can be used as alternative compliance paths, as noted below:

Title 24 Part 11 Section(s)	Topic/Requirement	Alternate Compliance Option:
5.106.8	Light pollution reduction	Meet LEED <u>SS Credit Light Pollution Reduction</u>
5.508.1.2	Halons not allowed in HVAC, refrigeration and fire suppression equipment.	Meet LEED <u>EA Credit Enhanced Refrigerant Management</u> , and additionally document that all HVAC&R systems do not contain CFCs or halons.

**5.103.3 Major Alterations to Existing Non Residential Buildings.**

**5.103.3.1 Rating requirement.** Permit applicants must submit documentation to achieve LEED "Gold" certification.

**5.103.3.2 Low emitting materials.** Permit applicants must submit documentation verifying that low-emitting materials are used, subject to in-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

**5.103.4 New Large Commercial Interiors.**

5.103.4.1 Rating requirement. Permit applicants must submit documentation to achieve LEED "Gold" certification.

5.103.4.2 Low emitting materials. Permit applicants must submit documentation verifying that low-emitting materials are used, subject to in-site verification, meeting at least the following categories of materials covered under LEED EQ Credit Low-Emitting Materials: interior paints and coatings applied on-site, interior sealants and adhesives applied on site, flooring, and composite wood.

*Replacethe following section:*

## SECTION 5.104– HISTORIC PRESERVATION

5.104.1 On-site Retention of Historical Features. For alterations of buildings determined to be historical resources, after demonstrating compliance with all applicable codes, including the 2013 2016 California Building Energy Efficiency Standards (Title 24, Part 6) and the 2013-2016 California Historical Building Code (Title 24, Part 8), the minimum points or credits required under this chapter shall be reduced for retention and in-situ reuse or restoration of certain character defining features, as described in Table 5.104A. Retention includes the rehabilitation and repair of character-defining features that conform to the Secretary of the Interior's Standards for the Treatment of Historic Properties.

TABLE 5.104.A

SIGNIFICANT HISTORICAL ARCHITECTURAL FEATURES	PERCENT RETAINED*	ADJUSTMENT TO MINIMUM LEED POINT REQUIREMENT	ADJUSTMENT TO MINIMUM GREENPOINTS REQUIREMENT
Windows @ principal façade(s)	100%	4	15
Other windows	At least 50%	1	3
Other windows	100%	2	6
Exterior doors @ principal façade(s)	100%	1	3
Siding or wall finish @ principal façade(s)	<u>100%</u>	1	4
Trim & casing @ wall openings on principal	100%	1	3

façade(s)			
Roof cornices or decorative eaves visible from right-of-way	100%	1	3
Sub-cornices, belt courses, water tables, and running trim visible from right-of-way	<u>100%</u>	1	3
Character-defining elements of significant interior spaces	100%	4	15
Other exterior ornamentation (e.g. cartouches, corbels, quoins, etc.) visible from right-of-way	80%	1	3

**5.104.2. Adjustment to Green Credit for Retention of Historic Features.** Where the historical resource is a portion of the total project, the LEED or GreenPoint Rated point requirement shall be adjusted to equal the percentage of gross floor area of the historical resource compared to the total project gross floor area.

*Replace the following section:*

## **SECTION 5.105 – DEMOLITION OF EXISTING STRUCTURES**

**5.105.1 Adjustments to Rating Requirements.** Applications subject to the San Francisco Green Building Code, whereby construction of a new building is proposed within five years of the demolition of a building on the site, where such demolition occurred after November 3, 2008, the sustainability requirements for new buildings pursuant to the San Francisco Green Building Code shall be increased as follows:

**5.105.1.1 LEED® Projects.** For projects attaining a LEED® certification:

- (1) Where the building demolished was an historical resource, the required points shall be increased by 10 points, which is 10% of the total available in the LEED® rating system, absent demolition.

- (2) Where the building demolished was not an historical resource, the required points shall be increased by 6 additional points, which is 10% of the maximum total required points under this chapter, absent demolition.
- (3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 5 additional points, which is 8% of the maximum total required points under this chapter, absent demolition.

**5.105.1.2 GreenPoint Rated Projects. For projects attaining GreenPoint Rated:**

- (1) Where the building demolished was an historical resource, the required points shall be increased by 25 additional points.
- (2) Where the building demolished was not an historical resource, the required points shall be increased by 20 additional points.
- (3) Where the building demolished was not an historical resource and the number of dwellings in the residential portion of the replacement structure are tripled, the required points shall be increased by 17 additional points.

## Division 5.2

# ENERGY EFFICIENCY

### SECTION 5.201 –GENERAL

*Add the following section:*

#### 5.201.1.1 Energy performance. [Reserved]

#### 5.201.1.2. RENEWABLE ENERGY AND BETTER ROOFS

(a) Newly constructed buildings of nonresidential occupancy that are of 10 occupied floors or less, are 2000 square feet or greater in gross floor area, and apply for a building permit on or after January 1, 2017 shall install solar photovoltaic systems and/or solar thermal systems in the solar zone required by California Title 24, Part 6 Section 110.10.

(b) The required solar zone area for the project shall be calculated under California of Regulations (CCR), Title 24, Part 6, Section 110.10(b) through (e), and Nonresidential Compliance Manual Chapter 9; provided, however that Exceptions 3 and 5 to Title 24, Part 6, Section 110.10(b)1B may be applied in the calculation of the minimum solar zone area and Exceptions 1, 2, and 4 shall not be applied in the calculation. Buildings with a calculated minimum solar zone area of less than 150 contiguous square feet due to limited solar access under Exception 3 are exempt from the solar energy requirements in this Section 5.201.1.2.

(b) The sum of the areas occupied by solar photovoltaic collectors and/or solar thermal collectors must be equal to or greater than the solar zone area. The solar zone shall be located on the roof or overhang of the building, or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project. Solar photovoltaic systems and solar thermal systems shall be installed in accord with all applicable state and local code requirements, manufacturer's specifications, and the following performance requirements:

(1) Solar photovoltaic systems: The total nameplate capacity of photovoltaic collectors shall be at least 10 Watts<sub>DC</sub> per square foot of roof area allocated to the photovoltaic collectors.

(2) Solar thermal systems: Solar thermal systems installed to serve non-residential building occupancies shall use collectors with OG-100 Collector Certification by the Solar Rating and Certification Corporation (SRCC) or the International Association of Plumbing and Mechanical Officials (IAPMO), shall be designed to generate annually at least 100 kBtu per square foot of roof area allocated to the solar thermal collectors, and, for systems with at least 500 square feet of collector area, shall include a Btu meter installed on either the collector loop or potable water side of the solar thermal system.

#### 5.201.1.3 Renewable energy. Permit applicants constructing new buildings of 11 floors or greater must submit documentation verifying either:

(1) Acquisition of renewable on-site energy (demonstrated via EA Credit Renewable Energy Production) or purchase of green energy credits (demonstrated via EA Credit Green Power and Carbon Offsets) OR

(2) Enhance energy efficiency (demonstrated via at least 5 LEED points under EA Credit Optimize Energy Performance) in addition to compliance with Title 24 Part 6 2016 California Energy Standards

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## Chapter 7

# INSTALLER AND SPECIAL INSPECTOR QUALIFICATIONS

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### SECTION 701—GENERAL

*Add the following section:*

**701.1** These requirements apply to installers and Special inspectors with regards to the requirements of this chapter.

---

### SECTION 702 – QUALIFICATIONS

*Modify the following section:*

**702.2** Special inspection....

2. Certification by a statewide energy consulting or verification organization, such as HERS raters, building performance contractors, and home energy auditors, and ICC Certified CALGreen Inspectors.

*Add the section as follows:*

**702.3** Special inspection. The Director of the Department of Building Inspection may require special inspection to verify compliance with this code or other laws that are enforced by the agency. The special inspector shall be a qualified person who shall demonstrate competence, to the satisfaction of the Director of the Department of Building Inspection, for inspection of the particular type of construction or operation requiring special inspection. In addition, the special inspector shall have a certification from a recognized state, national, or international association, as determined by the Director of the Department of Building Inspection. The area of certification shall be closely related to the primary job function, as determined by the local agency.

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### SECTION 703 – VERIFICATIONS

*Modify the section as follows:*

**703.1 Documentation.** Documentation used to show compliance with this code shall include but is not limited to, construction documents, plans, specifications, builder or installer certification, inspection reports, or other methods acceptable to the enforcing agency-Director of the Department of Building

**Inspection** which demonstrate substantial conformance. When specific documentation or special inspection is necessary to verify compliance, that method of compliance will be specified in the appropriate section or identified in the application checklist **Administrative Bulletin 93**.

DRAFT



**CALIFORNIA  
ADOPTED THE FOLLOWING:**

FINAL EXPRESS TERMS  
FOR  
APPROVED BUILDING STANDARDS  
FOR THE  
2016 CALIFORNIA GREEN BUILDING STANDARDS CODE  
AND  
2016 BUILDING ENERGY EFFICIENCY STANDARDS  
OF THE  
CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PARTS 11 & 6 RESPECTIVELY

- THE CALIFORNIA BUILDING STANDARDS COMMISSION (BSC)
- THE CALIFORNIA ENERGY COMMISSION (CEC)
- THE DIVISION OF THE STATE ARCHITECT – STRUCTURAL SAFETY (DSA/SS)
- THE DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPEMENT (HCD)

Disclaimer: All Final Express Terms for the above mentioned agencies are available and were obtained from the Building Standards Commission at the following link:

<http://www.bsc.ca.gov/Rulemaking/adoptcycle/2015CodeAdoptionCycle/ApprovedStandardsDecember2015.aspx><http://www.bsc.ca.gov/Rulemaking/adoptcycle/2015CodeAdoptionCycle/ApprovedStandardsJanuary2016.aspx>



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2. THE CALIFORNIA ENERGY COMMISSION	(CEC 01/15)
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4. THE DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT	(HCD 07/15)
<b>II) 2016 CALIFORNIA BUILDING ENERGY EFFICIENCY STANDARDS</b>	
1. THE CALIFORNIA ENERGY COMMISSION	(CEC 02/15)

Disclaimer: All Final Express Terms for the above mentioned agencies are available and were obtained from the Building Standards Commission at the following link:

<http://www.bsc.ca.gov/Rulemaking/adoptcycle/2015CodeAdoptionCycle/ApprovedStandardsDecember2015.aspx>  
<http://www.bsc.ca.gov/Rulemaking/adoptcycle/2015CodeAdoptionCycle/ApprovedStandardsJanuary2016.aspx>



**FINAL EXPRESS TERMS  
FOR  
PROPOSED BUILDING STANDARDS  
OF THE  
CALIFORNIA BUILDING STANDARDS COMMISSION (CBSC)**

**REGARDING THE CALIFORNIA GREEN BUILDING STANDARDS CODE (CALGreen)  
CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PART 11**

(The State agency shall draft the regulations in plain, straightforward language, avoiding technical terms as much as possible and using a coherent and easily readable style. The agency shall draft the regulation in plain English. A notation shall follow the express terms of each regulation listing the specific statutes authorizing the adoption and listing specific statutes being implemented, interpreted, or made specific. (PART 1 – ADMINISTRATIVE CODE))

**LEGEND FOR EXPRESS TERMS**

1. New California amendments: All such language appears underlined.
2. Repealed text: All such language appears in ~~strikeout~~.

**FINAL EXPRESS TERMS:**

The California Building Standards Commission (CBSC) proposes to amend the 2013 edition of the California Green Building Standards Code (CALGreen) for the 2015 Triennial Code Cycle.  
Amended text is as follows:

**ITEM NUMBERS LISTED BELOW**

**ITEM 1. CBSC Proposes to amend the Preface, Acknowledgements & Legend Agency Adoptions**

**PREFACE**

This document is the Part 11<sup>th</sup> of ~~twelve~~ thirteen parts of the official triennial compilation and publication of the adoptions, amendments and repeal of regulations to *California Code of Regulations, Title 24*, also referred to as the *California Building Standards Code*. This part is known as the *California Green Building Standards Code*, and it is intended that it shall also be known as the *CALGreen Code*.

The *California Building Standards Code* is published in its entirety every...

**ACKNOWLEDGEMENTS**

The 2013~~6~~ *California Building Standards Code* (Code) was developed through the outstanding collaborative efforts of the Department of Housing and Community Development, the Division of the State Architect, the Office of the State Fire Marshal, the Office of Statewide Health Planning and Development, the California Energy Commission, the California Department of Public Health, the California State Lands Commission, the Board of State and Community Corrections, and the California Building Standards Commission (Commission).

This collaborative effort included the assistance of the Commission's Code Advisory Committees and many other volunteers who worked tirelessly to assist the Commission in the production of this Code.

*Governor Edmund G. Brown Jr.*

*Members of the Building Standards Commission*

*Secretary Anna Caballero Marybel Batjer – Chair*  
*~~James Barthman~~ Steven Winkel – Vice-Chair*

<i><del>Stephen Jensen</del> <u>Elley Klausbruckner</u></i>	<i><del>Rose Conroy</del> <u>Cheryl Roberts</u></i>
<i><del>Randy Twist</del> <u>Larry Booth</u></i>	<i><del>Sheila Lee</del> <u>David Malcolm Carson</u></i>
<i><del>Richard Sawhill</del></i>	<i><del>Richard Sierra</del> <u>Pedro Santillan</u></i>
<i><del>Kent Sasaki</del></i>	<i><del>James Barthman</del></i>
<i><u>Rajesh Patel</u></i>	<i><u>Erick Mikiten</u></i>

*Jim McGowan – Executive Director*  
*Michael L. Nearman – Deputy Executive Director*

For questions on California state agency amendments; please refer to the contact list on page v.

### LEGEND FOR AGENCY ADOPTIONS

Unless otherwise noted, state agency adoptions are indicated by the following banners in the section leaders:  
Department...  
California Building Standards Commission, CALGreen: **[BSC-CG]**  
Division ...  
Office...

Notation:

**Authority:** Health and Safety Code § Sections 18930.5, 18934.5, and 18938.

**Reference:** Health and Safety Code §, Division 13, Part 2.5, commencing with Section 18901.

### **ITEM 2. CBSC Proposes to amend Chapter 1, Section 101 General**

#### **CHAPTER 1 ADMINISTRATION**

#### **SECTION 101 GENERAL**

**101.1 Title.** These regulations shall be known as the *California Green Building Standards Code* and may be cited as such and will be referred to herein as "this code." It is intended that it shall also be known as the *CALGreen Code*. The *California Green Building Standards Code* is Part 11 of ~~twelve~~ thirteen parts of the official compilation and publication of the adoption, amendment and repeal of building regulations to the *California Code of Regulations*, Title 24, also referred to as the *California Building Standards Code*.

...

**101.7 City, county, or city and county amendments, additions or deletions.** This code is intended to set mandatory minimum Green Building Standards and includes optional tiers that may, at the discretion of any city, county, or city and county, be applied.

This code does not limit the authority of city, county, or city and county governments to make necessary changes to the provisions contained in this code pursuant to Section 101.7.1. The effective date of amendments, additions, or deletions to this code for cities, counties, or cities and counties filed pursuant to Section 101.7.1 shall be the date on which it is filed. However, in no case shall the

amendments, additions or deletions to this code be effective any sooner than the effective date of this code.

Local modifications shall comply with *Health and Safety Code* Section 18941.5(b) for Building Standards Law, *Health and Safety Code* Section 17958.5 for State Housing Law or *Health and Safety Code* Section 13869.7 for Fire Protection Districts.

#### **101.7.1 Findings and filings.**

1. The city, county, or city and county shall make express findings for each amendment, addition or deletion based upon climatic, topographical or geological conditions. For the purpose of this section, climatic, topographical or geological conditions include local environmental conditions as established by the city, county, or city and county.
2. The city, county, or city and county shall file the amendments, additions or deletions expressly marked and identified as to the applicable findings. Cities, counties, cities and counties, and fire departments shall file the amendments, additions or deletions and the findings with the California Building Standards Commission at 2525 Natomas Park Drive, Suite 130, Sacramento, CA 95833.
3. Findings prepared by fire protection districts shall be ratified by the local city, county, or city and county and filed with the California Department of Housing and Community Development at 1800 3<sup>rd</sup> Street, Room 260, Sacramento, CA 95811 2020 West El Camino Avenue, Suite 250, Sacramento, CA 95833-1829.
4. The city, county, or city and county shall obtain California Energy Commission approval for any energy related ordinances consistent with *Public Resources Code* Section 25402.1(h)(2) and Title 24, Part 1, Section 10-106. Local governmental agencies may adopt and enforce energy standards for newly constructed buildings, additions, alterations and repairs, provided the California Energy Commission finds that the standards will require buildings to be designed to consume no more energy than permitted by Part 6. Such local standards include, but are not limited to, adopting the requirements of Part 6 before their effective date, requiring additional energy conservation measures, or setting more stringent energy budgets.

...

Notation:

**Authority:** Health and Safety Code § Sections 18930.5, 18934.5, and 18938.

**Reference:** Health and Safety Code §, Division 13, Part 2.5, commencing with Section 18901.

### **ITEM 3. CBSC Proposes to amend Chapter 1, Section 103 Building Standards Commission**

#### **SECTION 103 BUILDING STANDARDS COMMISSION**

**103.1 BSC-CG.** Specific scope of application of the agency responsible for enforcement, the enforcement agency, and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

- ~~1. **Application** — New construction, unless otherwise indicated in this code, of State buildings (all occupancies), including buildings constructed by the Trustees of the California State University and the Regents of the University of California.~~

~~**Enforcing agency** — State or local agency specified by the applicable provisions of law.~~

~~**Authority cited** — *Health and Safety Code* Section 18934.5.~~

~~**Reference** — *Health and Safety Code*, Division 13, Part 2.5, commencing with Section 18901.~~

- 21. **Application** — All occupancies where no state agency has the authority to adopt green building standards applicable to those occupancies.**

**Enforcing agency** — State or local agency specified by the applicable provisions of law.

**Authority cited** — *Health and Safety Code* Sections 18930.5(a), and 18938(b), and 18940.5.

**Reference** — *Health and Safety Code*, Division 13, Part 2.5, commencing with Section 18901.

**103.1.1 Adopting agency identification.** The provisions of this code applicable to buildings identified in this section will be identified in the Matrix Adoption Tables under the acronym **BSC-CG**.

- 3. University of California, California State Universities and California Community Colleges.**

**Application** — Standards for lighting for parking lots and primary campus walkways at the University of California, California State Universities and California Community Colleges.

**Enforcing agency** — State or local agency specified by the applicable provisions of law.

**Authority cited** — *Government Code* Section 14617.

**Reference** — *Government Code* Section 14617.

- 4. Existing state-owned buildings, including those owned by the University of California and by the California State University.**

**Application** — Building seismic retrofit standards including abating falling hazards of structural and nonstructural components and strengthening of building structures. See also Division of the State Architect.

**Enforcing agency** — State or local agency specified by the applicable provisions of law.

**Authority cited** — *Health and Safety Code* Sections 16600.

**Reference** — *Health and Safety Code* Sections 16600 through 16604.

- 5. Unreinforced masonry bearing wall buildings.**

**Application** — Minimum seismic strengthening standards for buildings specified in



~~Appendix Chapter 1 of the California Existing Building Code, except for buildings subject to building standards adopted pursuant to Health and Safety Code (commencing with Section 17940.~~

~~Enforcing agency—State or local agency specified by the applicable provisions of law.~~

~~Authority cited—Health and Safety Code Section 18934.6.~~

~~Reference—Health and Safety Code Sections 18901 through 18949.~~

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 4. CBSC Proposes to amend Chapter 2, Section 202 Definitions**

**CHAPTER 2  
DEFINITIONS**

...

**SECTION 202  
DEFINITIONS**

...

**HYBRID URINAL.** A urinal that conveys waste into the drainage system without the use of water for flushing; and automatically performs a drain-cleansing action after a predetermined amount of time. [Note: As defined in IAPMO IGC 311-2014]

...

**METERING FAUCET.** A self-closing faucet that dispenses a specific volume of water for each actuation cycle. The volume or cycle duration can be fixed or adjustable. [Note: As defined in California Plumbing Code (CPC) Appendix L Section L 201.6]

...

**ORGANIC WASTE.** Food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper waste that is mixed in with food waste. [Note: As defined by Public Resources Code (PRC) Section 42649.8(c)]

...

**OVE. [BSC-CG]** *[also adopted by DSA-SS]* Optimal Value Engineering, another term for advanced wood framing techniques.

...

**POSTCONSUMER CONTENT. [BSC-CG]** *[also adopted by DSA-SS]* Waste material generated by consumers after it is used and which would otherwise be discarded.

...

**PRECONSUMER ( or POSTINDUSTRIAL). [BSC-CG]** *[also adopted by DSA-SS]* Material diverted from the waste stream during one manufacturing process, including scraps, damaged goods, and excess production, that is used in another manufacturing process.

...

**RECYCLED CONTENT. [BSC-CG]** *[also adopted by DSA-SS]* Refer to International Organization of Standards for Standardization ISO 14021 – Environmental labels and declarations – Self-declared

environmental claims (Type II environmental labeling).

...

**RECYCLED CONTENT VALUE (RCV).** [BSC-CG] [also adopted by DSA-SS] Material cost multiplied by postconsumer content plus  $\frac{1}{2}$  the preconsumer content, or  $RCV = \$ X$  (postconsumer content +  $\frac{1}{2}$  preconsumer content).

...

**UNIVERSAL WASTE.** The wastes listed below are subject to regulation pursuant to Chapter 23 of Title 22, *California Code of Regulations*, and shall be known as "universal wastes."

- (1) Batteries, as described in Title 22 CCR, Section 66273.2, Subsection (a);
  - (2) Electronic devices, as described in Title 22 CCR, Section 66273.3, Subsection (a);
  - (3) Mercury-containing equipment, as described in Title 22 CCR, Section 66273.4, Subsection (a);
  - (4) Lamps, as described in Title 22 CCR, Section 66273.5, Subsection (a);
  - (5) Cathode ray tubes, as described in Title 22 CCR, Section 66273.6, Subsection (a);
  - (6) Cathode ray tube glass, as described in Title 22 CCR, Section 66273.7, Subsection (a); and
  - (7) Aerosol cans, as specified in Health and Safety Code, Section 25201.16.
- [Note: As defined by Title 22, CCR § 66261.9]

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 5. CBSC Proposes to amend Chapter 3, Section 301 General**

**CHAPTER 3  
GREEN BUILDING**

**SECTION 301  
GENERAL**

...

**301.3 Nonresidential additions and alterations.** [BSC-CG] The provisions of individual sections of Chapter 5 apply to newly constructed buildings, building additions of 1,000 square feet or greater, and/or building alterations with a permit valuation of \$200,000 or above (for occupancies within the authority of California Building Standards Commission). Code sections relevant to additions and alterations shall only apply to the portions of the building being added or altered within the scope of the permitted work.

**301.3.1 Nonresidential additions and alterations that cause updates to plumbing fixtures only:**

...

**301.3.2 Waste Diversion.** The requirements of Section 5.408 shall be required for additions and alterations whenever a permit is required for work.

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 6. CBSC Proposes to amend Chapter 3, Section 303 Phased Projects**

**SECTION 303  
PHASED PROJECTS**

**303.1 Phased projects.** For shell buildings and others constructed for future tenant improvements, only those code measures relevant to the building components and systems considered to be new construction (or newly constructed) shall apply.

**303.1.1 Initial Tenant improvements.** The provisions of this code shall apply only to the initial tenant or occupant improvements to a project. Subsequent tenant improvements shall comply with the scoping provisions in Section 301.3 nonresidential additions and alterations.

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 7. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.1, Section 5.106  
Site Development**

**CHAPTER 5  
NONRESIDENTIAL MANDATORY MEASURES  
DIVISION 5.1  
PLANNING AND DESIGN**

**SECTION 5.106  
SITE DEVELOPMENT**

**5.106.4 Bicycle parking.** For buildings within the authority of California Building Standards Commission as specified in Section 103, comply with Section 5.106.4.1. For buildings within the authority of the Division of the State Architect pursuant to Section 105, comply with Section 5.106.4.2.

**5.106.4.1 Bicycle parking. [BSC-CG] . . .**

**5.106.4.1.1 Short-term bicycle parking. [BSC-CG] . . .**

**5.106.4.1.2 Long-term bicycle parking.** For new buildings with over 10 or more tenant-occupants or for additions or alterations that add 10 or more tenant vehicular parking spaces, provide secure bicycle parking for 5 percent of the tenant vehicular parking spaces being added, with a minimum of one space. Acceptable parking facilities shall be convenient from the street and shall meet one of the following:

1. . . .
2. . . .
3. . . .

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 8. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.1, Section 5.106  
Site Development**

**5.106.5.2 Designated parking for clean air vehicles.** In new projects or additions or alterations that add 10 or more vehicular parking spaces, provide designated parking for any combination of low-emitting, fuel-efficient and carpool/van pool vehicles as follows:

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 9. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.1, Section 5.106  
Site Development**

**5.106.5.3 Electric vehicle (EV) charging. [N]** Construction shall comply with Section 5.106.5.3.1 or Section 5.106.5.3.2 to facilitate future installation of electric vehicle supply equipment (EVSE). When EVSE(s) is/are installed, it shall be in accordance with the *California Building Code*, the *California Electrical Code* and as follows:

**5.106.5.3.1 Single charging space requirements. [N] ...**

**5.106.5.3.2 Multiple charging space requirements. [N] ...**

**5.106.5.3.3 EV charging space calculation. [N]** Table 5.106.5.3.3 shall be used to determine if single or multiple charging space requirements apply for the future installation of EVSE.

Exceptions: ...

**Table 5.106.5.3.3**

Total number of <u>actual</u> parking spaces	Number of required spaces
<del>0-50</del> 0-9	0
10-25	<u>1</u>
26-50	<u>2</u>
51-75	<del>4</del> 4
76-100	<del>2</del> 5
101-200 <u>150</u>	<del>3</del> 7
<u>151-200</u>	<u>10</u>
201 and over	<del>3%</del> <sup>4</sup> 6 Percent of total <sup>1</sup>

1. Calculation for spaces shall be rounded up to the nearest whole number.

**5.106.5.3.4 [N] Identification...**

**5.106.5.3.5 [N]** Future charging spaces qualify as designated parking as described in Section 5.106.5.2 Designated parking for clean air vehicles.

**Notes:**

1. ...
2. ...
3. ...

**Notation:**

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938 (b) and 18941.10.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 10. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.1, Section 5.106 Site Development**

**5.106.8 Light pollution reduction.** [N] Outdoor lighting systems shall be designed and installed to comply with the following:

1. The minimum requirements in the *California Energy Code* for Lighting Zones 1-4 as defined in Chapter 10 of the California Administrative Code; and
2. Backlight, Uplight and Glare (BUG) ratings as defined in IES TM-15-11; and
3. Allowable BUG ratings not exceeding those shown in Table 5.106.8, or

Comply with a local ordinance lawfully enacted pursuant to Section 101.7, whichever is more stringent.

**Exceptions: [N]**

1. Luminaires that qualify as exceptions in Section 140.7 of the *California Energy Code*.
2. Emergency lighting.
3. Building facade meeting the requirements in Table 140.7-B of the *California Energy Code*, Part 6.
4. Custom lighting features as allowed by the local enforcing agency, as permitted by Section 101.8 Alternate materials, designs and methods of construction.

...

**Notation:**

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 11. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.3, Section 5.302 Definitions**

**DIVISION 5.3  
WATER EFFICIENCY AND CONSERVATION**

...

**SECTION 5.302  
DEFINITIONS**

**5.302.1 Definitions.** The following terms are defined in Chapter 2.

...

## **METERING FAUCET**

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

### **ITEM 12. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.3, Section 5.303 Indoor Water Use**

#### **SECTION 5.303 INDOOR WATER USE**

**5.303.1 Meters.** Separate submeters or metering devices shall be installed for the uses described in Sections 5.303.1.1 and 5.303.1.2.

...

#### **5.303.3 Water conserving plumbing fixtures and fittings...**

**5.303.3.1 Water closets.** The effective flush volume...

Note: ...

...

#### **5.303.3.2 Wall mounted urinals...**

**5.303.3.2.1 Floor mounted urinals...**

...

#### **5.303.3.4 Faucets and Fountains.**

**5.303.3.4.1 Nonresidential Lavatory faucets...**

**5.303.3.4.2 Kitchen faucets...**

**5.303.3.4.3 Wash fountains...**

**5.303.3.4.4 Metering faucets...**

**5.303.3.4.5 Metering faucets for wash fountains.** Metering faucets for wash fountains shall have a maximum flow rate of not more than 0.20 gallons per minute cycle /20 [rim space (inches) at 60 psi].

#### **5.303.4 Commercial kitchen equipment.**

**5.303.4.1 Food Waste Disposers.** Disposers shall either modulate the use of water to no more than 1 gpm when the disposer is not in use (not actively grinding food waste/no-load) or shall automatically shut off after no more than 10 minutes of inactivity. Disposers shall use no more than 8 gpm of water.

[Note: This code section does not affect local jurisdiction authority to prohibit or require disposer installation.]

#### **5.303.4.5 Areas of addition or alteration.**

For those occupancies within the authority of the California Building Standards Commission as specified in Section 103, the provisions of Section 5.303.3 and 5.303.4 shall apply to new fixtures in additions or areas of alteration to the building.

**5.303.6 Standards for plumbing fixtures and fittings.** Plumbing fixtures and fittings shall be installed in accordance with the *California Plumbing Code*, and shall meet the applicable standards referenced in Table 4401.4 1701.1 of the *California Plumbing Code* and in Chapter 6 of this code.

....

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 13. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.4, Section 5.402**  
**Definitions**

**DIVISION 5.4**  
**MATERIAL CONSERVATION AND RESOURCE EFFICIENCY**

...

**SECTION 5.402**  
**DEFINITIONS**

**5.402.1 Definitions.** The following terms are defined in Chapter 2.

...

**ORGANIC WASTE**

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 14. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.4, Section 5.408**  
**Construction Waste Reduction, Disposal and Recycling**

**SECTION 5.408**  
**CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING**

**5.408.1 Construction waste management.** Recycle and/or salvage for reuse a minimum of ~~50%~~ 65% of the non-hazardous construction and demolition waste in accordance with Section 5.408.1.1, 5.408.1.2 or 5.408.1.3; or meet a local construction and demolition waste management ordinance, whichever is more stringent.

**5.408.1.1 Construction waste management plan . . .**

**5.408.1.2 Waste management company . . .**

**5.408.1.3 Waste stream reduction alternative.** The combined weight of new construction disposal that does not exceed two pounds per square foot of building area may be deemed to meet the ~~50~~ 65 percent minimum requirement as approved by the enforcing agency.

**5.408.1.4 Documentation . . .**

*[Note: See Item 27 for corresponding Tier amendments.]*

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 15. CBSC Proposes to add a regulation in Division 5.4 Material Conservation and Resource Efficiency, Section 5.408.2 Universal Waste**

**5.408.2 Universal Waste. [A]**

Additions and alterations to a building or tenant space that meet the scoping provisions in Section 301.3 for nonresidential additions and alterations, shall require verification that Universal Waste items such as fluorescent lamps and ballast and mercury containing thermostats as well as other California prohibited Universal Waste materials are disposed of properly and are diverted from landfills. A list of prohibited Universal Waste materials shall be included in the construction documents.

**Note:** Refer to the Universal Waste Rule link at:

[http://www.dtsc.ca.gov/LawsRegsPolicies/Regs/upload/OEARA\\_REGS\\_UWR\\_FinalText.pdf](http://www.dtsc.ca.gov/LawsRegsPolicies/Regs/upload/OEARA_REGS_UWR_FinalText.pdf)

**5.408.3 Excavated soil and land clearing debris. [BSC-CG] . . .**

. . .

Notation:

**Authority** – Health and Safety Code Sections 18930.5, 18934.5 and 18938 (b).

**Reference** – Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 16. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.4, Section 5.410 Building Maintenance and Operation**

**SECTION 5.410  
BUILDING MAINTENANCE AND OPERATION**

**5.410.1 Recycling by occupants.** Provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics, organic waste, and metals or meet a lawfully enacted local recycling ordinance, if more restrictive.

**Exception:** Rural jurisdictions that meet and apply for the exemption in Public Resources Code 42649.82 (a)(2)(A) et seq. shall also be exempt from the organic waste portion of this section.

**5.410.1.1 Additions. [A]** All additions conducted within a 12-month period under single or multiple permits, resulting in an increase of 30 percent or more in floor area, shall provide recycling areas on site.

**Exception:** . . .

**5.410.1.2 Sample ordinance . . .**

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 17. CBSC Proposes to amend regulations in Division 5.4 Material Conservation and Resource Efficiency, Section 5.410 Building Maintenance and Operation**

**SECTION 5.410**



## BUILDING MAINTENANCE AND OPERATION

**5.410.2 Commissioning. [N]** For new buildings 10,000 square feet and over, building commissioning shall be included in the design and construction processes of the building project to verify that the building systems and components meet the owner's or owner representative's project requirements. Commissioning shall be performed in accordance with this section by trained personnel with experience on projects of comparable size and complexity. All occupancies other than I-occupancies and L-occupancies shall comply with the *California Energy Code* as prescribed in *California Energy Code* Section 120.8. For I-occupancies which are not regulated by OSHPD or for I-occupancies and L-occupancies which are not regulated by the *California Energy Code* Section 100.0 Scope; all requirements in sections 5.410.2 through 5.410.2.6 shall apply.

Commissioning requirements shall include:

1. ...
2. ...
3. ...
4. ...
5. ...
6. ...
7. ...

**Exceptions:**

1. Unconditioned warehouses of any size.
2. Areas less than 10,000 square feet used for offices or other conditioned accessory spaces within unconditioned warehouses.
3. Tenant improvements less than 10,000 square feet as described in Section 303.1.1.
4. ~~Commissioning requirements for energy systems covered by the *California Energy Code*.~~
5. Open parking garages of any size, or open parking garage areas, of any size, within a structure.

**Note:** For the purposes ...

~~All building operating systems covered by Title 24, Part 6, as well as process equipment and controls, and renewable energy systems shall be included in the scope of the commissioning requirements.~~

**5.410.2.1 Owner's or Owner representative's Project Requirements (OPR). [N]**

The expectations and requirements of the building appropriate to its phase shall be documented before the design phase of the project begins. This documentation shall include the following:

1. Environmental and sustainability goals.
2. Energy efficiency goals ~~{Refer to 2013 *California Energy Code*, Section 120.8(b)}.~~
3. Indoor environmental quality requirements.
4. Project program, including facility functions and hours of operation, and need for after hours operation.
5. Equipment and systems expectations.
6. Building occupant and operation and maintenance (O&M) personnel expectations.

**5.410.2.2 Basis of Design (BOD). [N]**

A written explanation of how the design of the building systems meets the OPR shall be completed at the design phase of the building project. The Basis of Design document shall cover the following systems:

1. Heating, ventilation, air conditioning (HVAC) systems and controls. ~~{Refer to 2013 *California Energy Code*, Section 120.8(c)}.~~
2. Indoor lighting system and controls ~~{Refer to 2013 *California Energy Code* Section 120.8(c)}.~~
3. Water heating system ~~{Refer to 2013 *California Energy Code* Section 120.8(c)}.~~

4. Renewable energy systems.
5. Landscape irrigation systems.
6. Water reuse systems.

...

Notation

Authority: Health and Safety Code Sections 18930.5, 18934.5 and 18938 (b). [This one is for 180 days?]

Reference: Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 18. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.5, Section 5.503  
Fireplaces**

**DIVISION 5.5  
ENVIRONMENTAL QUALITY**

...

**SECTION 5.503  
FIREPLACES**

**5.503.1 General Fireplaces.** Install only a direct-vent sealed-combustion gas or sealed wood-burning fireplace, or a sealed woodstove or pellet stove, and refer to residential requirements in the *California Energy Code*, Title 24, Part 6, Subchapter 7, Section 150. Woodstoves, pellet stoves and fireplaces shall comply with applicable local ordinances.

**5.503.1.1 Woodstoves.** Woodstove and pellet stoves shall comply with U.S. EPA Phase II New Source Performance Standards (NSPS) emission limits where as applicable, and shall have a permanent label indicating they are certified to meet the emission limits.

Notation:

Authority: Health and Safety Code Sections 18930.5, 18934.5, 18938.

Reference: Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 19. CBSC Proposes to amend mandatory regulations in Chapter 5, Division 5.5, Section 5.504  
Pollutant Control**

**SECTION 5.504  
POLLUTANT CONTROL**

**5.504.1.3 Temporary ventilation.** The permanent HVAC system shall only be used during construction if necessary to condition the building or areas of addition or alteration within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.2-1999, or an average efficiency of 30 percent based on ASHRAE 52.1-1992. Replace all filters immediately prior to occupancy, or, if the building is occupied during alteration, at the conclusion of construction.

**5.504.3 Covering of duct openings and protection of mechanical equipment during construction.**

...

**5.504.4 Finish material pollutant control.** Finish materials shall comply with Sections 5.504.4.1 through 5.504.4.46.

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 19.1 CBSC Proposes to amend mandatory regulations in Chapter 8, COMPLIANCE FORMS AND WORKSHEETS**

**CHAPTER 8**

**COMPLIANCE FORMS AND WORKSHEETS**

[BSC] Sample forms...

[HCD 1] Sample forms...

**WORKSHEET (WS-1)  
BASELINE WATER USE**

BASELINE WATER USE CALCULATION TABLE								
FIXTURE TYPE	FLOW RATE		DURATION		DAILY USES		OCCUPANT <sup>1</sup>	GALLONS PER DAY
Showerheads	2.0 gpm@80psi	<input type="checkbox"/>	5 min.	<input type="checkbox"/>	1	<input type="checkbox"/>	Note 1a	=
Lavatory faucets nonresidential	0.5 gpm@60psi	<input type="checkbox"/>	.25 min.	<input type="checkbox"/>	3			=
Kitchen faucets	1.8 gpm@60psi	<input type="checkbox"/>	4 min.	<input type="checkbox"/>	1	<input type="checkbox"/>	Note 1b	=
Replacement aerators	2.2 gpm@60psi	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		=
Wash fountains	1.8gpm/20 [rim space (in.) @ 60 psi]	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		=
Metering faucets	0.20 gal/cycle	<input type="checkbox"/>		<input type="checkbox"/>	3	<input type="checkbox"/>		=
Metering faucets for wash fountains	0.20gpm gal/cycle /20 [rim space (in.) @ 60 psi]	<input type="checkbox"/>	.25 min.	<input type="checkbox"/>		<input type="checkbox"/>		=
Gravity tank-type water closets	1.28 gal/flush	<input type="checkbox"/>	1 flush	<input type="checkbox"/>	1 male <sup>2</sup> 3 female	<input type="checkbox"/>		=
Flushometer tank water closets	1.28 gal/flush	<input type="checkbox"/>	1 flush	<input type="checkbox"/>	1 male <sup>2</sup> 3 female	<input type="checkbox"/>		=
Flushometer valve water closets	1.28 gal/flush	<input type="checkbox"/>	1 flush	<input type="checkbox"/>	1 male <sup>2</sup> 3 female	<input type="checkbox"/>		=
Electromechanical hydraulic water closets	1.28 gal/flush	<input type="checkbox"/>	1 flush	<input type="checkbox"/>	1 male <sup>2</sup> 3 female	<input type="checkbox"/>		=
Urinals	0.5 gal/flush	<input type="checkbox"/>	1 flush	<input type="checkbox"/>	2 male	<input type="checkbox"/>		=
Total daily baseline water use (BWU)								=

1...

2...

Notation:

**Authority:** Health and Safety Code § Sections 18930.5, 18934.5, and 18938.

**Reference:** Health and Safety Code §, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 20. CBSC Proposes to amend voluntary regulations in Appendix A5, Division A5.1, Section A5.101 General**

**APPENDIX A5  
NONRESIDENTIAL VOLUNTARY MEASURES  
DIVISION A5.1  
PLANNING AND DESIGN**

...

**SECTION A5.101  
GENERAL**

**A5.101.1 General Scope.** The provisions of this chapter outline planning, design and development methods that include environmentally responsible site selection, building design, building siting and development to protect, restore and enhance the environmental quality of the site and respect the integrity of adjacent properties.

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 21. CBSC Proposes to amend non-regulatory notes in Appendix A5, Division A5.1, Section A5.106 Site Development**

**SECTION A5.106  
SITE DEVELOPMENT**

...

**A5.106.2 Storm water design.** Design storm water runoff rate and quantity in conformance with Section A5.106.2.1 and storm water runoff quality by Section A5.106.3 2.2 or by local requirements, whichever are stricter.

**A5.106.2.1 Storm water runoff rate and quantity...**

**A5.106.2.2 Storm water runoff quality...**

...

**A5.106.5.1 Designated parking for fuel-efficient clean air vehicles.** Provide designated parking for any combination of low-emitting, fuel-efficient and carpool/van pool vehicles as shown in Table A5.106.5.1.1 or A5.106.5.1.2.

...

**A5.106.5.1.4 Vehicle Designations.** Building managers may consult with local community Transit Management Associations (TMAs) for methods of designating qualifying vehicles, such as issuing parking stickers.

**Notes:**

1. Information on qualifying vehicles, car labeling regulations and DMV SOV stickers CAV decals may be obtained from the following sources:
  - a. California DriveClean.
  - b. California Air Resources Board
  - c. U.S. EPA fuel efficiency economy regulations and standards.
  - d. DMV Registration Operations, (916) 657-6678 and ARB Public Information, (626) 575-6858.
2. Purchasing policy and refueling sites for low emitting vehicles for state employees use can be found at the Department of General Services.

...

**A5.106.5.3.4 Future charging spaces** qualify as designated parking as described in Section A5.106.5.1 Designated parking for clean air vehicles.

**Notation:**

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 22. CBSC Proposes to amend voluntary regulations in Division A5.1, Section A5.106 related to EV Charging**

**SECTION A5.106  
SITE DEVELOPMENT**

**A5.106.5.3 Electric vehicle (EV) charging.** Construction shall comply with Section A5.106.5.3.1 and A5.106.5.3.2 to facilitate future installation of electric vehicle supply equipment (EVSE). When EVSE(s) is/are installed, it shall be in accordance with the *California Building Code Section 406.9*, and the *California Electrical Code* and as follows:

**A5.106.5.3.1 Tier 1.** Table A5.106.5.3.1 shall be used to determine the number of multiple charging spaces required if single or multiple charging space requirements apply for future installation of EVSE. Refer to Section 5.106.5.3.2 for design space requirements. ~~When a single charging space is required per Table A5.106.5.3.1, refer to Section 5.106.5.3.1 for design requirements. When multiple charging spaces are required, refer to Section 5.106.5.3.2 for design requirements.~~

**A5.106.5.3.2 Tier 2.** Table A5.106.5.3.2 shall be used to determine if single or multiple charging space requirements apply the number of multiple charging spaces required for future installation of EVSE. Refer to Section 5.106.5.3.2 for design space requirements. When a single charging space is required, refer to Section 5.106.5.3.1 for design requirements. When multiple charging spaces are required, refer to Section 5.106.5.3.2 for design requirements.

**Table A5.106.5.3.1**

Total number of <u>actual</u> parking spaces	TIER 1 Number of required EV charging spaces
0-50 <u>0-9</u>	4 <u>0</u>
<u>10-25</u>	<u>2</u>
<u>26-50</u>	<u>3</u>
51-75	<u>2</u> <u>5</u>
76-100	<u>3</u> <u>7</u>
101- 200 <u>150</u>	<u>5</u> <u>10</u>
<u>151-200</u>	<u>14</u>
201 and over	4% <sup>1</sup> <u>8 Percent of total</u> <sup>1</sup>

1. Calculation for spaces shall be rounded up to the nearest whole number.

**Table A5.106.5.3.2**

Total number of <u>actual</u> parking spaces	TIER 2 Number of required EV charging spaces
0-50 <u>0-9</u>	<u>2</u> <u>1</u>
<u>10-25</u>	<u>2</u>
<u>26-50</u>	<u>4</u>
51-75	<u>3</u> <u>6</u>
76-100	<u>4</u> <u>9</u>
101- 200 <u>150</u>	<u>7</u> <u>12</u>
<u>151-200</u>	<u>17</u>
201 and over	6% <sup>1</sup> <u>10 Percent of total</u> <sup>1</sup>

1. Calculation for spaces shall be rounded up to the nearest whole number.

**A5.106.5.3.3 Identification.** The service panel...

**A5.106.5.3.4 Future charging spaces...**

Notation:

**Authority** – Health and Safety Code Sections 18930.5, 18934.5 and 18938 (b).

**Reference** – Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 22.1 CBSC Proposes to amend voluntary regulations in Division A5.3, Section A5.303 related to Indoor Water Use**

**SECTION A5.303**

INDOOR WATER USE

TABLE A5.303.2.2  
WATER USE BASELINE

FIXTURE TYPE	BASELINE FLOW RATE	DURATION	DAILY USES	OCCUPANTS <sup>2</sup>
Showerheads	2.0 gpm @ 80 psi	5 min.	1	X <sup>2a</sup>
Lavatory faucets nonresidential	0.5 gpm @ 60 psi	.25 min.	3	X <sup>2b</sup>
Kitchen faucets	1.8 gpm @ 60 psi	4 min.	1	X
Replacement aerators	2.2 gpm @ 60 psi			X
Wash fountains	1.8 gpm/20 [rim space (in.) @ 60 psi]			X
Metering faucets	0.20 gallons/cycle	.25 min.	3	X
Metering faucets for wash fountains	0.20 gpm gallons/cycle /20 [rim space (in.) @ 60 psi]	.25 min.	1 male 3 female	X
Gravity tank type water closets	1.28 gallons/flush	1 flush	1 male 3 female	X
Flushometer tank water closets	1.28 gallons/flush	1 flush	1 male 3 female	X
Flushometer valve water closets	1.28 gallons/flush	1 flush	1 male 3 female	X
Electromechanical hydraulic water closets	1.28 gallons/flush	1 flush	1 male 3 female	X
Urinals	0.5 gallons/flush	1 flush	2 male	X

1...  
2...  
3...

TABLE A5.303.2.3.1  
FIXTURE FLOW RATES

FIXTURE TYPE	BASELINE FLOW-RATE <sup>2</sup>	MAXIMUM FLOW RATE AT 12 PERCENT REDUCTION
Showerheads	2.0 gpm @ 80 psi	1.8 gpm @ 80 psi
Lavatory faucets nonresidential	0.5 gpm @ 60 psi	0.35 gpm @ 60 psi
Kitchen faucets	1.8 gpm @ 60 psi	1.6 gpm @ 60 psi
Wash fountains	1.8 gpm/20 [rim space(in.) @ 60 psi]	1.6 [rim space(in.)/20 gpm @ 60 psi] 1.6 gpm/20 [rim space(in.) @ 60 psi]
Metering faucets	0.20 gallons/cycle	0.18 gallons/cycle
Metering faucets for wash fountains	0.20 gpm gallons/cycle /20 [rim space(in.)/ @ 60 psi]	0.18 [rim space(in.)/20 gpm @ 60 psi] 0.18 gallons/cycle /20 [rim space(in.)/ @

		60 psi]
Gravity tank type water closets	1.28 gallons/flush	1.12 gallons/flush
Flushometer tank water closets	1.28 gallons/flush	1.12 gallons/flush
Flushometer valve water closets	1.28 gallons/flush	1.12 gallons/flush
Electromechanical hydraulic water closets	1.28 gallons/flush	1.12 gallons/flush
Urinals	0.5 gallons/flush	0.44 gallons/flush

1...

2...

3...

Notation:

**Authority:** Health and Safety Code § Sections 18930.5, 18934.5, and 18938.

**Reference:** Health and Safety Code §, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 23. CBSC Proposes to amend voluntary regulations in Division A5.3, Section A5.303 related to Indoor Water Use**

**SECTION A5.303  
INDOOR WATER USE**

**A5.303.3 Appliances and fixtures for commercial application.** Appliances and fixtures shall meet the following:

1. Clothes washers shall have a maximum Water Factor (WF) that will reduce the use of water by 20 percent below the California Energy Commission' WF standards for commercial clothes washers located in *Title 20 of the California Code of Regulations*.
2. Dishwashers shall meet the following water use standards:
  - a. Residential – ENERGY STAR
    - i. Standard Dishwashers – 4.25 gallons per cycle.
  - b. Commercial – ~~refer to Table A5.303.~~ Shall be in accordance with ENERGY STAR requirements. Refer to Table A5.303.3
3. Ice makers shall be air cooled.
4. Food steamers shall be connectionless or boilerless ~~and shall consume no more than 2 gallons of water per pan per hour, including condensate water, for batch type steamers, and no more than 5 gallons of water per pan per hour, including condensate water, for cook to order steamers.~~
5. [BSC-CG] The use and installation of water softeners that discharge to the community sewer system may be limited or prohibited by local agencies if certain conditions are met.
6. Combination ovens shall ~~not consume more than 10 gph (38 L/h) in the full operational mode. use a maximum of 1.5 gallons of water per hour per pan, including condensate water.~~
7. Commercial pre-rinse spray valves shall be



8. Food waste pulping systems shall use no more than 2 gpm of potable water.

8.1 Note: potable water excludes on-site graywater use, such as dishwasher discharge water.

**TABLE A5.303.3: COMMERCIAL DISHWASHER WATER USE**

Type	High-Temperature - Maximum Gallons Per Rack	<u>Low-Temperature - Maximum Gallons Per Rack</u>	
Conveyor	0.70 (2.6 L)	$\leq 0.79$ (3 L)	
Single Tank Conveyor			
Multiple Tank Conveyor	$\leq 0.54$ (2 L)	$\leq 0.54$ (2 L)	
Stationary Single Tank	$0.95$ (3.6 L) $\leq 0.89$ (3.4 L)	$\leq 1.18$ (4.5 L)	
Door			
Under eCounter	$0.90$ (3.4 L) $\leq 0.86$ (3.3 L)	$\leq 1.19$ (4.5 L)	
Pot, Pan, and Utensil	$\leq 0.58$ GPSF	$\leq 0.58$ GPSF	
Single Tank Flight Type	$GPH \leq 2.975x + 55.00$	$GPH \leq 2.975x + 55.00$	
Multiple Tank Flight Type	$GPH \leq 4.96x + 17.00$	$GPH \leq 4.96x + 17.00$	

Note: GPSF = gallons per square foot of rack; GPH = gallons per hour;

X = square feet of conveyor belt/minute (max conveyor speed sf/min as tested and certified to NSF/ANSI Standard 3)

**ITEM 24. CBSC Proposes to amend voluntary regulations in Division A5.3, Section A5.303 related to Indoor Water Use**

**SECTION A5.303  
INDOOR WATER USE**

**A5.303.4 Water conserving plumbing fixtures and fittings**

*[New code section title added]*

**A5.303.4.1 Nonwater supplied urinals.**

Nonwater supplied urinals are installed in accordance with the California Plumbing Code.

Where approved, Hybrid urinals, as defined in Chapter 2, shall be considered waterless urinals.

*[Make changes accordingly to Table A5.303.2.2 Water Use Baseline and table A5.303.2.3.1 Fixture Flow Rates for code section A5.303.4.1 listed above to add fixtures to the tables]*

...

**ITEM 25. CBSC Proposes to amend voluntary regulations in Appendix A5, Division A5.4, Section A5.405 Material Sources**

**DIVISION A5.4  
MATERIAL CONSERVATION AND RESOURCE EFFICIENCY**

**SECTION A5.405  
MATERIAL SOURCES**

**A5.405.4 Recycled content.** Use materials, equivalent in performance to virgin materials with a total (combined) recycled content value (RCV) of:

**Tier 1 [BSC]. Recycled content.** The RCV shall not be less than 10 percent of the total material cost of the project, or use 2 products which meet the minimum recycled content levels in Table A5.405.4 for at least 75%, by cost, of all products in that category in the project. [See Table A5.405.4: *Minimum Recycled Content Levels*]

Required Total RCV (dollars) = Total Material Cost (dollars) × 10 percent **(Equation A5.4-1)**

**Tier 2 [BSC].** The RCV shall not be less than 15 percent of the total material cost of the project, or use 3 products which meet the minimum recycled content levels in Table A5.405.4 for at least 75%, by cost, of all products in that category in the project. [See Table A5.405.4: *Minimum Recycled Content Levels*]

**A5.405.4.1 Total material cost . . .**

**A5.405.4.2 Determination of total recycled content value (RCV) . . .**

**A5.405.4.3 Determination of recycled content value of materials (RCV<sub>M</sub>).** The recycled content value of each material (RCV<sub>M</sub>) is calculated by multiplying the cost of material, as defined by the recycled content. See Equations A5.4-6 and A5.4-7.

RCV<sub>M</sub> (dollars) = Material cost (dollars) × RC<sub>M</sub> (percent) **(Equation A5.4-6)**

RC<sub>M</sub> (percent) = Postconsumer content percentage + (1/2) Preconsumer content percentage  
**(Equation A5.4-7)**

**Notes:**

1. If the postconsumer and preconsumer recycled content is provided in pounds, Equation A5.4-7 may be used, but the final result (in pounds) must be multiplied by 100 to show RC<sub>M</sub> as a percentage.
2. If the manufacturer does not separately identify the preconsumer and postconsumer recycled content of a material but reports it as a total single percentage, one-half of the total amount shall be considered preconsumer and one-half shall be considered postconsumer recycled material.

**A5.405.4.4 Determination of recycled content value of assemblies – (RCV<sub>A</sub>).** Recycled content value of assemblies is calculated by multiplying the total cost of assembly by the total recycled content of the assembly (RC<sub>A</sub>), and shall be determined by Equation A5.4-8.

RCV<sub>A</sub> (dollars) = Assembly cost (dollars) × Total RC<sub>A</sub> (percent) **(Equation A5.4-8)**

If not provided by the manufacturer, Total  $RC_A$  (percent) is the sum ( $\Sigma$ ) of the Proportional Recycled Content (PRCM) of each material in the assembly.  $RC_A$  shall be determined by Equation A5.4-9.

$$RC_A = \Sigma PRC_M \quad \text{(Equation A5.4-9)}$$

$PRC_M$  of each material may be calculated by one of two methods using the following formulas:

**Method 1:** Recycled content (Postconsumer and Preconsumer) of each material provided in percentages

$$PRC_M \text{ (percent)} = \text{Weight of material (percent)} \times RC_M \text{ (percent)} \quad \text{(Equation A5.4-10)}$$

$$\text{Weight of material (percent)} = [\text{Weight of material (lbs)} \div \text{Weight of assembly (lbs)}] \times 100 \quad \text{(Equation A5.4-11)}$$

$$RC_M \text{ (percent)} = \text{Postconsumer content percentage} + (1/2) \text{ Preconsumer content percentage} \quad \text{(See Equation A5.4-7)}$$

**Method 2:** Recycled content (Postconsumer and Preconsumer) provided in pounds

$$PRC_M \text{ (percent)} = [RC_M \text{ (lbs)} \div \text{Weight of material (lbs)}] \times 100 \quad \text{(Equation A5.4-12)}$$

$$RC_M \text{ (lbs)} = \text{Postconsumer content (lbs)} + (1/2) \text{ Preconsumer content (lbs)} \quad \text{(Equation A5.4-13)}$$

**Note:** If the manufacturer does not separately identify the preconsumer and postconsumer recycled content of a material but reports it as a total single percentage, one-half of the total amount shall be considered preconsumer and one-half shall be considered postconsumer recycled material.

#### A5.405.4.5 Alternate method for concrete . . .

**Table A5.405.4**  
**MINIMUM RECYCLED CONTENT LEVELS**

<u>MATERIAL/PRODUCT TYPE</u>	<u>MINIMUM TOTAL RECYCLED CONTENT</u>	<u>MINIMUM POST-CONSUMER RECYCLED CONTENT</u>
<u>Insulation, fiberglass</u>	<u>30%</u>	<u>30%</u>
<u>Insulation, cellulose</u>	<u>75%</u>	<u>75%</u>
<u>Exterior Paint, latex</u>	<u>50%</u>	<u>50%</u>
<u>Carpet, nylon</u>	<u>10%</u>	<u>10%</u>
<u>Compost</u>	<u>80%</u>	<u>80%</u>
<u>Mulch</u>	<u>80%</u>	<u>80%</u>
<u>Acoustical ceiling panels</u>	<u>60%</u>	<u>=</u>

<u>Drywall, gypsum</u>	<u>4%</u>	<u>4%</u>
<u>Aggregate base</u>	<u>80%</u>	<u>80%</u>

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 26. CBSC Proposes to amend voluntary regulations in Appendix A5, Division A5.4, Section A5.408 Construction Waste Reduction, Disposal, and Recycling**

**SECTION A5.408  
CONSTRUCTION WASTE REDUCTION, DISPOSAL, AND RECYCLING**

**A5.408.3.1 Enhanced construction waste reduction – Tier 1.** Divert to recycle or salvage at least 65% of nonhazardous construction and demolition waste generated at the site. Any mixed recyclables that are sent to mixed-waste recycling facilities shall include a qualified third party verified facility average diversion rate. Verification of diversion rates shall meet minimum certification eligibility guidelines, acceptable to the local enforcing agency.

**A5.408.3.1.1 Enhanced construction waste reduction – Tier 2 [BSC].** Divert to recycle or salvage at least 80% of nonhazardous construction and demolition waste generated at the site.

**A5.408.3.1.2 Verification of compliance.** A copy of the completed waste management report or documentation of certification of the waste management company utilized shall be provided.

**Exceptions:**

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 27. CBSC Proposes to amend voluntary regulations in Appendix A5, Division A5.5, Section A5.504 Pollutant Control**

**DIVISION A5.5  
ENVIRONMENTAL QUALITY**

...

**SECTION A5.504  
POLLUTANT CONTROL**

**A5.504.1 Indoor air quality (IAQ) during construction ...**

**A5.504.1.1 Temporary ventilation ...**

1. ...

2. If the building is occupied during demolition or construction, meet or exceed the recommended Control Measures of the Sheet Metal and Air Conditioning National Contractors' National Association (SMACNA) IAQ Guidelines for Occupied Buildings under Construction, 1995, Chapter 3.

3. ~~The permanent HVAC system shall only be used during construction if necessary to condition the building within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.2-1999, or an average efficiency of 30 percent based on ASHRAE 52.1-1992. Replace all filters immediately prior to occupancy.~~
4. ~~During dust-producing operations, protect supply and return HVAC system openings from dust.~~

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 28. CBSC Proposes to amend regulations in Appendix A5, Division A5.6, Section A5.601  
CALGreen TIER 1 AND TIER 2**

**DIVISION A5.6  
VOLUNTARY TIERS  
SECTION A5.601  
CALGreen TIER 1 AND TIER 2**

...

**A5.601.2 CALGreen Tier 1**

...

**A5.601.2.4 Voluntary measures for CALGreen Tier 1.** In addition to the provisions of Sections A5.601.2.1 and A5.601.2.3 above, compliance with the following voluntary measures from Appendix A5 is required for Tier 1:

...

3. From Division A5.4,<sup>2</sup>
  - a. Comply with recycled content of 10 percent of materials based on estimated total cost, or use 2 products from Table A5.405.4 for at least 75% by cost in Section A5.405.4.
  - b. Comply with the 65 -percent reduction in construction and demolition waste in Section A5.408.3.1.
  - c. Comply with one elective measure selected from this division.

...

**A5.601.3 CALGreen Tier 2.**

...

**A5.601.3.4 Voluntary measures for Tier 2.** In addition to the provisions of Sections A5.601.3.1 and A5.601.3.3 above, compliance with the following voluntary measures from Appendix A5 and additional elective measures shown in Table A5.601.3.4 is required for Tier 2:

...

3. From Division A5.4,<sup>2</sup>
  - a. Comply with recycled content of 15 percent of materials based on estimated total cost, or use 2 products from Table A5.405.4 for at least 75% by cost in Section A5.405.4.1.
  - b. Comply with the 80-percent reduction in construction and demolition waste in Section A5.408.3.1.
  - c. Comply with three elective measures selected from this division.

...

Notation:

**Authority:** Health and Safety Code Sections 18930.5, 18934.5, 18938.

**Reference:** Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.

**ITEM 29. CBSC Proposes to amend Table A5.602**

**SECTION A5.602**

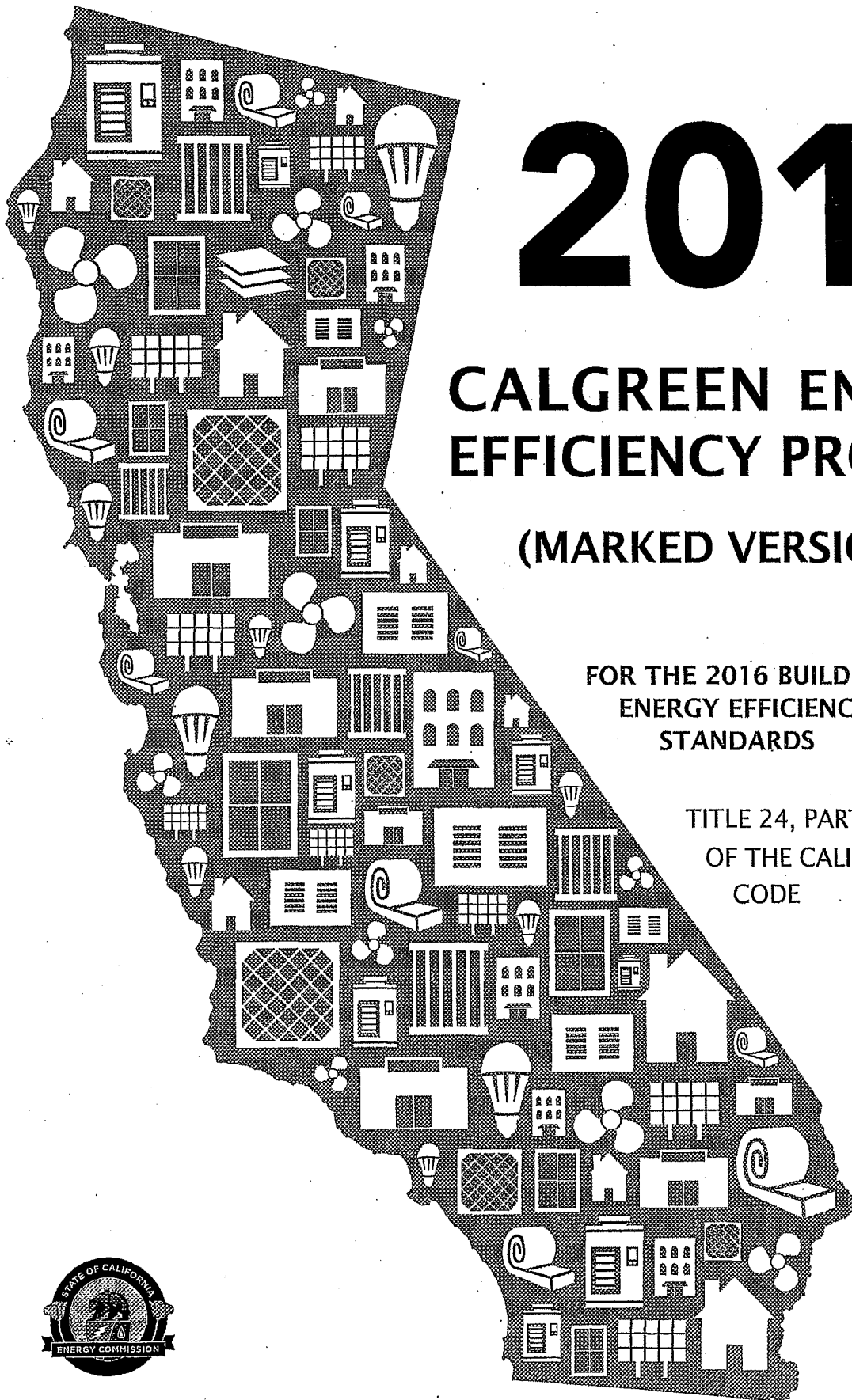
**NONRESIDENTIAL OCCUPANCIES APPLICATION CHECKLISTS**

*[Update the application checklist based on the proposed code changes for publication]*

Notation:

**Authority** – Health and Safety Code Sections 18930.5, 18934.5 and 18938 (b).

**Reference** – Health and Safety Code, Division 13, Part 2.5, commencing with Section 18901.



# 2016

## CALGREEN ENERGY EFFICIENCY PROVISIONS

(MARKED VERSION)

FOR THE 2016 BUILDING  
ENERGY EFFICIENCY  
STANDARDS

TITLE 24, PART 11  
OF THE CALIFORNIA BUILDING  
CODE







## CHAPTER 4

### RESIDENTIAL MANDATORY MEASURES

#### DIVISION 4.2 – ENERGY EFFICIENCY

##### SECTION 4.201

##### GENERAL

**4.201.1 Scope.** For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory standards.

Authority: Public Resources Code ~~S~~sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~s~~Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~S~~Sections 18930.5 and 18941.5.

**APPENDIX A4****RESIDENTIAL VOLUNTARY MEASURES****DIVISION A4.2 – ENERGY EFFICIENCY****SECTION A4.201****GENERAL**

**A4.201.1 Scope.** For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory standards. It is the intent of these voluntary standards provisions to encourage buildings local jurisdictions through codification to achieve exemplary performance in the area of building energy efficiency. Local jurisdictions adopting these voluntary provisions as mandatory local energy efficiency standards shall submit the required application and receive the required approval of the California Energy Commission in compliance with Title 24, Part 1 Chapter 10, Section 10-106 of the California Administrative Code, prior to enforcement. Once approval is granted by the Energy Commission, local jurisdictions shall file an ordinance expressly marking the local modification along with findings submit their application and receive the required acceptance from the California Building Standards Commissions in compliance with Title 24, Part 11, Section 101.7 of this code, prior to enforcement. (Chapter 10, Section 106 of the California Administrative Code is available at <http://www.energy.ca.gov/title24/2016standards/>)

Authority: Public Resources Code Sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

**SECTION A4.202**

**DEFINITIONS**

**ENERGY BUDGET.**

**ENERGY DESIGN RATING.**

**TIME DEPENDENT VALUATION (TDV) ENERGY.**

Authority: Public Resources Code Sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

## SECTION A4.203

## PERFORMANCE APPROACH FOR NEWLY CONSTRUCTED BUILDINGS

**A4.203.1 Energy Efficiency.** Newly constructed low-rise residential buildings shall comply with Sections A4.203.1.1 and either A4.203.1.2.1, A4.203.1.2.2 or A4.203.1.2.3.

**A4.203.1.1 Tier 1, Tier 2, and Zero Net Energy Design ~~Tier 3~~ Prerequisites.** Each of the following efficiency measures is required for all applicable components of the building project.

**A4.203.1.1.1 Energy Design Rating.** An energy design rating for the Proposed Design Building shall be computed by Compliance Software certified by the Commission and this rating shall be included in the Certificate of Compliance documentation.

**A4.203.1.1.2 Quality Insulation Installation (QII).** The QII procedures specified in the Building Energy Efficiency Standards Reference Residential Appendix RA3.5 shall be completed.

**A4.203.1.1.3 Lighting.** Comply with all applicable requirements of Title 24, Part 6 Section 150.0(k). In addition:

1. ~~All permanently installed interior lighting shall be high efficacy. Permanently installed interior lighting shall be controlled by vacancy sensors if installed in kitchens, bathrooms, utility rooms, and private garages at a minimum. Lighting installed in closets that are 70 square feet or larger shall be controlled by vacancy sensors or dimmers.~~

~~— Exceptions:~~

1. ~~Night lights which comply with Title 24, Part 6 Section 150.0(k)1E.~~
2. ~~Lighting integral to exhaust fans which comply with Title 24, Part 6 Section 150.0(k)1F.~~
2. ~~All permanently installed lighting in bathrooms shall be controlled by a vacancy sensor.~~

~~— Exception: One high efficacy luminaire with total lamp wattage rated to consume no greater than 26 watts of power.~~

3. ~~Every room greater than 70 square feet which does not have permanently installed lighting and has receptacles installed shall have at least one switched receptacle installed.~~
42. ~~For single family residences, all permanently installed outdoor lighting shall be high efficacy and have controls complying with Title 24, Part 6 Sections 150.0(k)9A3Ai and iii.~~
3. ~~For multi family residential buildings, all permanently installed outdoor lighting shall be high efficacy and have controls controlled from within a dwelling unit shall have controls complying with Title 24, Part 6 Sections 150.0(k)9B3BAi and iii. For multi family residential buildings, all~~

permanently installed outdoor lighting which is not controlled from within a dwelling unit shall have controls complying with Title 24, Part 6 Section 150.0(k)9Bii.

4. All outdoor lighting for residential parking lots shall be high efficacy and comply with Title 24, Part 6, Section 150.0(k)93D.

**A4.203.1.2 Performance Standard.** Comply with one of the advanced efficiency levels indicated below.

**A4.203.1.2.1 Tier 1:** Buildings complying with the first level of advanced energy efficiency shall have either an Energy Budget that is no greater than 85 percent of the Title 24, Part 6 Energy Budget for the Proposed Standard Design Building, or shall have an Energy Design Rating, without considering on-site generation, reflecting showing a 15% or greater reduction in total energy uses regulated by Title 24, Part 6 its Energy Budget component compared to the Standard Design Building, as calculated by Title 24, Part 6 Compliance Software certified approved by the Energy Commission.

**A4.203.1.2.2 Tier 2:** Buildings complying with the second level of advanced energy efficiency shall have either an Energy Budget that is no greater than 70 percent of the Title 24, Part 6 Energy Budget for the Proposed Standard Design Building, or shall have an Energy Design Rating, without considering on-site generation, reflecting showing a 30% or greater reduction in total energy uses regulated by Title 24, Part 6 its Energy Budget component compared to the Standard Design Building, as calculated by Title 24, Part 6 Compliance Software certified approved by the Energy Commission.

**A4.203.1.2.3 (Zero Net Energy Design) Tier:** ~~Buildings complying with the third level of advanced energy efficiency (Tier 2):~~ Buildings complying with this elective designation shall have shall comply with ALL of the following requirements:

1. The building shall be shown on-site renewable energy generation sufficient to be in compliance with Section A4.203.1.2.2 (Tier 2 requirements).

2. The building shall have achieve an Energy Design Rating of zero (0) or less as calculated by Title 24, Part 6 Compliance Software certified approved by the Energy Commission, and:

1. Single family buildings in Climate Zones 6 and 7, and low-rise multifamily buildings in Climate Zone 3, 5, 6, and 7 shall comply with Section A4.203.1.2.1 (Tier 1); and
2. Single family Buildings in Climate Zones 1 through 5 and 8 through 16 and low-rise multifamily building in Climate Zones 1, 2, 4, and 8 through 16 shall comply with Section A4.203.1.2.2 (Tier 2).

**Note:** For Energy Budget calculations high-rise residential and hotel/motel buildings are considered nonresidential buildings.

Authority: Public Resources Code Sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

## SECTION A4.204

## PERFORMANCE APPROACH FOR ADDITIONS AND ALTERATIONS

**A4.204.1 Energy Efficiency.** Additions and alterations to low-rise residential buildings shall comply with Sections A4.204.1.1 or A4.204.1.2.

**A4.204.1.1 Tier 1 and Tier 2 Prerequisites.** Each of the following efficiency measures is required if applicable to the addition or alteration building project:

**A4.204.1.1.1 Lighting.** Comply with all applicable requirements of Title 24, Part 6 Section 150.0(k). In addition:

1. ~~All newly installed, permanently installed interior lighting shall be high efficacy and shall be controlled by vacancy sensors if installed in a kitchen, bathroom, utility room, or private garage. Lighting installed in closets that are 70 square feet or larger shall be controlled by vacancy sensors or dimmers.~~

~~— Exceptions:~~

1. ~~Night lights complying with Title 24, Part 6 Section 150.0(k)1E.~~
2. ~~Lighting integral to exhaust fans complying with Title 24, Part 6 Section 150.0(k)1F.~~
2. ~~All newly installed, permanently installed lighting in bathrooms shall be controlled by a vacancy sensor.~~
- ~~— Exception: One high efficacy luminaire with total lamp wattage rated to consume no greater than 26 watts of power.~~
3. ~~Every new room greater than 70 square feet which does not have newly installed, permanently installed lighting and has newly installed receptacles shall have at least one switched receptacle installed.~~
4. ~~For single family residences, all newly installed, permanently installed outdoor lighting shall be high efficacy and have controls complying with Title 24, Part 6 Sections 150.0(k)9Ai and iii.~~
3. ~~For multi family residential buildings, all newly installed, permanently installed outdoor lighting shall be high efficacy and have controls controlled from within a dwelling unit shall have controls complying with Title 24, Part 6 Sections 150.0(k)9Ai and iii. For multi family residential buildings, all newly installed, permanently installed outdoor lighting which is not controlled from within a dwelling unit shall have controls complying with Title 24, Part 6 Section 150.0(k)9Bii.~~
4. ~~All newly installed, permanently installed outdoor lighting for residential parking lots shall be high efficacy and comply with Title 24, Part 6, Section 150.0(k)9D.~~

**~~A4.204.1.2 Performance Standard.~~** ~~Comply with one of the advanced efficiency levels indicated in Section A4.204.1.2.1 or Section A4.204.1.2.2.~~

~~below.~~

**~~A4.204.1.2~~**

**A4.204.1.1 Tier 1:** Buildings complying with the first level of advanced energy efficiency shall have an Energy Budget that is no greater than indicated below, depending on the number of mechanical systems added or modified. Space heating systems, space cooling systems and water heating systems are each separate mechanical systems for the purpose of complying with this requirement. If the addition or alteration changes only the envelope with no change to any mechanical system, then no additional performance requirements above Title 24, Part 6 are required.

1. For one and only one mechanical system: No greater than 95 percent of the Title 24, Part 6 Energy Budget for the ~~Proposed~~ Standard Design Building as calculated by Compliance Software certified by the Energy Commission.
2. For two or more mechanical systems: No greater than 90 percent of the Title 24, Part 6 Energy Budget for the ~~Proposed~~ Standard Design Building as calculated by Compliance Software certified by the Energy Commission.

**~~A4.204.1.2.2~~ Tier 2:** Buildings complying with the second level of advanced energy efficiency shall have an Energy Budget that is no greater than indicated below, depending on the number of mechanical systems added or modified. Space heating systems, space cooling systems and water heating systems are each separate mechanical systems for the purpose of complying with this requirement. If the addition or alteration changes only the envelope with no change to any mechanical system, then no additional performance requirements above Title 24, Part 6 are required.

1. For one and only one mechanical system: No greater than 90 percent of the Title 24, Part 6 Energy Budget for the ~~Proposed~~ Standard Design Building as calculated by Compliance Software certified by the Energy Commission.
2. For two or more mechanical systems: No greater than 85 percent of the Title 24, Part 6 Energy Budget for the ~~Proposed~~ Standard Design Building as calculated by Compliance Software certified by the Energy Commission.

**Note:** For Energy Budget calculations high-rise residential and hotel/motel buildings are considered nonresidential buildings.

Authority: Public Resources Code ~~Sections~~ 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5; 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~Sections~~ 18930.5 and 18941.5.



Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

**APPENDIX A4**

**RESIDENTIAL VOLUNTARY MEASURES**

**DIVISION A4.6 – TIER 1 AND TIER 2**

**SECTION A4.601**

**GENERAL**

**A4.601.4.2 Prerequisite and elective measures for Tier 1.**

**2. From Division A4.2, Energy Efficiency.**

2.1 For newly constructed low-rise residential buildings, comply with the energy efficiency requirements in Sections A4.203.1.1 and ~~Section A4.203.1.2.1.~~

2.2 For additions and alterations to low-rise residential buildings, comply with the energy efficiency requirements in Section A4.204.1.1 and ~~Section A4.204.1.2.1.~~

**A4.601.5.2 Prerequisite and elective measures for Tier 2.**

**2. From Division A4.2, Energy Efficiency.**

2.1 For newly constructed low-rise residential buildings, comply with the energy efficiency requirements in Sections A4.203.1.1 and ~~Section A4.203.1.2.2.~~

2.2 For additions and alterations to low-rise residential buildings, comply with the energy efficiency requirements in Section A4.204.1.1 and ~~Section A4.204.1.2.2.~~

**A4.601.6.2 Prerequisite and elective measures for Tier 3.**

**2. From Division A4.2, Energy Efficiency.**

For newly constructed low-rise residential buildings, comply with the energy efficiency requirements in Section A4.203.1.1 and Section A4.203.1.2.3.

Authority: Public Resources Code ~~S~~sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~s~~Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~s~~Sections 18930.5 and 18941.5.

## APPENDIX A4

## RESIDENTIAL VOLUNTARY MEASURES

## DIVISION A4.6 – TIER 1 AND TIER 2

## SECTION A4.602

## RESIDENTIAL OCCUPANCIES APPLICATION CHECKLIST

FEATURE OR MEASURE	LEVELS			VERIFICATIONS		
	ELECTIVE MEASURES ADOPTED AS MANDATORY <sup>1</sup>			ENFORCING AGENCY TO SPECIFY VERIFICATION METHOD		
	Mandatory	Tier 1	Tier 2	Enforcing Agency <input type="checkbox"/> All	Installer or Designer <input type="checkbox"/> All	Third party <input type="checkbox"/> All
<b>ENERGY EFFICIENCY</b>						
<b>General</b>						
<b>4.201.1</b> Building meets or exceeds the requirements of the <i>California Building Energy Efficiency Standards</i> . <sup>3</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Performance Approach for Newly Constructed Buildings</b>						
<b>A4.203.1.1.1</b> An Energy Design Rating for the Proposed Design Building is included in the Certificate of Compliance documentation.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.203.1.1.2</b> QJI procedures specified in the Building Energy Efficiency Standards Reference Residential Appendix RA3.5 are completed.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FEATURE OR MEASURE	LEVELS			VERIFICATIONS		
	ELECTIVE MEASURES ADOPTED AS MANDATORY <sup>1</sup>			ENFORCING AGENCY TO SPECIFY VERIFICATION METHOD		
	Mandatory	Tier 1	Tier 2	Enforcing Agency <input type="checkbox"/> All	Installer or Designer <input type="checkbox"/> All	Third party <input type="checkbox"/> All
<b>A4.203.1.1.3</b> All permanently installed lighting is high efficacy and has required controls.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.203.1.2.1 (Tier 1)</b>  The Energy Budget is no greater than 85 percent of the Title 24, Part 6 Energy Budget for the <del>Proposed</del> <u>Standard</u> Design Building.		<input checked="" type="checkbox"/> <sup>2</sup>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.203.1.2.2 (Tier 2)</b>  The Energy Budget is no greater than 70 percent of the Title 24, Part 6 Energy Budget for the <del>Proposed</del> <u>Standard</u> Design Building.			<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.203.1.2.3 (Tier III): Zero Net Energy Design Tier (elective):</b>  <u>Shall comply with all of the following:</u>  1. <u>Section A4.203.1.1 (Prerequisite) and</u>  2. <u>Section A4.203.1.2.1</u>  • <u>for single family buildings in Climate Zones 6 and 7, and low-rise multifamily buildings in Climate Zones 3, 5, 6, and 7</u>  <u>or Section A4.203.1.2.2</u>  • <u>for single family buildings in Climate Zones 1-5 and 8-16, and low-rise multifamily buildings in Climate Zones 1, 2, 4, and 8-16</u>  3. <u>Energy Design Rating of zero (0) or less</u>				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FEATURE OR MEASURE	LEVELS			VERIFICATIONS		
	ELECTIVE MEASURES ADOPTED AS MANDATORY <sup>1</sup>			ENFORCING AGENCY TO SPECIFY VERIFICATION METHOD		
	Mandatory	Tier 1	Tier 2	Enforcing Agency <input type="checkbox"/> All	Installer or Designer <input type="checkbox"/> All	Third party <input type="checkbox"/> All
<b>Performance Approach for Additions and Alterations</b>						
<b>A4.204.1.1.1</b> All newly installed, permanently installed lighting is high efficacy and has required controls.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.204.1.2.1 Tier 1:</b>  If only one mechanical system is added or modified, the Energy Budget is no greater than 95 percent of the Title 24, Part 6 Energy Budget for the Proposed Standard Design Building.  If two or more mechanical systems are added or modified, the Energy Budget is no greater than 90 percent of the Title 24, Part 6 Energy Budget for the Proposed Standard Design Building.		<input checked="" type="checkbox"/> <sup>2</sup>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.204.1.2.2 Tier 2</b>  If only one mechanical system is added or modified, the Energy Budget is no greater than 90 percent of the Title 24, Part 6 Energy Budget for the Proposed Standard Design Building.  If two or more mechanical systems are added or modified, the Energy Budget is no greater than 85 percent of the Title 24, Part 6 Energy Budget for the Proposed Standard Design Building.			<input checked="" type="checkbox"/> <sup>2</sup>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

- Green building measures in this table may be mandatory if adopted by a city, county, or city and county as specified in Section 101.7.
- Required prerequisite for this Tier.
- These measures are currently required elsewhere in statute or in regulation.

Authority: Public Resources Code Sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

## APPENDIX A5

## NONRESIDENTIAL VOLUNTARY MEASURES

## DIVISION A5.2 ENERGY EFFICIENCY

## SECTION A5.201

## GENERAL

**A5.201.1 Scope.** For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory standards. It is the intent of these voluntary standards provisions to encourage buildings local jurisdictions through codification to achieve exemplary performance in the area of building energy efficiency. Local jurisdictions adopting these voluntary provisions as mandatory local energy efficiency standards shall submit the required application and receive the required approval of the California Energy Commission in compliance with ~~Title 24, Part 1~~ Chapter 10, Section ~~10-106~~ 106 of the *California Administrative Code*, prior to enforcement. Once approval is granted by the Energy Commission, local jurisdictions shall file an ordinance expressly marking the local modifications along with findings and receive the required acceptance approved from the California Building Standards ~~Commissions~~ Commission in compliance with ~~Title 24, Part 11~~ Section 101.7 of this code, prior to enforcement. (Chapter 10, Section 106 of the *California Administrative Code* is available at <http://www.energy.ca.gov/title24/2016standards/>)

Authority: Public Resources Code ~~S~~sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~s~~Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~S~~Sections 18930.5 and 18941.5.



**SECTION A5.202****DEFINITIONS****ENERGY BUDGET****GEOHERMAL****PROCESS****SOLAR ACCESS****TIME DEPENDENT VALUATION (TDV)**

Authority: Public Resources Code Sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

**SECTION A5.203****PERFORMANCE APPROACH**

**A5.203.1 Energy Efficiency.** Nonresidential, high-rise residential and hotel/motel buildings that include lighting and/or mechanical systems shall comply with Sections A5.203.1.1 and either A5.203.1.2.1 or A5.203.1.2.2. Newly constructed buildings ~~as well as and additions and alterations~~ are included in the scope of these sections. Buildings permitted without lighting or mechanical systems shall comply with Section A5.203.1.1 but are not required to comply with Sections A5.203.1.1.2 or A5.203.1.2.

**A5.203.1.1 Tier 1 and Tier 2 Prerequisites.** Each of the following efficiency measures is required for all applicable components of the building project:

**A5.203.1.1.1 Outdoor Lighting.** Newly installed outdoor lighting power shall be no greater than 90 percent of the ~~Title 24, Part 6 calculated value of a~~ Allowed eOutdoor ~~Lighting p~~Power. The Allowed Outdoor Lighting Power calculation is specified in Title 24, Part 6, Section 140.7 "Requirements For Outdoor Lighting."

**A5.203.1.1.2 Service Water Heating in Restaurants.** Newly constructed restaurants 8,000 square feet or greater and with service water heaters rated 75,000 Btu/h or greater shall install a solar water-heating system with a minimum solar savings fraction of 0.15.

**Exceptions:**

1. Buildings with a natural gas service water heater with a minimum of 95 percent thermal efficiency.
2. Buildings where greater than 75 percent of the total roof area has annual solar access that is less than 70 percent. Solar access is the ratio of solar insolation including shade to the solar insolation without shade. Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

~~**A5.203.1.1.3 Functional Areas where Compliance with Residential Lighting Standards is required.** For newly constructed high-rise residential dwelling units and hotel and motel guest rooms, indoor lighting shall comply with the applicable requirements in Appendix A4 Residential Voluntary Measures, Division A4.2—Energy Efficiency, Section A4.203.1.1.3. For additions and alterations to high-rise residential dwelling units and hotel and motel guest rooms, indoor lighting shall comply with the applicable requirements in Appendix A4 Residential Voluntary Measures, Division A4.2—Energy Efficiency, Section A4.204.1.1.1.~~

**A5.203.1.2 Performance Standard.** Comply with one of the advanced efficiency levels indicated below.

**A5.203.1.2.1 Tier 1:** Buildings complying with the first level of advanced energy efficiency shall have an Energy Budget that is no greater than indicated below, depending on the type of energy systems included in the building project. If the newly constructed building or, addition ~~or alteration~~ does not include indoor lighting or mechanical systems, then no additional performance requirements above Title 24, Part 6 are required.

1. For building projects that include indoor lighting or mechanical systems, but not both: No greater than 95 percent of the Title 24, Part 6 Energy Budget for the Standard-Proposed Design Building as calculated by Compliance Software certified by the Energy Commission.
2. For building projects that include indoor lighting and mechanical systems: No greater than 90 percent of the Title 24, Part 6 Energy Budget for the Standard-Proposed Design Building as calculated by Compliance Software certified by the Energy Commission.

**A5.203.1.2.2 Tier 2:** Buildings complying with the second level of advanced energy efficiency shall have an Energy Budget that is no greater than indicated below, depending on the type of energy systems included in the building project. If the newly constructed building or, ~~addition or alteration~~ does not include indoor lighting or mechanical systems, then no additional performance requirements above Title 24, Part 6 are required.

1. For building projects that include indoor lighting or mechanical systems, but not both: No greater than 90 percent of the Title 24, Part 6 Energy Budget for the ~~Standard-Proposed~~ Design Building as calculated by Compliance Software certified by the Energy Commission.
2. For building projects that include indoor lighting and mechanical systems: No greater than 85 percent of the Title 24, Part 6 Energy Budget for the ~~Standard-Proposed~~ Design Building as calculated by Compliance Software certified by the Energy Commission.

**Note:** For Energy Budget calculations, high-rise residential and hotel/motel buildings are considered nonresidential buildings.

Authority: Public Resources Code ~~S~~sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~S~~sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~s~~Sections 18930.5 and 18941.5.

## APPENDIX A5

### NONRESIDENTIAL VOLUNTARY MEASURES

#### DIVISION A5.6 – VOLUNTARY TIERS

#### SECTION A5.601

##### CALGREEN TIER 1 AND TIER 2

**A5.601.2.2 Energy Performance.** For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory standards.

**A5.601.2.3 Tier 1.** Comply with the energy efficiency requirements in Section A5.203.1.1 and Section A5.203.1.2.1.

**A5.601.3.2 Energy Performance.** For the purposes of mandatory energy efficiency standards in this code, the California Energy Commission will continue to adopt mandatory standards.

**A5.601.3.3 Tier 2.** Comply with the energy efficiency requirements in Section A5.203.1.1 and Section A5.203.1.2.2.

Authority: Public Resources Code Sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code Sections 18930.5 and 18941.5.

## APPENDIX A5

## NONRESIDENTIAL VOLUNTARY MEASURES

## DIVISION A5.6 – VOLUNTARY TIERS

## SECTION A5.602

## NONRESIDENTIAL OCCUPANCIES APPLICATION CHECKLIST

APPLICATION CHECKLIST FOR BSC	MANDATORY	VOLUNTARY <sup>1</sup>	
		CALGreen Tier 1	CALGreen Tier 2
Energy Efficiency			
Performance Requirements for Newly Constructed Buildings and Additions			
A5.201.1 Scope. Building meets or exceeds the requirements of the California Building Energy Efficiency Standards. <sup>3</sup>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>
A5.203.1 Energy efficiency. Nonresidential, high-rise residential and hotel/motel buildings that include lighting and/or mechanical systems shall comply with Sections A5.203.1.1 and either A5.203.1.2.1 or A5.203.1.2.2. Newly constructed buildings and additions are included in the scope of these sections. Buildings permitted without lighting or mechanical systems shall comply with Section A5.203.1.1 but are not required to comply with Sections A5.203.1.1.2 or A5.203.1.2.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A5.203.1.1.1 Outdoor Lighting. Newly installed outdoor lighting power is no greater than 90 percent of the Title 24, Part 6 calculated value of allowed outdoor lighting power.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>
A5.203.1.1.2 Service Water Heating in Restaurants. Newly constructed restaurants 8,000 square feet or greater and with service water heaters rated 75,000 Btu/h or greater installed a solar water-heating system with a minimum solar savings fraction of 0.15 or meet one of the exceptions.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>

APPLICATION CHECKLIST FOR BSC	MANDATORY	VOLUNTARY <sup>1</sup>	
		CALGreen Tier 1	CALGreen Tier 2
<del><b>A5.203.1.1.3 Functional Areas where Compliance with Residential Lighting Standards is required.</b></del> For newly constructed high-rise residential dwelling units and hotel and motel guest rooms, indoor lighting complies with the applicable requirements in Appendix A4 Residential Voluntary Measures, Division A4.2—Energy Efficiency, Section A4.203.1.1.3. For additions and alterations to high-rise residential dwelling units and hotel and motel guest rooms, indoor lighting complies with the applicable requirements in Appendix A4 Residential Voluntary Measures, Division A4.2—Energy Efficiency, Section A4.204.1.1.1.		<input checked="" type="checkbox"/> <sup>2</sup>	<input checked="" type="checkbox"/> <sup>2</sup>
	<input type="checkbox"/>		
<b>A5.203.1.2.1 Tier 1.</b>  For building projects that include indoor lighting or mechanical systems, but not both, the Energy Budget is no greater than 95 percent of the Title 24, Part 6 Energy Budget for the <u>Standard</u> <del>Proposed</del> Design Building.  For building projects that include indoor lighting and mechanical systems, the Energy Budget is no greater than 90 percent of the Title 24, Part 6 Energy Budget the <u>Standard</u> <del>Proposed</del> Design Building.		<input checked="" type="checkbox"/> <sup>2</sup>	
<b>A5.203.1.2.2 Tier 2.</b>  For building projects that include indoor lighting or mechanical systems, but not both, the Energy Budget is no greater than 90 percent of the Title 24, Part 6 Energy Budget for the <u>Standard</u> <del>Proposed</del> Design Building.  For building projects that include indoor lighting and mechanical systems, the Energy Budget is no greater than 85 percent of the Title 24, Part 6 Energy Budget for the <u>Standard</u> <del>Proposed</del> Design Building.			<input checked="" type="checkbox"/> <sup>2</sup>

1. Green building measures in this table may be mandatory if adopted by a city, county, or city and county as specified in Section 101.7.
2. Required prerequisite for this Tier.
3. These measures are currently required elsewhere in statute or in regulation.

Authority: Public Resources Code ~~S~~sections 25218, subd. (e), 25402, 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~S~~sections 18930.5 and 18941.5.

Reference: Public Resources Code Sections 25402, subd. (a)-(c), 25402.1, 25402.4, 25402.5, 25402.5.4, 25402.8, 25910, and 25943, and Health and Safety Code ~~S~~Sections 18930.5 and 18941.5.





**FINAL EXPRESS TERMS  
FOR  
PROPOSED BUILDING STANDARDS  
OF THE  
DIVISION OF THE STATE ARCHITECT – STRUCTURAL SAFETY (DSA-SS)  
REGARDING THE CALIFORNIA GREEN BUILDING STANDARDS CODE (CALGreen)  
CALIFORNIA CODE OF REGULATIONS (CCR), TITLE 24, PART 11  
(DSA-SS 07/15)**

**LEGEND FOR EXPRESS TERMS**

1. Existing California amendments or code language being modified are in italics when they appear in the model code text: All such language appears in *italics*, modified language is underlined.
2. New California amendments: All such language appears underlined and in italics.
3. Repealed text: All such language appears in ~~strikeout~~.

**INITIAL EXPRESS TERMS**

The Division of the State Architect (DSA) proposes to amend the 2013 edition of the California Green Building Standards Code (CGBSC) for the 2013 Triennial Code Cycle. Amended text is as follows:

**ITEM NUMBERS LISTED BELOW:**

**ITEM 1.** DSA proposes to amend Chapter 1, Section 105.1.

...  
**CHAPTER 1  
ADMINISTRATION**  
...

**SECTION 105  
DIVISION OF THE STATE ARCHITECT**

...  
**105.1.1 Application - Public elementary and secondary schools and community colleges.** New building construction, and additions and related site work on a new or existing site.

*Note: The Application of Standards outlined in Title 24, Part 6 supersedes the above application as it applies to the California Energy Code.*

...

**ITEM 2.** DSA proposes to amend Chapter 2, Section 202.

**CHAPTER 2  
DEFINITIONS**

...  
**SECTION 202  
DEFINITIONS**

...

**Hybrid Urinal.** A urinal that conveys waste into the drainage system without the use of water for flushing; and automatically performs a drain-cleansing action after a predetermined amount of time.

*[Note: As defined in IAPMO IGC 311-2014]*

...

**METERING FAUCET.** A self-closing faucet that dispenses a specific volume of water for each actuation cycle. The volume or cycle duration can be fixed or adjustable.

*[Note: As defined in California Plumbing Code (CPC) Appendix L Section L 201.6]*

...

**ORGANIC WASTE.** Food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper waste that is mixed in with food waste.

*[Note: As defined by Public Resources Code (PRC) Section 42649.8(c)]*

...

**OVE.** Optimal Value Engineering, another term for advanced wood framing techniques...

**POSTCONSUMER CONTENT.** Waste material generated by consumers after it is used and which would otherwise be discarded.

...

**PRECONSUMER (or POSTINDUSTRIAL).** Material diverted from the waste stream during one manufacturing process, including scraps, damaged goods, and excess production, that is used in another manufacturing process.

...

**RECYCLED CONTENT.** Refer to International Organization of Standards for Standardization ISO 14021 – Environmental labels and declarations – Self-declared environmental claims (Type II environmental labeling).

...

**RECYCLED CONTENT VALUE (RCV).** Material cost multiplied by postconsumer content plus ½ the preconsumer content, or  $RCV = \$ X (\text{postconsumer content} + \frac{1}{2} \text{preconsumer content})$ .

...

**UNIVERSAL WASTE.** The wastes listed below are subject to regulation pursuant to Chapter 23 of Title 22, California Code of Regulations, and shall be known as "universal wastes."

- (1) Batteries, as described in Title 22 CCR, Section 66273.2, Subsection (a);
- (2) Electronic devices, as described in Title 22 CCR, Section 66273.3, Subsection (a);
- (3) Mercury-containing equipment, as described in Title 22 CCR, Section 66273.4, Subsection (a);
- (4) Lamps, as described in Title 22 CCR, Section 66273.5, Subsection (a);
- (5) Cathode ray tubes, as described in Title 22 CCR, Section 66273.6, Subsection (a);
- (6) Cathode ray tube glass, as described in Title 22 CCR, Section 66273.7, Subsection (a); and
- (7) Aerosol cans, as specified in Health and Safety Code, Section 25201.16.

*[Note: As defined by Title 22, CCR § 66261.9]*

...

**ITEM 3.** DSA proposes to repeal Chapter 3, Section 303.

**SECTION 303  
PHASED PROJECTS**

**303.1 Phased projects.** ~~For shell buildings and others constructed for future tenant improvements, only these code measures relevant to the building components and systems considered to be new construction (or newly constructed) shall apply.~~

**303.1.1 Tenant improvements.** ~~The provisions of this code shall apply only to the initial tenant improvements to a project.~~

...  
**ITEM 4. DSA proposes to amend mandatory regulations in Chapter 5, Division 5.1, Section 5.106.**

**5.106.8 Light pollution reduction. [N]** Outdoor lighting systems shall be designed and installed to comply with the following:

1. The minimum requirements in the *California Energy Code* for Lighting Zones 40-4 as defined in Chapter 10 of the California Administrative Code; and
2. Backlight, Uplight and Glare (BUG) ratings as defined in IES TM-15-11; and
3. Allowable BUG ratings not exceeding those shown in Table 5.106.8, or

Comply with a local ordinance lawfully enacted pursuant to Section 101.7, whichever is more stringent.

**Exceptions: [N]**

1. Luminaires that qualify as exceptions in Section 140.7 of the *California Energy Code*.
2. Emergency lighting.
3. Building facade meeting the requirements in Table 140.7-B of the *California Energy Code*, Part 6.
4. Custom lighting features as allowed by the local enforcing agency, as permitted by Section 101.8 Alternate materials, designs and methods of construction.

...  
**ITEM 5. DSA proposes to amend mandatory regulations in Chapter 5, Division 5.3, Section 5.302.**

**DIVISION 5.3  
WATER EFFICIENCY AND CONSERVATION**

**SECTION 5.302  
DEFINITIONS**

**5.302.1 Definitions.** The following terms are defined in Chapter 2.

...  
**METERING FAUCET**

...

**ITEM 6.** DSA proposes to amend mandatory regulations in Chapter 5, Division 5.3, Section 5.303.

**SECTION 5.303  
INDOOR WATER USE**

**5.303.1 Meters.** Separate submeters or metering devices shall be installed for the uses described in Sections 5.303.1.1 and 5.303.1.2.

...

**5.303.6 Standards for plumbing fixtures and fittings.** Plumbing fixtures and fittings shall be installed in accordance with the *California Plumbing Code*, and shall meet the applicable standards referenced in Table 4404.4 1701.1 of the *California Plumbing Code* and in Chapter 6 of this code.

**ITEM 6.1** DSA proposes to amend mandatory regulations in Chapter 5, Division 5.3, Section 5.303.3.4.5.

**5.303.3.4.5 Metering faucets for wash fountains.** Metering faucets for wash fountains shall have a maximum flow rate of no more than 0.20 gallons per minute cycle/20 [rim space (inches) at 60 psi.

...

**ITEM 7.** DSA proposes to amend mandatory regulations in Chapter 5, Division 5.4, Section 5.402.

**DIVISION 5.4  
MATERIAL CONSERVATION AND RESOURCE EFFICIENCY**

...

**SECTION 5.402  
DEFINITIONS**

**5.402.1 Definitions.** The following terms are defined in Chapter 2.

...

**ORGANIC WASTE**

...

**ITEM 8.** DSA proposes to amend mandatory regulations in Chapter 5, Division 5.4, Section 5.408.

**SECTION 5.408  
CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING**

**5.408.1 Construction waste management.** Recycle and/or salvage for reuse a minimum of ~~50%~~ 65% of the non-hazardous construction and demolition waste in accordance with Section 5.408.1.1, 5.408.1.2 or 5.408.1.3; or meet a local construction and demolition waste management ordinance, whichever is more stringent.

**5.408.1.1 Construction waste management plan . . .**

**5.408.1.2 Waste management company . . .**

**5.408.1.3 Waste stream reduction alternative.** The combined weight of new construction disposal that does not exceed two pounds per square foot of building area may be deemed to meet the ~~50~~ 65 percent minimum requirement as approved by the enforcing agency.

**5.408.1.4 Documentation . . .**

**ITEM 9.** DSA proposes to amend mandatory regulations in Chapter 5, Division 5.4, Section 5.410.

**SECTION 5.410  
BUILDING MAINTENANCE AND OPERATION**

**5.410.1 Recycling by occupants.** Provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics, organic waste and metals or meet a lawfully enacted local recycling ordinance, if more restrictive.

**Exception:** Rural jurisdictions that meet and apply for the exemption of Public Resources Code 42649.82 (a)(2)(A) et seq. will also be exempt from the organics waste portion of this section.

**ITEM 10.** DSA proposes to amend mandatory regulations in Chapter 5, Division 5.5, Section 5.504.

**SECTION 5.504  
POLLUTANT CONTROL**

**5.504.1.3 Temporary ventilation.** The permanent HVAC system shall only be used during construction if necessary to condition the building or areas of addition or alteration within the required temperature range for material and equipment installation. If the HVAC system is used during construction, use return air filters with a Minimum Efficiency Reporting Value (MERV) of 8, based on ASHRAE 52.2-1999, or an average efficiency of 30 percent based on ASHRAE 52.1-1992. Replace all filters immediately prior to occupancy, or, if the building is occupied during alteration, at the conclusion of construction.

**5.504.3 Covering of duct openings and protection of mechanical equipment during construction.**

...

**5.504.4 Finish material pollutant control.** Finish materials shall comply with Sections 5.504.4.1 through 5.504.4.46.

...

**Notation**

**Authority:** Education Code Sections 17280—17317 and 81130—81147.

**References:** Education Code Sections 17310 and 81142.



FINAL EXPRESS TERMS  
FOR  
PROPOSED BUILDING STANDARDS  
OF THE  
DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT  
REGARDING THE 2016 CALIFORNIA GREEN BUILDING STANDARDS CODE (CALGREEN)  
CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 11

(HCD 07/15)

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The Department of Housing and Community Development (HCD) proposes to make necessary changes to be included in the 2016 edition of the California Green Building Standards Code (CGBC), also known as CALGreen, as presented on the following pages:

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**LEGEND FOR EXPRESS TERMS:**

1. **Existing California text or language being modified:** All language is shown in normal Arial 9 point; modified language is underlined or shown in ~~strikeout~~.
  2. **Existing text not being modified:** All language not displayed in full is shown as "..." (i.e., ellipsis).
  3. **Repealed text:** All language appears in ~~strikeout~~.
  4. **Notation:** Authority and Reference citations are provided at the end of each section.
- 

**1. HCD proposes to continue adoption of Chapter 1 from the 2013 CALGreen Code into the 2016 CALGreen Code with new modifications as follows:**

CHAPTER 1  
ADMINISTRATION

SECTION 101  
GENERAL

**101.5.1 Building.** The provisions of the *California Building Code*, and *California Residential Code*, and *California Existing Building Code*, as applicable, shall apply to the construction, alteration, movement, enlargement, replacement, repair, use and occupancy, location, maintenance, removal and demolition of every structure or any appurtenances connected or attached to such buildings or structures.

**101.7.1 Findings and filings.**

- 1.... (No Change)
- 2.... (No Change)
3. Findings prepared by fire protection districts shall be ratified by the local city, county, or city and county and filed with the California Department of Housing and Community Development at 4800 3<sup>rd</sup> Street, Room 260, Sacramento, CA 95814 2020 W. El Camino Avenue, Suite 250, Sacramento, CA 95833-1829.

SECTION 104  
DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

**104.1 Scope.** Specific scope of application of the agency responsible for enforcement, the enforcement agency and the specific authority to adopt and enforce such provisions of this code, unless otherwise stated.

**1. Housing construction.**

**Application**—Hotels, motels, lodging houses, apartment houses apartments, dwellings, dormitories, condominiums, shelters for homeless persons, congregate residences, employee housing, factory-built housing and other types of dwellings containing sleeping accommodations with or without common toilet or cooking facilities including accessory buildings, facilities and uses thereto.

---

**2. HCD proposes to continue adoption of Chapter 2 from the 2013 CALGreen Code into the 2016 CALGreen Code with new modifications as follows:**

**CHAPTER 2  
DEFINITIONS**

**SECTION 202  
DEFINITIONS**

**DEMAND HOT WATER RECIRCULATION SYSTEM.** A hot water recirculation system requiring manual activation and equipped with a thermostat that will automatically shut off the recirculation pump when the water temperature reaches a preset level at the point of use.

**ELECTRIC VEHICLE (EV) CHARGER.** Off-board charging equipment used to charge an electric vehicle.

**ELECTRIC VEHICLE CHARGING SPACE (EV SPACE).** A space intended for future installation of EV charging equipment and charging of electric vehicles.

**ELECTRIC VEHICLE CHARGING STATION(S) (EVCS).** One or more spaces intended for charging electric vehicles. One or more electric vehicle charging spaces served by electric vehicle charger(s) or other charging equipment allowing charging of electric vehicles. Electric vehicle charging stations are not considered parking spaces.

**HOT WATER RECIRCULATION SYSTEM.** A hot water distribution system that reduces the time needed to deliver hot water to fixtures that are distant from the water heater, boiler or other water heating equipment. The recirculation system is comprised of hot water supply and return piping with shutoff valves, balancing valves, circulating pumps, and a method of controlling the circulating system.

**HYBRID URINAL.** A urinal that conveys waste into the drainage system without the use of water for flushing, and automatically performs a drain-cleaning action after a predetermined amount of time.

**ORGANIC WASTE.** Food waste, green waste, landscape and pruning waste, nonhazardous wood waste, and food-soiled paper waste that is mixed in with food waste.

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**3. HCD proposes to continue adoption of Chapter 4 from the 2013 CALGreen Code into the 2016 CALGreen Code with new modifications as follows:**

**CHAPTER 4  
RESIDENTIAL MANDATORY MEASURES**

***Division 4.1 – PLANNING AND DESIGN***

**SECTION 4.106  
SITE DEVELOPMENT**

**4.106.4.2 New multifamily dwellings.** Where 17 or more multifamily dwelling units are constructed on a building site, 3 percent of the total number of parking spaces provided for all types of parking facilities, but in no case less than one, shall be electric vehicle charging stations spaces (EVCS EV spaces) capable of supporting future EVSE and shall be identified on construction documents. Calculations for the required number of EVCS spaces shall be rounded up to the nearest whole number.

**Note:** Construction documents are intended to demonstrate the project's capability and capacity for facilitating future EV charging. There is no requirement for EVCS EV spaces to be constructed or available until EV chargers are installed for use.



**4.106.4.2.1 Electric vehicle charging station (EVCS) space (EV space) locations.** Construction documents shall indicate the location of proposed EVCS EV spaces. At least one EVCS EV space shall be located in common use areas and available for use by all residents.

When EV chargers are installed, EVCS EV spaces required by Section 4.106.4.2.2, Item 3, shall comply with at least one of the following options:

1. The EVCS EV space shall be located adjacent to an accessible parking space meeting the requirements of the *California Building Code*, Chapter 11A, to allow use of the EV charger from the accessible parking space.
2. The EVCS EV space shall be located on an accessible route, as defined in the *California Building Code*, Chapter 2, to the building.

**4.106.4.2.2 Electric vehicle charging station (EVCS) space (EV space) dimensions and slope.** The EVCS EV spaces shall be designed to comply with the following:

1. The minimum length of each EVCS EV space shall be 18 feet (5486 mm).
2. The minimum width of each EVCS EV space shall be 9 feet (2743 mm).
3. One in every 25 EVCS EV spaces, but not less than one EVCS, shall also have an 8-foot (2438 mm) wide minimum aisle. A 5-foot (1524 mm) wide minimum aisle shall be permitted provided the minimum width of the EVCS EV space is 12 feet (3658 mm).
  - a. Surface slope for this EVCS EV space and the aisle shall not exceed 1 unit vertical in 48 units horizontal (2.083 percent slope) in any direction.

**4.106.4.2.3 Single EVCS EV space required.** Install a listed raceway capable of accommodating a 208/240-volt dedicated branch circuit. The raceway shall not be less than trade size 1 (nominal 1-inch inside diameter). The raceway shall originate at the main service or subpanel and shall terminate into a listed cabinet, box or enclosure in close proximity to the proposed location of the EVCS EV spaces. Construction documents shall identify the raceway termination point. The service panel and/or subpanel shall provide capacity to install a 40-ampere minimum dedicated branch circuit and space(s) reserved to permit installation of a branch circuit overcurrent protective device.

**4.106.4.2.4 Multiple EVCS EV spaces required.** Construction documents shall indicate the raceway termination point and proposed location of future EVCS EV spaces and EV chargers. Construction documents shall also provide information on amperage of future EVSE, raceway method(s), wiring schematics and electrical load calculations to verify that the electrical panel service capacity and electrical system, including any on-site distribution transformer(s), have sufficient capacity to simultaneously charge all EVs at all required EVCS EV spaces at the full rated amperage of the EVSE. Plan design shall be based upon a 40-ampere minimum branch circuit. Raceways and related components that are planned to be installed underground, enclosed, inaccessible or in concealed areas and spaces shall be installed at the time of original construction.

**4.106.4.2.5 Identification.** The service panel or subpanel circuit directory shall identify the overcurrent protective device space(s) reserved for future EV charging purposes as "EV CAPABLE" in accordance with the *California Electrical Code*.

**Notes:**

1. The California Department of Transportation adopts and publishes the "California Manual on Uniform Traffic Control Devices (California MUTCD)" to provide uniform standards and specifications for all official traffic control devices in California. Zero Emission Vehicle Signs and Pavement Markings can be found in the New Policies & Directives Number 13-01. Website: [www.dot.ca.gov/hq/traffops/signtech/signdel/policy.htm](http://www.dot.ca.gov/hq/traffops/signtech/signdel/policy.htm)  
<http://www.dot.ca.gov/hq/traffops/policy/13-01.pdf>
2. See Vehicle Code Section 22511 for EV charging space signage in off-street parking facilities and for use of EV charging spaces.
3. The Governor's Office of Planning and Research (OPR) published a "Zero-Emission Vehicle Community Readiness Guidebook" which provides helpful information for local governments, residents and businesses. Website: [http://opr.ca.gov/docs/ZEV\\_Guidebook.pdf](http://opr.ca.gov/docs/ZEV_Guidebook.pdf)

4. The Governor's Office of Planning and Research (OPR) has developed draft guidelines, "Plug-in Electric Vehicles: Universal Charging Access Guidelines and Best Practices", addressing physical accessibility standards and design guidelines for EVs. Website: [http://opr.ca.gov/docs/PEV\\_Access\\_Guidelines.pdf](http://opr.ca.gov/docs/PEV_Access_Guidelines.pdf)

#### **Division 4.3 – WATER EFFICIENCY AND CONSERVATION**

##### **SECTION 4.303 INDOOR WATER USE**

**4.303.1.2 Urinals.** ~~On or after January 1, 2016, the~~ The effective flush volume of wall mounted urinals shall not exceed 0.125 gallons per flush. The effective flush volume of all other urinals shall not exceed 0.5 gallons per flush.

**4.303.1.4.1 Residential lavatory faucets.** ~~On or after July 1, 2016, the~~ The maximum flow rate of residential lavatory faucets shall not exceed 1.2 gallons per minute at 60 psi. The minimum flow rate of residential lavatory faucets shall not be less than 0.8 gallons per minute at 20 psi.

**4.303.2 Standards for plumbing fixtures and fittings.** Plumbing fixtures and fittings shall be installed in accordance with the *California Plumbing Code*, and shall meet the applicable standards referenced in Table 4401.1 ~~1701.1~~ of the *California Plumbing Code*.

#### **Division 4.4 – MATERIAL CONSERVATION AND RESOURCE EFFICIENCY**

##### **SECTION 4.408 CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING**

**4.408.1 Construction waste management.** Recycle and/or salvage for reuse a minimum of ~~50~~ 65 percent of the nonhazardous construction and demolition waste in accordance with either Section 4.408.2, 4.408.3 or 4.408.4, or meet a more stringent local construction and demolition waste management ordinance.

Exceptions: (....No Change)

**4.408.4 Waste stream reduction alternative.** (LR) Projects that generate a total combined weight of construction and demolition waste disposed of in landfills, which do not exceed ~~four (4) lbs./sq. ft.~~ 3.4 pounds per square foot of the building area shall meet the minimum ~~50~~ 65 percent construction waste reduction requirement in Section 4.408.1.

**4.408.4.1 Waste stream reduction alternative.** Projects that generate a total combined weight of construction and demolition waste disposed of in landfills, which do not exceed ~~two (2) 2~~ pounds per square foot of the building area, shall meet the minimum ~~50~~ 65-percent construction waste reduction requirement in Section 4.408.1.

##### **SECTION 4.410 BUILDING MAINTENANCE AND OPERATION**

**4.410.1 Operation and maintenance manual.** At the time of final inspection, a manual, compact disc, web-based reference or other media acceptable to the enforcing agency which includes all of the following shall be placed in the building:

1. Directions to the owner or occupant that the manual shall remain with the building throughout the life cycle of the structure.
2. Operation and maintenance instructions for the following:
  - a. Equipment and appliances, including water-saving devices and systems, HVAC systems, photovoltaic systems, electric vehicle chargers, water-heating systems and other major appliances and equipment.
  - b. Roof and yard drainage, including gutters and downspouts.
  - c. Space conditioning systems, including condensers and air filters.
  - d. Landscape irrigation systems.
  - e. Water reuse systems.
3. Information from local utility, water and waste recovery providers on methods to further reduce resource consumption, including recycle programs and locations.

4. Public transportation and/or carpool options available in the area.
5. Educational material on the positive impacts of an interior relative humidity between 30–60 percent and what methods an occupant may use to maintain the relative humidity level in that range.
6. Information about water-conserving landscape and irrigation design and controllers which conserve water.
7. Instructions for maintaining gutters and downspouts and the importance of diverting water at least 5 feet away from the foundation.
8. Information on required routine maintenance measures, including, but not limited to, caulking, painting, grading around the building, etc.
9. Information about state solar energy and incentive programs available.
10. A copy of all special inspection verifications required by the enforcing agency or this code.

**4.410.2 Recycling by occupants.** Where 5 or more multifamily dwelling units are constructed on a building site, provide readily accessible area(s) that serves all buildings on the site and is identified for the depositing, storage and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics, organic waste, and metals or meet a lawfully enacted local recycling ordinance, if more restrictive.

**Exception:** Rural jurisdictions that meet and apply for the exemption in Public Resources Code Section 42649.82 (a)(2)(A) et seq. are not required to comply with the organic waste portion of this section.

#### Division 4.5 – ENVIRONMENTAL QUALITY

##### SECTION 4.503 FIREPLACES

**4.503.1 General.** Any installed gas fireplace shall be a direct-vent sealed-combustion type. Any installed woodstove or pellet stove shall comply with U.S. EPA Phase-II New Source Performance Standards (NSPS) emission limits where as applicable, and shall have a permanent label indicating they are certified to meet the emission limits. Woodstoves, pellet stoves and fireplaces shall also comply with applicable local ordinances.

##### SECTION 4.504 POLLUTANT CONTROL

**4.504.2.3 Aerosol paints and coatings.** Aerosol paints and coatings shall meet the Product-weighted MIR Limits for ROC in Section 94522(a)(3 2) and other requirements, including prohibitions on use of certain toxic compounds and ozone depleting substances, in Section 94522(e)(2) (e)(1) and (d)(2) (f)(1) of California Code of Regulations, Title 17, commencing with Section 94520; and in areas under the jurisdiction of the Bay Area Air Quality Management District additionally comply with the percent VOC by weight of product limits of Regulation 8, Rule 49.

**TABLE 4.504.1**  
**ADHESIVE VOC LIMIT**  
Less Water and Less Exempt Compounds in Grams per Liter

ARCHITECTURAL APPLICATIONS	CURRENT VOC LIMIT
No changes to table content	

(No Change to Table footnotes)

**TABLE 4.504.2**  
**SEALANT VOC LIMIT**  
Less Water and Less Exempt Compounds in Grams per Liter

SEALANTS	CURRENT VOC LIMIT
No changes to table content	

**TABLE 4.504.3**  
**VOC CONTENT LIMITS FOR ARCHITECTURAL COATINGS<sup>2, 3</sup>**  
Grams of VOC per Liter of Coating,  
Less Water and Less Exempt Compounds

COATING CATEGORY	VOC LIMIT
No changes to table content	

(No Change to Table footnotes)

**4.504.5 Composite wood products.** Hardwood plywood, particleboard and medium density fiberboard composite wood products used on the interior or exterior of the building shall meet the requirements for formaldehyde as specified in ARB's Air Toxics Control Measure for Composite Wood (17 CCR 93120 et seq.), by or before the dates specified in those sections, as shown in Table 4.504.5.

**4.504.5.1 Documentation.** Verification of compliance with this section shall be provided as requested by the enforcing agency. Documentation shall include at least one of the following:

1. Product certifications and specifications.
2. Chain of custody certifications.
3. Product labeled and invoiced as meeting the Composite Wood Products regulation (see CCR, Title 17, Section 93120, et seq.).
4. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269, or European 636 3S, and Canadian CSA O121, CSA O151, CSA O153 and CSA O325 standards.
5. Other methods acceptable to the enforcing agency.

#### SECTION 4.507 ENVIRONMENTAL COMFORT

**4.507.2 Heating and air-conditioning system design.** Heating and air-conditioning systems shall be sized, designed and have their equipment selected using the following methods:

1. The heat loss and heat gain is established according to ANSI/ACCA 2 Manual J - 2004 2011 (Residential Load Calculation), ASHRAE handbooks or other equivalent design software or methods.
2. Duct systems are sized according to ANSI/ACCA 1 Manual D - ~~2009~~ 2014 (*Residential Duct Systems*), ASHRAE handbooks or other equivalent design software or methods.
3. Select heating and cooling equipment according to ANSI/ACCA 3 Manual S - ~~2004~~ 2014 (*Residential Equipment Selection*) or other equivalent design software or methods.

**Exception:** Use of alternate design temperatures necessary to ensure the systems function are acceptable.

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#### **4. HCD proposes to continue adoption of Chapter 6 from the 2013 CALGreen Code into the 2016 CALGreen Code with new modifications as follows:**

##### CHAPTER 6 REFERENCED ORGANIZATIONS AND STANDARDS

**601.1** This chapter lists the organizations and standards that are referenced in various sections of this document. The standards are listed herein by the promulgating agency of the standard.

ORGANIZATION	STANDARD	REFERENCED SECTION
<b>AHAM</b> Association of Home Appliance Manufacturers 1111 19 <sup>th</sup> Street NW, Suite 402 Washington, D.C. 20026-3627 <a href="http://www.aham.org">http://www.aham.org</a>	ANSI/AHAM DW-1-2010	202
<b>AABC</b> Associated Air Balance Council 1518 K Street NW Washington, D.C. 20005 <a href="http://www.aabc.com">http://www.aabc.com</a>	National Standards, 1989	5.410.4.3.1 A5.410.5.3.1
<b>ACCA</b> Air Conditioning Contractors of America 2800 Shirlington Road, Suite 300 Arlington, VA 22206 <a href="http://www.acca.org">http://www.acca.org</a>	ANSI/ACCA 2 Manual J-2004 2011 ANSI/ACCA 1 Manual D-2009 2014 ANSI/ACCA 3 Manual S-2004 2014	4.507.2 4.507.2 4.507.2
<b>ANSI</b> American National Standards Institute Operations Office 25 West 43rd Street, Fourth Floor New York, NY 10036 <a href="http://www.ansi.org">http://www.ansi.org</a>	ANSI/AHAM DW-1-2010 NSF/ANSI 140-2007 2014 ANSI/ACCA 2 Manual J-2004 2011 ANSI/ACCA 1 Manual D-2009 2014 ANSI/ACCA 3 Manual S-2004 2014	202 4.504.3, 5.504.4.4 4.507.2 4.507.2 4.507.2
<b>ASTM</b> ASTM International 100 Barr Harbor Drive West Conshohocken, PA 19428-2859 <a href="http://www.astm.org">http://www.astm.org</a>	ASTM C 33 ASTM C 150 ASTM C 595 ASTM C 618 ASTM C 989 ASTM C 1157 ASTM C 1240 ASTM C 1371-98 ASTM C 1549 - 09(2014) ASTM C 1602 ASTM C 1697 ASTM E 90 ASTM E 408-02 ASTM E 413 ASTM E 1332 ASTM E 1333 - 14 ASTM E 1903-97 11 ASTM E 1918 - 06(2015) ASTM E 1980-04 11	A 5.405.5.3.2 A 5.405.5.1 A 5.405.5.1 A 5.405.5.2.1 A 5.405.5.2.1 A 5.405.5.1 A 5.405.5.2.1 A5.106.11.2.2 A4.106.7, A5.106.11.1 A5.405.5.3.2.3 A5.405.5.2.1 5.507.4 A5.10, 6.11.2.2 5.507.4 5.507.4 Table 4.504.5, 5.504.4.5 A5.103.4 A4.106.7, A5.106.11.1 A4.106.5.3, A5.106.11.2.3
<b>CSA</b> Canadian Standards Association 5060 Spectrum Way, Suite 100 Mississauga, Ontario, Canada L4W 5N6 <a href="http://www/csa/ca">http://www/csa/ca</a>	CSA B125.1, <u>CSA O121</u> , <u>CSA O151</u> , <u>CSA O153</u> , <u>CSA O325</u>	<u>4.504.5.1</u>

**5. HCD proposes to continue adoption of Chapter A4 from the 2013 CALGreen Code into the 2016 CALGreen Code with new modifications as follows:**

**APPENDIX A4  
RESIDENTIAL VOLUNTARY MEASURES**

**Division A4.1 – PLANNING AND DESIGN**

**SECTION A4.106  
SITE DEVELOPMENT**

**A4.106.3 Landscape design.** Postconstruction landscape designs shall accomplish one or more of the following:

1. Areas disrupted during construction are restored to be consistent with native vegetation species and patterns.

~~2. Limit turf areas to the greatest extent possible.~~

~~Tier 1 not more than 50 percent of the total landscaped area.~~

~~Tier 2 not more than 25 percent of the total landscaped area.~~

3. Utilize at least 75 percent native California or drought tolerant plant and tree species appropriate for the climate zone region.

4. Hydrozoning irrigation techniques are incorporated into the landscape design.

**TABLE A4.106.5.1(1)  
Tier 1 – Low-Rise Residential**

ROOF SLOPE	CLIMATE ZONE	Minimum 3-year Aged Solar Reflectance	Thermal Emittance	SRI
≤ 2 : 12	13 & 15	<del>0.55</del> 0.63	0.75	<del>64</del> 75
> 2 : 12	10-15	0.20	0.75	16

**TABLE A4.106.5.1(3)  
Tier 1 - High-Rise Residential Buildings, Hotels, and Motels**

ROOF SLOPE	CLIMATE ZONE	Minimum 3-Year Aged Solar Reflectance	Thermal Emittance	SRI
≤ 2 : 12	40 & 44, 13-15 9, 10, 11, 13, 14, 15	0.55	0.75	64
> 2 : 12	2-15	0.20	0.75	16

**A4.106.8.2 New multifamily dwellings.**

**Tier 1 and Tier 2.** Where 17 or more multifamily dwelling units are constructed on a building site, 5 percent of the total number of parking spaces provided for all types of parking facilities, but in no case less than one, shall be electric vehicle charging stations spaces (EVCS EV spaces) capable of supporting future EVSE and shall be identified on construction documents. Calculations for the required number of EVCS EV spaces shall be rounded up to the nearest whole number.

See Section 4.106.4.2 for additional requirements related to EVCS for multifamily dwellings.

Notes:

- 1 The California Department of Transportation adopts and publishes the "California Manual on Uniform Traffic Control Devices (California MUTCD)" to provide uniform standards and specifications for all official traffic control devices in California. Zero Emission Vehicle Signs and Pavement Markings can be found in the New

Policies & Directives Number 13-01. Website: [www.dot.ca.gov/hq/traffops/signtech/signdel/policy.htm](http://www.dot.ca.gov/hq/traffops/signtech/signdel/policy.htm)  
<http://www.dot.ca.gov/hq/traffops/policy.htm>

2. See Vehicle Code Section 22511 for EV charging space signage in off-street parking facilities and for use of EV charging spaces.
3. The Governor's Office of Planning and Research (OPR) published a "Zero-Emission Vehicle Community Readiness Guidebook" which provides helpful information for local governments, residents and businesses. Website: [http://opr.ca.gov/docs/ZEV\\_Guidebook.pdf](http://opr.ca.gov/docs/ZEV_Guidebook.pdf)
4. The Governor's Office of Planning and Research (OPR) has developed draft guidelines, "Plug-In Electric Vehicles: Universal Charging Access Guidelines and Best Practices", addressing physical accessibility standards and design guidelines for EVs. Website: [http://opr.ca.gov/docs/PEV\\_Access\\_Guidelines](http://opr.ca.gov/docs/PEV_Access_Guidelines).

#### **Division A4.3 – WATER EFFICIENCY AND CONSERVATION**

##### **SECTION A4.303 INDOOR WATER USE**

**A4.303.3 Appliances.** Dishwashers and clothes washers in residential buildings shall comply with the following:

Install at least one qualified ENERGY STAR appliance with maximum water use as follows: dishwasher or clothes washer.

1. Standard Dishwashers—4.25 gallons per cycle.
2. Compact Dishwashers—3.5 gallons per cycle.
3. Clothes Washers—water factor of 6 gallons per cubic foot of drum capacity.

**Note:** See Section A5.303.3 for nonresidential dishwashers and clothes washers.

**A4.303.4 Nonwater supplied urinals and waterless toilets.** Nonwater supplied urinals or composting toilets are installed.

Where approved, hybrid urinals, as defined in Chapter 2, shall be considered waterless urinals.

**A4.303.5 Hot water recirculation systems.** One- and two-family dwellings shall be equipped with a demand hot water recirculation system, as defined in Chapter 2. The demand hot water recirculation system shall be installed in accordance with the California Plumbing Code, California Energy Code, and the manufacturer's installation instructions.

##### **SECTION A4.304 OUTDOOR WATER USE**

**A4.304.2 Potable water elimination.** When landscaping is provided by the builder and as allowed by local ordinance, a water efficient landscape irrigation design that eliminates the use of potable water beyond the initial requirements for plant installation and establishment. Methods used to accomplish the requirements of this section must be designed to the requirements of the *California Building Standards Code* and shall include, but not be limited to, the following:

1. – 6. (...No change)

#### **Division A4.4 – MATERIAL CONSERVATION AND RESOURCE EFFICIENCY**

##### **SECTION A4.404 EFFICIENT FRAMING TECHNIQUES**

**A4.404.1 Lumber size.** Beams, and headers and trimmers are sized and installed as specified in CRC Tables R502.5(1) and R502.5(2) Chapter 23 of the *California Building Code*, or Chapter 6 of the *California Residential Code*, as applicable. Other calculations acceptable to the enforcing agency which use the minimum size member for the tributary load shall be acceptable.

**A4.404.2 Dimensions and layouts.** Building dimensions and layouts are designed to minimize waste by one or more of the following measures in at least 80 percent of the structure:

1. Building design dimensions in 2-foot increments are used.
2. Windows and doors are located at regular 16" or 24" stud positions.
3. Other methods acceptable to the enforcing agency.

#### SECTION A4.405 MATERIAL SOURCES

**A4.405.3.1.1 Total material cost.** Total material cost is the total estimated or actual cost of materials and assembly products used in the project. The required total recycled content value for the project (in dollars) shall be determined by Equation A4.4-1 or Equation A4.4-2.

Total material cost shall be calculated by using one of the methods specified below:

1. **Simplified method.** To obtain the total cost of the project, multiply the square footage of the residential structure by the square foot valuation established pursuant to ~~Table A4.405.3~~ the ICC Building Valuation Data (BVD) or other valuation data as approved and/or established by the enforcing agency. The total material cost is 45 percent of the total cost of the project. Use Equations A4.4-3A or A4.4-3B to determine total material costs using the simplified method.

**TABLE A4.405.3  
SQUARE FOOT VALUATION**

TYPE OF STRUCTURE	SQUARE FOOT CONSTRUCTION COSTS
Residential, one- and two-family	\$101.90
Residential, multiple-family	\$92.94

**Note:** Minimum square-foot construction costs for residential one- and two-family, and multiple-family dwellings are from the International Code Council's (ICC) *Building Valuation Data (BVD)* – February 2011.

**A4.405.3.1.3 Determination of recycled content value of materials (RCV<sub>M</sub>).** The recycled content value of each material (RCV<sub>M</sub>) is calculated by multiplying the cost of material, as defined by the recycled content. See Equations A4.4-6 and A4.4-7. (No Changes proposed to equations)

**Notes:**

1. If the postconsumer and preconsumer recycled content is provided in pounds, Equation A4.4-7 may be used, but the final result (in pounds) must be multiplied by 100 to show RCM as a percentage.
2. If the manufacturer reports total recycled content of a material as one percentage in lieu of separately reporting preconsumer and postconsumer values, ~~one-half of the total shall be considered preconsumer recycled material and one-half of the total shall be considered postconsumer recycled material.~~

**A4.405.3.1.4 Determination of recycled content value of assemblies – (RCV<sub>A</sub>).**

Recycled content value of assemblies is calculated by multiplying the total cost of the assembly by the total recycled content of the assembly (RCA), and shall be determined by Equation A4.4-8.

(No Changes proposed to equations)

**Note:** If the manufacturer reports total recycled content of a material as one percentage in lieu of separately reporting preconsumer and postconsumer values, ~~one-half of the total shall be considered preconsumer recycled material and one-half of the total shall be considered postconsumer recycled material.~~

#### SECTION A4.408 CONSTRUCTION WASTE REDUCTION, DISPOSAL AND RECYCLING

**A4.408.1 Enhanced construction waste reduction.** Nonhazardous construction and demolition debris generated at the site is diverted to recycle or salvage in compliance with one of the following:



**Tier 1.** At least a 65 percent reduction. Any mixed recyclables that are sent to mixed-waste recycling facilities shall include a qualified third party verified facility average diversion rate. Verification of diversion rates shall meet minimum certification eligibility guidelines, acceptable to the local enforcing agency.

**Tier 2.** At least a 75 percent reduction with a third party verification as required for Tier 1.

**Exceptions:** (...No Change)

## SECTION A4.602

### RESIDENTIAL OCCUPANCIES APPLICATION CHECKLIST

FEATURE OR MEASURE	LEVELS APPLICANT TO SELECT ELECTIVE MEASURES			VERIFICATIONS ENFORCING AGENCY TO SPECIFY VERIFICATION METHOD		
	Mandatory	Prerequisites and electives <sup>1</sup>		Enforcing Agency	Installer or Designer	Third party
		Tier 1	Tier 2	<input type="checkbox"/> All	<input type="checkbox"/> All	<input type="checkbox"/> All
<b>WATER EFFICIENCY AND CONSERVATION</b>						
<b>Indoor water use</b>						
<b>A4.303.3 Appliances.</b> Dishwashers and clothes washers in residential buildings shall comply with the following: Install at least one qualified ENERGY STAR appliance with maximum water use as follows: 1. Standard Dishwashers—4.25 gallons per cycle. 2. Compact Dishwashers—3.5 gallons per cycle. 3. Clothes Washers—water factor of 6 gallons per cubic foot of drum capacity.		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>A4.303.3.</b> Install at least one qualified ENERGY STAR dishwasher or clothes washer.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>A4.303.5.</b> One- and two-family dwellings shall be equipped with a demand hot water recirculation system.		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>MATERIAL CONSERVATION AND RESOURCE EFFICIENCY</b>						
<b>Construction Waste Reduction, Disposal and Recycling</b>						
<b>4.408.1</b> Recycle and/or salvage for reuse a minimum of 50 65 percent of the nonhazardous construction and demolition waste in accordance with one of the following: 1. Comply with a more stringent local construction and demolition waste management ordinance; or 2. A construction waste management plan, per Section 4.408.2; or 3. A waste management company, per Section 4.408.3; or 4. The waste stream reduction alternative, per Section 4.408.4.	<input checked="" type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

FEATURE OR MEASURE	LEVELS APPLICANT TO SELECT ELECTIVE MEASURES			VERIFICATIONS ENFORCING AGENCY TO SPECIFY VERIFICATION METHOD		
	Mandatory	Prerequisites and electives <sup>1</sup>		Enforcing Agency	Installer or Designer	Third party
		Tier 1	Tier 2	<input type="checkbox"/> All	<input type="checkbox"/> All	<input type="checkbox"/> All
<b>A4.408.1</b> Construction waste generated at the site is diverted to recycle or salvage in compliance with one of the following: 1. Tier 1 at least a 65 percent reduction <u>with a third party verification.</u> 2. Tier 2 at least a 75 percent reduction <u>with a third party verification.</u>  <b>Exception:</b> Equivalent waste reduction methods are developed by working with local agencies.		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/>
<b>Building Maintenance and Operation</b>						
<b>4.410.2</b> Where 5 or more multifamily dwelling units are constructed on a building site, provide readily accessible areas that serve the entire building and are identified for the depositing, storage and collection of non-hazardous materials for recycling, including (at a minimum) paper, corrugated cardboard, glass, plastics, organic waste, and metals or meet a lawfully enacted local recycling ordinance, if more restrictive.  <b>Exception:</b> Rural jurisdictions that meet and apply for the exemption in Public Resources Code Section 42649.82 (a)(2)(A) et seq. will also be exempt from the organic waste portion of this section.	<input checked="" type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>ENVIRONMENTAL QUALITY</b>						
<b>Fireplaces</b>						
<b>4.503.1</b> Any installed gas fireplace shall be a direct-vent sealed-combustion type. Any installed woodstove or pellet stove shall comply with U.S. EPA Phase II New Source Performance Standards (NSPS) emission limits where as applicable, and shall have a permanent label indicating they are certified to meet the emission limits. Woodstoves, pellet stoves and fireplaces shall also comply with applicable local ordinances.	<input checked="" type="checkbox"/>			<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>



# 2016

## **BUILDING ENERGY EFFICIENCY STANDARDS FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS**

**(MARKED VERSION)**

**FOR THE 2016 BUILDING  
ENERGY EFFICIENCY  
STANDARDS**

**TITLE 24, PART 6, AND ASSOCIATED  
ADMINISTRATIVE REGULATIONS  
IN PART 1.**





**ADMINISTRATIVE REGULATIONS**

**CALIFORNIA CODE OF REGULATIONS**

**TITLE 24, PART 1**

# ARTICLE 1 – ENERGY BUILDING REGULATIONS

## 10-101 – SCOPE

- (a) This article contains administrative regulations relating to the energy building regulations in Title 24, Part 6. This article applies to all residential and nonresidential buildings.
- (b) Nothing in this article lessens any necessary qualifications or responsibilities of licensed or registered building professionals or other designers or builders, or the duties of enforcement agencies that exist under state or local law.
- (c) If any provision of the regulations in this article or the Building Energy Efficiency Standards, Title 24, Part 6, of the California Code of Regulations is found invalid by a court of competent jurisdiction, the remainder of these regulations shall remain in effect.

**NOTE:** Authority: Sections 25402 and 25402.1, Public Resources Code. Reference: Sections 25402 and 25402.1, Public Resources Code.

## 10-102 – DEFINITIONS

In this article the following definitions apply:

**ACCEPTANCE REQUIREMENTS** are "acceptance requirements for code compliance" as defined in Section 100.1(b) of Part 6.

**ACCEPTANCE TEST TECHNICIAN** is a Field Technician as defined in Section 10-102 who is certified by an authorized Acceptance Test Technician Certification Provider pursuant to the requirements of Sections ~~40-103-A10-103.1~~ or ~~40-103-B10-103.2~~.

**LIGHTING CONTROLS ACCEPTANCE TEST TECHNICIAN** is a professional certified by an authorized Lighting Controls Acceptance Test Technician Certification Provider to perform nonresidential lighting controls acceptance tests and complete the documentation required for nonresidential lighting controls acceptance tests as required by the Building Energy Efficiency Standards.

**MECHANICAL ACCEPTANCE TEST TECHNICIAN** is a professional certified by an authorized Mechanical Acceptance Test Technician Certification Provider to perform nonresidential mechanical acceptance tests and complete the documentation required for nonresidential mechanical acceptance tests as required by the Building Energy Efficiency Standards.

**ACCEPTANCE TEST EMPLOYER** is a person or entity who employs an Acceptance Test Technician and is certified by an authorized Acceptance Test Technician Certification Provider.

**LIGHTING CONTROLS ACCEPTANCE TEST EMPLOYER** is a person or entity who is the employer of a Lighting Controls Acceptance Test Technician and certified by an authorized Lighting Controls Acceptance Test Technician Certification Provider.

**MECHANICAL ACCEPTANCE TEST EMPLOYER** is a person or entity who is the employer of a Mechanical Acceptance Test Technician and certified by an authorized Mechanical Acceptance Test Technician Certification Provider.

**ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDER** is an agency, organization or entity approved by the Energy Commission to train and certify Acceptance Test Technicians and Acceptance Test Employers according to the requirements of Sections ~~40-103-A10-103.1~~ or ~~B10-103.2~~.

**LIGHTING CONTROLS ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDER** is an agency, organization or entity approved by the Energy Commission to train and certify Lighting Controls Acceptance Test Technicians and Lighting Controls Acceptance Test Employers according to the requirements of Section ~~40-103-A10-103.1~~.

**MECHANICAL ACCEPTANCE TEST TECHNICIAN CERTIFICATION PROVIDER** is an agency, organization or entity approved by the Energy Commission to train and certify Mechanical Acceptance Test Technicians and Mechanical Acceptance Test Employers according to the requirements of Section ~~10-103-B~~ 10-103.2.

**ACM** means **ALTERNATIVE CALCULATION METHOD** 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.

**ACM APPROVAL MANUALS** 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.

**ACM REFERENCE MANUAL** is the document establishing the procedures required to implement Sections 140.1 and 150.1 of Title 24, Part 6 of the California Code of Regulations in Compliance Software.

**ALTERNATIVE COMPONENT PACKAGE** is a set of building measures whose aggregate calculated energy use is less than or equal to the maximum allowed Energy Budget.

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

**APPROVED CALCULATION METHOD** is compliance software, or alternative component packages, or exceptional methods approved under Section 10-109.

**BUILDING ENERGY EFFICIENCY STANDARDS** are those regulations contained in Title 24, Part 6 of the California Code of Regulations.

**BUILDING PERMIT** is an electrical, plumbing, mechanical, building, or other permit or approval, that is issued by an enforcement agency, and that authorizes any construction that is subject to Part 6.

**CALIFORNIA ENERGY COMMISSION** is the California State Energy Resources Conservation and Development Commission.

**COMMISSION** is the California State Energy Resources Conservation and Development Commission.

**COMPLEX MECHANICAL SYSTEMS** are defined here for the purposes of complying with the Design Phase Review component of Section 10-103(a)1. Complex Mechanical Systems are systems that include 1) fan systems each serving multiple thermostatically controlled zones, or 2) built-up air handler systems (non-unitary or non-packaged HVAC equipment), or 3) hydronic or steam heating systems, or 4) hydronic cooling systems. Complex systems are NOT the following: unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C, and 110.2-E, that each serve one zone, or two-pipe, heating only systems serving one or more zones.

**COMPLIANCE APPROACH** is any one of the allowable methods by which the design and construction of a building may be demonstrated to be in compliance with Part 6. The compliance approaches are the performance compliance approach and the prescriptive compliance approach. The requirements for each compliance approach are set forth in Section 100.0(e)2 of Part 6.

**COMPLIANCE DOCUMENT** is any of the documents specified in Section 10-103(a) utilized to demonstrate compliance with Part 6 (i.e., Certificate of Compliance, Certificate of Installation, Certificate of Acceptance, and Certificate of Verification).

**COMPLIANCE SOFTWARE** is software that has been approved pursuant to Section 10-109 of Part 1.

**CONDITIONED FLOOR AREA** is the "conditioned floor area" as defined in Section 100.1(b) of Part 6.

**CRRC-1** is the Cool Roof Rating Council document titled "Product Rating Program".

**DATA REGISTRY** is a web service with a user interface and database maintained by a Registration Provider that complies with the applicable requirements in Reference Joint Appendix JA7, with guidance from the Data Registry Requirements Manual, and provides for registration of residential or nonresidential compliance documentation used for demonstrating compliance with Part 6.

**RESIDENTIAL DATA REGISTRY** is a data registry that is maintained by a HERS Provider that provides for registration, when required by Part 6 of all residential compliance documentation and the nonresidential Certificate of Verification.

**NONRESIDENTIAL DATA REGISTRY** is a data registry that is maintained by a Registration Provider approved by the Commission that provides for registration, when required by Part 6 of all nonresidential compliance documentation. However, nonresidential data registries may not provide for registration of nonresidential Certificates of Verification.

**DATA REGISTRY REQUIREMENTS MANUAL** is a document that provides additional detailed guidance regarding the functional and technical aspects of the data registry requirements given in Joint Appendix JA7.

**DOCUMENTATION AUTHOR** is a person who prepares a Title 24 Part 6 compliance document that must subsequently be reviewed and signed by a responsible person in order to certify compliance with Part 6.

**ENERGY BUDGET** is the “energy budget” as defined in Section 100.1(b) of Part 6.

**ENERGY COMMISSION** is the California State Energy Resources Conservation and Development Commission.

**ENFORCEMENT AGENCY** is the city, county, or state agency responsible for issuing a building permit.

**EXCEPTIONAL METHOD** is a method for estimating the energy performance of building features that cannot be adequately modeled using existing Compliance Software and that is approved by the Executive Director.

**EXECUTIVE DIRECTOR** is the executive director of the Commission.

**FIELD TECHNICIAN** is a person who performs acceptance tests in accordance with the specifications in Reference Joint Appendix NA7, and reports the results of the acceptance tests on the Certificate of Acceptance in accordance with the requirements of Section 10-103(a)4.

**HERS** is the California Home Energy Rating System as described in Title 20, Chapter 4, Article 8, Section 1670.

**HERS PROVIDER** is an organization that administers a home energy rating system as described in Title 20, Chapter 4, Article 8, Section 1670.

**HERS PROVIDER DATA REGISTRY** is a data registry maintained by a HERS provider.

**HERS RATER** is a person who has been trained, tested, and certified by a HERS Provider to perform the field verification and diagnostic testing required for demonstrating compliance with the Part 6 as described in Title 20, Chapter 4, Article 8, Section 1670(i).

**HVAC SYSTEM** is the “HVAC system” as defined in Section 100.1(b) of Part 6.

**MANUFACTURED DEVICE** is the “manufactured device” as defined in Section 100.1(b) of Part 6.

**NFRC 100** is the National Fenestration Rating Council document titled “NFRC 100: Procedure for Determining Fenestration Product U-factors.” (2011) NFRC 100 includes procedures for the Component Modeling Approach (CMA) and site built fenestration formerly included in a separate document, NFRC 100-SB.

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

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

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

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

**NSHP GUIDEBOOK** is the New Solar Homes Partnership Guidebook, currently adopted by the Energy Commission.

**PART 6** is Title 24, Part 6 of the California Code of Regulations.

**PUBLIC ADVISER** is the Public Adviser of the Commission.

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



**RECORD DRAWINGS** are drawings that document the as installed location and performance data on all lighting and space conditioning system components, devices, appliances and equipment, including but not limited to wiring sequences, control sequences, duct and pipe distribution system layout and sizes, space conditioning system terminal device layout and air flow rates, hydronic system and flow rates, and connections for the space conditioning system. Record drawings are sometimes called “as built.”

**REFERENCE APPENDICES** are 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) currently adopted by the Energy Commission.

**REFERENCE JOINT APPENDICES** are the Reference Joint Appendices currently adopted by the Energy Commission.

**REFERENCE NONRESIDENTIAL APPENDICES** are the Reference Nonresidential Appendices currently adopted by the Energy Commission.

**REFERENCE RESIDENTIAL APPENDICES** are the Reference Residential Appendices currently adopted by the Energy Commission.

**REGISTERED DOCUMENT** is a document that has been submitted to a residential or nonresidential data registry for retention, and the data registry has assigned a unique registration number to the document.

**REGISTRATION PROVIDER** is an organization that administers a data registry service that conforms to the requirements in Reference Joint Appendix JA7.

**STANDARD DESIGN BUILDING** is a “Standard Design Building” as defined in Section 100.1(b) of Part 6.

**NOTE:** Authority: Sections 25402 and 25402.1, and 25213, Public Resources Code. Reference: Sections 25007, 25402 and 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

## 10-103 – PERMIT, CERTIFICATE, INFORMATIONAL, AND ENFORCEMENT REQUIREMENTS FOR DESIGNERS, INSTALLERS, BUILDERS, MANUFACTURERS, AND SUPPLIERS

(a) **Documentation.** The following documentation is required to demonstrate compliance with Part 6. This documentation shall meet the requirements of Section 10-103(a) or alternatives approved by the Executive Director.

1. **Certificate of Compliance.** For all buildings, the Certificate of Compliance described in Section 10-103 shall be signed by the person ~~in charge of the building design~~, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the building design (*responsible person*); and submitted in accordance with Sections 10-103(a)1 and 10-103(a)2 to certify conformance with Part 6. If more than one person has responsibility for the building design, each person shall sign the Certificate of Compliance document(s) applicable to that portion of the design for which the person is responsible. Alternatively, the person with chief responsibility for the building design shall prepare and sign the Certificate of Compliance document(s) for the entire building design. Subject to the requirements of Sections 10-103(a)1 and 10-103(a)2, persons who prepare Certificate of Compliance documents (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. In accordance with applicable requirements of 10-103(a)1, the signatures provided by *responsible persons* and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

For all Nonresidential buildings, the Design Review Kickoff Certificate(s) of Compliance, and the Construction Document Design Review Checklist Certificate(s) of Compliance shall be ~~completed, reviewed~~ and signed by a licensed professional engineer or licensed architect, or a licensed contractor representing services performed by or under the direct supervision of a licensed engineer or architect, as specified in the provisions of Division 3 of the Business and Professions Code. For buildings less than 10,000 square feet, ~~the licensed professional engineer~~ this signer may be the engineer or architect of record. For buildings greater than 10,000 square feet but less than 50,000 square feet, ~~the licensed professional engineer~~ this signer shall be a qualified in-house engineer or architect with no other project involvement or a third party engineer, architect, or contractor. ~~Contractors accepting the responsibilities of the engineer under the provision of the Business and Professions Code may also complete and sign these certificates.~~ For buildings greater than 50,000 square feet and all buildings with complex mechanical systems serving more than 10,000 square feet, ~~the licensed professional engineer~~ this signer shall be a third party engineer, architect, or contractor.

A. All Certificate of Compliance documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

- i. Identify the energy features, performance specifications, materials, components, and manufactured devices required for compliance with Part 6.
- ii. Identify the building project name and location. The building project name and location identification on the Certificate of Compliance shall be consistent with the building project name and location identification given on the other applicable building design plans and specifications submitted to the enforcement agency for approval with the building permit application.
- iii. Display the unique registration number assigned by the data registry if Section 10-103(a)1 requires the document to be registered.
- iv. Include a declaration statement to the effect that the building energy features, performance specifications, materials, components, and manufactured devices for the building design identified on the Certificate of Compliance indicate the building is in compliance with the requirements of Title 24, Parts 1 and 6, and the building design features identified on the Certificate of Compliance are consistent with the building design features identified on the other applicable compliance

documents, worksheets, calculations, plans, and specifications submitted to the enforcement agency for approval with the building permit application.

- v. Be signed by the *documentation author* to certify the documentation is accurate and complete. When document registration is required by Section 10-103(a)1, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
- vi. Be signed by the *responsible person* eligible under Division 3 of the Business and Professions Code to accept responsibility for the design to certify conformance with Part 6. When document registration is required by Section 10-103(a)1, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

- B. For all low-rise residential buildings for which compliance requires HERS field verification, the person(s) responsible for the Certificate(s) of Compliance shall submit the Certificate(s) for registration and retention to a HERS provider data registry. The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Compliance documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

- C. For alterations to existing residential buildings for which HERS field verification is not required, including but not limited to such as water heater and window replacements, and for additions to existing residential buildings that are less than 300 square feet for which HERS field verification is not required, the enforcement agencies may at their discretion not require any Certificate of Compliance documentation, or may develop simplified Certificate of Compliance documentation for demonstrating compliance with the Standards.

Exemptions from submitting compliance documentation shall not be deemed to grant authorization for any work to be done in any manner in violation of this code or other provisions of law.

- D. ~~Beginning on January 1, 2015, e~~Contingent upon approval of data registry(s) by the Commission, all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Compliance shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Compliance documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

- 2. **Application for a building permit.** Each application for a building permit subject to Part 6 shall contain at least one copy of the documents specified in Sections 10-103(a)2A, 10-103(a)2B, and 10-103(a)2C.

- A. For all newly constructed buildings, additions, alterations, or repairs regulated by Part 6 the applicant shall submit the applicable Certificate(s) of Compliance to the enforcement agency for approval. The certificate(s) shall conform to the requirements of Section 10-103(a)1, and shall be approved by the local enforcement agency, in accordance with all applicable requirements of Section 10-103(d), by stamp or authorized signature prior to issuance of a building permit. A copy of the Certificate(s) of Compliance shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

For alterations to existing residential buildings for which HERS field verification is required, and when the enforcement agency does not require building design plans to be submitted with the application for a building permit, the applicable Certificate of Compliance documentation specified in 10-103(a)1 is not required to be approved by the enforcement agency prior to issuance of a building permit, but shall be approved by the enforcement agency prior to final inspection of the dwelling unit, and shall be made

available to the enforcement agency for all applicable inspections, or made available for viewing on an approved data registry.

When the enforcement agency requires building design plans to be submitted with the application for a building permit, the applicable Certificate of Compliance documents shall be incorporated into the building design plans. When Section 10-103(a)1 requires document registration, the certificate(s) that are incorporated into the building design plans shall be copies of the registered Certificate of Compliance documents from a HERS provider data registry, or a data registry approved by the Commission.

- B. When the enforcement agency requires building design plans and specifications to be submitted with the application for a building permit, the plans shall conform to the specifications for the features, materials, components, and manufactured devices identified on the Certificate(s) of Compliance, and shall conform to all other applicable requirements of Part 6. Plans and specifications shall be submitted to the enforcement agency for any other feature, material, component, or manufactured device that Part 6 requires be indicated on the building design plans and specifications. Plans and specifications submitted with each application for a building permit for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall provide acceptance requirements for code compliance of each feature, material, component or manufactured device when acceptance requirements are required under Part 6. Plans and specifications for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall require, and indicate with a prominent note on the plans, that within 90 days after the Enforcement Agency issues a permanent final occupancy permit, record drawings be provided to the building owner.

For all buildings, if the specification for a building design feature, material, component, or manufactured device is changed before final construction or installation, such that the building may no longer comply with Part 6 the building must be brought back into compliance, and so indicated on amended plans, specifications, and Certificate(s) of Compliance that shall be submitted to the enforcement agency for approval. Such characteristics shall include the efficiency (or other characteristic regulated by Part 6) of each building design feature, material, component, or device.

- C. The enforcement agency shall have the authority to require submittal of any supportive documentation that was used to generate the Certificate(s) of Compliance, including but not limited to the electronic input file for the compliance software tool that was used to generate performance method Certificate(s) of Compliance; or any other supportive documentation that is necessary to demonstrate that the building design conforms to the requirements of Part 6.
3. **Certificate of Installation.** For all buildings, the person in charge of the construction or installation, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the construction or installation of features, materials, components, or manufactured devices regulated by Part 6 or the Appliance Efficiency Regulations (*responsible person*) shall sign and submit Certificate of Installation documentation as specified in Section 10-103(a)3 to certify conformance with Part 6. If more than one person has responsibility for the construction or installation, each person shall sign and submit the Certificate of Installation documentation applicable to the portion of the construction or installation for which they are responsible; alternatively, the person with chief responsibility for the construction or installation shall sign and submit the Certificate of Installation documentation for the entire construction or installation scope of work for the project. Subject to the requirements of Section 10-103(a)3, persons who prepare Certificate of Installation documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. In accordance with applicable requirements of 10-103(a)3, the signatures provided by *responsible persons* and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.

**Delegation of Signature Authority.** Except where prohibited by law, including but not limited to any requirements under Division 3 of the Business and Professions Code, the Responsible Person may delegate signature authority to third parties (Authorized Representatives) provided that there is a written agreement:

- i. Between the Responsible Person and the person to be designated as the Authorized Representative.

- ii. Specifying that the *Authorized Representative* may sign Certificates of Installation on behalf of the *Responsible Person*, ~~and~~
- iii. Specifying that the legal responsibility for construction or installation in the applicable classification for the scope of work specified on the Certificate of Installation document(s) remains with the *Responsible Person*.
- iv. That is signed by both the *Responsible Person* and the *Authorized Representative*, ~~and~~
- v. That is retained by the HERS Provider to which all compliance documents are submitted for the building to which the Certificate of Installation documentation pertains, ~~and~~
- vi. That is maintained in the HERS Provider Data Registry such that it is accessible for verification by, included but not limited to, the Energy Commission and enforcement agencies.

A. All Certificate of Installation documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

- i. Identify the features, materials, components, manufactured devices, and system performance diagnostic results required to demonstrate compliance with Part 6 and the Appliance Efficiency Regulations.
- ii. State the number of the building permit under which the construction or installation was performed.
- iii. Display the unique registration number assigned by the data registry if Section 10-103(a)3 requires the document to be registered.
- iv. Include a declaration statement indicating that the constructed or installed features, materials, components or manufactured devices (the installation) identified on the Certificate of Installation conforms to all applicable codes and regulations, and the installation conforms to the requirements given on the plans and specifications approved by the enforcement agency.
- v. Be signed by the *documentation author* to certify the documentation is accurate and complete. When document registration is required by Section 10-103(a)3, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
- vi. Be signed by the ~~\*Responsible p~~*Person* eligible under Division 3 of the Business and Professions Code to accept responsibility for construction or installation in the applicable classification for the scope of work specified on the Certificate of Installation document(s), or shall be signed by their ~~a~~*Authorized \*Representative*. When document registration is required by Section 10-103(a)3, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.

B. For all low-rise residential buildings ~~for which compliance requires HERS field verification~~, the person(s) responsible for the Certificate(s) of Installation, or their ~~a~~*Authorized \*Representative(s)*, shall submit ~~all the following~~ Certificate of Installation documentation that is applicable to the building to a HERS provider data registry for registration and retention in accordance with procedures specified in Reference Residential Appendix RA2:

- i. All Certificates of Installation for which compliance requires HERS field verification.
- ii. All other Certificates of Installation, except those exempted by the Energy Commission.

The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Installation documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

- C. For alterations to existing residential buildings for which HERS field verification is not required, such as including but not limited to water heater and window replacements, and for additions to existing residential buildings that are less than 300 square feet for which HERS field verification is not required, the enforcement agencies may, at their discretion, not require any Certificate of Installation documentation, or may develop simplified Certificate of Installation documentation for demonstrating compliance with the Standards.

Exemptions from submitting compliance documentation shall not be deemed to grant authorization for any work to be done in any manner in violation of this code or other provisions of law.

- D. ~~Beginning on January 1, 2015,~~ Contingent upon approval of data registry(s) by the Commission, all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Installation, except those documents exempted by the Energy Commission, shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Installation documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

- E. For all buildings, a copy of the Certificate(s) of Installation shall be posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and shall be made available to the enforcement agency for all applicable inspections. When document registration is required by Section 10-103(a)3, registered copies of the Certificate(s) of Installation from a HERS provider data registry or a data registry approved by the Commission shall be posted or made available with the building permit(s) issued for the building, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Installation to be posted upon completion of that portion. A copy of the Certificate(s) of Installation shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).
4. **Certificate of Acceptance.** For all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person in charge of the acceptance testing, who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the applicable scope of system design, or construction, or installation of features, materials, components, or manufactured devices regulated by Part 6 or the Appliance Efficiency Regulations (*responsible person*), shall sign and submit all applicable Certificate of Acceptance documentation in accordance with Section 10-103(a)4 and Nonresidential Appendix NA7 to certify conformance with Part 6. If more than one person has responsibility for the acceptance testing, each person shall sign and submit the Certificate of Acceptance documentation applicable to the portion of the construction or installation, for which they are responsible; alternatively, the person with chief responsibility for the system design, construction or installation, shall sign and submit the Certificate of Acceptance documentation for the entire construction or installation scope of work for the project. Subject to the requirements of Section 10-103(a)4, persons who prepare Certificate of Acceptance documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. Persons who perform acceptance test procedures in accordance with the specifications in Reference Joint Appendix NA7, and report the results of the acceptance tests on the Certificate of Acceptance (*field technicians*) shall sign a declaration statement on the documents they submit to certify the information provided on the documentation is true and correct. In accordance with applicable requirements of 10-103(a)4, the signatures provided by *responsible persons*, *field technicians*, and *documentation authors* shall be original signatures on paper documents or electronic signatures on electronic documents conforming to the electronic signature specifications in Reference Joint Appendix JA7.
- A. All Certificate of Acceptance documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

- i. Identify the features, materials, components, manufactured devices, and system performance diagnostic results required to demonstrate compliance with the acceptance requirements to which the applicant must conform as indicated in the plans and specifications submitted under Section 10-103(a)2, and as specified in Reference Nonresidential Appendix NA7.
  - ii. State the number of the building permit under which the construction or installation was performed.
  - iii. Display the unique registration number assigned by the data registry if Section 10-103(a)4 requires the document to be registered.
  - iv. Include a declaration statement indicating that the features, materials, components or manufactured devices identified on the Certificate of Acceptance conform to the applicable acceptance requirements as indicated in the plans and specifications submitted under Section 10-103(a), and with applicable acceptance requirements and procedures specified in the Reference Nonresidential Appendix NA7, and confirms that Certificate(s) of Installation described in Section 10-103(a)3 has been completed and is posted or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry.
  - v. Be signed by the *documentation author* to certify the documentation is accurate and complete. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
  - vi. Be signed by the *field technician* who performed the acceptance test procedures and reported the results on the Certificate of Acceptance. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
  - vii. Be signed by the *responsible person* in charge of the acceptance testing who is eligible under Division 3 of the Business and Professions Code to accept responsibility for the system design, construction or installation in the applicable classification for the scope of work identified on the Certificate of Acceptance, or shall be signed by their authorized representative. When document registration is required by Section 10-103(a)4, the signature shall be an electronic signature on an electronic document in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
- B. Beginning on January 1, 2015, eContingent upon approval of data registry(s) by the Commission, for all nonresidential buildings, high-rise residential buildings, and hotels and motels, when designated to allow use of an occupancy group or type regulated by Part 6 the person(s) responsible for the Certificate(s) of Acceptance shall submit the Certificate(s) for registration and retention to a data registry approved by the Commission. The submittals to the approved data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.
- Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Acceptance documents that are registered and retained by an approved data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.
- C. A copy of the registered Certificate(s) of Acceptance shall be posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Acceptance to be posted upon completion of that portion. A copy of the Certificate(s) of Acceptance shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).
5. **Certificate of Field Verification and Diagnostic Testing (Certificate of Verification).** For all buildings for which compliance requires HERS field verification, a certified HERS Rater shall conduct all required HERS field verification and diagnostic testing in accordance with applicable procedures specified in

Reference Appendices RA2, RA3, NA1, and NA2. All applicable Certificate of Verification documentation shall be completed, signed, and submitted by the certified HERS Rater who performed the field verification and diagnostic testing services (*responsible person*) in accordance with the requirements of Section 10-103(a)5, and Reference Appendices RA2, and NA1, to certify conformance with Part 6. If more than one rater has responsibility for the HERS verification for the building, each rater shall sign and submit the Certificate of Verification documentation applicable to the portion of the building for which they are responsible. Subject to the requirements of Section 10-103(a)5, persons who prepare Certificate of Verification documentation (*documentation authors*) shall sign a declaration statement on the documents they prepare to certify the information provided on the documentation is accurate and complete. The signatures provided by *responsible persons* and *documentation authors* shall be electronic signatures on electronic documents.

- A All Certificate of Verification documentation shall conform to a format and informational order and content approved by the Energy Commission.

These documents shall:

- i. Identify the installed features, materials, components, manufactured devices, or system performance diagnostic results that require HERS verification for compliance with Part 6 as specified on the Certificate(s) of Compliance for the building.
  - ii. State the number of the building permit under which the construction or installation was performed,
  - iii. Display the unique registration number assigned by the HERS provider data registry, and provide any additional information required by Reference Appendices RA2, RA3, NA1, and NA2.
  - iv. Include a declaration statement indicating that the installed features, materials, components or manufactured devices requiring HERS verification conform to the applicable requirements in Reference Appendices RA2, RA3, NA1, NA2, and the requirements specified on the Certificate(s) of Compliance approved by the local enforcement agency, and confirms the same features, materials, components or manufactured devices are identified on the applicable Certificate(s) of Installation signed and submitted by the person(s) responsible for the construction or installation as described in Section 10-103(a)3.
  - v. Be signed by the *documentation author* to certify the documentation is accurate and complete. The signatures shall be electronic signatures on electronic documents in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
  - vi. Be signed by the HERS Rater who performed the field verification and diagnostic testing services (*responsible person*). The signatures shall be electronic signatures on electronic documents in accordance with the electronic signature specifications in Reference Joint Appendix JA7.
- B. For all buildings for which compliance requires HERS field verification, the certified HERS Rater responsible for the Certificate(s) of Verification shall submit the Certificates for registration and retention to a HERS provider data registry in accordance with the applicable procedures in Reference Appendices RA2 and NA1.

The submittals to the HERS provider data registry shall be made electronically in accordance with the specifications in Reference Joint Appendix JA7.

Contingent upon availability and approval of an electronic document repository by the Executive Director, Certificate of Verification documents that are registered and retained by a HERS provider data registry shall also be automatically transmitted by the data registry, to an electronic document repository for retention in accordance with the specifications in Reference Joint Appendix JA7.

- C. For all buildings, a copy of the registered Certificate(s) of Verification shall be posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and shall be made available to the enforcement agency for all applicable inspections. If construction on any portion of the building subject to Part 6 will be impossible to inspect because of subsequent construction, the enforcement agency may require the Certificate(s) of Verification to be posted upon completion of that portion. A copy of the registered Certificate(s) of



Verification shall be included with the documentation the builder provides to the building owner at occupancy as specified in Section 10-103(b).

**EXCEPTION to Section 10-103(a):** Enforcing agencies may exempt nonresidential buildings that have no more than 1,000 square feet of conditioned floor area in the entire building and an occupant load of 49 persons or less from the documentation requirements of Section 10-103(a), provided a statement of compliance with Part 6 is submitted and signed by a licensed engineer or the licensed architect with chief responsibility for the design.

**(b) Compliance, Operating, Maintenance, and Ventilation Information to be provided by Builder.**

**1. Compliance information.**

- A. For low-rise residential buildings, at final inspection, the enforcement agency shall require the builder to leave in the building, copies of the completed, signed, and submitted compliance documents for the building owner at occupancy. For low-rise residential buildings, such information shall, at a minimum, include copies of all Certificate of Compliance, Certificate of Installation, and Certificate of Verification documentation submitted. These documents shall be in paper or electronic format and shall conform to the applicable requirements of Section 10-103(a).
- B. For nonresidential buildings, high-rise residential buildings and hotels and motels, at final inspection, the enforcement agency shall require the builder to leave in the building, copies of the completed, signed, and submitted compliance documents for the building owner at occupancy. For nonresidential buildings, high-rise residential buildings and hotels and motels, such information shall include copies of all Certificate of Compliance, Certificate of Installation, Certificate of Acceptance and Certificate of Verification documentation submitted. These documents shall be in paper or electronic format and shall conform to the applicable requirements of Section 10-103(a).

- 2. Operating information.** At final inspection, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, operating information for all applicable features, materials, components, and mechanical devices installed in the building. Operating information shall include instructions on how to operate the features, materials, components, and mechanical devices correctly and efficiently. The instructions shall be consistent with specifications set forth by the Executive Director. For low-rise residential buildings, such information shall be contained in a folder or manual which provides all information specified in Section 10-103(b). This operating information shall be in paper or electronic format.

For dwelling units, buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating the feature, material, component or mechanical device installed in the building. This operating information shall be in paper or electronic format.

- 3. Maintenance information.** At final inspection, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, maintenance information for all features, materials, components, and manufactured devices that require routine maintenance for efficient operation. Required routine maintenance actions shall be clearly stated and incorporated on a readily accessible label. The label may be limited to identifying, by title and/or publication number, the operation and maintenance manual for that particular model and type of feature, material, component or manufactured device. For low-rise residential buildings, this information shall include a schedule of all interior luminaires and lamps installed to comply with Section 150(k).

For dwelling units, buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for maintaining the feature, material, component or mechanical device installed in the building. This information shall be in paper or electronic format.

- 4. Ventilation information.** For low-rise residential buildings, the enforcement agency shall require the builder to leave in the building, for the building owner at occupancy, a description of the quantities of outdoor air that the ventilation system(s) are designed to provide to the building's conditioned space, and instructions for proper operation and maintenance of the ventilation system. For buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating and maintaining the feature, material, component or mechanical ventilation device installed in the building. This information shall be in paper or electronic format.

For nonresidential buildings, high-rise residential buildings and hotels and motels, the enforcement agency shall require the builder to provide the building owner at occupancy a description of the quantities of outdoor and recirculated air that the ventilation systems are designed to provide to each area. For buildings or tenant spaces that are not individually owned and operated, or are centrally operated, such information shall be provided to the person(s) responsible for operating and maintaining the feature, material, component or mechanical device installed in the building. This information shall be in paper or electronic format.

- (c) **Equipment Information to be Provided by Manufacturer or Supplier.** The manufacturer or supplier of any manufactured device shall, upon request, provide to building designers and installers information about the device. The information shall include the efficiency (and other characteristics regulated by Part 6). This information shall be in paper or electronic format.

(d) **Enforcement Agency Requirements.**

1. **Permits.** An enforcement agency shall not issue a building permit for any construction unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 that are in effect on the date the building permit was applied for. The enforcement agency determination shall confirm that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met.

If a building permit has been previously issued, there has been no construction under the permit, and the permit has expired, the enforcement agency shall not issue a new permit unless the enforcement agency determines in writing that the construction is designed to comply with the requirements of Part 6 in effect on the date the new permit is applied for. The enforcement agency determination shall confirm that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met.

"Determines in writing" includes, but is not limited to, approval of a building permit with a stamp normally used by the enforcement agency.

2. **Inspection.** The enforcement agency shall inspect newly constructed buildings and additions, and alterations to existing buildings to determine whether the construction or installation is consistent with the agency's approved plans and specifications, and complies with Part 6. Final certificate of occupancy shall not be issued until such consistency and compliance is verified. For Occupancy Group R-3, final inspection shall not be complete until such consistency and compliance is verified.

Such verification shall include determination that:

- A. All installed features, materials, components or manufactured devices, regulated by the Appliance Efficiency Regulations or Part 6 are indicated, when applicable, on the Certificate(s) of Installation, Certificate(s) of Acceptance and Certificate(s) of Verification, and are consistent with such features, materials, components or manufactured devices given in the plans and specifications and the Certificate(s) of Compliance approved by the local enforcement agency.
- B. All required Certificates of Installation are posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Installation conform to the specifications of Section 10-103(a)3.
- C. All required Certificates of Acceptance are posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Acceptance conform to the specifications of Section 10-103(a)4.
- D. All required Certificates of Verification are posted, or made available with the building permit(s) issued for the building, or made available for viewing on an approved data registry, and are made available to the enforcement agency for all applicable inspections, and that all required Certificates of Verification conform to the specifications of Section 10-103(a)5.

**EXCEPTION to Section 10-103(d):** For newly constructed buildings that meet the requirements of the New Solar Homes Partnership (NSHP) as specified in the NSHP Guidebook, the enforcement agency may waive the plan check and inspection of all measures other than the mandatory measures in the building.

**NOTE:** Authority: Section 25402, Public Resources Code. Reference: Section 25402, Public Resources Code.

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**~~10-103-A~~10-103.1 – NONRESIDENTIAL LIGHTING CONTROLS  
ACCEPTANCE TEST TRAINING AND CERTIFICATION**

- (a) **Scope.** The requirements of this section apply to nonresidential lighting control Acceptance Test Technicians and Employers, and the Certification Providers that train and certify them.
- (b) **Industry Certification Threshold.** Lighting Controls Acceptance Test Technician and Employer certification requirements shall take effect when the Energy Commission finds that each of the following conditions are met. Until such time that Section ~~40-103-A~~10-103.1(b)1 and ~~40-103-A~~10-103.1(b)2 are met, Field Technicians are allowed to complete the acceptance test requirements in Section 130.4 without completing the Acceptance Test Technician certification requirements.
1. **Number of Certified Acceptance Test Technicians.** There shall be no less than 300 Lighting Controls Acceptance Test Technicians certified to perform the acceptance tests in Building Energy Efficiency Standards, Section 130.4. The number of certified Acceptance Test Technicians shall be demonstrated by Certification Provider-prepared reports submitted to the Energy Commission.
  2. **Industry Coverage by Certification Provider(s).** The Certification Provider(s) approved by the Energy Commission, in their entirety, shall provide reasonable access to certification for technicians representing the majority of the following industry groups: electrical contractors, certified general electricians, licensed architects, professional engineers, controls installation and startup contractors and certified commissioning professionals who have verifiable training, experience and expertise in lighting controls and electrical systems. The Energy Commission will determine whether ~~in their entirety~~ reasonable access to certification is provided by considering factors such as certification costs commensurate with the complexity of the training being provided, certification marketing materials, prequalification criteria, class availability, and curriculum.
- (c) **Qualifications and Approval of Certification Providers.** The Acceptance Test Technician Certification Providers (ATTCPs) shall submit a written application to the Energy Commission with a summary and the related background documents to explain how the following criteria and procedures have been met:
1. **Requirements for Applicant ATTCPs to Document Organizational Structure.** ATTCPs shall provide written explanations of the organization type, by-laws, and ownership structure. ATTCPs shall explain in writing how their certification program meets the qualification requirements of Title 24, Part 1, Section ~~40-103-A~~10-103.1(c). ATTCPs shall explain in their application to the Energy Commission ~~how their organizational structure and their procedures include for independent oversight, quality assurance, supervision and support of the acceptance test training and certification processes.~~
  2. **Requirements for Certification of Employers.** The ATTCPs shall provide written explanations of ~~how their program includes certification and oversight of Acceptance Test Employers. This explanation shall document how the ATTCP to ensures that the Employers are providing quality control and appropriate supervision and support for their Acceptance Test Technicians.~~
  3. **Requirements for Applicant ATTCPs to Document Training and Certification Procedures.** ATTCPs shall ~~provide include with their application~~ a complete copy of all training and testing procedures, manuals, handbooks and materials. ATTCPs shall explain in writing how their training and certification procedures include, but are not limited to, the following:
    - A. **Training Scope.** ~~The scope of the training shall include B~~both hands-on experience and theoretical training to certify competency in the technologies and skills necessary to perform the acceptance tests such that Acceptance Test Technicians demonstrate their ability to apply the Building Energy Efficiency Standards acceptance testing and documentation requirements to a comprehensive variety of lighting control systems and networks that are reflective of the range of systems currently encountered in the field. The objective of the hands-on training is to practice and certify competency in the technologies and skills necessary to perform the acceptance tests.
    - B. **Lighting Controls Acceptance Test Technician Training.**

- (i) **Curricula.** Acceptance Test Technician Certification Provider training curricula for Lighting Control Acceptance Test Technicians shall include, but not be limited to, the analysis, theory, and practical application of the following:
- a) Lamp and ballast systems;
  - b) Line voltage switching controls;
  - c) Low voltage switching controls;
  - d) Dimming controls;
  - e) Occupancy sensors;
  - f) Photosensors;
  - g) Demand responsive signal inputs to lighting control systems;
  - h) Building Energy Efficiency Standards required lighting control systems;
  - i) Building Energy Efficiency Standards required lighting control system-specific analytical/problem solving skills;
  - j) Integration of mechanical and electrical systems for Building Energy Efficiency Standards required lighting control installation and commissioning;
  - k) Safety procedures for low-voltage retrofits (<50 volts) to control line voltage systems (120 to 480 volts);
  - l) Accurate and effective tuning, calibration, and programming of Building Energy Efficiency Standards required lighting control systems;
  - m) Measurement of illuminance according to the Illuminating Engineering Society's measurement procedures as provided in the IESNA Lighting Handbook, 10<sup>th</sup> Edition, 2011, which are incorporated by reference;
  - n) Building Energy Efficiency Standards lighting controls acceptance testing procedures; and
  - o) Building Energy Efficiency Standards acceptance testing compliance documentation for lighting controls.
- (ii) **Hands-on training.** The ATTCP shall describe in their application the design and technical specifications of the laboratory boards, equipment and other elements that will be used to meet the hands-on requirements of the training and certification.
- (iii) **Prequalification.** Participation in the technician certification program shall be limited to persons who have at least three years of verifiable professional experience and expertise in lighting controls and electrical systems as determined by the Lighting Controls ATTCPs, to demonstrate their ability to understand and apply the Lighting Controls Acceptance Test Technician certification training. The criteria and review processes used by the ATTCP to determine the relevance of technician professional experience shall be described in the ATTCP application to the Energy Commission.
- (iv) **Instructor to Trainee Ratio.** A sufficient ratio of instructors to participants in classroom and laboratory work to ensure integrity and efficacy of the curriculum and program. The ATTCP shall document in its application to the Energy Commission why its instructor to trainee ratio is sufficient to ensure the integrity and efficacy of the curriculum and program based on industry standards and other relevant information.
- (v) **Tests.** The ATTCP shall describe the A-written and practical tests that used to demonstrates each certification applicant's competence in all specified subjects. The ATTCPs shall retain all results of these tests for five years from the date of the test.
- (vi) **Recertification.** The ATTCP shall recertify all Acceptance Test Technicians and Acceptance Test Employers prior to the implementation of each adopted update to the

Building Energy Efficiency Standards as these updates affect the acceptance test requirements. Requirements and Procedures for recertification of Acceptance Test Technicians each time the Building Energy Efficiency Standards is updated with new and/or modified acceptance test requirements. Recertification requirements and procedures shall only apply to those specific elements that are new or modified in future updates to Building Energy Efficiency Standards.

- C. **Lighting Controls Acceptance Test Employer Training.** Training for Lighting Controls Acceptance Test Employers shall consist of a single class or webinar consisting of at least four hours of instruction that covers the scope and process of the acceptance tests in Building Energy Efficiency Standards, Section 130.4.
  - D. **Complaint Procedures.** The ATTCPs shall describe in their applications to the Energy Commission procedures for accepting and addressing complaints regarding the performance of any certified Acceptance Test Technician or Employer certified by the ATTCP, and explain how building departments and the public will be notified of these procedures/proceedings.
  - E. **Certification Revocation Procedures.** The ATTCPs shall describe in their applications to the Energy Commission procedures for revoking their certification of Acceptance Test Technicians and Employers based upon poor quality or ineffective work, failure to perform acceptance tests, falsification of documents, failure to comply with the documentation requirements of these regulations or other specified actions that justify decertification.
  - F. **Quality Assurance and Accountability.** The ATTCP shall describe in their application to the Energy Commission how their certification business practices include quality assurance, independent oversight and accountability measures, such as, including but not limited to independent oversight of the certification processes and procedures, visits to building sites where certified technicians are completing acceptance tests, certification process evaluations, building department surveys to determine acceptance testing effectiveness, and expert review of the training curricula developed for Building Energy Efficiency Standards, Section 130.4. The ATTCP shall review a random sample of no less than 1 percent of each Technician's completed compliance forms, and shall perform randomly selected on-site audits of no less than 1 percent of each Technician's completed acceptance tests. Independent oversight may be demonstrated by accreditation under the ISO/IEC 17024 standard.
  - G. **Certification Identification Number and Verification of ATT Certification Status.** Upon certification of an ATT, the ATTCP shall issue a unique certification identification number to the ATT. The ATTCP shall maintain an accurate record of the certification status for all ATTs that the ATTCP has certified. The ATTCP shall provide verification of current ATT certification status upon request to authorized document Registration Provider personnel or enforcement agency personnel to determine the ATT's eligibility to sign Certificate of Acceptance documentation according to all applicable requirements in Sections ~~10-103-A~~ 10-103.1, 10-102, 10-103(a)4, and the Reference Joint Appendix JA7.
- (d) **Requirements for ATTCPs to Provide Annual Regular Reports.** The ATTCP shall provide the following regular reports to the Energy Commission:
- 1. **Annual Report:** The ATTCP shall provide an annual report to the Energy Commission summarizing the certification services provided over the reporting period, including the total number of Acceptance Test Technicians and Employers certified by the ATTCP (a) during the reporting period and (b) to date. The annual report shall include a summary of all actions taken against any Acceptance Test Technician or Employer as a result of the complaint or quality assurance procedures described by the ATTCP as required under Section 10-103.1(c)(3)(D) and 10-103.1(c)(3)(F).
  - 2. **Update Report:** The ATTCP shall have not less than six months following the adoption of an update to the Building Energy Efficiency Standards to prepare an Update Report. The ATTCP shall submit an Update Report to the Energy Commission not less than six months prior to the effective date of any newly adopted, or amendment to existing, update to the Building Energy Efficiency Standards. The ATTCP shall report to the Energy Commission what adjustments have been made to the training curricula, if any, to address changes to the Building Energy Efficiency Standards Acceptance Testing requirements, adopted updates to the Building Energy Efficiency Standards or to ensure

training is reflective of the variety of lighting controls that are currently encountered in the field, no less than six months prior to the effective date of any newly adopted, or amendment to existing, Building Energy Efficiency Standards. All required update reports shall contain a signed certification that the ATTCP has met all requirements under Section 10-103.1(c). Update reports shall be approved through the Amendment Process provided under Section 10-103.1(f).

All required reports shall contain a signed certification that the ATTCP has met all requirements for this program.

~~(e)~~ **Interim Approval of Lighting Controls Acceptance Test Technician Certification Provider.** The California Advanced Lighting Controls Training Program (CALCTP) shall be approved as an authorized Lighting Controls Acceptance Test Technician Certification Provider subject to the following conditions:

- ~~1. Interim approval shall be conditioned upon submittal of an application that contains the information required by subdivision (e)(1) (3), including documentation demonstrating that the certification includes training and testing on the Building Energy Efficiency Standards lighting control acceptance testing procedures and the Building Energy Efficiency Standards acceptance testing compliance documentation for lighting control systems.~~
- ~~2. Technicians who have been certified by CALCTP prior to the inclusion of training on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation shall qualify as Lighting Control Acceptance Test Technicians upon successful completion of a class or webinar consisting of at least four hours of instruction on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation.~~
- ~~3. Employers who have been certified by CALCTP prior to the inclusion of training on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation shall qualify as a Lighting Control Acceptance Test Employer upon successful completion of a class or webinar consisting of at least four hours of instruction on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation.~~
- ~~4. Interim approval for all ATTCPs shall end on the later date of, July 1, 2014 or six months after the effective date of the 2013 California Building Energy Efficiency Standards. The Energy Commission may extend the interim approval period for up to six additional months total, if it determines the threshold requirements in Section 10-103-A(b) have not been met for the certification requirements to take effect. If the Energy Commission determines that an extension is necessary, its determination shall be approved at a publicly noticed meeting.~~
- ~~5. During the interim approval period, including any possible extensions to this interim period, the Energy Commission may approve additional ATTCP providers meeting the requirements of 10-103-A(e).~~

~~(e)~~ **Application Review and Determination.** The Energy Commission shall review Acceptance Test Technician Certification Provider applications according to the criteria and procedures in Section ~~10-103-A~~ 10-103.1(c) to determine if such providers are approved to meet the specified requirements for providing acceptance testing certification services.

- ~~1. Energy Commission staff will review and validate all information received on Acceptance Test Technician Certification Provider applications, and determine that whether the application is complete and contains sufficient information to be evaluated approved by staff. Complete applications shall be evaluated by staff based on their contents.~~
- ~~2. The Executive Director may require that the applicant provide additional information as required by staff to fully evaluate the Provider application.~~
- ~~3. The Executive Director shall provide a copy of its the staff evaluation to interested persons and provide a reasonable opportunity for public comment.~~
- ~~34. The Executive Director shall issue a written recommendation that the Energy Commission designate the applicant as an authorized Acceptance Test Technician Certification Provider or deny the Provider application.~~
- ~~45. The Energy Commission shall make a final decision on the application at a publicly noticed hearing.~~

**(f) Amendment Process.**

The ATTCP may amend a submitted or approved application as described in this Section.

**1. Amendment Scope.**

- A. Nonsubstantive Changes.** A nonsubstantive change is a change that does not substantively alter the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making only nonsubstantive changes, the ATTCP shall submit a letter describing the change to the Energy Commission as an addendum to the application.
- B. Substantive Changes.** A substantive change is a change that substantively alters the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making any substantive changes, the ATTCP shall submit the following:
- (i) A document describing the scope of the change to the application, the reason for the change and the potential impact to the ATTCP, ATT, and ATT Employer as an addendum to the application;
  - (ii) A replacement copy of the affected sections of the ATTCP application with the changes incorporated; and
  - (iii) A copy of the affected sections of the ATTCP application showing the changes in underline and strikeout format.

**2. Amendment Review.** Amendments submitted prior to approval of an ATTCP application shall be included in the application's Application Review and Determination process specified in Section ~~40-103-A~~10-103.1(e).

Amendments submitted after approval of an ATTCP's application that contain only nonsubstantive changes shall be reviewed by the Executive Director for consistency with Section ~~40-103-A~~10-103.1. Amendments determined to be consistent with this Section shall be incorporated into the approval as errata.

Amendments submitted after approval of an ATTCP's application that contain any substantive changes shall be subject to the Application Review and Determination process specified in Section ~~40-103-A~~10-103.1(e). If the Energy Commission finds that the amended application does not meet the requirements of Section ~~40-103-A~~10-103.1, then the ATTCP shall either abide by the terms of their previously approved application or have their approval suspended.

**(g) Review by the Energy Commission.**

If the Energy Commission determines there is a violation of these regulations or that an Acceptance Test Technician Certification Provider is no longer providing adequate certification services, the Energy Commission may revoke the authorization of the Acceptance Test Technician Certification Provider pursuant to Section 1230 et. seq. of Title 20 of the California Code of Regulations.

**NOTE:** Authority: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, -25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

## **~~10-103-B~~10-103.2 – NONRESIDENTIAL MECHANICAL ACCEPTANCE TEST TRAINING AND CERTIFICATION**

- (a) Scope.** The requirements of this section apply to nonresidential mechanical Acceptance Test Technicians and Employers and the Certification Providers that train and certify them.
- (b) Industry Certification Threshold.** Mechanical Acceptance Test Technician and Employer certification requirements shall take effect when the Energy Commission finds that each of the following conditions are met. Until such time that Sections ~~40-103-B~~10-103.2(b)1 and ~~40-103-B~~10-103.2(b)2 are met, Field Technicians are allowed to complete the acceptance test requirements in Section 120.5 without completing the Acceptance Test Technician certification requirements.

**1. Number of Certified Acceptance Test Technicians.**

- A. There shall be no less than 300 Mechanical Acceptance Test Technicians certified to perform all of the acceptance tests in Building Energy Efficiency Standards, Section 120.5, except as provided in Subsection ~~10-103-B10-103.2(b)~~ 1.B, below. The number of certified Mechanical Acceptance Test Technicians shall be demonstrated by Certification Provider-provided reports submitted to the Energy Commission.
- B. If there are less than 300 Mechanical Acceptance Test Technicians certified to perform all of the acceptance tests in Building Energy Efficiency Standards, Section 120.5, then there shall be at least 300 Mechanical Acceptance Test Technicians certified to complete the following tests:
  - (i) NA7.5.1 Outdoor Air Ventilation Systems
  - (ii) NA7.5.2 Constant Volume, Single Zone Unitary Air Conditioners and Heat Pumps
  - (iii) NA7.5.4 Air Economizer Controls
  - (iv) NA7.5.5 Demand Control Ventilation Systems
  - (v) NA 7.5.6 Supply Fan Variable Flow Controls
  - (vi) NA7.5.7, NA7.5.9 Hydronic System Variable Flow Controls
  - (vii) NA7.5.10 Automatic Demand Shed Controls

The number of certified Mechanical Acceptance Test Technicians shall be demonstrated by Certification Provider-provided reports submitted to the Energy Commission.

- 2. **Industry Coverage by Certification Provider(s).** The Mechanical Acceptance Test Technician Certification Provider(s) approved by the Energy Commission, in their entirety, provide reasonable access to certification for technicians representing the majority of the following industry groups: Professional engineers, licensed architects, HVAC installers, mechanical contractors, Testing and Balancing (TAB) certified technicians, controls installation and startup contractors and certified commissioning professionals who have verifiable training, experience and expertise in HVAC systems. The Energy Commission will determine reasonable access by considering factors such as certification costs commensurate with the complexity of the training being provided, certification marketing materials, prequalification criteria, class availability and curriculum.

- (c) **Qualifications and Approval of Certification Providers.** The Acceptance Test Technician Certification Providers (ATTCPs) shall submit a written application to the Energy Commission with a summary and the necessary background documents to explain how the following criteria and procedures have been met:
  - 1. **Requirements for Applicant ATTCPs to Document Organizational Structure.** ATTCPs shall provide written explanations of the organization type, by-laws, and ownership structure. ATTCPs shall explain in writing how their certification program meets the qualifications of Building Energy Efficiency Standards, Section ~~10-103-B10-103.2(c)~~. ATTCPs shall explain in their application to the Energy Commission how their organizational structure and their procedures include for independent oversight, quality assurance, supervision and support of the acceptance test training and certification processes.
  - 2. **Requirement for Certification of Employers.** The ATTCPs shall provide written explanations of ~~how their program includes their~~ certification and oversight of Acceptance Test Employers, ~~to~~ This explanation shall document how the ATTCP ensures that the Employers are providing quality control and appropriate supervision and support for their Acceptance Test Technicians.
  - 3. **Requirements for Applicant ATTCPs to Document Training and Certification Procedures.** ATTCPs shall ~~provide~~ include with their application a complete copy of all training and testing procedures, manuals, handbooks and materials. ATTCPs shall explain in writing how their training and certification procedures include, but are not limited to, the following:
    - A. **Training Scope.** ~~The scope of the training shall include B~~ both hands-on experience and theoretical training to certify competency in the technologies and skills necessary to perform the acceptance tests such that Acceptance Test Technicians demonstrate their ability to apply the Building Energy Efficiency Standards acceptance testing and documentation requirements to a comprehensive variety of mechanical systems and controls that is reflective of the range of systems currently encountered in the field.
    - B. **Mechanical Acceptance Test Technician Training.**



(i) **Curricula.** Acceptance Test Technician Certification Provider training curricula for Mechanical Acceptance Test Technicians shall include, but not be limited to, the analysis, theory, and practical application of the following:

- a) Constant volume system controls;
- b) Variable volume system controls;
- c) Air-side economizers;
- d) Air distribution system leakage;
- e) Demand controlled ventilation with CO<sub>2</sub> sensors;
- f) Demand controlled ventilation with occupancy sensors;
- g) Automatic demand shed controls;
- h) Hydronic valve leakage;
- i) Hydronic system variable flow controls;
- j) Supply air temperature reset controls;
- k) Condenser water temperature reset controls;
- l) Outdoor air ventilation systems;
- m) Supply fan variable flow controls;
- n) Boiler and chiller isolation controls;
- o) Fault detection and diagnostics for packaged direct-expansion units;
- p) Automatic fault detection and diagnostics for air handling units and zone terminal units;
- q) Distributed energy storage direct-expansion air conditioning systems;
- r) Thermal energy storage systems;
- s) Building Energy Efficiency Standards mechanical acceptance testing procedures; and
- t) Building Energy Efficiency Standards acceptance testing compliance documentation for mechanical systems.

(ii) **Hands-on training.** The ATTCP shall describe in their application the design and technical specifications of the laboratory boards, equipment and other elements that will be used to meet the hands-on requirements of the training and certification.

(iii) **Prequalification.** Participation in the technician certification program shall be limited to persons who have at least three years of verifiable professional experience and expertise in mechanical controls and systems as determined by the Mechanical ATTCPs to demonstrate an ability to understand and apply the Mechanical Acceptance Test Technician certification training. The criteria and review processes used by the ATTCP to determine the relevance of technician professional experience shall be described in the ATTCP application to the Energy Commission.

(iv) **Instructor to Trainee Ratio.** A sufficient ratio of instructors to participants in classroom and laboratory work to ensure integrity and efficacy of the curriculum and program. The ATTCP shall document in its application to the Energy Commission why its instructor to trainee ratio is sufficient to ensure the integrity and efficacy of the curriculum and program based on industry standards and other relevant information.

(v) **Tests.** The ATTCP shall describe the A-written and practical tests used to that demonstrates each certification applicant's competence in all specified subjects. The ATTCPs shall retain all results of these tests for five years from the date of the test.

(vi) **Recertification.** The ATTCP shall recertify all Acceptance Test Technicians and Acceptance Test Employers prior to the implementation of each adopted update to the Building Energy Efficiency Standards as these updates affect the acceptance test requirements. Requirements and Procedures for recertification of Acceptance Test Technicians each time the Building Energy Efficiency Standards is updated with new and/or modified acceptance test requirements. Recertification requirements and procedures shall only apply to those specific elements that are new and/or modified in future updates to Building Energy Efficiency Standards.

- C. **Mechanical Acceptance Test Employer Training.** Training for Mechanical Acceptance Test Employers shall consist of a single class or webinar consisting of at least four hours of instruction that covers the scope and process of the acceptance tests in Building Energy Efficiency Standards, Section 120.5.
- D. **Complaint Procedures.** Procedures described in writing for notifying building departments and the public that the Acceptance Test Certification Provider will accept complaints regarding the performance of any certified acceptance test technician or employer, and procedures for how the Provider will address these complaints.
- E. **Certification Revocation Procedures.** Procedures described in writing for revoking their certification of Acceptance Test Technicians and Employers based upon poor quality or ineffective work, failure to perform acceptance tests, falsification of documents, failure to comply with the documentation requirements of these regulations or other specified actions that justify decertification.
- F. **Quality Assurance and Accountability.** The ATTCPs shall describe in their applications to the Energy Commission how their certification business practices include quality assurance, independent oversight and accountability measures, including but not limited to such as independent oversight of the certification processes and procedures, visits to building sites where certified technicians are completing acceptance tests, certification process evaluations, building department surveys to determine acceptance testing effectiveness, and expert review of the training curricula developed for Building Energy Efficiency Standards, Section 120.5. The ATTCP shall review a random sample of no less than 1 percent of each Technician's completed compliance forms, and shall perform randomly selected on-site audits of no less than 1 percent of each Technician's completed acceptance tests. Independent oversight may be demonstrated by accreditation under the ISO/IEC 17024 standard.
- G. **Certification Identification Number and Verification of ATT Certification Status.** Upon certification of an ATT, the ATTCP shall issue a unique certification identification number to the ATT. The ATTCP shall maintain an accurate record of the certification status for all ATTs that the ATTCP has certified. The ATTCP shall provide verification of current ATT certification status upon request to authorized document Registration Provider personnel or enforcement agency personnel to determine the ATT's eligibility to sign Certificate of Acceptance documentation according to all applicable requirements in Sections ~~10-103-B~~ 10-103.2, 10-102, 10-103(a)4, and Reference Joint Appendix JA7.

(d) **Requirements for ATTCPs to Provide Annual Regular Reports.** The ATTCP shall provide the following regular reports to the Energy Commission:

1. **Annual Report:** The ATTCP shall provide an annual report to the Energy Commission summarizing the certification services provided over the reporting period, including the total number of Acceptance Test Technicians and Employers certified by the agency (a) during the reporting period and (b) to date. The annual report shall include a summary of all actions taken against any Acceptance Test Technician or Employer as a result of the complaint or quality assurance procedures described by the ATTCP as required under Section 10-103.2(c)(3)(D) and 10-103.2(c)(3)(F).
2. **Update Report:** The ATTCP shall have not less than six months following the adoption of an update to the Building Energy Efficiency Standards to prepare an Update Report. The ATTCP shall submit an Update Report to the Energy Commission not less than ~~Six~~ six months prior to the effective date of any newly adopted, or amendment to existing, update to the Building Energy Efficiency Standards. ~~The~~ The ATTCP shall report to the Energy Commission what adjustments have been made to the training

curricula, if any, to address changes to the Building Energy Efficiency Standards Acceptance Testing requirements, adopted updates to the Building Energy Efficiency Standards or to ensure training is reflective of the variety of ~~lighting controls that are~~ mechanical equipment and systems currently encountered in the field, ~~no less than six months prior to the effective date of any newly adopted, or amendment to existing Building Energy Efficiency Standards.~~ All required update reports shall contain a signed certification that the ATTCP has met all requirements under Section 10-103.2(c). Update reports shall be approved through the Amendment Process provided under Section 10-103.2(f).

All required reports shall contain a signed certification that the ATTCP has met all requirements for this program.

~~(e) — Interim Approval of Mechanical Acceptance Test Technician Certification Providers. The Associated Air Balance Council (AABC), National Environmental Balancing Bureau (NEBB), and the Testing Adjusting and Balancing Bureau (TABB) shall be conditionally approved as authorized Mechanical Acceptance Test Technician Certification Providers, each separately subject to the following conditions:~~

- ~~1. Interim approval shall only apply to Mechanical Acceptance Test Technicians completing the following mechanical acceptance tests required in Building Energy Efficiency Standards, Section 120.5. Mechanical Acceptance Test Technicians certified by one of the above organizations do not have interim approval to complete all other mechanical acceptance tests in Building Energy Efficiency Standards, Section 120.5.~~
  - ~~A. NA7.5.1 Outdoor Air Ventilation Systems~~
  - ~~B. NA7.5.2 Constant Volume, Single Zone Unitary Air Conditioners and Heat Pumps~~
  - ~~C. NA7.5.4 Air Economizer Controls~~
  - ~~D. NA7.5.5 Demand Control Ventilation Systems~~
  - ~~E. NA 7.5.6 Supply Fan Variable Flow Controls~~
  - ~~F. NA7.5.7, NA7.5.9 Hydronic System Variable Flow Controls~~
  - ~~G. NA7.5.10 Automatic Demand Shed Controls~~
- ~~2. Interim approval shall be conditioned upon submittal of an application that contains the information required by subdivision (e)(1)–(3), including documentation demonstrating that the certification includes training and testing on the Building Energy Efficiency Standards mechanical acceptance testing procedures and the Building Energy Efficiency Standards acceptance testing compliance documentation for mechanical systems.~~
- ~~3. Technicians who have been certified by AABC, NEBB, or TABB prior to the inclusion of training on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation shall qualify as a Mechanical Acceptance Test Technicians upon successful completion of a class or webinar on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation.~~
- ~~4. Employers who have been certified by AABC, NEBB, or TABB prior to the inclusion of training on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation shall qualify as a Mechanical Acceptance Test Employer upon successful completion of a class or webinar consisting of at least four hours of instruction on the Building Energy Efficiency Standards acceptance testing procedures and compliance documentation.~~
- ~~5. Interim approval for all ATTCPs shall end on the later date of July 1, 2014 or six months after the effective date of the 2013 California Building Energy Efficiency Standards. The Energy Commission may extend the interim approval period for up to six additional months total, if it determines the threshold requirements in Section 10-103-B(b) have not been met for the certification requirements to take effect. If the Energy Commission determines that an extension is necessary, its determination shall be approved at a publicly noticed meeting.~~
- ~~6. During the interim approval period, including any possible extensions to this interim period, the Energy Commission may approve additional ATTCP providers meeting the requirements of Section 10-103-B(e).~~

(~~fe~~) **Application Review and Determination.** The Energy Commission shall review Acceptance Test Technician Certification Provider applications according to the criteria and procedures in Section ~~10-103-B~~10-103.2(c) to determine if such providers are approved to meet the specified requirements for providing acceptance testing certification services.

1. Energy Commission staff will review and validate all information received on Acceptance Test Technician Certification Provider applications, and determine ~~that whether~~ the application is complete and contains sufficient information to be ~~evaluated approved by staff~~. Complete applications shall be evaluated by staff based on their contents.
2. The Executive Director may require that the applicant provide additional information as required by staff to fully evaluate the Provider application.
3. The Executive Director shall provide a copy of its ~~the staff~~ evaluation to interested persons and provide an opportunity for public comment.
34. The Executive Director shall issue a written recommendation that the Energy Commission designate the applicant as an authorized Mechanical Acceptance Tester Certification Provider or deny the Provider application.
45. The Energy Commission shall make a final decision on the application at a publicly noticed hearing.

(f) **Amendment Process.**

The ATTCP may amend a submitted or approved application as described in this Section.

1. **Amendment Scope.**

A. **Nonsubstantive Changes.** A nonsubstantive change is a change that does not substantively alter the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making only nonsubstantive changes, the ATTCP shall submit a letter describing the change to the Energy Commission as an addendum to the application.

B. **Substantive Changes.** A substantive change is a change that substantively alters the requirements of the application materials for the ATTCP, ATT, or ATT Employer. For amendments making any substantive changes, the ATTCP shall submit the following:

- (i) A document describing the scope of the change to the application, the reason for the change and the potential impact to the ATTCP, ATT, and ATT Employer as an addendum to the application;
- (ii) A replacement copy of the affected sections of the ATTCP application with the changes incorporated; and
- (iii) A copy of the affected sections of the ATTCP application showing the changes in underline and strikeout format.

2. **Amendment Review.** Amendments submitted prior to approval of an ATTCP application shall be included in the application's Application Review and Determination process specified in Section ~~10-103-B~~10-103.2(e).

Amendments submitted after approval of an ATTCP's application that contain only nonsubstantive changes shall be reviewed by the Executive Director for consistency with Section ~~10-103-B~~10-103.2. Amendments determined to be consistent with this Section shall be incorporated into the approval as errata.

Amendments submitted after approval of an ATTCP's application that contain any substantive changes shall be subject to the Application Review and Determination process specified in Section ~~10-103-B~~10-103.2(e). If the Energy Commission finds that the amended application does not meet the requirements of Section ~~10-103-B~~10-103.2, then the ATTCP shall either abide by the terms of their previously approved application or have their approval suspended.

(g) **Review by the Energy Commission.**

If the Energy Commission determines there is a violation of these regulations or that an Acceptance Test Technician Certification Provider is no longer providing adequate certification services, the Energy

Commission may revoke the authorization of the Acceptance Test Technician Certification Provider pursuant to Section 1230 et. seq. of Title 20 of the California Code of Regulations.

**NOTE:** Authority: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

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## 10-104 – EXCEPTIONAL DESIGNS

**NOTE:** See Section 10-109 for approval of calculation methods and Alternative Component Packages.

- (a) **Requirements.** If a building permit applicant proposes to use a performance compliance approach, and the building designs cannot be adequately modeled by an approved calculation method, an applicant shall be granted a building permit if the Commission finds:
1. That the design cannot be adequately modeled with an approved calculation method;
  2. Using an alternative evaluation technique, that the design complies with Part 6; and
  3. That the enforcement agency has determined that the design complies with all other legal requirements.
- (b) **Applications.** The applicant shall submit four copies of a signed application with the following materials to the Executive Director:
1. A copy of the plans and documentation required by Section 10-103(a)2;
  2. A statement explaining why meeting the energy budget cannot be demonstrated using an approved calculation method;
  3. Documentation from the enforcement agency stating that:
    - A. Meeting the energy budget requirements cannot be demonstrated using an approved calculation method; and
    - B. The design complies with all other legal requirements; and
  4. A detailed evaluation of the energy consumption of the proposed building and the building's materials, components, and manufactured devices proposed to be installed to meet the requirements of Part 6 using an alternative evaluation technique. The evaluation shall include a copy of the technique, instructions for its use, a list of all input data, and all other information required to replicate the results.

**NOTE:** Authority: Sections 25402 and 25402.1, Public Resources Code. Reference: Sections 25402 and 25402.1, Public Resources Code.

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**10-105 – ENFORCEMENT BY THE COMMISSION**

- (a) **Where there is No Local Enforcement Agency.** Before new construction may begin in an area where there is no local enforcement agency, the Executive Director shall determine in writing that the building design conforms to the requirements of Part 6. The person proposing to construct the building shall submit the information described in Sections 10-103(a)1 and 10-103(a)2 to the Executive Director when such a determination is sought.
- (b) **Where building construction is under the jurisdiction of a State agency.** Pursuant to Public Resources Code Section 25402.1(g)(5), no construction of any State building shall commence until the Department of General Services or the State agency that otherwise has jurisdiction over the property determines that the construction is designed to comply with the requirements of Part 6, and confirms that the documentation requirements of Sections 10-103(a)1 and 10-103(a)2 have been met; and that the plans indicate the features and performance specifications needed to comply with Part 6. The responsible state agency shall notify the Commission's Executive Director of its determination.
- (c) **Where the Enforcement Agency Fails to Enforce.** If an enforcement agency fails to enforce the requirements of this article or of Part 6 the Commission, after furnishing 10 days written notice, may condition building permit issuance on submission of the information described in Sections 10-103(a)1 and 10-103(a)2 to the Executive Director and on his or her written determination that proposed construction conforms to the requirements of Part 6.

**NOTE:** Authority: Code Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

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**10-106 – LOCALLY ADOPTED ENERGY STANDARDS**

- (a) **Requirements.** Local governmental agencies may adopt and enforce energy standards for newly constructed buildings, additions, alterations, and repairs to existing buildings provided the Energy Commission finds that the standards will require buildings to be designed to consume no more energy than permitted by Title 24, Part 6.
- (b) **Documentation Application.** Local governmental agencies wishing to enforce locally adopted energy standards shall submit an application with the following materials to the Executive Director:
1. The proposed energy standards;
  2. The local governmental agency's findings and supporting analyses on the energy savings and cost effectiveness of the proposed energy standards;
  3. A statement or finding by the local governmental agency that the local energy standards will require buildings to be designed to consume no more energy than permitted by Part 6; and;
  4. Any findings, determinations, declarations or reports, including any negative declaration or environmental impact report, required pursuant to the California Environmental Quality Act, Pub. Resources Code Section 21000 et seq.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Sections 25402.1, 21080.4, 21153, Public Resources Code.

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**10-107 – INTERPRETATIONS**

- (a) The Commission may make a written determination as to the applicability or interpretation of any provision of this article or of Part 6 upon written application, if a dispute concerning a provision arises between an applicant for a building permit and the enforcement agency, and the dispute has been heard by the local board of permit appeals or other highest local review body. Notice of any such appeal, including a summary of the dispute and the section of the regulations involved, shall if possible be sent to the Commission by the enforcing agency 15 days before the appeal is heard, and the result of the appeal shall be sent to the Commission within 15 days after the decision is made. Either party to the dispute may apply for a determination but shall concurrently deliver a copy of the application to the other party. The determinations are binding on the parties.
- (b) The Executive Director may, upon request, give written advice concerning the meaning of any provision of this article or of Part 6. Such advice is not binding on any person.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.



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**10-108 – EXEMPTION**

- (a) **Requirements.** The Commission may exempt any building from any provision of Part 6 if it finds that:
1. Substantial funds had been expended in good faith on planning, designing, architecture, or engineering of the building before the adoption date of the provision; and.
  2. Compliance with the requirements of the provision would be impossible without both substantial delays and substantial increases in costs of construction above the reasonable costs of the measures required to comply with the provision.
- (b) **Application.** The applicant shall submit four copies of a signed application with the following materials to the Executive Director:
1. A summary of the claimant's contracts for the project;
  2. A summary of internal financial reports on the project;
  3. Dated schedules of design activities; and
  4. A progress report on project completion.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

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**10-109 – COMPLIANCE SOFTWARE, ALTERNATIVE COMPONENT PACKAGES, EXCEPTIONAL METHODS, DATA REGISTRIES AND RELATED DATA INPUT SOFTWARE, ALTERNATIVE RESIDENTIAL FIELD VERIFICATION PROTOCOLS, AND ELECTRONIC DOCUMENT REPOSITORIES**

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- (a) Compliance software, alternative component packages, exceptional methods, data registries and related data input software, alternative residential field verification protocols or electronic document repositories must be approved by the Commission in order to be used to demonstrate compliance with Part 6.
- (b) **Application.** Applications for approval of compliance software, alternative component packages, exceptional methods, data registries and related data input software, and alternative field verification protocols must be made as follows:
1. An applicant shall submit four copies of a signed application form specified by the Executive Director.
  2. The application shall include the following materials:
    - A. A description of the functional or analytical capabilities of the compliance software, alternative component package, calculation method, exceptional method, data registry or related data input software, and alternative field verification protocol; and
    - B. A demonstration that the criteria in Section 10-109 are met; and
    - C. An initial fee of one thousand dollars (\$1,000). The total fee shall cover the Commission's cost of reviewing and analyzing the application. Within 75 days of receipt of an application, the Commission will provide an estimate of the total maximum cost to review and analyze the application and make a determination as to the completeness of the application. Consideration of the application will be delayed until the applicant submits requested additional information. After the Commission determines the total cost, if the cost exceeds the initial fee, the Commission shall assess an additional fee to cover the total cost. If the actual cost is less than the initial, or any estimated maximum, fee the Commission shall refund the difference to the applicant.
- (c) **Compliance Software.**
1. **Public Domain Computer Programs.** In addition to the public domain computer programs that are approved pursuant to Public Resources Code Section 25402.1, the Commission may, upon written application or its own motion, approve additional public domain computer programs that may be used to demonstrate that proposed building designs meet energy budgets.
    - A. The Commission shall ensure that users' manuals or guides for each approved program are available.
    - B. The Commission shall approve a program only if it predicts energy consumption substantially equivalent to that predicted by the above-referenced public domain computer program, when it models building designs or features.
  2. **Alternative Calculation Methods (All Occupancies).** The Commission may approve non-public domain computer programs as an alternative calculation method that building permit applicants may then use to demonstrate compliance with the performance standards (energy budgets) in Part 6. In addition to the application requirements of subdivision (b) above, an application for approval of compliance software must include documentation demonstrating that the compliance software meets the requirements, specifications, and criteria set forth in the Residential or Nonresidential ACM Approval Manual, as appropriate.

**NOTE:** Copies of the ACM Approval Manuals may be obtained from the Commission's website at: [www.energy.ca.gov/title24](http://www.energy.ca.gov/title24).

- (d) **Alternative Component Packages.** In addition to the application requirements of subdivision (b) above, an application for approval of an alternative component package must include documentation that demonstrates that the package:
1. Will meet the applicable energy budgets; and
  2. Is likely to apply to a significant percentage of newly constructed buildings or to a significant segment of the building construction and design community.
- (e) **Exceptional Methods.** The Commission may approve an exceptional method that analyzes a design, material, or device that cannot be adequately modeled using the public domain computer programs. Applications for approval of exceptional methods shall include all information needed to verify the method's accuracy.
- (f) **Commission Action.** The Commission may take the following actions on an application submitted pursuant to this section:
1. Approve the application unconditionally;
  2. Restrict approval to specified occupancies, designs, materials, or devices; or
  3. Reject the application.
- (g) **Resubmittal.** An applicant may resubmit a rejected application or may request modification of a restricted approval. Such application shall include the information required pursuant to this section, and, if applicable, shall indicate how the proposed compliance software, alternative component package, exceptional method, data registry or related data input software has been changed to enhance its accuracy or capabilities, if applicable.
1. **Modification.** Whenever an approved compliance software, alternative component package, exceptional method, data registry or related data input software is changed in any way, it must be resubmitted under this section for approval.
  2. The Commission may modify or withdraw approval of compliance software, an alternative component package, an exceptional method, or a data registry or related data input software based on its approval of other programs, methods, registries or data input software that are more suitable.
- (h) **In addition to the procedures and protocols identified in the Alternative Calculation Method Approval Manuals and the Reference Appendices, the Commission may authorize alternative procedures or protocols that demonstrate compliance with Part 6.**
- (i) **Data Registries And Related Data Input Software, And Electronic Document Repositories.**
1. **Data Registries and Related Data Input Software.**

Data registries and related data input software shall conform to the requirements specified in Reference Joint Appendix JA7.

    - A. The Commission may approve residential data registries that provide for registration, when required by Part 6 of all residential compliance documentation and the nonresidential Certificates of Verification.
    - B. The Commission may approve nonresidential data registries that provide for registration, when required by Part 6 of all nonresidential compliance documentation. However, nonresidential data registries may not provide for registration of nonresidential Certificates of Verification.
    - C. The Commission may approve software used for data input to various data registries for registering, when required by Part 6 residential or nonresidential compliance documentation.
  2. **Electronic Document Repositories.**
    - A. The Commission may approve electronic document repositories that retain for the Commission electronic compliance documentation generated by residential and nonresidential data registries when registration is required by Part 6.
- (j) **Alternative Residential Field Verification Protocols.**

Alternative residential field verification protocols shall comply with the application requirements of Section 10-109(b) and any applicable requirements of Reference Residential Appendices RA1.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

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**10-110 – PROCEDURES FOR CONSIDERATION OF APPLICATIONS UNDER SECTIONS 10-104, 10-106, 10-108, AND 10-109**

- (a) Within 75 days of receipt of an application, the Executive Director shall determine if the application is complete with all the supporting information required pursuant to Sections 10-104, 10-106, 10-108, or 10-109 (the complete application package). If the application is complete, the Executive Director shall make the complete application package available to interested parties. Comments from interested parties must be submitted within 60 days after being made available.
- (b) Within 75 days of the date the application is determined to be complete, the Executive Director may request any additional information needed to evaluate the application. Consideration of the application will be delayed until the applicant submits the requested additional information.
- (c) Within 75 days of receipt of the date the application is determined to be complete, the Executive Director may convene a workshop to gather additional information from the applicant and other interested parties. Interested parties will have 15 days after the workshop to submit additional information regarding the application.
- (d) Within 90 days of the date the application is determined to be complete, or within 30 days after receipt of complete additional information requested under Section 10-110(b), or within 60 days after the receipt of additional information submitted by interested parties under Section 10-110(c), whichever is later, the Executive Director shall submit to the Commission a written recommendation on the application.
- (e) The complete application package, any additional information considered by the Executive Director, and the Executive Director's recommendation shall be placed on the consent calendar and considered at the next business meeting after submission of the recommendation. The matter may be removed from the consent calendar at the request of any person.
- (f) The Executive Director may charge a fee to recover the costs of processing and reviewing applications, with the exception of Section 10-106 applications.
- (g) All applicants have the burden of proof to establish that their applications should be granted.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

## 10-111 – CERTIFICATION AND LABELING OF FENESTRATION PRODUCT U-FACTORS, SOLAR HEAT GAIN COEFFICIENTS, VISIBLE TRANSMITTANCE AND AIR LEAKAGE

This section establishes rules for implementing labeling and certification requirements relating to U-factors, solar heat gain coefficients (SHGCs), visible transmittance (VT) and air leakage for fenestration products under Section 110.6(a) of Part 6. This section also provides for designation of the National Fenestration Rating Council (NFRC) as the supervisory entity responsible for administering the state's certification program for fenestration products, provided NFRC meets specified criteria.

### (a) Labeling Requirements.

#### 1. Temporary labels.

- A. Every manufactured fenestration product shall have attached to it a clearly visible temporary label that lists the U-factor, the solar heat gain coefficient (SHGC) and Visible Transmittance (VT) and that certifies compliance with the air leakage requirements of Section 110.6(a)1. ~~For the Component Modeling Approach (CMA) and site-built fenestration products shall have a label certificate that lists the U-factor, the Solar Heat Gain Coefficient (SHGC), and the Visible Transmittance (VT).~~
- B. U-factor, SHGC, ~~and VT~~ and Air Leakage shall be determined by either:
  - i. Fenestration products rated and certified using NFRC 100, NFRC 200, NFRC 202 NFRC 203 or NFRC 400 Rating Procedures. The manufacturer shall stipulate that the ratings were determined in accordance with applicable NFRC procedures. For manufactured fenestration products, a temporary label certificate approved by the supervisory entity (NFRC) meets the requirements of this section. For component modeling and site-built fenestration products, a label certificate approved by the supervisory entity (NFRC) meets the requirements of this section.
  - ii. For manufactured or site-built fenestration products not rated by NFRC, a temporary label with the words "CEC Default U-factor," followed by the appropriate default U-factor specified in Section 110.6(a)2 and with the words "CEC Default SHGC," followed by the appropriate default SHGC specified in Section 110.6(a)3 and with the words "CEC Default VT," followed by the appropriate VT as specified in Section 110.6(a)4, meets the requirements of this Subsection B.
- C. Temporary labels shall also certify that the manufactured fenestration product complies with the air leakage requirements of Section 110.6(a)1 of the Standards.

- 2. **Permanent labels.** ~~NFRC-Rated~~ products shall have a permanent label consistent with their rating and certification that is either a stand-alone label, an extension or tab of an existing permanent certification label being used by the manufacturer/responsible party, or series of marks or etchings on the product. The permanent label, coupled with observable product characteristics, ~~can shall be used-usable~~ to trace the product to certification information on file with the supervisory entity or to a directory of certified products, published by the supervisory entity. For CMA and site-built fenestration products, a label certificate approved by the supervisory entity meets the requirements of this section.

**EXCEPTION to Section 10-111(a):** Field-fabricated fenestration products.

### (b) Certification Requirements.

- 1. **Certification to default ratings.** The manufacturer shall certify on the Default Label that the product's U-factor, SHGC and VT meets the default criteria in Sections 110.6(a)2, 110.6(a)3 and 110.6(a)4; and
  - A. A temporary label, affixed to the product, that meets the requirements of Section 10-111(a)1B meets this requirement.
  - B. If the product claims the default U-factor for a thermal-break product, the manufacturer shall also certify on the label that the product meets the thermal-break product criteria, specified on the default table, on which the default value is based. Placing the terms "Meets Thermal-Break Default Criteria" on the default temporary label or default label certificate meets this requirement.

2. **Certification to NFRC rating procedure.** If a product's U-factor, SHGC or VT is based on the NFRC Rating Procedure, the U-factor, SHGC or VT shall be certified by the manufacturer according to the procedures of an independent certifying organization approved by the Commission.
  - A. A temporary label, affixed to the product or label certificate for CMA and site-built fenestration, meeting the requirements of Section 10-111(a) certified by the independent certifying organization complies with this requirement.
  - B. An "independent certifying organization approved by the Commission" means any organization authorized by the supervisory entity to certify U-factor ratings, Solar Heat Gain Coefficient and Visible Transmittance ratings in accordance with the NFRC Rating Procedure. If the Commission designates the NFRC as the supervisory entity, any independent certification and inspection agency (IA) licensed by NFRC shall be deemed to be an "independent certifying organization approved by the Commission."
  - C. The "supervisory entity" means the ~~National Fenestration Rating Council (NFRC)~~, except as provided in Section 10-111(c)1.

**EXCEPTION to Section 10-111(b):** Field-fabricated fenestration products.

- (c) **Designation of Supervisory Entity.** ~~The National Fenestration Rating Council~~ NFRC shall be the supervisory entity to administer the certification program relating to U-factors, SHGC, and VT ratings for fenestration products, provided the Commission determines that the NFRC meets the criteria in Section 10-111(d).
  1. The Commission may consider designating a supervisory entity other than NFRC only if the Commission determines that the NFRC cannot meet the criteria in Section 10-111(d). Such other supervisory entity shall meet the criteria in Section 10-111(d) prior to being designated.
  2. The Commission shall periodically review, at least annually, the structure and operations of the supervisory entity to ensure continuing compliance with the criteria in Section 10-111(d).
- (d) **Criteria for Supervisory Entity.**
  1. Membership in the entity shall be open on a nondiscriminatory basis to any person or organization that has an interest in uniform thermal performance ratings for fenestration products, including, but not limited to, members of the fenestration industry, glazing infill industry, building industry, design professionals, specifiers, utilities, government agencies, and public interest organizations. The membership shall be composed of a broad cross section of those interested in uniform thermal performance ratings for fenestration products.
  2. The governing body of the entity shall reflect a reasonable cross-section of the interests represented by the membership.
  3. The entity shall maintain a program of oversight of product manufacturers, laboratories, and independent certifying organizations that ensures uniform application of the NFRC Rating Procedures, labeling and certification, and such other rating procedures for other factors affecting energy performance as the NFRC and the Commission may adopt.
  4. The entity shall require manufacturers and independent certifying organizations within its program to use laboratories accredited by the supervisory entity to perform simulations and tests under the NFRC Rating Procedure or by an NFRC Approved Calculation Entity (ACE) under the Component Modeling Approach (CMA)- Product Certification Program(PCP).
  5. The entity shall maintain appropriate guidelines for testing and simulation laboratories, manufacturers, and certifying agencies, including requirements for adequate:
    - A. Possession and calibration of equipment;
    - B. Education, competence, and training of personnel;
    - C. Quality control;
    - D. Record keeping and reporting;
    - E. Periodic review (including, but not limited to, blind testing by laboratories; inspections of products; and inspections of laboratories, manufacturing facilities, and certifying agencies);
    - F. Challenges to certified ratings; and

- G. Guidelines to maintain the integrity of the program, including, but not limited to, provisions to avoid conflicts of interest within the rating and certification process.
6. The entity shall be a nonprofit organization and shall maintain reasonable, nondiscriminatory fee schedules for the services it provides and shall make its fee schedules, the financial information on which fees are based, and financial statements available to its members for inspection.
  7. The entity shall provide hearing processes that give laboratories, manufacturers, and certifying agencies a fair review of decisions that adversely affect them.
  8. The entity shall maintain a certification policy committee whose procedures are designed to avoid conflicts of interest in deciding appeals, resolving disputes, and setting policy for the certifying organizations within its program.
  9. The entity shall publish at least annually a directory of products certified and decertified within its program.
  10. The entity itself shall be free from conflict-of-interest ties or to undue influence from any particular fenestration manufacturing interest(s), testing or simulation lab(s), or independent certifying organization(s).
  11. The entity shall provide or authorize the use of labels and label certificates for Component Modeling Approach and site-built fenestration products that can be used to meet the requirements of Sections 110.6(a)2, 110.6(a)3 and 110.6(a)4, and this section.
  12. The entity's certification program shall allow for multiple participants in each aspect of the program to provide for competition between manufacturers, testing labs, simulation labs, and independent certifying organizations.
- (e) **Certification for Other Factors.** Nothing in this section shall preclude any entity, whether associated with a U-factor, SHGC ~~and~~ or VT certification program or not, from providing certification services relating to factors other than U-factors, SHGCs and VTs for fenestration products.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.



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**10-112 – CRITERIA FOR DEFAULT TABLES**

- (a) The Commission shall maintain tables of default U-factors and SHGCs for use as an alternative to U-factors and SHGCs derived based on the NFRC Rating Procedure. The default values shall meet the following criteria:
1. The values shall be derived from simulations of products using the same computer simulation program(s) used in the NFRC Rating Procedure.
  2. The default values shall be set so that they do not provide to any significant number of products a lower U-factor or SHGC than those products would obtain if they were rated using the full NFRC Rating Procedure.
- (b) The Commission shall periodically review and revise the default tables as necessary to ensure that the criteria are met.

**NOTE:** Authority : Section 25402.1, Public Resources Code.

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## 10-113 – CERTIFICATION AND LABELING OF ROOFING PRODUCT REFLECTANCE AND EMITTANCE

This section establishes rules for implementing labeling and certification requirements relating to reflectance and emittance for roofing products for showing compliance with Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H, and 150.2(b)2 of Title 24, California Code of Regulations, Part 6. This section also provides for designation of the Cool Roof Rating Council (CRRC) as the supervisory entity responsible for administering the state's certification program for roofing products, provided CRRC meets specified criteria.

### (a) Labeling Requirements.

Every roofing product installed in construction to take compliance credit or meet the prescriptive requirements for reflectance and emittance under Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H or 150.2(b)2 shall have a clearly visible packaging label that lists the emittance and the initial and 3-year aged solar reflectance, or a CRRC approved accelerated aged solar reflectance, tested in accordance with CRRC-1.

Packaging for liquid-applied roof coatings shall state the product meets the requirements specified in Section 110.8(i)4.

### (b) Certification Requirements.

Every roofing product installed in construction to take compliance credit or meet the prescriptive requirements for reflectance and emittance under Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H or 150.2(b)2 shall be certified by CRRC or another supervisory entity approved by the Commission pursuant to Section 10-113(c).

### (c) Designation of Supervisory Entity. The Cool Roof Rating Council CRRC shall be the supervisory entity to administer the certification program relating to reflectance and emittance ratings for roofing products, provided the Commission determines that the CRRC meets the criteria in Section 10-113(d).

1. The Commission may consider designating a supervisory entity other than CRRC if the Commission determines that the CRRC is not meeting the criteria in Section 10-113(d). Such other supervisory entity shall meet the criteria in Section 10-113(d) prior to being designated.
2. The Commission shall periodically review, at least annually, the structure and operations of the supervisory entity to ensure continuing compliance with the criteria in Section 10-113(d). The supervisory entity shall provide an annual report to the Commission explaining all of the measures it has taken to comply with the criteria in Section 10-113(d).

### (d) Criteria for Supervisory Entity.

1. Membership in the entity shall be open on a nondiscriminatory basis to any person or organization that has an interest in uniform performance ratings for roofing products, including, but not limited to, members of the roofing industry, building industry, design professionals, specifiers, utilities, government agencies, and public interest organizations. The membership shall be composed of a broad cross section of those interested in uniform thermal performance ratings for roofing products.
2. The governing body of the entity shall reflect a reasonable cross-section of the interests represented by the membership.
3. The entity shall maintain a program of oversight of product manufacturers, laboratories, and independent certifying organizations that ensures uniform application of the CRRC testing and rating procedures, labeling and certification, and such other rating procedures for other factors that improves the accuracy of properties of roofing products affecting energy performance as the CRRC and the Commission may adopt.
4. The entity shall require manufacturers and independent certifying organizations within its program to use only laboratories accredited by the supervisory entity to perform tests under the CRRC rating procedure.
5. The entity shall maintain appropriate guidelines for testing laboratories and manufacturers, including requirements for adequate:
  - A. Possession and calibration of equipment; and

- B. Education, competence, and training of personnel; and
  - C. Quality control; and
  - D. Record keeping and reporting; and
  - E. Periodic review (including but not limited to, blind testing by laboratories; inspections of products; inspections of laboratories, and manufacturing facilities); and
  - F. Challenges to certified ratings; and
  - G. Guidelines to maintain the integrity of the program, including, but not limited to, provisions to avoid conflicts of interest within the rating and certification process.
6. The entity shall be a nonprofit organization and shall maintain reasonable, nondiscriminatory fee schedules for the services it provides, and shall make its fee schedules, the financial information on which fees are based, and financial statements available to its members for inspection.
  7. The entity shall provide hearing processes that give laboratories, manufacturers and certifying agencies a fair review of decisions that adversely affect them.
  8. The entity shall maintain a certification policy committee, whose procedures are designed to avoid conflicts of interest in deciding appeals, resolving disputes and setting policy for the certifying organizations in its program.
  9. The entity shall publish at least annually a directory of products certified and decertified within its program.
  10. The entity itself shall be free from conflict-of-interest ties or to undue influence from any particular roofing product manufacturing interest(s), testing or independent certifying organization(s).
  11. The entity shall provide or authorize the use of labels that can be used to meet the requirements for showing compliance with the requirements of Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H and 150.2(b)2, and this section.
  12. The entity's certification program shall allow for multiple participants in each aspect of the program to provide for competition between manufacturers and between testing labs.

**NOTE:** Authority: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

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## 10-114 – DETERMINATION OF OUTDOOR LIGHTING ZONES AND ADMINISTRATIVE RULES FOR USE

This section establishes rules for implementing outdoor lighting zones to show compliance with Section 140.7 of Title 24, California Code of Regulations, Part 6.

- (a) **Lighting Zones.** Exterior lighting allowances in California vary by Lighting Zones (LZ).
- (b) **Lighting Zone Characteristics.** TABLE 10-114-A specifies the relative ambient illumination level and the statewide default location for each lighting zone.
- (c) **Amending the Lighting Zone Designation.** A local jurisdiction may officially adopt changes to the lighting zone designation of an area by following a public process that allows for formal public notification, review, and comment about the proposed change. The local jurisdiction may determine areas where Lighting Zone 4 is applicable and may increase or decrease the lighting zones for areas that are in State Default Lighting Zones 1, 2 and 3, as specified in TABLE 10-114-A.
- (d) **Commission Notification, Amended Outdoor Lighting Zone Designation.** Local jurisdictions who adopt changes to the State Default Lighting Zones shall notify the Commission by providing the following materials to the Executive Director:
  - 1. A detailed specification of the boundaries of the adopted Lighting Zones, consisting of the county name, the city name if any, the zip code(s) of the re designated areas, and a description of the physical boundaries within each zip code;
  - 2. A description of the public process that was conducted in adopting the Lighting Zone changes; ~~and~~
  - 3. An explanation of how the adopted Lighting Zone changes are consistent with the specifications of Section 10-114.
- (e) The Commission shall have the authority to not allow Lighting Zone changes which the Commission finds to be inconsistent with the specifications of Section 10-114.

TABLE 10-114-A LIGHTING ZONE CHARACTERISTICS AND RULES FOR AMENDMENTS BY LOCAL JURISDICTIONS

Zone	Ambient Illumination	State wide Default Location	Moving Up to Higher Zones	Moving Down to Lower Zones
LZ0	Very Low	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves.	Undeveloped areas of government designated parks, recreation areas, and wildlife preserves can be designated as LZ1 or LZ2 if they are contained within such a zone.	Not applicable
LZ1	DarkLow	Developed portion of Government designated parks, recreation areas, and wildlife preserves. Those that are wholly contained within a higher lighting zone may be considered by the local government as part of that lighting zone.	A Developed portion of a government designated park, recreation area, or wildlife preserve, or portions thereof, can be designated as LZ2 or LZ3 if they are contained within such a zone.	Not applicable.
LZ2	LowModerate	Rural areas, as defined by the 2010 U.S. Census.	Special districts within a default LZ2 zone may be designated as LZ3 or LZ4 by a local jurisdiction. Examples include special commercial districts or areas with special security considerations located within a rural area.	Special districts and government designated parks within a default LZ2 zone may be designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits.
LZ3	MediumModerately High	Urban areas, as defined by the 2010 U.S. Census.	Special districts within a default LZ3 may be designated as a LZ4 by local jurisdiction for high intensity nighttime use, such as entertainment or commercial districts or areas with special security considerations requiring very high light levels.	Special districts and government designated parks within a default LZ3 zone may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits.
LZ4	High	None.	Not applicable.	Not applicable.

**EFFICIENCY STANDARDS  
CALIFORNIA CODE OF REGULATIONS  
TITLE 24, PART 6**

## SUBCHAPTER 1

# ALL OCCUPANCIES—GENERAL PROVISIONS

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### SECTION 100.0 – SCOPE

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

1. That are of Occupancy Group A, B, E, F, H, M, R, S, or U; and
2. For which an application for a building permit or renewal of an existing permit is filed (or is required by law to be filed) on or after the effective date of the provisions, or which are constructed by a governmental agency; and
3. That are:
  - A. Unconditioned; or
  - B. Indirectly or directly conditioned, by mechanical heating or mechanical cooling, or process spaces; or
  - C. Low-rise residential buildings that are heated with a non-mechanical heating system.

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

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

(b) **Parts of Buildings Regulated.** The provisions of Part 6 apply to the building envelope, space-conditioning systems, water-heating systems, pool and spas, solar ready buildings, indoor lighting systems of buildings, outdoor lighting systems, 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 110.10 apply to all buildings.

**EXCEPTION to Section 100.0(e)1:** Spaces or requirements not listed in TABLE 100.0-A.

2. **Newly constructed buildings.**

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

- B. Nonresidential, high-rise residential, and hotel/motel buildings** that are mechanically heated or mechanically cooled.
- Sections applicable. Sections 120.0 through 140.8 apply to newly constructed nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled.
  - Compliance approaches. In order to comply with Part 6 newly constructed nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled must meet the requirements of:
    - Mandatory measures: The applicable provisions of Sections 120.0 through 130.5; and
    - Either:
      - Performance approach: Section 140.1; or
      - Prescriptive approach: Sections 140.2 through 140.8.
- 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), 140.1, and 141.0~~ for process spaces within the scope of Section 100.0(a).
- D. Low-rise residential buildings.**
- Sections applicable. Sections 150.0 through 150.1 apply to newly constructed low-rise residential buildings.
  - Compliance approaches. In order to comply with Part 6 newly constructed low-rise residential buildings must meet the requirements of:
    - Mandatory measures: The applicable provisions of Sections 110.0 through 110.10, and 150.0; and
    - Either:
      - Performance approach: Section 150.1(a) and (b); or
      - Prescriptive approach: Section 150.1(a) and (c).
- EXCEPTION 1 to Section 100.0(e)2Diib:** Seasonally occupied agricultural housing limited by state or federal agency contract to occupancy not more than 180 days in any calendar year.
- EXCEPTION 2 to Section 100.0(e)2Diib:** Low-rise residential buildings that are heated with a wood heater or another nonmechanical heating system and that use no energy obtained from depletable sources for lighting or water heating.
- E. Covered Processes.**
- Sections applicable. Sections 110.2, 120.6 and 140.9 apply to covered processes.
  - Compliance approaches. In order to comply with Part 6 covered processes must meet the requirements of:
    - The applicable mandatory measures in Section 120.6; and
    - Either:
      - The Performance approach requirements of Section 140.1; or
      - 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, high-rise residential, and hotel/motel buildings.** Section 141.0 applies to new construction in existing nonresidential, high-rise residential, and hotel/motel buildings that will be



nonresidential, high-rise residential, and hotel/motel occupancies. 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. Low-rise residential buildings.** Section 150.2 applies to new construction in existing low-rise residential buildings that will be low-rise residential occupancies. 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 specify 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.

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 or 150.0(k) are met for each occupancy and space and mandatory measures in Sections 110.0 through 130.5, and 150.0 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 the following manufactured equipment, products, and devices to those that have been certified according to that as specified by Sections 110.0 and 110.1, to:
1. ~~For items listed below that are regulated by Title 20, limited to those that have been certified to the Energy Commission by their manufacturer, pursuant to the provisions of Title 20 California Code of Regulations, Section 1606, to meet or exceed minimum specifications or efficiencies adopted by the Commission; or~~
  2. ~~For items listed below that are required to be certified to the Energy Commission and are not regulated by Title 20, limited to those certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable provisions of Part 6; and if applicable that the equipment, product, or device was tested under the applicable test method specified in Part 6; or~~
  3. ~~For items listed below that are required to be listed in directories or certified by someone other than the Energy Commission, limited to those that comply with the applicable provisions of Item 4, below.~~
    - A. ~~Central air conditioning heat pumps and other central air conditioners (Sections 110.1 and 110.2).~~
    - B. ~~Combination equipment: space heating and cooling, or space heating and water heating (Section 110.2(a)3).~~
    - C. ~~Fenestration products (Section 110.6).~~

- ~~D. Fluorescent lamp ballasts (Section 110.1).~~
  - ~~E. Gas space heaters (Sections 110.1 and 110.2).~~
  - ~~F. Insulating materials and roofing products (Section 110.8).~~
  - ~~G. Lighting control devices and lighting control systems (Section 110.9).~~
  - ~~H. Oil fired storage water heaters (Section 110.3).~~
  - ~~I. Other heating and cooling equipment (Sections 110.1 and 110.2).~~
  - ~~J. Plumbing fittings (Section 110.1).~~
  - ~~K. Pool heaters (Section 110.4).~~
  - ~~L. Refrigerators, refrigerator freezers, and freezers (Section 110.1).~~
  - ~~M. Room air conditioners (Section 110.1).~~
  - ~~N. Slab floor perimeter insulation (Section 150.0 (I)).~~
  - ~~O. Water heaters (Section 110.3).~~
  - ~~P. Track lighting integral current limiter (Section 110.9).~~
  - ~~Q. High efficacy LED light sources (Section 110.9).~~
  - ~~R. Ballasts for residential recessed luminaires (Section 110.9).~~
- ~~4. The certification status of any such manufactured device shall be confirmed only by reference to:~~
- ~~A. A directory published or approved by the Commission; or~~
  - ~~B. A copy of the application for certification from the manufacturer and the letter of acceptance from the Commission staff; or~~
  - ~~C. Written confirmation from the publisher of a Commission approved directory that a device has been certified; or~~
  - ~~D. A Commission approved label on the device.~~
- ~~5. NOTE: Part 6 does not require a builder, designer, owner, operator, or enforcing agency to test any certified device to determine its compliance with minimum specifications or efficiencies adopted by the Commission.~~

TABLE 100.0-A APPLICATION OF STANDARDS

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
General Provisions for All Buildings		100.0, 100.1, 100.2, 110.0, 110.10			
Nonresidential, High-Rise Residential, And Hotels/Motels	General	<del>140.0</del> 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, <del>120.0-120.1</del> , 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	N.A.	N.A. 141.0
	Indoor Lighting (unconditioned and parking garages)	110.9, 120.8, 130.0, 130.1, 130.4	140.3(c), 140.6		
	Outdoor Lighting	110.9, 130.0, 130.2, 130.4	140.7		
	Building Electrical Power Distribution	<del>110.11</del> , 130.5	N.A.		
	Pool and Spa Systems	110.4, <del>110.5</del> , 150.0(p)	N. A.		
	Solar Ready Buildings	110.10	N.A.		N.A. 141.0(a)
Covered Processes <sup>1</sup>	Envelope, Ventilation, Process Loads	110.2, 120.6, <del>120.8</del>	140.9	140.1	120.6, 140.9
Signs	Indoor and Outdoor	130.0, 130.3	140.8	N.A.	141.0, <del>141.0(b)2H</del>
Low-Rise Residential	General	150.0	150.1(a, c)	150.1(a, <del>b</del> ) 150.1(a), 150.1(b)	150.2(a), 150.2(b)
	Envelope (conditioned)	110.6, 110.7, 110.8, <del>150.0(a-e, g)</del> 150.0(a), 150.0(b), 150.0(c), 150.0(d), 150.0(e), 150.0(g)			
	HVAC (conditioned)	110.2, 110.5, <del>150.0(h, i, m)</del> 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.	<del>150.2(a), 150.2(b)</del> N.A.
	Solar Ready Buildings	110.10	N. A.	N.A.	N.A.

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

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## 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 52, Chapter 2 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.

**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 – 2006).

**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.

**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.

**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-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 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-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.

**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.

**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.

**ALTERED COMPONENT** is a component that has undergone an alteration and is subject to all applicable Standards requirements.

**ALTERNATIVE CALCULATION METHODS (ACM)** are compliance softwares, 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.

**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 C82.6-2005** is the American National Standards Institute document titled "Ballasts for High-Intensity Discharge Lamps – Methods of Measurement." (ANSI C82.6-2005)

**ANSI/IES RP-16-10** is the document coauthored by the American National Standards Institute and the Illuminating Engineering Society of North America, Recommended Practice titled "Nomenclature and Definitions for Illuminating Engineering" (ANSI/IES RP-16-2010)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**ASHRAE** is the American Society of Heating, Refrigerating, and Air-conditioning Engineers.

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

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

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

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

**ASHRAE STANDARD 52.2** is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document titled "Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size," 2007-2012 (ANSI/ASHRAE Standard 52.2-2012~~2007 including ANSI/ASHRAE Addendum b to ANSI/ASHRAE Standard 52.2-2007~~).

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

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

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

**ASME** is the American Society of Mechanical Engineers.

**ASME A17.1/CSA B44** is the American Society of Mechanical Engineers document titled "Handbook on Safety Code for Elevators and Escalators" 2013 (ASME Standard A17.1/CSAB44-2013).

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

**ASTM** is the American Society for Testing and Materials International.

**ASTM C55** is the American Society for Testing and Materials document titled "Standard Specification for Concrete Brick," 2014 (ASTM C55-14).

**ASTM C177** is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus," 2013 (ASTM C177-13).

**ASTM C272** is the American Society for Testing and Materials document titled "Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions," 2012 (ASTM C272-12).

**ASTM C335** is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation," 2010 (ASTM C335-10).

**ASTM C518** is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," 2010 (ASTM C518-10).

**ASTM C731** is the American Society for Testing and Materials document titled "Standard Test Method for Extrudability, After Package Aging of Latex Sealants," 2010 (ASTM C731-10).

**ASTM C732** is the American Society for Testing and Materials document titled "Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants," 2006/2012 (ASTM C732-06 (2012)).

**ASTM C836** is the American Society of Testing and Materials document titled, "Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course," 2012 (ASTM C836/C836M-12).

**ASTM C1167** is the American Society for Testing and Materials document titled "Standard Specification for Clay Roof Tiles," 2011 (ASTM C1167-11).

**ASTM C1371** is the American Society for Testing and Materials document titled "Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers," 2010 (ASTM C1371- 04a(2010)).

**ASTM C1492** is the American Society for Testing and Materials document entitled "Standard Specification for Concrete Roof Tile," 2009 (ASTM C1492-03(2009)).

**ASTM C1549** is the American Society for Testing and Materials document entitled, "Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer," 2014 (ASTM C1549- 09 (2014)).

**ASTM C1583** is the American Society of Testing and Materials document titled, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)," 2013 (ASTM C1583/c1583M-13).

**ASTM D448** is the American Society for Testing and Materials document titled, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction," 2012 (ASTM D448-12).

**ASTM D522** is the American Society of Testing and Materials document titled, "Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings," 2013 (ASTM D522/D522M-13).

**ASTM D822** is the American Society of Testing and Materials document titled, "Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings," 2013 (ASTM D822/D822M-13).

ASTM D1003 is the American Society for Testing and Materials document titled "Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics," 2013 (ANSI/ASTM D1003-13).

ASTM D1653 is the American Society of Testing and Materials document titled, "Standard Test Methods for Water Vapor Transmission of Organic Coating Films," 2013 (ASTM D1653-13).

ASTM D1863 is the American Society for Testing and Materials document titled, "Standard Specification for Mineral Aggregate Used on Built-Up Roofs," 2011 (ASTM D1863/D1863M-05 (2011)).

ASTM D2370 is the American Society of Testing and Materials document titled, "Standard Test Method for Tensile Properties of Organic Coatings," 2010 ASTM D2370-98 (2010).

ASTM D2824 is the American Society of Testing and Materials document titled "Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos," 2013 (ASTM D2824/D2824M-13).

ASTM D3468 is the American Society of Testing and Materials document titled, "Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing," 2013 (ASTM D3468/D3468M-99 (2013)).

ASTM D3805 is the American Society of Testing and Materials document titled "Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings," 1997 (ASTM D3805/D3805M-97 (2009)).

ASTM D4798 is the American Society for Testing and Materials document titled "Standard Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)," 2011 (ASTM D4798/D4798M-11).

ASTM D5870 is the American Society of Testing and Materials document titled, "Standard Practice for Calculating Property Retention Index of Plastics," 2011 (ASTM D5870-11).

ASTM D6083 is the American Society of Testing and Materials document titled, "Standard Specification for Liquid Applied Acrylic Coating Used in Roofing," 2005 (ASTM D6083-05e1).

ASTM D6694 is the American Society of Testing and Materials document titled, "Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing," 2013 (ASTM D6694/D6694M-08 (2013)).

ASTM D6848 is the American Society of Testing and Materials document titled "Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing," 2002 (ASTM D6848-02).

ASTM E96 is the American Society for Testing and Materials document titled "Standard Test Methods for Water Vapor Transmission of Materials," 2014 (ASTM E96/E96M-14).

ASTM E283 is the American Society for Testing and Materials document titled "Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen," 2012 (ASTM E283-04(2012)).

ASTM E408 is the American Society for Testing and Materials document titled, "Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques," 2013 (ASTM E408-13).

ASTM E779 is the American Society for Testing and Materials document titled, "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization," 2010 (ASTM E779-10).

ASTM E972 is the American Society for Testing and Materials document titled, "Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight," 1996 (ASTM E972-96(2013)).

ASTM E1677 is the American Society for Testing and Materials document titled, "Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls," 2011 (ASTM E1677-11).

ASTM E1918 is the American Society for Testing and Materials document entitled, "Standard Test Method for Measuring Solar reflectance of Horizontal and Low-Sloped Surfaces in the Field," 2015 (ASTM E1918-06(2015)).

ASTM E1980 is the American Society for Testing and Materials document titled, "Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surface," 2011 (ASTM E1980-11).

ASTM E2178 is the American Society for Testing and Materials document titled, "Standard Test Method for Air Permeance of Building Materials," 2013 (ASTM E2178-13).



~~ASTM E2357 is the American Society for Testing and Materials document titled, "Standard Test Method for determining air leakage of air barrier assemblies" 2011 (ASTM E2357-11).~~

~~ASTM C55 is the American Society for Testing and Materials document titled "Standard Specification for Concrete Brick," 2001 2014 (ASTM C55-1401).~~

~~ASTM C177 is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus," 1997 (ASTM C177-97).~~

~~ASTM C272 is the American Society for Testing and Materials document titled "Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions," 2001 (ASTM C272-0112).~~

~~ASTM C335 is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation," 1995 2010 (ASTM C335-1095).~~

~~ASTM C518 is the American Society for Testing and Materials document titled "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," 2002 (ASTM C518-0210).~~

~~ASTM C731 is the American Society for Testing and Materials document titled "Standard Test Method for Extrudability, After Package Aging of Latex Sealants," 2000 2010 (ASTM C731-0010).~~

~~ASTM C732 is the American Society for Testing and Materials document titled "Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants," 2001 (ASTM C732-0112).~~

~~ASTM C836 is the American Society of Testing and Materials document titled, "Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course," 2005 (ASTM C836-0512).~~

~~ASTM C1167 is the American Society for Testing and Materials document titled "Standard Specification for Clay Roof Tiles," 2011 (ASTM C1167-11).~~

~~ASTM C1371 is the American Society for Testing and Materials document titled "Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers," 2010 1998 (ASTM C1371-1098).~~

~~ASTM C1492 is the American Society for Testing and Materials document titled "Standard Specification for Concrete Roof Tile" 2009 (ASTM C1492-03(2009)).~~

~~ASTM C1583 is the American Society of Testing and Materials document titled, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension" (Pull-off Method)," 2004 2013 (ASTM C1583-0413).~~

~~ASTM C1549 is the American Society for Testing and Materials document titled, "Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer," 2004 2014 (ASTM C1549-104).~~

~~ASTM D448 is the American Society for Testing and Materials document titled, "Standard Classification for Sizes of Aggregate for Road and Bridge Construction," 2008 2012 (ASTM D448-0812).~~

~~ASTM D522 is the American Society of Testing and Materials document titled, "Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings," 2001 [ASTM D522-93a (2001)].~~

~~ASTM D822 is the American Society of Testing and Materials document titled, "Standard Practice for Filtered Open Flame Carbon-Arc Exposures of Paint and Related Coatings," 2001 2012 (ASTM D822-0112).~~

~~ASTM D1003 is the American Society for Testing and Materials document titled "Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics," 2000 2013 (ANSI/ASTM D1003-1200).~~

~~ASTM D1653 is the American Society of Testing and Materials document titled, "Standard Test Methods for Water Vapor Transmission of Organic Coating Films," 2013 03 (ASTM D1653-0313).~~

~~ASTM D1863 is the American Society for Testing and Materials document titled, "Standard Specification for Mineral Aggregate Used on Built-Up Roofs," 2003 2005 (ASTM D1863-053 (2011)).~~

~~ASTM D2370 is the American Society of Testing and Materials document titled, "Standard Test Method for Tensile Properties of Organic Coatings," 2002 2010 [ASTM D2370-98 (20022010)].~~

~~ASTM D2824 is the American Society of Testing and Materials document titled "Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos-Fibered, and Fibered without Asbestos," 2002 (ASTM D2824-0212).~~

~~ASTM D3468 is the American Society of Testing and Materials document titled, "Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing," 1999 2013 (ASTM D3468-1399).~~

~~ASTM D3805 is the American Society of Testing and Materials document titled "Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings," 1997 (ASTM D3805-97 (reapproved 20032009)).~~

~~ASTM D4798 is the American Society of Testing and Materials document titled "Standard Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)," 2001 2011 (ASTM D4798-0111).~~

~~ASTM D5870 is the American Society of Testing and Materials document titled, "Standard Practice for Calculating Property Retention Index of Plastics," 2003 2011 [ASTM D5870-95-11 (20032011)].~~

~~ASTM D6083 is the American Society of Testing and Materials document titled, "Standard Specification for Liquid-Applied Acrylic Coating Used in Roofing," 2005 (ASTM D6083-0501).~~

~~ASTM D6694 is the American Society of Testing and Materials document titled, "Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing," 200112 (ASTM D6694-1301).~~

~~ASTM D6848 is the American Society of Testing and Materials document titled "Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing," 2002 (ASTM D6848-02).~~

~~ASTM E96 is the American Society of Testing and Materials document titled "Standard Test Methods for Water Vapor Transmission of Materials," 200 (ASTM E96-0014).~~

~~ASTM E283 is the American Society of Testing and Materials document titled "Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen," 1991 2004 (ASTM E283-0491 (20121999)).~~

~~ASTM E408 is the American Society of Testing and Materials document titled, "Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection Meter Techniques," 1971 2013 (ASTM E408-1371 (201302)).~~

~~ASTM E779 is the American Society of Testing and Materials document titled, "Standard Test Method for Determining Air Leakage Rate by Fan Pressurization," 2010 (ASTM E779-10).~~

~~ASTM E972 is the American Society of Testing and Materials document titled, "Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight," 1996 (ASTM E972-96 (20072013)).~~

~~ASTM E1677 is the American Society of Testing and Materials document titled, "Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls," 2011 (ASTM E1677-11).~~

~~ASTM E1918 is the American Society of Testing and Materials document titled, "Standard Test Method for Measuring Solar reflectance of Horizontal and Low-Sloped Surfaces in the Field," 201506 (ASTM E972-06).~~

~~ASTM E1980 is the American Society of Testing and Materials document titled, "Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surface," 2011 (ASTM E1980-11).~~

~~ASTM E2178-03 is the American Society of Testing and Materials document titled, "Standard Test Method for Air Permeance of Building Materials," 2013 (ASTM E2178-13).~~

ASTM E2357-05 is the American Society of Testing and Materials document titled, "Standard Test Method for determining air leakage of air barrier assemblies" 2011 (ASTM E2357-11).

ATTIC is an enclosed space directly below the roof deck and above the ceiling beams.

AUTOMATIC is capable of operating without human intervention.

AUTOMATED TELLER MACHINE (ATM) is any electronic information processing device which accepts or dispenses currency in connection with a credit, deposit, or convenience account without involvement by a clerk.

**BACK-UP COMPRESSORS** are those compressors not used to meet peak compressed air loads. Back-up compressors are physically connected to the compressed air piping system and can be automatically controlled to turn on if one of the online compressors fails. Back-up compressors do not normally operate.

**BELOW-GRADE WALL** is the portion of a wall, enclosing conditioned space that is below the grade line.

**BUBBLE POINT** is the liquid saturation temperature of a refrigerant at a specified pressure.

**BUILDING** is any structure or space covered by Section 100.0 of the Building Energy Efficiency Standards.

**BUILDING COMMISSIONING** is a systematic quality assurance process that spans the entire design and construction process, including verifying and documenting that building systems and components are planned, designed, installed, tested, operated and maintained to meet the owner's project requirements.

**BUILDING ENVELOPE** is the ensemble of exterior and demising partitions of a building that enclose conditioned space.

**CALL CENTER** is a phone center that handles large number of phone calls including but not limited to help desk, customer and sales support, technical support, emergency response, telephone answering service, and inbound and outbound telemarketing.

**CENTRAL FAN-INTEGRATED VENTILATION SYSTEM** is a central forced air heating and/or cooling system which is intended to operate on a regular basis to bring in outdoor ventilation air and/or distribute air around the home for comfort and ventilation even when heating and cooling are not needed.

**CERTIFIED TO THE ENERGY COMMISSION** means, when used in association with appliances, certified under Section 1606 of Title 20 of the California Code of Regulations; and otherwise means certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable provisions of Part 6; and if applicable that the equipment, product, or device was tested under the applicable test method specified in Part 6.

**CERTIFYING ORGANIZATION** is an independent organization recognized by the Commission to certify manufactured devices for performance values in accordance with procedures adopted by the Commission.

**CIE 13.3** is the International Commission on Illumination (Commission Internationale de l'Eclairage) document titled "Method of Measuring and Specifying Colour Rendering Properties of Light Sources," 1995 (CIE 13.3-1995).

**CIE 15** is the International Commission on Illumination (Commission Internationale de l'Eclairage) document titled "Technical Report: Colorimetry," 2004 (CIE 15:2004).

**CLIMATE ZONES** are the 16 geographic areas of California for which the Commission has established typical weather data, prescriptive packages and energy budgets. Climate zones are defined by ZIP code and listed in Reference Joint Appendix JA2 FIGURE 100.1-A is an approximate map of the 16 Climate Zones.

**CLOSED-CIRCUIT COOLING TOWER** is a cooling tower that utilizes indirect contact between a heated fluid, typically water or glycol, and the cooling atmosphere to transfer the source heat load through sensible heat, latent heat, and mass transfer indirectly to the air, essentially combining a heat exchanger and cooling tower into an integrated and relatively compact device.

**CODES, CALIFORNIA HISTORICAL BUILDING CODE** is the California Historical Building Code, California Code of Regulations, Title 24, Part 8 and Part 2 (Chapter 34).

**CODES, CBC** is the 2010 California Building Code.

**CODES, CEC** is the 2010 California Electric Code.

**CODES, CMC** is the 2010 California Mechanical Code.

**CODES, CPC** is the 2010 California Plumbing Code.

**COEFFICIENT OF PERFORMANCE (COP), COOLING**, is the ratio of the rate of net heat removal to the rate of total energy input, calculated under designated operating conditions and expressed in consistent units, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

**COEFFICIENT OF PERFORMANCE (COP), HEATING**, is the ratio of the rate of net heat output to the rate of total energy input, calculated under designated operating conditions and expressed in consistent units, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

**COEFFICIENT OF PERFORMANCE (COP), HEAT PUMP** is the ratio of the rate of useful heat output delivered by the complete heat pump unit (exclusive of supplementary heating) to the corresponding rate of energy input, in consistent units and as determined using the applicable test method in Appliance Efficiency Regulations or Section 110.2.

**COMBUSTION AIR POSITIVE SHUT-OFF** is a means of restricting air flow through a boiler combustion chamber during standby periods, used to reduce standby heat loss. A flue damper and a vent damper are two examples of combustion air positive shut-off devices.

**COMBUSTION EFFICIENCY** is a measure of the percentage of heat from the combustion of gas or oil that is transferred to the medium being heated or lost as jacket loss.

**COMMERCIAL BOILER** is a type of boiler with a capacity (rated maximum input) of 300,000 Btus per hour (Btu/h) or more and serving a space heating or water heating load in a commercial building.

**COMMISSION** is the California State Energy Resources Conservation and Development Commission.

**COMPLEX MECHANICAL SYSTEMS**: are systems that include 1) fan systems each serving multiple thermostatically controlled zones; or 2) built-up air handler systems (non-unitary or non-packaged HVAC equipment); or 3) hydronic or steam heating systems; or 4) hydronic cooling systems. Complex systems are NOT the following: (a) unitary or packaged equipment listed in Tables 110.2-A, 110.2-B, 110.2-C, and 110.2-E that each serve one zone, or (b) two-pipe, heating only systems serving one or more zones.

**COMPLIANCE SOFTWARE** is software that has been approved pursuant to Section 10-109 of Part 1 of Title 24 of the California Code of Regulations, to demonstrate compliance with the performance approach of Part 6.

**COMPRESSED AIR SYSTEM** is a system of at least one compressor providing compressed air at 40 psig or higher.

**COMPUTER ROOM** is a room within a building whose primary function is to house electronic equipment and that has a design equipment power density exceeding 20 watts/ft<sup>2</sup> (215 watts/m<sup>2</sup>) of conditioned floor area.

**CONDENSER SPECIFIC EFFICIENCY** is the full load condenser Total Heat of Rejection (THR) capacity at standardized conditions divided by the fan input electric power (including but not limited to spray pump electric input power for evaporative condensers) at 100 percent rated fan speed.

**CONDITIONED FLOOR AREA (CFA)** is the floor area (in square feet) of enclosed conditioned space on all floors of a building, as measured at the floor level of the exterior surfaces of exterior walls enclosing the conditioned space.

**CONDITIONED SPACE** is space in a building that is either directly conditioned or indirectly conditioned.

**CONDITIONED SPACE, DIRECTLY** is an enclosed space that is provided with wood heating, is provided with mechanical heating that has a capacity exceeding 10 Btu/hr-ft<sup>2</sup>, or is provided with mechanical cooling that has a capacity exceeding 5 Btu/hr-ft<sup>2</sup>, unless the space-conditioning system is designed for process space or process load. (See "process load" and "process space.")

**CONDITIONED SPACE, INDIRECTLY** is enclosed space, including, but not limited to, unconditioned volume in atria, that (1) is not directly conditioned space; and (2) either (a) has a thermal transmittance area product (UA) to directly conditioned space exceeding that to the outdoors or to unconditioned space and does not have fixed vents or openings to the outdoors or to unconditioned space, or (b) is a space through which air from directly conditioned spaces is transferred at a rate exceeding three air changes per hour.

**CONDITIONED VOLUME** is the total volume (in cubic feet) of the conditioned space within a building.

**CONTINUOUS INSULATION (c.i.)** is insulation that is continuous across all assemblies that separate conditioned from unconditioned space. It is installed on the exterior or interior or is integral to any opaque surface of the building envelope and has no thermal bridges other than fasteners and necessary service openings.

**CONTROLLED ATMOSPHERE** is an airtight space maintained at reduced oxygen levels for the purpose of reducing respiration of perishable product in long term storage.

**COOLER** is a space to be capable of operation at a temperature greater than or equal to 28°F but less than 55°F.

**COOL ROOF** is a roofing material with high thermal emittance and high solar reflectance, or low thermal emittance and exceptionally high solar reflectance as specified in Part 6 that reduces heat gain through the roof.

**COOLING EQUIPMENT** is equipment used to provide mechanical cooling for a room or rooms in a building.

**CRAWL SPACE** is a space immediately under the first floor of a building adjacent to grade.

**CRRC-1** is the Cool Roof Rating Council document titled "Product Rating Program Manual." (2014)

**CTI** is the Cooling Technology Institute.

**CTI ATC-105** is the Cooling Technology Institute document titled "Acceptance Test Code for Water Cooling Towers," 2000 (CTI ATC-105-00).

**CTI ATC-105S(11)** is the Cooling Technology Institute document titled "Acceptance Test Code for Closed-Circuit Cooling Towers," 2011 (CTI ATC-105-11).

**CTI STD-201** is the Cooling Technology Institute document titled "Standard for Thermal Performance Certification of Evaporative Heat Rejection Equipment," 2011 (CTI STD-201-11).

**CURRENT AIR DEMAND** is the actual cubic feet per minute (acfm) of total air flow necessary for end uses in a compressed air system.

**C-VALUE** (also known as C-factor) is the time rate of heat flow through unit area of a body induced by a unit temperature difference between the body surfaces, in Btu (hr x ft<sup>2</sup> x °F). It is not the same as K-value or K-factor.

**CYCLES OF CONCENTRATION** is the number of times the concentration of total dissolved solids (TDS) in cooling tower water is multiplied relative to the TDS in the makeup water. Because evaporation of pure water leaves dissolved solids behind in the system water, TDS increases over time as the tower operates. The number of times the dissolved minerals are concentrated is relative to the TDS in the makeup water. For example, five cycles of concentration represents five times the concentration of solids in the cooling tower system water relative to the TDS in the makeup water entering the tower.

**DATA CENTER** is a building whose primary function is to house electronic equipment and that has a design equipment power density exceeding 20 watts/ft<sup>2</sup> (215 watts/m<sup>2</sup>) of conditioned floor area computer room(s).

**DAYLIT ZONE** is the floor area under skylights or next to windows. Types of Daylit Zones include Primary Sidelit Daylit Zone, Secondary Sidelit Daylit Zone, and Skylit Daylit Zone.

**DEADBAND** is the temperature range within which the HVAC system is neither calling for heating or cooling.

**DECORATIVE GAS APPLIANCE** is a gas appliance that is designed or installed for visual effect only, cannot burn solid wood, and simulates a fire in a fireplace.

**DEGREE DAY, HEATING**, is a unit, based upon temperature difference and time, used in estimating fuel consumption and specifying nominal annual heating load of a building. For any one day, when the mean temperature is less than 65°F, there exist as many degree days as there are Fahrenheit degrees difference in temperature between the mean temperature for the day and 65°F. The number of degree days for specific geographical locations are those listed in the Reference Joint Appendix JA2. For those localities not listed in the Reference Joint Appendix JA2, the number of degree days is as determined by the applicable enforcing agency.

**DEMAND RESPONSE** is short-term changes in electricity usage by end-use customers from their normal consumption patterns. Demand response may be in response to:

- a. changes in the price of electricity; or
- b. participation in programs or services designed to modify electricity use
  - i. in response to wholesale market prices, or
  - ii. when system reliability is jeopardized.

**DEMAND RESPONSE PERIOD** is a period of time during which electricity loads are modified in response to a demand response signal.

**DEMAND RESPONSE SIGNAL** is a signal sent by the local utility, Independent System Operator (ISO), or designated curtailment service provider or aggregator, to a customer, indicating a price or a request to modify electricity consumption, for a limited time period.

**DEMAND RESPONSIVE CONTROL** is a kind of control that is capable of receiving and automatically responding to a demand response signal.

**DEMISING PARTITION** is a wall, fenestration, floor, or ceiling that separates conditioned space from enclosed unconditioned space.

**DESIGN CONDITIONS** are the parameters and conditions used to determine the performance requirements of space-conditioning systems. Design conditions for determining design heating and cooling loads are specified in Section 140.4(b) for nonresidential, high-rise residential, and hotel/motel buildings and in Section 150.0(h) for low-rise residential buildings.

**DESIGN HEAT GAIN RATE** is the total calculated heat gain through the building envelope under design conditions.

**DESIGN HEAT LOSS RATE** is the total calculated heat loss through the building envelope under design conditions.

**DESIGN REVIEW** is an additional review of the construction documents (drawings and specifications) that seeks to improve compliance with existing Title 24 regulations, to encourage adoption of best practices in design, and to encourage designs that are constructible and maintainable. It is an opportunity for an experienced design engineer or architect to look at a project with a fresh perspective in an effort to catch missing or unclear design information and to suggest design enhancements.

**DEW POINT TEMPERATURE** is the vapor saturation temperature at a specified pressure for a substance undergoing phase change from vapor to liquid.

**DIRECT DIGITAL CONTROL (DDC)** is a type of control where controlled and monitored analog or binary data, such as temperature and contact closures, are converted to digital format for manipulation and calculations by a digital computer or microprocessor, then converted back to analog or binary form to control mechanical devices.

**DIRECT-VENT APPLIANCE** or “sealed combustion” appliance is an appliance that is constructed and installed so that air from combustion is derived directly from the outdoors and flue gases are discharged to the outdoors.

**DISPLAY PERIMETER** is the length of an exterior wall in a Group B; Group F, Division 1; or Group M, Occupancy that immediately abuts a public sidewalk, measured at the sidewalk level for each story that abuts a public sidewalk.

**DOOR** is an operable opening in the building envelope, including swinging and roll-up doors, fire doors, pet doors and access hatches with less than 50 percent glazed area. When that operable opening has 50 percent or more glazed area it is a glazed door. See Fenestration: Glazed Door.

**DUAL-GLAZED GREENHOUSE WINDOWS** are a type of dual-glazed fenestration product which adds conditioned volume but not conditioned floor area to a building.

**DUCT SEALING** is a procedure for installing a space conditioning distribution system that minimizes leakage of air from or to the distribution system. Minimum specifications for installation procedures, materials, diagnostic testing and field verification are contained in the Reference Residential Appendix RA3 and Reference Nonresidential Appendix NA1.

**DUCT SYSTEM** is all the ducts, duct fittings, plenums and fans when assembled to form a continuous passageway for the distribution of air.

**DUCTED SYSTEM** is an air conditioner or heat pump, either a split system or single-packaged unit, that is designed to be permanently installed equipment and delivers conditioned air to an indoor space through a duct.

**DWELLING** is a building that contains one or two dwelling units used, intended or designed to be used, rented, leased, let or hired out to be occupied for living purposes.

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

**EAST-FACING** (See "orientation.")

**ECONOMIZER, AIR**, is a ducting arrangement, including dampers, linkages, and an automatic control system that allows a cooling supply fan system to supply outside air to reduce or eliminate the need for mechanical cooling.

**ECONOMIZER, WATER**, is a system by which the supply air of a cooling system is cooled directly or indirectly by evaporation of water, or other appropriate fluid, in order to reduce or eliminate the need for mechanical cooling.

**Electrical Power Distribution Systems.** The following definitions are intended to apply to Section 130.5 only:

**EQUIPMENT.** A general term, including devices, luminaires, apparatus, machinery, and the like used as a part of, or in connection with, an electrical installation.

**PLUG LOAD.** A plug load is the energy consumed by any appliances or electronic device that is plugged into a receptacle or receptacle outlet. Plug loads are not related to general lighting, heating, ventilation, cooling, and water heating, domestic and service water system, renewable power, information technology equipment, computer room electronic equipment, and electric vehicle charging.

**ELECTRICAL METERING** is a device or system for measuring the electrical power and energy supplied to a customer or premise(s).

**LOW VOLTAGE DRY-TYPE DISTRIBUTION TRANSFORMER** is a distribution transformer that has an input voltage of 600 volts or less, that is air-cooled, and that does not use oil as a coolant.

**SERVICE** is the conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premise served.

**SERVICE EQUIPMENT** is the necessary equipment, usually consisting of a circuit breaker(s) or switch(es) and fuse(s) and their accessories, connected to the load end of service conductors to a building or other structure, or an otherwise designated area, and intended to constitute the main control and cutoff of the supply.

**ELECTRONICALLY-COMMUTATED MOTOR** is a brushless DC motor with a permanent magnet rotor that is surrounded by stationary motor windings, and an electronic controller that varies rotor speed and direction by sequentially supplying DC current to the windings.

**EMITTANCE, THERMAL** is the ratio of the radiant heat flux emitted by a sample to that emitted by a blackbody radiator at the same temperature.

**ENCLOSED SPACE** is space that is substantially surrounded by solid surfaces, including walls, ceilings or roofs, doors, fenestration areas, and floors or ground.

**ENERGY BUDGET** is the maximum amount of Time Dependent Valuation (TDV) energy that a proposed building, or portion of a building, can be designed to consume, calculated with the approved procedures specified in Part 6.

**ENERGY COMMISSION** is the California State Energy Resources Conservation and Development Commission.

**ENERGY EFFICIENCY RATIO (EER)** is the ratio of net cooling capacity (in Btu/hr) to total rate of electrical energy input (in watts), of a cooling system under designated operating conditions, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 110.2.

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

**ENERGY MANAGEMENT CONTROL SYSTEM (EMCS)** is a computerized control system designed to regulate the energy consumption of a building by controlling the operation of energy consuming systems, such as the heating, ventilation and air conditioning (HVAC), lighting, and water heating systems, and is capable of monitoring environmental and system loads, and adjusting HVAC operations in order to optimize energy usage and respond to demand response signals.

**ENERGY OBTAINED FROM DEPLETABLE SOURCES** is electricity purchased from a public utility, or any energy obtained from coal, oil, natural gas, or liquefied petroleum gases.

**ENERGY OBTAINED FROM NONDEPLETABLE SOURCES** is energy that is not energy obtained from depletable sources.

**ENFORCEMENT AGENCY** is the city, county, or state agency responsible for issuing a building permit.

**ENTIRE BUILDING** is the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all existing conditioned and unconditioned space within the structure.

**ENVELOPE** (See "building envelope")

**EXFILTRATION** is uncontrolled outward air leakage from inside a building, including leakage through cracks and interstices, around windows and doors, and through any other exterior partition or duct penetration.

**EXTERIOR FLOOR/SOFFIT** is a horizontal exterior partition, or a horizontal demising partition, under conditioned space. For low-rise residential occupancies, exterior floors also include those on grade.

**EXTERIOR PARTITION** is an opaque, translucent, or transparent solid barrier that separates conditioned space from ambient air or space. For low-rise residential occupancies, exterior partitions also include barriers that separate conditioned space from unconditioned space, or the ground.

**EXTERIOR ROOF/CEILING** is an exterior partition, or a demising partition, that has a slope less than 60 degrees from horizontal, that has conditioned space below, and that is not an exterior door or skylight.

**EXTERIOR ROOF/CEILING AREA** is the area of the exterior surface of exterior roof/ceilings.

**EXTERIOR WALL** is any wall or element of a wall, or any member or group of members, which defines the exterior boundaries or courts of a building and which has a slope of 60 degrees or greater with the horizontal plane. An exterior wall or partition is not an exterior floor/soffit, exterior door, exterior roof/ceiling, window, skylight, or demising wall.

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

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

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

**FENESTRATION:** Includes the following:

**ACE** is an NFRC-Approved eCalculation Entity (ACE) that conducts calculations of fenestration product ratings for certification authorization using the NFRC Component Modeling approach and issues label certificates to Specifying Authorities for product certification authorization in accordance with NFRC requirements.

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

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

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

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

**CMA** (component modeling approach) is a fenestration product certification program from the National Fenestration Rating Council (NFRC) that enables energy-related performance ratings for nonresidential fenestration products, including the thermal performance U-factor, Solar Heat Gain Coefficient, and Visible Transmittance.



**CMAST** (Component Modeling Approach Software Tool) is an NFRC approved software which 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.

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

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

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

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

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

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

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

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

**FIELD-FABRICATED** is a fenestration product whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product. Field fabricated does not include site-built fenestration.

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

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

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

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

**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.

**MANUFACTURED or KNOCKED DOWN PRODUCT** is a fenestration product constructed of materials which 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 "NFRC 100: Procedure for Determining Fenestration Product U-factors." (2011; ~~NFRC 100 includes procedures for site fenestration formerly included in a separate document, NFRC 100-SB).~~

**NFRC 200** is the National Fenestration Rating Council document titled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (2014).

**NFRC 202** is the National Fenestration Rating Council document titled "NFRC 202: Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence." (2014).

**NFRC 203** is the National Fenestration Rating Council document titled "NFRC 203: Procedure for Determining Visible Transmittance of Tubular Daylighting Devices." (2014).

**NFRC 400** is the National Fenestration Rating Council document titled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (2014).

**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.

**RELATIVE SOLAR HEAT GAIN COEFFICIENT (RSHGC)** is the ratio of solar heat gain through a fenestration product (corrected for external shading) to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

**SITE-BUILT** is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units, that are manufactured with the intention of being assembled at the construction site. These include storefront systems, curtain walls, and atrium roof systems.

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

**SPANDREL** is opaque glazing material most often used to conceal building elements between floors of a building so they cannot be seen from the exterior, also known as "opaque in-fill systems".

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

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

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

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

**WINDOW HEAD HEIGHT** is the height from the floor to the top of the window.

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

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

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

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

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

**FLUX** is the rate of energy flow per unit area.

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

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

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

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

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

**GLAZING** (See "fenestration product")

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**HOTEL/MOTEL** is a building or buildings that has six or more guest rooms or a lobby serving six or more guest rooms, where the guest rooms are intended or designed to be used, or which are used, rented, or hired out to be occupied, or which are occupied for sleeping purposes by guests, and all conditioned spaces within the same building envelope. Hotel/motel also includes all conditioned spaces which are (1) on the same property as the hotel/motel, (2) served by the same central heating, ventilation, and air-conditioning system as the hotel/motel, and (3) integrally related to the functioning of the hotel/motel as such, including, but not limited to, exhibition facilities, meeting and conference facilities, food service facilities, lobbies, and laundries.

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

**IES HB** (See IES Lighting Handbook)

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

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

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

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

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

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

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

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

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

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

**LIGHTING definitions:**

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

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

**Color Rendering Index (CRI)** is the ability of a light source to reflect the color of illuminated objects with fidelity relative to ideal or natural light sources of the same color temperature. CRI is calculated according to CIE 13.3

**Correlated Color Temperature (CCT)** is a description of color of light relative to the chromaticity of the radiative emission of heated black body and reported in temperature units of Kelvin according to CIE 15

**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 less than 2,200 K or greater than 7,000 K as determined according to the method set forth in IES LM-66 or IES LM-79 as appropriate.

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

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

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

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

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

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

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

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

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

**Inseparable Solid State Lighting (SSL) Luminaire** is a luminaire featuring solid state lighting components such as LEDs and 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.

**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.

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

**Landscape Lighting** is a type of outdoor lighting that is recessed into or mounted on the ground, paving, or raised deck, which is mounted less than 42 inches above grade or mounted onto trees or trellises, and that is intended to be aimed only at landscape features.

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

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

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

**Light Emitting Diode (LED)** definitions used in Part 6 are in Section 6.8 of ANSI/IES RP-16-10 is a p-n junction solid state diode whose radiated output is a function of its physical construction, material used and exciting current. The output may be in the near ultraviolet, the visible or in the infrared regions of the spectrum.

**LED Light Engine** is an integrated assembly comprised of LED packages, LED components, LED arrays, LED modules, or 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 and does not use an ANSI standard base. (IES RP-16-10).

**Non-integrated LED lamp** is an assembly comprised of an LED array (module) or LED packages (components) and 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 to the branch circuit. (ANSI/IES RP-16-10).

**Integrated LED lamp** is an integrated assembly comprised of LED packages (components) or LED arrays (modules), LED driver, ANSI standard base and other optical, thermal, mechanical and electrical components. The device is intended to connect directly to the branch circuit via a corresponding ANSI standard lamp-holder (socket). (ANSI/IES RP-16-10).

**Low Voltage** is less than 90 volts.

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

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

**Luminance** is a measure of the light emitting power of a surface, in a particular direction, per unit apparent area 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 visually evaluated radiant flux and defines "light" for purposes of lighting design and illuminating engineering.

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

**Ornamental Lighting** for compliance with Part 6 is the following:

**Luminaires** installed outdoor which are rated for 100 watts or less that are post-top luminaires, lanterns, pendant luminaires, chandeliers, and marquee lighting, not providing general lighting or task lighting.

**Decorative Luminaires** installed indoor that are chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights, and light color panels, not providing general lighting or task lighting.

**Pendant (Suspended)** ~~is a mounting method in which the luminaire is suspended from above. 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 Section 658 and 660, except as provided below. Permanently installed luminaires may be mounted inside or outside of a building or site. Permanently installed luminaires may have either plug-in or hardwired connections for electric power. Examples include track and flexible lighting systems; lighting attached to walls, ceilings, columns, inside or outside of permanently installed cabinets, internally illuminated cabinets, mounted on poles, in trees, or in the ground; attached to ceiling fans and integral to exhaust fans. Permanently installed lighting does not include portable lighting or lighting that is installed by the manufacturer in exhaust hoods for cooking equipment, refrigerated cases, food preparation equipment, and scientific and industrial equipment.

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

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

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

**Radiant Power** is the time-rate-flow of radiant energy.

**Radiant Energy** ~~is the electromagnetic or photonic radiant energy from a source~~ energy travelling in the form of electromagnetic waves. It is measured in units of energy such as joules or kilowatt hours.

**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.

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

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

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

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

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

**Line-Voltage Track Lighting** is equipped with luminaires that, use line-voltage lamps or that are equipped with integral transformers at each luminaire.

**Low-Voltage Track Lighting** is equipped with remote transformers for use with low-voltage equipment along the entire length of track.

**Track 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.

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

**LIGHTING CONTROLS** consist of the following:

**Astronomical Time-Switch Control** is an Automatic Time-Switch Control that 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** uses one or more photosensors to detect changes in daylight illumination and then automatically adjusts the luminous flux of the electric lighting system in response.

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

**Automatic Scheduling Control** is a time-based lighting control device or system that is capable of being programmed to turn off outdoor luminaire power for a portion of the night and 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.

**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 had elapsed.

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

**Dimmer, Full-Range** (Also known as a Continuous Dimmer, 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, 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.

**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.

**Lighting Control, Self Contained** is a unitary lighting control module that requires no additional components to be a fully functional lighting control.

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

**Multi-Level Astronomical Time Switch** is an Astronomical Time Switch Control that reduces lighting power in multiple steps.

**Multi-Level Lighting Control** reduces power going to a lighting system in multiple steps.

**Multiscene Programmable Control** allows for two or more pre-defined lighting settings, in addition to all-OFF, for two or more groups of luminaires to suit multiple activities in the space.

**NEMA SSL 7A** is the National Electrical Manufacturers Association document titled "Phase Cut Dimming for Solid State Lighting: Basic Compatibility." 2013. (NEMA SSL 7A-2013).

**Occupant Sensing Controls** automatically control levels of illumination, allow for manual operation, and consist of the following types:

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



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

**Partial-ON Occupant/Motion Sensor** automatically turns lights OFF after an area is vacated of occupants and is capable of automatically or manually turning ON part of the lighting load when an area is occupied.

**Partial-OFF Occupant/Motion Sensor** automatically turns OFF part of the lighting load after an area is vacated of occupants and is capable of automatically turning ON the lighting load when an area is occupied.

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

**Part-Night Outdoor Lighting Control** is a light sensing and time or occupancy-based lighting control device or system that is programmed to reduce or turn off the lighting power to an outdoor luminaire for a portion of the night.

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

**Shut-off Controls** is any lighting control capable of automatically shutting OFF ~~all of the lighting in a space when the space is typically unoccupied.~~

**Track Lighting Integral Current Limiter** consists of a current limiter integral to the end feed housing of a manufactured line voltage track lighting system.

**Track Lighting Supplementary Overcurrent Protection Panel** is a panelboard containing Supplementary Overcurrent Protection Devices as defined in Article 100 of the California Electrical Code, and used only with line voltage track lighting

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

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

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

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

R-3, single family; or

U-building, located on a residential site.

**LPG** is liquefied petroleum gas.

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

**MANUAL** is capable of being operated by personal intervention.

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

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

**MECHANICAL COOLING** is lowering the temperature within a space using refrigerant compressors or absorbers, desiccant dehumidifiers, or other systems that require energy from depletable sources to directly condition the space.

In nonresidential, high-rise residential, and hotel/motel buildings, cooling of a space by direct or indirect evaporation of water alone is not considered mechanical cooling.

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

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

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

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

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

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

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

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

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

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

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

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

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

**NFRC 200** is the National Fenestration Rating Council document titled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (2014+).

**NFRC 202** is the National Fenestration Rating Council document titled "NFRC 202: Procedures for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence." (2014+).

**NFRC 203** is the National Fenestration Rating Council document titled "NFRC 203: Procedure for Determining Visible Transmittance of Tubular Daylighting Devices." (2014+).

**NFRC 400** is the National Fenestration Rating Council document titled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (2014+).

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

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

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

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

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

**Commercial and Industrial Storage Building** is a building for which a minimum of 90 percent of the building floor area is used for storing items.

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

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

**General Commercial and Industrial Work Building** is a building in which a minimum of 90 percent of the building floor area are rooms for performing a craft, assembly or manufacturing operation.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**Auto Repair Bay** is a room or area used to repair automotive equipment and/or vehicles.

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

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

**Classroom, Lecture, Training, Vocational Room** is a room or area where an audience or class receives instruction.

**Commercial and Industrial Storage Area** is a room or area used for storing of items such as goods and merchandise.

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

**Convention, Conference, and Meeting Centers** are rooms or areas that are designed or used for meetings, conventions or events, and that have neither fixed seating nor fixed staging.

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

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

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

**Exercise Center or Gymnasium** is a room or area equipped for gymnastics, exercise equipment, or indoor athletic activities.

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

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

**General Commercial and Industrial Work Area** is a room or area in which an art, craft, assembly or manufacturing operation is performed. Lighting installed in these areas is classified as follows:

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

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

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

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

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

**Kitchen/Food Preparation** is a room or area with cooking facilities or an area where food is prepared.

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

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

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

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

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

### **Lobby**

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

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

**Locker or Dressing Room** is a room or area for changing clothing, sometimes equipped with lockers.

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

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

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

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

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

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

**Parking Garage Areas** include the following:

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

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

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

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

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

**Retail Merchandise Sales Area** is a room or area in which the primary activity is the sale of merchandise.

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

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

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

**Stairwell** is a vertical shaft in which stairs are located.

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

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

**Theater Areas** include the following:

**Motion Picture Theater** is an assembly room or area with tiers of rising seats or steps for the showing of motion pictures.

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

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

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

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

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

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

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

**NORTH-FACING** (See "orientation.")

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

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

**OPERABLE FENESTRATION** is designed to be opened or closed.

**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.

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

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

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

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

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

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

**OUTDOOR LIGHTING** is electrical lighting used to illuminate outdoor areas.

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

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

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

~~**Commercial Vehicle Fuel Station Sales Canopy** is the sales canopy of a fuel station intended to primarily serve customers operating commercial vehicles of 10001 lb. or more, including tractor trailers and buses. Any fuel station sales canopy that has dual pumps and/or contains 50% or more of the pumps that are designed to dispense diesel fuel is considered a commercial fuel station sales canopy. Dual pump is a type of fuel station pumping system that provides fuel pumps on both sides of a vehicle such that drivers can fill both fuel tanks located on each side of the vehicle at the same time.~~

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

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

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

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

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

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

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

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

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

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

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

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

**OUTDOOR LIGHTING ZONE** is a geographic area designated by the California Energy Commission in accordance with Part 1, Section 10-114, that determines requirements for outdoor lighting, including lighting power densities and specific control, equipment or performance requirements. Lighting zones are numbered LZ0, LZ1, LZ2, LZ3 and LZ4.

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

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

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

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

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

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

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

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

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

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

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

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

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

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



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

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

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

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

**PROCESS, COVERED** are processes that are regulated under Part 6, ~~which serving include but are not limited to computer rooms, data centers, elevators, escalators and moving walkways, laboratories, exhaust, enclosed parking garages, exhaust, commercial kitchens, ventilation, refrigerated warehouses, supermarket commercial refrigeration systems, compressed air systems, process cooling towers and process boilers.~~

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

**PROCESS LOAD** is a load resulting from a process.

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

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

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

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

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

**R-VALUE** is the measure of the thermal resistance of insulation or any material or building component expressed in ft<sup>2</sup>-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.

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

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

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

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

**RESIDENTIAL BUILDING** (See “high-rise residential building” and “low-rise residential building.”)

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

**RESIDENTIAL SPACE TYPE** is one of the following:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

**SHADING COEFFICIENT (SC)** is the ratio of the solar heat gain through a fenestration product to the solar heat gain through an unshaded 1/8-inch-thick clear double strength glass under the same set of conditions. For nonresidential, high-rise residential, and hotel/motel buildings, this shall exclude the effects of mullions, frames, sashes, and interior and exterior shading devices.

**SIGN** definitions include the following:

**Electronic Message Center (EMC)** is a pixilated image producing electronically controlled sign formed by any light source. Bare lamps used to create linear lighting 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 letters or symbol that are each independently illuminated, with a separate translucent panel over the light source for each element.

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

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

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

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

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

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

**SINGLE PACKAGE VERTICAL AIR CONDITIONER (SPVAC):** Is a type of air-cooled small or large commercial package air-conditioning and heating equipment; factory assembled as a single package having its major components arranged vertically, which is an encased combination of cooling and optional heating components; is

intended for exterior mounting on, adjacent interior to, or through an outside wall; and is powered by single or three-phase current. It may contain separate indoor grille, outdoor louvers, various ventilation options, indoor free air discharge, ductwork, wall plenum, or sleeve. Heating components may include electrical resistance, steam, hot water, gas, or no heat but may not include reverse cycle refrigeration as a heating means.

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

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

**SITE-BUILT** is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units that are manufactured with the intention of being assembled at the construction site. These include storefront systems, curtain walls and atrium roof systems.

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

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

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

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

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

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

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

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

**SOLAR 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<sub>s</sub>")

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

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

**SPANDREL** is opaque glazing material most often used to conceal building elements between floors of a building so they cannot be seen from the exterior, also known as "opaque in-fill systems."

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

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

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

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

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

**THERMAL RESISTANCE (R)** is a measurement of the resistance over time of a material or building component to the passage of heating ( $\text{hr} \times \text{ft}^2 \times ^\circ\text{F}$ )/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.

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

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

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

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

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

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

**UL** is the Underwriters Laboratories.

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

**UL 731** is the Underwriters Laboratories document titled "Standard for Oil-Fired Unit Heaters," 2006 with revision 1 through 7. **UL 1574** is the Underwriters Laboratories document entitled "Track Lighting Systems," 2000.

**UL 1598** is the Underwriters Laboratories document titled "Luminaires," 2008.

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

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

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

**USDOE 10 CFR 431** is the regulation issued by Department of Energy and available in the Code of Federal Regulation - Title 10, Chapter II, Sub-chapter 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 2010 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 non-refrigerated food and beverages or general merchandise.

**VERTICAL GLAZING** (See "window")

**VERY VALUABLE MERCHANDISE** is 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.

**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 fenestration attachment products which consist 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")

**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, NON-CRITICAL** 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.

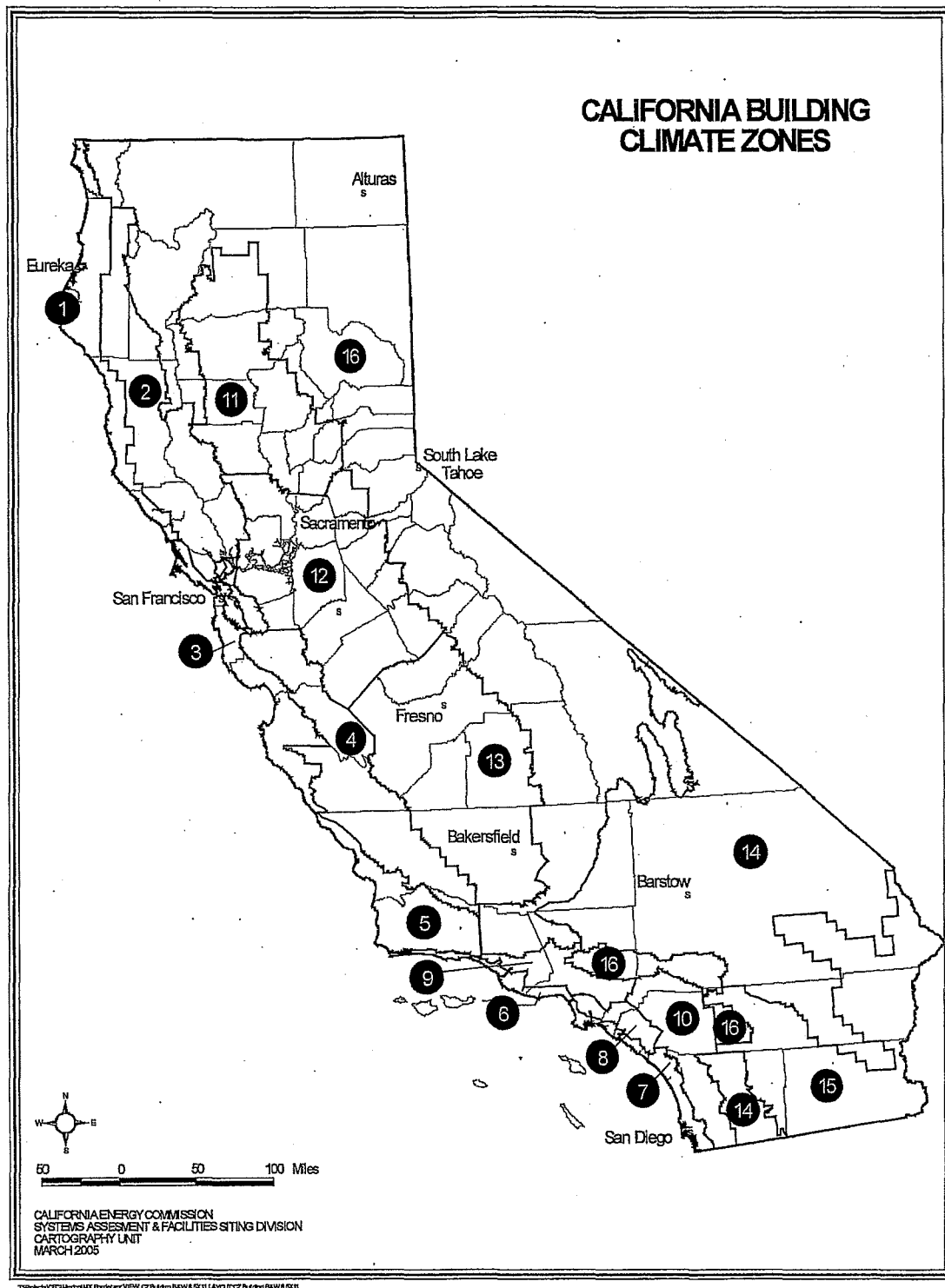


FIGURE 100.1-A—CALIFORNIA CLIMATE ZONES

*Climate Zones for Residential and Nonresidential Occupancies*

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## **SECTION 100.2 – CALCULATION OF TIME DEPENDENT VALUATION (TDV) ENERGY**

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

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## SUBCHAPTER 2

# ALL OCCUPANCIES—MANDATORY REQUIREMENTS FOR THE MANUFACTURE, CONSTRUCTION AND INSTALLATION OF SYSTEMS, EQUIPMENT AND BUILDING COMPONENTS

### SECTION 110.0 – SYSTEMS AND EQUIPMENT—GENERAL

Sections 110.1 through 110.40-11 ~~establish~~ specify requirements for manufacturing, construction, and installation of certain systems, equipment, appliances and building components that are installed in buildings regulated by Part 6 ~~within the scope of Section 100.0(a).~~

**NOTE:** The requirements of Sections 110.0 through 110.40-11 apply to newly constructed buildings. Sections 141.0 and 150.2 specify which requirements of Sections 110.1 through 110.40-11 also apply to additions and alterations to existing buildings.

- (a) **General Requirements.** ~~Systems, equipment, appliances and building components may~~ shall only be installed in a building ~~within the scope of Section 100.0(a)~~ regulated by Part 6 only if:
1. (a) ~~The manufacturer has certified that the system, equipment, appliances or building component complies with the applicable manufacturing provisions of Sections 110.1 through 110.40-11, and~~
  2. (b) ~~The system, equipment, appliance or building component complies with all applicable installation provisions of Sections 110.1 through 110.40-11.~~

(b) **Certification Requirements for Manufactured Systems, Equipment, Appliances and Building Components.**

1. Appliances that are within the scope of Section 1601 of the Appliance Efficiency Regulations shall only be installed if they have been certified to the Energy Commission by the manufacturer, pursuant to the provisions of Title 20 California Code of Regulations, Section 1606; or
2. Systems, equipment, appliances and building components that are required by Part 6 or the Reference Appendices to be certified to the Energy Commission, which are not appliances that are within the scope of Section 1601 of the Appliance Efficiency Regulations, shall only be installed if they are certified by the manufacturer in a declaration, executed under penalty of perjury under the laws of the State of California, that:
  - A. all the information provided pursuant to the certification is true, complete, accurate and in compliance with all applicable requirements of Part 6; and
  - B. the equipment, product, or device was tested using the test procedure specified in Part 6 if applicable;
3. The certification status of any system, equipment, appliance or building component shall be confirmed only by reference to:
  - A. A directory published or approved by the Commission; or
  - B. A copy of the application for certification from the manufacturer and the letter of acceptance from the Commission staff; or
  - C. Written confirmation from the publisher of a Commission-approved directory that a device has been certified; or
  - D. A Commission-approved label on the device.

5. NOTE: Part 6 does not require a builder, designer, owner, operator, or enforcing agency to test any certified device to determine its compliance with minimum specifications or efficiencies adopted by the Commission.

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**SECTION 110.1 – MANDATORY REQUIREMENTS FOR APPLIANCES**

- (a) Any appliance regulated by the Appliance Efficiency Regulations, Title 20 California Code of Regulations, Section 1601 et seq., may be installed only if the appliance fully complies with Section 1608(a) of those regulations.
- (b) Except for those circumstances described in Section 110.1(c), ~~conformance with Part 6 specific efficiency levels required to comply with Part 6 mandatory, prescriptive and performance standards requirements~~ shall be verified utilizing data from either:
  - 1. The Energy Commission's database of certified appliances maintained pursuant to Title 20 California Code of Regulations, Section 1606, and which is available at: [www.energy.ca.gov/appliances/database/](http://www.energy.ca.gov/appliances/database/); or
  - 2. An equivalent directory published by a federal agency; or
  - 3. An approved trade association directory as defined in Title 20 California Code of Regulations, Section 1606(h).
- (c) ~~Conformance with Part 6 specific efficiency levels required to comply with Part 6 mandatory, prescriptive and performance standards requirements may shall~~ be demonstrated either by ~~utilizing minimal default to the mandatory efficiency values defined levels specified in Part 6 or by following criteria procedures approved by the Commission pursuant to Section 10-109 of Title 24, Part 1, when:~~
  - 1. ~~Data to verify conformance with Part 6 specific efficiency levels required to comply with Part 6 mandatory, prescriptive and performance standards requirements is not available pursuant to subdivision (b); or~~
  - 2. ~~Field verification and diagnostic testing is required for compliance with Part 6 and there is the Energy Commission has not approved an applicable field verification and diagnostic test protocol available in Part 6 that is suitable that is applicable to the appliance; or~~
  - 3. ~~The appliance meets the requirements of Section 110.1(a) and but~~ has been site-modified in a way that affects its performance; or
  - 4. ~~The system-U.S. Department of Energy has received approved a waiver from federal test procedures, pursuant to under 10 CFR Section 430.27 or Section 431.401 and that waiver fails to specify how the efficiency of the system shall be determined.~~

## SECTION 110.2 – MANDATORY REQUIREMENTS FOR SPACE-CONDITIONING EQUIPMENT

**Certification by Manufacturers.** Any space-conditioning equipment listed in this section may be installed only if the manufacturer has certified to the Commission that the equipment complies with all the applicable requirements of this section.

- (a) **Efficiency.** Equipment shall meet the applicable efficiency requirements in TABLE 110.2-A through TABLE 110.2-K subject to the following:
1. If more than one efficiency standard is listed for any equipment in TABLE 110.2-A through TABLE 110.2-K, the equipment shall meet all the applicable standards that are listed; and
  2. If more than one test method is listed in TABLE 110.2-A through TABLE 110.2-K, the equipment shall comply with the applicable efficiency standard when tested with each listed test method; and
  3. Where equipment ~~can serve~~ more than one function, ~~such as both heating and cooling, or both space heating and water heating,~~ it shall comply with all the efficiency standards applicable to each function; and
  4. Where a requirement is for equipment rated at its "maximum rated capacity" or "minimum rated capacity," the capacity shall be as provided for and allowed by the controls, during steady-state operation.

**EXCEPTION 1 to Section 110.2(a):** Water-cooled centrifugal water-chilling packages that are not designed for operation at ANSI/AHRI Standard 550/590 test conditions of 44°F leaving chilled water temperature and 85°F entering condenser water temperature with 3 gallons per minute per ton condenser water flow shall have a maximum full load kW/ton and NPLV ratings adjusted using the following equation:

Adjusted maximum full-load kW/ton rating = (fullload kW/ton from TABLE 110.2-D) / Kadj

Adjusted maximum NPLV rating = (IPLV from TABLE 110.2-D) / Kadj

Where:

$$K_{adj} = (A) \times (B)$$

$$A = 0.00000014592 \times (\text{LIFT})^4 - 0.0000346496 \times (\text{LIFT})^3 + 0.00314196 \times (\text{LIFT})^2 - 0.147199 \times (\text{LIFT}) + 3.9302$$

$$\text{LIFT} = \text{LvCond} - \text{LvEvap} \text{ (°F)}$$

$$\text{LvCond} = \text{Full-load leaving condenser fluid temperature (°F)}$$

$$\text{LvEvap} = \text{Full-load leaving evaporator fluid temperature (°F)}$$

$$B = (0.0015 \times \text{LvEvap}) + 0.934$$

The adjusted full-load and NPLV values are only applicable for centrifugal chillers meeting all of the following full-load design ranges:

- Minimum Leaving Evaporator Fluid Temperature: 36°F
- Maximum Leaving Condenser Fluid Temperature: 115°F
- LIFT ≥ 20°F and ≤ 80°F

Centrifugal chillers designed to operate outside of these ranges are not covered by this exception.

**EXCEPTION 2 to Section 110.2(a):** Positive displacement (air- and water-cooled) chillers with a leaving evaporator fluid temperature higher than 32°F shall show compliance with TABLE 110.2-D when tested or certified with water at standard rating conditions, per the referenced test procedure.

**EXCEPTION 3 to Section 110.2(a):** Equipment primarily serving refrigerated warehouses or commercial refrigeration exempt or covered process loads.

- (b) **Controls for Heat Pumps with Supplementary Electric Resistance Heaters.** Heat pumps with supplementary electric resistance heaters shall have controls:

1. That prevent supplementary heater operation when the heating load can be met by the heat pump alone; and
2. In which the cut-on temperature for compression heating is higher than the cut-on temperature for supplementary heating, and the cut-off temperature for compression heating is higher than the cut-off temperature for supplementary heating.

**EXCEPTION 1 to Section 110.2(b):** The controls may allow supplementary heater operation during:

- A. Defrost; and
- B. Transient periods such as start-ups and following room thermostat setpoint advance, if the controls provide preferential rate control, intelligent recovery, staging, ramping or another control mechanism designed to preclude the unnecessary operation of supplementary heating.

**EXCEPTION 2 to Section 110.2(b):** Room air-conditioner heat pumps.

- (c) **Thermostats.** All unitary heating or cooling systems, ~~including heat pumps~~, not controlled by a central energy management control system (EMCS) shall have a setback thermostat.

1. **Setback Capabilities.** All thermostats shall have a clock mechanism that allows the building occupant to Program the temperature setpoints for at least four periods within 24 hours. Thermostats for heat pumps shall meet the requirements of Section 110.2(b).

**EXCEPTION to Section 110.2(c):** Gravity gas wall heaters, gravity floor heaters, gravity room heaters, noncentral electric heaters, fireplaces or decorative gas appliances, wood stoves, room air conditioners, and room air-conditioner heat pumps.

- (d) **Gas- and Oil-Fired Furnace Standby Loss Controls.** Gas-fired and oil-fired forced air furnaces with input ratings  $\geq 225,000$  Btu/h shall also have an intermittent ignition or interrupted device (IID), and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for furnaces where combustion air is drawn from the conditioned space. All furnaces with input ratings  $\geq 225,000$  Btu/h, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75 percent of the input rating.

- (e) **Open and Closed Circuit Cooling Towers.** All open and closed circuit cooling tower installations shall comply with the following:

1. Be equipped with Conductivity or Flow-based Controls that maximize cycles of concentration based on local water quality conditions. Controls shall automate system bleed and chemical feed based on conductivity, or in proportion to metered makeup volume, metered bleed volume, recirculating pump run time, or bleed time. Conductivity controllers shall be installed in accordance with manufacturer's specifications in order to maximize accuracy.
2. Documentation of Maximum Achievable Cycles of Concentration. Building owners shall document the maximum cycles of concentration based on local water supply as reported annually by the local water supplier, and using the calculator approved by the Energy Commission. The calculator is intended to determine maximum cycles based on a Langelier Saturation Index (LSI) of 2.5 or less. Building owner shall document maximum cycles of concentration on the mechanical compliance form which shall be reviewed and signed by the Professional Engineer (P.E.) of Record.
3. Be equipped with a Flow Meter with an analog output for flow either hardwired or available through a gateway on the makeup water line.
4. Be equipped with an Overflow Alarm to prevent overflow of the sump in case of makeup water valve failure. Overflow alarm shall send an audible signal or provide an alert via the Energy Management Control System to the tower operator in case of sump overflow.
5. Be equipped with Efficient Drift Eliminators that achieve drift reduction to 0.002 percent of the circulated water volume for counter-flow towers and 0.005 percent for cross-flow towers.

**EXCEPTION to Section 110.2(e):** Towers with rated capacity < 150 tons.

- (f) **Low Leakage Air-Handling Units.** To qualify as a low leakage air-handling unit for use for meeting the requirements for applicable low leakage air-handling unit compliance credit(s) available in the performance standards set forth in Sections 150.1(b) and 140.1, the manufacturer shall certify to the Energy Commission that the air-handling unit meets the specifications in Reference Joint Appendix JA9.

TABLE 110.2-A ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Efficiency <sup>a,b</sup>		Test Procedure <sup>c</sup>
		Before 1/1/2016 <sup>5</sup>	After 1/1/2016 <sup>5</sup>	
Air conditioners, air cooled both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	11.2 EER <sup>b</sup> 11.4 IEER <sup>b</sup>	<u>11.2 EER</u> <u>12.9 IEER</u>	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	11.0 EER <sup>b</sup> 11.2 IEER <sup>b</sup>	<u>11.0 EER</u> <u>12.4 IEER</u>	ANSI/AHRI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	10.0 EER <sup>b</sup> 10.1 IEER <sup>b</sup>	<u>10.0 EER</u> <u>11.6 IEER</u>	
	≥ 760,000 Btu/h	9.7 EER <sup>b</sup> 9.8 IEER <sup>b</sup>	<u>9.7 EER</u> <u>11.2 IEER</u>	
Air conditioners, water cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	12.1 EER <sup>b</sup> 12.3 IEER <sup>b</sup>	<u>12.1 EER</u> <u>13.9 IEER</u>	ANSI/AHRI 340/360
	≥135,000 Btu/h and < 240,000 Btu/h	12.5 EER <sup>b</sup> 12.5 IEER <sup>b</sup>	<u>12.5 EER</u> <u>13.9 IEER</u>	ANSI/AHRI 340/360
	≥240,000 Btu/h and < 760,000 Btu/h	12.4 EER <sup>b</sup> 12.6 IEER <sup>b</sup>	<u>12.4 EER</u> <u>13.6 IEER</u>	ANSI/AHRI 340/360
	≥ 760,000 Btu/h	12.2 EER <sup>b</sup> 12.4 IEER <sup>b</sup>	<u>12.2 EER</u> <u>13.5 IEER</u>	ANSI/AHRI 340/360
Air conditioners, evaporatively cooled	≥65,000 Btu/h and < 135,000 Btu/h	12.1 EER <sup>b</sup> 12.3 IEER <sup>b</sup>		ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	12.0 EER <sup>b</sup> 12.2 IEER <sup>b</sup>		ANSI/AHRI 340/360
	≥240,000 Btu/h and < 760,000 Btu/h	11.9 EER <sup>b</sup> 12.1 IEER <sup>b</sup>		ANSI/AHRI 340/360
	≥ 760,000 Btu/h	11.7 EER <sup>b</sup> 11.9 IEER <sup>b</sup>		ANSI/AHRI 340/360
Condensing units, air cooled	≥ 135,000 Btu/h	10.5 EER 11.8 IEER		ANSI/AHRI 365
Condensing units, water cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		
Condensing units, evaporatively cooled	≥ 135,000 Btu/h	13.5 EER 14.0 IEER		

<sup>a</sup> IEERs are only applicable to equipment with capacity control as peras specified by ANSI/AHRI 340/360 test procedures

<sup>b</sup> Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat.

<sup>c</sup> Applicable test procedure and reference year are provided under the definitions.

TABLE 110.2-B UNITARY AND APPLIED HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Efficiency <sup>a,b</sup>		Test Procedure <sup>c</sup>
		Before 1/1/2016	After 1/1/2016	
Air Cooled (Cooling Mode), both split system and single package	≥ 65,000 Btu/h and < 135,000 Btu/h	<u>11.0 EER<sup>a</sup></u> <u>11.2 IEER<sup>a</sup></u>	<u>11.0 EER</u> <u>12.2 IEER</u>	ANSI/AHRI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	<u>10.6 EER<sup>a</sup></u> <u>10.7 IEER<sup>a</sup></u>	<u>10.6 EER</u> <u>11.6 IEER</u>	
	≥ 240,000 Btu/h	<u>9.5 EER<sup>a</sup></u> <u>9.6 IEER<sup>a</sup></u>	<u>9.5 EER</u> <u>10.6 IEER</u>	
Water source (cooling mode)	≥ 65,000 Btu/h and < 135,000 Btu/h <del>≥ 135,000 Btu/h and &lt; 240,000 Btu/h</del>	86°F entering water <del>86°F entering water</del>	<del>12.0</del> 13.0 EER <del>12.0 EER</del>	ISO-13256-1
Groundwater source (cooling mode)	< 135,000 Btu/h	59°F entering water	<del>16.2</del> 18.0 EER	ISO-13256-1
Ground source (cooling mode)	< 135,000 Btu/h	77°F entering water	<del>13.4</del> 14.1 EER	ISO-13256-1
Water source water-to- water (cooling mode)	< 135,000 Btu/h	86°F entering water	10.6 EER	ISO-13256-2
Groundwater source water-to-water (cooling mode)	< 135,000 Btu/h	59°F entering water	16.3 EER	ISO-13256-1
Ground source brine- to-water (cooling mode)	< 135,000 Btu/h	77°F 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	3.3 COP	ANSI/AHRI 340/360
		17° F db/15° F wb outdoor air	2.25 COP	
	≥ 135,000 Btu/h (cooling capacity)	47° F db/43° F wb outdoor air	3.2 COP	
		17° F db/15° F wb outdoor air	2.05 COP	

CONTINUED: TABLE 110.2-B UNITARY AND APPLIED HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Size Category	Subcategory or Rating Condition	Efficiency <sup>a</sup>	Test Procedure <sup>c</sup>
Water source (heating mode)	< 135,000 Btu/h (cooling capacity)	68°F entering water	4.2-3 COP	ISO-13256-1
	≥ 135,000 Btu/h and < 240,000 Btu/h	68°F entering water	2.90 COP	
Groundwater source (heating mode)	< 135,000 Btu/h (cooling capacity)	50°F entering water	3.6-7 COP	ISO-13256-1
Ground source (heating mode)	< 135,000 Btu/h (cooling capacity)	32°F entering water	3.4-2 COP	ISO-13256-1
Water source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	68°F entering water	3.7 COP	ISO-13256-2
Groundwater source water-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	50°F entering water	3.1 COP	ISO-13256-2
Ground source brine-to-water (heating mode)	< 135,000 Btu/h (cooling capacity)	32°F entering water	2.5 COP	ISO-13256-2
<sup>a</sup> IEERs are only applicable to equipment with capacity control as peras specified by ANSI/AHRI 340/360 test procedures. <sup>b</sup> Deduct 0.2 from the required EERs and IEERs for units with a heating section other than electric resistance heat. <sup>c</sup> 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 <sup>a</sup>
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
<sup>a</sup> Applicable test procedure and reference year are provided under the definitions.				



TABLE 110.2-D WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS <sup>a,b</sup>

Equipment Type	Size Category	Path A Efficiency <sup>a,b</sup>	Path B Efficiency <sup>a,b</sup>	Test Procedure <sup>c</sup>
Air Cooled, With Condenser	< 150 Tons	<del>≥ 9.56</del> <u>10.100</u> EER <del>≥ 12.500</del> <u>13.700</u> IPLV	<del>≥ 9.700</del> EER <del>≥ 15.800</del> IPLV <del>N.A.</del> <sup>d</sup>	AHRI 550/590
Electrically Operated	≥ 150 Tons	<del>≥ 9.56</del> <u>10.100</u> EER <del>≥ 14.000</del> <u>12.750</u> IPLV	<del>≥ 9.700</del> EER <del>≥ 16.100</del> IPLV <del>N.A.</del> <sup>d</sup>	
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.		
Water Cooled, Electrically Operated, Reciprocating	All Capacities	Reciprocating units must comply with the water-cooled positive displacement efficiency requirements.		AHRI 550/590
<del>(Reciprocating)</del>				
Water Cooled, Electrically Operated Positive Displacement	< 75 Tons	<del>≤ 0.780</del> <u>750</u> kW/ton <del>≤ 0.630</del> <u>600</u> IPLV	<del>≤ 0.800</del> <u>780</u> kW/ton <del>≤ 0.600</del> <u>500</u> IPLV	AHRI 550/590
	≥ 75 tons and < 150 tons	<del>≤ 0.775</del> <u>720</u> kW/ton <del>≤ 0.615</del> <u>560</u> IPLV	<del>≤ 0.750</del> <u>790</u> kW/ton <del>≤ 0.586</del> <u>490</u> IPLV	
	≥ 150 tons and < 300 tons	<del>≤ 0.680</del> <u>660</u> kW/ton <del>≤ 0.540</del> <u>580</u> IPLV	<del>≤ 0.718</del> <u>680</u> kW/ton <del>≤ 0.540</del> <u>440</u> IPLV	
	≥ 300 Tons and < 600 tons	<del>≤ 0.620</del> <u>610</u> kW/ton <del>≤ 0.540</del> <u>520</u> IPLV	<del>≤ 0.639</del> <u>625</u> kW/ton <del>≤ 0.490</del> <u>410</u> IPLV	
	≥ 600 tons	<del>≤ 0.560</del> kW/ton <del>≤ 0.500</del> IPLV	<del>≤ 0.585</del> kW/ton <del>≤ 0.380</del> IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	<del>≤ 0.634</del> <u>610</u> kW/ton <del>≤ 0.550</del> <u>596</u> IPLV	<del>≤ 0.639</del> <u>695</u> kW/ton <del>≤ 0.450</del> <u>440</u> IPLV	AHRI 550/590
	≥ 150 tons and < 300 tons	<del>≤ 0.634</del> <u>610</u> kW/ton <del>≤ 0.596</del> <u>550</u> IPLV	<del>≤ 0.639</del> <u>635</u> kW/ton <del>≤ 0.450</del> <u>400</u> IPLV	
	≥ 300 tons and < 600 tons	<del>≤ 0.576</del> <u>560</u> kW/ton <del>≤ 0.549</del> <u>520</u> IPLV	<del>≤ 0.600</del> <u>595</u> kW/ton <del>≤ 0.400</del> <u>390</u> IPLV	
	<del>≥ 400 tons and &lt; 600 tons</del> <del>tons ≥ 600 Tons</del>	<del>≤ 0.570</del> <u>560</u> kW/ton <del>≤ 0.539</del> <u>500</u> IPLV	<del>≤ 0.590</del> <u>585</u> kW/ton <del>≤ 0.400</del> <u>380</u> IPLV	
	≥ 600 tons	<del>≤ 0.560</del> kW/ton <del>≤ 0.500</del> IPLV	<del>≤ 0.585</del> kW/ton <del>≤ 0.380</del> IPLV	

**CONTINUED: TABLE 110.2-D WATER CHILLING PACKAGES – MINIMUM  
EFFICIENCY REQUIREMENTS <sup>a,b</sup>**

Equipment Type	Size Category	Path A Efficiency <sup>a,b</sup>	Path B Efficiency <sup>a,b</sup>	Test Procedure <sup>c</sup>
Air Cooled Absorption, Single Effect	All Capacities	$\geq 0.600$ COP	N.A. <sup>d</sup>	ANSI/AHRI 560
Water Cooled Absorption, Single Effect	All Capacities	$\geq 0.700$ COP	N.A. <sup>d</sup>	
Absorption Double Effect, Indirect-Fired	All Capacities	$\geq 1.000$ COP $\geq 1.050$ IPLV	N.A. <sup>d</sup>	
Absorption Double Effect, Direct-Fired	All Capacities	$\geq 1.000$ COP $\geq 1.000$ IPLV	N.A. <sup>d</sup>	
Water Cooled Gas Engine Driven Chiller	All Capacities	$\geq 1.2$ COP $\geq 2.0$ IPLV	N.A. <sup>d</sup>	ANSI Z21.40.4A
<sup>a</sup> No requirements for: <ul style="list-style-type: none"> <li>Centrifugal chillers with design leaving evaporator temperature <math>&lt; 36^{\circ}\text{F}</math>; or</li> <li>Positive displacement chillers with design leaving fluid temperature <math>\leq 32^{\circ}\text{F}</math>; or</li> <li>Absorption chillers with design leaving fluid temperature <math>&lt; 40^{\circ}\text{F}</math></li> </ul> <sup>b</sup> 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. <sup>c</sup> See Section 100.1 for definitions <sup>d</sup> NA means not applicable				

*TABLE 110.2-E PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS –  
MINIMUM EFFICIENCY REQUIREMENTS*

Equipment Type	Size Category (Input)	Subcategory or Rating Condition	Efficiency		Test Procedure <sup>c</sup>
			Before 10/08/2012	After 10/08/2012	
PTAC (Cooling mode) Newly constructed or newly conditioned buildings or additions	All Capacities	95°F db Outdoor Air	<del>12.5 - (0.213 x Cap/1000) <sup>a</sup> EER</del>	<del>13.8</del> 14.0 - (0.300 x Cap/1000) <sup>a</sup> EER	ANSI/AHRI/CSA 310/380
PTAC (Cooling mode) Replacements <sup>b</sup>	All Capacities	95°F db Outdoor Air	<del>10.9 - (0.213 x Cap/1000) <sup>a</sup> EER</del>	10.9 - (0.213 x Cap/1000) <sup>a</sup> EER	
PTHP (Cooling mode) Newly constructed or newly conditioned buildings or additions	All Capacities	95°F db Outdoor Air	<del>12.3 - (0.213 x Cap/1000) <sup>a</sup> EER</del>	14.0 - (0.300 x Cap/1000) <sup>a</sup> EER	
PTHP (Cooling mode) Replacements <sup>b</sup>	All Capacities	95°F db Outdoor Air	<del>10.8 - (0.213 x Cap/1000) <sup>a</sup> EER</del>	10.8 - (0.213 x Cap/1000) <sup>a</sup> EER	
PTHP (Heating Mode) Newly constructed or newly conditioned buildings or additions	All Capacities	-	<del>3.2 - (0.026 x Cap/1000) <sup>a</sup> COP</del>	3.7 - (0.052 x Cap/1000) <sup>a</sup> COP	
PTHP (Heating mode) Replacements <sup>b</sup>	All Capacities	-	<del>2.9 - (0.026 x Cap/1000) <sup>a</sup> COP</del>	2.9 - (0.026 x Cap/1000) <sup>a</sup> COP	
SPVAC (Cooling Mode)	<65,000 Btu/h	95°F db / 75°F wb Outdoor Air	<del>9.0 EER</del>	<del>9.0</del> 10.0 EER	ANSI/AHRI 390
	≥65,000 Btu/h and <135,000 Btu/h	95°F db / 75°F wb Outdoor Air	<del>8.9 EER</del>	<del>8.9</del> 10.0 EER	
	≥135,000 Btu/h and <240,000 Btu/h	95°F db / 75°F wb Outdoor Air	<del>8.6 EER</del>	<del>8.6</del> 10.0 EER	
SPVAC (Cooling Mode) nonweatherized space constrained	≤ 30,000 Btu/h	95°F db / 75°F wb outdoor air		9.20 EER	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95°F db / 75°F wb outdoor air		9.00 EER	
SPVHP (Cooling Mode)	<65,000 Btu/h	95°F db / 75°F wb Outdoor Air	<del>9.0 EER</del>	<del>9.0</del> 10.0 EER	
	≥65,000 Btu/h and <135,000 Btu/h	95°F db / 75°F wb Outdoor Air	<del>8.9 EER</del>	<del>8.9</del> 10.0 EER	
	≥135,000 Btu/h and <240,000 Btu/h	95°F db / 75°F wb Outdoor Air	<del>8.6 EER</del>	<del>8.6</del> 10.0 EER	
SPVHP (Cooling Mode) nonweatherized space constrained	≤ 30,000 Btu/h	95°F db / 75°F wb Outdoor Air		9.20 EER	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	95°F db / 75°F wb Outdoor Air		9.00 EER	
SPVHP (Heating Mode)	<65,000 Btu/h	47°F db / 43°F wb Outdoor Air	<del>3.0 COP</del>	3.0 COP	
	≥65,000 Btu/h and <135,000 Btu/h	47°F db / 43°F wb Outdoor Air	<del>3.0 COP</del>	3.0 COP	
	≥135,000 Btu/h and <240,000 Btu/h	47°F db / 43°F wb Outdoor Air	<del>2.9 COP</del>	<del>2.9</del> 3.0 COP	
SPVHP (Heating Mode) nonweatherized space constrained	≤ 30,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.00 COP	
	> 30,000 Btu/h and ≤ 36,000 Btu/h	47°F db / 43°F wb Outdoor Air		3.00 COP	

<sup>a</sup> Cap means the rated cooling capacity of the product in Btu/h. If the unit's capacity is less than 7000 Btu/h, use 7000 Btu/h in the calculation. If the unit's capacity is greater than 15,000 Btu/h, use 15,000 Btu/h in the calculation.

<sup>b</sup> Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEWLY CONSTRUCTED BUILDINGS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high or less than 42 inch wide and having a cross-sectional area less than 670 square inches.

<sup>c</sup> Applicable test procedure and reference year are provided under the definitions

## SECTION 110.2 – MANDATORY REQUIREMENTS FOR SPACE-CONDITIONING EQUIPMENT

TABLE 110.2-F HEAT TRANSFER EQUIPMENT

Equipment Type	Subcategory	Minimum Efficiency <sup>a</sup>	Test Procedure <sup>b</sup>
Liquid-to-liquid heat exchangers	Plate type	NR	ANSI/AHRI 400
<sup>a</sup> NR = no requirement			
<sup>b</sup> Applicable test procedure and reference year are provided under the definitions			

TABLE 110.2-G PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Type	Total System Heat Rejection Capacity at Rated Conditions	Subcategory or Rating Condition	Performance Required, <sup>a, b, c, d</sup>	Test Procedure <sup>e</sup>
Propeller or axial fan Open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering air wb	$\geq 42.1$ gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal fan Open-circuit cooling towers	All	95°F entering water 85°F leaving water 75°F entering air wb	$\geq 20.0$ gpm/hp	CTI ATC-105 and CTI STD-201
Propeller or axial fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering air wb	$\geq 14.0$ gpm/hp	CTI ATC-105S and CTI STD-201
Centrifugal fan closed-circuit cooling towers	All	102°F entering water 90°F leaving water 75°F entering air wb	$\geq 7.0$ gpm/hp	CTI ATC-105S and CTI STD-201
Propeller or axial fan evaporative condensers	All	<u>"R-507A test fluid</u> 165°F entering gas temp 105°F condensing temp 75°F entering air wb <sup>d</sup>	$\geq 157,000$ Btu/h • hp	CTI ATC-106
	All	<u>"Ammonia test fluid</u> 140°F entering gas temp 96.3°F condensing temp 75°F entering air wb <sup>d</sup>	$\geq 134,000$ Btu/h • hp	
Centrifugal fan evaporative condensers	All	<u>"R-507A test fluid</u> 165°F entering gas temp 105°F condensing temp 75°F entering air wb <sup>d</sup>	$\geq 135,000$ Btu/h • hp	
	All	<u>"Ammonia test fluid</u> 140°F entering gas temp 96.3°F condensing temp 75°F entering air wb <sup>d</sup>	$\geq 110,000$ Btu/h • hp	
Air cooled condensers	All	125°F condensing temperature R22 test fluid 190°F entering gas temperature 15°F subcooling 95°F entering drybulb	$\geq 176,000$ Btu/h • hp	ANSI/AHRI 460
<sup>a</sup> For purposes of this table, open-circuit cooling tower performance is defined as the water flow rating of the tower at the given rated conditions divided by the fan motor nameplate power. <sup>b</sup> For purposes of this table, closed-circuit cooling tower performance is defined as the process water flow rating of the tower at the given rated conditions divided by the sum of the fan motor nameplate rated power and the integral spray pump motor nameplate power. <sup>c</sup> For purposes of this table air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan motor nameplate power. <sup>d</sup> Open cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled open cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Open factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90 percent of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of open factory assembled cooling towers are open cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers. <sup>e</sup> Applicable test procedure and reference year are provided under the definitions. <u>For refrigerated warehouses or commercial refrigeration applications, condensers shall comply with requirements specified by Section 120.6(a) or Section 120.6(b).</u>				

**TABLE 110.2-H Electrically Operated Variable Refrigerant Flow (VRF) Air Conditioners**  
**Minimum Efficiency Requirements**

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure <sup>a</sup>
VRF Air Conditioners, Air Cooled	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	ANSI/AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.2 EER 13.1 IEER <sup>b</sup>	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	11.0 EER 12.9 IEER <sup>b</sup>	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System	10.0 EER 11.6 IEER <sup>b</sup>	

<sup>a</sup> Applicable test procedure and reference year are provided under the definitions.

<sup>b</sup> IEERs are only applicable to equipment with capacity control as per specified by ANSI/AHRI 1230 test procedures.

TABLE 110.2-1 Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps - Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure <sup>b</sup>
VRF Air Cooled, (cooling mode)	<65,000 Btu/h	All	VRF Multi-split System	13.0 SEER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System <sup>a</sup>	11.0 EER 12.9 IEER <sup>c</sup>	
	≥135,000 Btu/h and <240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System <sup>a</sup>	10.6 EER 12.3 IEER <sup>c</sup>	
	≥240,000 Btu/h	Electric Resistance (or none)	VRF Multi-split System <sup>a</sup>	9.5 EER 11.0 IEER <sup>c</sup>	
VRF Water source (cooling mode)	<65,000 Btu/h	All	VRF Multi-split systems <sup>a</sup> 86°F entering water	12.0 EER	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h	All	VRF Multi-split System <sup>a</sup> 86°F entering water	12.0 EER	
	≥135,000 Btu/h	All	VRF Multi-split System <sup>a</sup> 86°F entering water	10.0 EER	
VRF Groundwater source (cooling mode)	<135,000 Btu/h	All	VRF Multi-split System <sup>a</sup> 59°F entering water	16.2 EER	AHRI 1230
	≥135,000 Btu/h	All	VRF Multi-split System <sup>a</sup> 59°F entering water	13.8 EER	
VRF Ground source (cooling mode)	<135,000 Btu/h	All	VRF Multi-split System <sup>a</sup> 77°F entering water	13.4 EER	AHRI 1230
	≥135,000 Btu/h	All	VRF Multi-split System <sup>a</sup> 77°F entering water	11.0 EER	



CONTINUED: TABLE 110.2-I Electrically Operated Variable Refrigerant Flow Air-to-Air and Applied Heat Pumps - Minimum Efficiency Requirements

Equipment Type	Size Category	Heating Section Type	Sub-Category or Rating Condition	Minimum Efficiency	Test Procedure <sup>b</sup>
VRF Air Cooled (heating mode)	<65,000 Btu/h (cooling capacity)	---	VRF Multi-split System	7.7 HSPF	AHRI 1230
	≥65,000 Btu/h and <135,000 Btu/h (cooling capacity)	---	VRF Multi-split system 47°F db/ 43°F wb outdoor air	3.3 COP	
			VRF Multi-split system 17°F db/15°F wb outdoor air	2.25 COP	
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split system 47°F db/ 43°F wb outdoor air	3.2 COP	
			VRF Multi-split system 17°F db/15°F wb outdoor air	2.05 COP	
VRF Water source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 68°F entering water	4.2 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 68°F entering water	3.9 COP	
VRF Groundwater source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 50°F entering water	3.6 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 50°F entering water	3.3 COP	
VRF Ground source (heating mode)	<135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 32°F entering water	3.1 COP	AHRI 1230
	≥135,000 Btu/h (cooling capacity)	---	VRF Multi-split System 32°F entering water	2.8 COP	

<sup>a</sup> Deduct 0.2 from the required EERs and IEERs for Variable Refrigerant Flow (VRF) Multi-split system units with a heating recovery section.

<sup>b</sup> Applicable test procedure and reference year are provided under the definitions.

<sup>c</sup> IEERs are only applicable to equipment with capacity control as per specified by ANSI/AHRI 1230 test procedures.

TABLE 110.2-J Warm-Air Furnaces and Combination Warm-Air Furnaces/Air-Conditioning Units, Warm-Air Duct Furnaces, and Unit Heaters

Equipment Type	Size Category (Input)	Subcategory or Rating Condition <sup>b</sup>	Minimum Efficiency <sup>d,e</sup>	Test Procedure <sup>a</sup>
Warm-Air Furnace, Gas-Fired	< 225,000 Btu/h	Maximum Capacity <sup>b</sup>	78% AFUE or 80% E <sub>t</sub>	DOE 10 CFR Part 430 or Section 2.39, Thermal Efficiency, ANSI Z21.47
	≥ 225,000 Btu/h	Maximum Capacity <sup>b</sup>	80% E <sub>t</sub>	Section 2.39, Thermal Efficiency, ANSI Z21.47
Warm-Air Furnace, oil-Fired	< 225,000 Btu/h	Maximum Capacity <sup>b</sup>	78% AFUE or 80% E <sub>t</sub>	DOE 10 CFR Part 430 or Section 42, Combustion, UL 727
	≥ 225,000 Btu/h	Maximum Capacity <sup>b</sup>	81% E <sub>t</sub>	Section 42, Combustion, UL 727
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity <sup>b</sup>	80% E <sub>c</sub>	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity <sup>b</sup>	80% E <sub>c</sub>	Section 2.10, Efficiency, ANSI Z83.8
Warm-Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity <sup>b</sup>	80% E <sub>c</sub>	Section 40, Combustion, UL 731

<sup>a</sup> Applicable test procedure and reference year are provided under the definitions.

<sup>b</sup> Compliance of multiple firing rate units shall be at maximum firing rate.

<sup>c</sup> Combustion units not covered by NAECA (3-phase power or cooling capacity greater than or equal to 19 kW) may comply with either rating.

<sup>d</sup> E<sub>t</sub> = thermal efficiency. Units must also include an interrupted or intermittent ignition device (IID), have jacket losses not exceeding 0.75% of the input rating, and have either power venting or a flue damper. A vent damper is an acceptable alternative to a flue damper for those furnaces where combustion air is drawn from the conditioned space.

<sup>e</sup> E<sub>c</sub> = combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

<sup>f</sup> As of August 8, 2008, according to the Energy Policy Act of 2005, units must also include interrupted or intermittent ignition device (IID) and have either power venting or an automatic flue damper.

TABLE 110.2-K Gas- and Oil-Fired Boilers, Minimum Efficiency requirements

Equipment Type	Sub Category	Size Category (Input)	Minimum Efficiency <sup>b,c</sup>		Test Procedure <sup>a</sup>
			Before 3/2/2020	After 3/2/2020	
Boiler, hot water	Gas-Fired	< 300,000 Btu/h	82% AFUE	<u>82% AFUE</u>	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h <sup>d</sup>	80% E <sub>t</sub>	<u>80% E<sub>t</sub></u>	DOE 10 CFR Part 431
		> 2,500,000 Btu/h <sup>e</sup>	82% E <sub>c</sub>	<u>82% E<sub>c</sub></u>	
	Oil-Fired	< 300,000 Btu/h	84% AFUE	<u>84% AFUE</u>	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h <sup>d</sup>	82% E <sub>t</sub>	<u>82% E<sub>t</sub></u>	DOE 10 CFR Part 431
		> 2,500,000 Btu/h <sup>e</sup>	84% E <sub>c</sub>	<u>84% E<sub>c</sub></u>	
Boiler, steam	Gas-Fired	< 300,000 Btu/h	80% AFUE	<u>80% AFUE</u>	DOE 10 CFR Part 430
	Gas-Fired all, except natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h <sup>d</sup>	79% E <sub>t</sub>	<u>79% E<sub>t</sub></u>	DOE 10 CFR Part 431
		> 2,500,000 Btu/h <sup>e</sup>	79% E <sub>t</sub>	<u>79% E<sub>t</sub></u>	DOE 10 CFR Part 431
	Gas-Fired, natural draft	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h <sup>d</sup>	77% E <sub>t</sub>	<u>79% E<sub>t</sub></u>	DOE 10 CFR Part 431
		> 2,500,000 Btu/h <sup>e</sup>	77% E <sub>t</sub>	<u>79% E<sub>t</sub></u>	DOE 10 CFR Part 431
	Oil-Fired	< 300,000 Btu/h	82% AFUE	<u>82% AFUE</u>	DOE 10 CFR Part 430
		≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h <sup>d</sup>	81% E <sub>t</sub>	<u>81% E<sub>t</sub></u>	DOE 10 CFR Part 431
		> 2,500,000 Btu/h <sup>e</sup>	81% E <sub>t</sub>	<u>81% E<sub>t</sub></u>	DOE 10 CFR Part 431

<sup>a</sup> Applicable test procedure and reference year are provided under the definitions.

<sup>b</sup> E<sub>c</sub> = combustion efficiency (100% less flue losses) .See reference document for detailed information.

<sup>c</sup> E<sub>t</sub> = thermal efficiency. See test procedure for detailed information.

<sup>d</sup> Maximum capacity - minimum and maximum ratings as provided for and allowed by the unit's controls.

<sup>e</sup> Included oil-fired (residual).

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

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

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

**EXCEPTION to Section 110.3(a)1:** Residential occupancies.

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

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

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

1. **Outlet temperature controls.** On systems that have a total capacity greater than 167,000 Btu/hr, outlets that require higher than service water temperatures as listed in the ASHRAE Handbook, Applications Volume, shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature.
2. **Controls for hot water distribution systems.** Service hot water systems with circulating pumps or with electrical heat trace systems shall be capable of automatically turning off the system.
3. **Temperature controls for public lavatories.** The controls shall limit the outlet temperature at the fixtures to 110°F.
4. **Insulation.** Unfired service water heater storage tanks and backup tanks for solar water-heating systems shall have:
  - A. External insulation with an installed R-value of at least R-12; or
  - B. Internal and external insulation with a combined R-value of at least R-16; or
  - C. The heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.
5. **Water Heating Recirculation Loops Serving Multiple Dwelling Units, High-Rise Residential, Hotel/Motel and Nonresidential Occupancies.** A water heating recirculation loop is a type of hot water distribution system that reduces the time needed to deliver hot water to fixtures that are distant from the water heater, boiler or other water heating equipment. The recirculation loop is comprised of a supply portion, connected to branches that serve multiple dwelling units, guest rooms, or fixtures and a return portion that completes the loop back to the water heating equipment. A water heating recirculation loop shall meet the following requirements:

- A. **Air release valve or vertical pump installation.** An automatic air release valve shall be installed on the recirculation loop piping on the inlet side of the recirculation pump and no more than 4 feet from the pump. This valve shall be mounted on top of a vertical riser at least 12" in length and shall be accessible for replacement and repair. Alternatively, the pump shall be installed on a vertical section of the return line.
  - B. **Recirculation loop backflow prevention.** A check valve or similar device shall be located between the recirculation pump and the water heating equipment to prevent water from flowing backwards through the recirculation loop.
  - C. **Equipment for pump priming.** A hose bibb shall be installed between the pump and the water heating equipment. An isolation valve shall be installed between the hose bibb and the water heating equipment. This hose bibb is used for bleeding air out of the pump after pump replacement.
  - D. **Pump isolation valves.** Isolation valves shall be installed on both sides of the pump. These valves may be part of the flange that attaches the pump to the pipe. One of the isolation valves may be the same isolation valve as in Item C.
  - E. **Cold water supply and recirculation loop connection to hot water storage tank.** Storage water heaters and boilers shall be plumbed in accordance with the manufacturer's specifications. The cold water piping and the recirculation loop piping shall not be connected to the hot water storage tank drain port.
  - F. **Cold water supply backflow prevention.** A check valve shall be installed on the cold water supply line between the hot water system and the next closest tee on the cold water supply line. The system shall comply with the expansion tank requirements as described in the California Plumbing Code Section 608.3.
6. **Service water heaters in state buildings.** Any newly constructed building constructed by the State shall derive its service water heating from a system that provides at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy.
- EXCEPTION to Section 110.3(c)6:** Buildings for which the state architect determines that service water heating from site solar energy or recovered energy is economically or physically infeasible.
7. **Isolation valves.** Instantaneous water heaters with an input rating greater than 6.8 kBTU/hr (2 kW) shall have isolation valves on both the cold water supply and the hot water pipe leaving the water heater, and hose bibbs or other fittings on each valve for flushing the water heater when the valves are closed.

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## SECTION 110.4 – MANDATORY REQUIREMENTS FOR POOL AND SPA SYSTEMS AND EQUIPMENT

(a) Certification by Manufacturers. Any pool or spa heating system or equipment may be installed only if the manufacturer has certified that the system or equipment has all of the following:

1. Efficiency. A thermal efficiency that complies with the Appliance Efficiency Regulations; and
2. On-off switch. A readily accessible on-off switch, mounted on the outside of the heater that allows shutting off the heater without adjusting the thermostat setting; and
3. Instructions. A permanent, easily readable, and weatherproof plate or card that gives instruction for the energy efficient operation of the pool or spa heater and for the proper care of pool or spa water when a cover is used; and
4. Electric resistance heating. No electric resistance heating; and

**EXCEPTION 1 to Section 110.4(a)4:** Listed package units with fully insulated enclosures, and with tight-fitting covers that are insulated to at least R-6.

**EXCEPTION 2 to Section 110.4(a)4:** Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.

(b) Installation. Any pool or spa system or equipment shall be installed with all of the following:

1. Piping. At least 36 inches of pipe shall be installed between the filter and the heater or dedicated suction and return lines, or built-in or built-up connections shall be installed to allow for the future addition of solar heating equipment; and
2. Covers. A cover for outdoor pools or outdoor spas that have a heat pump or gas heater.
3. Directional inlets and time switches for pools. If the system or equipment is for a pool:
  - i. The pool shall have directional inlets that adequately mix the pool water; and
  - ii. A time switch or similar control mechanism shall be installed as part of a pool water circulation control system that will allow all pumps to be set or programmed to run only during the off-peak electric demand period and for the minimum time necessary to maintain the water in the condition required by applicable public health standards.

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**SECTION 110.5 – NATURAL GAS CENTRAL FURNACES, COOKING EQUIPMENT, AND POOL AND SPA HEATERS: PILOT LIGHTS PROHIBITED**

Any natural gas system or equipment listed below may be installed only if it does not have a continuously burning pilot light:

- (a) Fan-type central furnaces.
- (b) Household cooking appliances.

**EXCEPTION to Section 110.5(b):** Household cooking appliances without an electrical supply voltage connection and in which each pilot consumes less than 150 Btu/hr.

- (c) Pool heaters.
- (d) Spa heaters.

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## SECTION 110.6 – MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

- (a) **Certification of Fenestration Products and Exterior Doors other than Field-fabricated.** Any fenestration product and exterior door, other than field-fabricated fenestration products and field-fabricated exterior doors, may be installed only if the manufacturer has certified to the Commission, or if an independent certifying organization approved by the Commission has certified that the product complies with all of the applicable requirements of this subsection.
1. **Air leakage.** Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft<sup>2</sup> of window area, 0.3 cfm/ft<sup>2</sup> of door area for residential doors, 0.3 cfm/ft<sup>2</sup> of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft<sup>2</sup> for nonresidential double doors (swinging), when tested according to NFRC-400 or ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft<sup>2</sup>), incorporated herein by reference.

### NOTES TO SECTION 110.6(a)1:

1. Pet doors must meet 0.3 cfm/ft<sup>2</sup> when tested according to ASTM E283 at 75 pascals (or 1.57 pounds/ft<sup>2</sup>).
2. AAMA/WDMA/CSA 101/I.S.2/A440-2011 specification is equivalent to ASTM E283 at a pressure differential of 75 pascals (or 1.57 pounds/ft<sup>2</sup>) satisfies the air leakage certification requirements of this section.

**EXCEPTION to Section 110.6(a)1:** Field-fabricated fenestration and field-fabricated exterior doors.

2. **U-factor.** The fenestration product's U-factor shall be rated in accordance with NFRC 100, or use the applicable default U-factor set forth in TABLE 110.6-A.

**EXCEPTION 1 to Section 110.6(a)2:** If the fenestration product is a ~~vertical~~ skylight or is a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

**EXCEPTION 2 to Section 110.6(a)2:** If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default U-factor may be calculated as set forth in Reference Nonresidential Appendix NA6.

3. **Solar Heat Gain Coefficient (SHGC).** The fenestration product's SHGC shall be rated in accordance with NFRC 200, or use the applicable default SHGC set forth in TABLE 110.6-B.

**EXCEPTION 1 to Section 110.6(a)3:** If the fenestration product is a skylight or is a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of site-built fenestration, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

**EXCEPTION 2 to Section 110.6(a)3:** If the fenestration product is an alteration consisting of any area replacement of glass in a skylight product or in a vertical site-built fenestration product, in a building covered by the nonresidential standards, the default SHGC may be calculated as set forth in Reference Nonresidential Appendix NA6.

4. **Visible Transmittance (VT).** The fenestration product's VT shall be rated in accordance with NFRC 200 or ASTM E972, for tubular skylights VT shall be rated using NFRC 203.

**EXCEPTION 1 to Section 110.6(a)4:** If the fenestration product is a skylight or is a vertical site-built fenestration product in a building covered by the nonresidential standards with less than 1,000 square feet of



site-built fenestration, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

**EXCEPTION 2 to Section 110.6(a)4:** If the fenestration product is an alteration consisting of any area; replacement of glass in a skylight product or in a vertical site-built fenestration product in a building covered by the nonresidential standards, the default VT may be calculated as set forth in Reference Nonresidential Appendix NA6.

**5. Labeling.** Fenestration products shall:

- A. Have a temporary label for manufactured fenestration products or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)1. The temporary label listing the certified U-factor, SHGC and VT, shall not be removed before inspection by the enforcement agency. The temporary label shall certify that the air leakage requirements of Section 110.6(a)1 are met for each product line; and
- B. Have a permanent label or a label certificate when the Component Modeling Approach (CMA) is used and for site-built fenestration meeting the requirements of Section 10-111(a)2 if the product is rated using NFRC procedures.

**6. Fenestration Acceptance Requirements.** Before an occupancy permit is granted, site-built fenestration products in other than low-rise residential buildings shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified in the Reference Nonresidential Appendix NA7 to ensure that site-built fenestration meet Standards requirements, including a matching label certificate for product(s) installed and be readily accessible at the project location. A Certificate of Acceptance certifying that the fenestration product meets the acceptance requirements shall be completed, signed and submitted to the enforcement agency.

**EXCEPTION to Section 110.6(a):** Fenestration products removed and reinstalled as part of a building alteration or addition.

- (b) **Installation of Field-fabricated Fenestration and Exterior Doors.** Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance for the installation using U-factors from TABLE 110.6-A and SHGC values from TABLE 110.6-B. Field-fabricated fenestration and field-fabricated exterior doors shall be caulked between the fenestration products or exterior door and the building, and shall be weatherstripped.

**EXCEPTION to Section 110.6(b):** Unframed glass doors and fire doors need not be weather stripped or caulked.

TABLE 110.6-A DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME	PRODUCT TYPE	SINGLE PANE <sup>3,4</sup> U-FACTOR	DOUBLE PANE <sup>1,3,4</sup> U-FACTOR	GLASS BLOCK <sup>2,3</sup> U-FACTOR
Metal	Operable	1.28	0.79	0.87
	Fixed	1.19	0.71	0.72
	Greenhouse/garden window	2.26	1.40	N.A.
	Doors	1.25	0.77	N.A.
	Skylight	1.98	1.30	N.A.
Metal, Thermal Break	Operable	N.A.	0.66	N.A.
	Fixed	N.A.	0.55	N.A.
	Greenhouse/garden window	N.A.	1.12	N.A.
	Doors	N.A.	0.59	N.A.
	Skylight	N.A.	1.11	N.A.
Nonmetal	Operable	0.99	0.58	0.60
	Fixed	1.04	0.55	0.57
	Doors	0.99	0.53	N.A.
	Greenhouse/garden windows	1.94	1.06	N.A.
	Skylight	1.47	0.84	N.A.
<p>1. For all dual-glazed fenestration products, adjust the listed U-factors as follows:</p> <p>a. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide.</p> <p>b. Add 0.05 to any product with true divided lite (dividers through the panes).</p> <p>2. Translucent or transparent panels shall use glass block values when not rated by NFRC 100.</p> <p>3. Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.</p> <p>4. Windows with window film applied that is not rated by NFRC 100 shall use the default values from this table.</p>				

TABLE 110.6-B DEFAULT SOLAR HEAT GAIN COEFFICIENT (SHGC)

FRAME TYPE	PRODUCT	GLAZING	FENESTRATION PRODUCT SHGC		
			Single Pane <sup>2,3</sup> SHGC	Double Pane <sup>2,3</sup> SHGC	Glass Block <sup>1,2</sup> SHGC
Metal	Operable	Clear	0.80	0.70	0.70
	Fixed	Clear	0.83	0.73	0.73
	Operable	Tinted	0.67	0.59	N.A.
	Fixed	Tinted	0.68	0.60	N.A.
Metal, Thermal Break	Operable	Clear	N.A.	0.63	N.A.
	Fixed	Clear	N.A.	0.69	N.A.
	Operable	Tinted	N.A.	0.53	N.A.
	Fixed	Tinted	N.A.	0.57	N.A.
Nonmetal	Operable	Clear	0.74	0.65	0.70
	Fixed	Clear	0.76	0.67	0.67
	Operable	Tinted	0.60	0.53	N.A.
	Fixed	Tinted	0.63	0.55	N.A.
1 Translucent or transparent panels shall use glass block values when not rated by NFRC 200.					
2. Visible Transmittance (VT) shall be calculated by using Reference Nonresidential Appendix NA6.					
3. Windows with window film applied that is not rated by NFRC 200 shall use the default values from this table					

## SECTION 110.7 – MANDATORY REQUIREMENTS TO LIMIT AIR LEAKAGE

All joints, penetrations and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weather stripped, or otherwise sealed to limit infiltration and exfiltration.

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

- (a) **Insulation Certification by Manufacturers.** Any insulation shall be certified by Department of Consumer Affairs, Bureau of Home Furnishing and Thermal Insulation 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 four-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) **Flame Spread Rating of Insulation.** All insulating material shall be installed in compliance with the flame spread 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).  
**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 1203.2 of Title 24, Part 2.
  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-12, 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 605604.0 of the CMC.
- (e) **RESERVED Insulation Placement on Roof/Ceilings.** Insulation installed to limit heat loss and gain through the top of conditioned spaces shall comply with the following:
1. Insulation shall be installed in direct contact with a continuous 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; and
  2. When insulation is installed at the roof in nonresidential buildings, fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed and the space between the ceiling and the roof is either directly or indirectly conditioned space and shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements; and
  3. Insulation shall not be placed on top of a suspended ceiling with removable ceiling panels to meet the Roof/Ceiling requirement of Sections 120.7, 140.3 and 141.0; and
- EXCEPTION to Section 110.8(e)3:** When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.

4. ~~Insulation shall be installed below the roofing membrane or layer used to seal the roof from water penetration unless the insulation has a maximum water absorption of 0.3 percent by volume when tested according to ASTM Standard C272.~~

**NOTE:** Vents, that do not penetrate the roof deck, that are designed for wind resistance for roof membranes are not within the scope of Section 110.8(e)2.

- (f) ~~RESERVED~~ **Insulation for Demising Walls in Nonresidential Buildings.** The opaque portions of framed demising walls in nonresidential buildings shall be insulated with an installed R-value of no less than R-13 between framing members.
- (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 are 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.

**TABLE 110.8-A SLAB INSULATION REQUIREMENTS FOR HEATED SLAB FLOOR**

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

- (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.
- (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)1H 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  $\rho_{\text{aged}} = [0.2 + \beta[\rho_{\text{initial}} - 0.2]]$ , where  $\rho_{\text{initial}}$  = the initial solar reflectance and soiling resistance  $\beta$  is listed by product type in TABLE 110.8-B.

**TABLE 110.8-B VALUES OF SOILING RESISTANCE  $\beta$  BY PRODUCT TYPE**

Product Type	CRRC Product Category	$\beta$
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 E 1980-01, may be used as an alternative to thermal emittance and an aged solar reflectance when complying with the requirements of Sections 140.1, 140.2, 140.3(a)1, 141.0(b)2B, 150.1(c)11, 150.2(b)1H, 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 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 or ASTM D6848 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.

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

Physical Property	ASTM Test Procedure	Requirement
Initial percent elongation (break)	D 2370	Minimum 200% @ 73° F (23° C)
Initial percent elongation (break) OR Initial Flexibility	D 2370  D522, Test B	Minimum 60% @ 0° F (-18° C)  Minimum pass 1" mandrel @ 0° F (-18° C)
Initial tensile strength (maximum stress)	D 2370	Minimum 100 psi (1.38 Mpa) @ 73° F (23° C)
Initial tensile strength (maximum stress) OR Initial Flexibility	D 2370  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 1000 h OR Flexibility after accelerated weathering 1000h	D2370  D522, Test B	Minimum 40% @ 0° F (-18° C)  Minimum pass 1" mandrel @ 0° F (-18° C)
Permeance	D 1653	Maximum 50 perms
Accelerated weathering 1000 h	D 4798	No cracking or checking <sup>1</sup>
1. Any cracking or checking visible to the eye fails the test procedure.		

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.

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## SECTION 110.9 – MANDATORY REQUIREMENTS FOR LIGHTING CONTROL DEVICES AND SYSTEMS, BALLASTS, AND LUMINAIRES

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- (a) All lighting control devices and systems, ballasts, and luminaires subject to the requirements of Section 110.9 shall meet the following requirements:
1. Shall be installed only if the lighting control device or system, ballast, or luminaire complies with all of the applicable requirements of Section 110.9.
  2. Lighting controls may be individual devices (Self Contained Lighting Control) or systems (Lighting Control Systems) consisting of two or more components.
  3. Self Contained Lighting Controls, as defined in Section 100.1, shall be certified by the Manufacturer as required by the Title 20 Appliance Efficiency Regulations.
  4. Lighting Control Systems, as defined in Section 100.1, shall be a fully functional lighting control system complying with the applicable requirements in Section 110.9(b), and shall meet the Lighting Control Installation requirements in Section 130.4.
  5. If indicator lights are integral to a lighting control system, they shall consume no more than one watt of power per indicator light.
- (b) All Installed Lighting Control Systems listed in Section 110.9(b) shall comply with the requirements listed below; and all components of the system considered together as installed shall meet all applicable requirements for the application for which they are installed as required in Sections 130.0 through 130.5, Sections 140.6 through 140.8, Section 141.0, and Section 150.0(k).
1. **Time-Switch Lighting Controls**
    - A. **Automatic Time-Switch Controls** shall meet all requirements for Automatic Time Switch Control devices in the Title 20 Appliance Efficiency Regulations.
    - B. **Astronomical Time-Switch Controls** shall meet all requirements for Astronomical Time-Switch Control devices in the Title 20 Appliance Efficiency Regulations.
    - C. **Multi-Level Astronomical Time-Switch Controls**, in addition to meeting all of the requirements for Astronomical Time-Switch Controls, shall include at least 2 separately programmable steps per zone.
    - D. **Outdoor ~~Outdoor~~ Astronomical Time-Switch Controls**, in addition to meeting all of the requirements for Astronomical Time-Switch Controls, shall have setback functions that allow the lighting on each controlled channel to be switched or dimmed to lower levels. The set back functions shall be capable of being programmed by the user for at least one specific time of day.
  2. **Daylighting Controls**
    - A. **Automatic Daylight Controls** shall meet all requirements for Automatic Daylight Control devices in the Title 20 Appliance Efficiency Regulations.
    - B. **Photo Controls** shall meet all requirements for Photo Control devices in the Title 20 Appliance Efficiency Regulations.
  3. **Dimmers** shall meet all requirements for Dimmer Control devices in the Title 20 Appliance Efficiency Regulations.
  4. **Occupant Sensing Controls:** Occupant, Motion, and Vacancy Sensor Controls shall meet the following requirements:
    - A. **Occupant Sensors** shall meet all applicable requirements for Occupant Sensor Control devices in the Title 20 Appliance Efficiency Regulations.



- B. **Motion Sensors** shall meet all applicable requirements for Motion Sensor Controls devices in the Title 20 Appliance Efficiency Regulations.
- C. **Vacancy Sensors** shall meet all applicable requirements for Vacancy Sensor Controls devices in the Title 20 Appliance Efficiency Regulations.
- D. **Partial-ON Sensors** shall meet all applicable requirements for partial on sensing devices in the Title 20 Appliance Efficiency Regulations.
- E. **Partial-OFF Sensors** shall meet all applicable requirements for partial off sensing devices in the Title 20 Appliance Efficiency Regulations.
- F. All Occupant Sensing Control types shall be programmed to turn OFF all or part of the lighting no longer than 20 minutes after the space is vacated of occupants, except as specified by the applicable controls requirements of Section 130.1(c)8.

**EXCEPTION to Section 110.9(b)4:** Occupant Sensing Control systems may consist of a combination of single or multi-level Occupant, Motion, or Vacancy Sensor Controls, provided that components installed to comply with manual-on requirements shall not be capable of conversion by the user from manual-on to automatic-on functionality.

- 5. **Part-Night Outdoor Lighting Controls**, as defined in Section 100.1, shall meet all of the following requirements:
  - A. Have sunrise and sunset prediction accuracy within +/- 15 minutes and timekeeping accuracy within five minutes per year; and
  - B. Have the ability to setback or turn off lighting at night as required in Section 130.2(c), by means of a programmable timeclock or motion sensing device; and
  - C. When controlled with a timeclock, shall be capable of being programmed to allow the setback or turning off of the lighting to occur from any time at night until any time in the morning, as determined by the user.
- (c) **Track Lighting Integral Current Limiter.** An integral current limiter for line-voltage track lighting shall be recognized for compliance with Part 6 only if it meets all of the following requirements:
  - 1. Shall be certified to the Energy Commission as meeting all of the applicable requirements in Section 110.9(c); and
  - 2. Shall comply with the Lighting Control Installation requirements in accordance with Section 130.4; and
  - 3. Shall be manufactured so that the current limiter housing is used exclusively on the same manufacturer's track for which it is designed; and
  - 4. Shall be designed so that the current limiter housing is permanently attached to the track so that the system will be irreparably damaged if the current limiter housing were to be removed after installation into the track. Methods of attachment may include but are not limited to one-way barbs, rivets, and one-way screws; and
  - 5. Shall employ tamper resistant fasteners for the cover to the wiring compartment; and
  - 6. Shall have the identical volt-ampere (VA) rating of the current limiter, as installed and rated for compliance with Part 6 clearly marked as follows; and:
    - A. So that it is visible for the ~~building officials'~~enforcement agency's field inspection without opening coverplates, fixtures, or panels; and
    - B. Permanently marked on the circuit breaker; and
    - C. On a factory-printed label that is permanently affixed to a non-removable base-plate inside the wiring compartment.
  - 7. Shall have a conspicuous factory installed label permanently affixed to the inside of the wiring compartment warning against removing, tampering with, rewiring, or bypassing the device; and

8. Each electrical panel from which track lighting integral current limiters are energized shall have a factory printed label permanently affixed and prominently located, stating the following: "NOTICE: Current limiting devices installed in track lighting integral current limiters connected to this panel shall only be replaced with the same or lower amperage. Adding track or replacement of existing current limiters with higher continuous ampere rating will void the track lighting integral current limiter certification, and will require re-submittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."
- (d) **Track Lighting Supplementary Overcurrent Protection Panel.** A Track Lighting Supplementary Overcurrent Protection Panel shall be used only for line-voltage track lighting and shall be recognized for compliance with Part 6 only if it meets all of the following requirements:
  1. Shall comply with the Lighting Control Installation requirements in accordance with Section 130.4; and
  2. Shall be listed as defined in Section 100.1; and
  3. Shall be used only for line voltage track lighting. No other lighting or building power shall be used in a Supplementary Overcurrent Protection Panel used to determine input wattage for track lighting; and
  4. Be permanently installed in an electrical equipment room, or permanently installed adjacent to the lighting panel board providing supplementary overcurrent protection for the track lighting circuits served by the supplementary over current protection pane; and
  5. Shall have a permanently installed label that is prominently located stating the following: "NOTICE: This Panel for Track Lighting Energy Code Compliance Only. The overcurrent protection devices in this panel shall only be replaced with the same or lower amperage. No other overcurrent protective device shall be added to this panel. Adding to, or replacement of existing overcurrent protective device(s) with higher continuous ampere rating, will void the panel listing and require re-submittal of compliance documentation to the enforcement agency responsible for compliance with the California Title 24, Part 6 Building Energy Efficiency Standards."
- (e) **~~Residential JA8 High Efficacy Light Emitting Diode (LED) Lighting Sources.~~** To qualify as JA8 high efficacy light source for compliance with the residential lighting Standards in Section 150.0(k), a residential LED luminaire or LED light engine light source shall be certified to the Energy Commission according to Reference Joint Appendix JA-8. LED lighting not certified to the Energy Commission shall be classified as low efficacy for compliance with Section 150.0(k). ~~Nonresidential LED lighting light sources is are not required to be certified to the Energy Commission.~~
- (f) **Ballasts for Residential Recessed Luminaires.** To qualify as high efficacy for compliance with Section 150.0(k), any compact fluorescent lamp ballast in a residential recessed luminaire shall meet all of the following conditions:
  1. Be rated by the ballast manufacturer to have a minimum rated life of 30,000 hours when operated at or below a specified maximum case temperature. This maximum ballast case temperature specified by the ballast manufacturer shall not be exceeded when tested in accordance to UL 1598 Section 19.15; and
  2. Have a ballast factor of not less than 0.90 for non-dimming ballasts and a ballast factor of not less than 0.85 for dimming ballasts.

## SECTION 110.10 – MANDATORY REQUIREMENTS FOR SOLAR READY BUILDINGS

### (a) Covered Occupancies.

1. **Single Family Residences.** Single family residences located in subdivisions with ten or more single family residences and where the application for a tentative subdivision map for the residences has been deemed complete, by the enforcement agency, on or after January 1, 2014, shall comply with the requirements of Section 110.10(b) through 110.10(e).
2. **Low-rise Multi-family Buildings.** Low-rise multi-family buildings shall comply with the requirements of Section 110.10(b) through 110.10(d).
3. **Hotel/Motel Occupancies and High-rise Multi-family Buildings.** Hotel/motel occupancies and high-rise multi-family buildings with ten habitable stories or fewer shall comply with the requirements of Section 110.10(b) through 110.10(d).
4. **All Other Nonresidential Buildings.** All other nonresidential buildings with three habitable stories or fewer shall comply with the requirements of Section 110.10(b) through 110.10(d).

### (b) Solar Zone.

1. **Minimum Area.** The solar zone shall have a minimum total area as described below. The solar zone shall comply with access, pathway, smoke ventilation, and spacing requirements as specified in Title 24, Part 9 or other Parts of Title 24 or in any requirements adopted by a local jurisdiction. The solar zone total area shall be comprised of areas that have no dimension less than five feet and are no less than 80 square feet each for buildings with roof areas less than or equal to 10,000 square feet or no less than 160 square feet each for buildings with roof areas greater than 10,000 square feet.

- A. **Single Family Residences.** The solar zone shall be located on the roof or overhang of the building and have a total area no less than 250 square feet.

**EXCEPTION 1 to Section 110.10(b)1A:** Single family residences with a permanently installed solar electric system having a nameplate DC power rating, measured under Standard Test Conditions, of no less than 1000 watts.

**EXCEPTION 2 to Section 110.10(b)1A:** Single family residences with a permanently installed domestic solar water-heating system meeting the installation criteria specified in the Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.50.

**EXCEPTION 3 to Section 110.10(b)1A:** Single family residences with three habitable stories or more and with a total floor area less than or equal to 2000 square feet and having a solar zone total area no less than 150 square feet.

**EXCEPTION 4 to Section 110.10(b)1A:** Single family residences located in Climate zones 8-14 and the Wildland-Urban Interface Fire Area as defined in Title 24, Part 2 and having a whole house fan and having a solar zone total area no less than 150 square feet.

**EXCEPTION 5 to Section 110.10(b)1A:** Buildings with a designated solar zone area that is no less than 50 percent of the potential solar zone area. The potential solar zone area is the total area of any low-sloped roofs where the annual solar access is 70 percent or greater and any steep-sloped roofs oriented between 110 degrees and 270 degrees of true north where the annual solar access is 70 percent or greater. Solar access is the ratio of solar insolation including shade to the solar insolation without shade. Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

**EXCEPTION 6 to Section 110.10(b)1A:** Single family residences having a solar zone total area no less than 150 square feet and where all thermostats comply with Reference Joint Appendix JA5 and are capable of receiving and responding to Demand Response Signals prior to granting of an occupancy permit by the enforcing agency.

**EXCEPTION 7 to Section 110.10(b)1A:** Single family residences meeting the following conditions:

- A. All thermostats comply with Reference Joint Appendix JAS and are capable of receiving and responding to Demand Response Signals prior to granting of an occupancy permit by the enforcing agency.
- B. ~~Comply with one of the following measures. All applicable requirements of Section 150.0(k), except as required below:~~
- ~~i. Install a dishwasher that meets or exceeds the ENERGY STAR Program requirements with either a refrigerator that meets or exceeds the ENERGY STAR Program requirements or a whole house fan driven by an electronically commutated motor; or~~
  - ~~ii. Install a home automation system capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; or~~
  - ~~iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the California Plumbing Code and any applicable local ordinances; or~~
  - ~~i. Install a rainwater catchment system designed to comply with the California Plumbing Code and any applicable local ordinances, and that uses rainwater flowing from at least 65 percent of the available roof area. All permanently installed indoor lighting is high efficacy as defined in TABLE 150.0-A or 150.0-B and is installed in kitchens, bathrooms, utility rooms, and garages at a minimum.~~
  - ~~ii. All permanently installed lighting in bathrooms is controlled by a vacancy sensor.~~
  - ~~iii. EXCEPTION to EXCEPTION 7Bii: One high efficacy luminaire as defined in TABLE 150.0-A or 150.0-B with total lamp wattage rated to consume no greater than 26 watts of power is not required to be controlled by a vacancy sensor.~~
  - ~~iv. Every room which does not have permanently installed lighting has at least one switched receptacle installed.~~
  - ~~v. Permanently installed night lights complying with Section 150.0(k)1F are allowed.~~
  - ~~vi. Lighting integral to exhaust fans complying with Section 150.0(k)1F is allowed.~~
  - ~~vii. All permanently installed outdoor lighting is high efficacy as defined in TABLE 150.0-A or 150.0-B and is controlled as required in Section 150.0(k)9Ai and iii.~~
- B. **Low-rise and High-rise Multi-family Buildings, Hotel/Motel Occupancies, and Nonresidential Buildings.** The solar zone shall be located on the roof or overhang of the building or on the roof or overhang of another structure located within 250 feet of the building or on covered parking installed with the building project and have a total area no less than 15 percent of the total roof area of the building excluding any skylight area.

**EXCEPTION 1 to Section 110.10(b)1B:** Buildings with a permanently installed solar electric system having a nameplate DC power rating, measured under Standard Test Conditions, of no less than one watt per square foot of roof area.

**EXCEPTION 2 to Section 110.10(b)1B:** Buildings with a permanently installed domestic solar water-heating system complying with Section 150.1(c)8Ciii.

**EXCEPTION 3 to Section 110.10(b)1B:** Buildings with a designated solar zone area that is no less than 50 percent of the potential solar zone area. The potential solar zone area is the total area of any low-sloped roofs where the annual solar access is 70 percent or greater and any steep-sloped roofs oriented between 110 degrees and 270 degrees of true north where the annual solar access is 70 percent or greater. Solar access is the ratio of solar insolation including shade to the solar insolation without shade. Shading from obstructions located on the roof or any other part of the building shall not be included in the determination of annual solar access.

**EXCEPTION 4 to Section 110.10(b)1B:** Low-rise and high-rise multifamily buildings meeting the following conditions:

- A. All thermostats in each dwelling unit comply with Reference Joint Appendix JA5 and are capable of receiving and responding to Demand Response Signals prior to granting of an occupancy permit by the enforcing agency.
- B. ~~C~~In each dwelling unit, comply with one of the following measures. All applicable requirements of Section 150.0(c), except as required below:
- i. Install a dishwasher that meets or exceeds the ENERGY STAR Program requirements with either a refrigerator that meets or exceeds the ENERGY STAR Program requirements or a whole house fan driven by an electronically commutated motor; or
  - ii. Install a home automation system capable of, at a minimum, controlling the appliances and lighting of the dwelling and responding to demand response signals; or
  - iii. Install alternative plumbing piping to permit the discharge from the clothes washer and all showers and bathtubs to be used for an irrigation system in compliance with the California Plumbing Code and any applicable local ordinances; or
  - iv. Install a rainwater catchment system designed to comply with the California Plumbing Code and any applicable local ordinances, and that uses rainwater flowing from at least 65 percent of the available roof area.

~~All permanently installed indoor lighting in each dwelling unit is high efficacy as defined in TABLE 150.0-A or 150.0-B and is installed in kitchens, bathrooms, utility rooms, and private garages at a minimum.~~

~~All permanently installed lighting in bathrooms is controlled by a vacancy sensor.~~

~~EXCEPTION to EXCEPTION 4Bii: One high efficacy luminaire as defined in TABLE 150.0-A or 150.0-B with total lamp wattage rated to consume no greater than 26 watts of power is not required to be controlled by a vacancy sensor.~~

~~Every room which does not have permanently installed lighting has at least one switched receptacle installed.~~

~~Permanently installed night lights complying with Section 150.0(c)1E are allowed.~~

~~Lighting integral to exhaust fans complying with Section 150.0(c)1F is allowed.~~

~~All permanently installed outdoor lighting for private patios, entrances, balconies, and porches is high efficacy as defined in TABLE 150.0-A or 150.0-B and is controlled as required in Section 150.0(c)9Ai and iii.~~

**EXCEPTION 5 to Section 110.10(b)1B:** Buildings where the roof is designed and approved to be used for vehicular traffic or parking or for a heliport.

2. **Orientation.** All sections of the solar zone located on steep-sloped roofs shall be oriented between 110 degrees and 270 degrees of true north.
3. **Shading.**
  - A. No obstructions, including but not limited to, vents, chimneys, architectural features, and roof mounted equipment, shall be located in the solar zone.
  - B. Any obstruction, located on the roof or any other part of the building that projects above a solar zone shall be located at least twice the distance, measured in the horizontal plane, of the height difference between the highest point of the obstruction and the horizontal projection of the nearest point of the solar zone, measured in the vertical plane.

**EXCEPTION to Section 110.10(b)3:** Any roof obstruction, located on the roof or any other part of the building, that is oriented north of all points on the solar zone.

4. **Structural Design Loads on Construction Documents.** For areas of the roof designated as solar zone, the structural design loads for roof dead load and roof live load shall be clearly indicated on the construction documents.

**NOTE:** Section 110.10(b)4 does not require the inclusion of any collateral loads for future solar energy systems.

**(c) Interconnection Pathways.**

1. The construction documents shall indicate a location for inverters and metering equipment and a pathway for routing of conduit from the solar zone to the point of interconnection with the electrical service. For single family residences the point of interconnection will be the main service panel.
2. The construction documents shall indicate a pathway for routing of plumbing from the solar zone to the water-heating system.

**(d) Documentation.** A copy of the construction documents or a comparable document indicating the information from Sections 110.10(b) through 110.10(c) shall be provided to the occupant.**(e) Main Electrical Service Panel.**

1. The main electrical service panel shall have a minimum busbar rating of 200 amps.
2. The main electrical service panel shall have a reserved space to allow for the installation of a double pole circuit breaker for a future solar electric installation.
  - A. **Location.** The reserved space shall be positioned at the opposite (load) end from the input feeder location or main circuit location.
  - B. **Marking.** The reserved space shall be permanently marked as "For Future Solar Electric".

## **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.

## SUBCHAPTER 3

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

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### SECTION 120.0—GENERAL

Sections 120.1 through 120.9 establish requirements for the design and installation of building envelopes, ventilation, space-conditioning and service water-heating systems and equipment in nonresidential, high-rise residential, and hotel/motel buildings as well as covered processes that are subject to Title 24, Part 6 within the scope of Section 100.0(a). ~~All such buildings and covered processes shall comply with the applicable provisions of Sections 120.1 through 120.9.~~

**NOTE:** The requirements of Sections 120.1 through 120.9 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 120.1 through 120.9 also apply to additions or alterations to existing buildings.



## SECTION 120.1 – REQUIREMENTS FOR VENTILATION

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

### (a) General Requirements.

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

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

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

### (b) Design Requirements for Minimum Quantities of Outdoor Air. Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:

#### 1. Natural ventilation.

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

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

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

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

- A. The conditioned floor area of the space times the applicable ventilation rate from TABLE 120.1-A; or
- B. 15 cfm per person times the expected number of occupants.

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

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

- A. None of the spaces from which air is transferred have any unusual sources of indoor air contaminants; and
- B. The outdoor air that is supplied to all spaces combined, is sufficient to meet the requirements of Section 120.1(b)2 for each space individually.

### (c) Operation and Control Requirements for Minimum Quantities of Outdoor Air.

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

**EXCEPTION 1 to Section 120.1(c)1:** Demand control ventilation. In intermittently occupied spaces that do not have processes or operations that generate dusts, fumes, mists, vapors or gasses and are not provided with local exhaust ventilation (such as indoor operation of internal combustion engines or areas designated for unvented food service preparation), the rate of outdoor air may be reduced if the ventilation system

serving the space is controlled by a demand control ventilation device complying with Section 120.1(c)4 or by an occupant sensor ventilation control device complying with Section 120.1(c)5.

**EXCEPTION 2 to Section 120.1(c)1:** Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 120.1(b)2 for up to 30 minutes at a time if the average rate for each hour is equal to or greater than the required ventilation rate.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 120.1(b)2 or three complete air changes shall be supplied to the entire building during the 1-hour period immediately before the building is normally occupied.
3. **Required Demand Control Ventilation.** HVAC systems with the following characteristics shall have demand ventilation controls complying with 120.1(c)4:
  - A. They have an air economizer; and
  - B. They serve a space with a design occupant density, or a maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1000 square feet (40 square feet or less per person); and
  - C. They are either:
    - i. Single zone systems with any controls; or
    - ii. Multiple zone systems with Direct Digital Controls (DDC) to the zone level.

**EXCEPTION 1 to Section 120.1(c)3:** Classrooms, call centers, office spaces served by multiple zone systems that are continuously occupied during normal business hours with occupant density greater than 25 people per 1000 ft<sup>2</sup> per as specified by Section 120.1(b)2B, healthcare facilities and medical buildings, and public areas of social services buildings are not required to have demand control ventilation.

**EXCEPTION 2 to Section 120.1(c)3:** Where space exhaust is greater than the design ventilation rate specified in Section 120.1(b)2B minus 0.2 cfm per ft<sup>2</sup> of conditioned area.

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

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

**EXCEPTION 5 to Section 120.1(c)3:** Spaces with an area of less than 1,500 square feet complying with Section 120.1(c)5.

4. **Demand Control Ventilation Devices.**
  - A. For each system with demand control ventilation, CO<sub>2</sub> sensors shall be installed in each room that meets the criteria of Section 120.1(c)3 with no less than one sensor per 10,000 ft<sup>2</sup> of floor space. When a zone or a space is served by more than one sensor, signal from any sensor indicating that CO<sub>2</sub> is near or at the setpoint within a space, shall trigger an increase in ventilation to the space;
  - B. CO<sub>2</sub> sensors shall be located in the room between 3 ft and 6 ft above the floor or at the anticipated height of the occupants heads;
  - C. Demand ventilation controls shall maintain CO<sub>2</sub> concentrations less than or equal to 600 ppm plus the outdoor air CO<sub>2</sub> concentration in all rooms with CO<sub>2</sub> sensors;

**EXCEPTION to Section 120.1(c)4C:** The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 120.1(b)2 regardless of CO<sub>2</sub> concentration.
  - D. Outdoor air CO<sub>2</sub> concentration shall be determined by one of the following:
    - i. CO<sub>2</sub> concentration shall be assumed to be 400 ppm without any direct measurement; or
    - ii. CO<sub>2</sub> concentration shall be dynamically measured using a CO<sub>2</sub> sensor located within 4 ft of the outdoor air intake.

- E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in TABLE 120.1-A times the conditioned floor area for spaces with CO<sub>2</sub> sensors, plus the rate required by Section 120.1(b)2 for other spaces served by the system, or the exhaust air rate whichever is greater;
  - F. CO<sub>2</sub> sensors shall be certified by the manufacturer to be accurate within plus or minus 75 ppm at a 600 and 1000 ppm concentration when measured at sea level and 25°C, factory calibrated, and certified by the manufacturer to require calibration no more frequently than once every 5 years. Upon detection of sensor failure, the system shall provide a signal which resets to supply the minimum quantity of outside air to levels required by Section 120.1(b)2 to the zone serviced by the sensor at all times that the zone is occupied.
  - G. The CO<sub>2</sub> sensor(s) reading for each zone shall be displayed continuously, and shall be recorded on systems with DDC to the zone level.
5. **Occupant Sensor Ventilation Control Devices.** When occupancy sensor ventilation devices are required by Section 120.2(e)3 or when meeting EXCEPTION 5 to Section 120.1(c)3, occupant sensors shall be used to reduce the rate of outdoor air flow when occupants are not present in accordance with the following:
- A. Occupant sensors shall meet the requirements in Section 110.9(b)4 and shall have suitable coverage and placement to detect occupants in the entire space ventilated. Occupant sensors controlling lighting may be used for ventilation as long as the ventilation signal is independent of daylighting, manual lighting overrides or manual control of lighting. When a single zone damper or a single zone system serves multiple rooms, there shall be an occupancy sensor in each room and the zone is not considered vacant until all rooms in the zone are vacant.
  - B. One hour prior to normal scheduled occupancy, the occupancy sensor ventilation control shall allow pre-occupancy purge as described in Section 120.1(c)2.
  - C. Within 30 minutes after being vacant for all rooms served by a zone damper on a multiple zone system, and the space temperature is between the heating and cooling setpoints, then no outside air is required and supply air shall be zero.
  - D. Within 30 minutes after being vacant for all rooms served by a single zone system, the single zone system shall cycle off the supply fan when the space temperature is between the heating and cooling setpoints.
  - E. In spaces equipped with an occupant sensor, when vacant during hours of expected occupancy and the occupied ventilation rate required by Section 120.1(b)2 is not provided, then the system or zone controls shall cycle or operate to maintain the average outdoor air rate over an averaging period of 120 minutes equal to 25percent of the rate listed in TABLE 120.1-A.

**Exception to 120.1(c)5:** If Demand Control Ventilation is implemented as required by Section 120.1(4).

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

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

- (e) **Design and Control Requirements for Quantities of Outdoor Air.**

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

3. Measured outdoor air rates of constant volume mechanical ventilation and space-conditioning systems shall be within 10 percent of the required outside air rate.

*TABLE 120.1-A MINIMUM VENTILATION RATES*

TYPE OF USE	CFM PER SQUARE FOOT OF CONDITIONED FLOOR AREA
Auto Repair Workshops	1.50
Barber Shops	0.40
Bars, cocktail lounges, and casinos	0.20
Beauty shops	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Ventilation Rates Specified by the CBC
Hotel guest rooms (less than 500 ft <sup>2</sup> )	30 cfm/guest room
Hotel guest rooms (500 ft <sup>2</sup> or greater)	0.15
Retail stores	0.20
All others	0.15

## SECTION 120.2 – REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS

~~Space-conditioning systems~~ Nonresidential, high-rise residential, and hotel/motel buildings shall be installed with controls that comply with the applicable requirements of ~~Subsections (a) through (i)~~ 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;
2. The perimeter system is designed solely to offset envelope heat losses or gains;
3. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and
4. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

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

1. Where used to control comfort heating, the thermostatic controls shall be capable of being set, locally or remotely, down to 55°F or lower.
2. Where used to control comfort cooling, the thermostatic controls shall be capable of being set, locally or remotely, up to 85°F or higher.
3. Where used to control both comfort heating and comfort cooling, the thermostatic controls shall meet Items 1 and 2 and shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

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

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

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

**EXCEPTION 2 to Section 120.2(b)4:** ~~Gravity gas wall heaters, gravity floor heaters, gravity room heaters, non-central electric heaters, fireplaces or decorative gas appliances, wood stoves, package terminal air conditioners, package terminal heat pumps, room air conditioners, and room air-conditioner heat pumps.~~

- (c) **Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats.**

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

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

2. High-rise residential dwelling unit thermostats shall meet the requirements of Section 150.0(i).
- (d) **Heat Pump Controls.** All heat pumps with supplementary electric resistance heaters shall be installed with controls that comply with Section 110.2(b).
- (e) **Shut-off and Reset Controls for Space-conditioning Systems.** Each space-conditioning system shall be installed with controls that comply with the following:
  1. The control shall be capable of automatically shutting off the system during periods of nonuse and shall have:
    - A. An automatic time switch control device complying with Section 110.9, with an accessible manual override that allows operation of the system for up to 4 hours; or
    - B. An occupancy sensor; or
    - C. A 4-hour timer that can be manually operated.

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

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

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

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

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

3. Multipurpose room less than 1000 square feet, classrooms greater than 750 square feet and conference, convention, auditorium and meeting center rooms greater than 750 square feet that do not have processes or operations that generate dusts, fumes, vapors or gasses shall be equipped with occupant sensor(s) to accomplish the following during unoccupied periods:
  - A. Automatically setup the operating cooling temperature set point by 2°F or more and setback the operating heating temperature set point by 2°F or more; and
  - B. Automatically reset the minimum required ventilation rate with an occupant sensor ventilation control device according to Section 120.1(c)5.

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

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

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

**EXCEPTION 5 to Sections 120.2(e)3:** If Demand Control Ventilation is implemented as required by Section 120.1(c)3 and 120.1(c)4.

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 setup at least +5°F (+3°C) in cooling mode and set-down at least -5°F (-3°C) in heating mode.

- (f) **Dampers for Air Supply and Exhaust Equipment.** Outdoor air supply and exhaust equipment shall be installed with dampers that:

~~a. Automatically close upon fan shutdown; and~~

~~1. Automatically close during unoccupied periods; and~~

~~EXCEPTION 1 to Section 120.2(f)2: During pre-occupancy as specified by Section 120.1(e)2.~~

~~EXCEPTION 2 to Section 120.2(f)2: When enabled by an Occupant Sensor as specified by 120.1(e)5.~~

~~EXCEPTION 3 to Section 120.2(f)2: When enabled by an Override signal as specified by 120.2(e)1 and dampers open to provide outdoor air ventilation.~~

~~2. Remain closed during setback heating and cooling as specified by 120.2(e)2~~

~~EXCEPTION 1 to Section 120.2(f)3: When equipped with an economizer as specified by 140.4(e) and the outdoor air conditions are below the high limit shutoff in TABLE 140.4-B.~~

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

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

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

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

- (g) **Isolation Area Devices.** Each space-conditioning system serving multiple zones with a combined conditioned floor area of more than 25,000 square feet shall be designed, installed, and controlled to serve isolation areas.
1. Each zone, or any combination of zones not exceeding 25,000 square feet, shall be a separate isolation area.
  2. Each isolation area shall be provided with isolation devices, such as valves or dampers that allow the supply of heating or cooling to be reduced or shut-off independently of other isolation areas.
  3. Each isolation area shall be controlled by a device meeting the requirements of Section 120.2(e)1.
- EXCEPTION to Section 120.2(g):** A zone need not be isolated if it can be demonstrated to the satisfaction of the enforcement agency that the zone must be heated or cooled continuously.
- (h) **Automatic Demand Shed Controls.** HVAC systems with DDC to the Zone level shall be programmed to allow centralized demand shed for non-critical zones as follows:
1. The controls shall have a capability to remotely setup the operating cooling temperature set points by 4 degrees or more in all non-critical 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 setdown the operating heating temperature set points by 4 degrees or more in all non-critical 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 non-critical zones to original operating levels on signal from a centralized contact or software point within an EMCS.
  4. The controls shall be programmed to provide an adjustable rate of change for the temperature setup and reset.
  5. The controls shall have the following features:
    - A. Disabled. Disabled by authorized facility operators; and
    - B. Manual control. Manual control by authorized facility operators to allow adjustment of heating and cooling set points globally from a single point in the EMCS; and
    - C. Automatic Demand Shed Control. Upon receipt of a demand response signal, the space-conditioning systems shall conduct a centralized demand shed, as specified in Sections 120.2(h)1 and 120.2(h)2, for non-critical zones during the demand response period.

- (i) **Economizer Fault Detection and Diagnostics (FDD).** All newly installed air-cooled unitary packaged direct-expansion units with an air handler, equipped with an economizer and with mechanical cooling capacity at AHRI conditions of greater than or equal to 54,000 Btu/hr, and equipped with 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)98. Air-cooled unitary direct expansion units include packaged, split systems, heat pumps, and variable refrigerant flow (VRF), where the VRF capacity is defined by that of the condensing unit.
1. 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. 2. Temperature sensors shall have an accuracy of  $\pm 2^{\circ}\text{F}$  over the range of  $40^{\circ}\text{F}$  to  $80^{\circ}\text{F}$ ; and
  3. 3. Refrigerant pressure sensors, if used, shall have an accuracy of  $\pm 3$  percent of full scale; and
  4. 4. The controller shall have the capability of displaying the value of each sensor; and
  5. 5. The controller shall provide system status by indicating the following conditions:
    - A. Free cooling available;
    - B. Economizer enabled;
    - C. Compressor enabled;
    - D. Heating enabled, if the system is capable of heating; and
    - E. Mixed air low limit cycle active.
  6. 6. The unit controller shall manually initiate each operating mode so that the operation of compressors, economizers, fans, and heating systems can be independently tested and verified; and
  7. 7. Faults shall be reported to a fault management application accessible by day-to-day operating or service personnel, or annunciated locally on zone thermostats; and 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 remote HVAC service provider.
  8. 8. The FDD system shall detect the following faults:
    - A. Air temperature sensor failure/fault;
    - B. Not economizing when it should;
    - C. Economizing when it should not;
    - D. Damper not modulating; and
    - E. Excess outdoor air.
  9. 9. The FDD System shall be certified by the Energy Commission as meeting requirements of Sections 120.2(i)1 through 120.2(i)8-7 in accordance with Section 110.0(4) and JA6.3.

(i) **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(c) and 120.2(h), 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 zones(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 non-critical zones upon receipt of a signal from a centralized contact or software point as described in Section 120.2(h)

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 with fan system bhp of 40 hp (7.45 kW) and larger
Newly Constructed Buildings	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
Newly Constructed Buildings	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
Additions or Alterations	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
Additions or Alterations	New air handling system and all new zones served by the system	Individual systems with design heating or cooling capacity of 300 kBtu/h with fan system bhp of 40 hp (7.45 kW) and larger and supplying more than three zones and more than 75% percent of zones are new
Additions or Alterations	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
Additions or Alterations	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

(k) Optimum Start/Stop Controls. Space conditioning systems with DDC to the zone level shall have optimum start/stop controls. ~~These controls shall have access to space temperature, ambient air temperature and historical thermal lag profiles of each controlled zone.~~ 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 amount of time prior to scheduled occupancy. Mass radiant floor slab systems shall incorporate floor temperature onto the optimum start algorithm.

## SECTION 120.3 – REQUIREMENTS FOR PIPE INSULATION

Nonresidential, high-rise residential, 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 all space-conditioning and service water-heating systems with fluid temperatures listed in TABLE 120.3-A, shall have the amount of insulation specified in Subsection (ac) or (b):

1. Space Cooling Systems. All refrigerant suction, chilled water and brine lines.

2. Space Heating Systems. All steam, steam condensate and hot water lines.

3. Service water-heating systems.

A. Recirculating system piping, including the supply and return piping of the water heater.

B. The first 8 feet of hot and cold outlet piping for a nonrecirculating storage system.

C. The inlet pipe between the storage tank and a heat trap in a nonrecirculating storage system.

D. Pipes that are externally heated. All recirculating sections, all piping in electric trace tape systems, and the first 8 feet of hot and cold water pipes from the storage tank.

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.

### (b) Insulation Protection

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

A1. Insulation exposed to weather shall be suitable for outdoor service by either being rated by the manufacturer for outdoor use or by being covered e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that be installed with a cover suitable for outdoor service. The cover shall be is water retardant and provides shielding from solar radiation that can cause degradation of the material.

B2. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall include a vapor retardant located outside the insulation (unless the insulation is inherently vapor retardant), have a Class I or Class II vapor retarder. All penetrations and joints of which shall be sealed.

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

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

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

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

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

### (ac) 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 thickness shown in TABLE 120.3-A.

(b)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 thickness as calculated with:

**INSULATION THICKNESS EQUATION**

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

WHERE:

- T = Minimum insulation thickness for material with conductivity K, inches.
- PR = Pipe actual outside radius, inches.
- t = Insulation thickness from TABLE 120.3-A, inches.
- K = Conductivity of alternate material at the mean rating temperature indicated in TABLE 120.3-A for the applicable fluid temperature range, in Btu-inch per hour per square foot per °F.
- k = The lower value of the conductivity range listed in TABLE 120.3-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

**TABLE 120.3-A PIPE INSULATION THICKNESS**

FLUID TEMPERATURE RANGE (°F)	CONDUCTIVITY RANGE (in Btu-inch per hour per square foot per °F)	INSULATION MEAN RATING TEMPERATURE (°F)	NOMINAL PIPE DIAMETER (in inches)						
			<1	1 to <1.5	1.5 to <4	4 to <8	8 and larger		
			INSULATION THICKNESS REQUIRED (in inches)						
Space heating, Hot Water systems (steam, steam condensate and hot water) and Service Water Heating Systems (recirculating sections, all piping in electric trace tape systems, and the first 8 feet of piping from the storage tank for nonrecirculating systems)									
Above 350	0.32-0.34	250	4.5	5.0	5.0	5.0	5.0		
251-350	0.29-0.324	200	3.0	4.0	4.5	4.5	4.5		
201-250	0.27-0.30	150	2.5	2.5	2.5	3.0	3.0		
141-200	0.25-0.29	125	1.5	1.5	2.0	2.0	2.0		
105-140	0.22-0.28	100	1.0	1.5	1.5	1.5	1.5		
Space cooling systems (chilled water, refrigerant and brine)									
40-60	0.21-0.27	75	<u>Nonres</u> 0.5	<u>Res</u> 0.75	<u>Nonres</u> 0.5	<u>Res</u> 0.75	1.0	1.0	1.0
Below 40	0.20-0.26	50	1.0	1.5	1.5	1.5	1.5	1.5	

**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:** Gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

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

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

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## SECTION 120.4 – REQUIREMENTS FOR AIR DISTRIBUTION SYSTEM DUCTS AND PLENUMS

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.4(a) through 120.4(f).

- (a) **CMC Compliance.** All air distribution system ducts and plenums, including, but not limited to, building cavities, mechanical closets, air-handler boxes and support platforms used as ducts or plenums, shall be installed, sealed and insulated to meet the requirements of the 2010-CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0, and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition, incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum installed level of R-8:

1. Outdoors; or
2. In a space between the roof and an insulated ceiling; or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces; or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

Portions of supply-air ducts that are not in one of these spaces, including ducts buried in concrete slab, shall be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 605.0) or be enclosed in directly conditioned space.

- (b) **Duct and Plenum Materials.**

1. **Factory-fabricated duct systems.**

- A. All factory-fabricated duct systems shall comply with UL 181 for ducts and closure systems, including collars, connections, and splices, and be labeled as complying with UL 181. UL 181 testing may be performed by UL laboratories or a laboratory approved by the Executive Director.
- B. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181 and UL 181A.
- C. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 and UL 181B.
- D. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

2. **Field-fabricated duct systems.**

- A. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems shall comply with UL 181. All pressure-sensitive tapes, mastics, aerosol sealants, or other closure systems used for installing field-fabricated duct systems shall meet the applicable requirements of UL 181, UL 181A, and UL 181B.
- B. Mastic sealants and mesh.
  - i. Sealants shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B, and be nontoxic and water resistant.
  - ii. Sealants for interior applications shall pass ASTM tests C731 (extrudability after aging) and D2202 (slump test on vertical surfaces), incorporated herein by reference.

- iii. Sealants for exterior applications shall pass ASTM tests C731, C732 (artificial weathering test), and D2202, incorporated herein by reference.
- iv. Sealants and meshes shall be rated for exterior use.
- C. Pressure-sensitive tape. Pressure-sensitive tapes shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B.
- D. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.
- E. Drawbands used with flexible duct.
  - i. Drawbands shall be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.
  - ii. Drawbands shall have a minimum tensile strength rating of 150 pounds.
  - iii. Drawbands shall be tightened as recommended by the manufacturer with an adjustable tensioning tool.
- F. Aerosol-sealant closures.
  - i. Aerosol sealants shall meet the requirements of UL 723 and be applied according to manufacturer specifications.
  - ii. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.
- (c) All duct insulation product R-values shall be based on insulation only (excluding air films, vapor retarders, or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C518 or ASTM C177, incorporated herein by reference, and certified pursuant to Section 110.8.
- (d) The installed thickness of duct insulation used to determine its R-value shall be determined as follows:
  - 1. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
  - 2. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.
  - 3. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.
- (e) Insulated flexible duct products installed to meet this requirement must include labels, in maximum intervals of 3 feet, showing the thermal performance R-value for the duct insulation itself (excluding air films, vapor retarder, or other duct components), based on the tests in Section 120.4(c) and the installed thickness determined by Section 120.4(d)3.
- (f) **Protection of Insulation.** Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind but not limited to the following: Insulation exposed to weather shall be suitable for outdoor service e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.

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## SECTION 120.5 – REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.5(a) and 120.5(b).

(a) Before an occupancy permit is granted 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:

1. Outdoor air ventilation systems shall be tested in accordance with NA7.5.1
2. Constant volume, single zone unitary-air conditioning and heat pump unit controls shall be tested in accordance with NA7.5.2.
3. Duct systems shall be tested in accordance with NA7.5.3 where either:
  - A. They are new duct systems that meet the criteria of Sections 140.4(l)1, 140.4(l)2, and 140.4(l)3; or
  - B. They are part of a system that meets the criteria of Section 141.0(b)2D.
4. Air economizers shall be tested in accordance with NA7.5.4.

**EXCEPTION to Section 120.5(a)4:** Air economizers installed by the HVAC system manufacturer and certified to the Commission as being factory calibrated and tested are exempt from the Functional Testing section of the Air Economizer Controls acceptance test as described in NA7.5.4.2.
5. Demand control ventilation systems required by Section 120.1(c)3 shall be tested in accordance with NA7.5.5
6. Supply fan variable flow controls shall be tested in accordance with NA7.5.6
7. Hydronic system variable flow controls shall be tested in accordance with NA7.5.7 and NA7.5.9
8. Boiler or chillers that require isolation controls per as specified by Section 140.4(k)2 or 140.4(k)3 shall be tested in accordance with NA7.5.7
9. Hydronic systems with supply water temperature reset controls shall be tested in accordance with NA7.5.8
10. Automatic demand shed controls shall be tested in accordance with NA7.5.10.
11. Fault Detection and Diagnostics (FDD) for Packaged Direct-Expansion Units shall be tested in accordance with NA7.5.11.
12. Automatic Fault Detection and Diagnostics (FDD) for air handling units and zone terminal units shall be tested in accordance with NA7.5.12.
13. Distributed Energy Storage DX AC Systems shall be tested in accordance with NA7.5.13.
14. Thermal Energy Storage (TES) Systems shall be tested in accordance with NA7.5.14.
15. Supply air temperature reset controls shall be tested in accordance with NA7.5.15.
16. Water-cooled chillers served by cooling towers with condenser water reset controls shall be tested in accordance with NA7.5.16.
17. When an Energy Management Control System is installed, it shall functionally meet all of the applicable requirements of Part 6.

- (b) When certification is required by Title 24, Part 1, Section 10-103-B.2, the acceptance testing specified by Section 120.5(a) shall be performed by a Certified Mechanical Acceptance Test Technician (CMATT). If the CMATT is operating as an employee, the CMATT shall be employed by a Certified Mechanical Acceptance Test Employer. The CMATT shall disclose on the Certificate of Acceptance a valid CMATT certification identification number issued by an approved Acceptance Test Technician Certification Provider. The CMATT shall complete all Certificate of Acceptance documentation in accordance with the applicable requirements in Section 10-103(a)4.

**NOTE:** Authority: Sections 25402, 25402.1, and 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

## SECTION 120.6 – MANDATORY REQUIREMENTS FOR COVERED PROCESSES

Nonresidential, high-rise residential, and hotel/motel buildings shall comply with the applicable requirements of Sections 120.6(a) through 120.6(g).

### (a) Mandatory Requirements for Refrigerated Warehouses

Refrigerated Warehouses that are greater than or equal to 3,000 square feet shall meet the requirements of Subsections 1, 2, 3, 6 and 7 of Section 120.6(a).

Refrigerated Spaces that are less than 3,000 square feet shall meet the requirements of the Appliance Efficiency Regulations for walk-in coolers or freezers contained in the Appliance Efficiency Regulations (California Code of Regulations, Title 20, Sections 1601 through 1608).

Refrigerated Spaces that (i) comprise a total of 3,000 square feet or more; and (ii) are collectively served by the same refrigeration system compressor(s) and condenser(s) shall meet the requirements of Subsections 4, 5 and 7 of Section 120.6(a).

1. **Insulation Requirements.** Exterior surfaces of refrigerated warehouses shall be insulated at least to the R-values in TABLE 120.6-A.

TABLE 120.6-A REFRIGERATED WAREHOUSE INSULATION

SPACE	SURFACE	MINIMUM R-VALUE (°F·hr·sf/Btu)
Freezers	Roof/Ceiling	R-40
	Wall	R-36
	Floor	R-35
	Floor with all heating from productive refrigeration capacity <sup>1</sup>	R-20
Coolers	Roof/Ceiling	R-28
	Wall	R-28

<sup>1</sup> All underslab heating is provided by a heat exchanger that provides refrigerant subcooling or other means that result in productive refrigeration capacity on the associated refrigerated system.

2. **Underslab heating.** Electric resistance heat shall not be used for the purposes of underslab heating.

**EXCEPTION to Section 120.6(a)2:** Underslab heating systems controlled such that the electric resistance heat is thermostatically controlled and disabled during the summer on-peak period defined by the local electric utility.

3. **Evaporators.** New fan-powered evaporators used in coolers and freezers shall conform to the following:

- A. Single phase fan motors less than 1 hp and less than 460 Volts in newly installed evaporators 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.
- B. Evaporator fans served either by a suction group with multiple compressors, or by a single compressor with variable capacity capability shall be variable speed and the speed shall be controlled in response to space temperature or humidity.

**EXCEPTION 1 to Section 120.6(a)3B:** Addition, alteration or replacement of less than all of the evaporators in an existing refrigerated space that does not have speed-controlled evaporators.

**EXCEPTION 2 to Section 120.6(a)3B:** Coolers within refrigerated warehouses that maintain a Controlled Atmosphere for which a licensed engineer has certified that the types of products stored will require constant operation at 100 percent of the design airflow.

**EXCEPTION 3 to Section 120.6(a)3B:** Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products, including but not limited to (spaces with design cooling capacities of greater than 240 Btu/hr·ft<sup>2</sup> (2 tons per 100 ft<sup>2</sup>)).



- C. Evaporator fans served by a single compressor that does not have variable capacity shall utilize controls to reduce airflow by at least 40 percent for at least 75 percent of the time when the compressor is not running.

**EXCEPTION to Section 120.6(a)3C:** Areas within refrigerated warehouses that are designed solely for the purpose of quick chilling/freezing of products (space with design cooling capacities of greater than 240 Btu/hr-ft<sup>2</sup> (2 tons per 100 ft<sup>2</sup>)).

4. **Condensers.** New fan-powered condensers on new refrigeration systems shall conform to the following:

- A. Design saturated condensing temperatures for evaporative-cooled condensers and water-cooled condensers served by fluid coolers or cooling towers shall be less than or equal to:
- The design wetbulb temperature plus 20°F in locations where the design wetbulb temperature is less than or equal to 76°F; or
  - The design wetbulb temperature plus 19°F in locations where the design wetbulb temperature is between 76°F and 78°F; or
  - The design wetbulb temperature plus 18°F in locations where the design wetbulb temperature is greater than or equal to 78°F.

**EXCEPTION to Section 120.6(a)4A:** Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

- B. Design saturated condensing temperatures for air-cooled condensers shall be less than or equal to the design drybulb temperature plus 10°F for systems serving freezers and shall be less than or equal to the design drybulb temperature plus 15°F for systems serving coolers.

**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 or freezing, or process refrigeration cooling for other than a refrigerated space.

- C. All condenser fans for evaporative-cooled condensers or fans on cooling towers or fluid coolers shall be continuously variable speed, and the condensing temperature control system shall control the speed of all fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.
- D. All condenser fans for air-cooled condensers shall be continuously variable speed and the condensing temperature or pressure control system shall control the speed of all condenser fans serving a common condenser high side in unison. The minimum condensing temperature setpoint shall be less than or equal to 70°F.
- E. 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.

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

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

**EXCEPTION to Section 120.6(a)4G:** Micro-channel condensers.

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	
Indoor Air-Cooled	All	Exempt	

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

- A. Compressors shall be designed to operate at a minimum condensing temperature of 70°F or less.
- B. 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)5B:** Refrigeration plants with more than one dedicated compressor per suction group.

**EXCEPTION 2 to Section 120.6(a)5B:** Compressors and condensers on a refrigeration system for which more than 20 percent of the total design refrigeration cooling load is for quick chilling or freezing, or process refrigeration cooling for other than a refrigerated space.

- C. 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)5:** Openings with less than 16 square feet of opening area.

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

7. **Refrigeration System 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. Variable speed compressors shall be tested in accordance with NA7.10.4.

(b) **Mandatory Requirements for Commercial Refrigeration**

Retail food stores with 8,000 square feet or more of conditioned area, and that utilize either: refrigerated display cases, or walk-in coolers or freezers connected to remote compressor units or condensing units, shall meet 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, 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.

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

- D. The minimum condensing temperature setpoint shall be less than or equal to 70°F.
- E. Fan-powered condensers shall meet the specific efficiency requirements listed in Table 120.6-C.

**TABLE 120.6-C FAN-POWERED CONDENSERS—SPECIFIC EFFICIENCY REQUIREMENTS**

CONDENSER TYPE	MINIMUM SPECIFIC EFFICIENCY <sup>a</sup>	RATING CONDITION
Evaporative-Cooled	160 Btuh/W	100°F Saturated Condensing Temperature (SCT), 70°F Entering Wetbulb Temperature
Air-Cooled	65 Btuh/W	105°F Saturated Condensing Temperature (SCT), 95°F Entering Drybulb Temperature

<sup>a</sup> See Section 100.1 for definition of condenser specific efficiency.

**EXCEPTION 1 to Section 120.6(b)1E:** 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)1E:** Stores located in Climate Zone 1.

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

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

**EXCEPTION 1 to Section 120.6(b)1F:** Microchannel condensers.

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

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

**EXCEPTION to Section 120.6(b)2A and 2B:** 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.

~~**EXCEPTION to Section 120.6(b)3:** Stores which are normally open for business 140 hours or more per week.~~

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.

- 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.

(c) **Mandatory Requirements for Enclosed Parking Garages.** Mechanical ventilation systems for enclosed parking garages where the total design exhaust rate for the garage is greater than or equal to 10,000 cfm shall conform to all of the following:

1. Automatically detect contaminant levels and stage fans or modulate fan airflow rates to 50 percent or less of design capacity provided acceptable contaminant levels are maintained.
2. Have controls and/or devices that will result in fan motor demand of no more than 30 percent of design wattage at 50 percent of design airflow.
3. CO shall be monitored with at least one sensor per 5,000 square feet, with the sensor located in the highest expected concentration locations, with at least two sensors per proximity zone. A proximity zone is defined as an area that is isolated from other areas either by floor or other impenetrable obstruction.
4. CO concentration at all sensors is maintained at 25 ppm or less at all times.
5. The ventilation rate shall be at least 0.15 cfm/ft<sup>2</sup> when the garage is scheduled to be occupied.
6. The system shall maintain the garage at negative or neutral pressure relative to other occupiable spaces when the garage is scheduled to be occupied.
7. CO sensors shall be:
  - A. Certified by the manufacturer to be accurate within plus or minus 5 percent of measurement.
  - B. Factory calibrated.
  - C. Certified by the manufacturer to drift no more than 5 percent per year.

- D. Certified by the manufacturer to require calibration no more frequently than once a year.
- E. Monitored by a control system. The system shall have logic that automatically checks for sensor failure by the following means. Upon detection of a failure, the system shall reset to design ventilation rates and transmit an alarm to the facility operators.
  - i. If any sensor has not been calibrated according to the manufacturer's recommendations within the specified calibration period, the sensor has failed.
  - ii. During unoccupied periods the system compares the readings of all sensors, e.g. if any sensor is more than 15 ppm above or below the average of all sensors for longer than 4 four hours, the sensor has failed.
  - iii. During occupied periods the system compares the readings of sensors in the same proximity zone, e.g. if the 30 minute rolling average for any sensor in a proximity zone is more than 15 ppm above or below the 30 minute rolling average for other sensor(s) in that proximity zone, the sensor has failed.

8. **Parking Garage Ventilation System Acceptance.** Before an occupancy permit is granted for a parking garage system subject to Section 120.6(c), 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 NA7.12.

**EXCEPTION 1 to Section 120.6(c):** Any garage, or portion of a garage, where more than 20 percent of the vehicles expected to be stored have non gasoline combustion engines.

**EXCEPTION 2 to Section 120.6(c):** Additions and alterations to existing garages where less than 10,000 cfm of new exhaust capacity is being added.

**(d) Mandatory Requirements for Process Boilers**

- 1. Combustion air positive shut-off shall be provided on all newly installed process boilers as follows:
  - A. All process boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a non-positive vent static pressure.
  - B. All process boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).
- 2. Process boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:
  - A. The fan motor shall be driven by a variable speed drive; or
  - B. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.
- 3. Newly installed process boilers with an input capacity of 5 MMBtu/h (5,000,000 Btu/h) to 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stackgas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent. Combustion air volume shall be controlled with respect to firing rate or measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.
- 4. Newly installed process boilers with an input capacity greater than 10 MMBtu/h (10,000,000 Btu/h) shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 3.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent. Combustion air volume shall be controlled with respect to measured flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

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

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

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

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

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

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

**(f) Mandatory Requirements for Elevators**

1. The light power density for the luminaires inside the elevator cab shall be no greater than 0.6 watts per square foot.
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 1 to Section 120.6(f)1:** Interior signal lighting and interior display lighting are not included in the calculation of lighting power density.

**(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.

## SECTION 120.7 –MANDATORY INSULATION REQUIREMENTS

~~Any newly constructed nonresidential and Nonresidential, high-rise residential, and hotel/motel building buildings shall meet comply with the minimum applicable requirements in this Section Sections 120.7(a) through 120.7(c).~~

(a) **Roof/Ceiling Insulation.** The opaque portions of the roof/ceiling that separates conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 ~~and 2~~ through 3 below:

1. **Metal Building-** The weighted average U-factor of the roof assembly shall not exceed 0.098.
2. **Wood Framed and Others-** The weighted average U-factor of the roof assembly shall not exceed 0.075.
3. **Insulation Placement-** Insulation installed to limit heat loss and gain from conditioned spaces to unconditioned spaces shall comply with the following:
  - A. Insulation shall be installed in direct contact with a continuous 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 the finished ceiling; and
  - B. When insulation is installed at the roof in nonresidential buildings, fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed and the space between the ceiling and the roof is either directly or indirectly conditioned space and shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements; and
  - C. Insulation shall not be placed on top of a suspended ceiling with removable ceiling panels shall not be used to meet the Roof/Ceiling requirement of Sections 140.3 and 141.0; and  
EXCEPTION to Section 120.7(a)3: When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.
  - ~~D. Where insulation is installed above the roofing membrane or above the layer used to seal the roof from water penetration the insulation shall have a maximum water absorption of 0.3 percent by volume when tested according to ASTM Standard C272.~~

NOTE: Vents, that do not penetrate the roof deck, that are designed for wind resistance for roof membranes are not within the scope of Section 120.7(a)3B.

(b) **Wall Insulation.** The opaque portions of walls that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through ~~6-7~~ below:

1. **Metal Building-** The weighted average U-factor of the wall assembly shall not exceed 0.113.
2. **Metal Framed-** The weighted average U-factor of the wall assembly shall not exceed 0.151 ~~0.105~~.
3. **Light Mass Walls-** A 6 inches or greater Hollow Core Concrete Masonry Unit shall have a U-factor not to exceed 0.440.
4. **Heavy Mass Walls-** An 8 inches or greater Hollow Core Concrete Masonry Unit shall have a U-factor not to exceed 0.690.
5. **Wood Framed and Others-** The weighted average U-factor of the wall assembly shall not exceed 0.110.
6. **Spandrel Panels and ~~Opaque Glass~~ Curtain Wall-** The weighted average U-factor of the ~~Glass~~ spandrel panels and ~~glass opaque~~ curtain wall assembly shall not exceed 0.280.
7. **Demising Walls-** ~~The opaque portions of framed demising walls shall be insulated with an installed R-value of no less than R-13 between framing members, or shall have a U-factor not greater than 0.102. The opaque portions of framed demising walls shall meet the requirements of Item A or B below:~~
  - A. Wood framed walls shall be insulated to meet a U-factor not greater than 0.099.



**B. Metal Framed walls shall be insulated to meet a U-factor not greater than 0.151.**

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

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

**EXCEPTION to Section 120.7:** A dedicated building used solely as a data center that has a total covered process load exceeding 750 kW.

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## SECTION 120.8 - NONRESIDENTIAL BUILDING COMMISSIONING

~~For all new nonresidential buildings with conditioned space of 10,000 square feet or more, shall comply with the applicable requirements of Subsections Sections of 120.8(a) through (i) 120.8(i) for building commissioning shall be included in the building design and construction processes of the building project to verify that the building energy systems and components meet the owner's or owner representative's project requirements. All building systems and components covered by Sections 110.0, 120.0, 130.0, and 140.0 shall be included in the scope of the commissioning requirements in this Section, excluding those related solely to covered processes.~~

~~For Nonresidential buildings with conditioned space of less than 10,000 square feet only shall comply with the design review requirements specified in Sections 120.8(d), and shall include any measures or requirements necessary for completing this review in the construction documents in a manner consistent with Section 120.8(e) shall be completed.~~

NOTE: Nonresidential buildings include nonresidential spaces such as nonresidential function areas within hotel/motel and highrise residential buildings. The requirements of Section 120.8 apply based on the square footage of the nonresidential spaces.

The commissioning described in this Section is in addition to any commissioning required by Title 24, Part 11, Section 5.410.2, 5.410.4, and subsections.

(a) **Summary of Commissioning Requirements.** Commissioning shall include completion of the following items shall be completed:

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

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

1. Energy efficiency goals;
- ~~32.~~ 2. Ventilation requirements;
- ~~43.~~ 3. Project documentation program requirements, including facility functions and hours of operation, and need for after hours operation; and
- ~~54.~~ 4. Equipment and systems expectations; and
- ~~5.~~ 5. Building envelope performance expectations.

**EXCEPTION to Section 120.8(b):** Buildings less than 10,000 square feet.

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

1. Heating, ventilation, air conditioning (HVAC) systems and controls;
2. Indoor lighting system and controls; ~~and~~

3. Water heating systems and controls; and
4. Any building envelope component considered in the OPR and ~~Covered processes.~~

~~EXCEPTION to Section 120.8(e): Buildings less than 10,000 square feet.~~

(d) Design Phase Design Review.

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

(e) **Commissioning measures shown in the construction documents.** ~~Include commissioning Complete descriptions of all measures or requirements necessary for commissioning shall be included in the construction documents (plans and specifications). Commissioning measures or requirements should shall be clear, detailed and complete to clarify the commissioning process. These requirements should include the list of systems and assemblies commissioned, testing scope, roles and responsibilities of contractors, requirements for meetings, management of issues, the commissioning schedule, operations and maintenance manual development and of training, and checklist and test form development, execution and documentation. Include, for information only, roles of none contractor parties.~~

(f) **Commissioning Plan.** Prior to permit issuance a commissioning plan shall be completed to document how the project will be commissioned and shall be started during the design phase of the building project. The Commissioning Plan shall include the following:

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

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

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

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

- (h) **Documentation and training.** A Systems Manual and Systems Operations Training shall be completed.

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

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

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

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

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**SECTION 120.9 – MANDATORY REQUIREMENTS FOR COMMERCIAL BOILERS.**

- (a) Combustion air positive shut-off shall be provided on all newly installed boilers as follows:
1. All boilers with an input capacity of 2.5 MMBtu/h (2,500,000 Btu/h) and above, in which the boiler is designed to operate with a nonpositive vent static pressure.
  2. All boilers where one stack serves two or more boilers with a total combined input capacity per stack of 2.5 MMBtu/h (2,500,000 Btu/h).
- (b) Boiler combustion air fans with motors 10 horsepower or larger shall meet one of the following for newly installed boilers:
1. The fan motor shall be driven by a variable speed drive, or
  2. The fan motor shall include controls that limit the fan motor demand to no more than 30 percent of the total design wattage at 50 percent of design air volume.
- (c) Newly installed boilers with an input capacity 5 MMBtu/h (5,000,000 Btu/h) and greater shall maintain excess (stack-gas) oxygen concentrations at less than or equal to 5.0 percent by volume on a dry basis over firing rates of 20 percent to 100 percent. Combustion air volume shall be controlled with respect to firing rate or flue gas oxygen concentration. Use of a common gas and combustion air control linkage or jack shaft is prohibited.

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

## SUBCHAPTER 4

# NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS FOR LIGHTING SYSTEMS AND EQUIPMENT, AND ELECTRICAL POWER DISTRIBUTION SYSTEMS

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### SECTION 130.0 – LIGHTING CONTROLS AND SYSTEMS AND EQUIPMENT, AND ELECTRICAL POWER DISTRIBUTION SYSTEMS — GENERAL

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- (a) ~~Except as provided in Subsection (b), the~~ The design and installation of all lighting systems and equipment in nonresidential, high-rise residential, hotel/motel buildings, outdoor lighting, and electrical power distribution systems ~~subject to Part 6 within the scope of Section 100.0(a)~~ shall comply with the applicable provisions of Sections 130.0 through 130.5.

**NOTE:** The requirements of Sections 130.0 through 130.5 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 130.0 through 130.05 also apply to additions and alterations to existing buildings.

- (b) **Functional areas where compliance with the residential lighting Standards is required.** The design and installation of all lighting systems, lighting controls, and equipment in the following functional areas shall comply with the applicable provisions of Section 150.0(k). In buildings containing these functional areas, all other functional areas, such as common areas, shall comply with the applicable nonresidential lighting Standards and the applicable nonresidential controlled receptacle requirements in Section 130.5(d).

1. High-rise residential dwelling units.
2. Outdoor lighting that is attached to a high-rise residential or hotel/motel building, and is separately controlled from the inside of a dwelling unit or guest room.
3. Fire station dwelling accommodations.
4. Hotel and motel guest rooms. Additionally, hotel and motel guest rooms shall meet the requirements of Section 130.1(c) ~~8~~ and Section 130.5(d)4.
5. Dormitory and Senior housing dwelling accommodations.

**NOTE:** The requirements of Section 130.0(b) also apply to additions and alterations to functional areas of existing buildings as specified in Section 130.0(b).

- (c) **Luminaire classification and power.** Luminaires shall be classified and wattage determined as follows:

1. **Luminaire labeling.** Luminaire wattage shall be labeled as follows:
  - A. The maximum relamping rated wattage of a luminaire shall be listed on a permanent, preprinted, factory-installed label, as specified by UL 1574, 1598, 2108, or 8750, as applicable; and
  - B. The factory-installed maximum relamping rated wattage label shall not consist of peel-off or peel-down layers or other methods that allow the rated wattage to be changed after the luminaire has been shipped from the manufacturer.

**EXCEPTION to Section 130.0(c)1B:** Peel-down labels may be used only for the following luminaires when they can accommodate a range of lamp wattages without changing the luminaire housing, ballast, transformer or wiring. Qualifying luminaires shall have a single lamp, and shall have integrated ballasts or transformers. Peel-down labels must be layered such that the rated wattage reduces as successive layers are removed.

- i. High intensity discharge luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 150 watts.
  - ii. Low-voltage luminaires (except low voltage track systems),  $\leq 24$  volts, with a maximum relamping rated wattage of 50 watts.
  - iii. Compact fluorescent luminaires, having an integral electronic ballast, with a maximum relamping rated wattage of 42 watts.
2. For luminaires with line voltage lamp holders not containing permanently installed ballasts or transformers; the wattage of such luminaires shall be determined as follows:
    - A. The maximum relamping rated wattage of the luminaire; and
    - B. For recessed luminaires with line-voltage medium screw base sockets, wattage shall not be less than 50 watts per socket.
  3. Luminaires and luminaire housings designed to accommodate a variety of trims or modular components that allow the conversion between incandescent and any other lighting technology without changing the luminaire housing or wiring shall be classified as incandescent.
  4. Screwbased adaptors shall not be used to convert an incandescent luminaire to any type of nonincandescent technology. Screw-based adaptors, including screw-base adaptors classified as permanent by the manufacturer, shall not be recognized for compliance with Part 6.
  5. Luminaires and luminaire housings ~~manufactured with incandescent screw base sockets~~ shall be classified only as incandescent. Field modifications, including but not limited to hard wiring of an LED module, shall not be recognized as converting an incandescent luminaire or luminaire housing to a nonincandescent technology for compliance with Part 6 unless such sockets are removed.
  6. Luminaires with permanently installed or remotely installed ballasts or drivers. The wattage of such luminaries shall be determined as follows:
    - ~~A. A. Wattage shall be the~~ The operating input wattage of the rated lamp/ballast combination published in ballast manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.
    - B. The maximum input wattage of the rated driver published in driver's manufacturer catalogs based on independent testing lab reports as specified by UL 8750 or LM-79.
    - ~~B. Replacement of lamps in a luminaire manufactured or rated for use with linear fluorescent lamps, with linear lamps of a different technology such as linear LED lamps, shall not be recognized as converting the fluorescent luminaire to a different technology for compliance with Part 6.~~
  7. Line-voltage lighting track and plug-in busway that allows the addition or relocation of luminaires without altering the wiring of the system. The wattage of such luminaires shall be determined by one of the following methods:
    - A. The wattage of line voltage busway and track rated for more than 20 amperes shall be the total volt-ampere rating of the branch circuit feeding the busway and track.
    - B. The wattage of line voltage busway and track rated for 20 amperes or less shall be determined by one of the following methods:
      - i. The volt-ampere rating of the branch circuit feeding the track or busway; or
      - ii. The higher of the rated wattage of all of the luminaires included in the system, where luminaire classification and wattage is determined according to the applicable provisions in Section 130.0(c), or 45 watts per linear foot; or

- iii. When using a line-voltage track lighting integral current limiter, the higher of the volt-ampere rating of an integral current limiter controlling the track or busway, or 12.5 watts per linear foot of track or busway. An Integral current limiter shall be certified to the Energy Commission in accordance with Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biii to determine luminaire power; or
    - iv. When using a dedicated track lighting supplementary overcurrent protection panel, the sum of the ampere (A) rating of all of the overcurrent protection devices times the branch circuit voltages. Track lighting supplementary overcurrent protection panels shall comply with the applicable requirements in Section 110.9, and shall comply with the Lighting Control Installation Requirements in accordance with Section 130.4, to qualify to use Subsection Biv to determine luminaire power.
- 8. Luminaires and lighting systems with permanently installed or remotely installed transformers. The wattage of such luminaires shall be determined as follows:
  - A. For low-voltage luminaires that do not allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the rated wattage of the lamp/transformer combination.
  - B. For low-voltage lighting systems, including low voltage tracks and other low-voltage lighting systems that allow the addition of lamps, lamp holders, or luminaires without rewiring, the wattage shall be the maximum rated input wattage of the transformer, labeled in accordance with Item 1, or the maximum rated wattage published in transformer manufacturer's catalogs, as specified by UL 2108.
- 9. Light emitting diode (LED) Luminaires, and LED Light Engine.
  - A. The wattage of such luminaires shall be the maximum rated input wattage of the system when tested in accordance with IES LM-79-08.
  - B. The maximum rated input wattage shall be labeled in accordance with Section 130.0(c)1.
  - C. An LED lamp, integrated or nonintegrated type in accordance with the definition in ANSI/IES RP-16-2010, shall not be classified as a LED lighting system for compliance with Part 6. LED modules having screw bases, including but not limited to screw based pig-tails, screw-based sockets, or screw-based adaptors, shall not be recognized as a LED lighting system for compliance with Part 6.
  - ~~D. Luminaires and luminaire housings equipped with screw-base sockets shall not be classified as a LED lighting system for compliance with Part 6.~~
  - ~~ED. Luminaires manufactured or rated for use with low-voltage incandescent lamps, into which have been installed LED modules or LED lamps, shall not be recognized as a LED lighting system for compliance with Part 6.~~
  - ~~FE. For LED lighting systems that allow the addition of luminaires or light engines without rewiring, the wattage of such luminaires shall be the maximum rated input wattage of the power supply, labeled in accordance with Section 130.0(c)1 or published in the power supply manufacturer's catalog.~~
- EXCEPTION to Section 130.0(c)9: Luminaires in areas that must comply with Section 150.0(k), as specified covered by Section 130.0(b).**
- 10. The wattage of all other miscellaneous lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, labeled in accordance with Section 130.0(c)1, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598. Lighting technologies listed in Subsections 2 through 9 shall be determined in accordance with the applicable requirements in Subsections 1 through 9.
- (d) **Lighting Controls.** All lighting controls and equipment shall comply with the applicable requirements in Section 110.9, and shall be installed in accordance with the manufacturer's instructions.
- (e) **Energy Management Control System (EMCS).**
  - 1. An EMCS may be installed to comply with the requirements of one or more lighting controls if it meets the following minimum requirements:



- A. Provides all applicable functionality for each specific lighting control or system for which it is installed in accordance with Section 110.9; and
- B. Complies with all applicable Lighting Control Installation Requirements in accordance with Section 130.4 for each specific lighting control or system for which it is installed; and
- C. Complies with all applicable application requirements for each specific lighting control or system for which it is installed, in accordance with Part 6.

**SECTION 130.1 – MANDATORY INDOOR LIGHTING CONTROLS THAT SHALL BE INSTALLED**

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.1(a) through 130.1(e).

(a) Area Controls.

1. All luminaires shall be functionally controlled with ~~manually-switched manual~~ ON and OFF lighting controls. Each area enclosed by ceiling-height partitions shall be independently controlled.

**EXCEPTION to Section 130.1(a)1:** Up to 0.2 watts per square foot of lighting in any area within a building may be continuously illuminated ~~during occupied times~~ to allow for emergency means of egress illumination, if:

- A. The area is designated ~~an emergency for means of egress area~~ on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1; and
  - B. The controls ~~switches~~ for the egress lighting are not accessible to unauthorized personnel.
2. The lighting controls shall meet the following requirements:
    - A. Be readily accessible; and
    - B. Be operated with a manual ~~switch-control~~ that is located in the same room or area with the lighting that is controlled by that lighting control; and
    - C. ~~If controlling dimmable luminaires, be a dimmer switch that allows manual ON and OFF functionality, and is capable of manually controlling lighting through all lighting control steps that are required in~~ Section 130.1(b).

**EXCEPTION 1 to Section 130.1(a)2:** In malls and atria, auditorium areas, retail merchandise sales areas, ~~and wholesale sales floors~~, showroom areas, commercial and industrial storage areas, general commercial and industrial work areas, ~~industrial facilities~~, convention centers, and arenas, the lighting control shall be located so that a person using the lighting control can see the lights or area controlled by that lighting control, or so that the area being lit is annunciated.

**EXCEPTION 2 to Section 130.1(a)2:** Public restrooms having two or more stalls, parking areas, stairwells, and corridors may use a manual ~~switch-control~~ not accessible to unauthorized personnel.

3. **Other Lighting Controls.**

- A. Other lighting controls may be installed in addition to the manual lighting controls provided they do not override the functionality of controls installed in accordance with Section 130.1(a)1, 2, or 4.

4. **Separately Controlled Lighting Systems.** In addition to the requirements in Section 130.1(a)1, 2, and 3:

- A. General lighting shall be separately controlled from all other lighting systems in an area.
- B. Floor and wall display, window display, case display, ornamental, and special effects lighting shall each be separately controlled on circuits that are 20 amps or less.
- C. When track lighting is used, general, display, ornamental, and special effects lighting shall each be separately controlled.

- (b) **Multi-Level Lighting Controls.** The general lighting of any enclosed area 100 square feet or larger, with a connected lighting load that exceeds 0.5 watts per square foot shall provide multi-level lighting control that meets the following requirements:

1. Lighting shall have the required number of control steps and meet the uniformity requirements in accordance with TABLE 130.1-A; and
2. Multi-level lighting controls shall not override the functionality of other lighting controls required for compliance with Sections 130.1(a), and (c) through (e); and

3. ~~Each luminaire shall be controlled by at least one of the following methods: Dimmable luminaires shall be controlled by a dimmer switch control that is capable of controlling lighting through all required lighting control steps and that allows the manual ON and OFF functionality required by Section 130.1(a) and is additionally capable of manually controlling lighting through all required lighting control steps.~~

- A. ~~Manual dimming meeting the applicable requirements of Section 130.1(a)~~
- B. ~~Lumen maintenance as defined in Section 100.1~~
- C. ~~Tuning as defined in Section 100.1~~
- D. ~~Automatic daylighting controls in accordance with Section 130.1(d)~~
- E. ~~Demand responsive lighting controls in accordance with Section 130.1(e)~~

**EXCEPTION 1 to Section 130.1(b):** Classrooms, with a connected general lighting load of 0.7 watts per square foot ~~and or less~~, and public restrooms shall have at least one control step between 30-70 percent of full rated power.

**EXCEPTION 2 to Section 130.1(b):** An area enclosed by ceiling height partitions that has only one luminaire with no more than two lamps.

**EXCEPTION 3 to Section 130.1(b):** The areas specified in Sections 130.1(c)6 and 7 are not also required to meet the requirements of Section 130.1(b).

**(c) Shut-OFF Controls**

1. In addition to lighting controls installed to comply with Sections 130.1(a) and (b), all installed indoor lighting shall be equipped with controls that meet the following requirements:
  - A. Shall be controlled with an occupant sensing control, automatic time-switch control, ~~signal from another building system~~, or other control capable of automatically shutting OFF all of the lighting when the space is typically unoccupied; and
  - B. Separate controls for the lighting on each floor, other than lighting in stairwells; and
  - C. Separate controls for a space enclosed by ceiling height partitions not exceeding 5,000 square feet; and

**EXCEPTION to Section 130.1(c)1C:** In the following function areas the area controlled may not exceed 20,000 square feet: Malls, auditoriums, single tenant retail, industrial, convention centers, and arenas,

- D. Separate controls for general, display, ornamental, and display case lighting.

**EXCEPTION 1 to Section 130.1(c)1:** Where the lighting is serving an area that is in continuous use, 24 hours per day/365 days per year.

**EXCEPTION 2 to Section 130.1(c)1:** Lighting complying with Section 130.1(c)5, or 7.

**EXCEPTION 3 to Section 130.1(c)1:** ~~In office buildings, up to 0.050.1~~ Up to 0.050.1 watts per square foot of lighting in any area within a building may be continuously illuminated, provided that the area is designated an emergency for means of egress area on the plans and specifications submitted to the enforcement agency under Section 10-103(a)2 of Part 1.

**EXCEPTION 4 to Section 130.1(c)1:** Electrical equipment rooms subject to Article 110.26(D) of the California Electrical Code.

**EXCEPTION 5 to Section 130.1(c):** Illumination provided by lighting equipments that is designated for emergency lighting, connected to an emergency power source or battery supply, and is intended to function in emergency mode only when normal power is absent.

2. Countdown timer switches shall not be used to comply with the automatic shut-OFF control requirements in Section 130.1(c)1.

**EXCEPTION 1 to Section 130.1(c)2:** Single-stall bathrooms less than 70 square feet, and closets less than 70 square feet may use countdown timer switches with a maximum setting capability of ten minutes to comply with the automatic shut-Off requirements.

**EXCEPTION 2 to Section 130.1(c)2:** Lighting in a Server Aisle in a Server Room, as defined in Section 100.1, may use countdown timer switches with a maximum setting capability of 30 minutes to comply with the automatic shut-OFF requirements.

3. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an override lighting control that:

A. Complies with Section 130.1(a); and

B. Allows the lighting to remain ON for no more than 2 hours when an override is initiated.

**EXCEPTION to Section 130.1(c)3B:** In the following function areas, the override time may exceed 2 hours: Malls, auditoriums, single tenant retail, industrial, and arenas where captive-key override is utilized.

4. If an automatic time-switch control, other than an occupant sensing control, is installed to comply with Section 130.1(c)1, it shall incorporate an automatic holiday "shut-OFF" feature that turns OFF all loads for at least 24 hours, and then resumes the normally scheduled operation.

**EXCEPTION to Section 130.1(c)4:** In retail stores and associated malls, restaurants, grocery stores, churches, and theaters, the automatic time-switch control is not required to incorporate an automatic holiday shut-OFF feature.

5. **Areas where Occupant Sensing Controls are required to shut OFF All Lighting.** In offices 250 square feet or smaller, multipurpose rooms of less than 1,000 square feet, classrooms of any size, and conference rooms of any size, lighting shall be controlled with occupant sensing controls to automatically shut OFF all of the lighting when the room is unoccupied.

In areas required by Section 130.1(b) to have multi-level lighting controls, the occupant sensing controls shall function either as a:

A. Partial-ON Occupant Sensor capable of automatically activating between 50-70 percent of controlled lighting power, or

B. Vacancy Sensor, where all lighting responds to a manual ON input only.

In areas not required by Section 130.1(b) to have multi-level lighting controls, the occupant sensing controls shall function either as a:

A. Occupant Sensor; or

B. Partial-ON Occupant Sensor, or

C. Vacancy Sensor, where all lighting responds to a manual ON input only.

In addition, controls shall be provided that allow the lights to be manually shut-OFF in accordance with Section 130.1(a) regardless of the sensor status.

~~**EXCEPTION to Section 130.1(c)5A:** Areas that are not required by Section 130.1(b) to have multi-level lighting controls may instead use occupant sensing controls that function as any Occupant Sensor or Vacancy Sensor.~~

6. **Areas where full or partial ON/OFF occupant sensing controls are required.** Multi-level lighting installed in the following areas shall meet the following requirements in addition to complying with Section 130.1(c)1.

A. In aisle ways and open areas in warehouses, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.

**EXCEPTION 1 to Section 130.1(c)6A:** In aisle ways and open areas in warehouses in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce lighting power by at least 40 percent.

**EXCEPTION 2 to Section 130.1(c)6A:** When metal halide lighting or high pressure sodium lighting is installed in warehouses, occupant sensing controls shall reduce lighting power by at least 40 percent.

- B. In library book stack aisles 10 feet or longer that are accessible from only one end, and library book stack aisles 20 feet or longer that are accessible from both ends, lighting shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall independently control lighting in each aisle way, and shall not control lighting beyond the aisle way being controlled by the sensor.
- C. Lighting installed in corridors and stairwells shall be controlled by occupant sensing controls that separately reduce the lighting power in each space by at least 50 percent when the space is unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

7. **Areas where partial ON/OFF occupant sensing controls are required. ~~Multi-level~~ Lighting installed in the following areas shall meet the following requirements** instead of complying with Section 130.1(c)1.

- A. Lighting in stairwells and common area corridors that provide access to guestrooms and dwelling units of high-rise residential buildings and hotel/motels shall be controlled with occupant sensing controls that automatically reduce lighting power by at least 50 percent when the areas are unoccupied. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

**EXCEPTION to Section 130.1(c)7A:** In corridors and stairwells in which the installed lighting power is 80 percent or less of the value allowed under the Area Category Method, occupant sensing controls shall reduce power by at least 40 percent.

- B. In parking garages, parking areas and loading and unloading areas, general lighting shall be controlled by occupant sensing controls having at least one control step between 20 percent and 50 percent of design lighting power. No more than 500 watts of rated lighting power shall be controlled together as a single zone. A reasonably uniform level of illuminance shall be achieved in accordance with the applicable requirements in TABLE 130.1-A. The occupant sensing controls shall be capable of automatically turning the lighting fully ON only in the separately controlled space, and shall be automatically activated from all designed paths of egress.

Interior areas of parking garages are classified as indoor lighting for compliance with Section 130.1(c)7B. Parking areas on the roof of a parking structure are classified as outdoor hardscape and shall comply with the applicable provisions in Section 130.2.

**EXCEPTION to Section 130.1(c)7B:** Metal halide luminaires with a lamp plus ballast mean system efficacy of greater than 75 lumens per watt, used for general lighting in parking garages, parking areas and loading and unloading areas, shall be controlled by occupant sensing controls having at least one control step between 20 percent and 60 percent of design lighting power.

- 8. Hotel 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, lighting power is switched off.

**EXCEPTION to Section 130.1(c)8:** One high efficacy luminaire as defined in TABLE 150.0-A or 150.0-B that is switched separately and where the switch is located within 6 feet of the entry door.

(d) **Automatic Daylighting Controls.**

- 1. Daylit Zones shall be defined as follows:

- A. **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 the following: A permanent obstruction that is taller than one-half 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.

- B. **PRIMARY SIDELIT DAYLIT ZONE** is the area ~~on a plan in plan view and is~~ 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.
- C. **SECONDARY SIDELIT DAYLIT ZONE** is the area ~~on a plan in plan view and is~~ 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.

**Note:** Modular furniture walls shall not be considered a permanent obstruction.

2. Luminaires providing general lighting that are in or are partially in the Skylit Daylit Zones or the Primary Sidelit Daylit Zones shall be controlled independently by fully functional automatic daylighting controls that meet the applicable requirements of Section 110.9, and the applicable requirements below:
- A. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on the plans.
  - B. Luminaires in the Skylit Daylit Zone shall be controlled separately from those in the Primary Sidelit Daylit Zones.
  - C. Luminaires that fall in both a Skylit and Primary Sidelit Daylit Zone shall be controlled as part of the Skylit Daylit Zone.
  - D. **Automatic Daylighting Control Installation and Operation.** For luminaires in daylight zones, automatic daylighting controls shall be installed and configured to operate according to all of the following requirements:
    - i. Photosensors shall be located so that they are not readily accessible to unauthorized personnel, and ~~the location where calibration adjustments are made to automatic daylighting controls shall not be~~ readily accessible to unauthorized personnel and may be inside a locked case or under a cover which requires a tool for access.
    - ii. Automatic daylighting controls shall provide functional multilevel lighting having at least the number of control steps specified in TABLE 130.1-A.
 

**EXCEPTION 1 to Section 130.1(d)2Dii:** Controlled lighting having a lighting power density less than 0.3 W/ft<sup>2</sup> is not required to provide multilevel lighting controls.

~~**EXCEPTION 2 to Section 130.1(d)2Dii:** When skylights are replaced or added to an existing building where there is an existing general lighting system that is not being altered, multilevel lighting controls are not required.~~
    - iii. For each space, the combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.
    - iv. In areas served by lighting that is daylight controlled, when the daylight illuminance ~~received from the daylight~~ is greater than 150 percent of the design illuminance received from the general lighting system at full power, the general lighting power in that daylight zone shall be reduced by a minimum of 65 percent.

**EXCEPTION 1 to Section 130.1(d)2:** Rooms in which the combined total installed general lighting power in the Skylit Daylit Zone and Primary Sidelit Daylit Zone is less than 120 Watts.

**EXCEPTION 2 to Section 130.1(d)2:** Rooms that have a total glazing area of less than 24 square feet.

**EXCEPTION 3 to Section 130.1(d)2:** Parking garages complying with Section 130.1(d)3.

3. **Parking Garage Daylighting Requirements.** In a parking garage area with a combined total of 36 square feet or more of glazing or opening, luminaires providing general lighting that are in the combined primary and secondary sidelit daylit zones shall be controlled independently from other lighting in the parking garage by automatic daylighting controls, and shall meet the following requirements as applicable:
- A. All primary and secondary sidelit daylit zones shall be shown on the plans.

- B. Automatic Daylighting Control Installation and Operation. Automatic daylighting control shall be installed and configured to operate according to all of the following requirements:
- i. Automatic daylighting controls shall have photosensors that are located so that they are not readily accessible to unauthorized personnel, ~~and the location where calibration adjustments are made to the automatic daylighting controls shall not be readily accessible to unauthorized personnel but may be inside a locked case or under a cover which requires a tool for access.~~
  - ii. Automatic daylighting controls shall be multilevel, continuous dimming or ON/OFF.
  - iii. The combined illuminance from the controlled lighting and daylight shall not be less than the illuminance from controlled lighting when no daylight is available.
  - iv. When ~~primary sidelit zones receive~~ illuminance levels measured at the farthest edge of the secondary sidelit zone away from the glazing of opening are greater than 150 percent of the illuminance provided by the controlled lighting when no daylight is available, the controlled lighting power consumption shall be zero.

**EXCEPTION 1 to Section 130.1(d)3:** Luminaires located in the daylight transition zone and luminaires for only dedicated ramps. Daylight transition zone and dedicated ramps are defined in Section 100.1.

**EXCEPTION 2 to Section 130.1(d)3:** The total combined general lighting power in the primary sidelit daylight zones is less than 60 watts.

(e) Demand Responsive Controls.

1. ~~Lighting power in buildings larger than 10,000 square feet, excluding spaces with a lighting power density of 0.5 watts per square foot or less, shall be capable of being automatically reduced~~ Lighting power in buildings larger than 10,000 square feet, excluding spaces with a lighting power density of 0.5 watts per square foot or less, shall be capable of being automatically reduced power in response to a Demand Response Signal; so that the building's total lighting power of non-excluded spaces can be lowered by a minimum of 15 percent below the total installed lighting power when a Demand Response Signal is received. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A.  
  
~~Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power density of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.~~
- EXCEPTION to Section 130.1(e):** Lighting not permitted by a health or life safety statute, ordinance, or regulation to be reduced shall not be counted toward the total lighting power.
2. Demand responsive controls and equipment shall be capable of receiving and automatically responding to at least one standards-based messaging protocol by enabling demand response after receiving a demand response signal.

TABLE 130.1-A MULTI-LEVEL LIGHTING CONTROLS AND UNIFORMITY REQUIREMENTS

Luminaire Type	Minimum Required Control Steps ( percent of full rated power <sup>1</sup> )				Uniform level of illuminance shall be achieved by:
Line-voltage sockets except GU-24	Continuous dimming 10-100 percent				
Low-voltage incandescent systems					
LED luminaires and LED source systems					
GU-24 rated for LED					
GU-24 sockets rated for fluorescent > 20 watts	Continuous dimming 20-100 percent				
Pin-based compact fluorescent > 20 watts <sup>2</sup>					
GU-24 sockets rated for fluorescent ≤ 20 watts	Minimum one step between 30-70 percent				Stepped dimming; or Continuous dimming; or Switching alternate lamps in a luminaire
Pin-based compact fluorescent ≤ 20 watts <sup>2</sup>					
Linear fluorescent and U-bent fluorescent ≤ 13 watts					
Linear fluorescent and U-bent fluorescent > 13 watts	Minimum one step in each range:				Stepped dimming; or Continuous dimming; or Switching alternate lamps in each luminaire, having a minimum of 4 lamps per luminaire, illuminating the same area and in the same manner
	20-40 %	50-70 %	80-85 %	100 %	
Track Lighting	Minimum one step between 30 – 70 percent				Step dimming; or Continuous dimming; or Separately switching circuits in multi-circuit track with a minimum of two circuits.
HID > 20 watts	Minimum one step between 50 - 70 percent				Stepped dimming; or Continuous dimming; or Switching alternate lamps in each luminaire, having a minimum of 2 lamps per luminaire, illuminating the same area and in the same manner.
Induction > 25 watts					
Other light sources					

1. Full rated input power of ballast and lamp, corresponding to maximum ballast factor

2. Includes only pin based lamps: twin tube, multiple twin tube, and spiral lamps



## SECTION 130.2 – OUTDOOR LIGHTING CONTROLS AND EQUIPMENT

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.2(a) through 130.2(c).

- (a) **Outdoor Incandescent Lighting.** All outdoor incandescent luminaires rated over 100 watts, determined in accordance with Section 130.0(c)2, shall be controlled by a motion sensor.
- (b) **Luminaire Cutoff Requirements.** All outdoor luminaires rated for use with lamps greater than 150 lamp watts, determined in accordance with Section 130.0(c), shall comply with Backlight, Uplight, and Glare (collectively referred to as "BUG" in accordance with IES TM-15-11, Addendum A) requirements as follows:
  - 1. There are no Backlight requirements in Section 130.2 of Part 6; and
  - 2. Maximum zonal lumens for Uplight shall be in accordance with TABLE 130.2-A; and
  - 3. Maximum zonal lumens for Glare shall be in accordance with TABLE 130.2-B.

NOTE: Note that Title 24, Part 11, Section 5.106.8 includes additional restrictions on backlight, uplight and glare that may apply.

**EXCEPTION 1 to Section 130.2(b):** Signs.

**EXCEPTION 2 to Section 130.2(b):** Lighting for building facades, public monuments, statues, and vertical surfaces of bridges.

**EXCEPTION 3 to Section 130.2(b):** Lighting not permitted by a health or life safety statute, ordinance, or regulation to be a cutoff luminaire.

**EXCEPTION 4 to Section 130.2(b):** Temporary outdoor lighting.

**EXCEPTION 5 to Section 130.2(b):** Replacement of existing pole mounted luminaires in hardscape areas meeting all of the following conditions:

- A. Where the existing luminaire does not meet the luminaire BUG requirements in Section 130.2(b); and
- B. Spacing between existing poles is greater than six times the mounting height of the existing luminaires; and
- C. Where no additional poles are being added to the site; and
- D. Where new wiring to the luminaires is not being installed; and
- E. Provided that the connected lighting power wattage is not increased.

**EXCEPTION 6 to Section 130.2(b):** Luminaires that illuminate the public right of way on publicly maintained roadways, sidewalks, and bikeways.

- (c) **Controls for Outdoor Lighting.** Outdoor lighting controls shall be installed that meet the following requirements as applicable:

**EXCEPTION 1 to Section 130.2(c):** Outdoor lighting not permitted by a health or life safety statute, ordinance, or regulation to be turned OFF.

**EXCEPTION 2 to Section 130.2(c):** Lighting in tunnels required to be illuminated 24 hours per day and 365 days per year.

- 1. All installed outdoor lighting shall be controlled by a photocontrol or outdoor-astronomical time-switch control, or other control capable of that automatically turns shutting OFF the outdoor lighting when daylight is available.
- 2. All installed outdoor lighting shall be ~~circuit~~ and independently controlled from other electrical loads by an automatic scheduling control.
- 3. All installed outdoor lighting, where the bottom of the luminaire is mounted 24 feet or less above the ground, shall be controlled with automatic lighting controls that meet all of the following requirements:

- A. Shall be motion sensors or other lighting control systems that automatically controls lighting in accordance with Item B in response to the area being vacated of occupants; and
- B. Shall be capable of automatically reducing the lighting power of each luminaire by at least 40 percent but not exceeding ~~80-90~~ percent, or provide continuous dimming through a range that includes 40 percent through ~~80-90~~ percent, and
- C. Shall employ auto-ON functionality when the area becomes occupied; and
- D. No more than 1,500 watts of lighting power shall be controlled together.

**EXCEPTION 1 to Section 130.2(c)3:** Lighting for Outdoor Sales Frontage, ~~Outdoor Sales Lots, and Outdoor Sales Canopies~~ complying with Section 130.2(c)4.

**EXCEPTION 2 to Section 130.2(c)3:** Lighting for Building Facades, Ornamental Hardscape and Outdoor Dining complying with Section 130.2(c)5.

**EXCEPTION 3 to Section 130.2(c)3:** Outdoor lighting, where luminaire rated wattage is determined in accordance with Section 130.0(c), and which meet one of the following conditions:

- A. Pole-mounted luminaires each with a maximum rated wattage of 75 watts; or
- B. Non-pole mounted luminaires with a maximum rated wattage of 30 watts each; or
- C. Linear lighting with a maximum wattage of 4 watts per linear foot of luminaire.

**EXCEPTION 4 to Section 130.2(c)3:** Applications listed as Exceptions to Section 140.7(a) shall not be required to meet the requirements of Section 130.2(c)3.

**~~EXCEPTION 5 to Section 130.2(c)3: Lighting for Commercial Vehicle Fuel Station Sales Canopies.~~**

- 4. For Outdoor Sales Frontage, ~~Outdoor Sales Lots, and Outdoor Sales Canopies~~ lighting, an automatic lighting control shall be installed that meets the following requirements:
  - A. A part-night outdoor lighting control as defined in Section 100.1; or
  - B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding ~~80-90~~ percent, and which have auto-ON functionality.
- 5. For Building Facade, Ornamental Hardscape and Outdoor Dining lighting, an automatic lighting control shall be installed that meets one or more of the following requirements:
  - A. A part-night outdoor lighting control as defined in Section 100.1; or
  - B. Motion sensors capable of automatically reducing lighting power by at least 40 percent but not exceeding ~~80-90~~ percent, and which have auto-ON functionality; or
  - C. A centralized time-based zone lighting control capable of automatically reducing lighting power by at least 50 percent.
  - D. Outdoor wall mounted luminaires having a bilaterally symmetric distribution as described in the IES Handbook (typically referred to as "wall packs") where the bottom of the luminaire is mounted 24 feet or less above the ground shall comply with the applicable requirements in Section 130.2(c)3.

**TABLE 130.2-A Uplight Ratings (Maximum Zonal Lumens)**

Secondary Solid Angle	Maximum Zonal Lumens per Outdoor Lighting Zone				
	<u>LZ0</u>	OLZ 1	OLZ 2	OLZ 3	OLZ 4
Uplight High (UH) 100 to 180 degrees	0	10	50	500	1,000
Uplight Low (UL) 90 to <100 degrees	0	10	50	500	1,000

TABLE 130.2-B Glare Ratings (Maximum Zonal Lumens)

Glare Rating for Asymmetrical Luminaire Types (Type I, Type II, Type III, Type IV)					
Secondary Solid Angle	Maximum Zonal Lumens per Outdoor Lighting Zone				
	LZ 0	OLZ 1	OLZ 2	OLZ 3	OLZ 4
Forward Very High (FVH) 80 to 90 degrees	10	100	225	500	750
Backlight Very High (BVH) 80 to 90 degrees	10	100	225	500	750
Forward High (FH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000
Backlight High (BH) 60 to <80 degrees	110	500	1,000	2,500	5,000
Glare Rating for Quadrilateral Symmetrical Luminaire Types (Type V, Type V Square)					
Secondary Solid Angle	Maximum Zonal Lumens per Outdoor Lighting Zone				
	LZ 0	OLZ 1	OLZ 2	OLZ 3	OLZ 4
Forward Very High (FVH) 80 to 90 degrees	10	100	225	500	750
Backlight Very High (BVH) 80 to 90 degrees	10	100	225	500	750
Forward High (FH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000
Backlight High (BH) 60 to <80 degrees	660	1,800	5,000	7,500	12,000

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## SECTION 130.3 – SIGN LIGHTING CONTROLS

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Section 130.3(a)1 through 130.3(a)3.

(a) **Controls for Sign Lighting.** All sign lighting shall meet the requirements below as applicable:

1. **Indoor Signs.** All indoor sign lighting shall be controlled with an automatic time-switch control or astronomical time-switch control.
2. **Outdoor Signs.** Outdoor sign lighting shall meet the following requirements as applicable:
  - A. All outdoor sign lighting shall be controlled with a photocontrol in addition to an automatic time-switch control, or an astronomical time-switch control.

**EXCEPTION to Section 130.3(a)2A:** Outdoor signs in tunnels, and signs in large permanently covered outdoor areas that are intended to be continuously lit, 24 hours per day and 365 days per year.

- B. All outdoor sign lighting that is ON both day and night shall be controlled with a dimmer that provides the ability to automatically reduce sign lighting power by a minimum of 65 percent during nighttime hours. Signs that are illuminated at night and for more than 1 hour during daylight hours shall be considered ON both day and night.

**EXCEPTION to Section 130.3(a)2B:** Outdoor signs in tunnels and large covered areas that are intended to be illuminated both day and night.

3. **Demand Responsive Electronic Message Center Control.** An Electronic Message Center (EMC) having a new connected lighting power load greater than 15 kW shall have a control installed that is capable of reducing the lighting power by a minimum of 30 percent when receiving a demand response signal.

**EXCEPTION to Section 130.3(a)3:** Lighting for EMCs that is not permitted by a health or life safety statute, ordinance, or regulation to be reduced by 30 percent.

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## SECTION 130.4 –LIGHTING CONTROL ACCEPTANCE AND INSTALLATION CERTIFICATE REQUIREMENTS

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.4(a) through 130.4(c).

(a) **Lighting Control Acceptance Requirements.** Before an occupancy permit is granted for a newly constructed building or area, or a new lighting system serving a building, area, or site is operated for normal use, indoor and outdoor lighting controls serving the building, area, or site shall be certified as meeting the Acceptance Requirements for Code Compliance in accordance with Section 130.4(a). A Certificate of Acceptance shall be submitted to the enforcement agency under Section 10-103(a) of Part 1, that:

1. Certifies that all of the lighting acceptance testing necessary to meet the requirements of Part 6 is completed; are included on the plans and specifications; plans, specifications, installation certificates, and operating and maintenance information meet the requirements of Part 6.
2. Completes Certifies that the applicable procedures in Reference Nonresidential Appendix NA7.6; NA7.7, and NA7.8, and NA7.9 have been followed; and submits all applicable compliance forms.
3. Certifies that automatic daylight controls comply with Section 130.1(d) and Reference Nonresidential Appendix NA7.6.1;
4. Certifies that lighting shut-OFF controls comply with Section 130.1(c) and Reference Nonresidential Appendix NA7.6.2;
5. Certifies that demand responsive controls comply with Section 130.1(e) and Reference Nonresidential Appendix NA7.6.3; and
6. Certifies that outdoor lighting controls comply with the applicable requirements of Section 130.2(c) and Reference Nonresidential Appendix NA7.8; and
7. Certifies that lighting systems receiving the Institutional Tuning Power Adjustment Factor, comply with Section 140.6(a)2J and Reference Nonresidential Appendix NA7.7.6.2.

(b) **Lighting Control Installation Certificate Requirements.** To be recognized for compliance with Part 6 an Installation Certificate shall be submitted in accordance with Section 10-103(a) for any lighting control system, Energy Management Control System, track lighting integral current limiter, track lighting supplementary overcurrent protection panel, 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. Certification that line-voltage track lighting integral current limiters comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.3.
4. Certification that line-voltage track lighting supplementary overcurrent protection panels comply with the applicable requirements of Section 110.9 and installed wattage has been determined in accordance with Section 130.0(c); and comply with Reference Nonresidential Appendix NA7.7.4.
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 NA7.7.5.

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 NA7.7.6.
  7. Certification that additional lighting wattage installed for a videoconference studio complies with Section 140.6(c)2Gviii; and complies with Reference Nonresidential Appendix NA7.7.7.
- (c) When certification is required by Title 24, Part 1, Section 10-103-A.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: Sections 25402, 25402.1, 25213, Public Resources Code. Reference: Sections 25007, 25402(a)-(b), 25402.1, 25402.4, 25402.5, 25402.8 and 25910, Public Resources Code.

## SECTION 130.5 –ELECTRICAL POWER DISTRIBUTION SYSTEMS

Nonresidential, high-rise residential and hotel/motel buildings shall comply with the applicable requirements of Sections 130.5(a) through 130.5(f).

(a) **Service-Service Electrical Metering.** Each electrical service or feeder shall have a permanently installed user accessible metering system which measures of total electrical energy use per in accordance with TABLE 130.5-A.

1. The electrical usage shall be recorded a minimum of every 15 minutes and reported at least hourly, daily, monthly, and annually. The metering system shall be capable of maintaining all data collected for a minimum of 36 months.
2. For buildings with tenants, the distribution systems shall be separately monitored for the total building and for each individual tenant space. The data for each tenant space shall be made available to that tenant.

**EXCEPTION to Section 130.5(a):** Buildings Service or feeder for which the utility company provides a metering system capable of electrical energy measurement in accordance with TABLE 130.5-A requirements for occupant or user use that indicates instantaneous kW demand and kWh for a user-resettable period that indicates instantaneous kW demand and kWh for a utility-defined period.

**EXCEPTION to Section 130.5(a)1:** The following buildings and areas are not required to comply with this section:

1. Building less than 25,000 square feet;
2. Individual tenant areas less than 10,000 square feet;
3. Dwelling units;
4. Functional areas where compliance with the residential lighting standards is required in accordance with Section 130.0(b);
5. Residential buildings with less than 10,000 square feet of common area;
6. Critical and Equipment branches as defined by California Electrical Code.

- (b) **Disaggregation Separation of Electrical Circuits for Electrical Energy Monitoring.** Electrical power distribution systems shall allow installation of be designed so that measurement devices for can monitoring the electrical energy usage of load types be designed to permit the disaggregated measurement of electrical load energy uses downstream from the service meter according to TABLE 130.5-B. Additive and subtractive methods may be used to determine aggregate and disaggregated energy use. This may be accomplished by any of the following methods:

1. ~~Separate switchboards, motor control centers, or panelboards loads shall be disaggregated to which are connected only the required load for each load type of TABLE 130.5-B allowing their independent energy measurement per TABLE 130.5-B. Up to 10 percent of the disaggregated connected load is permitted to be from any other disaggregated load types specified in TABLE 130.5-B or group of loads; or~~
2. ~~Switchboards, motor control centers, or panelboards may supply other distribution equipments with their loads disaggregated for each load types in accordance with TABLE 130.5-B. The measured interval demand loads for each distribution equipment must be able to be added or subtracted from other distribution equipment supplying them. This method must permit permanent measurement and determination of actual interval demand load value for each disaggregated load in the system. Up to 10 percent of the disaggregated connected load type is permitted to be from any other disaggregated load types specified in TABLE 130.5-B. Subpanels of the above to which are connected only the required load or group of loads and for which the subpanel load can be independently measured in aggregate; or~~
3. ~~Buildings for which a complete metering and measurement system is provided that at a minimum measures and reports the loads called for in TABLE 130.5-B. Branch circuits, taps or disconnects requiring overcurrent protection devices rated 60 amperes or greater.~~

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

**EXCEPTION 1 to Section 130.5(b)** Buildings for which a complete metering and measurement system is provided that at a minimum measures and reports the loads called for in TABLE 130.5-B.

**EXCEPTION 2 to Section 130.5(b)** Alterations where all of the following conditions exist are not required to comply with this section:

- A. The following existing equipment remains in place:
  - i. Service distribution switchboards or panelboards; and
  - ii. Feeders; and
  - iii. Motor control centers or panelboards.
- B. Existing equipment included in Item A (above) remains unaltered except for:
  - i. Changes to load circuit connections; or
  - ii. Changes to the quantity of outgoing overcurrent protection devices; or
  - iii. Changes to the ampacity of outgoing overcurrent protection devices.

**(c) Voltage Drop.**

The maximum total combined voltage drop on both installed feeder conductors and branch circuit conductors to the farthest connected load or outlet, shall not exceed 5 percent.

1. **Feeders.** Feeder conductors shall be sized for a maximum voltage drop of 2 percent at design load.
2. **Branch Circuits.** Branch circuit conductors shall be sized for a maximum voltage drop of 3 percent at design load.

EXCEPTION 1 to Section 130.5(c): Feeder conductors and branch circuits that are dedicated to fire pump emergency services systems.

EXCEPTION 2 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 ~~each private office, open office areas, reception lobbies,~~ conference rooms, kitchenette areas in office spaces, and copy rooms. Additionally, hotel/motel guest rooms shall comply with ~~Item 59~~ Section 130.5(d)4. Controlled receptacles shall meet the following requirements, as applicable:

1. ~~Electric circuits serving controlled receptacles shall be equipped with~~ Install an occupant sensing control, automatic time switch control, or other a control capable of automatically shutting OFF the controlled receptacles when the space is typically unoccupied, either at the receptacle or circuit level. ~~automatic shut-OFF controls following the requirements prescribed in Section 130.1(c)(1 through 5). 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 shall be installed within 6 feet from each uncontrolled receptacle, or install a splitwired duplex receptacle with at least one controlled and one uncontrolled receptacle, shall be installed. Where receptacles are installed in modular furniture in open office areas, at least one controlled receptacle shall be installed at each workstation; and~~
3. ~~Controlled receptacles shall have~~ Provide a permanent and durable marking for controlled receptacles or circuits to differentiate them from uncontrolled receptacles or circuits; and
4. ~~If an automatic time switch control, other than an occupant sensing control, is installed to comply with Section 130.5(d)1, 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 For open office areas, controlled circuits shall be provided and marked to support installation and configuration of office furniture with receptacles that comply with Section 130.5(d) 1, 2, and 3; and~~
5. ~~If an automatic time switch control, other than an occupant sensing control, is installed to comply with Section 130.5(d)1, it shall incorporate an automatic holiday "shut-OFF" feature that turns OFF all loads for at least 24 hours and then resumes the normally scheduled operation. For hotel and motel guest rooms at least one-half of the 120-volt receptacles in each guest room shall be controlled receptacles that comply with Section 130.5(d)1, 2, and 3. Electric circuits serving controlled receptacles 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, power is switched off; and~~
6. ~~Plug-in strips and other plug-in devices that incorporate an occupant sensor shall not be used to comply with this requirement; and,~~
7. ~~Countdown timer switch shall not be used to comply with the requirements of Section 130.5(d)1; and~~
8. ~~For open office areas, controlled circuits shall be provided and marked to support installation and configuration of office furniture with receptacles that comply with Section 130.5(d) 1, 2, 3, 4, 5, 6 and 7.~~
94. ~~For hotel and motel guest rooms, install controlled receptacles for at least one-half of the 120-volt receptacles in each guest room shall be controlled receptacles that comply with Section 130.5(d)1, 2, and 3. Electric circuits serving controlled receptacles in guestrooms shall have captive card key controls, occupancy sensing controls, or automatic controls such that so the power is switched off no longer than 30 minutes after the guest room has been vacated; power is switched off.~~

**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 this Section.

**EXCEPTION 1 to Section 130.5(d):** In open office areas, controlled circuit receptacles are not required if, at time of final permit, workstations are installed, and each workstation is equipped with an occupant sensing control that is permanently mounted in each workstation, and which controls a hardwired, nonresidential-rated power strip. Plug-in strips and other plug-in devices that incorporate an occupant sensor shall not be used for this exception.

**EXCEPTION 2 to Section 130.5(d):** Receptacles that are only for the following purposes:

- i. Receptacles specifically for refrigerators and water dispensers in kitchenette areas.
- 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.
- v. Receptacles connected to an uninterruptible power supply (UPS) that are intended to be in continuous use, 24 hours per day/365 days per year, and are marked to differentiate them from other uncontrolled receptacles or circuits.
- (e) **Demand responsive controls and equipment.** Demand responsive controls and equipment where installed shall be capable of receiving and automatically responding to at least one standards-based messaging protocol which enables demand response after receiving a demand response signal.
- ~~(f) **Energy Management Control System (EMCS).**~~
  - ~~1. An EMCS may be installed to comply with the requirements of one or more lighting controls if it meets the following minimum requirements:~~
    - ~~A. Provides all applicable functionality for each specific lighting control or system for which it is installed in accordance with Section 110.9; and~~
    - ~~B. Complies with all applicable Lighting Control Installation Requirements in accordance with Section 130.4 for each specific lighting control or system for which it is installed; and~~
    - ~~C. Complies with all applicable application requirements for each specific lighting control or system for which it is installed, in accordance with Part 6.~~
  - ~~2. An EMCS may be installed to comply with the requirements of a thermostat if it complies with all applicable application requirements for each thermostat in accordance with Part 6.~~

**NOTE:** Definitions of terms and phrases in Section 130.5 are determined as specified in Section 100.1(b). Terms and phrases not found in Section 100.1(b) shall be defined as specified in Title 24, Part 3, Article 100 of the California Electrical Code.

TABLE 130.5-A MINIMUM REQUIREMENTS FOR METERING OF ELECTRICAL LOAD

<u>Metering Type/Functionality</u>	<u>Electrical Services</u> rated 50 kVA or less	<u>Electrical Services</u> rated more than 50kVA and less than or equal to 250 kVA	<u>Electrical Services</u> rated more than 250 kVA and less than or equal to 1000kVA	<u>Electrical Services</u> rated more than 1000kVA
Instantaneous (at the time) kW demand	Required	Required	Required	Required
Historical peak demand (kW)	Not required	Not required	Required	Required
<u>Resettable Tracking kWh for a user-definable period.</u>	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

<u>Electrical Load Type</u>	<u>Electrical Services rated 50 kVA or less</u>	<u>Electrical Services rated more than 50kVA and less than or equal to 250 kVA</u>	<u>Electrical Services rated more than 250 kVA and less than or equal to 1000kVA</u>	<u>Electrical Services rated more than 1000kVA</u>
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 50kVA
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 25kVA or greater	Not required	All loads in aggregate	All loads in aggregateEach	All loads in aggregateEach
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 aggregateEach	All loads in aggregateEach
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, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR ACHIEVING ENERGY EFFICIENCY

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### SECTION 140.0 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

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

- (a) The requirements of Sections 100.0 through 110.10 applicable to the building project (mandatory measures for all buildings).
- (b) The requirements of Sections 120.0 through 130.5 (mandatory measures for nonresidential, high-rise residential 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 140.9 apply to newly constructed buildings. Section 141.0 specifies which requirements of Sections 140.1 through 140.9 also apply to additions or alterations to existing buildings.

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### SECTION 140.1 – PERFORMANCE APPROACH: ENERGY BUDGETS

A building complies with the performance approach if the energy budget calculated for the Proposed Design Building under Subsection (b) is no greater than the energy budget calculated for the Standard Design Building under Subsection (a).

- (a) **Energy Budget for the Standard Design Building.** The energy budget for a proposed building is determined by applying the mandatory and prescriptive requirements to the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation, service water heating, and covered process loads.
- (b) **Energy Budget for the Proposed Design Building.** The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, indoor lighting, mechanical ventilation and service water heating and covered process loads.
- (c) **Calculation of Energy Budget.** The TDV energy for both the Standard Design Building and the Proposed Design Building shall be computed by Compliance Software certified for this use by the Commission. The processes for Compliance Software approval by the Commission are documented in the Nonresidential ACM Approval Manual.

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## SECTION 140.2 – PRESCRIPTIVE APPROACH

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

- ~~(a)~~ ~~(a)~~ A building envelope that complies with Section 140.3(a);
- ~~(a)~~ ~~or 140.3(b)~~, and for ~~A minimum daylighting requirement for large enclosed spaces~~ applicable buildings complying with Section 140.3(c);
- ~~(b)~~
- ~~(b)~~ ~~(b)~~ A space-conditioning system that complies with Section 140.4;
- ~~(c)~~
- ~~(e)~~ ~~(e)~~ A service water-heating system that complies with Section 140.5;
- ~~(d)~~ ~~(d)~~
- ~~(d)~~ ~~—~~ An indoor lighting system that complies with Section 140.6;
- ~~(e)~~ ~~(e)~~
- ~~(e)~~ ~~—~~ An outdoor lighting system that complies with Section 140.7;
- ~~(f)~~ ~~(f)~~
- ~~(f)~~ ~~—~~ Interior and exterior signs that comply with Section 140.8; and
- ~~(g)~~ ~~(g)~~
- ~~(e)~~ ~~(h)~~ Covered processes that comply with Section 140.9.

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## SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

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

### (a) Envelope Component Approach 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 0.0390, 0.034 or lower.

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

**EXCEPTION 3-2 to Section 140.3(a)1Aia:** Roof constructions that have thermal mass with a weight of at least 25 lb/ft<sup>2</sup> over the roof membrane are exempt from the requirements of Section 140.3(a)1Aia.

**EXCEPTION 43 to SECTION 140.3(a)1Aia:** An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling U-factor in TABLE 140.3 is not exceeded.

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

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

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

**EXCEPTION to Section 140.3(a)1Aia:** Roof constructions that have thermal mass with a weight of at least 25 lb/ft<sup>2</sup> 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.

TABLE 140.3 - ROOF/CEILING INSULATION TRADEOFF FOR AGED SOLAR REFLECTANCE

Nonresidential			
Aged Solar Reflectance	Metal Building	Wood framed and Other	Wood Framed and Other
	Climate Zone 1-16 U-factor	Climate Zone 1 & 5 & 6 & 7 U-factor	All Other Climate Zones Zone 2-4, 9-16 U-factor
0.62-0.60-0.56	0.0410-0.0380-0.06 4	0.0490-0.0450-0.045	0.0340-0.0320-0.036
0.59-0.55-0.46	0.0380-0.0350-0.05 4	0.0450-0.0420-0.041	0.0320-0.0300-0.034
0.54-0.50-0.45-0.36	0.0363-0.049	0.0420-0.0390-0.038	0.0310-0.0290-0.032
0.49-0.45-0.35-0.25	0.0350-0.0310-0.04 7	0.0420-0.0370-0.035	0.0280-0.030
0.44-0.40	0.043	0.033	0.028
0.39-0.35	0.039	0.031	0.027
0.34-0.30	0.035	0.029	0.025
0.29-0.25	0.033	0.027	0.024

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

- B. **Roof Insulation.** Roofs shall have an overall assembly U-factor no greater than the applicable value in Table 140.3- B, C or D, and where required by Section 110.8(e), insulation shall be placed in direct contact with a continuous roof or drywall ceiling.
2. **Exterior Walls.** Exterior walls shall have an overall assembly U-factor no greater than the applicable value in TABLE 140.3-B, C or D.
3. **Demising Walls.** Demising walls shall meet the requirements of Section ~~110.8(d)~~ 120.7(b)7.
4. **Exterior Floors and Soffits.** Exterior floors and soffits shall have an overall assembly U-factor no greater than the applicable value in TABLE 140.3-B, C or D.
5. **Fenestration.** Vertical Windows shall:
- A. have (1) a west-facing area no greater than 40 percent of the gross west-facing exterior wall area, or 6 feet times the west-facing display perimeter, whichever is greater; and (2) a total area no greater than 40 percent of the gross exterior wall area, or 6 feet times the display perimeter, whichever is greater; and

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

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

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

- i. the lower-rated labeled U-factor shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and
  - ii. chromogenic glazing shall be considered separately from other fenestration; and
  - iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.
- C. Have an area-weighted average Relative Solar Heat Gain Coefficient, RSHGC, excluding the effects of interior shading, no greater than the applicable value in TABLE 140.3-B, C or D.

For purposes of this paragraph, the Relative Solar Heat Gain Coefficient, RSHGC, of a vertical window is:

- i. the ~~solar-Solar heat-Heat gain-Gain eCoefficient-Coefficient~~ of the window; or
- ii. ~~relative-Relative solar-Solar heat-Heat gain-Gain eCoefficient as-is~~ calculated by ~~using~~ EQUATION 140.3-A, if the window has an overhang that extends beyond each side of the window jamb by a distance equal to the overhang's horizontal projection.

**EXCEPTION 1 to Section 140.3(a)5C:** An area-weighted average Relative Solar Heat Gain ~~eCoefficient~~ of 0.56 or less shall be used for windows:

- a. that are in the first story of exterior walls that form a display perimeter; and
- b. for which codes restrict the use of overhangs to shade the windows.

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

- i. the lower-rated 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 fenestration; and
  - iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.
- D. Have an area-weighted average Visible Transmittance (VT) no less than the applicable value in TABLE 140.3-B and C, or EQUATION 140.3-B, as applicable.

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

**EXCEPTION 2 to Section 140.3(a)5D:** If the fenestration's visible transmittance is not within the scope of NFRC 200, or ASTM E972, ~~or EQUATION 140.3-B,~~ then the VT shall be calculated according to Reference Nonresidential Appendix NA6.

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

- i. the higher 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 fenestration; and
- iii. area-weighted averaging with other fenestration that is not chromogenic shall not be permitted.



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

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

WHERE:

- RSHGC = Relative ~~Solar Heat Gain Coefficient~~.
- SHGC<sub>win</sub> = Solar ~~Heat Gain Coefficient~~ Coefficient of the window.
- H = Horizontal projection of the overhang from the surface of the window in feet, but no greater than V.
- V = Vertical distance from the window sill to the bottom of the overhang in feet.
- a = -0.41 for north-facing windows, -1.22 for south-facing windows, and -0.92 for east and west-facing windows.
- b = 0.20 for north-facing windows, 0.66 for south-facing windows, and 0.35 for east and west-facing windows.

## EQUATION 140.3-B VERTICAL FENESTRATION MINIMUM VT

$$VT \geq 0.11 / WWR$$

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 (SRR); and  
**EXCEPTION to Section 140.3(a)6A:** Atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.
- B. Have an Area-Weighted Performance Rating U-factor no greater than the applicable value in TABLE 140.3-B, C or D.  
**EXCEPTION to Section 140.3(a)6B:** For skylights containing chromogenic type glazing:
  - i. the lower-rate labeled U-factor shall be used with automatic controls to modulate the amount of U-factor heat flow into the space in multiple steps in response to daylight levels or solar intensity; and
  - ii. chromogenic glazing shall be considered separately from other skylights; and
  - iii. area-weighted averaging with other skylights that is not chromogenic shall not be permitted.
- C. Have an area-weighted performance rating Solar Heat Gain Coefficient no greater than the applicable value in TABLE 140.3-B, C or D.  
**EXCEPTION to Section 140.3(a)6C:** For skylights containing chromogenic type glazing:
  - i. the lower-rated labeled SHGC shall be used with automatic controls to modulate the amount of heat flow into the space in multiple steps in response to daylight levels or solar intensity; and
  - ii. chromogenic glazing shall be considered separately from other skylights; and
  - iii. area-weighted averaging with other skylights that are not chromogenic shall not be permitted.

- D. Have an Area-Weighted Performance Rating VT no less than the applicable value in TABLE 140.3-B or C; and

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

- i. the higher-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 skylights; and
  - iii. area-weighted averaging with other skylights that are not chromogenic shall not be permitted.
- E. Have a glazing material or diffuser that has a measured haze value greater than 90 percent, determined according to ASTM D1003, or other test method approved by the Energy Commission.

**EXCEPTION 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.

7. **Exterior doors.** All exterior doors that separate conditioned space from unconditioned space or from ambient air shall have a U-factor not greater than the applicable value in TABLE 140.3-B, C or D. Doors that are more than one-half glass in area are considered Glazed Doors.
8. **Relocatable Public School Buildings.** In complying with Sections 140.3(a)1 to 7 shall meet the following:
- A. Relocatable public school buildings shall comply with TABLE 140.3-B for a specific Climate Zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use only in a specific Climate Zone; or
  - B. Relocatable public school buildings shall comply with TABLE 140.3-D for any Climate Zone when the manufacturer or builder of the relocatable public school building certifies that the building is intended for use in any Climate Zone; and
  - C. The manufacturer or builder of a relocatable public school building shall certify that components of the building comply with requirements of this section by:
    - i. The placement of two (2) metal identification labels on the building, one mechanically fastened and visible from the exterior and the other mechanically fastened to the interior frame above the ceiling at the end of the module., both labels stating (in addition to any other information by the Division of the State Architect or other law) "Complies with Title 24, Part 6 for all Climate Zones; and
    - ii. Identification of the location of the 2 labels on the plans submitted to the enforcing agency.
9. **Air Barrier.** To meet the requirement of TABLE 140.3-B, all buildings shall have a continuous air barrier that is designed and constructed to control air leakage into, and out of, the building's conditioned space. The air barrier shall be sealed at all joints for its entire length and shall be composed of:
- A. Materials that have an air permeance not exceeding 0.004 cfm/ft<sup>2</sup>, under a pressure differential of 0.3 in. w.g. (1.57 psf) (0.02 L/m<sup>2</sup> at 75 pa), when tested in accordance with ASTM E2178; or

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

TABLE 140.3-A MATERIALS DEEMED TO COMPLY WITH SECTION 140.3(a)9A

MATERIALS AND THICKNESS		MATERIALS AND THICKNESS	
1	Plywood – min. 3/8 inches thickness	9	Built up roofing membrane
2	Oriented strand board – min. 3/8 inches thickness	10	Modified bituminous roof membrane
3	Extruded polystyrene insulation board – min. ½ inches thickness	11	Fully adhered single-ply roof membrane
4	Foil-back polyisocyanurate insulation board – min. ½ inches thickness	12	A Portland cement or Portland sand parge, or a gypsum plaster, each with min. 5/8 inches thickness
5	Closed cell spray foam with a minimum density of 2.0 pcf and a min. 2.0 inches thickness	13	Cast-in-place concrete, or precast concrete
6	Open cell spray foam with a density no less than 0.4 pcf and no greater than 1.5 pcf, and a min. 5½ inches thickness	14	Fully grouted concrete block masonry
7	Exterior or interior gypsum board min. 1/2 inches thickness	15	Sheet steel or sheet aluminum
8	Cement board – min. 1/2 inches thickness	---	-----

- B. -Assemblies of materials and components that have an average air leakage not exceeding 0.04 cfm/ft<sup>2</sup>, under a pressure differential of 0.3 in. w.g (1.57 psf) (0.2 L/m<sup>2</sup> at 75 pa), when tested in accordance with ASTM E2357, ASTM E1677, ASTM E1680, or ASTM E283; or

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

- i. Concrete masonry walls that have at least two coatings of paint or at least two coatings of sealer coating.
- ii. Concrete masonry walls with integral rigid board insulation.
- iii. Structurally Insulated Panels.
- iv. Portland cement or Portland sand parge, or stucco, or a gypsum plaster, each with min. 1/2 inches thickness

- C. -The entire building has an air leakage rate not exceeding 0.40 cfm/ft<sup>2</sup> at a pressure differential of 0.3 in w.g. (1.57 psf) (2.0 L/ m<sup>2</sup> at 75 pa), when the entire building is tested, after completion of construction, in accordance with ASTM E779 or another test method approved by the Commission.

**EXCEPTION to Section 140.3(a)9:** Relocatable Public School Buildings.

**TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)**

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	
			Wood Framed and Other	0.034	0.034	0.034	0.034	0.034	0.049	0.049	0.067	0.049	0.034	0.034	0.034	0.034	0.034	0.034	0.034
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061
			Metal-framed	0.069	0.062	0.082	0.062	0.062	0.069	0.069	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062
			Mass Light <sup>1</sup>	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy <sup>1</sup>	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.690	0.690	0.650	0.184	0.253	0.211	0.184	0.184
			Wood-framed and Other	0.095	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.045	0.059	0.059	0.059	0.042	0.059
		Floors/ Soffits	Raised Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.058
			Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.071	0.039	0.039	0.039
	Roofing Products	Low- sloped	Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Steep- Sloped	Aged Solar Reflectance	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
			Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Air Barrier				NR	NR	NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ
	Exterior Doors, Maximum U-factor			Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
				Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
			Wood Framed and Other	0.049	0.039	0.039	0.039	0.049	0.075	0.067	0.067	0.039	0.039	0.039	0.039	0.039	0.039	0.039	0.039
		Walls	Metal Building	0.113	0.061	0.113	0.061	0.061	0.113	0.113	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.061
			Metal-framed	0.098	0.062	0.082	0.062	0.062	0.098	0.098	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062	0.062

**SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES**

Roofing Products	Sloped	Mass Light <sup>†</sup>	0.196	0.170	0.278	0.227	0.440	0.440	0.440	0.440	0.170	0.170	0.170	0.170	0.170	0.170	0.170
		Mass Heavy <sup>†</sup>	0.253	0.650	0.650	0.650	0.650	0.690	0.690	0.690	0.184	0.211	0.184	0.184	0.184	0.184	0.160
		Wood-framed and Other	0.102	0.059	0.110	0.059	0.102	0.110	0.110	0.102	0.059	0.059	0.059	0.059	0.059	0.042	0.059
	Low Sloped	Mass	0.092	0.092	0.269	0.269	0.269	0.269	0.269	0.269	0.092	0.092	0.092	0.092	0.092	0.092	0.058
		Other	0.048	0.039	0.071	0.071	0.071	0.071	0.071	0.071	0.039	0.071	0.039	0.039	0.039	0.039	0.039
		Aged Solar Reflectance	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63
	Deep Sloped	Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
		Aged Solar Reflectance	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
		Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
	Air Barrier		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Exterior Doors, Maximum U-factor		Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
		Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

## SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

CONTINUED: TABLE 140.3-B – PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)

Envelope	Fenestration			All Climate Zones				
					Fixed Window	Operable Window	Curtainwall or Storefront	Glazed Doors <sup>2</sup>
		Vertical	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45
				Max RSHGC	0.25	0.22	0.26	0.23
			Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17
			Maximum WWR%	40%				
		Skylights			Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted	
			Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88	
				Max SHGC	0.25	0.25	NR	
			Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64	
Maximum SRR%	5%							

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

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/ Ceilings	Metal Building	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	0.041	
			Wood Framed and Other	0.028	0.028	0.034	0.028	0.034	0.034	0.039	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028
		Walls	Metal Building	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057
			Metal-framed	0.069	0.069	0.069	0.069	0.069	0.069	0.105	0.069	0.069	0.069	0.069	0.069	0.069	0.069	0.048	0.069
			Mass Light <sup>1</sup>	0.170	0.170	0.170	0.170	0.170	0.227	0.227	0.227	0.196	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy <sup>1</sup>	0.160	0.160	0.160	0.184	0.211	0.690	0.690	0.690	0.690	0.690	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042
		Floors/ Soffits	Raised Mass	0.045	0.045	0.058	0.058	0.058	0.069	0.092	0.092	0.092	0.069	0.058	0.058	0.058	0.045	0.058	0.037
			Other	0.034	0.034	0.039	0.039	0.039	0.039	0.071	0.039	0.039	0.039	0.039	0.039	0.039	0.034	0.039	0.034
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	0.55	0.55	0.55	NR	0.55	0.55	NR	
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	NR	0.75	0.75	NR	
		Steep-Sloped	Aged Solar Reflectance	NR	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR	
			Thermal Emittance	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	NR	
	Exterior Doors, Maximum U-factor	Non-Swinging	0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50		
		Swinging	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70		

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Envelope	Maximum U-factor	Roofs/Ceilings	Metal Building	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065	0.065
			Wood Framed and Other	0.034	0.028	0.039	0.028	0.039	0.039	0.039	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028

SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

		Walls	Metal Building	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.061	0.057	0.057	0.057	0.057	0.057	0.057
			Metal-framed	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105	0.105
			Mass Light <sup>†</sup>	0.170	0.170	0.170	0.170	0.170	0.227	0.227	0.227	0.196	0.170	0.170	0.170	0.170	0.170	0.170	0.170
			Mass Heavy <sup>†</sup>	0.160	0.160	0.160	0.184	0.211	0.690	0.690	0.690	0.690	0.690	0.184	0.253	0.211	0.184	0.184	0.160
			Wood-framed and Other	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.059	0.042	0.059	0.059	0.042	0.042	0.042
		Floors/ Soffits	Mass	0.045	0.045	0.058	0.058	0.058	0.069	0.092	0.092	0.092	0.069	0.058	0.058	0.058	0.045	0.058	0.037
			Other	0.034	0.034	0.039	0.039	0.039	0.039	0.071	0.039	0.039	0.039	0.039	0.039	0.039	0.034	0.039	0.034
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	0.55	0.55	0.55	NR	0.55	0.55	0.55	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	NR	0.75	0.75	0.75	NR
		Steep-Sloped	Aged Solar Reflectance	NR	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	NR
	Exterior Doors, Maximum U-factor	Non-Swinging		0.50	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	1.45	0.50
		Swinging		0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70

CONTINUED: TABLE 140.3-C – PRESCRIPTIVE ENVELOPE CRITERIA FOR HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

Envelope	Penetration		All Climate Zones			
			Fixed Window	Operable Window	Curtainwall/Storefront	Glazed Doors <sup>2</sup>

SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES.



		Vertical	Area-Weighted Performance Rating	Max U-factor	0.36	0.46	0.41	0.45	
				Max RSHGC	0.25	0.22	0.26	0.23	
			Area-Weighted Performance Rating	Min VT	0.42	0.32	0.46	0.17	
				Maximum WWR%	40%				
		Skylights			Glass, Curb Mounted	Glass, Deck Mounted	Plastic, Curb Mounted		
			Area-Weighted Performance Rating	Max U-factor	0.58	0.46	0.88		
				Max SHGC	0.25	0.25	NR		
			Area-Weighted Performance Rating	Min VT	0.49	0.49	0.64		
			Maximum SRR%	5%					

## Notes:

1. Light mass walls are walls with a heat capacity of at least 7.0 Btu/ft<sup>2</sup>-°F and less than 15.0 Btu/ft<sup>2</sup>-°F. Heavy mass walls are walls with a heat capacity of at least 15.0 Btu/ft<sup>2</sup>-°F.

2. Glazed Doors applies to both site-built and to factory-assembled glazed doors.

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

<u>Roofs/ Ceilings</u>	<u>Metal Buildings</u>	<u>Maximum U-factor</u>		<u>0.048/0.41</u>	
	<u>Non-Metal Buildings</u>			<u>0.0349</u>	
<u>Walls</u>	<u>Wood frame buildings</u>			<u>0.045/25/9</u>	
	<u>Metal frame buildings</u>			<u>0.057/62</u>	
	<u>Metal buildings</u>			<u>0.057</u>	
	<u>Mass/7.0&lt; HC</u>			<u>0.170</u>	
	<u>All Other Walls</u>			<u>0.059</u>	
<u>Floors and Soffits</u>	<u>Floors and Soffits</u>			<u>0.048</u>	
<u>Roofing Products</u>	<u>Low-Sloped</u>	<u>Aged Solar Reflectance</u>		<u>0.63</u>	
		<u>Thermal Emittance</u>		<u>0.75</u>	
	<u>Steep-Sloped</u>	<u>Aged Solar Reflectance</u>		<u>0.20</u>	
		<u>Thermal Emittance</u>		<u>0.75</u>	
<u>Fenestration</u>	<u>Windows</u>	<u>Maximum U-factor</u>		<u>0.47</u>	
		<u>Maximum SHGC</u>		<u>0.26</u>	
	<u>Glazed Doors (Site-Built and Factory Assembled)</u>	<u>Maximum U-factor</u>		<u>0.45</u>	
		<u>Maximum SHGC</u>		<u>0.23</u>	
	<u>Skylights</u>	<u>Glass with Curb</u>		<u>0.99</u>	
		<u>Glass without Curb</u>		<u>Maximum U-factor</u>	<u>0.57</u>
		<u>Plastic with Curb</u>			<u>0.87</u>
		<u>Glass Type</u>	<u>0-2% SRR</u>	<u>Maximum SHGC</u>	<u>0.46</u>
			<u>2.1-5% SRR</u>		<u>0.36</u>
		<u>Plastic Type</u>	<u>0-2% SRR</u>		<u>0.69</u>
			<u>2.1-5% SRR</u>		<u>0.57</u>
<u>Exterior Doors</u>	<u>Non-Swinging doors</u>	<u>Maximum U-factor</u>		<u>0.50</u>	
	<u>Swinging doors</u>			<u>0.70</u>	

<b><u>Roofs/Ceilings</u></b>	
<b><u>Roofs of Metal Buildings</u></b>	<b><u>Maximum U-factor 0.048</u></b>
<b><u>Roofs of all non-Metal Buildings</u></b>	<b><u>Maximum U-factor 0.039</u></b>
<b><u>Roofing Products — Aged Solar Reflectance/Emittance</u></b>	
<b><u>Low-sloped — Low-Sloped</u></b>	<b><u>0.63/0.75</u></b>
<b><u>Steep-Sloped — Steep-Sloped</u></b>	<b><u>0.20/0.75</u></b>

**SECTION 140.3 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES**

Walls		
- Walls of Wood frame buildings		Maximum U factor 0.059
- Walls of Metal frame buildings		Maximum U factor 0.062
- Walls of Metal buildings		Maximum U factor 0.057
- Walls of Mass/ $7.0 \leq HC$ , any building		Maximum U factor 0.170
- All Other Walls		Maximum U factor 0.059
Floors and soffits of all buildings		Maximum U factor 0.048
Windows of all buildings		
U factor		Maximum U factor 0.47
RSHGC		Maximum RSHGC 0.26
Glazed Doors, All Buildings		
- Max Average Weighted U factor		0.45
- Max Average Weighted RSHGC		0.23
Exterior Doors, all buildings		
- Non-Swinging doors		Maximum U factor 0.50
- Swinging doors		Maximum U factor 0.70
Skylights		
- Glass with Curb		Maximum U factor 0.99
Glass without Curb		Maximum U factor 0.57
Plastic with Curb		Maximum U factor 0.87
Glass Skylights	0-2% SRR	Maximum SHGC 0.46
	2.1-5% SRR	Maximum SHGC 0.36
- Plastic Skylights	0-2% SRR	Maximum SHGC 0.69
	2.1-5% SRR	Maximum SHGC 0.57

**(b) RESERVED**

- (c) Minimum Daylighting Requirement for Large Enclosed Spaces.** In Climate Zones 2 through 15, conditioned enclosed spaces, and unconditioned enclosed spaces, that are greater than 5,000 ft<sup>2</sup> and that are directly under a roof with ceiling heights greater than 15 feet, shall meet the following requirements:

1. A combined total of at least 75 percent of the floor area, as determined in building floor plan (drawings) view, shall be within one or more of the following:
  - A. Primary Sidelight Daylit Zone in accordance with Section 130.1(d)1B, or
  - B. ~~Skylit Daylit Zone in accordance with Section 130.1(d)1A~~ The total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of rough opening of skylights.
2. All Skylit Daylit Zones and Primary Sidelit Daylit Zones shall be shown on building plans.
3. General lighting in daylit zones shall be controlled in accordance with Section 130.1(d).
4. The total skylight area is at least 3 percent~~4~~ of the total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of rough opening of skylights; or the product of the total skylight area and the average skylight visible transmittance is no less than 1.5 percent~~4~~ of the total floor area in the space within a horizontal distance of 0.7 times the average ceiling height from the edge of rough opening of skylights.

54. All Skylights skylights shall have:

- A. ~~Have a glazing material or diffuser that has a measured haze value greater than 90 percent, tested according to ASTM D1003 (notwithstanding its scope) or another test method approved by the Commission; and~~
- B. ~~If the space is conditioned, meet the requirements in 6. Skylights for conditioned and unconditioned spaces shall have an area-weighted average Visible Transmittance (VT) no less than the applicable value required by Section 140.3(a)6D.~~

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

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

- A. A floor area of less than or equal to 5,000 square feet; or
- B. Ceiling heights of less than or equal to 15 feet. This exception shall not be used for S-1 or S-2 (storage), or for F-1 or F-2 (factory) occupancies.

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

**EXCEPTION 4 to Section 140.3(c):** Enclosed spaces where it is documented that permanent architectural features of the building, existing structures or natural objects block direct beam sunlight on at least half of the roof over the enclosed space for more than 1500 daytime hours per year between 8 a.m. and 4 p.m.

## SECTION 140.4 – PRESCRIPTIVE REQUIREMENTS FOR SPACE CONDITIONING SYSTEMS

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

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

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

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

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

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

1. **Methodology.** The methodologies, computer programs, inputs, and assumptions approved by the Commission shall be used.
2. **Heating and cooling loads.** Heating and cooling system design loads shall be determined in accordance with the procedures described in the ASHRAE Handbook, Fundamentals Volume, or as specified in a method approved by the Commission.
3. **Indoor design conditions.** Indoor design temperature and humidity conditions for general comfort applications shall be determined in accordance with ASHRAE Standard 55 or the ASHRAE Handbook, Fundamentals Volume, Chapter 8, except that winter humidification and summer dehumidification shall not be required.
4. **Outdoor design conditions.** Outdoor design conditions shall be selected from Reference Joint Appendix JA2, 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.

**EXCEPTION to Section 140.4(b)4:** Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent Cooling Design Wet bulb values.

5. **Ventilation.** Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section 120.1.
6. **Envelope.** Envelope heating and cooling loads shall be calculated using envelope characteristics, including square footage, thermal conductance, ~~solar heat gain coefficient~~ Solar Heat Gain Coefficient or shading coefficient, and air leakage, consistent with the proposed design.
7. **Lighting.** Lighting loads shall be based on actual design lighting levels or power densities as specified in Section 140.6.
8. **People.** Occupant density shall be based on the expected occupancy of the building and shall be the same as determined under Section 120.1(b)2B, if used. Sensible and latent heat gains shall be as listed in the 2005 ASHRAE Handbook- Fundamentals, Chapter 30, Table 1.
9. **Process loads.** Loads caused by a process shall be based upon actual information on the intended use of the building.
10. **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.
11. **Internal heat gains.** Internal heat gains may be ignored for heating load calculations.
12. **Safety factor.** Design loads may be increased by up to 10 percent to account for unexpected loads or changes in space usage.
13. **Other loads.** Loads such as warm-up or cool-down shall be calculated from principles based on the heat 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)12.
- (c) **Power Consumption of Fans.** Each fan system used for space conditioning shall meet the requirements of Items 1, 2, 3 and 4 below. Total fan system power demand equals the sum of the power demand of all fans in the system that are required to operate at design conditions in order to supply air from the heating or cooling source to the conditioned space, and to return it back to the source or to exhaust it to the outdoors; however, total fan system power demand need not include (i) the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than 245 pascals or one-inch water column (only the energy accounted for by the amount of pressure drop that is over 1 inch may be excluded), or (ii) fan system power caused solely by exempt process loads.
- 1. **Constant volume fan systems.** The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 0.8 watts per cfm of supply air.
  - 2. **Variable air volume (VAV) systems.**
    - A. The total fan power index at design conditions of each fan system with total horsepower over 25 hp shall not exceed 1.25 watts per cfm of supply air; and
    - B. **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)2C. 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
    - C. **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 set point is reset lower until one zone damper is nearly wide open.
  - 3. **Air-treatment or filtering systems.** For systems with air-treatment or filtering systems, calculate the total adjusted fan power index using Equation 140.4-A:

#### EQUATION 140.4-A ADJUSTED TOTAL FAN POWER INDEX

Adjusted total fan power index = Fan power index x Fan Adjustment

$$\text{Fan Adjustment} = 1 - \left( \frac{\text{SP}_a - 1}{\text{SP}_f} \right)$$

WHERE:

$\text{SP}_a$  = Air pressure drop across the air-treatment or filtering system.

$\text{SP}_f$  = Total pressure drop across the fan.

4. **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)4:** Motors in fan-coils and terminal units that operate only when providing heating to the space served.

**EXCEPTION 2 to Section 140.4(c)4:** Motors in space conditioning equipment certified under Section 110.1 or 110.2.

(d) **Space-conditioning Zone Controls.** Each space-conditioning zone shall have controls that prevent:

1. Reheating; and
2. Recooling; and
3. 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.

**EXCEPTION 1 to Section 140.4(d):** Zones served by variable air-volume systems that are designed and controlled to reduce, to a minimum, the volume of reheated, re-cooled, or mixed air are allowed only if the controls meet all of the following requirements:

A. For each zone with direct digital controls (DDC):

- i. The volume of primary air that is reheated, re-cooled or mixed air supply shall not exceed the larger of:
  - a. 50 percent of the peak primary airflow; or
  - b. The design zone outdoor airflow rate ~~peras~~ specified by Section 120.1.
- ii. The volume of primary air in the deadband shall not exceed the larger of:
  - a. 20 percent of the peak primary airflow; or
  - b. The design zone outdoor airflow rate ~~peras~~ specified by Section 120.1.
- iii. The first stage of heating consists of modulating the zone supply air temperature setpoint up to a maximum setpoint no higher than 95°F while the airflow is maintained at the dead band flow rate.
- iv. The second stage of heating consists of modulating the airflow rate from the dead band flow rate up to the heating maximum flow rate.

B. For each zone without DDC, the volume of primary air that is reheated, re-cooled, 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 ~~peras~~ specified by Section 120.1.

**EXCEPTION 2 to Section 140.4(d):** Zones with special pressurization relationships or cross-contamination control needs.

**EXCEPTION 3 to Section 140.4(d):** 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 4 to Section 140.4(d):** Zones in which specific humidity levels are required to satisfy exempt process loads. ~~Computer Rooms Data Centers~~ Computer rooms or other spaces where the only process load is from IT equipment may not use this exception.

**EXCEPTION 5 to Section 140.4(d):** Zones with a peak supply-air quantity of 300 cfm or less.

**(e) Economizers.**

1. Each cooling fan system ~~air handler~~ that has a design total mechanical cooling capacity over 54,000 Btu/hr shall include either:
  - A. An air economizer capable of modulating outside-air dampers to 100 percent open and return-air dampers to supply 100 percent of the design supply air quantity as outside-air closed; or
  - B. A water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 50°F dry-bulb and 45°F wet-bulb and below.

**EXCEPTION 1 to Section 140.4(e)1:** Where special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

**EXCEPTION 2 to Section 140.4(e)1:** Where the use of outdoor air for cooling will affect other systems, such as humidification, dehumidification, or supermarket refrigeration systems, so as to increase overall building TDV energy use.

**EXCEPTION 3 to Section 140.4(e)1:** Systems serving high-rise residential living quarters and hotel/motel guest rooms.

**EXCEPTION 4 to Section 140.4(e)1:** Where comfort cooling systems have the cooling efficiency that meets or exceeds the cooling efficiency improvement requirements in TABLE 140.4-A.

**EXCEPTION 5 to Section 140.4(e)1:** Fan systems primarily serving computer room~~computer room data center~~. See Section 140.9(a) for computer room~~computer room data center~~ economizer requirements.

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

Climate Zone	Efficiency Improvement <sup>a</sup>	
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%	

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

2. If an economizer is required by Section 140.4(e)1 it shall be:
  - A. Designed and equipped with controls so that economizer operation does not increase the building heating energy use during normal operation; and
 

**EXCEPTION to Section 140.4(e)2A:** Systems that provide 75 percent of the annual energy used for mechanical heating from site-recovered energy or a site-solar energy source.
  - B. Capable of providing partial cooling even when additional mechanical cooling is required to meet the remainder of the cooling load.



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

TABLE 140.4-B AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type <sup>a</sup>	Climate Zones	Required High Limit (Economizer Off When):	
		Equation <sup>b</sup>	Description
Fixed Dry Bulb	1, 3, 5, 11-16	$T_{OA} > 75^{\circ}\text{F}$	Outdoor air temperature exceeds 75°F
	2, 4, 10	$T_{OA} > 73^{\circ}\text{F}$	Outdoor air temperature exceeds 73°F
	6, 8, 9	$T_{OA} > 71^{\circ}\text{F}$	Outdoor air temperature exceeds 71°F
	7	$T_{OA} > 69^{\circ}\text{F}$	Outdoor air temperature exceeds 69°F
Differential Dry Bulb	1, 3, 5, 11-16	$T_{OA} > T_{RA}^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature
	2, 4, 10	$T_{OA} > T_{RA}-2^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature minus 2°F
	6, 8, 9	$T_{OA} > T_{RA}-4^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature minus 4°F
	7	$T_{OA} > T_{RA}-6^{\circ}\text{F}$	Outdoor air temperature exceeds return air temperature minus 6°F
Fixed Enthalpy <sup>c</sup> + Fixed Drybulb	All	$h_{OA} > 28 \text{ Btu/lb}^{\circ}$ or $T_{OA} > 75^{\circ}\text{F}$	Outdoor air enthalpy exceeds 28 Btu/lb of dry air <sup>c</sup> or Outdoor air temperature exceeds 75°F

<sup>a</sup> 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.

<sup>b</sup> 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.

<sup>c</sup> 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.

4. If an economizer is required by Section 140.4(e)1, and an air economizer is used to meet the requirement, then the air economizer, and all return air dampers on any individual cooling fan system that has a total mechanical cooling capacity over 54,000 Btu/hr shall have the following features:
- Warranty.** 5-year Manufacturer warranty of economizer assembly.
  - Damper reliability testing.** Suppliers of economizers shall certify that the economizer assembly, including but not limited to outdoor air damper, return air damper, drive linkage, and actuator, have been tested and are able to open and close against the rated airflow and pressure of the system after for 60,000 damper opening and closing cycles.
  - Damper leakage.** Economizer outdoor air and return air dampers shall be certified to have a maximum leakage rate of 10 cfm/sf at 1.0 in. w.g. 250 Pascals (1.0 in. w.g.) 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.
  - 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.
  - Sensor accuracy.** Outdoor air, return air, mixed air, and supply air sensors shall be calibrated within the following accuracies.
    - Drybulb and wetbulb temperatures accurate to  $\pm 2^{\circ}\text{F}$  over the range of 40°F to 80°F.

- ii. Enthalpy accurate to  $\pm 3$  Btu/lb over the range of 20 Btu/lb to 36 Btu/lb.
- iii. Relative humidity (RH) accurate to  $\pm 5$  percent over the range of 20 percent to 80 percent RH.
- F. **Sensor calibration data.** Data used for control of the economizer shall be plotted on a sensor performance curve.
- G. **Sensor high limit control.** Sensors used for the high limit control shall be located to prevent false readings, including but not limited to being properly shielded from direct sunlight.
- H. **Relief air system.** Relief air systems shall be capable of providing 100 percent outside air without over-pressurizing the building.
- 5. Systems that include an air economizer to meet Section 140.4(e)1 shall include the following:
  - A. Unit controls shall have mechanical capacity controls interlocked with economizer controls such that the economizer is at 100 percent open position when mechanical cooling is on and does not begin to close until the leaving air temperature is less than 45°F.
  - B. Direct Expansion (DX) units 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 2 stages of mechanical cooling capacity, per the following effective dates:
    - i.  ~~$\geq 75,000$  Btu/hr Effective 1/1/2014~~
    - ii.  ~~$\geq 65,000$  Btu/hr Effective 1/1/2016~~
  - C. ~~Effective 1/1/2014, DX units not within the scope of Section 140.4(e)5,B, such as those that control space temperature by modulating the airflow to the space, shall (i) comply with the requirements in TABLE 140.4-C, and (ii) shall have controls that do not false load the mechanical cooling system by limiting or disabling the economizer or by any other means, such as hot gas bypass, except at the lowest stage of mechanical cooling capacity.~~

**TABLE 140.4-C DIRECT EXPANSION (DX) UNIT REQUIREMENTS FOR COOLING STAGES AND COMPRESSOR DISPLACEMENT**

Cooling Capacity	Minimum Number of Mechanical Cooling Stages	Minimum Compressor Displacement
$\geq 65,000$ Btu/h and $< 240,000$ Btu/h	3 stages	$\leq 35\%$ full load
$\geq 240,000$ Btu/h	4 stages	$\leq 25\%$ full load

- (f) **Supply Air Temperature Reset Controls.** Space-conditioning systems supplying heated or cooled air to multiple zones shall include controls that automatically reset supply-air temperatures. Air distribution systems serving zones that are likely to have constant loads, such as interior zones, shall be designed for the air flows resulting from the fully reset supply air temperature. Supply air temperature reset controls shall be:

1. In response to representative building loads or to outdoor air temperature; and
2. At least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

**EXCEPTION 1 to Section 140.4(f):** Systems that meet the requirements of Section 140.4(d), without using Exception 1 or 2 to that section.

**EXCEPTION 2 to Section 140.4(f):** Where supply-air temperature reset would increase overall building energy use.

**EXCEPTION 3 to Section 140.4(f):** Systems supplying zones in which specific humidity levels are required to satisfy exempt process loads. ~~Computer Room Data Centers~~ Computer Rooms or other spaces with only IT equipment may not use this exception.

- (g) **Electric Resistance Heating.** Electric resistance heating systems shall not be used for space heating.

**EXCEPTION 1 to Section 140.4(g):** Where an electric-resistance heating system supplements a heating system in which at least 60 percent of the annual energy requirement is supplied by site-solar or recovered energy.

**EXCEPTION 2 to Section 140.4(g):** Where an electric-resistance heating system supplements a heat pump heating system, and the heating capacity of the heat pump is more than 75 percent of the design heating load calculated in accordance with Section 140.4(a) at the design outdoor temperature specified in Section 140.4(b)4.

**EXCEPTION 3 to Section 140.4(g):** Where the total capacity of all electric-resistance heating systems serving the entire building is less than 10 percent of the total design output capacity of all heating equipment serving the entire building.

**EXCEPTION 4 to Section 140.4(g):** Where the total capacity of all electric-resistance heating systems serving the 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 high-rise residential or hotel/motel building; and has a conditioned floor area no greater than 5,000 square feet; and has no mechanical cooling; and is in an area where natural gas is not currently available and an extension of a natural gas system is impractical, as determined by the natural gas utility.

**(h) Heat Rejection Systems.**

1. **Scope.** Subsection 140.4(h) applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers.
2. **Fan Speed Control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at 2/3 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)2:** Heat rejection devices included as an integral part of the equipment listed in TABLE 110.2-A through TABLE 110.2-I.

**EXCEPTION 2 to Section 140.4(h)2:** Condenser fans serving multiple refrigerant circuits.

**EXCEPTION 3 to Section 140.4(h)2:** Condenser fans serving flooded condensers.

**EXCEPTION 4 to Section 140.4(h)2:** 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.

3. **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.
4. **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)4:** 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)4:** Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 110.2, TABLE 110.2-G.

5. **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 per as specified by the manufacturer's recommendation. Staging of fans is allowed once the fans are at their minimum operating speed.

**(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  $\geq 40$  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 3 chillers, only 3 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 degrees F (4 degrees C).

**EXCEPTION 3 to Section 140.4(j):** Air cooled chillers with minimum efficiencies approved by the Commission pursuant to Section 10-109(d).

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

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 set point 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 deadband 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.

- (l) **Air Distribution System Duct Leakage Sealing.** Duct systems shall be sealed to a leakage rate not to exceed 6 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 if the criteria in Subsections 1, 2 and 3 below are met:

- 1. The duct system provides conditioned air to an occupiable space for a constant volume, single zone, space-conditioning system; and
- 2. The space conditioning system serves less than 5,000 square feet of conditioned floor area; and
- 3. 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; or
  - 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 140.3(a)1B, or
    - ii. Has fixed vents or openings to the outside or unconditioned spaces; or
  - C. In an unconditioned crawlspace; or
  - D. In other unconditioned spaces.

- (m) **Fan Control.** ~~As of the applicable date listed in TABLE 140.4-D, each~~ Each cooling system listed in TABLE 140.4-D 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 2 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 140.4(e)1 shall have a minimum of two speeds of fan control during economizer operation.

**EXCEPTION 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.

TABLE 140.4-D EFFECTIVE DATES FOR FAN CONTROL SYSTEMS

Cooling System Type	Fan Motor Size	Cooling Capacity
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DX Cooling	any	$\geq 65,000$ Btu/hr
Chilled Water and Evaporative	$\geq 1/4$ HP	any

Cooling System Type	Fan Motor Size	Cooling Capacity	Effective Date
DX Cooling	any	$\geq 110,000$ Btu/hr	1/1/2012
		$\geq 75,000$ Btu/hr	1/1/2014
		$\geq 65,000$ Btu/hr	1/1/2016
Chilled Water and Evaporative	$\geq 5$ HP	any	1/1/2010
	$\geq 1$ HP	any	1/1/2014
	$\geq 1/4$ HP	any	1/1/2016

**(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):** Alterations to existing buildings

## SECTION 140.5 – PRESCRIPTIVE REQUIREMENTS FOR SERVICE WATER HEATING SYSTEMS

- (a) **Nonresidential Occupancies.** A service water heating system installed in a nonresidential building complies with this section if it complies with the applicable requirements of Sections 110.1, 110.3 and 120.3.
- (b) **High-Rise Residential and Hotel/Motel Occupancies.** A service water heating system installed in a high-rise residential or hotel/motel building complies with this section if it meets the requirements of Section 150.1(c)8.

## SECTION 140.6 – PRESCRIPTIVE REQUIREMENTS FOR INDOOR LIGHTING

A building complies with this section if:

- i. The Calculation of Actual Indoor Lighting Power ~~Density~~ of all proposed building areas combined, calculated under Subsection (a) is no greater than the ~~Density~~ Calculation of Allowed Indoor Lighting Power ~~Density~~, Specific Methodologies calculated under Subsection (c); and
  - ii. The Calculation of Allowed Indoor Lighting Power ~~Density~~, General Rules comply with Subsection (b); and
  - iii. General lighting complies with the Automatic Daylighting Controls in Secondary Daylit Zone requirements in Subsection (d).
- (a) **Calculation of Actual Indoor Lighting Power ~~Density~~.** The actual indoor Lighting Power ~~Density~~ of all proposed building areas is the total watts of all planned permanent and portable lighting systems in all areas of the proposed building; subject to the applicable adjustments under Subdivisions 1 through 3 of this subsection and the requirements of Subdivision 4 of this subsection.

**EXCEPTION to Section 140.6(a):** Up to 0.3 watts per square foot of portable lighting for office areas shall not be required to be included in the calculation of actual indoor Lighting Power ~~Density~~.

- 1. **Two interlocked lighting systems:** No more than two lighting systems may be used for an area, and if there are two they must be interlocked. Where there are two interlocked lighting systems, the watts of the lower wattage system may be excluded from the actual indoor Lighting Power ~~Density~~ if:
  - A. An Installation Certificate detailing compliance with Section 140.6(a)1 is submitted in accordance with Section 10-103 and Section 130.4; and
  - B. The area or areas served by the interlocking systems is an auditorium, a convention center, a conference room, a multipurpose room, or a theater; and
  - C. The two lighting systems are interlocked with a Nonprogrammable Double-Throw Switch to prevent simultaneous operation of both systems.

For compliance with Part 6 a Nonprogrammable Double-Throw Switch is an electrical switch commonly called a "single pole double throw" or "three-way" switch that is wired as a selector switch allowing one of two loads to be enabled. It can be a line voltage switch or a low voltage switch selecting between two relays. It cannot be overridden or changed in any manner that would permit both loads to operate simultaneously.

- 2. **Reduction of wattage through controls.** In calculating actual indoor Lighting Power ~~Density~~, the installed watts of a luminaire providing general lighting in an area listed in TABLE 140.6-A may be reduced by the product of (i) the number of watts controlled as described in TABLE 140.6-A, times (ii) the applicable Power Adjustment Factor (PAF), if all of the following conditions are met:
  - A. An Installation Certificate is submitted in accordance with Section 130.4(b); and

- B. Luminaires and controls meet the applicable requirements of Section 110.9, and Sections 130.0 through 130.5; and
- C. The controlled lighting is permanently installed general lighting systems and the controls are permanently installed nonresidential-rated lighting controls. ~~(Thus, for example, portable lighting, portable lighting controls, and residential-rated lighting controls shall not qualify for PAFs.)~~

When used for determining PAFs for general lighting in offices, furniture mounted luminaires that comply with all of the following conditions shall qualify as permanently installed general lighting systems:

- i. The furniture mounted luminaires shall be permanently installed no later than the time of building permit inspection; and
  - ii. The furniture mounted luminaires shall be permanently hardwired; and
  - iii. The furniture mounted lighting system shall be designed to provide indirect general lighting; and
  - iv. Before multiplying the installed watts of the furniture mounted luminaire by the applicable PAF, 0.3 watts per square foot of the area illuminated by the furniture mounted luminaires shall be subtracted from installed watts of the furniture mounted luminaires; and
  - v. The lighting control for the furniture mounted luminaire complies with all other applicable requirements in Section 140.6(a)2.
- D. At least 50 percent of the light output of the controlled luminaire is within the applicable area listed in TABLE 140.6-A. Luminaires on lighting tracks shall be within the applicable area in order to qualify for a PAF.
- E. Only one PAF from TABLE 140.6-A may be used for each qualifying luminaire. PAFs shall not be added together unless allowed in TABLE 140.6-A.
- F. Only lighting wattage directly controlled in accordance with Section 140.6(a)2 shall be used to reduce the calculated actual indoor Lighting Power ~~Densities~~ as allowed by Section 140.6(a)2. If only a portion of the wattage in a luminaire is controlled in accordance to Section 140.6(a)2, then only that portion of controlled wattage may be reduced in calculating actual indoor Lighting Power ~~Density~~.
- G. Lighting controls used to qualify for a PAF shall be designed and installed in addition to manual, multilevel, and automatic lighting controls required in Section 130.1, and in addition to any other lighting controls required by any provision of Part 6. ~~PAFs shall not be available for lighting controls required by Part 6.~~

~~**EXCEPTION to Section 140.6(a)2C:** Lighting controls designed and installed for the sole purpose of compliance with Section 130.1(b)3 may be used to qualify for a PAF, provided the lighting controls are designed and installed in addition to all manual, and automatic lighting controls otherwise required in Section 130.1.~~

- ~~H. To qualify for the PAF for a Partial ON Occupant Sensing Control in TABLE 140.6-A, a Partial On Occupant Sensing Control shall meet all of the following requirements:~~
- ~~i. The control shall automatically deactivate all of the lighting power in the area within 30 minutes after the room has been vacated; and~~
  - ~~ii. The first stage shall automatically activate between 30-70 percent of the lighting power in the area and may be a switching or dimming system; and~~
  - ~~iii. The second stage shall require manual activation of the alternate set of lights, and this manual ON requirements shall not be capable of conversion from manual ON to automatic ON functionality via manual switches or dip switches; and~~
  - ~~iv. Switches shall be located in accordance with Section 130.1(a) and shall allow occupants to manually do all of the following regardless of the sensor status: activate the alternate set of lights in accordance with Item (iii); activate 100 percent of the lighting power; and deactivate all of the lights.~~



- H. To qualify for the PAF for daylight dimming plus OFF~~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 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 only to the luminaires in the primary sidelit daylit zone and the skylit daylit zone.
- I. To qualify for the PAF for an occupant sensing control controlling the general lighting in large open plan office areas above workstations, in accordance with TABLE 140.6-A, the following requirements shall be met:
- i. The open plan office area shall be greater than 250 square feet; and
  - ii. This PAF shall be available only in office areas which contain workstations; and
  - iii. Controlled luminaires shall only be those that provide general lighting directly above the controlled area, or furniture mounted luminaires that comply with Section 140.6(a)2 and provide general lighting directly above the controlled area; and
  - iv. Qualifying luminaires shall be controlled by occupant sensing controls that meet all of the following requirements, as applicable:
    - a. Infrared sensors shall be equipped by the manufacturer, or fitted in the field by the installer, with lenses or shrouds to prevent them from being triggered by movement outside of the controlled area.
    - b. Ultrasonic sensors shall be tuned to reduce their sensitivity to prevent them from being triggered by movements outside of the controlled area.
    - c. All other sensors shall be installed and adjusted as necessary to prevent them from being triggered by movements outside of the controlled area.
- J. To qualify for the PAF for a Manual Dimming System PAF or a Multiscene Programmable Dimming System PAF, the lighting shall be controlled with a control that can be manually operated by the user; 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% of full light output or full power draw.
- K. To qualify for the PAF for a Demand Responsive Control in TABLE 140.6-A, a Demand Responsive Control shall meet all of the following requirements:
- i. The building shall be 10,000 square feet or smaller; and
  - ii. The controlled lighting shall be capable of being automatically reduced in response to a demand response signal; and
  - iii. Lighting shall be reduced in a manner consistent with uniform level of illumination requirements in TABLE 130.1-A; and
  - iv. Spaces that are non-habitable shall not be used to comply with this requirement, and spaces with a lighting power density of less than 0.5 watts per square foot shall not be counted toward the building's total lighting power.
- L. To qualify for the PAF for Combined Manual Dimming plus Partial ON Occupant Sensing Control in TABLE 140.6-A, (i) the lighting controls shall comply with the applicable requirements in Section 140.6(a)2J; and (ii) the lighting shall be controlled with a dimmer control that can be manually operated, or with a multi-scene programmable control that can be manually operated.

3. **Lighting wattage excluded.** The watts of the following indoor lighting applications may be excluded from actual indoor Lighting Power Density. (Indoor lighting not listed below shall comply with all applicable nonresidential indoor lighting requirements in Part 6.):
- A. In theme parks: Lighting for themes and special effects.
  - B. Studio lighting for film or photography provided that these lighting systems are in addition to and separately switched from a general lighting system.
  - C. Lighting for dance floors, lighting for theatrical and other live performances, and theatrical lighting used for religious worship, provided that these lighting systems are additions to a general lighting system and are separately controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.  
Lighting intended for makeup, hair, and costume preparation in performing arts facility dressing rooms, provided that the lighting is separately switched from the general lighting system, switched independently at each dressing station, and is controlled with a Vacancy Sensor.
  - D. In civic facilities, transportation facilities, convention centers, and hotel function areas: Lighting for temporary exhibits, if the lighting is in addition to a general lighting system and is separately controlled from a panel accessible only to authorized operators.
  - E. Lighting installed by the manufacturer in walk-in freezers, vending machines, food preparation equipment, and scientific and industrial equipment.
  - F. In medical and clinical buildings: Examination and surgical lights, low-ambient night-lights, and lighting integral to medical equipment, provided that these lighting systems are additions to and separately switched from a general lighting system.
  - G. Lighting for plant growth or maintenance, if it is controlled by a multi-level astronomical time-switch control that complies with the applicable provisions of Section 110.9.
  - H. Lighting equipment that is for sale.
  - I. Lighting demonstration equipment in lighting education facilities.
  - J. Lighting that is required for exit signs subject to the CBC. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.
  - K. Exitway or egress illumination that is normally off and that is subject to the CBC.
  - L. In hotel/motel buildings: Lighting in guestrooms (lighting in hotel/motel guestrooms shall comply with Section 130.0(b). (Indoor lighting not in guestrooms shall comply with all applicable nonresidential lighting requirements in Part 6.)
  - M. In high-rise residential buildings: Lighting in dwelling units (Lighting in high-rise residential dwelling units shall comply with Section 130.0(b).) (Indoor lighting not in dwelling units shall comply with all applicable nonresidential lighting requirements in Part 6.)
  - N. Temporary lighting systems. (As defined in Section 100.1.)
  - O. Lighting in occupancy group U buildings less than 1,000 square feet.
  - P. Lighting in unconditioned agricultural buildings less than 2,500 square feet.
  - Q. Lighting systems in qualified historic buildings, as defined in the California Historical Building Code (Title 24, Part 8), are exempt from the Lighting Power Density allowances, if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems in qualified buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other lighting systems in qualified historic buildings shall comply with the Lighting Power Density allowances.
  - R. Lighting in nonresidential parking garages for seven or less vehicles: Lighting in nonresidential parking garages for seven or less vehicles shall comply with the applicable residential parking garage provisions of Section 150.0(k).

S. Lighting for signs: Lighting for signs shall comply with Section 140.8.

~~T. Lighting for automatic teller machines that are located inside parking garages.~~

~~UT. Lighting in refrigerated cases less than 3,000 square feet. (Lighting in refrigerated cases less than 3,000 square feet shall comply with the Title 20 Appliance Efficiency Regulations).~~

~~VU. Lighting in elevators where the lighting meets the requirements of ASHRAE/IESNA Standard 90.1, 2010 in Section 120.6(f).~~

4. **Luminaire Classification and Power.** Luminaire Classification and Power shall be determined in accordance with Section 130.0(c).

(b) **Calculation of Allowed Indoor Lighting Power ~~Density~~: General Rules**

1. The allowed Indoor Lighting Power ~~Density~~ allotment for conditioned areas shall be calculated separately from the allowed Lighting Power ~~Density~~ 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.
2. Allowed Indoor Lighting Power ~~Density~~ allotment shall be calculated separately from the allowed Outdoor Lighting Power ~~Density~~ 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.
3. The Allowed Indoor Lighting Power ~~Density~~ allotment for general lighting shall be calculated as follows:
  - A. The Complete Building Method, as described in Section 140.6(c)1, shall be used only for an entire building, except as permitted by Section 140.6(c)1. As described more fully in Section 140.6(c)1, and subject to the adjustments listed there, the Allowed Indoor Lighting Power ~~Density~~ allotment for general lighting for the entire building shall be calculated as follows:
    - i. For a conditioned building, the product of the square feet of conditioned space of the building times the applicable allotment of watts per square foot described in TABLE 140.6-B.
    - ii. For an unconditioned building, the product of the square foot of unconditioned space of the building times the applicable allotment of watts per square foot described in TABLE 140.6-B.
  - B. The Area Category Method, as described in Section 140.6(c)2, shall be used either by itself for all areas in the building, or when some areas in the building use the Tailored Method described in Section 140.6(c)3. Under the Area Category Method (either by itself or in conjunction with the Tailored Method), as described more fully in Section 140.6(c)2, and subject to the adjustments listed there, the allowed Indoor Lighting Power ~~Density~~ 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 140.6-C (or TABLE 140.6-D if the Tailored 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 140.6-C (or TABLE 140.6-D if the Tailored Method is used for that area).

The Allowed Indoor Lighting Power ~~Density~~ 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 ~~Density~~ 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.

- C. The Tailored Method, as described in Section 140.6(c)3, 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 140.6(c)2. Under the Tailored Method (either by itself or in conjunction with the Area Category Method) as described more fully in Section 140.6(c)3, and subject to the adjustments listed there, allowed Indoor Lighting Power ~~Density~~ 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 140.6-D (or TABLE 140.6-C 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 140.6-D (or TABLE 140.6-C if the Area Category Method is used for that area);

The Allowed Indoor Lighting Power ~~Density~~ 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 Power Lighting ~~Density~~ 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.

- 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 ~~Density~~ 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; ornamental; 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; ornamental/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 ~~Density~~: Specific Methodologies.** The allowed indoor Lighting Power ~~Density~~ 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 highrise 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  
**EXCEPTION to Section 140.6(c)1Bi:** If a parking garage plus another type of use listed in TABLE 140.6-B are part of a single building, the parking garage portion of the building and other type of use portion of the building shall each separately use the Complete Building Method.
      - 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.
  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.

- 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 140.6-C.
- 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. If at the time of permitting for a newly constructed building, a tenant is not identified for a multi-tenant area, a maximum of 0.6 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 Density for each primary area is the Lighting Power Density value in TABLE 140.6-C times the square feet of the primary function. The total allowed indoor Lighting Power Density for the building is the sum of all allowed indoor Lighting Power Densities for all areas in the building.
- G. In addition to the allowed indoor Lighting Power Density calculated according to Sections 140.6(c)2. A through F, the building may add additional lighting power allowances for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in TABLE 140.6-C under the following conditions:
  - i. Only primary function areas having a footnote next to the allowed Lighting Power Density allotments in TABLE 140.6-C shall qualify for the added lighting power allowances in accordance with the correlated footnote listed at the bottom of the table; 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 lighting power listed in the applicable footnote in TABLE 140.6-C, or the actual design wattage may be added to the allowed lighting power; and
  - vii. In addition to all other additional lighting power allowed under Sections 140.6(c)2Gi through vi, up to 1.5 watts per square foot of additional lighting power 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, and for IES allowances listed in Section 140.6(c)3H.

- B. Allowed Indoor Lighting Power ~~Density~~-allotments for general lighting shall be determined according to Section 140.6(c)3G or H, as applicable. General lighting shall not qualify for a mounting height multiplier.
- C. For compliance with this Item, 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 ~~Density~~-allotments for general lighting calculated according to Sections 140.6(c)3G or H, as applicable, the building may add additional lighting power allowances for wall display, floor display and task lighting, ornamental/special effects, and very valuable display cases according to Section 140.6(c)3I through L.
- F. The general lighting system shall not use narrow beam direction lamps, wall-washer, valance, direct cove, or perimeter linear slot types of lighting systems.
- G. Determine allowed indoor Lighting Power ~~Density~~-allotments for general lighting for primary function areas listed in TABLE 140.6-D as follows:
- Use the IES Illuminance values (Lux) listed in Column 2 to determine the Allowed General Lighting Power Density allotments for the area.
  - Determine the room cavity ratio (RCR) for the area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.
  - Find the allowed Lighting Power Density allotments in TABLE 140.6-G that is applicable to the IES illuminance value (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).
  - Determine the square feet of the area in accordance with Section 140.6(c)3C and D.
  - 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 ~~Density~~-allotment for general lighting for the area.
- H. Determine allowed indoor Lighting Power ~~Density~~-allotments for general lighting for only specific primary function areas NOT listed in TABLE 140.6-D as follows:
- Use this Section only to calculate allowed indoor lighting power ~~densities~~ for general lighting in the following primary function areas. Do not use Section 140.6(c)3H for any primary function areas NOT listed below:
    - Exercise Center, Gymnasium
    - Medical and Clinical Care
    - Police Stations and Fire Stations
    - Public rest areas along state and federal roadways
    - Other primary function areas that are not listed in neither TABLE 140.6-C nor TABLE 140.6-D.
  - When calculating allowed indoor Lighting Power ~~Density~~-allotments for general lighting using Section 140.6(c)3H, the building shall not add additional lighting power allowances for any other use, including but not limited to wall display, floor display and task, ornamental/special effects, and very valuable display case lighting.
  - Calculate the allowed indoor Lighting Power ~~Density~~ for each primary function area in the building as follows:
    - Determine the illuminance values (Lux) according to the Tenth Edition IES Lighting Handbook (IES HB), using the Recommended Horizontal Maintained Illuminance Targets for Observers 25-65 years old for illuminance.

- b. Determine the room cavity ratio (RCR) for area. The RCR shall be calculated according to the applicable equation in TABLE 140.6-F.
  - c. Find the allowed lighting power density in TABLE 140.6-G that is applicable to the illuminance value (Lux) determined in accordance with Item (a) and the RCR determined in accordance with Item (b).
  - d. Determine the square feet of the area. For compliance with this item, an "area" shall be defined as all contiguous areas that accommodate or are associated with a single primary function area listed in Item (i). 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. Multiply the square feet determined in accordance with Item (d), by the allowed lighting power density determined in accordance with item (c). The product is the Allowed Indoor Lighting Power Density allotment for general lighting for the area.
- I. Determine additional allowed power for wall display lighting according to column 3 of Table 140.6-D for each primary function area as follows:
  - i. Additional wall display lighting power shall not be available when using Section 140.6(c)3H for determining the Allowed Indoor Lighting Power Density allotment for general lighting for the area.
  - ii. Floor displays shall not qualify for wall display allowances.
  - iii. Qualifying wall lighting shall:
    - a. Be mounted within 10 feet of the wall having the wall display. When track lighting is used for wall display, and where portions of that lighting track are more than 10 feet from the wall and other portions are within 10 feet of the wall, portions of track more than 10 feet from the wall shall not be used for the wall display allowance.
    - b. Be a lighting system type appropriate for wall lighting. Lighting systems appropriate for wall lighting are lighting track adjacent to the wall, wall-washer luminaires, luminaires behind a wall valance or wall cove, or accent light. (Accent luminaires are adjustable or fixed luminaires with PAR, R, MR, AR, or other directional lamp types.)
  - iv. Additional allowed power for wall display lighting is available only for lighting that illuminates walls having wall displays. The length of display walls shall include the length of the perimeter walls, including but not limited to closable openings and permanent full height interior partitions. Permanent full height interior partitions are those that (I) extend from the floor to no more than two feet of the ceiling or are taller than ten feet, and (II) are permanently anchored to the floor, provided, however, that neither commercial industrial stacks nor industrial storage stacks are permanent full height interior partitions.
  - v. The wall display mounting height multiplier is the applicable factor from TABLE 140.6-E. Mounting height is the distance from the finished floor to the bottom of the luminaire. ~~Wall display lighting with varying mounting heights shall be separately determined under Item vi. The wall display mounting height multipliers shall be used to reduce the design watts of the space.~~
  - vi. The additional allowed power for wall display lighting shall be the smaller of:
    - a. The product of wall display power determined in accordance with TABLE 140.6-D, times the wall display lengths determined in accordance with Item iv, ~~times the mounting height multiplier determined in accordance with Item v;~~ or
    - b. The actual power used for the wall display lighting systems.
- J. Determine additional allowed power for floor display lighting and task lighting as follows:
  - i. Neither additional allowed power for floor display lighting nor additional allowed power for task lighting shall be available when using Section 140.6(c)3H for determining allowed indoor Lighting Power Density allotment for general lighting.
  - ii. Displays that are installed against a wall shall not qualify for the floor display lighting power allowances.

- iii. Lighting internal to display cases shall be counted as floor display lighting in accordance with Section 140.6(c)3J; or very valuable display case lighting in accordance with Section 140.6(c)3Li and iv.
  - iv. Additional allowed power for floor display lighting, and additional allowed power for task lighting, may be used by qualifying floor display lighting systems, qualifying task lighting systems, or a combination of both. For floor areas qualifying for both floor display and task lighting power allowances, the additional allowed power shall be used only once for the same floor area, so that the allowance shall not be additive.
  - v. Qualifying floor display lighting shall:
    - a. Be mounted no closer than 2 feet to a wall.
    - b. Consist of only (I) directional lighting types, such as PAR, R, MR, AR; or (II) lighting employing optics providing directional display light from nondirectional lamps.
    - c. If track lighting is used, shall be only track heads that are classified as direction lighting types.
  - vi. Qualifying task lighting shall:
    - a. Be located immediately adjacent to and capable of illuminating the task for which it is installed.
    - b. Be of a type different from the general lighting system.
    - c. Be separately switched from the general lighting system.
  - vii. If there are illuminated floor displays, floor display lighting power shall be used only if allowed by column 4 of TABLE 140.6-D.
  - viii. Additional allowed power for a combination of floor display lighting and task lighting shall be available only for (I) floors having floor displays; or (II) floors not having floor displays but having tasks having illuminance recommendations that appear in the Tenth Edition of the IES Lighting Handbook and that are higher than the general lighting level in column 2 of TABLE 140.6-D. The square footage of floor display or the square footage of task areas shall be determined in accordance with Section 140.6(c)3C and D, except that any floor area designed to not have floor displays or tasks, such as floor areas designated as a path of egress, shall not be included for the floor display allowance.
  - ix. For floor display lighting where the bottom of the luminaire is 12 feet or higher above the finished floor, the wattage allowed in column 4 of TABLE 140.6-D may be increased by multiplying the floor display lighting power allowance by the appropriate factor from TABLE 140.6-E.  

Luminaire mounting height is the distance from the finished floor to the bottom of the luminaire.  
~~Wall display lighting with varying mounting heights shall be separately determined under Item~~  
~~The floor display mounting height multipliers shall be used to reduce the design watts of the space.~~
  - x. The additional allowed power for floor display lighting for each applicable area shall be the smaller of:
    - a. The product of allowed floor display and task lighting power determined in accordance with Section 140.6(c)3Jvii times the floor square footage determined in accordance with Section 140.6(c)3Jviii ~~times the height multiplier if appropriate in accordance with Section 140.6(c)3Jix;~~ or
    - b. The actual power used for the floor display lighting systems.
- K. Determine additional allowed power for ornamental/special effects lighting as follows:
- i. Additional allowed power for ornamental/special effects lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power ~~Density~~ allowances.
  - ii. Qualifying ornamental lighting includes luminaires such as chandeliers, sconces, lanterns, neon and cold cathode, light emitting diodes, theatrical projectors, moving lights and light color panels



when any of those lights are used in a decorative manner that does not serve as display lighting or general lighting.

- iii. Additional lighting power for ornamental/special effects lighting shall be used only if allowed by Column 5 of TABLE 140.6-D.
- iv. Additional lighting power for ornamental/special effects lighting shall be used only in areas having ornamental/special effects lighting. The square footage of the floor area shall be determined in accordance with Section 140.6(c)3C and D, and it shall not include floor areas not having ornamental/special effects lighting.
- v. The additional allowed power for ornamental/special effects lighting for each applicable area shall be the smaller of:
  - a. The product of the allowed ornamental/special effects lighting power determined in accordance with Section 140.6(c)3Kiii, times floor square footage determined in accordance with Section 140.6(c)3Kiv; or
  - b. The actual power of allowed ornamental/special effects lighting.

**L. Determine additional allowed power for very valuable display case lighting as follows:**

- i. Additional allowed power for very valuable display case lighting shall not be available when using Section 140.6(c)3H for determining general Lighting Power Density allowances.
- ii. Additional allowed power for very valuable display case lighting shall be available only for display cases in appropriate function areas in retail merchandise sales, museum and religious worship.
- iii. To qualify for additional allowed power for very valuable display case lighting, a case shall contain jewelry, coins, fine china, fine crystal, precious stones, silver, small art objects and artifacts, and/or valuable collections the display of which involves customer inspection of very fine detail from outside of a locked case.
- iv. Qualifying lighting includes internal display case lighting or external lighting employing highly directional luminaires specifically designed to illuminate the case or inspection area without spill light, and shall not be fluorescent lighting unless installed inside of a display case.
- v. If there is qualifying very valuable display case lighting, in accordance with Section 140.6(c)3Liii, the smallest of the following separate lighting power for display cases presenting very valuable display items is permitted:
  - a. The product of the area of the primary function and 0.8 watt per square foot; or
  - b. The product of the area of the display case and 12 watts per square foot; or
  - c. The actual power of lighting for very valuable displays.

**(d) Automatic Daylighting Controls in Secondary Daylit Zones.** All luminaires providing general lighting that is in, or partially in a Secondary Sidelit Daylit Zone as defined in Section 130.1(d)1C, and that is not in a Primary Sidelit Daylit Zone shall:

- 1. Be controlled independently from all other luminaires by automatic daylighting controls that meet the applicable requirements of Section 110.9; and
- 2. Be controlled in accordance with the applicable requirements in Section 130.1(d)2; and
- 3. All Secondary Sidelit Daylit Zones shall be shown on the plans submitted to the enforcing agency.

**EXCEPTION 1 to Section 140.6(d):** Luminaires in Secondary Sidelit Daylit Zone(s) in areas where the total wattage of general lighting is less than 120 Watts.

**EXCEPTION 2 to Section 140.6(d):** Luminaires in parking garages complying with Section 130.1(d)3.

TABLE 140.6-A LIGHTING POWER DENSITY-ADJUSTMENT FACTORS (PAF)

TYPE OF CONTROL		TYPE OF AREA	FACTOR
a. To qualify for any of the Power Adjustment Factors in this table, the installation shall comply with the applicable requirements in Section 140.6(a)2 b. Only one PAF may be used for each qualifying luminaire unless combined below. c. Lighting controls that are required for compliance with Part 6 shall not be eligible for a PAF			
1. Partial ON Occupant Sensing Control		Any area $\leq$ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room.	0.20
1. Daylight Dimming plus OFF Control		Luminaires in skylit daylit zone or primary sidelit daylit zone	0.10
2. Occupant Sensing Controls in Large Open Plan Offices		In open plan offices > 250 square feet: One sensor controlling an area that is:	No larger than 125 square feet
			From 126 to 250 square feet
			From 251 to 500 square feet
3. Dimming System	Manual Dimming	Hotels/motels, restaurants, auditoriums, theaters	0.10
	Multiscene Programmable		0.20
3. Institutional Tuning		Luminaires in non-daylit areas: Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.	0.10
		Luminaires in daylit areas: Luminaires that qualify for other PAFs in this table may also qualify for this tuning PAF.	0.05
4. Demand Responsive Control		All building types less than 10,000 square feet. Luminaires that qualify for other PAFs in this table may also qualify for this demand responsive control PAF	0.05
5. Combined Manual Dimming plus Partial ON Occupant Sensing Control		Any area $\leq$ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, conference or waiting room	0.25

TABLE 140.6-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES

TYPE OF BUILDING	ALLOWED LIGHTING POWER DENSITY (WATTS PER SQUARE FOOT)
Auditorium Building	<u>1.5</u> <u>1.4</u>
Classroom Building	1.1
Commercial and Industrial Storage Building	0.60
Convention Center Building	<u>1.2</u> <u>1.0</u>
Financial Institution Building	<u>1.1</u> <u>1.0</u>
General Commercial Building/Industrial Work Building	1.00
Grocery Store Building	1.50
Library Building	<u>1.3</u> <u>1.2</u>
Medical Building/Clinic Building	<u>1.1</u> <u>1.0</u>
Office Building	0.80
Parking Garage Building	0.20
Religious Facility Building	<u>1.6</u> <u>1.5</u>
Restaurant Building	<u>1.2</u> <u>1.1</u>
School Building	<u>1.00</u> <u>0.95</u>
Theater Building	1.3
All others buildings	<u>0.60</u> <u>0.50</u>

TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT<sup>2</sup>)

PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER DENSITY (W/ft <sup>2</sup> )	PRIMARY FUNCTION AREA		ALLOWED LIGHTING POWER DENSITY (W/ft <sup>2</sup> )
Auditorium Area		<u>1.5</u> <u>1.40</u> <sup>3</sup>	Library Area	Reading areas	<u>1.2</u> <u>1.1</u> <sup>3</sup>
Auto Repair Area		0.90 <sup>2</sup>		Stack areas	1.5 <sup>3</sup>
Beauty Salon Area		1.7	Lobby Area	Hotel lobby	<u>1.10</u> <u>0.95</u> <sup>3</sup>
Civic Meeting Place Area		1.3 <sup>3</sup>		Main entry lobby	<u>1.50</u> <u>0.95</u> <sup>3</sup>
Classroom, Lecture, Training, Vocational Areas		1.2 <sup>5</sup>	Locker/Dressing Room		<u>0.80</u> <u>0.70</u>
Commercial and Industrial Storage Areas (conditioned and unconditioned)		0.60	Lounge Area		<u>1.10</u> <u>0.90</u> <sup>3</sup>
Commercial and Industrial Storage Areas (refrigerated)		0.7	Malls and Atria		<u>1.20</u> <u>0.95</u> <sup>3</sup>
Convention, Conference, Multipurpose and Meeting Center Areas		<u>1.4</u> <u>1.2</u> <sup>3</sup>	Medical and Clinical Care Area		1.2
Corridor, Restroom, Stair, and Support Areas		0.60	Office Area	> 250 square feet	0.75
Dining Area		<u>1.1</u> <u>1.0</u> <sup>3</sup>		≤ 250 square feet	1.0
Electrical, Mechanical, Telephone Rooms		<u>0.70</u> <u>0.55</u> <sup>2</sup>	Parking Garage Area	Parking Area <sup>10</sup>	0.14
Exercise Center, Gymnasium Areas		1.0		Dedicated Ramps	0.30
Exhibit, Museum Areas		<u>2.0</u> <u>1.8</u>		Daylight Adaptation Zones <sup>9</sup>	0.60
Financial Transaction Area		<u>1.2</u> <u>1.0</u> <sup>3</sup>	Religious Worship Area		1.5 <sup>3</sup>
General Commercial and Industrial Work Areas	Low bay	0.9 <sup>2</sup>	Retail Merchandise Sales, Wholesale Showroom Areas		1.2 <sup>6 and 7</sup>
	High bay	1.0 <sup>2</sup>			
	Precision	1.2 <sup>4</sup>	Theater Area	Motion picture	0.90 <sup>3</sup>
Grocery Sales Area		1.2 <sup>6 and 7</sup>		Performance	1.4 <sup>3</sup>

CONTINUED: TABLE 140.6-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES  
(WATTS/FT<sup>2</sup>)

Hotel Function Area	1.5 <sup>2</sup>	Transportation Function Area		1.2
Hotel Function Area	1.4 <sup>3</sup>	Transportation Function Area	Concourse & Baggage	0.50
			Ticketing	1.0
Kitchen, Food Preparation Areas	1.61.2	Videoconferencing Studio		1.2 <sup>8</sup>
Laboratory Area, Scientific	1.4 <sup>1</sup>	Waiting Area		1.10.80 <sup>3</sup>
Laundry Area	0.90.70	All other areas		0.60.50
Footnotes for this table are listed below.				
FOOTNOTES FOR TABLE 140.6-C:				
See Section 140.6(c)2 for an explanation of additional lighting power available for specialized task work, ornamental, precision, accent, display, decorative, and white boards and chalk boards, in accordance with the footnotes in this table. The smallest of the added lighting power listed in each footnote below, or the actual design wattage, may be added to the allowed lighting power only when using the Area Category Method of compliance.				
Footnote number	Type of lighting system allowed		Maximum allowed added lighting power density (W/ft <sup>2</sup> of task area unless otherwise noted)	
1	Specialized task work		0.20 W/ft <sup>2</sup>	
2	Specialized task work		0.50 W/ft <sup>2</sup>	
3	Ornamental lighting as defined in Section 100.1 and in accordance with Section 140.6.(c)2.		0.50 W/ft <sup>2</sup>	
4	Precision commercial and industrial work		1.0 W/ft <sup>2</sup>	
5	Per linear foot of white board or chalk board.		5.5 W per linear foot	
6	Accent, display and feature lighting - luminaires shall be adjustable or directional		0.30 W/ft <sup>2</sup>	
7	Decorative lighting - primary function shall be decorative and shall be in addition to general illumination.		0.20 W/ft <sup>2</sup>	
8	Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii.		1.5 W/ft <sup>2</sup>	
9	Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage			
10	Additional allowance for ATM locations in Parking Garages. Allowance per ATM.		200 watts for first ATM location, 50 watt for each additional ATM location in a group.	
8	Additional Videoconferencing Studio lighting complying with all of the requirements in Section 140.6(c)2Gvii.		1.5 W/ft <sup>2</sup>	
9	Daylight Adaptation Zones shall be no longer than 66 feet from the entrance to the parking garage			

TABLE 140.6-D TAILORED METHOD LIGHTING POWER ALLOWANCES

1	2	3	4	5
Primary Function Area	General Illumination Level (Lux)	Wall Display Lighting Power Density (W/ft <sup>2</sup> )	Allowed Combined Floor Display Power and Task Lighting Power Density (W/ft <sup>2</sup> )	Allowed Ornamental/Special Effect Lighting Power Density (W/ft <sup>2</sup> )
Auditorium Area	300	2.25	0.3	0.5
Civic Meeting Place	300	3.15	0.2	0.5
Convention, Conference, Multipurpose, and Meeting Center Areas	300	2.50	0.4	0.5
Dining Areas	200	1.50	0.6	0.5
Exhibit, Museum Areas	150	15.0	1.2	0.5
Financial Transaction Area	300	3.15	0.2	0.5
Grocery Store Area	500	8.00	0.9	0.5
Hotel Function Area	400	2.25	0.2	0.5
Lobby Area:				
Hotel lobby	200	3.15	0.2	0.5
Main entry lobby	200	0	0.2	0
Lounge Area	200	7.00	0	0.5
Malls and Atria	300	3.50	0.5	0.5
Religious Worship Area	300	1.50	0.5	0.5
Retail Merchandise Sales, and Showroom Areas	400	14.00	1.0	0.5
Theater Area:				
Motion picture	200	3.00	0	0.5
Performance	200	6.00	0	0.5
Transportation Function Area	300	3.15	0.3	0.5
Waiting Area	300	3.15	0.2	0.5

TABLE 140.6-E ADJUSTMENTS FOR MOUNTING HEIGHT ABOVE FLOOR

Height in feet above finished floor and bottom of luminaire(s)	Floor Display or Wall Display – Multiply by
< 12'	1.00
12' to 16'	<del>1.15</del> 0.87
> 16'	<del>1.30</del> 0.77

TABLE 140.6-F ROOM CAVITY RATIO (RCR) EQUATIONS

Determine the Room Cavity Ratio for TABLE 140.6-G using one of the following equations.
Room cavity ratio for rectangular rooms
$RCR = \frac{5 \times H \times (L + W)}{L \times W}$
Room cavity ratio for irregular-shaped rooms
$RCR = \frac{2.5 \times H \times P}{A}$
Where: L = Length of room; W = Width of room; H = Vertical distance from the work plane to the centerline of the lighting fixture; P = Perimeter of room, and A = Area of room

TABLE 140.6-G ILLUMINANCE LEVEL (LUX) POWER DENSITY VALUES (WATTS/FT<sup>2</sup>)

Illuminance Level (Lux)	RCR ≤ 2.0	RCR > 2.0 and ≤ 3.5	RCR > 3.5 and ≤ 7.0	RCR > 7.0
50	<u>0.20.18</u>	<u>0.30.22</u>	<u>0.40.32</u>	<u>0.60.46</u>
100	<u>0.40.30</u>	<u>0.60.38</u>	<u>0.80.56</u>	<u>1.20.84</u>
200	<u>0.60.48</u>	<u>0.80.64</u>	<u>1.30.88</u>	<u>1.91.34</u>
300	<u>0.80.64</u>	<u>1.00.82</u>	<u>1.41.12</u>	<u>2.01.76</u>
400	<u>0.90.78</u>	<u>1.10.98</u>	<u>1.51.34</u>	<u>2.22.08</u>
500	<u>1.00.90</u>	<u>1.21.10</u>	<u>1.61.52</u>	<u>2.42.32</u>
600	<u>1.21.06</u>	<u>1.41.26</u>	<u>2.01.74</u>	<u>2.92.60</u>
700	<u>1.41.24</u>	<u>1.71.46</u>	<u>2.31.98</u>	<u>3.32.96</u>
800	<u>1.61.44</u>	<u>1.91.70</u>	<u>2.62.28</u>	<u>3.83.30</u>
900	<u>1.81.66</u>	<u>2.22.00</u>	<u>3.02.64</u>	<u>4.33.74</u>
1000	<u>1.91.84</u>	<u>2.42.20</u>	<u>3.32.90</u>	<u>4.84.06</u>

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## SECTION 140.7 – REQUIREMENTS FOR OUTDOOR LIGHTING

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- (a) An outdoor lighting installation complies with this section if it meets the requirements in Subsections (b) and (c), and the actual outdoor lighting power installed is no greater than the allowed outdoor lighting power calculated under Subsection (d). The allowed outdoor lighting shall be calculated according to Outdoor Lighting Zone in Title 24, Part 1, Section 10-114.

**EXCEPTIONS to Section 140.7(a):** When more than 50 percent of the light from a luminaire falls within one or more of the following applications, the lighting power for that luminaire shall be exempt from Section 140.7:

1. Temporary outdoor lighting.
2. Lighting required and regulated by the Federal Aviation Administration, and the Coast Guard.
3. Lighting for public streets, roadways, highways, and traffic signage lighting, including lighting for driveway entrances occurring in the public right-of-way.
4. Lighting for sports and athletic fields, and children's playgrounds.
5. Lighting for industrial sites, including but not limited to, rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants, and aviation facilities.
6. ~~Lighting specifically for Automated Teller Machines as required by California Financial Code Section 13040, or required by law through a local ordinance.~~
76. Lighting of public monuments.
87. Lighting of signs complying with the requirements of Sections 130.3 and 140.8.
98. Lighting of tunnels, bridges, stairs, wheelchair elevator lifts for American with Disabilities Act (ADA) compliance, and ramps that are other than parking garage ramps.
109. Landscape lighting.
110. In theme parks: outdoor lighting only for themes and special effects.
121. Lighting for outdoor theatrical and other outdoor live performances, provided that these lighting systems are additions to area lighting systems and are controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators.
1312. Outdoor lighting systems for qualified historic buildings, as defined in the California Historic Building Code (Title 24, Part 8), if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems for qualified historic buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other outdoor lighting systems for qualified historic buildings shall comply with Section 140.7.

- (b) **Outdoor Lighting Power Trade-offs.** Outdoor lighting power trade-offs shall be determined as follows:

1. Allowed lighting power determined according to Section 140.7(d)1 for general hardscape lighting allowance may be traded to specific applications in Section 140.7(d)2, provided the hardscape area from which the lighting power is traded continues to be illuminated in accordance with Section 140.7(d)1A.
2. Allowed lighting power determined according to Section 140.7(d)2 for additional lighting power allowances for specific applications shall not be traded between specific applications, or to hardscape lighting in Section 140.7(d)1.
3. Trading off lighting power allowances between outdoor and indoor areas shall not be permitted.

- (c) **Calculation of Actual Lighting Power.** The wattage of outdoor luminaires shall be determined in accordance with Section 130.0(c).

- (d) **Calculation of Allowed Lighting Power.** The allowed lighting power shall be the combined total of the sum of the general hardscape lighting allowance determined in accordance with Section 140.7(d)1, and the sum of the additional lighting power allowance for specific applications determined in accordance with Section 140.7(d)2.
1. **General Hardscape Lighting Allowance.** Determine the general hardscape lighting power allowances as follows:
    - A. The general hardscape area of a site shall include parking lot(s), roadway(s), driveway(s), sidewalk(s), walkway(s), bikeway(s), plaza(s), bridge(s), tunnel(s), and other improved area(s) that are illuminated. In plan view of the site, determine the illuminated hardscape area, which is defined as any hardscape area that is within a square pattern around each luminaire or pole that is ten times the luminaire mounting height with the luminaire in the middle of the pattern, less any areas that are within a building, beyond the hardscape area, beyond property lines, or obstructed by a structure. The illuminated hardscape area shall include portions of planters and landscaped areas that are within the lighting application and are less than or equal to 10 feet wide in the short dimensions and are enclosed by hardscape or other improvement on at least three sides. Multiply the illuminated hardscape area by the Area Wattage Allowance (AWA) from Table 140.7-A for the appropriate Lighting Zone.
    - B. Determine the perimeter length of the general hardscape area. The total perimeter shall not include portions of hardscape that is not illuminated according to Section 140.7(d)1A. Multiply the hardscape perimeter by the Linear Wattage Allowance (LWA) for hardscape from Table 140.7-A for the appropriate lighting zone. The perimeter length for hardscape around landscaped areas and permanent planters shall be determined as follows:
      - i. Landscaped areas completely enclosed within the hardscape area, and which have a width or length less than 10 feet wide, shall not be added to the hardscape perimeter length.
      - ii. Landscaped areas completely enclosed within the hardscape area, and which width or length is a minimum of 10 feet wide, the perimeter of the landscaped areas or permanent planter shall be added to the hardscape perimeter length.
      - iii. Landscaped edges that are not abutting the hardscape shall not be added to the hardscape perimeter length.
    - C. Determine the Initial Wattage Allowance (IWA) for general hardscape lighting from Table 140.7-A for the appropriate lighting zone. The hardscape area shall be permitted one IWA per site.
    - D. The general hardscape lighting allowance shall be the sum of the allowed watts determined from (A), (B) and (C) above.
  2. **Additional Lighting Power Allowance for Specific Applications.** Additional lighting power for specific applications shall be the smaller of the additional lighting allowances for specific applications determined in accordance with TABLE 140.7-B for the appropriate lighting zone, or the actual installed lighting power meeting the requirements for the allowance.



TABLE 140.7-A GENERAL HARDSCAPE LIGHTING POWER ALLOWANCE

Type of Power Allowance	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2 <sup>2</sup>	Lighting Zone 3 <sup>2</sup>	Lighting Zone 4
Area Wattage Allowance (AWA)	No allowance* <sup>1</sup>	0.0350.020 W/ft <sup>2</sup>	0.0450.030 W/ft <sup>2</sup>	0.0900.040 W/ft <sup>2</sup>	0.1150.050 W/ft <sup>2</sup>
Linear Wattage Allowance (LWA)		0.250.15 W/lf	0.450.25 W/lf	0.600.35 W/lf	0.850.45 W/lf
Initial Wattage Allowance (IWA)		340 W	510450 W	770520 W	1030640 W

\*<sup>1</sup>Continuous lighting is explicitly prohibited in Lighting Zone 0. A single luminaire of 15 Watts or less may be installed at an entrance to a parking area, trail head, fee payment kiosk, outhouse, or toilet facility, as required to provide safe navigation of the site infrastructure. Luminaires installed in Lighting Zone 0 shall meet the maximum zonal lumen limits for Uplight and Glare specified in Table 130.2-A and 130.2-B.

<sup>2</sup>For Lighting Zone 2 and 3, where greater than 50% of the paved surface of a parking lot is finished with concrete, the AWA for that area shall be 0.035 W/ft<sup>2</sup> for Lighting Zone 2 and 0.040 W/ft<sup>2</sup> for Lighting Zone 3, and the LWA for both lighting zones shall be 0.70 W/lf. This does not extend beyond the parking lot, and does not include any other General Hardscape areas.

**TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS**  
*All area and distance measurements in plan view unless otherwise noted.*

Lighting Application	Lighting Zone 0	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
<b>WATTAGE ALLOWANCE PER APPLICATION. Use all that apply as appropriate.</b>					
<b>Building Entrances or Exits.</b> Allowance per door. Luminaires qualifying for this allowance shall be within 20 feet of the door.	<u>Not applicable</u>	30-15 watts	60-25 watts	90-35 watts	90-45 watts
<b>Primary Entrances to Senior Care Facilities, Police Stations, Hospitals, Fire Stations, and Emergency Vehicle Facilities.</b> Allowance per primary entrance(s) only. Primary entrances shall provide access for the general public and shall not be used exclusively for staff or service personnel. This allowance shall be in addition to the building entrance or exit allowance above. Luminaires qualifying for this allowance shall be within 100 feet of the primary entrance.	<u>Not applicable</u>	45 watts	80 watts	120 watts	130 watts
<b>Drive Up Windows.</b> Allowance per customer service location. Luminaires qualifying for this allowance shall be within 2 mounting heights of the sill of the window.	<u>Not applicable</u>	40 watts	75 watts	125 watts	200 watts
<b>Vehicle Service Station Uncovered Fuel Dispenser.</b> Allowance per fueling dispenser. Luminaires qualifying for this allowance shall be within 2 mounting heights of the dispenser.	<u>Not applicable</u>	120 watts	175 watts	185 watts	330 watts
<b>ATM Machine Lighting.</b> Allowance per ATM machine. Luminaires qualifying for this allowance shall be within 50 feet of the dispenser.	<u>Not applicable</u>	250 watts for first ATM machine, 70 watts for each additional ATM machine.			
<b>WATTAGE ALLOWANCE PER UNIT LENGTH (w/linear ft). May be used for one or two frontage side(s) per site.</b>					
<b>Outdoor Sales Frontage.</b> Allowance for frontage immediately adjacent to the principal viewing location(s) and unobstructed for its viewing length. A corner sales lot may include two adjacent sides provided that a different principal viewing location exists for each side. Luminaires qualifying for this allowance shall be located between the principal viewing location and the frontage outdoor sales area.	<u>Not applicable</u>	No Allowance	22.5 W/linear ft	36 W/linear ft	45 W/linear ft
<b>WATTAGE ALLOWANCE PER HARDSCAPE AREA (W/ft²). May be used for any illuminated hardscape area on the site.</b>					
<b>Hardscape Ornamental Lighting.</b> Allowance for the total site illuminated hardscape area. Luminaires qualifying for this allowance shall be rated for 100 watts or less as determined in accordance with Section 130.0(d), and shall be post-top luminaires, lanterns, pendant luminaires, or chandeliers.	<u>Not applicable</u>	No Allowance	0.02 W/ft²	0.04 W/ft²	0.06 W/ft²
<b>WATTAGE ALLOWANCE PER SPECIFIC AREA (W/ft²). Use as appropriate provided that none of the following specific applications shall be used for the same area.</b>					
<b>Building Facades.</b> Only areas of building façade that are illuminated shall qualify for this allowance. Luminaires qualifying for this allowance shall be aimed at the façade and shall be capable of illuminating it without obstruction or interference by permanent building features or other objects.	<u>Not applicable</u>	No Allowance	0.18 W/ft²	0.35 W/ft²	0.50 W/ft²
<b>Outdoor Sales Lots.</b> Allowance for uncovered sales lots used exclusively for the display of vehicles or other merchandise for sale. Driveways, parking lots or other non sales areas shall be considered hardscape areas even if these areas are completely surrounded by sales lot on all sides. Luminaires qualifying for this allowance shall be within 5 mounting heights of the sales lot area.	<u>Not applicable</u>	0.164 W/ft²	0.555 W/ft²	0.758 W/ft²	1.285 W/ft²
<b>Vehicle Service Station Hardscape.</b> Allowance for the total illuminated hardscape area less area of buildings, under canopies, off property, or obstructed by signs or structures. Luminaires qualifying for this allowance shall be illuminating the hardscape area and shall not be within a building, below a canopy, beyond property lines, or obstructed by a sign or other structure.	<u>Not applicable</u>	0.014 W/ft²	0.155 W/ft²	0.308 W/ft²	0.485 W/ft²
<b>Vehicle Service Station Canopies.</b> Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	<u>Not applicable</u>	0.514 W/ft²	1.005 W/ft²	1.300 W/ft²	2.200 W/ft²
<b>Sales Canopies.</b> Allowance for the total area within the drip line of the canopy. Luminaires qualifying for this allowance shall be located under the canopy.	<u>Not applicable</u>	No Allowance	0.655 W/ft²	0.908 W/ft²	1.135 W/ft²
<b>Non-sales Canopies and Tunnels.</b> Allowance for the total area within the drip line of the canopy or inside the tunnel. Luminaires qualifying for this allowance shall be located under the canopy or tunnel.	<u>Not applicable</u>	0.084 W/ft²	0.205 W/ft²	0.408 W/ft²	0.585 W/ft²

**SECTION 140.7 – REQUIREMENTS FOR OUTDOOR LIGHTING**

<b>Guard Stations.</b> Allowance up to 1,000 square feet per vehicle lane. Guard stations provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants, including identification, documentation, vehicle license plates, and vehicle contents. Qualifying luminaires shall be within 2 mounting heights of a vehicle lane or the guardhouse.	<u>Not applicable</u>	0.154 W/ft <sup>2</sup>	0.355 W/ft <sup>2</sup>	0.708 W/ft <sup>2</sup>	0.985 W/ft <sup>2</sup>
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CONTINUED: TABLE 140.7-B ADDITIONAL LIGHTING POWER ALLOWANCE FOR SPECIFIC APPLICATIONS

*All area and distance measurements in plan view unless otherwise noted.*

Lighting Application	<u>Lighting Zone 0</u>	<u>Lighting Zone 1</u>	<u>Lighting Zone 2</u>	<u>Lighting Zone 3</u>	<u>Lighting Zone 4</u>
<b>Student Pick-up/Drop-off zone.</b> Allowance for the area of the student pick-up/drop-off zone, with or without canopy, for preschool through 12th grade school campuses. A student pick-up/drop off zone is a curbside, controlled traffic area on a school campus where students are picked-up and dropped off from vehicles. The allowed area shall be the smaller of the actual width or 25 feet, times the smaller of the actual length or 250 feet. Qualifying luminaires shall be within 2 mounting heights of the student pick-up/drop-off zone.	<u>Not applicable</u>	No Allowance	0.12 W/ft <sup>2</sup>	0.45 W/ft <sup>2</sup>	No Allowance
<b>Outdoor Dining.</b> Allowance for the total illuminated hardscape of outdoor dining. Outdoor dining areas are hardscape areas used to serve and consume food and beverages. Qualifying luminaires shall be within 2 mounting heights of the hardscape area of outdoor dining.	<u>Not applicable</u>	0.014 W/ft <sup>2</sup>	0.135 W/ft <sup>2</sup>	0.240 W/ft <sup>2</sup>	0.400 W/ft <sup>2</sup>
<b>Special Security Lighting for Retail Parking and Pedestrian Hardscape.</b> This additional allowance is for illuminated retail parking and pedestrian hardscape identified as having special security needs. This allowance shall be in addition to the building entrance or exit allowance.	<u>Not applicable</u>	0.007 W/ft <sup>2</sup>	0.009 W/ft <sup>2</sup>	0.019 W/ft <sup>2</sup>	No Allowance

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**SECTION 140.8 – REQUIREMENTS FOR SIGNS**

This section applies to all internally illuminated and externally illuminated signs, unfiltered light emitting diodes (LEDs), and unfiltered neon, both indoor and outdoor. Each sign shall comply with either Subsection (a) or (b), as applicable.

**(a) Maximum Allowed Lighting Power.**

1. For internally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 12 watts per square foot. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power.
2. For externally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 2.3 watts per square foot. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more luminaires, shall be used.
3. Lighting for unfiltered light emitting diodes (LEDs) and unfiltered neon shall comply with Section 140.8(b).

**(b) Alternate Lighting Sources.** The sign shall comply if it is equipped only with one or more of the following light sources:

1. High pressure sodium lamps; or
2. Metal halide lamps that are:
  - A. Pulse start or ceramic served by a ballast that has a minimum efficiency of 88 percent or greater; or
  - B. Pulse start that are 320 watts or smaller, are not 250 watt or 175 watt lamps, and are served by a ballast that has a minimum efficiency of 80 percent.

Ballast efficiency is the measured output wattage to the lamp divided by the measured operating input wattage when tested according to ANSI C82.6-2005.

3. Neon or cold cathode lamps with transformer or power supply efficiency greater than or equal to following:
  - A. A minimum efficiency of 75 percent when the transformer or power supply rated output current is less than 50 mA; or
  - B. A minimum efficiency of 68 percent when the transformer or power supply rated output current is 50 mA or greater.

The ratio of the output wattage to the input wattage is at 100 percent tubing load.

4. Fluorescent lighting systems meeting one of the following requirements:
  - A. Use only lamps with a minimum color rendering index (CRI) of 80; or
  - B. Use only electronic ballasts with a fundamental output frequency not less than 20 kHz.
5. Light emitting diodes (LEDs) with a power supply having an efficiency of 80 percent or greater; or

**EXCEPTION to Section 140.8(b)5:** Single voltage external power supplies that are designed to convert 120 volt AC input into lower voltage DC or AC output, and have a nameplate output power less than or equal to 250 watts, shall comply with the applicable requirements of the Appliance Efficiency Regulations (Title 20).

6. Compact fluorescent lamps that do not contain a medium screw base sockets (E24/E26).

**EXCEPTION 1 to Section 140.8:** Unfiltered incandescent lamps that are not part of an electronic message center (EMC), an internally illuminated sign, or an externally illuminated sign.

**EXCEPTION 2 to Section 140.8:** Exit signs. Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

**EXCEPTION 3 to Section 140.8:** Traffic Signs. Traffic signs shall meet the requirements of the Appliance Efficiency Regulations.

## SECTION 140.9 – PRESCRIPTIVE REQUIREMENTS FOR COVERED PROCESSES

- (a) **Prescriptive Requirements for Computer Rooms~~Computer Room Data Centers~~.** Space conditioning systems serving ~~an~~A computer room with a power density greater than 20 W/ft<sup>2</sup> ~~computer room data center~~ shall ~~complies~~complies with this section by being designed with and having constructed and installed a cooling system that meets the requirements of Subsections 1 through 6.

1. **Economizers.** Each individual cooling system primarily serving computer room~~computer room data center~~(s) shall include either:
  - A. An integrated air economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 55°F dry-bulb/50°F wet-bulb and below; or
  - B. An integrated water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the Commission, at outside air temperatures of 40°F dry-bulb/35°F wet-bulb and below.

**EXCEPTION 1 to Section 140.9(a)1:** Individual computer room~~computer room data centers~~ under 5 tons in a building that does not have any economizers.

**EXCEPTION 2 to Section 140.9(a)1:** New cooling systems serving an existing computer room~~computer room data center~~ in an existing building up to a total of 50 tons of new cooling equipment per building.

**EXCEPTION 3 to Section 140.9(a)1:** New cooling systems serving a new computer room~~computer room data center~~ in an existing building up to a total of 20 tons of new cooling equipment per building.

**EXCEPTION 4 to Section 140.9(a)1:** A computer room~~computer room data center~~ may be served by a fan system without an economizer if it is also served by a fan system with an economizer that also serves other spaces within the building ~~none~~computer room(s) provided that all of the following are met:

- i. The economizer system is sized to meet the design cooling load of the computer room~~computer room data center~~(s) when the other spaces within the building~~none~~computer room(s) are at 50 percent of their design load; and
  - ii. The economizer system has the ability to serve only the computer room~~computer room data center~~(s), e.g. shut off flow to other spaces within the building~~none~~computer rooms when unoccupied; and
  - iii. The noneconomizer system does not operate when the outside air drybulb temperatures is below 60°F and, the cooling load of other spaces within the building~~the none~~computer room(s) served by the economizer system is less than 50 percent of design load.
2. **Reheat.** Each computer room~~computer room data center~~ zone shall have controls that prevent reheating, recooling and simultaneous provisions of heating and cooling to the same zone, such as mixing or simultaneous supply of air that has been previously mechanically heated and air that has been previously cooled, either by cooling equipment or by economizer systems.
  3. **Humidification.** Nonadiabatic humidification (e.g. steam, infrared) is prohibited. Only adiabatic humidification (e.g. direct evaporative, ultrasonic) is permitted.
  4. **Power Consumption of Fans.** The total fan power at design conditions of each fan system shall not exceed 27 W/kBtu·h of net sensible cooling capacity.
  5. **Fan Control.** Each unitary unitary~~unitary~~ air cooled direct expansion unit with an air handler~~conditioner with conditioner~~ with mechanical cooling capacity exceeding 60,000 Btu/hr and each chilled water fan system shall be designed to vary the airflow rate as a function of actual load and shall have controls and/or devices (such as two-speed or variable speed control) that will result in fan motor demand of no more than 50 percent of design wattage at 66 percent of design fan speed.

6. **Containment.** ~~Computer rooms~~ ~~Computer room~~ ~~Data centers~~ with air-cooled computers in racks and with a design load exceeding 175 kW/room shall include air barriers such that there is no significant air path for computer discharge air to recirculate back to computer inlets without passing through a cooling system.

**EXCEPTION 1 to Section 140.9(a)6:** Expansions of existing ~~computer rooms~~ ~~computer room~~ ~~data centers~~.

**EXCEPTION 2 to Section 140.9(a)6:** Computer racks with a design load less than 1 kW/rack.

**EXCEPTION 3 to Section 140.9(a)6:** Equivalent energy performance based on computational fluid dynamics or other analysis.

(b) **Prescriptive Requirements for Commercial Kitchens.**

1. **Kitchen exhaust systems.**

- A. Replacement air introduced directly into the hood cavity of kitchen exhaust hoods shall not exceed 10 percent of the hood exhaust airflow rate.
- B. For kitchen/dining facilities having total Type I and Type II kitchen hood exhaust airflow rates greater than 5,000 cfm, each Type I hood shall have an exhaust rate that complies with TABLE 140.9-A. If a single hood or hood section is installed over appliances with different duty ratings, then the maximum allowable flow rate for the hood or hood section shall not exceed the TABLE 140.9-A values for the highest appliance duty rating under the hood or hood section. Refer to ASHRAE Standard 154-2011 for definitions of hood type, appliance duty and next exhaust flow rate.

**EXCEPTION 1 to Section 140.9(b)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.

**TABLE 140.9-A MAXIMUM NET EXHAUST FLOW RATE, CFM PER LINEAR FOOT OF HOOD LENGTH**

Type of Hood	Light Duty Equipment	Medium Duty Equipment	Heavy Duty Equipment	Extra Heavy Duty Equipment
Wall-mounted Canopy	140	210	280	385
Single Island	280	350	420	490
Double Island	175	210	280	385
Eyebrow	175	175	Not Allowed	Not Allowed
Backshelf / Passover	210	210	280	Not Allowed

2. **Kitchen ventilation.**

- A. Mechanically cooled or heated makeup air delivered to any space with a kitchen hood shall not exceed the greater of:
- The supply flow required to meet the space heating and cooling load; or
  - 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:
- At least 50 percent of all replacement air is transfer air that would otherwise be exhausted; or
  - 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 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 ~~per~~as specified by Section 120.1.
- 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; ~~and~~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.

- (c) **Prescriptive Requirements for Laboratory exhaust systems.** 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):** 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):** New zones on an existing constant volume exhaust system.

## SUBCHAPTER 6

# NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—ADDITIONS, ALTERATIONS, AND REPAIRS

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### SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, THAT WILL BE NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES AND TO EXISTING OUTDOOR LIGHTING, AND FOR THESE OCCUPANCIES AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

Additions, alterations, and repairs to existing nonresidential, high-rise residential, and hotel/motel buildings, as well as 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 (mandatory measures), and either the performance compliance approach (energy budgets) in Section 141.0(a)12, (for additions) or 141.0(b)13, (for alterations), or the prescriptive compliance approach in Section 141.0(a)21, (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, high-rise residential, and hotel/motel buildings are covered specified in Section 141.1.

**NOTE:** 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.

(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 serving the addition; any addition to an outdoor lighting system; and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110.0 through 130.5 and Sections 140.2 through 140.9.
2. **Performance approach.**
  - A. The envelope and indoor lighting in the conditioned space of the addition, and any newly installed space-conditioning system, electrical power distribution system, or water-heating system serving the addition, shall meet the applicable requirements of Sections 110.0 through 130.5; and
  - B. Either:
    - i. The addition alone shall comply with Section 140.1; or
    - ii. Existing plus addition plus alteration. The standard design for existing plus addition, plus alteration energy use is the combination of the existing building's unaltered components to remain, existing building altered components that are the more efficient, in TDV energy, of either the existing conditions, or the requirements of Section 141.0(b)2, plus the proposed addition's energy use meeting the requirements of Section 140.1. The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered component's energy features, plus the proposed energy features of the addition.

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SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

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**EXCEPTION 1 to Section 141.0(a):** When heating, cooling, or service water heating to an addition are provided by expanding existing systems, the existing systems and equipment need not comply with Sections 110.0 through 120.9, or Sections 140.4 through 140.5.

**EXCEPTION 2 to Section 141.0(a):** Where an existing system with electric reheat is expanded by adding variable air volume (VAV) boxes to serve an addition, total electric reheat capacity may be expanded so that the total capacity does not exceed 150 percent of the existing installed electric heating capacity in any one permit, and the system need not comply with Section 140.4(g). Additional electric reheat capacity in excess of 150 percent of the existing installed electric heating capacity may be added subject to the requirements of the Section 140.4(g).

**EXCEPTION 3 to Section 141.0(a): Duct Sealing.** When ducts are extended from an existing duct system to serve the addition, the existing duct system and the extended ducts shall meet the applicable requirements specified in Section 141.0(b)2D.

**EXCEPTION 4 to Section 141.0(a):** Additions that increase the area of the roof by 2,000 square feet or less are exempt from the requirements of Section 110.10.

- (b) **Alterations.** Alterations to existing nonresidential, high-rise residential, or hotel/motel buildings, relocatable public school buildings or alterations in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy are not subject to Subsection (a) and shall meet item 1, and either Item 2 or 3 below:

1. **Mandatory Insulation Requirements for Roofs, Walls, and Floors.** Altered components in a nonresidential, high-rise residential, or hotel/motel building shall meet the minimum requirements in this Section.

A. **Roof/Ceiling Insulation.** The opaque portions of the roof/ceiling that separate conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Section 141.0(b)2Biii.

B. **Wall Insulation.** For the altered opaque portion of walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 4 below:

1. **Metal Building.** A minimum of R-13 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.113.
2. **Metal Framed.** A minimum of R-13 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.217.
3. **Wood Framed and Others.** A minimum of R-11 insulation between framing members, or the weighted average U-factor of the wall assembly shall not exceed U-0.110.
4. **Spandrel Panels and Glass Curtain Walls.** A minimum of R-4, or the weighted average U-factor of the wall assembly shall not exceed U-0.280.

**EXCEPTION to Section 141.0(b)1B:** Light and heavy mass walls.

C. **Floor Insulation.** For the altered portion of raised floors that separate conditioned spaces from unconditioned spaces or ambient air shall meet the applicable requirements of Items 1 through 3 below:

1. **Raised Framed Floors.** A minimum of R-11 insulation between framing members, or the weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.071.
2. **Raised Mass Floors in High-rise Residential and Hotel/Motel Guest Rooms.** A minimum of R-6 insulation, or the weighted average U-factor of the floor assembly shall not exceed the U-factor of U-0.111.
3. **Raised Mass Floors in Other Occupancies.** No minimum U-factor requirement.

2. **Prescriptive approach.** The altered components of the envelope, or space conditioning, lighting, 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 120.89 through 130.5, and

**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. Fenestration alterations other than repairs and those subject to Section 141.0(b)2 shall meet the applicable requirements below:

i. ~~i. For all nonresidential, high-rise residential, and hotel/motel occupancies, when fenestration is altered or where when there are alterations that 50 square feet or less of window and 50 square feet or less of skylight area is added, do not increase the fenestration area, all altered fenestration shall meet the requirements of TABLE 141.0-A. When greater than 50 square feet of new fenestration area is added to alterations, it shall meet the requirements of TABLE 140.3-B, C or D. 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:** Replacing 150 square feet or less of the entire building's vertical fenestration, 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.

**EXCEPTION to Section 141.0(b)2Ai:** The RSHGC and Visible Transmittance (VT) requirement of Table 141.0-A shall not apply when:

- ~~1. 150 square feet or less of an entire building's fenestration is replaced, or~~
- ~~2. 50 square feet or less of fenestration window area is added, or~~
- ~~3. 50 square feet or less of skylight is added.~~

*Table 141.0-A Altered Window Vertical Fenestration Maximum U-Factor and Minimum 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 being replaced, recovered or recoated, of a nonresidential, high-rise residential and hotels/motels shall meet the requirements of Section 110.8(i). Roofs with more than 50 percent of the roof area or more than 2,000 square feet of roof, whichever is less, is being altered the requirements of i through iii below apply:

i. Roofing Products. Nonresidential buildings:

- a. Low-sloped roofs in Climate Zones 1 through 16 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75, or a minimum SRI of 75.

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

**EXCEPTION to Section 141.0(b)2Bia:** An aged solar reflectance less than 0.63 is allowed provided the maximum roof/ceiling U-factor in TABLE 141.0-B is not exceeded.

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

- a. Low-sloped roofs in Climate Zones 10, 11, 13, 14 and 15 shall have a minimum aged solar reflectance of 0.55 and a minimum thermal emittance of 0.75, or a minimum SRI of 64.
- b. Steep-sloped roofs Climate Zones 2 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

**EXCEPTION 1 to Section 141.0(b)2Bi and ii:** Roof area covered by building integrated photovoltaic panels and building integrated solar thermal panels are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

**EXCEPTION 2 to Section 141.0(b)2Bi and ii:** Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft<sup>2</sup> are not required to meet the minimum requirements for solar reflectance, thermal emittance, or SRI.

Table 141.0-B Roof/Ceiling Insulation Tradeoff for Aged Solar Reflectance

Aged Solar Reflectance	Climate Zone 1, 3-9 U-factor	Climate Zone 2, 10-16 U-factor
0.62- 0.60	0.075	0.052
0.59-0.55	0.066	0.048
0.54-0.50	0.060	0.044
0.49-0.45	0.055	0.041
0.44-0.40	0.051	0.039
0.39-0.35	0.047	0.037
0.34-0.30	0.044	0.035
0.29-0.25	0.042	0.034

- iii. For nonresidential buildings, high-rise residential buildings and hotels/motels, when low-sloped roofs are exposed to the roof decks, or to the roof recover boards, and meets Section 141.0(b)2Bia ~~and or iia~~, the exposed area shall be insulated to the levels specified in TABLE 141.0-C.

**EXCEPTION to Section 141.0(b)2Biii**

- a. Existing roofs that are insulated with at least R-7 insulation or that has a U-factor lower than 0.089 are not required to meet the R-value requirement of TABLE 141.0-C.
- b. If mechanical equipment is located on the roof and will not be disconnected and lifted as part of the roof replacement, insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing.
- c. If adding the required insulation will reduce the base flashing height to less than 8 inches (203 mm) at penthouse or parapet walls, the insulation added may be limited to the maximum insulation thickness that will allow a height of 8 inches (203 mm) from the roof membrane surface to the top of the base flashing, provided that the conditions in Subsections i through iv apply:
  - i. The penthouse or parapet walls are finished with an exterior cladding material other than the roofing covering membrane material; and
  - ii. The penthouse or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain a base flashing height of 8 inches (203 mm); and
  - iii. For nonresidential buildings, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for Climate Zones 2, and 10 through 16, and less than 100 square feet per linear foot for Climate Zones 1, and 3 through 9; and

- iv. For high-rise residential buildings, hotels or motels, the ratio of the replaced roof area to the linear dimension of affected penthouse or parapet walls shall be less than 25 square feet per linear foot for all Climate Zones.
- v. Tapered insulation may be used which has a thermal resistance less than that prescribed in TABLE 141.0-C at the drains and other low points, provided that the thickness of insulation is increased at the high points of the roof so that the average thermal resistance equals or exceeds the value that is specified in TABLE 141.0-C.

TABLE 141.0-C INSULATION REQUIREMENTS FOR ROOF ALTERATIONS

Climate Zone	Nonresidential		High-Rise Residential and Guest Rooms of Hotel/Motel Buildings	
	Continuous Insulation	U-factor	Continuous Insulation	U-factor
	R-value		R-value	
1	R-8	0.082	R-14	0.055
2	R-14	0.055	R-14	0.055
3-9	R-8	0.082	R-14	0.055
10-16	R-14	0.055	R-14	0.055

- C. **New or Replacement Space-Conditioning Systems or Components** other than new or replacement space-conditioning system ducts shall meet the requirements of Section 140.4 applicable to the systems or components being altered.

**EXCEPTION 1 to Section 141.0(b)2C.** Subsection (b)2C does not apply to replacements of equivalent or lower capacity electric resistance space heaters for high rise residential apartment units.

**EXCEPTION 2 to Section 141.0(b)2C.** Subsection (b)2C does not apply to replacement of electric reheat of equivalent or lower capacity electric resistance space heaters, when natural gas is not available.

**EXCEPTION 3 to Section 141.0(b)2C.** Section 140.4(n) is not applicable to new or replacement space conditioning systems.

- D. **Altered Duct Systems.** When new or replacement space-conditioning system ducts are installed to serve an existing building, the new ducts shall meet the requirements of Section 120.4. If the space conditioning system meets the criteria of Sections 140.4(l)1, 2, and 3, the duct system shall be sealed as confirmed through field verification and diagnostic testing in accordance with the procedures for duct sealing of an existing duct system as specified in Reference Nonresidential Appendix NA2, to meet one of the following requirements:

- i. If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to, or less than 6 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1.

Entirely new or replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the building's existing duct system ~~(e.g., including registers, grilles, boots, air handlers, coils, plenums, and ducts material)~~, if the reused parts are accessible and can be sealed to prevent leakage.

- ii. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:
  - a. The measured duct leakage shall be equal to or less than 15 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Nonresidential Appendix Section NA2.1.4.2.1; or
  - b. If it is not possible to comply with the duct leakage criterion in Subsection 141.0(b)2Diia, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test performed by a certified HERS Rater utilizing the methods specified in Reference Nonresidential Appendix NA2.1.4.2.2.

**EXCEPTION to Section 141.0(b)2Dii: Duct Sealing.** Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos are exempt from the requirements of subsection 141.0(b)2Dii.

- E. **Altered Space-Conditioning Systems.** When a space-conditioning system is altered by the installation or replacement of space-conditioning system equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil):
  - i. For all altered units where the existing thermostat does not comply with Reference Joint Appendix JA5, the existing thermostat shall be replaced with a thermostat that complies with Reference Joint Appendix JA5. All newly installed space-conditioning systems requiring a thermostat shall be equipped with a thermostat that complies with Reference Joint Appendix JA5; and
  - ii. The duct system that is connected to the new or replaced space-conditioning system equipment shall be sealed, if the duct system meets the criteria of Sections 140.4(l)1, 2 and 3, as confirmed through field verification and diagnostic testing, in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Nonresidential Appendix NA2, and conforming to the applicable leakage compliance criteria in Section 141.0(b)2D.

**EXCEPTION 1 to Section 141.0(b)2Eii: Duct Sealing.** Buildings altered so that the duct system no longer meets the criteria of Sections 144 (l)1, 2, and 3 are exempt from the requirements of Subsection 141.0(b)2Eii.

**EXCEPTION 2 to Section 141.0(b)2Eii: Duct Sealing.** Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Nonresidential Appendix NA2 are exempt from the requirements of Subsection 141.0(b)2Eii.

**EXCEPTION 3 to Section 141.0(b)2Eii: Duct Sealing.** Existing duct systems constructed, insulated or sealed with asbestos are exempt from the requirements of Subsection 141.0(b)2Eii.

- F. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 110.9, 130.0, 130.1, 130.2, 130.4, ~~130.5~~, 140.3(c), 140.6, and 140.7.
- G. When the requirements of Section 130.1(d) are triggered by the addition of skylights to an existing building and the lighting system is not recircuited, the daylighting control need not meet the multi-level 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. For each enclosed space, alterations to existing indoor lighting shall meet the following requirements:~~
  - ~~i. Luminaire Classification and Power shall be determined in accordance with Section 130.0(c).~~

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~~EXCEPTION to Section 141.0(b)2ii: For only a Lighting System Alteration in accordance with Section 141.0(b)2iii, or a Luminaire Modifications in Place in accordance with Section 141.0(b)2iii; an existing incandescent, fluorescent or HID luminaire may be modified and classified as a luminaire having a different number of, or type of light source(s), provided all of the following conditions are met:~~

- ~~a. The luminaire has been previously used and is in an existing installation; and,~~
- ~~b. The modified luminaire is listed with the different number or type of light source(s) under the installed conditions; and~~
- ~~c. The different light source(s) is not an LED lamp, integrated or nonintegrated type, as defined by ANI/IES RP-16-2010; and~~
- ~~d. The modified luminaire does not contain:
 
  - ~~1. Unused fluorescent or HID ballast(s); or~~
  - ~~2. Unused HID or fluorescent lamp sockets; or~~
  - ~~3. Sockets used only for lamp support; or~~
  - ~~4. Screw sockets of any kind or for any purpose; and~~~~
- ~~e. The wattage of the modified luminaire shall be published in the manufacturer's catalog based on accredited testing lab reports.~~
- ~~ii. Lighting System Alterations shall meet the applicable requirements in TABLE 141.0-E and the following:
 
  - ~~a. Lighting System Alterations include alterations where an existing lighting system is modified, luminaires are replaced, or luminaires are disconnected from the circuit, removed and reinstalled, whether in the same location or installed elsewhere.~~~~

~~EXCEPTION 1 to Section 141.0(b)2iii: Alterations that qualify as a Luminaire Modification in Place.~~

~~EXCEPTION 2 to Section 141.0(b)2iii: Portable luminaires, luminaires affixed to moveable partitions, and lighting excluded in accordance to Section 140.6(a)3.~~

- ~~iii. Luminaire Modifications in Place shall meet the applicable requirements in TABLE 141.0-F and the following:
 
  - ~~a. To qualify as a Luminaire Modification in Place, luminaires shall only be modified by one or more of the following methods:
 
    - ~~1. Replacing lamps and ballasts with like type or quantity in a manner that preserves the original luminaire listing.~~
    - ~~2. Changing the number or type of light source in a luminaire including: socket renewal, removal or relocation of sockets or lampholders, and/or related wiring internal to the luminaire including the addition of safety disconnecting devices.~~
    - ~~3. Changing the optical system of a luminaire in part or in whole.~~
    - ~~4. Replacement of whole luminaires one for one in which the only electrical modification involves disconnecting the existing luminaire and reconnecting the replacement luminaire.~~~~
  - ~~b. Luminaire Modifications In Place shall include only alterations to lighting system meeting the following conditions:
 
    - ~~1. Luminaire Modifications in Place shall not be part of or the result of any general remodeling or renovation of the enclosed space in which they are located.~~
    - ~~2. Luminaire Modifications in Place shall not cause, be the result of, or involve any changes to the panelboard or branch circuit wiring, including line voltage switches, relays, contactors, dimmers and other control devices providing power to the lighting system.~~~~~~

~~EXCEPTION to Section 141.0(b)2Iiii2. Circuit modifications strictly limited to the addition of occupancy or vacancy sensors and class two lighting controls are permitted for Luminaire Modifications in Place~~

~~iv. Lighting Wiring Alterations shall meet the applicable requirements in Sections 110.9, 130.1, and 130.4.~~

~~a. Lighting Wiring Alterations include the following:~~

- ~~1. Adding a circuit feeding luminaires.~~
- ~~2. Modifying or relocating wiring to provide power to new or relocated luminaires.~~
- ~~3. Replacing wiring between a switch or panelboard and luminaire(s).~~
- ~~4. Replacing or installing a new panelboard feeding lighting systems.~~

~~EXCEPTION to Section 141.0(b)2Iiv. Lighting Wiring Alterations allowed for Luminaire Modifications in Place in accordance with Section 141.0(b)2Iiii.~~

- ~~v. Any lighting alteration that increases the installed lighting power in an enclosed space shall meet the requirements of Sections 110.9, 130.0, 130.1, 130.4, 140.3(e) and 140.6.~~
- ~~vi. Lighting Alterations and Luminaire Modifications in Place shall not exceed the lighting power allowance in Section 140.6.~~
- ~~vii. The following indoor lighting alterations are not required to comply with the lighting requirements in Title 24, Part 6:~~
  - ~~a. Replacement in kind of parts of an existing luminaire that include only new lamps, lamp holders, or lenses, when replacement of those parts is not a Luminaire Modification in Place in accordance with Section 141.0(b)2Iiii.~~
  - ~~b. Lighting Alterations directly caused by the disturbance of asbestos.~~

~~EXCEPTION to Section 141.0(b)2Ivib: Lighting alterations made in conjunction with asbestos abatement shall comply with the applicable requirements in Section 141.0(b)2I.~~

~~I. For each enclosed space, where the following lighting system alterations specified in i through iii include a sum total of 10 percent or more of the existing luminaires, the alterations shall not cause the lighting power allowance in Section 140.6 to be exceeded and the altered luminaires shall meet the applicable requirements in TABLE 141.0-E:~~

- ~~i. Adding luminaires to the enclosed space;~~
- ~~ii. Replacing luminaires in a manner other than the one for one replacements described in Section 141.0(b)2I or Exception 2; or~~
- ~~iii. In an enclosed space, reinstalling a luminaire removed from the same space or elsewhere. Removing and reinstalling luminaires, whether they are reinstalled in the same location or elsewhere.~~

~~**EXCEPTION 1 to Section 141.0(b)2I. Alteration of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded in accordance to Section 140.6(a)3.**~~

~~**EXCEPTION 2 to Section 141.0(b)2I. One for one replacement of luminaires where the new luminaires have the same or lower power consumption compared to the original luminaires.**~~

~~**EXCEPTION 3 to Section 141.0(b)2I. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.**~~

~~J. Where 40 or more existing luminaires are modified as specified in i through iv below on any single floor of a building, the modifications shall not cause the lighting power allowance in Section 140.6 to be exceeded, shall comply with Section 130.1(a), and shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls installed to control the luminaires:~~

- ~~i. Replacing the ballasts or drivers and the associated lamps in the luminaire;~~
- ~~ii. Permanently changing the light source of the luminaire; or~~

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- ~~iii. Changing the optical system of the luminaire; or~~
- ~~iv. One for one replacement of whole luminaires where the only electrical modification is to disconnect the existing luminaire and reconnect the replacement luminaire.~~

~~For luminaires designed for the replacement of lamps, the replacement of lamps alone. Lamp replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps can be installed and powered without modifying the luminaire.~~

~~EXCEPTION 1 to Section 141.0(b)2J. Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded in accordance to Section 140.6(a)2.~~

~~EXCEPTION 2 to Section 141.0(b)2J. One for one replacement of luminaire components where the modified luminaires have at least 15 percent the same or lower power consumption compared to the original luminaires.~~

~~EXCEPTION 3 to Section 141.0(b)2J. Modifications that would directly cause the disturbance of asbestos, unless the modifications are made in conjunction with asbestos abatement.~~

- ~~K. For each enclosed space, the following wiring alterations serving permanently installed lighting shall not cause the lighting power allowance in Section 140.6 to be exceeded and shall meet the applicable requirements in Section 130.1(a) and (c):~~

- ~~i. Adding a circuit feeding luminaires;~~
- ~~ii. Modifying or relocating wiring to provide power to new or relocated luminaires;~~
- ~~iii. Replacing, modifying, or relocating wiring between a switch or panelboard and luminaires; or~~
- ~~iiiv. Replacing lighting control panels, panelboards, or branch circuit wiring.~~

~~EXCEPTION 1 to Section 141.0(b)2J. Modifications strictly limited to the addition of lighting controls.~~

~~EXCEPTION 2 to Section 141.0(b)2KJ. Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.~~

- ~~JKL. Alterations to existing outdoor lighting systems shall meet the following requirements:~~

- ~~i. Alterations that increase the connected lighting load 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, 130.4, and 140.7; and~~
- ~~ii. In alterations that replace 10 percent or more of the luminaires in a lighting application listed in TABLE 140.7 A or 140.7 B, the altered luminaires shall meet the applicable requirements of Sections 130.0, 130.2 and 130.4; and~~
- ~~iii. In alterations that replace more than 50 percent of the luminaires in a lighting application listed in TABLE 140.7 A or 140.7 B, the lighting in that application shall meet the applicable requirements of Sections 130.0, 130.2, 130.4 and 140.7.~~

- ~~I. Entire Luminaire Alterations. Entire luminaire alterations shall meet the following requirements:~~

- ~~i. For each enclosed space, alterations that consist of either (a) removing and reinstalling a total of 10 percent or more of the existing luminaires; or (b) replacing or adding entire luminaires; or (c) adding, removing, or replacing walls or ceilings along with any redesign of the lighting system, shall meet the lighting power allowance in Section 140.6, and the altered luminaires shall meet the applicable requirements in Table 141.0-E; or~~
- ~~ii. For alterations where existing luminaires are replaced with new luminaires, and that do not include adding, removing, or replacing walls or ceilings along with redesign of the lighting system, the replacement luminaires in each office, retail, and hotel occupancy shall have at least 50 percent, and in all other occupancies at least 35 percent, lower rated power at full light output compared to~~

the existing luminaires being replaced, and shall meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

**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.** In an enclosed space where two or fewer luminaires are replaced or reinstalled.

**EXCEPTION 3 to Section 141.0(b)2I.** Alterations that would directly cause the disturbance of asbestos, unless the alterations are 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.

**J. Luminaire Component Modifications.** Luminaire component modifications in place that include replacing the ballasts or drivers and the associated lamps in the luminaire, permanently changing the light source of the luminaire, or changing the optical system of the luminaire, where 70 or more existing luminaires are modified either on any single floor of a building or, where multiple tenants inhabit the same floor, in any single tenant space, in any single year, shall not prevent or disable the operation of any multi-level, shut-off, or daylighting controls, and shall:

- i. Meet the lighting power allowance in Section 140.6 and comply with Table 141.0-E; or
- ii. In office, retail, and hotel occupancies have at least 50 percent, and in all other occupancies have at least 35 percent, lower rated power at full light output as compared to the original luminaires prior to being modified, and meet the requirements of Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)2, 130.1(c)3, 130.1(c)4, 130.1(c)5, 130.1(c)6A, and for parking garages 130.1(c)7B.

Lamp replacements alone and ballast replacements alone shall not be considered a modification of the luminaire provided that the replacement lamps or ballasts are installed and powered without modifying the luminaire.

**EXCEPTION 1 to Section 141.0(b)2J.** Modification of portable luminaires, luminaires affixed to moveable partitions, or lighting excluded by Section 140.6(a)3.

**EXCEPTION 2 to Section 141.0(b)2J.** In an enclosed space where two or fewer luminaires are modified.

**EXCEPTION 3 to Section 141.0(b)2J.** Modifications that would directly cause the disturbance of asbestos, unless the modifications are made in conjunction with asbestos abatement.

**EXCEPTION 4 to Section 141.0(b)2J.** Acceptance testing requirements of Section 130.4 are not required for modifications where lighting controls are added to control 20 or fewer luminaires.

**K. Lighting Wiring Alterations.** For each enclosed space, wiring alterations that add a circuit feeding luminaires; that replace, modify, or relocate wiring between a switch or panelboard and luminaires; or that replace lighting control panels, panelboards, or branch circuit wiring; shall:

- i. meet the lighting power allowance in Section 140.6;
- ii. meet the requirements in Sections 130.1(a)1, 2, and 3, 130.1(c)1A through C, 130.1(c)3, and 130.1(c)4;
- iii. for each enclosed space, be wired to create a minimum of one step between 30-70 percent of lighting power or meet Section 130.1(b); and
- iv. for each enclosed space where wiring alterations include 10 or more luminaires that provide general lighting within the primary sidelit daylit zone or the skylit daylit zone, meet the requirements of 130.1(d).

**NOTE:** As specified in Section 141.0(b)2L, alterations that include adding, removing, or replacing walls or ceilings resulting in redesign of the lighting system shall meet the requirements of Table 141.0-E.

**EXCEPTION 1 to Section 141.0(b)2K.** Alterations strictly limited to addition of lighting controls.

**EXCEPTION 2 to Section 141.0(b)2K.** In an enclosed space where wiring alterations involve two or fewer luminaires.

**EXCEPTION 3 to Section 141.0(b)2K.** Alterations that would directly cause the disturbance of asbestos, unless the alterations are made in conjunction with asbestos abatement.

**EXCEPTION 4 to Section 141.0(b)2K.** Acceptance testing requirements of Section 130.4 are not required for wiring alterations where lighting controls are added to control 20 or fewer luminaires.

- 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(a), 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 the greater of 5 luminaires or 10 percent 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 all other lighting applications and where the bottom of the luminaire is mounted greater than 24 feet above the ground, 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 reduces lighting power by at least 40 percent in response to the area being vacated of occupants; and
    - iii.** In alterations that do not increase the connected lighting load, where the greater of 5 luminaires or 50 percent 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 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 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.

- KM.** 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.
- L.** **EXCEPTION to Section 141.0(b)2ML.** 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)2KM.
- MN.** Service water-heating systems shall meet the requirements of Section 140.5, except for the solar water heating requirements.
- NO.** 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 Section 130.5(d).

~~When adding, relocating, or replacing service, switchboards, distribution panelboards, motor control centers, panelboards, distribution equipment, circuits, or receptacles, the altered component of the electrical power distribution system shall meet the requirements of Section 130.5.~~

~~**EXCEPTION 1 to Section 141.0(b)2OP:** Conductors for non-motor branch circuits shall be sized to prevent a voltage drop exceeding 3 percent at the farthest connected load or outlet.~~

~~**EXCEPTION 2 to Section 141.0(b)2OP:** When the installation is for motors only, the conductors for motor branch circuits shall be sized to prevent a voltage drop exceeding 6 percent at the farthest connected load or outlet.~~

~~**EXCEPTION 3 to Section 141.0(b)2OP:** Addition of 120-volt receptacle(s) to an existing circuit containing 10 or more receptacles.~~

~~**EXCEPTION 4 to Section 141.0(b)2OP:** Replacement of 120-volt receptacles in an existing circuit.~~

~~**EXCEPTION 5 to Section 141.0(b)2OP:** Addition of one 120-volt receptacle to an existing circuit in an office space.~~

~~**Q. Demand Responsive Controls and Equipment.** Alterations where the altered space is larger than 10,000 square feet shall meet the demand responsive control requirements of Section 130.1(c) and 130.5(e).~~

**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 120.89 through 130.5.

**EXCEPTION 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-D.

- B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in TABLE 141.0-D. For components not being altered, the standard design shall be based on the existing conditions. 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.

**TABLE 141.0-D – 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.	
Fenestration The allowed glass area shall be the smaller of the 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 Sections 141.0(b)2C, 141.0(b)2Di or Section 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 TABLE 110.6-A and Table 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.	

C. 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 meet the requirements of Section 141.0(b)3.
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 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 the Section 140.4(g).

Relocation or moving of a relocatable public school building is not considered an alteration for the purposes of complying with Title 24, Part 6. If an alteration is made to envelope, space-conditioning system, lighting or water heating components of a relocatable public school building, the alteration is subject to Section 141.0(b).

- (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.

**TABLE 141.0-E Control Requirements for Lighting System Entire Luminaire Alterations**

<b><u>Mandatory Control requirements that shall be met when 10% or more of existing luminaires are altered</u></b>	<b><u>Resulting lighting power, compared to the lighting power allowance specified in Section 140.6(c)2, Area Category Method</u></b>	
	<b><u>Lighting power is &lt; 85% of allowance</u></b>	<b><u>Lighting power is &gt; 85% to 100% of allowance</u></b>
<b><u>Section 130.1(a) 1, 2, and 3 Area Controls</u></b>	<b><u>Yes</u></b>	<b><u>Yes</u></b>
<b><u>Section 130.1(b) Multi-Level Lighting Controls – only for alterations to general lighting of enclosed spaces 100 square feet or larger with a connected lighting load that exceeds 0.5 watts per square foot</u></b>	<b><u>For each luminaire enclosed space, minimum one step between 30-70 percent of lighting power regardless of luminaire type, or meet Section 130.1(b)</u></b>	<b><u>Yes</u></b>
<b><u>Section 130.1(c) Shut-Off Controls</u></b>	<b><u>Yes</u></b>	<b><u>Yes</u></b>
<b><u>Section 130.1(d) Automatic Daylight Controls</u></b>	<b><u>Not Required</u></b>	<b><u>Yes</u></b>
<b><u>Section 130.1(e) Demand Responsive Controls – only for alterations &gt; 10,000 ft<sup>2</sup> in a single building, where the alteration also changes the area of the space, or changes the occupancy type of the space, or increases the lighting power</u></b>	<b><u>Not Required</u></b>	<b><u>Yes</u></b>

**TABLE 141.0-E Requirements for Luminaire Alterations**

<b><u>Quantity of existing affected luminaires per Enclosed Space<sup>1</sup></u></b>	<b><u>Resulting Lighting Power for Each Enclosed Space</u></b>	<b><u>Applicable Mandatory Control Provisions for Each Enclosed Space</u></b>	<b><u>Multi-level Lighting Control Requirements for Each Altered Luminaire</u></b>
<b><u>Alterations that do not change the area of the enclosed space or the space type</u></b>			
<b><u>Sum total &lt; 10% of existing luminaires</u></b>	<b><u>Existing lighting power is permitted</u></b>	<b><u>Existing provisions are permitted</u></b>	<b><u>Existing controls are permitted</u></b>
<b><u>Sum total ≥ 10% of existing luminaires</u></b>	<b><u>≤ 85% of allowed lighting power per Section 140.6 Area Category Method</u></b>	<b><u>§130.1(a), (e)</u></b>	<b><u>Two-level lighting control<sup>2</sup> or §130.1(b)</u></b>
	<b><u>&gt; 85% of allowed lighting power per Section 140.6 Area Category Method</u></b>	<b><u>§130.1(a), (e), (d)<sup>3</sup></u></b>	<b><u>§130.1(b)</u></b>
<b><u>Alterations that change the area of the enclosed space or the space type or increase the lighting power in the enclosed space</u></b>			
<b><u>Any number</u></b>	<b><u>Comply with Section 140.6</u></b>	<b><u>§130.0(d)<sup>3</sup> §130.1(a), (e), (d)<sup>3</sup>, (e)</u></b>	<b><u>§130.1(b)</u></b>
<ol style="list-style-type: none"> <li>1. Affected luminaires include any luminaire that is changed, replaced, removed, relocated; or, connected to, altered or revised wiring, except as permitted by EXCEPTIONS 1 and 2 to Section 141.0(b)2iii;</li> <li>2. Two-level lighting control shall have at least one control step between 30-percent and 70-percent of design lighting power in a manner providing reasonably uniform illuminations</li> <li>3. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are altered.</li> </ol>			

**TABLE 141.0-F Requirements for Luminaire Modifications in Place**

SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

For compliance with this Table, building space is defined as any of the following:			
<ol style="list-style-type: none"> <li>1. A complete single-story building</li> <li>2. A complete floor of a multifloor building</li> <li>3. The entire space in a building of a single tenant under a single lease</li> <li>4. All of the common, not leasable space in single building</li> </ol>			
Quantity of affected luminaires per Building Space per annum	Resulting Lighting Power per Each Enclosed Space Where $\geq 10\%$ of Existing Luminaires are Luminaire Modifications in Place	Applicable mandatory control provisions for each enclosed space <sup>1</sup>	Applicable multi-level lighting control requirements for each modified luminaire <sup>2</sup>
Sum total < 40 Luminaire Modifications in Place	Existing lighting power is permitted	Existing provisions are permitted	Existing controls are permitted
Sum total $\geq 40$ Luminaire Modifications in Place	$\leq 85\%$ of allowed lighting power per Section 140.6 Area Category Method	§130.1(a), (e)	Two level lighting control <sup>3</sup> Or §130.1(b)
	$> 85\%$ of allowed lighting power per Section 140.6 Area Category Method	§130.0(d) <sup>4</sup> §130.1(a), (e), (d) <sup>4</sup>	§130.1(b)
<ol style="list-style-type: none"> <li>1. Control requirements only apply to enclosed spaces for which there are Luminaire Modifications in Place.</li> <li>2. Multi-level controls are required only for luminaires for which there are Luminaire Modifications in Place.</li> <li>3. Two level lighting control shall have at least one control step between 30 percent and 70 percent of design lighting power in a manner providing reasonably uniform illuminations.</li> <li>4. Daylight controls in accordance with Section 130.0(d) are required only for luminaires that are modified in place.</li> </ol>			

## SECTION 141.1 – REQUIREMENTS FOR COVERED PROCESSES IN ADDITIONS, ALTERATIONS TO EXISTING BUILDINGS THAT WILL BE NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES BUILDINGS

Covered processes in additions or alterations to existing buildings that will be nonresidential, high-rise residential, and hotel/motel occupancies shall comply with the applicable subsections of section 120.6 and 140.9.

- (a) ~~Refrigerated Warehouses.~~ A refrigerated warehouse complies with this section if it complies with the applicable requirements of Sections 120.6(a).
- (b) ~~Commercial Refrigeration.~~ Commercial refrigeration systems comply with this section if they comply with the applicable requirements of Sections 120.6(b).
- (c) ~~Enclosed Parking Garages.~~ An enclosed parking garage complies with this section if it complies with the applicable requirements of Sections 120.6(c).
- (d) ~~Process Boilers.~~ A process boiler complies with this section if it complies with the applicable requirements of Sections 120.6(d).
- (e) ~~Compressed Air Systems.~~ Compressed air systems comply with this section if they comply with the applicable requirements of Sections 120.6(e).

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.

SECTION 141.0 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL BUILDINGS, TO EXISTING OUTDOOR LIGHTING, AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS



## SUBCHAPTER 7

# LOW-RISE RESIDENTIAL BUILDINGS – MANDATORY FEATURES AND DEVICES

### SECTION 150.0 – MANDATORY FEATURES AND DEVICES

~~Any newly constructed low-rise~~ Low-rise residential building buildings shall meet shall comply with the applicable requirements of this Section Sections 150(a) through 150.0(r).

**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) **Ceiling and Rafter Roof Insulation.** The opaque portions of ceilings and roofs separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1 or 2 through 4 below:

1. Ceilings and rafter roofs shall be insulated to achieve a weighted average U-factor not exceeding U-0.034 or shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-30 or greater for the insulation alone. For unvented attics, the mandatory insulation shall be installed at the ceiling level; for unvented attics, the mandatory insulation may shall be placed at either ceiling or roof level; and, Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage.

**EXCEPTION to Section 150.0(a)1:** Insulation of Ceilings and rafter roofs in an alteration shall be insulated to achieve a 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.

2. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners. The attic access shall be gasketed to prevent air leakage; and, The weighted average U factor shall not exceed 0.031 that would result from installing R-30 insulation between wood framing members.
3. Insulation shall be installed in direct contact with a continuous 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; and,
4. Insulation shall be installed below the roofing membrane or layer used to seal the roof from water penetration unless the insulation has a maximum water absorption of 0.3 percent by volume when tested according to ASTM Standard C272.

(b) **Loose-fill Insulation.** When loose-fill insulation is installed, the minimum installed weight per square foot shall conform with the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled R-value.

(c) **Wall Insulation.** Insulation installed in Opaque portions of above grade framed walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of Items 1, 2, 3 and 4 below:

1. Walls of 2x4 inch framing shall have an overall assembly U-factor not exceeding U-0.102, equivalent to or an installed R-value of 13 in a wood framed assembly.

be insulated between framing members with insulation having an installed thermal resistance of not less than R-13 in 2x4 inch framing, or the U factor shall not exceed U-0.102 that results from installing R-13 in a 2x4 inch wood framed assembly; and

**EXCEPTION to Section 150.0(c)1:** Existing walls already insulated to an installed 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. Walls of 2x6 inch or greater framing shall have an overall assembly U-factor not exceeding U-0.074 or an installed R-value of 19 in a wood framed assembly. Walls shall be insulated between framing members with insulation having an installed thermal resistance of not less than R-19 in framing of 2x6 inch or greater, or the U-factor shall not exceed the U-0.074 that results from installing R-19 in a 2x6 inch or greater wood framed assembly; and
  3. Opaque non-framed assemblies shall have an overall assembly U-factor not exceeding U-0.102, equivalent to an installed R-value of 13 in a wood framed assembly.
  34. Bay or Bow Window roofs and floors shall be insulated to meet the wall insulation requirements of TABLE 150.1-A.
- (d) **Raised-floor Insulation.** Raised floors separating conditioned space from unconditioned space or ambient air shall meet the requirements of 1 or 2 below:
1. Floors shall have an overall assembly U-factor not exceeding U-0.037 or an installed R-value of 19 or greater in a wood framed assembly.  
be insulated between wood framing members with insulation having an installed thermal resistance of R-19 or greater.
  2. The weighted average U factor of floor assemblies shall not exceed 0.037 that would result from installing R-19 insulation between wood framing members and accounting for the effects of framing members.
- EXCEPTION to Section 150.0(d):** A building with a controlled ventilation or unvented crawlspace may omit raised floor insulation if all of the following are met:
- A. The foundation walls are insulated to meet the wall insulation minimums as shown in TABLE 150.1-A; and
  - B. A Class I or Class II vapor retarder is placed over the entire floor of the crawlspace; and
  - C. Vents between the crawlspace and outside air are fitted with automatically operated louvers that are temperature actuated; and
  - D. The requirements in Reference Residential Appendix RA4.5.1.
- (e) **Installation of Fireplaces, Decorative Gas Appliances and Gas Logs**
1. If a masonry or factory-built fireplace is installed, it shall have the following:
    - A. Closeable metal or glass doors covering the entire opening of the firebox; and
    - B. A combustion air intake to draw air from the outside of the building, which is at least 6 square inches in area and is equipped with a readily accessible, operable, and tight-fitting damper or combustion-air control device; and

**EXCEPTION to Section 150.0(e)1B:** An outside combustion-air intake is not required if the fireplace will be installed over concrete slab flooring and the fireplace will not be located on an exterior wall.

    - C. A flue damper with a readily accessible control.

**EXCEPTION to Section 150.0(e)1C:** When a gas log, log lighter, or decorative gas appliance is installed in a fireplace, the flue damper shall be blocked open if required by the CMC or the manufacturer's installation instructions.
  2. Continuous burning pilot lights and the use of indoor air for cooling a firebox jacket, when that indoor air is vented to the outside of the building, are prohibited.
- (f) **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).

**RESERVED**

**(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, and
- ~~2A. In Climate Zones 1-16 with unvented crawl spaces the earth floor of the crawl space shall be covered with a Class I or Class II vapor retarder; or~~
- ~~3B. In a building having a controlled ventilation crawl space, a Class I or Class II vapor retarder shall be placed over the earth floor of the crawl space to reduce moisture entry and protect insulation from condensation, as specified in the exception to Section 150.0(d).~~

**(h) Space-Conditioning Equipment.**

1. **Building Cooling and Heating Loads.** Building heating and cooling loads shall be determined using a method based on any one of the following:
  - A. The ASHRAE Handbook, Equipment Volume, Applications Volume, and Fundamentals Volume; or
  - B. The SMACNA Residential Comfort System Installation Standards Manual; or
  - C. The ACCA Manual J.

The cooling and heating loads are two of the criteria that shall be used for equipment sizing and selection.

**NOTE:** Heating systems are required to have a minimum heating capacity adequate to meet the minimum requirements of the CBC. The furnace output capacity and other specifications are published in the Commission's directory of certified equipment or other directories approved by the Commission.

2. **Design conditions.** For the purpose of sizing the space-conditioning (HVAC) system, the indoor design temperatures shall be 68°F for heating and 75°F for cooling. Outdoor design conditions shall be selected from Reference Joint Appendix JA2, which is based on data from the ASHRAE Climatic Data for Region X. The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values. The outdoor design temperatures for cooling shall be no greater than the 1.0 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.
3. **Outdoor Condensing Units.**
  - A. **Clearances.** Installed air conditioner and heat pump outdoor condensing units shall have a clearance of at least five (5) feet (1.5 meters) from the outlet of any dryer vent.
  - 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 unitary 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 Heating systems shall be equipped with thermostats that meet the requirements of Section 110.2(c).
- (j) **Water System Piping and Insulation for Piping, Tanks, and Cooling System Lines.**
  1. **Storage tank insulation.**
    - A. ~~Storage gas water heaters with an energy factor equal to or less than the federal minimum standards shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater.~~

- ~~AB.~~ Unfired hot water tanks, such as storage tanks and backup storage tanks for solar water-heating systems, shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater or have internal insulation of at least R-16 and a label on the exterior of the tank showing the insulation R-value.
2. **Water piping and cooling system line insulation thickness and conductivity.** Piping shall be insulated to the thicknesses as follows:
- A. All domestic hot water system piping conditions listed below, whether buried or unburied, must be insulated and the insulation thickness shall be selected based on the conductivity range in TABLE 120.3-A and the insulation level shall be selected from the fluid temperature range based on the thickness requirements in TABLE 120.3-A:
    - i. The first 5 feet (1.5 meters) of hot and cold water pipes from the storage tank.
    - ii. All piping with a nominal diameter of 3/4 inch (19 millimeter) or larger.
    - iii. All piping associated with a domestic hot water recirculation system regardless of the pipe diameter.
    - iv. Piping from the heating source to storage tank or between tanks.
    - v. Piping buried below grade.
    - vi. All hot water pipes from the heating source to the kitchen fixtures.
  - B. In addition to insulation requirements, all domestic hot water pipes that are buried below grade must be installed in a water proof and non-crushable casing or sleeve ~~that allows for installation, removal, and replacement of the enclosed pipe and insulation.~~
  - C. Pipe for cooling system lines shall be insulated as specified in Subsection A. Piping Distribution piping for steam and hydronic heating systems, or hot water systems with pressure above 15 psig (103 kPa) shall meet the requirements in TABLE 120.3-A.

**EXCEPTION 1 to Section 150.0(j)2:** Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

**EXCEPTION 2 to Section 150.0(j)2:** Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

**EXCEPTION 3 to Section 150.0(j)2:** 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. Insulation shall butt securely against all framing members.

**EXCEPTION 4 to Section 150.0(j)2:** Piping installed in interior or exterior walls shall not be required to have pipe insulation if all of the requirements are met for compliance with Quality Insulation Installation (QII) as specified in the Reference Residential Appendix RA3.5.

**EXCEPTION 5 to Section 150.0(j)2:** Piping installed in attics with a minimum of 4 inches (10 cm) of attic insulation on top of the piping shall not be required to have pipe insulation.

**NOTE:** Where the Executive Director approves a water heater calculation method for particular water heating recirculation systems, piping insulation requirements are those specified in the approved calculation method.

3. **Insulation Protection.** Insulation outside conditioned space shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind. Protection includes but is not limited to the following:
- A. Insulation exposed to weather shall ~~either be rated for outdoor use or be~~ installed with a cover suitable for outdoor service, ~~e.g., including but not limited to protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is~~ The cover shall be water retardant and provides shielding from solar radiation that can cause degradation of the material.

- B. Insulation covering chilled water piping and refrigerant suction piping located outside the conditioned space shall have a Class I or Class II vapor retarder ~~ing facing, or the insulation shall be installed at the thickness that qualifies as a Class I or Class II vapor retarder.~~

(k) Residential Lighting.

1. Luminaire Requirements

- A. **Luminaire Efficacy:** ~~Installed~~ All installed luminaires shall be classified as high-efficacy or low-efficacy for compliance with Section 150.0(k) in accordance with TABLE 150.0-A or TABLE 150.0-B, as applicable.
- B. **Hybrid Luminaires:** ~~When a high efficacy and low efficacy lighting system are combined together in a single luminaire, the high efficacy and low efficacy lighting systems shall separately comply with the applicable provisions of Section 150.0(k).~~ **Blank Electrical Boxes.** -The number of electrical boxes that are more than 5 feet above the finished floor and do not contain a luminaire or other device shall be no greater than the number of bedrooms. These electrical boxes must be served by a dimmer, or vacancy sensor control, or fan speed control.
- C. **Luminaire Wattage and Classification.** ~~The Wattage and Classification of permanently installed luminaires in residential kitchens shall be determined in accordance with Section 130.0(c). In residential kitchens, the wattage of electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan, shall be calculated as 180 watts of low efficacy lighting per electrical box.~~ **Recessed Downlight Luminaires in Ceilings.** Luminaires recessed into ceilings shall meet all of the following requirements:
- Be listed, as defined in Section 100.1, for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratory; and
  - Have a label that certifies the luminaire is airtight with air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. An exhaust fan housing shall not be required to be certified airtight; and
  - Be sealed with a gasket or caulk between the luminaire housing and ceiling, and shall have all air leak paths between conditioned and unconditioned spaces sealed with a gasket or caulk; and
  - For luminaires with hardwired ballasts or drivers, allow ballast or driver maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling; and
  - Shall not contain screw based lamp sockets; and
  - Shall contain light sources that comply with References Joint Appendix JA8, including the elevated temperature requirements, and that are marked "JA8-2016-E" as specified in Reference Joint Appendix JA8 of JA8-104.8 and shall not contain light sources that are labeled "not for use in enclosed fixtures" or "not for use in recessed fixtures."
- D. **Electronic Ballasts.** Ballasts for fluorescent lamps rated 13 watts or greater shall be electronic and shall have an output frequency no less than 20 kHz.
- E. **Night Lights.** Permanently installed night lights and night lights integral to installed luminaires or exhaust fans shall be rated to consume no more than five watts of power per luminaire or exhaust fan as determined in accordance with Section 130.0(c). Night lights shall not be required to be controlled by vacancy sensors.
- F. **Lighting Integral to Exhaust Fans.** Lighting integral to exhaust fans shall meet the applicable requirements of Section 150.0(k).
- EXCEPTION to Section 150.0(k)1F:** Lighting installed by the manufacturer in kitchen exhaust hoods.
- G. **Screw based luminaires.** Screw based luminaires shall meet all of the following requirements:
- The luminaires shall not be recessed downlight luminaires in ceilings; and
  - The luminaires shall contain lamps that comply with Reference Joint Appendix JA8; and

- iii. The installed lamps shall be labeled-marked with "JA8-2016" or "JA8-2016-E" as compliant with specified in Reference Joint Appendix JA8.

EXCEPTION to Section 150.04(k)1G: Luminaires with hard-wired ballasts for high intensity discharge lamps.

- H. Enclosed Luminaires. Light sources that are not marked "JA8-2016-E" shall not be installed in enclosed luminaires.

## 2. Interior Lighting Switching Devices and Controls.

- A. High efficacy luminaires shall be switched separately from low efficacy luminaires. All leading-edge forward phase cut dimmers used with LED light sources shall comply with NEMA SSL 7A.

- B. Exhaust fans shall be switched separately from lighting systems.

EXCEPTION to Section 150.0(k)2B: Lighting integral to an exhaust fan may be on the same switch as the fan provided the lighting can be switched OFF in accordance with the applicable provisions in Section 150.0(k)2 while allowing the fan to continue to operate for an extended period of time.

- C. Luminaires shall be switched with readily accessible controls that permit the luminaires to be manually switched ON and OFF.
- D. Lighting controls and equipment shall be installed in accordance with the manufacturer's instructions.
- E. No controls shall bypass a dimmer or vacancy sensor function where that dimmer or vacancy sensor has been installed to comply with Section 150.0(k).

- F. Lighting controls shall comply with the applicable requirements of Section 110.9.

- G. An Energy Management Control System (EMCS) may be used to comply with dimmer requirements in Section 150.0(k) if at a minimum it provides the functionality of a dimmer in accordance with Section 110.9, meets the installation certificate requirements in Section 130.4, the EMCS requirements in Section 130.5(f), and complies with all other applicable requirements in Section 150.0(k)2.

- H. An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements in Section 150.0(k) if at a minimum it provides the functionality of a vacancy sensor in accordance with Section 110.9, meets the installation certificate requirements in Section 130.4, the EMCS requirements in Section 130.5(f), and complies with all other applicable requirements in Section 150.0(k)2.

- I. A multiscene programmable controller may be used to comply with dimmer requirements in Section 150.0(k) if at a minimum it provides the functionality of a dimmer in accordance with Section 110.9, and complies with all other applicable requirements in Section 150.0(k)2.

- J. In Bathrooms, Garages, Laundry Rooms, and Utility Rooms, at least one luminaire in each of these spaces shall be controlled by a vacancy sensor.

- K. Dimmers or vacancy sensors shall control all luminaires required to have light sources compliant with Reference Joint Appendix JA8.

EXCEPTION 1 to Section 150.0(k)2K: Luminaires in closets less than 70 square feet.

EXCEPTION 2 to Section 150.0(k)2K: Luminaires in hallways.

- L. Undercabinet lighting shall be switched separately from other lighting systems.

## 3. Lighting in Kitchens.

- A. A minimum of 50 percent of the total rated wattage of permanently installed lighting in kitchens shall be high efficacy.

- B. For the purpose of compliance with Section 150.0(k), kitchen lighting includes all permanently installed lighting in the kitchen except for lighting that is internal to cabinets for the purpose of illuminating only the

inside of the cabinets. Lighting in areas adjacent to the kitchen, including but not limited to dining and nook areas, are considered kitchen lighting if they are not separately switched from kitchen lighting.

**EXCEPTION to Section 150.0(k)3:** Up to 50 watts for dwelling units less than or equal to 2,500 ft<sup>2</sup> or 100 watts for dwelling units larger than 2,500 ft<sup>2</sup> may be exempt from the 50 percent high efficacy requirement when all lighting in the kitchen is controlled in accordance with the applicable provisions in Section 150.0(k)2, and is also controlled by vacancy sensors or dimmers.

4. **Lighting Internal to Cabinets.** Permanently installed lighting that is internal to cabinets shall use no more than 20 watts of power per linear foot of illuminated cabinet. The length of an illuminated cabinet shall be determined using one of the following measurements, regardless of the number of shelves or the number of doors per cabinet section:

- A. One horizontal length of illuminated cabinet; or
- B. One vertical length, per illuminated cabinet section; or
- C. No more than one vertical length per every 40 horizontal inches of illuminated cabinet.

5. **Lighting in Bathrooms.** Lighting installed in bathrooms shall meet the following requirements:

- A. A minimum of one high efficacy luminaire shall be installed in each bathroom; and
- B. All other lighting installed in each bathroom shall be high efficacy or controlled by vacancy sensors.

6. **Lighting in Garages, Laundry Rooms, and Utility Rooms.** Lighting installed in attached and detached garages, laundry rooms, and utility rooms shall be high efficacy luminaires and controlled by vacancy sensors.

7. **Lighting other than in Kitchens, Bathrooms, Garages, Laundry Rooms, and Utility Rooms.** Lighting installed in rooms or areas other than in kitchens, bathrooms, garages, laundry rooms, and utility rooms shall be high efficacy, or shall be controlled by either dimmers or vacancy sensors.

**EXCEPTION 1 to Section 150.0(k)7:** Luminaires in closets less than 70 square feet.

**EXCEPTION 2 to Section 150.0(k)7:** Lighting in detached storage buildings less than 1,000 square feet located on a residential site.

8. **Recessed Luminaires in Ceilings.** Luminaires recessed into ceilings shall meet all of the following requirements:

- A. Be Listed, as defined in Section 100.1, for zero clearance insulation contact (IC) by Underwriters Laboratories or other nationally recognized testing/rating laboratory; and
- B. Have a label that certifies that the luminaire is airtight with air leakage less than 2.0 CFM at 75 Pascals when tested in accordance with ASTM E283. An exhaust fan housing shall not be required to be certified airtight; and
- C. Be sealed with a gasket or caulk between the luminaire housing and ceiling, and shall have all air leak paths between conditioned and unconditioned spaces sealed with a gasket or caulk; and
- D. For recessed compact fluorescent luminaires with ballasts to qualify as high efficacy for compliance with Section 150.0(k), the ballasts shall be certified to the Commission to comply with the applicable requirements in Section 110.9; and
- E. Allow ballast maintenance and replacement to be readily accessible to building occupants from below the ceiling without requiring the cutting of holes in the ceiling.

9. **3. Residential Outdoor Lighting.** In addition to meeting the requirements of Section 150.0(k)1A, luminaires providing residential outdoor lighting shall meet the following requirements, as applicable:

- A. For single-family residential buildings, outdoor lighting permanently mounted to a residential building, or to other buildings on the same lot, shall be high efficacy, or may be low efficacy if it meets all of the following requirements in item i and the requirements in either item ii or item iii:

- i. Controlled by a manual ON and OFF switch that does not override to ON the automatic actions of Items ii or iii below; and
  - ii. Controlled by a photocell and motion sensor. Controls that override to ON shall not be allowed unless the override not having an override or bypass switch that disables the motion sensor, or controlled by a motion sensor having a temporary override switch which temporarily bypasses the motion sensing function and automatically reactivates the motion sensor within 6 hours; or
  - iii. Controlled by one of the following methods:
    - a. ~~Photocontrol not having an override or bypass switch that disables the photocontrol~~Photocontrol and automatic time switch control. Controls that override to ON shall not be allowed unless the override shall automatically return the photocontrol and automatic time switch control to its normal operation within 6 hours.; or
    - b. ~~Astronomical time clock, not having an override or bypass switch that disables the astronomical time clock, and~~Controls that override to ON shall not be allowed unless the override shall automatically return the astronomical clock to its normal operation within 6 hours and which is programmed to automatically turn the outdoor lighting OFF during daylight hours; or
    - c. Energy management control system which meets all of the following requirements:

At a minimum provides the functionality of an astronomical time clock in accordance with Section 110.9; meets the Installation Certification requirements in Section 130.4; ~~meets the requirements for an EMCS in Section 130.5;~~ does not have an override or bypass switch that allows the luminaire to be always ON; and, is programmed to automatically turn the outdoor lighting OFF during daylight hours.
- B. For low-rise multifamily residential buildings, outdoor lighting for private patios, entrances, balconies, and porches; and outdoor lighting for residential parking lots and residential carports with less than eight vehicles per site shall comply with one of the following requirements:
- i. Shall comply with Section 150.0(k)~~9A3A~~; or
  - ii. Shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.
- C. For low-rise residential buildings with four or more dwelling units, outdoor lighting not regulated by Section 150.0(k)~~9B-3B~~ or 150.0(k)~~9D-3D~~ shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.
- D. Outdoor lighting for residential parking lots and residential carports with a total of eight or more vehicles per site shall comply with the applicable requirements in Sections 110.9, 130.0, 130.2, 130.4, 140.7 and 141.0.
- 104. Internally illuminated address signs.** Internally illuminated address signs shall:
- A. Comply with Section 140.8; or
  - B. Shall consume no more than 5 watts of power as determined according to Section 130.0(c).
- 115. Residential Garages for Eight or More Vehicles.** Lighting for residential parking garages for eight or more vehicles shall comply with the applicable requirements for nonresidential garages in Sections 110.9, 130.0, 130.1, 130.4, 140.6, and 141.0.
- 126. Interior Common Areas of Low-rise Multi-Family Residential Buildings.**
- A. In a low-rise multifamily residential building where the total interior common area in a single building equals 20 percent or less of the floor area, permanently installed lighting for the interior common areas in that building shall be high efficacy luminaires ~~ex~~and controlled by an occupant sensor.
  - B. In a low-rise multifamily residential building where the total interior common area in a single building equals more than 20 percent of the floor area, permanently installed lighting in that building shall:
    - i. Comply with the applicable requirements in Sections 110.9, 130.0, 130.1, 140.6 and 141.0; and



- ii. Lighting installed in corridors and stairwells shall be controlled by occupant sensors that reduce the lighting power in each space by at least 50 percent. The occupant sensors shall be capable of turning the light fully ~~On/On~~ and ~~Off/Off~~ from all designed paths of ingress and egress.

(l) ~~RESERVED~~ **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).~~

(m) **Air-Distribution and Ventilation System Ducts, Plenums, and Fans.**

1. **CMC Compliance.** All air-distribution system ducts and plenums, including, but not limited to, mechanical closets and air-handler boxes, shall be installed, sealed and insulated to meet the requirements of the CMC Sections 601.0, 602.0, 603.0, 604.0, 605.0 and ANSI/SMACNA-006-2006 HVAC Duct Construction Standards Metal and Flexible 3rd Edition, incorporated herein by reference. Portions of supply-air and return-air ducts and plenums of a space heating or cooling system shall either be insulated to a minimum installed level of R-6.0 (or any higher level required by CMC Section 605.0) or a minimum installed level of R-4.2 when be enclosed entirely in directly-conditioned space as confirmed through field verification and diagnostic testing in accordance with the requirements of Reference Residential Appendix RA3.1.4.3.8. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A or UL 181B or aerosol sealant that meets the requirements of UL 723. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

Building cavities, support platforms for air handlers, and plenums ~~defined-designed~~ or constructed with materials other than sealed sheet metal, duct board or flexible duct shall not be used for conveying conditioned air. Building cavities and support platforms may contain ducts. Ducts installed in cavities and support platforms shall not be compressed to cause reductions in the cross-sectional area of the ducts.

**EXCEPTION to Section 150.0(m)1:** Ducts and fans integral to a wood heater or fireplace.

2. **Factory-Fabricated Duct Systems.**

- A. All factory-fabricated duct systems shall comply with UL 181 for ducts and closure systems, including collars, connections, and splices, and be labeled as complying with UL 181. UL 181 testing may be performed by UL laboratories or a laboratory approved by the Executive Director.
- B. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181 and UL 181A.
- C. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 and UL 181B.
- D. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.

3. **Field-Fabricated Duct Systems.**

- A. Factory-made rigid fiberglass and flexible ducts for field-fabricated duct systems shall comply with UL 181. All pressure-sensitive tapes, mastics, aerosol sealants, or other closure systems used for installing field-fabricated duct systems shall meet the applicable requirements of UL 181, UL 181A, and UL 181B.
- B. Mastic sealants and mesh.
  - i. Sealants shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B, and be nontoxic and water resistant.
  - ii. Sealants for interior applications shall be tested in accordance with ASTM C731 and D2202, incorporated herein by reference.

- iii. Sealants for exterior applications shall be tested in accordance with ASTM C731, C732, and D2202, incorporated herein by reference.
- iv. Sealants and meshes shall be rated for exterior use.
- C. Pressure-sensitive tape. Pressure-sensitive tapes shall comply with the applicable requirements of UL 181, UL 181A, and UL 181B.
- D. Joints and seams of duct systems and their components shall not be sealed with cloth back rubber adhesive duct tapes unless such tape is used in combination with mastic and drawbands.
- E. Drawbands used with flexible duct.
  - i. Drawbands shall be either stainless-steel worm-drive hose clamps or UV-resistant nylon duct ties.
  - ii. Drawbands shall have a minimum tensile strength rating of 150 pounds.
  - iii. Drawbands shall be tightened as recommended by the manufacturer with an adjustable tensioning tool.
- F. Aerosol-sealant closures.
  - i. Aerosol sealants shall meet the requirements of UL 723 and be applied according to manufacturer specifications.
  - ii. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this section.
- 4. **Duct Insulation R-value Ratings.** All duct insulation product R-values shall be based on insulation only (excluding air films, vapor retarder, or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C518 or ASTM C177, incorporated herein by reference, and certified pursuant to Section 110.8.
- 5. **Duct Insulation Thickness.** The installed thickness of duct insulation used to determine its R-value shall be determined as follows:
  - A. For duct board, duct liner, and factory-made rigid ducts not normally subjected to compression, the nominal insulation thickness shall be used.
  - B. For duct wrap, installed thickness shall be assumed to be 75 percent (25 percent compression) of nominal thickness.
  - C. For factory-made flexible air ducts, the installed thickness shall be determined by dividing the difference between the actual outside diameter and nominal inside diameter by two.
- 6. **Duct Labeling.** Insulated flexible duct products installed to meet this requirement shall include labels, in maximum intervals of 3 feet, showing the thermal performance R-value for the duct insulation itself (excluding air films, vapor retarder, or other duct components), based on the tests in Section 150.0(m)4 and the installed thickness determined by Section 150.0(m)5C.
- 7. **Backdraft Dampers.** All fan systems, regardless of volumetric capacity, that exchange air between the building conditioned space and the outside of the building shall be provided with backdraft or automatic dampers to prevent unintended air leakage through the fan system when the fan system is not operating.
- 8. **Gravity Ventilation Dampers.** All gravity ventilating systems that serve conditioned space shall be provided with either automatic or readily accessible, manually operated dampers in all openings to the outside except combustion inlet and outlet air openings and elevator shaft vents.
- 9. **Protection of Insulation.** Insulation shall be protected from damage, including that due to sunlight, moisture, equipment maintenance, and wind but not limited to the following: Insulation exposed to weather shall be suitable for outdoor service e.g., protected by aluminum, sheet metal, painted canvas, or plastic cover. Cellular foam insulation shall be protected as above or painted with a coating that is water retardant and provides shielding from solar radiation that can cause degradation of the material.
- 10. **Porous Inner Core Flex Duct.** Flexible ducts having porous inner cores shall not be used.

- 11. Duct System Sealing and Leakage Testing.** When space conditioning systems utilize forced air duct systems to supply conditioned air to an occupiable space, the ducts shall be sealed, as confirmed through field verification and diagnostic testing, in accordance with all applicable procedures specified in Reference Residential Appendix RA3.1, and the leakage compliance criteria specified in Reference Residential Appendix TABLE RA3.1-2, and conforming to one of the following Subsections A, B, or C as applicable:
- A. For single family dwellings and townhouses with the air-handling unit installed and the ducts connected directly to the air handler, the total leakage of the duct system shall not exceed ~~6~~<sup>5</sup> percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.
  - B. For single family dwellings and townhouses at the rough-in stage of construction prior to installation of the dwelling's interior finishing:
    - i. Air-handling unit installed.  
If the air-handling unit is installed and the ducts are connected directly to the air handler, the total leakage of the duct system shall not exceed ~~6~~<sup>5</sup> percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Sections RA3.1.4.3.2, RA3.1.4.3.2.1 and RA3.1.4.3.3.
    - ii. Air-handling unit not yet installed.  
If the air-handling unit is not yet installed, the total leakage of the duct system shall not exceed 4 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Sections RA3.1.4.3.2, RA3.1.4.3.2.2 and RA3.1.4.3.3.
  - C. For multifamily dwellings with the air-handling unit installed and the ducts connected directly to the air handler, regardless of duct system location,
    - i. The total leakage of the duct system shall not exceed 12 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1, or
    - ii. The duct system leakage to outside shall not exceed 6 percent of the nominal system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4.
- 12. Air Filtration.** Mechanical systems that supply air to an occupiable space through ductwork exceeding 10 ft (3 m) in length and through a thermal conditioning component, except evaporative coolers, shall be provided with air filter devices in accordance with the following:
- A. **System Design and Installation.**
    - i. The system shall be designed to ensure that all recirculated air and all outdoor air supplied to the occupiable space is filtered before passing through the system's thermal conditioning components.
    - ii. The system shall be designed to accommodate the clean-filter pressure drop imposed by the system air filter device(s). The design airflow rate and maximum allowable clean-filter pressure drop at the design airflow rate applicable to each air filter device shall be determined.
    - iii. All system air filter devices shall be located and installed in such a manner as to allow access and regular service by the system owner.
    - iv. All system air filter device locations shall be labeled to disclose the applicable design airflow rate and the maximum allowable clean-filter pressure drop as determined according to subsection ii above. The labels shall be permanently affixed to the air filter device-readily legible, and visible to a person replacing the air filter media.
  - B. **Air Filter Media Efficiency.** The system shall be provided with air filter media having a designated efficiency equal to or greater than MERV 6 when tested in accordance with ASHRAE Standard 52.2, or a particle size efficiency rating equal to or greater than 50percent in the 3.0–10 µm range when tested in accordance with AHRI Standard 680.
  - C. **Air Filter Media Pressure Drop.** The system shall be provided with air filter media that conforms to the maximum allowable clean-filter pressure drop determined according to Section 150.0(m)12Aii,

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 device(s). If the alternative to 150.0(m)13B is utilized for compliance, the design clean-filter pressure drop for the system air filter media shall conform to the requirements given in TABLE 150.0-BG or 150.0-CD.

- D. **Air Filter Media Product Labeling.** The system shall be provided with air filter media that has been labeled by the manufacturer to disclose the efficiency and pressure drop ratings that demonstrate conformance with Sections 150.0(m)12B and 150.0(m)12C
13. **Duct System Sizing and Air Filter Grille Sizing.** Space conditioning systems that utilize forced air ducts to supply cooling to an occupiable space shall:

- A. **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. **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 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the procedures given in Reference Residential Appendix RA3.3.~~

- 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 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.

~~ALTERNATIVE EXCEPTION 1 to Section 150.0(m)13B:~~ Standard ducted systems (systems without zoning dampers) may comply by meeting the applicable requirements in TABLE 150.0-BG or 150.0-CD as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Sections RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-BG and 150.0-CD.

**EXCEPTION 2 to Section 150.0(m)13B:** Multispeed compressor systems or variable speed compressor systems shall verify air flow (cfm/ton) and fan efficacy (Watt/cfm) for system operation at the maximum compressor speed and the maximum air handler fan speed.

**EXCEPTION 3 to Section 150.0(m)13B:** The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.

**EXCEPTION 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.

#### 14. **RESERVED**

- ~~15. **Zonally Controlled Central Forced Air Systems.** Zonally controlled central forced air cooling systems shall be capable of simultaneously delivering, in every zonal control mode, an airflow from the dwelling, through the air handler fan and delivered to the dwelling, of greater than or equal to 350 CFM per ton of nominal cooling capacity, and operating at an air-handling unit fan efficacy of less than or equal to 0.58 W/CFM as confirmed by field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.3.~~

~~EXCEPTION to Section 150.0(n)15: Multispeed compressor systems or variable speed compressor systems, or single speed compressor systems that utilize the performance compliance approach set forth in Section 150.1(b) shall demonstrate compliance for airflow (cfm/ton) and fan efficacy (Watt/cfm) by operating the system at maximum compressor capacity and maximum system fan speed and with all zones calling for conditioning.~~

(n) **Water Heating System.**

1. Systems using gas or propane water heaters to serve individual dwelling units shall include the following components:
  - A. A 120V electrical receptacle that is within 3 feet from the water heater and accessible to the water heater with no obstructions; and
  - B. A Category III or IV vent, or a Type B vent with straight pipe between the outside termination and the space where the water heater is installed; and
  - C. 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, and
  - D. A gas supply line with a capacity of at least 200,000 Btu/hr.
2. Water heating recirculation loops serving multiple dwelling units shall meet the requirements of Section 110.3(c)5.
3. Solar water-heating systems and collectors shall be certified and rated by the Solar Rating and Certification Corporation (SRCC), or by a ~~testing~~ 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)7.

(o) **Ventilation for Indoor Air Quality.** All dwelling units shall meet the requirements of ASHRAE Standard 62.2, Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings. Window operation is not a permissible method of providing the Whole-Building Ventilation airflow required in Section 4 of ASHRAE Standard 62.2. Continuous operation of central forced air system air handlers used in central fan integrated ventilation systems is not a permissible method of providing the whole-building ventilation airflow required in Section 4 of ASHRAE Standard 62.2. Additionally, all dwelling units shall meet the following requirements:

1. **Field Verification and Diagnostic Testing.**

- A. **Airflow Performance.** The Whole-Building Ventilation airflow required by Section 4 of ASHRAE Standard 62.2 shall be confirmed through field verification and diagnostic testing in accordance with the applicable procedures specified in Reference Residential Appendix RA3.7.

(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 pumps and pump motors installed 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 with a capacity of 1 hp or more shall be multi-speed; and
- E. Each auxiliary pool load shall be served by either separate pumps or the system shall be served by a multi-speed pump; and

**EXCEPTION to Section 150.0(p)1E:** Pumps less than 1 hp may be single speed.

- F. Multi-speed pumps shall have controls which default to the filtration flow rate when no auxiliary pool loads are operating; and
- G. For multi-speed 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 0.58.
- 2. The weighted average U-factor of all fenestration, including skylight products, shall not exceed 0.58.

**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.

**(r) Solar Ready Buildings.** Shall meet the requirements of Section 110.10 applicable to the building project.

TABLE 150.0-A CLASSIFICATION OF HIGH EFFICACY AND LOW EFFICACY LIGHT SOURCES

<b>High Efficacy Light Sources</b> Luminaires installed with only the lighting technologies in this table shall be classified as high efficacy	
<b>High Efficacy Light Sources</b> Luminaires manufactured, designed and rated for use with only lighting technologies in this column shall be classified as high efficacy. Light sources in this column other than those installed in ceiling recessed luminaires, downlight luminaires are classified as high efficacy and are not required to comply with Reference Joint Appendix JA8	<b>Low Efficacy Light Sources</b> Luminaires manufactured, designed or rated for use with any of the lighting technologies in this column shall be classified as low efficacy. Light sources in this column shall be certified to the Commission as High Efficacy Light Sources in accordance with Reference Joint Appendix JA8 and be marked as meeting JA8.
<ol style="list-style-type: none"> <li>1. Pin-based linear or compact linear or compact fluorescent lamps light sources with using electronic ballasts. Compact fluorescent lamps <math>\geq 13</math> watts shall have 4 pins for compliance with the electronic ballast requirements in Section 150.0(k)1D.</li> <li>2. Pulse-start metal halide lamps.</li> <li>3. High pressure sodium lamps.</li> <li>4. GU-24 sockets rated for LED lamps containing light sources other than LEDs.<sup>a,b</sup></li> <li>5. GU-24 sockets rated for compact fluorescent lamps. Luminaires with hardwired high frequency generator and induction lamp.</li> <li>6. Inseparable SSL luminaires that are installed outdoors.</li> <li>7. Inseparable SSL luminaires containing colored light sources that are installed to provide decorative lighting.</li> <li>6. Luminaires using LED light sources which have been certified to the Commission as high efficacy in accordance with Reference Joint Appendix JA8.</li> <li>7. Luminaire housings rated by the manufacturer for use with only LED light engines.</li> <li>8. Induction lamps.</li> </ol> <p>Note: Adapters which convert an incandescent lamp holder to a high efficacy luminaire shall not be used to classify a luminaire as high efficacy.</p>	<ol style="list-style-type: none"> <li>1. Line voltage lamp holders (sockets) capable of operating incandescent lamps of any type</li> <li>268. All Low-voltage lamp holders capable of operating incandescent lamps of any type light sources in ceiling recessed downlight luminaires. Note that ceiling recessed downlight luminaires shall not have screw bases regardless of lamp type as described in Section 150.0(k)1C.</li> <li>79. GU-24 sockets containing LED light sources.</li> <li>381310. High efficacy lamps installed in low efficacy luminaires, including screw-base compact fluorescent and screw-base LED lamps. Any light source not otherwise listed in this table and certified to the Commission as complying with Joint Appendix 8.-</li> <li>3. Mercury vapor lamps.</li> <li>4. Track lighting or other flexible lighting system which allows the addition or relocation of luminaires without altering the wiring of the system.</li> <li>6. Luminaires using LED light sources which have not been certified to the Commission as high efficacy.</li> <li>7. Lighting systems that have modular components that allow conversion between high efficacy and low efficacy lighting without changing the luminaires' housing or wiring.</li> <li>8. Electrical boxes finished with a blank cover or where no electrical equipment has been installed, and where the electrical box can be used for a luminaire or a surface mounted ceiling fan.</li> </ol>
<b>Notes:</b> a. GU-24 sockets containing light sources such as compact fluorescent lamps and induction lamps. b. California Title 20 Section 1605(k)3 does not allow incandescent sources to have a GU-24 base.	

**TABLE 150.0 B — MINIMUM REQUIREMENTS FOR OTHER LIGHT SOURCES TO QUALIFY AS HIGH EFFICACY**

Use this table to determine luminaire efficacy only for lighting systems not listed in TABLE 150.0 A	
Luminaire Power Rating	Minimum Luminaire Efficacy to Qualify as High Efficacy
5 watts or less	30 lumens per watt
over 5 watts to 15 watts	45 lumens per watt
over 15 watts to 40 watts	60 lumens per watt
over 40 watts	90 lumens per watt
<b>Note:</b> Determine minimum luminaire efficacy using the system initial rated lumens divided by the luminaire total rated system input power.	



TABLE 150.0-BG: Return Duct Sizing for Single Return Duct Systems

Return duct length shall not exceed 30 feet and shall contain no more than 180 degrees of bend. If the total bending exceeds 90 degrees, one bend shall be a metal elbow.

Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 12.5 Pa (0.05 inches water) for the air filter media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

System Nominal Cooling Capacity (Ton)*	Minimum Return Duct Diameter (inch)	Minimum Total Return Filter Grille Gross Area (inch <sup>2</sup> )
1.5	16	500
2.0	18	600
2.5	20	800

\*Not applicable to systems with nominal cooling capacity greater than 2.5 tons or less than 1.5 ton

TABLE 150.0-CD: Return Duct Sizing for Multiple Return Duct Systems

Each return duct length shall not exceed 30 feet and shall contain no more than 180 degrees of bend. If the total bending exceeds 90 degrees, one bend shall be a metal elbow.

Return grille devices shall be labeled in accordance with the requirements in Section 150.0(m)12A to disclose the grille's design airflow rate and a maximum allowable clean-filter pressure drop of 12.5 Pa (0.05 inches water) for the air filter media as rated in accordance with AHRI Standard 680 for the design airflow rate for the return grille.

System Nominal Cooling Capacity (Ton)*	Return Duct 1 Minimum Diameter (inch)	Return Duct 2 Minimum Diameter (inch)	Minimum Total Return Filter Grille Gross Area (inch <sup>2</sup> )
1.5	12	10	500
2.0	14	12	600
2.5	14	14	800
3.0	16	14	900
3.5	16	16	1000
4.0	18	18	1200
5.0	20	20	1500

\*Not applicable to systems with nominal cooling capacity greater than 5.0 tons or less than 1.5 tons.

## SUBCHAPTER 8

### LOW-RISE RESIDENTIAL BUILDINGS - PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR NEWLY CONSTRUCTED RESIDENTIAL BUILDINGS

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#### SECTION 150.1 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR NEWLY CONSTRUCTED LOW-RISE RESIDENTIAL BUILDINGS

(a) **Basic Requirements.** ~~New low-rise~~ Low-rise residential buildings shall meet all of the following:

1. The applicable requirements of Sections 110.0 through 110.10, ~~are applicable to new residential buildings.~~
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 ~~will be~~ 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, which is available in Reference Joint Appendix JA2 –Weather/Climate Data.

- ~~4. For other provisions applicable to new low-rise residential buildings, refer to Section 100.0.~~

**NOTE:** The requirements of Sections 150.0(a) through 150.0(r) apply to newly constructed buildings. Sections 150.2(a) and 150.2(be) specify which requirements of Sections 150.1(a) through 150.1(c) also apply to additions or alterations.

(b) **Performance Standards.** A building complies with the performance standard if the energy budget calculated for the Proposed Design Building under Subsection 2 is no greater than the energy budget calculated for the Standard Design Building under Subsection 1.

1. **Energy Budget for the *Standard Design Building*.** The energy budget for a 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 TDV energy for space conditioning, mechanical ventilation and water heating.
2. **Energy Budget for the *Proposed Design Building*.** The energy budget for a Proposed Design Building is determined by calculating the TDV energy for the Proposed Design Building. The energy budget is the sum of the TDV energy for space-conditioning, mechanical ventilation and water heating. The energy budget for the Proposed Design Building is reduced if on-site renewable energy generation is installed, according to methods established by the Commission in the Residential ACM Reference Manual.
3. **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 are documented in the Residential ACM Approval Manual.
4. **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 TDV energy use from depletable energy sources does not exceed the combined water-heating and space-conditioning energy budgets for the applicable Climate Zone.

**EXCEPTION to Section 150.1(b)4A: 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 of installed features, materials, components, manufactured devices and system performance 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, in accordance with the following requirements when applicable:
- i. SEER Rating. When performance compliance requires installation of space a conditioning system with a SEER rating that is greater than the minimum SEER rating required by TABLE 150.1-A, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.
  - ii. EER Rating. When performance compliance requires installation of a space conditioning system that meets or exceeds a specified EER rating, the installed system shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.4.4.1.
  - iii. Low Leakage Air Handler. When performance compliance requires installation of a low leakage air-handling unit that meets the qualifications in Reference Joint Appendix JA9, the installed air handling unit shall be field verified in accordance with the procedures specified in Reference Residential Appendix RA3.1.4.3.9.

- (c) **Prescriptive Standards/Component Package.** 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, a NA (not allowed) means that feature is not permitted in a particular Climate Zone and a 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 options i through iii below.
- i. Option A: A minimum R-value of continuous insulation installed above 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
  - 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 and multi-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.**

~~Roof/Ceiling insulation shall be installed with U factor equal to or less than, or a U factor equal to or less than, or R value equal to or greater than shown in TABLE 150.1 A. The maximum U factors or the minimum R-values shown are for insulation installed between wood framing members.—~~

- B. ~~Walls (including heated basements and crawl spaces) insulation shall be installed that has a shall be insulated such that the opaque wall has an assembly U-factor equal to or less than shown in Table~~

~~150.1-A, or walls shall be insulated between wood framing with an R-value equal to or greater than shown in TABLE 150.1-A, shall be installed. The maximum U-factors shown are maximum U-factors for the opaque wall assembly. Alternatively, for mass walls above grade and for below grade walls with insulation installed on the interior, the or minimum opaque wall R-values shown are for the minimum R-values for insulation installed between wood-framing members; and for below grade walls with exterior insulation, the R-values shown are the minimum R-values for continuous insulation.~~

- ~~A. C. Above-grade mass walls and below-grade walls shall have insulation installed resulting in a wall assembly U-factor equal to or less than shown in TABLE 150.1-A.~~

~~Walls less than a 2x6 framed wall shall meet the equivalent U-factor indicated in TABLE 150.1-A.~~

~~Walls greater than or equal to a 2x6 framed wall shall meet the equivalent U-factor indicated in TABLE 150.1-A.~~

~~Raised-floors insulation shall be installed shall be insulated such that the floor assembly has with 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 shown in TABLE 150.1-A. The maximum U-factors or minimum R-values shown are for insulation installed between wood-framing members.~~

**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 equivalent the required maximum U-factors or minimum R-values that consider the effects of all elements of the assembly, using a U-factor calculation method that considers the thermal effects of all elements of the assembly and is approved by the Executive Director.

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 shall have an area weighted average U-factor and SHGC no greater than the applicable 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 indoors 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 ~~only and meeting 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 Solar Heat Gain Coefficient (SHGC), the requirements shall be met by one of the following:
- A. Complying with the required SHGC pursuant to Section 150.1(c)3A; or
  - B. An exterior operable shading louver or other exterior shading device that meets the required SHGC; or
  - C. A combination of Items A and B to achieve the same performance as achieved in Section 150.1(c)3A.
  - D. For south-facing glazing only, optimal overhangs shall be installed so that the south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21.
  - E. Exterior shading devices must be permanently secured with attachments or fasteners that are not intended for removal.

**EXCEPTION to Section 150.1(c)4E:** Where the California Building Code (CBC) requires emergency egress or where compliance would conflict with Health and Safety regulations.

5. **RESERVED**

6. **Heating System Type.** Heating system types shall be installed as required in TABLE 150.1-A.

**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.

~~Additionally, all systems shall comply with the following requirements, as applicable:~~

- A. **Refrigerant Charge.** When refrigerant charge verification or ~~charge fault~~ indicator display is shown as required by TABLE 150.1-A, the system shall comply with either 150.1(c)7Ai or 150.1(c)7A ii:
  - i. air-cooled air conditioners and air-source heat pumps, ~~(including but not limited to ducted split systems, ducted packaged systems, and mini-split systems), shall shall comply with subsections a, b and c, unless the system is of a type that cannot be verified using the specified procedures the following requirements if the procedures are applicable to the system:~~
    - a. Have measurement access holes (MAH) installed according to the specifications in the Reference Residential Appendix Section RA3.2.2.3; ~~and~~
    - b. ~~Demonstrate that minimum system airflow rate greater than or equal to 350 cfm per ton complies with Section 150.0(m)13 or 150.0(m)15 as verified by~~ shall be demonstrated by the installer and be verified by the HERS rater through field verification and diagnostic testing in accordance with procedures as specified by in Reference Residential Appendix Section RA3.2.3 or an approved alternative procedure as specified by RA1; ~~and~~
    - c. The installer shall charge the system according to manufacturer's specifications. ~~Confirm and correct Refrigerant charge shall be shall be confirmed verified through field~~

~~verification and diagnostic testing in accordance with~~ according to one of the following applicable procedures or options, as applicable:

- I. The installer and rater shall perform the standard charge procedure as specified by Reference Residential Appendix Section RA3.2.2.2, or an approved alternative procedure as specified by 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 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 150.1(c)7Aia: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.2-1, shall not be required to provide holes as described in Figure RA3.2-1.

EXCEPTION 1 to Section 150.1(c)7Aib: The Executive Director may approve alternate airflow rate requirements for small duct high velocity systems.

EXCEPTION 2 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)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

EXCEPTION 1 to Section 150.1(c)7Aic: When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 to verify the refrigerant charge, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5. 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, and mini-split systems, which are of a type that cannot comply with the requirements of 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, ~~the~~, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.2.3.2; and
- I-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 RA3.3 or an approved alternative procedure in RA1.

~~b. EXCEPTION to Section 150.1(c)7Aia: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.2.1, shall not be required to provide holes as described in Figure RA3.2.1.~~

~~EXCEPTION 1 to Section 150.1(c)7Aiciii: Systems equipped with The system shall Bbe equipped with a charge fault indicator display (CIDFID) device that provides a clearly visible indication to the occupant when the air conditioner fails to meet the required system operating parameters specified in the applicable section of Reference Joint Appendix JA6 for the installed CIDFID technology shall not be required to confirm refrigerant charge using the procedure in Reference Residential Appendix Section RA3.2, provided that t. The CIDFID indication shall be constantly visible and within one foot of the air conditioner's thermostat. CIDFID installations shall instead be confirmed by through field verification and diagnostic testing utilizing the procedures as specified in Reference Residential Appendix Section RA3.4.2.~~

~~EXCEPTION 2 to Section 150.1(c)7Aiciii: Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to confirm refrigerant charge through field verification and diagnostic testing. The installer of these packaged systems shall submit Certificate of Installation documentation that certifies the system is a packaged system for which the correct refrigerant charge has been verified by the system manufacturer prior to shipment from the factory.~~

~~EXCEPTION to Section 150.1(c)7Aia: Systems that cannot conform to the specifications for hole location in Reference Residential Appendix Figure RA3.2.1, shall not be required to provide holes as described in Figure RA3.2.1.~~

~~EXCEPTION 3 to Section 150.1(c)7Aiciii: When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 to verify the refrigerant charge, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5 and shall be capable of receiving and responding to Demand Response Signals prior to final approval of the building permit by the enforcing agency. The system shall comply with minimum system airflow rate requirements in Section 150.1(c)7Aibii.~~

~~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 RA3.3 or an approved alternative in RA1.~~

ii. Air cooled air conditioners or air source heat pumps (including but not limited to packaged systems and mini split systems) that cannot comply with the requirements of Section 150.1(c)7Aia or 150.1(c)7Aib shall conform to the following requirement:

a. Correct refrigerant charge shall be confirmed by the system installer utilizing the weigh-in charging procedure specified in Reference Residential Appendix RA3.2.3.1, as confirmed through field verification by a HERS Rater according to the procedure specified in Reference Residential Appendix RA3.2.3.2.

**EXCEPTION to Section 150.1(c)7A:** Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to confirm refrigerant charge through field verification and diagnostic testing. The installer of these packaged systems shall submit Certificate of Installation documentation that certifies the system is a packaged system for which the correct refrigerant charge has been verified by the system manufacturer prior to shipment from the factory.

8. **Domestic Water-Heating Systems.** Water-heating systems shall meet the requirements of either A, B, or C, or D. For recirculation distribution systems serving individual dwelling unit, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used:
- ~~A. For systems serving individual dwelling units, a single gas or propane storage type water heater with an input of 75,000 Btu per hour or less, and that meets the tank insulation requirements of Section 150.0(f) and the requirements of Sections 110.1 and 110.3 shall be installed. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps shall be used.~~
- A. For systems serving individual dwelling units, the water heating system shall meet the requirement of either i, ii, or iii:
- ~~i. For systems serving individual dwelling units, a single gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no storage tank, and that meets the requirements of Sections 110.1 and 110.3 shall be installed.~~
- ~~For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps shall be used.~~
- ii. A single gas or propane storage type water heater with an input of 105,000 Btu per hour or less, rated volume less than or equal to 55 gallons and that meets the requirements of Sections 110.1 and 110.3. The dwelling unit shall meet all of the requirements for Quality Insulation Installation (QII) as specified in the Reference Appendix RA3.5, and in addition one of the following shall be installed:
- a. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or
- b. All domestic hot water piping shall be insulated and field verified as specified in the Reference Appendix RA4.4.1, RA4.4.3 and RA4.4.14.
- iii. A single gas or propane storage type water heater with an input of 105,000 Btu per hour or less, rated volume of more than 55 gallons, and that meets the requirements of Sections 110.1 and 110.3, and in addition one of the following shall be installed:
- a. A compact hot water distribution system that is field verified as specified in the Reference Appendix RA4.4.16; or
- b. All domestic hot water piping shall be insulated and field verified as specified in the Reference Appendix RA4.4.1, RA4.4.3 and RA4.4.14.
- B. For systems serving multiple dwelling units, a central water-heating system that includes the following components shall be installed:
- i. Gas or propane water heaters, boilers or other water heating equipment that meet the minimum efficiency requirements of Sections 110.1 and 110.3; and
- ii. A water heating recirculation loop that meets the requirements of Sections 110.3(c)2 and 110.3(c)5 and is equipped with an automatic control system that controls the recirculation pump operation based on measurement of hot water demand and hot water return temperature and has two recirculation loops each serving half of the building; and
- EXCEPTION to Section 150.1(c)8Cii:** Buildings with eight or fewer dwelling units are exempt from the requirement for two recirculation loops.
- iii. A solar water-heating system meeting the installation criteria specified in Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.20 in Climate Zones 1 through 9 or a minimum solar savings fraction of 0.35 in Climate Zones 10 through 16. The solar savings fraction shall be determined using a calculation method approved by the Commission.
- ~~D. For systems serving individual dwelling units, an electric resistance storage or instantaneous water heater may be installed as the main water heating source only if natural gas is unavailable, the water~~



heater is located within the building envelope, and a solar water heating system meeting the installation criteria specified in the Reference Residential Appendix RA4 and with a minimum solar savings fraction of 0.50 is installed. The solar savings fraction shall be determined using a calculation method approved by the Commission. Recirculation pumps shall not be used.

9. **Space Conditioning Duct Distribution Systems.** All ducts shall either be in directly conditioned space as confirmed by field verification and diagnostic testing in accordance with Reference Residential Appendix RA3.1.4.3.8 or be insulated to a minimum installed level as specified by TABLE 150.1-A. All ducts shall meet all applicable mandatory requirements of Section 150.0(m). All space conditioning systems shall meet all applicable requirements of A or B below:

NOTE: Requirements for duct insulation in TABLE 150.1-A do not apply to buildings with space conditioning systems that do not have ducts.

- A. High performance attics. Air handlers or ducts are allowed to be in ventilated attic spaces when the roof and ceiling insulation levels meet Option A or 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 directly conditioned space, ~~joist cavity between conditioned floors, or in sealed cavity below attic insulation. Air handlers containing a combustion component shall be direct vent, and shall not use air from conditioned space as combustion air. All ducts shall be located in directly conditioned space and confirmed by field verification and diagnostic testing in accordance with to meet the criterion of Reference Residential Appendix 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 in central fan integrated ventilation systems shall demonstrate to provide outside air, in Air Distribution Mode, shall have an air-handling unit fan efficacy less than or equal to 0.58 W/CFM as confirmed through field verification and diagnostic testing in accordance with all applicable procedures specified in Reference Residential Appendix RA3.3. 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.

11. **Roofing products.** All roofing products shall meet the requirements of Section 110.8 and the applicable requirements of Subsection A or B:

- A. Low-rise residential buildings with steep-sloped roofs, in Climate Zones 10 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.
- B. Low-rise residential buildings with low-sloped roofs; in Climate Zones 13 and 15 shall have a minimum aged solar reflectance of 0.63 and a minimum thermal emittance of 0.75 or a minimum SRI of 75.

**EXCEPTION 1 to Section 150.1(c)11:** Building integrated photovoltaic panels and building integrated solar thermal panels are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

**EXCEPTION 2 to Section 150.1(c)11:** Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft<sup>2</sup> are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

12. **Ventilation Cooling.** Single family homes shall comply with the Whole House Fan (WHF) requirements shown in TABLE 150.1-A. When a WHF is required, comply with Subsections A.i through C.iii below:

- A. Have installed one or more WHFs whose total Air Flow CFM as listed in the CEC Directory is at least ~~21~~21.5 CFM/ft<sup>2</sup> of conditioned floor area; and

- B. Have ~~the larger of~~ at least 1 square foot of attic vent free area for each ~~375-750~~ CFM of rated whole house fan Air Flow CFM, or if the manufacturer has specified a greater free vent area, the manufacturers' free vent area specifications; and
  - C. Provide homeowners who have WHFs with a one page "How to operate your whole house fan" informational sheet.
13. **HVAC System Bypass Ducts.** Bypass ducts that deliver conditioned supply air directly to the space conditioning system return duct airflow shall not be used.

TABLE 150.1-A COMPONENT PACKAGE-A Standard Building Design

Building Envelope Insulation				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Roofs/Ceilings																			
Option A (meets §150.1(c)(9A))	Continuous Insulation Above Roof Rafter	Roofing Type																	
		With Air Space <sup>2</sup>	No Air Space <sup>1</sup>																
	Ceiling Insulation																		
	Radiant Barrier																		
Option B (meets §150.1(c)(9A))	Below Roof Deck Insulation <sup>3</sup>	Roofing Type																	
		With Air Space	No Air Space																
	Ceiling Insulation																		
	Radiant Barrier																		
Option C (meets §150.1(c)(9B))	Ceiling Insulation																		
	Radiant Barrier																		

Building Envelope Insulation				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Option A (meets §150.1(c)(9A))	Continuous Insulation Above Roof Rafter <sup>2</sup>	Roofing Type																	
		With Air Space <sup>2</sup>	No Air Space <sup>1</sup>																
	Ceiling Insulation																		
	Radiant Barrier																		
Option B (meets §150.1(c)(9B))	Ceiling Insulation																		
	Radiant Barrier																		

Option B-C (meets §150.1(c)(9)(b))		Option A (meets §150.1(c)(9)(A)) Option A (meets §150.1(c)(9)(A))				
Radiant Barrier	Roof/Ceiling Insulation	Radiant Barrier	Ceiling Insulation	Insulation <sup>4</sup>		Roofing Type
				3/4" in with Air Space	No Air Space	
NR	U 0.03 R 38	NR	R 38	1 1/2"	R16 13	R16 13
Q	U 0.03 R 30	NR	R 38 16	1 1/2"	R16 13	R16 13
REQ	U 0.031 R 30	REQ	R 30	NR	NR	NR
Q	U 0.03 R 30	Q	R 38	1 1/2"	R16 13	R16 13
Q	U 0.03 R 30	Q	R 30	NR	NR	NR
Q	U 0.03 R 30	Q	R 30	NR	NR	NR
Q	U 0.03 R 30	Q	R 30	NR	NR	NR
Q	U 0.03 R 30	Q	R 30	NR	NR	NR
REQ	U 0.031 R 30	NR	R 38	R 13	R 13	R 13
Q	U 0.03 R 30	Q	R 38	R 13	R 13	R 13
Q	U 0.03 R 30	Q	R 38	R 13	R 13	R 13
Q	U 0.03 R 30	Q	R 38	R 13	R 13	R 13
Q	U 0.03 R 30	Q	R 38	R 13	R 13	R 13
Q	U 0.03 R 30	Q	R 38	R 13	R 13	R 13
REQ	U 0.025 R 38	REQ	R 38	R 13	R 13	R 13
Q	U 0.03 R 38	Q	R 38	R 13	R 13	R 13
Q	U 0.03 R 38	Q	R 38	R 13	R 13	R 13
NR	U 0.03 R 38	NR	R 38	R 13	R 13	R 13

TABLE 150.1-A COMPONENT PACKAGE-A Standard Building Design (continue)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Walls	Above Grade	2x4 Wood Framed	U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.06 50+ 55U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.06 55U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91	U 0.05 01U U 0.04 6 R-21 +6U 0.06 15+4 13+5 U 0.05 91
			Mass Wall 555 Interior	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.07 0 R 13R 13	U 0.05 9
			Mass Wall 53.5 Exterior	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.12 5 R 8.0R 8.0	U 0.07 0 R 13
			Below Grade	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.07 0 R 13	U 0.06 6 R 15
			Grade 568 Exterior	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.20 0 R 5.0	U 0.05 3 R 19
	Roof	Slab Perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
		Raised	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19	U 0.03 7 R-19
		Concrete Raised	U-0.092 R-8.0	U-0.092 R-8.0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0	U-0.269 R-0
	Radiant Barrier			NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

		Floor s Radi at Barri er	Slab Perimete r	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0	
			Raised	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.03 7 R 19	U 0.037 R 19	U 0.03 7 R 19	U 0.03 7 R 19		
			Concrete Raised	U 0.092 R 8.0 NR	U 0.092 R 8.0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.269 R 0 REQ	U 0.092 R 8.0 REQ	U 0.138 R 4.0 REQ	U 0.092 R 8.0 REQ	U 0.092 R 8.0 REQ	U 0.138 R 4.0 REQ	U 0.092 R 8.0 NR	
Building Envelope	Roofing Products	Low- slope d	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR	
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
		Steep Slope d	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
Building Envelope	Penetration		Maximum U- factor <sup>4</sup> fact <sup>5,6</sup>	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	
			Maximum SHGC <sup>7</sup> SHGC <sup>7,8</sup>	NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
			Maximum Total Area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20 %	
			Maximum West Facing Area	NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	

CONTINUED: TABLE 150.1-A COMPONENT PACKAGE-A Standard Building Design (continue)

			Climate Zone															
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
HVAC SYSTEM	Space Heating <sup>1011</sup>	Electric-Resistance Allowed	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
		If gas, AFUE	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N
		If Heat Pump, HSPF <sup>1012</sup>	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N
	Space cooling	SEER	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N	MI N
		Refrigerant Charge Verification or Charge-Fault Indicator Display	NR	RE Q	NR	NR	NR	NR	NR	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	NR
		Whole House Fan <sup>1013</sup>	NR	NR	NR	NR	NR	NR	NR	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	NR	NR
	Central System Air Handlers	Central Fan Integrated Ventilation System Fan Efficacy	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q
	Ducts <sup>112</sup>	Option A (meets §150.1(c)(9A))	Roof/Ceiling Duct Insulation Option A & B (meets §150.1(c)(9A))	R-6 A	R-6 A	R-6 NA	R-6 A	R-6 A	R-6 A	R-6 A	R-6 A	R-6 A	R-8 A	R-6 A	R-6 A	R-8 A	R-8 A	R-8 A
				N A	N A	NA	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	N A	NA
		Roof/Ceiling Option C	Duct Insulation Option C (meets §150.1(c)(9B))	R-6R EQ	R-6R EQ	R-6R EQ	R-6R EQ	R-6R EQ	R-6R EQ	R-6R EQ	R-6R EQ	R-6R EQ	R-8R EQ	R-6R EQ	R-6R EQ	R-8R EQ	R-8R EQ	R-8R EQ
				RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q	RE Q

All Buildings

System Shall meet Section 150.1(c)8

Footnote requirements to TABLE 150.1-A:

1. Install the specified R-value with no air space present between the roofing and the roof deck. The U-factors/R-values shown for ceiling, wall and raised floor insulation are for wood-frame construction with insulation installed between the framing members. For alternative construction assemblies, see Section 150.1(e)1A, B and C.
2. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
3. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members.
4. Assembly U-factors can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to meet these required maximum U-factors.
5. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. "Interior" denotes insulation installed on the inside surface of the wall.
6. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. "Exterior" denotes insulation installed on the exterior surface of the wall.
7. Below grade "interior" denotes insulation installed on the inside surface of the wall.
8. Below grade "exterior" denotes insulation installed on the outside surface of the wall.
9. "R-15+4" means R-15 cavity insulation plus R-4 continuous insulation sheathing. Any combination of cavity insulation and/or continuous insulation that results in a U-factor equal to or less than 0.065 is allowed, such as R-13+S.
3. ~~Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. Below grade "interior" denotes insulation installed on the inside surface of the wall. Below grade "exterior" denotes insulation installed on the outside surface of the wall.~~
4. ~~The installed fenestration products shall meet the requirements of Section 150.1(e)3.~~
5. ~~The installed fenestration products shall meet the requirements of Section 150.1(e)4.~~
69. HSPF means "heating seasonal performance factor."
710. ~~When whole house fans are required (REQ), only those whole house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHF's whose total airflow CFM is capable of meeting or exceeding a minimum 2-1.5 cfm/square foot of conditioned floor area as specified by per Section 150.1(c)12.~~
811. ~~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 kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.~~
12. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.



## SUBCHAPTER 9

# LOW-RISE RESIDENTIAL BUILDINGS - ADDITIONS AND ALTERATIONS ~~IN TO~~ EXISTING LOW-RISE RESIDENTIAL BUILDINGS

### SECTION 150.2 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS ~~IN TO~~ EXISTING LOW-RISE RESIDENTIAL BUILDINGS THAT WILL BE LOW-RISE RESIDENTIAL OCCUPANCIES

- (a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, ~~and~~ Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

**EXCEPTION 1 to Section 150.2(a):** Additions 1,000 square feet or less are exempt from the ASHRAE Standard 62.2 Section 4 requirements to provide whole-building ventilation airflow as referenced by Section 150.0(o), however all other applicable requirements of ASHRAE Standard 62.2 as referenced by Section 150.0(o) shall be met by the addition.

**EXCEPTION 2 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 3 to Section 150.2(a):** Existing inaccessible piping shall not require insulation as defined under Section 150.0(j)2Aiii.

**EXCEPTION 4 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 5 to Section 150.2(a): Space-Conditioning System Ducts.** 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 150.2(b)1D.

**EXCEPTION 6 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.

**NOTE:** For alterations that change the occupancy classification of the building, the requirements specified in Section 150.2(b) apply to the occupancy after the alterations.

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 prescriptive requirements of Section 150.1(c), except:
    - 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 2x4 framing and R-19 in a 2x6 framing.
    - ii. T-that 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).
  - B. Additions that are 700 square feet or less shall meet all the requirements of Section 150.1(c) except:
    - i. Roof and Ceiling insulation shall meet the requirement of Section 150.0.4(c)1A, and
    - ii. 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-19 in a 2x6 framing; and,

- iii. ~~that the wall insulation value need not exceed R-13. In Climate Zones 2, 4 and 6-16; the~~ maximum allowed west-facing fenestration area shall not be greater than 60 square feet; and shall also comply with either i-a or ii-b below:
- a. i.—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; or
  - b. ii.—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.
- C. Additions larger than 1,000 square feet shall meet the ASHRAE Standard 62.2 Section 4 requirement to provide whole-building ventilation airflow. The whole-building ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling conditioned floor area plus the addition conditioned floor area.
- 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 and assumed to comply:
- i. A natural gas or propane water-heating system that meets the requirements of Section 150.1(c)8; or
  - ii. If no natural gas is connected to the building, an electric water heater that has an energy factor equal to or greater than required under the Appliance Efficiency Regulations. ~~Recirculation pumps shall not be used.~~For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or
  - iii. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item 1 above; or if no natural gas is connected to the building, a water-heating system determined by the Executive Director to use no more energy than the one specified in Item 2 above; or
  - iv. Using the existing building plus addition compliance or addition alone compliance as defined in Section 150.2(a)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.
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. Additions larger than 1,000 square feet shall meet the ASHRAE Standard 62.2 Section 4 requirement to provide whole-building ventilation airflow. The whole-building ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling conditioned floor area plus the addition conditioned floor area.
- (b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise 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 and all applicable requirements of Section 150.0(a) through (am), Section 150.0(o) through (q); and

- A. **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 Sections 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.** Replacement of fenestration, where existing fenestration area in an existing wall or roof is replaced with a new manufactured fenestration product and up to the total fenestration area removed in the existing wall or roof, the replaced fenestration 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 6-16.

**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 replacement of sashes in an existing frame are considered repairs.

- 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 (e.g. condensing unit and cooling or heating coil for split systems; or complete replacement of a package unit); plus entirely new or replacement duct system (Section 150.2(b)1Dii); plus a new or replacement air handler.

Entirely New or complete replacement space-conditioning systems shall:

- i. Meet the requirements of Sections 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 through 150.0(m)13, 150.1(c)6, 150.1(c)7, 150.1(c)9, and 150.1(c)10 and Table 150.2-A; and
  - ii. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type unless it can be demonstrated that the TDV energy use of the new system is more efficient than the existing system.
- D. **Altered Duct Systems - Duct Sealing:** In all Climate Zones, when more than 40 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: are installed in unconditioned space or indirectly conditioned space:
- i. ~~The n~~New ducts located in unconditioned space shall meet the applicable requirements of Sections 150.0(m)1 through 150.0(m)11, and the duct insulation requirements of TABLE 150.12-A, and

TABLE 150.2-BA-DUCT INSULATION R-VALUE

Climate Zone	Climate Zone	
	1 through 10, 12&13†	11, 14 through 15, 16
	2	
	3	
	4	
	5	
	6	
	7	
	8	
	9	
	10	
	11	
	12	
	13	
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 the Reference Residential Appendix RA3.1, utilizing the leakage compliance criteria specified in Reference Residential Appendix TABLE RA3.1-2, and conforming to either Subsection a or b below:

- a. **Entirely New or Complete Replacement Duct System.** If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to or less than 56 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 shall be 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 (e.g., 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 Section 150.0(m)12 and 150.0(m)13.

- b. **Extension of an Existing Duct System.** If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:
  1. The measured duct leakage shall be equal to or less than 15 percent of nominal 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
  2. The measured duct leakage to outside shall be equal to or less than 10 percent of nominal 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
  3. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Diib1, or 150.2(b)1Diib2, 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.

- E. **Altered Space-Conditioning System - Duct Sealing:** In all Climate Zones, 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); 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 Reference Residential Appendix Table RA3.1-2, conforming to one of the following requirements:

- i. The measured duct leakage shall be equal to or less than 15 percent of system air handler airflow as determined 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 10 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 Section 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 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 in ~~unconditioned spaces 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:

~~then nonsetback-~~ i. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).

— Additionally, these systems shall comply with the following requirements as applicable:

- 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, and minisplit systems)~~, shall comply with subsections a and b the airflow rate requirements of a and b if the procedures, unless the system is of a type that cannot be verified using the specified procedures or b and the refrigerant charge requirement of c. Systems that cannot comply with the requirements of 150.2(b)1Fii shall comply with 150.2(b)1Fiii.

- a. ~~Demonstrate a~~ Minimum system airflow rate greater than or equal to 300 cfm per ton shall be demonstrated by the installer as and be verified by the HERS Rater 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 RA12.4; and

If unable to comply with the minimum 300 cfm per ton airflow requirement, perform the procedures in Section RA3.2.4.3; and the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5; and

- b. ~~Confirm correct refrigerant charge~~ 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, through field verification and diagnostic testing in accordance with

1. The installer and rater shall perform the standard charge verification procedure as the procedures specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1 have proper refrigerant charge field verified in accordance with all applicable procedures specified in Reference Residential Appendix Section RA3.2.2, or Reference Residential Appendix RA1, if the procedures in Section RA3.2.2, or RA1 are applicable to the system; 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

- 4.3. 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 1 to Section 150.2(b)1Fiii:** Systems unable to comply with the minimum 300 cfm per ton airflow rate requirement shall demonstrate compliance using the procedures in Section

RA3.3.3.1.54: and the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5.

**EXCEPTION 2 to Section 150.2(b)1Fiia:** The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.

**EXCEPTION 3 to Section 150.2(b)Fiia:** 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.

~~**EXCEPTION 1 to Section 150.2(b)1Fiie:** Systems equipped with a fault indicator display (FID) device that provides a clearly visible indication to the occupant when the air conditioner fails to meet the required system operating parameters specified in the applicable section of Reference Joint Appendix JA6 for the installed FID technology shall not be required to confirm refrigerant charge using the procedure in Reference Residential Appendix Section RA3.2, provided that the FID indication is constantly visible and within one foot of the air conditioner's thermostat. FID installations shall instead be confirmed through field verification and diagnostic testing as specified in Reference Residential Appendix Section RA3.4.2, or be equipped with a CID that meets the requirements in Section 150.1(e)7Aib if the CID is applicable to the system.~~

a. ~~Systems that do not comply with the minimum 300 cfm per ton airflow requirement as specified in Reference Residential Appendix Section RA3.2.4.22.7.2 shall comply with the procedures in Section RA3.2.4.22.7.3; and the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5 and shall be capable of receiving and responding to Demand Response Signals prior to final approval of the building permit by the enforcing agency.~~

~~**EXCEPTION 21 to Section 150.2(b)1Fiib:** When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1- to demonstrate compliance to verify the refrigerant charge, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5 and shall be capable of receiving and responding to Demand Response Signals prior to final approval of the building permit by the enforcing agency. Ducted systems shall comply with the minimum system airflow rate requirements in Section 150.2(b)1Fiia.~~

~~**EXCEPTION 3 to Section 150.2(b)1Fiie:** 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 confirm refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the submit Certificate of Installation that the documentation that certifies the system is a packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge, for which the correct refrigerant charge has been verified by the system manufacturer prior to shipment from the factory. 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.~~

~~iii. **ii.**—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 packaged systems and mini-split systems) that, including but not limited to ducted split systems, ducted package systems, 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 Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix RA3.2.3.2; and
- a-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 RA3.3 or an approved alternative procedure in RA1 with the requirements of Reference Residential Appendix Sections RA3.2.2, or RA1 shall conform to the following requirement:

EXCEPTION to Section 150.2(b)1Fiib: 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)1Fiib, 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. Correct refrigerant charge shall be confirmed by the system installer utilizing the weigh-in charging procedure specified in Reference Residential Appendix RA3.2.3.1, as confirmed through field verification by a HERS Rater according to the procedure specified in Reference Residential Appendix RA3.2.3.2.

Ducted systems shall comply with the minimum airflow rate requirements of Section 150.2(b)1Fiia or 150.2(b)1Fiib

EXCEPTION to Section 150.2(b)1F: Altered Space-Conditioning System. Packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to confirm refrigerant charge through field verification and diagnostic testing. The installer of these packaged systems shall submit Certificate of Installation documentation that certifies the system is a packaged system for which the correct refrigerant charge has been verified by the system manufacturer prior to shipment from the factory.

**G. Water-Heating System.** Replacement service water-heating systems or components shall:

i. Pipe Insulation. For newly installed piping, the insulation Meet the requirements of Section 150.0(j)2 shall be met. For existing accessible piping the applicable requirements of Section 150.0(i)2Ai, iii, and iv shall be met.

ii. Water heating system. The replacement water heating system shall meet one of the following requirements and either be:

- i-a. A natural gas or propane water-heating system that meets the requirements of 150.1(c)8, Section 110.1 and 110.3. No recirculation system shall be installed. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or
- ii-b. If no natural gas is connected to the building, an electric water heater that has an energy factor equal to or greater than required meets the requirements of under the Appliance Efficiency Regulations Section 110.1 and 110.3. For electric resistance storage type water heaters, the capacity shall not exceed 60 gallons. No recirculation system shall be installed. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or
- iii-c. A water-heating system determined by the executive director to use no more energy than the one specified in Item 1 above; or if no natural gas is connected to the building, a water-

heating system determined by the executive director to use no more energy than the one specified in Item 2 above; or

- ~~iv.d.~~ Using the existing building plus addition compliance approach as defined in Section 150.2(b)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.

~~EXCEPTION to Section 150.2(b): Existing inaccessible piping shall not require insulation as defined under 150.0(j)2A-iii.~~

- H. ~~Roofs.~~ Replacements of the exterior surface of existing roofs shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i and ~~ii-iii-ii~~ where more than 50 percent of the roof is being replaced:

~~When the entire roof, including the decking of the dwelling is replaced, applicable requirements of Section 150.1(c)1A shall be complied with.~~

- ~~ii~~ Low-rise residential buildings with steep-sloped roofs, in Climate Zones 10 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.

**EXCEPTION TO 150.2(b)1Hii:** The following shall be considered equivalent to Subsection ~~ii~~:

- a. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or
  - b. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or
  - c. Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or
  - d. Buildings with at least R-38 ceiling insulation; or
  - e. Buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2; or
  - f. Buildings that have no ducts in the attic; or
  - g. In Climate Zones 10-15, R-4-6-2 or greater insulation above the roof deck.
- ~~iii~~ Low-sloped roofs in Climate Zones 13 and 15 shall have a 3-year aged solar reflectance equal 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)1Hii:** Buildings with no ducts in the attic.

**EXCEPTION 2 to Section 150.2(b)1Hii:** The aged solar reflectance can be met by using insulation at the roof deck specified in TABLE 150.2-AB.

- I. 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. Luminaire power and luminaire classification shall be determined in accordance with Section 130.0(e).

~~EXCEPTION to Section 150.2(b)II:~~ For only residential lighting alterations, Light Emitting Diode (LED) modules may be hardwired into luminaire housings manufactured for use with incandescent lamps, provided all of the following conditions are met:

- ~~a. The luminaire has been previously used and is in an existing installation; and,~~
- ~~b. The LED modules are not LED lamps, integrated or non-integrated type, as defined by ANSI/IES RP-16-2010; and;~~
- ~~c. The LED modules comply with all other requirements in Section 130.0(e); and~~



- d. ~~The LED modules are certified as high efficacy to the Commission in accordance with Section 110.9; and~~
  - e. ~~The LED modules are not connected using screw-based sockets or screw base adapters.~~
2. **Performance approach.** This performance approach shall only be used for projects that include tradeoffs between two or more altered components that are listed in TABLE 150.2-BC.

**NOTE:** The altered components may be components of the same type, such as a tradeoff between two windows, or components of differing types, such as a tradeoff between a window and an amount of attic insulation.

- A. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9 and Section 150.0(a) through (q); and
- B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in TABLE 150.2-BC. 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.

**TABLE 150.2-A-B AGED SOLAR REFLECTANCE INSULATION TRADE OFF TABLE**

Aged Solar Reflectance	Roof Deck Insulation R-value	Aged Solar Reflectance	Roof Deck Insulation R-value
0.62-0.60	2	0.44-0.40	12
0.59-0.55	4	0.39-0.35	16
0.54-0.50	6	0.34-0.30	20
0.49-0.45	8	0.29-0.25	24

TABLE 150.2-B-C 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 $\leq 0.40$ and SHGC value is $\leq 0.35$ , 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 Table 110.6-A and Table 110.6-B.
Space-Heating and Space-Cooling Equipment	The requirements of TABLE 150.1-A.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Section 150.2(b)1D.	
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.1(b)1 without the solar water heating requirements.	The existing efficiency energy factor.
Roofing Products	The requirements of Section 150.2(b)1H.	
All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

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 is 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.

**EXCEPTION 3 to Section 150.2(b): Space-Conditioning System Ducts.** The requirements of Section 150.0(m)12, 150.0(m)13, 150.0(m)14 and 150.0(m)15 do not apply to altered existing duct systems are not applicable to Section 150.2(b).

- (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.

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**2010 CALIFORNIA MECHANICAL CODE, CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 4 CHAPTER 6, DUCT SYSTEMS**


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*TABLE P4-A ADOPTION TABLE*

CODE SECTION		CEC
Entire 2010 CMC as noted in this table <sup>1</sup>		
601.0		X
602.0		X
604.0		X
605.0		X
<sup>1</sup> Adopted by reference for Occupancies A, B, E, F, H, M, R and S; see Sections 110.8(d)3, 120.4 and 150.0(m).		

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## APPENDIX 1-A STANDARDS AND DOCUMENTS REFERENCED IN THE ENERGY EFFICIENCY REGULATIONS

### AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE

AHRI 210/240-2008	Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment (2008 with Addendum 1)
ANSI/AHRI/CSA 310/380-2004	Standard for Packaged Terminal Air-Conditioners and Heat Pumps (2004)
AHRI 320-98	Water-Source Heat Pumps (1998)
AHRI 325-98	Ground Water-Source Heat Pumps (1998)
ANSI/AHRI 340/360-2007	Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment (2007 with Addenda 1 and 2)
ANSI/AHRI 365-2009	Commercial and Industrial Unitary Air-Conditioning Condensing Units (2009)
<u>ANSI/AHRI 390-2003</u>	<u>Performance Rating of Single Package Vertical Air-Conditioners and Heat Pump (2003)</u>
<u>ANSI/AHRI 400-2001</u>	<u>Liquid to Liquid Heat Exchangers (2001)</u>
ANSI/AHRI 460-2005	Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (2005)
AHRI 550/590-2011	Performance Rating of Water-Chilling Packages Using the Vapor Compression Cycle (2011)
ANSI/AHRI 560-2000	Absorption Water Chilling and Water Heating Packages (2000)
<u>AHRI 680</u>	<u>Performance Rating of Residential Air Filter Equipment (2009)</u>
<u>AHRI 1230-2010</u>	<u>Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment (2010)</u>
Available from:	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, Virginia 22203 (703) 524-8800

### AIR CONDITIONING CONTRACTORS OF AMERICA

Manual J – Residential Load Calculation, Eighth Edition (~~2003~~)(2006)

Available from: Air Conditioning Contractors of America, Inc.  
2800 Shirlington Road, Suite 300  
Arlington, VA 22206  
[www.acca.org](http://www.acca.org)  
(703) 575-4477

**AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION  
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2010~~07~~      Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings

ASHRAE Standards 193-  
2010      Method of Test for Determining the Airtightness of HVAC Equipment

ASHRAE Handbook

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Equipment Volume,      Heating, Ventilating and Air-Conditioning Systems and Equipment (2008)

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<u>ASTM D1003-00/13</u>	<u>Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics (2000/2013)</u>
<u>ASTM D1653-01/3</u>	<u>Standard Test Methods for Water Vapor Transmission of Organic Coating Films (2000/13)</u>
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<u>ASTM D2824-02/13</u>	<u>Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos (-2002/2013)</u>
<u>ASTM D3468-13</u>	<u>Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing (2013)</u>
<u>ASTM D3805-07/09</u>	<u>Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings (2009), 1997 (reapproved 2009)</u>
<u>ASTM D4798-04/11</u>	<u>Standard Test Method Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method) (2004/2011)</u>
<u>ASTM D5870-11</u>	<u>Standard Practice for Calculating Property Retention Index of Plastics (2011)</u>
<u>ASTM D6083-05</u>	<u>Standard Specification for Liquid Applied Acrylic Coating Used in Roofing (2005)</u>
<u>ASTM D6694-13</u>	<u>Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing (2013)</u>
<u>ASTM DD6848-02</u>	<u>Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing (2002)</u>



ASTM E96- <del>00</del> 14	Standard Test Methods for Water Vapor Transmission of Materials <u>(2014)</u>
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ASTM E1677-11	Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls <u>(2011)</u>
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ASTM E1677- <del>05</del> (2000)14	Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls <u>(2011)</u>
ASTM C836-05	Standard Specification for High Solids Content, Cold Liquid Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course <u>(2005)</u>
ASTM C1583-04	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) <u>(2004)</u>
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ASTM D1653-03	Standard Test Methods for Water Vapor Transmission of Organic Coating Films <u>(2003)</u>
ASTM D2370-98 (2002)	Standard Test Method for Tensile Properties of Organic Coatings <u>(2002)</u>
ASTM D3468-99	Standard Specification for Liquid Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing <u>(1999)</u>
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2010 California Building Code

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Reference Appendices for the Building Energy Efficiency Standards for Residential and Nonresidential Buildings

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Nonresidential Alternative Calculation Method (ACM) Reference Manual

Nonresidential Compliance Manual

Residential Alternative Calculation Method (ACM) Approval Manual

Residential Alternative Calculation Method (ACM) Reference Manual

Residential Compliance Manual

New Solar Homes Partnership Guidebook, currently adopted by the Energy Commission.

Available from: California Energy Commission/Publications  
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CTI STD-201-04 Standard for the Certification of Water-Cooling Tower Thermal Performance  
(2004)(2011)  
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ISO 13256-2 Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Water Heat Pumps (1998)

ISO Standard 17025 General Criteria for the Competence of Testing and Calibration Laboratories (2005)

Available from: ISO  
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**NFRC 202**      **Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence (~~2014~~2014)**  
  
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UL 723 Standard for Test for Surface Burning Characteristics of Building Materials (1996)  
UL 727 Standard for Oil-Fired Central Furnaces (1994)  
UL 731 Standard for Oil-Fired Unit Heaters (1995)  
UL 1574 Track Lighting Systems (2000)  
UL 1598 Standard for Luminaires (2000)  
UL 2108 Low Voltage Lighting Systems (2008)  
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# **CA Statewide Codes and Standards Program**

## **Title 24, Part 11 Local Energy Efficiency Ordinances**

### **CALGreen Cost Effectiveness Study**

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Last Modified: September 2, 2016

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## 1 Introduction

The California Building Energy Efficiency Standards Title 24, Part 6 (Title 24) (CEC, 2016b) is maintained and updated every three years by two state agencies, the California Energy Commission (CEC) and the Building Standards Commission (BSC). In addition to enforcing the code, local jurisdictions have the authority to adopt local energy efficiency ordinances, or reach codes, that exceed the minimum standards defined by Title 24 (as established by Public Resources Code Section 25402.1(h)2 and Section 10-106 of the Building Energy Efficiency Standards). Local jurisdictions must demonstrate that the requirements of the proposed ordinance are cost effective and do not result in buildings consuming more energy than is permitted by Title 24. In addition, the jurisdiction must obtain approval from the CEC and file the ordinance with the BSC for the ordinance to be legally enforceable.

This report presents the results from analysis of the feasibility and cost-effectiveness of requiring new low-rise single family and multifamily residential construction to exceed the 2016 Building Energy Efficiency Standards, which become effective January 1, 2017. The analysis includes scenarios of compliance packages options and cost effectiveness analysis for all sixteen California climate zones. Four levels of building energy performance were examined:

- (1) exceeding the minimum requirements by at least 15%, consistent with the voluntary Tier 1 Performance Standard in Title 24, Part 11 (CALGreen),
- (2) exceeding minimum requirement by at least 30%, consistent with the voluntary Tier 2 Performance Standard in CALGreen,
- (3) meeting minimum Title 24 efficiency performance targets plus on-site renewable energy generation sufficient to achieve an Energy Design Rating of zero (TDV-Zero), consistent with the voluntary Zero Net Energy Design tier in CALGreen,
- (4) meeting minimum Title 24 efficiency performance targets plus on-site renewable energy generation sized to offset a portion of the total TDV loads of the building without risking sizing of the PV system larger than the estimated electrical energy use of the building.

## 2 Methodology and Assumptions

### 2.1 Building Prototypes

The CEC defines building prototypes which it uses to evaluate the cost-effectiveness of proposed changes to Title 24 requirements. There exist two single family prototypes and one multifamily prototype, all three of which are used in this analysis in development of the above-code efficiency packages. Table 1 describes the basic characteristics of each prototype. Additional details on the prototypes can be found in the ACM Approval Manual (CEC, 2016a).

**Table 1: Prototype Characteristics**

	<u>Single Family</u> <u>One-Story</u>	<u>Single Family</u> <u>Two-Story</u>	<u>Multifamily</u>
Conditioned Floor Area	2,100 ft <sup>2</sup>	2,700 ft <sup>2</sup>	6,960 ft <sup>2</sup> : (4) 780 ft <sup>2</sup> & (4) 960 ft <sup>2</sup> units
Num. of Stories	1	2	2
Num. of Bedrooms	3	3	(4) 1-bed & (4) 2-bed units
Window-to-Floor Area Ratio	20%	20%	15%

Additionally, each prototype building has the following features:

- Slab-on-grade foundation
- Vented attic. High performance attic in climates where prescriptively assigned (CZ 4, 8-16) with insulation installed below roof deck. Refer to Table 150.1-A in Appendix A.
- Ductwork located in the attic for single family homes and in conditioned space for multifamily.
- Split-system gas furnace with air conditioner that meet the minimum federal guidelines for efficiency
- Tankless gas water heater that meets the minimum federal guidelines for efficiency; individual water heaters in each multifamily apartment.

Other features are defined consistent with the Standard Design in the Alternative Calculation Method Reference Manual (CEC, 2016d), designed to meet, but not exceed, the minimum requirements.

The CEC's standard protocol for the single family prototypes is to weight the simulated energy impacts by a factor that represents the distribution of single-story and two-story homes being built statewide, assuming 45% single-story homes and 55% two-story homes. Simulation results in this study are therefore characterized according to this ratio, which is approximately equivalent to a 2,430 ft<sup>2</sup> house<sup>1</sup>.

## 2.2 Efficiency Measures & Package Development

The CBECC-RES 2016.2.0 ALPHA2<sup>2</sup> (833) compliance simulation tool was used to evaluate energy impacts using the 2016 prescriptive standards as the benchmark and the 2016 time dependent valuation (TDV) values. TDV is the energy metric used by the CEC since the 2005 Title 24 energy code to evaluate compliance with the Title 24 standards. TDV values energy use differently depending on the fuel source (gas, electricity, and propane), time of day, and season. TDV was developed to reflect the "societal value or cost" of energy including long-term projected costs of energy such as the cost of providing energy during peak periods of demand and other societal costs such as projected costs for carbon emissions. Electricity used (or saved) during peak periods of the summer has a much higher value than electricity used (or saved) during off-peak periods (Hori et al, 2014).

The methodology used in the analyses for each of the prototypical building types begins with a design that precisely meets the minimum 2016 prescriptive requirements (0% compliance margin). A table of prescriptive measures used in each base design by climate zone is located in Appendix A. Using the 2016 baseline as the starting point, prospective energy efficiency measures were identified and modeled in each of the prototypes to determine the projected energy (Therm and kWh) and compliance impacts. A large set of parametric runs<sup>3</sup> were conducted to develop packages of measures that exceed the minimum code performance level by 15% (CALGreen Tier 1), and 30% (Tier 2). The consultants authoring this study selected packages and measures based on decades of experience with residential architects, builders, and engineers along with general knowledge of the relative acceptance and preferences of many measures, as well as their incremental costs.

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<sup>1</sup> 2,430 ft<sup>2</sup> = 45% \* 2,100 ft<sup>2</sup> + 55% \* 2,700 ft<sup>2</sup>

<sup>2</sup> On June 14, 2016 the CEC approved CBECC-Res 2016.2.0 Version of the software. The version used for this study is nearly identical to the approved version with the exception of minor changes that do not affect the cost effective analysis of the measures evaluated.

<sup>3</sup> Using the "quick" simulation speed option.

Evaluation results for the selected packages show that meeting the performance targets for both single family and multifamily prototypes is feasible in most climate zones. In climates where it was not feasible, targets were relaxed to an appropriate level. It is important to note that the packages contained in this report are examples only; any project meeting requirements of a local ordinance, both single family and multifamily, must independently evaluate and identify the most cost effective approach based on project-specific factors.

Following are descriptions of each of the efficiency measures applied in this analysis.

**Quality Insulation Installation (QII):** HERS rater verification of insulation quality according to the procedures outlined in the 2016 Reference Appendices RA3.5 (CEC, 2016c). QII is included in all cases since it is a pre-requisite for all the voluntary tiers in 2016 CALGreen.

**Reduced Infiltration (ACH50):** HERS rater field verification and diagnostic testing of building air leakage according to the procedures outlined in the 2016 Reference Appendices RA3.8 (CEC, 2016c). The default infiltration assumption for single family homes is 5 air changes per hour at 50 Pascals (ACH50)<sup>4</sup> and the reduced level applied in this analysis is 3 ACH50. This measure was not applied to multifamily homes because the modeling software does not allow this credit unless each unit is modeled individually, which is not typical in the compliance process for multifamily buildings.

**Window Performance:** Reduce window U-value from the prescriptive value of 0.32 to 0.30 in all climates and reduce the solar heat gain coefficient (SHGC) from the prescriptive value of 0.25 to 0.23 in climate zone 2, 4, 6 through 16. In climate zones 1, 3, and 5 there is no prescriptive SHGC requirement and the default value of 0.50 is left as is.

**Door Performance:** Install insulated doors that meet a U-value of 0.20 at the front entry and doors between the house and garage. It's assumed there is a single 3' x 6'8" entry door per single family home and multifamily unit as well as a second 3' x 6'8" door to the garage per single family home.

**Cool Roof:** Install a roofing product that's rated by the Cool Roof Rating Council to have an aged solar reflectance of 0.20. This measure only applies to climates zones where this is not already required prescriptively.

**Exterior Wall Insulation:** Increase wall cavity insulation from R-19 to R-21 in 2x6 walls.

**High Performance Attics (HPA):** For climates where HPA is not already prescriptive under the 2016 code (CZ 1-3, 5-7), increase attic ceiling insulation to R-38 and add insulation under the roof deck between framing (R-13 for roof with air space, R-18 for roof without air space).

**High Efficiency Furnace:** Upgrade furnace to a condensing unit with an efficiency of 92% AFUE.

**High Efficiency Air Conditioner:** Upgrade air conditioner efficiency beyond federal efficiency minimum to either SEER 15 / EER 12.5 or SEER 16 / EER 13.

**High Efficacy Fan:** Upgrade the fan in the furnace or air handler using an electronically commutated motor (ECM) that meets an efficacy of 0.3 Watts / cfm or lower operating at full speed. Fan watt draw is verified by a HERS rater according to the procedures outlined in the 2016 Reference Appendices RA3.3 (CEC, 2016c). New federal regulations that go into effect July 3, 2019 are expected to result in equivalent performance for all newly manufactured furnaces provided that the ducts are sized properly.

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<sup>4</sup> Whole house leakage tested at a pressure difference of 50 Pascals between indoors and outdoors.

**Refrigerant Charge Verification:** HERS rater verification of proper air conditioner refrigerant charge according to the procedures outlined in the 2016 Reference Appendices RA3.2 (CEC, 2016c). This measure only applies to climates zones where this is not already required prescriptively.

**R-8 Duct Insulation:** Increase duct insulation to R-8. This measure only applies to climates zones where R-8 ducts are not already required prescriptively.

**High Efficiency Water Heater:** Upgrade tankless water heater to a condensing unit with a rated Energy Factor (EF) of either 0.94 or 0.96.

**Hot Water Pipe Insulation:** Beginning in January 1, 2017 the 2016 California Plumbing Code will require pipe insulation levels that are close to that required if taking the Title-24 pipe insulation credit. This credit will be obsolete under the 2016 energy code, however, the HERS-Verified Pipe Insulation Credit, as defined in the 2016 Reference Appendices RA3.6.3 (CEC, 2016c), will remain. While CBECC-Res has not yet been updated to reflect this, for this analysis it was assumed that the revised HERS verified credit would be equivalent to the current credit for pipe insulation without HERS verification. This was determined based on simulations that demonstrated the HERS credit to be valued at roughly twice that for pipe insulation without verification in terms of TDV energy. This credit was only applied to single family residences. For costing purposes, 120 linear feet of 1/2in insulated pipe is assumed to be insulated.

**Hot Water Compact Distribution:** HERS rater verification of compact distribution system requirements according to the procedures outlined in the 2016 Reference Appendices RA3.6.5 (CEC, 2016c). This measure was applied to multifamily buildings only. Many multifamily buildings with individual water heaters are expected to easily meet this credit with little or no alteration to plumbing design. This measure also requires verification of pipe insulation per the HERS-Verified Pipe Insulation Credit. Assumption is 60 linear feet per dwelling unit of 1/2in insulated pipe.

**PV Compliance Credit:** To be eligible for this compliance credit a PV system with a minimum capacity of 2 kW DC per single family home with no more than 2,000 ft<sup>2</sup> of conditioned floor area and 1 kW DC per multifamily unit with no more than 1,000 ft<sup>2</sup> of conditioned floor area is required. For the single family 2,430 ft<sup>2</sup> prototype the minimum capacity as calculated by CBECC-Res is 2.0 kW to 2.4 kW depending on the climate zone. The multifamily apartment units in the prototype are all under 1,000 ft<sup>2</sup> and therefore require a 1 kW system. The credit was developed to give builders an option with which to trade-off High Performance Attics and Walls, and to begin preparing for ZNE requirements.

Table 2 below summarizes the measures evaluated along with cost assumptions.



2016 Energy Efficiency Ordinance Cost Effectiveness Study

Table 2: Measure Descriptions & Cost Assumptions

Measure	Performance Level	Incremental Cost		Source & Notes
		Single Family	MF – Per Unit	
QII	Yes	\$519	\$133	City of Palo Alto 2016 Reach Code Ordinance: <a href="http://www.cityofpaloalto.org/civicax/filebank/documents/52054">http://www.cityofpaloalto.org/civicax/filebank/documents/52054</a>
ACH50	3.0	\$379	n/a	NREL measure cost database (\$0.115/ft <sup>2</sup> for sealing) + HERS rater verification (\$100).
Wall Insulation	R-21	\$164	n/a	2016 CASE Report: Residential High Performance Walls and QII, 2016-RES-ENV2-F
Cool Roof	Aged Reflect = 0.20	\$523	\$131	\$0-\$0.50 / ft <sup>2</sup> of roof area per local industry expert at LBNL. Used average of \$0.25/ft <sup>2</sup> .
Window U-factor/ SHGC	0.30/0.23	\$73	\$20	EnerComp (\$0.15/ft <sup>2</sup> of window area)
Doors	0.20 U-factor	\$210	\$140	NREL measure cost database (\$3.50/ft <sup>2</sup> ) for doors between house and garage. Double cost (\$7/ft <sup>2</sup> ) for front door assuming a premium product.
High Performance Attics (HPA)	R-15 under roof deck	\$878	\$219	For climate zones 1-3, & 5-7 only where HPA is not prescriptive. 2016 CASE Report: Residential Ducts in Conditioned Space / High Performance Attics, 2016-RES-ENV1-F
Furnace	92%	\$389	\$351	Local HVAC contractor, MF reduction for smaller capacity.
Air Conditioning	15/12.5	\$78	\$46	Local HVAC contractor, MF reduction for smaller capacity.
	16/13	\$839	\$699	Average of local HVAC contractor & NREL database costs. MF reduction for smaller capacity.
Fan Efficacy	0.3 Watts/cfm	\$143	\$104	Local HVAC contractor, MF reduction for smaller capacity.
Refrigerant Charge	HERS verified	n/a	\$75	Local HERS rater.
Duct Insulation	R-8	\$164	n/a	For climate zones 3, 6, & 7 where not prescriptive. 2016 CASE Report: Residential Ducts in Conditioned Space / High Performance Attics, 2016-RES-ENV1-F
Water heater	0.94 EF	\$0	\$0	Internet pricing and plumbing contractor input. Minimal incremental equip cost and lower cost to install PVC venting (condensing) vs stainless venting (standard). Slight premium going from 0.94 to 0.96.
	0.96 EF	\$100	\$100	
Hot water pipe insulation	HERS verified	\$146	n/a	Roughly equivalent to code requirements effective Jan. 2017. 10% of \$3.87 per ft (2013 SF DHW CASE study) for additional labor to pass HERS inspection: \$100 for HERS verification per local HERS raters.
Hot water compact distribution	HERS verified	n/a	\$112	Assume compact design already or easily achieved in MF units – no added cost. \$100 HERS verification fee per local HERS rater. Pipe insulation cost per the pipe insulation measure assumptions.
PV	System size varies	\$3.53 / kW DC	\$3.21 / kW DC	Avg. system cost for systems < 10kW (for the last 12 months) of \$5.29/Watt for single family ( <a href="http://www.gosolarcalifornia.ca.gov/">http://www.gosolarcalifornia.ca.gov/</a> ). For multi-family systems, an average of the < 10 kW and > 10kW system cost (\$4.37/Watt) was used; systems are expected to be typically greater than 10 kW, although not as large as some commercial systems reported on in the database. In both cases cost was reduced by \$0.25/Watt for the NSHP incentive & 30% for the solar investment tax credit.

## 2.3 Efficiency Packages

Three efficiency packages were developed for each climate zone where feasible, as described below. Since the federal government does not allow local or state government agencies to require the use of federally-regulated equipment that exceeds the minimum standard requirement, this analysis includes at least one package for each climate zone that does not require installing equipment with higher efficiencies than federally mandated. In climates where the PV Compliance Credit (PVCC) is available (all climates except 6 and 7) a package that includes the PVCC in addition to efficiency measures was evaluated to achieve Tier 2 performance levels.

- 1) **Envelope:** These packages focus on building envelope measures but also include efficient hot water pipe distribution and cooling fan efficiency measures that don't trigger federal preemption issues.
- 2) **Equipment:** Use of HVAC and water heating equipment that are more efficient than federal standards combined with efficient envelope measures if necessary.
- 3) **PV Credit:** Utilize the PV compliance credit (PVCC) available in all climate zones except 6 and 7.

## 2.4 PV Performance Packages

Using the Tier 2 efficiency package (or Tier 1 in cases where reaching Tier 2 wasn't feasible), the PV system was evaluated and sized to offset TDV loads for the following two conditions:

- 1) **PV-Plus:** Install a PV system sized to offset a portion of the total household energy use based on TDV energy. PV sizing is consistent with the methodology included in the California Energy Commission's proposed Solar PV Ordinance being developed by the CEC, and PV sizing calculations were developed such that PV size is to be equivalent to offsetting approximately 80% of total estimated building electricity use for a gas/electric home built to the 2016 Title 24. Table 3 summarizes the prescriptive PV sizing based on Climate Zone and home size.
- 2) **TDV-Zero:** Install a PV system sized to offset 100% of building energy use based on TDV energy, including appliances and plug loads. This is consistent with the requirements of the CALGreen Zero Net Energy Design tier.

In both these cases PV is evaluated in CBECC-Res according to the California Flexible Installation (CFI).

**Table 3: Minimum PV System Size (kW<sub>DC</sub>) required to meet Solar PV Ordinance by Climate Zone**

Conditioned Space (ft <sup>2</sup> )	CZ1	CZ2	CZ3	CZ4	CZ5	CZ6	CZ7	CZ8	CZ9	CZ10	CZ11	CZ12	CZ13	CZ14	CZ15	CZ16
Less than 1000	1.6	1.4	1.5	1.3	1.4	1.5	1.3	1.5	1.4	1.4	1.7	1.5	1.8	1.3	2.1	1.3
1000 - 1499	2.0	1.7	1.7	1.5	1.6	1.7	1.5	1.8	1.7	1.7	2.2	1.9	2.3	1.6	2.8	1.6
1500 - 1999	2.4	2.0	2.1	1.8	1.9	2.0	1.8	2.1	2.0	2.0	2.7	2.3	2.8	2.0	3.5	1.9
2000 - 2499	2.8	2.3	2.4	2.1	2.1	2.3	2.0	2.4	2.3	2.3	3.2	2.7	3.4	2.3	4.2	2.3
2500 - 2999	3.2	2.6	2.7	2.4	2.4	2.6	2.3	2.7	2.6	2.7	3.7	3.1	3.9	2.7	4.9	2.6
3000 - 3499	3.6	2.9	3.0	2.6	2.7	2.9	2.5	3.0	2.9	3.0	4.2	3.4	4.4	3.0	5.6	3.0
3500 - 3999	3.9	3.2	3.2	2.9	2.9	3.2	2.7	3.3	3.2	3.3	4.7	3.8	4.9	3.4	6.3	3.3
4000 - 4499	4.3	3.5	3.5	3.2	3.1	3.4	2.9	3.6	3.5	3.6	5.1	4.2	5.4	3.7	7.0	3.6

## 2.5 Cost Effectiveness

A customer based approach to evaluating cost effectiveness was used based on past experience with Reach Code adoption by local governments. The current residential utility rates at the time of the analysis were used to calculate utility costs for all cases and determine cost effectiveness for the proposed packages. Annual utility costs were calculated using hourly electricity and gas output from CBECC-Res and applying the utility tariffs summarized in Table 4. Appendix C includes the utility rate schedules used for this study. The standard residential rate (E1 in PG&E territory, D in SCE territory, & DR in SDG&E) was applied to the base case and all cases without PV systems. The applicable residential time-of-use (TOU) rate was applied to all cases with PV systems.<sup>5</sup> Any annual electricity production in excess of annual electricity consumption is credited to the utility account at the applicable wholesale rate based on the approved NEM tariffs for that utility. The net surplus compensation rates for the different utilities are as follows:

- PG&E: \$0.043 / kWh
- SCE: \$0.0298 / kWh<sup>6</sup>
- SDG&E: \$0.0321 / kWh<sup>7</sup>

*Table 4: IOU Utility Tariffs used based on Climate Zone*

Climate Zones	Electric / Gas Utility	Electricity (Standard)	Electricity (Time-of-use)	Natural Gas
1-5, 11-13, 16	PG&E	E1	E-TOU, Option A	G1
6, 8-10, 14, 15	SCE / SoCal Gas	D	TOU-D-T	GR
7	SDG&E	DR	DR-SES	GR

Cost effectiveness was evaluated for all sixteen climate zones and is presented according to lifecycle customer benefit-to-cost ratio. The benefit-to-cost ratio is a metric which represents the cost effectiveness of energy efficiency over a 30-year lifetime taking into account discounting of future savings and financing of incremental costs. A value of one indicates the savings over the life of the measure are equivalent to the incremental cost of that measure. A value greater than one represents a positive return on investment. The ratio is calculated as follows:

*Lifecycle Customer Benefit-Cost Ratio =*

$$(Annual\ utility\ cost\ savings * Lifecycle\ cost\ factor) / (First\ incremental\ cost * Financing\ factor)$$

The lifecycle cost factor is 19.6 and includes the following assumptions:

- 30-year measure life & utility cost savings
- 3% real discount rate
- No utility rate escalation (conservative assumption)

<sup>5</sup> Under NEM rulings by the CPUC (D-16-01-144, 1/28/16), all new PV customers shall be in an approved TOU rate structure. As of March 2016, all new PG&E net energy metering (NEM) customers are enrolled in a time-of-use rate.

(<http://www.pge.com/en/myhome/saveenergymoney/plans/tou/index.page?>).

<sup>6</sup> SCE net surplus compensation rate based on 1-year average September 2015 – August 2016.

<sup>7</sup> SDG&E net surplus compensation rate based on 1-year average August 2015 – July 2016.

The financing factor is 1.068 and includes the following assumptions:

- 30-year financing term
- 4.5% loan interest rate
- 3% real discount rate
- 20% average tax rate (to account for tax savings due to loan interest deductions)

Simple payback is also presented and is calculated using the equation below. Based on the terms described above the lifecycle cost-to-benefit ratio threshold of one is roughly equivalent to a simple payback of 18 years.

$$\text{Simple payback} = \text{First incremental cost} / \text{Annual customer utility cost savings}$$

## 2.6 Greenhouse Gas Emissions

Equivalent CO<sub>2</sub> emission savings were calculated using the following emission factors. Electricity factors are specific to California electricity production.

**Table 5: Equivalent CO<sub>2</sub> Emissions Factors**

		<i>Source</i>
<i>Electricity</i>	0.724 lb. CO <sub>2</sub> -e / kWh	U.S. Environmental Protection agency's 2007 eGRID data. <sup>8</sup>
<i>Natural Gas</i>	11.7 lb. CO <sub>2</sub> -e / Therm	Emission rates for natural gas combustion as reported by the U.S. Environmental Protection agency's GHG Equivalencies Calculator. <sup>9</sup>

<sup>8</sup> <https://www.epa.gov/energy/ghg-equivalencies-calculator-calculations-and-references>

<sup>9</sup> <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>

### 3 Results

Cost effective analysis including evaluating three efficiency packages and two PV performance packages was completed for all sixteen climate zones. Evaluations looked to identify cost effective Tier 1 and Tier 2 packages for both single family and multifamily prototypes at the CALGreen performance targets of 15% and 30%. When initial proposed packages were found to not be cost effective, multiple iterations were conducted to identify a cost effective package. In certain climates it was not feasible, and targets were subsequently relaxed to something more appropriate. In other climates no cost effective package could be identified. In almost every climate there was no cost effective way to achieve Tier 2 efficiency levels without the PV compliance credit, therefore all Tier 2 packages include PV. Because the PVCC is not available in climate zones 6 and 7, no Tier 2 packages were developed for those climates.

Since the results from this analysis are intended to support mandatory energy efficiency requirements, the authors intentionally selected proven cost-effective measures with wide market acceptance in typical residential construction. Achieving greater performance is feasible using advanced design strategies and measures.

#### 3.1 Single Family Results

##### 3.1.1 Single Family Cost Effectiveness Analysis

A comparison of cost effectiveness for each climate zone and five cases is presented in Figure 1. Table 6 and Table 7 provide the results in tabular form along with energy and greenhouse gas (GHG) savings for each efficiency and PV performance tier. Cost effectiveness results are presented for all three efficiency packages described previously (Envelope, Equipment, and PV Credit) as well as for the two PV performance packages (PV-Plus and TDV-Zero). A summary of measures included in each package is listed in Appendix B.1. The lifecycle benefit-to-cost ratio threshold of one is roughly equivalent to a simple payback of 18 years. Shaded rows in the tables reflect those cases which are not cost effective. While using high efficiency equipment is shown to result in the highest return on investment in many climates, it was necessary to find cost effective packages that do not require specification of equipment with efficiencies better than federally mandated values to avoid federal preemption prohibitions.

Tier 1 Envelope packages were found to be cost effective in climate zones 1 through 5 and 9 through 16. The Tier 1 threshold in climate zone 4 was reduced to 10% to meet the cost effectiveness criteria without installing equipment more efficient than federally mandated. No cost effective Tier 1 efficiency packages were identified in climate zones 6 through 8.

Table 7 presents results for the two PV performance packages including the PV capacity necessary to offset the specified TDV energy. The PV system capacity for the PV-Plus packages is sized based upon the values in Table 3 to provide approximately 80% of estimated annual kWh consumption. The required TDV-Zero PV capacity (as required to generate a TDV=0 compliance simulation result) ranges from 3.1 kW DC in the mild climates (CZ5 and 7) to 7.7 kW DC in hot climates (CZ15). In all cases the measures in these packages reflect those in the Tier 2 package, with the exception of climate zones 6 & 7 where they are based on the Tier 1 envelope package.

The PV-Plus cases demonstrate cost effectiveness with a benefit-to-cost ratio ranging from 1.08 to 1.49. Adding PV beyond the amount needed to offset electricity use reduces cost effectiveness in all cases. The Zero-TDV cases are cost effective in only four climate zones and benefit-cost ratios are consistently lower in all climates. This is impacted by the fact that the compliance model is based upon a home with natural gas space and water heating, thus when sizing PV to offset total house TDV, PV electricity generation is offsetting natural gas consumption. The customer is paid for excess electricity generation beyond what is consumed by the dwelling but only at the wholesale rate which is substantially lower than the retail rate.

Greenhouse gas (GHG) savings range from 4.1% to 12.7% for the envelope and equipment Tier 1 packages. Including the PV compliance credit increases GHG reductions to 39% on average. GHG reductions for the two PV packages average 50% and 77% for the PV-Plus and TDV-ZERO cases, respectively.

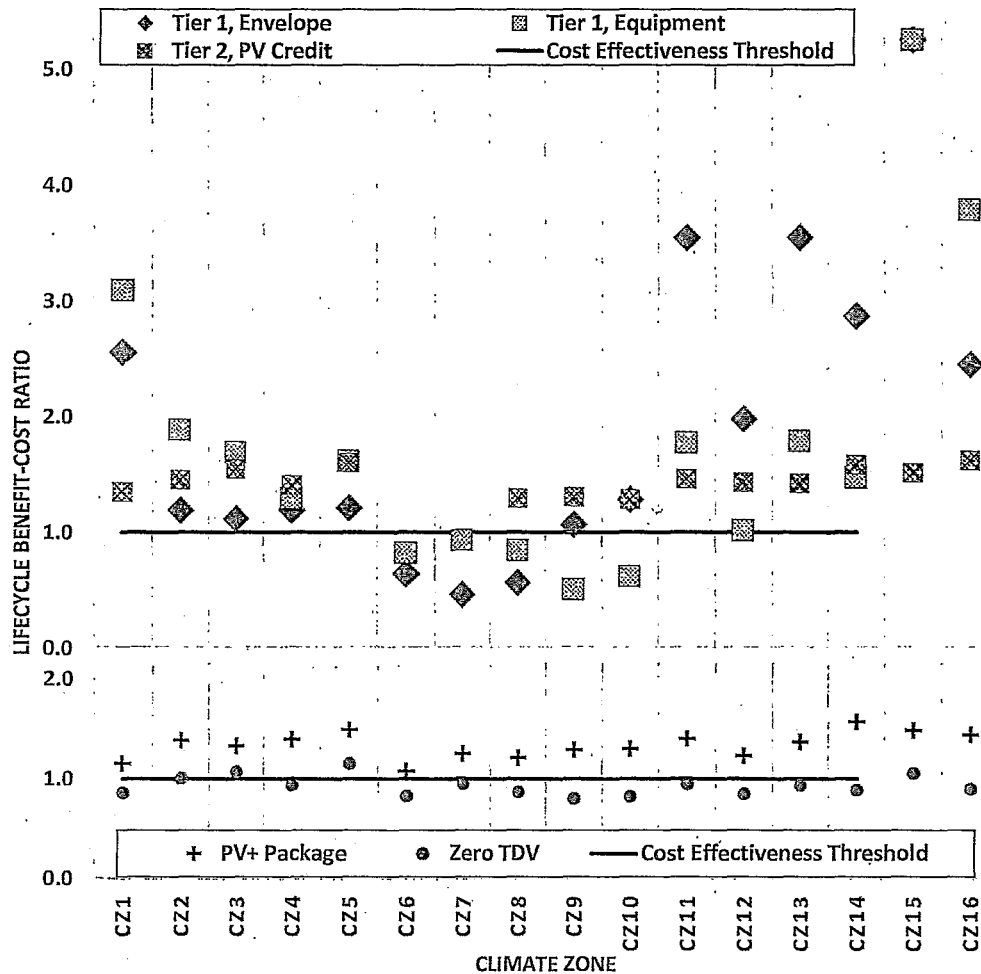


Figure 1: Single family cost effectiveness comparison

Table 6: Single Family Efficiency Package Cost Effectiveness Results<sup>1</sup>

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings <sup>2</sup>	Package Cost <sup>3</sup>	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
<b>Tier 1, Envelope Cases</b>								
CZ1	16.1%	67	83.7	10.7%	\$1,043	\$146	7.2	2.56
CZ2	15.8%	146	49.1	8.2%	\$1,617	\$105	15.4	1.20
CZ3	15.5%	32	43.6	7.7%	\$1,043	\$64	16.3	1.13
CZ4	12.0%	114	18.8	4.1%	\$808	\$53	15.3	1.20
CZ5	15.2%	27	39.3	7.3%	\$812	\$54	15.1	1.22
CZ6	8.7%	20	17.1	3.6%	\$571	\$20	28.4	0.65
CZ7	7.0%	9	9.7	2.3%	\$571	\$15	39.3	0.47
CZ8	8.9%	37	10.2	2.6%	\$571	\$18	32.1	0.57
CZ9	17.2%	169	11.1	4.1%	\$808	\$47	17.2	1.07
CZ10	17.2%	213	12.9	4.7%	\$808	\$57	14.2	1.29
CZ11	16.9%	460	25.9	7.1%	\$808	\$156	5.2	3.55
CZ12	16.4%	222	24.2	5.4%	\$808	\$87	9.3	1.98
CZ13	17.4%	485	22.1	7.0%	\$808	\$157	5.2	3.56
CZ14	16.4%	441	24.4	6.9%	\$808	\$127	6.4	2.88
CZ15	15.2%	896	4.7	8.1%	\$728	\$209	3.5	5.26
CZ16	15.8%	296	80.4	9.8%	\$1,456	\$195	7.5	2.46
<b>Tier 1, Equipment Cases</b>								
CZ1	19.3%	47	101.7	12.7%	\$999	\$169	5.9	3.10
CZ2	16.8%	34	67.0	9.7%	\$999	\$103	9.7	1.89
CZ3	15.3%	23	45.4	8.0%	\$681	\$63	10.8	1.69
CZ4	17.0%	103	45.4	8.3%	\$1,156	\$82	14.2	1.30
CZ5	16.9%	22	46.0	8.4%	\$681	\$60	11.3	1.62
CZ6	15.5%	20	36.2	7.3%	\$842	\$38	22.2	0.83
CZ7	15.6%	9	25.7	5.8%	\$681	\$35	19.6	0.94
CZ8	17.4%	68	25.1	6.0%	\$838	\$39	21.6	0.85
CZ9	16.9%	159	12.2	4.2%	\$1,650	\$46	35.8	0.51
CZ10	16.6%	203	14.2	4.9%	\$1,650	\$56	29.4	0.62
CZ11	17.3%	473	26.0	7.2%	\$1,650	\$160	10.3	1.78
CZ12	16.0%	247	22.7	5.4%	\$1,650	\$92	18.0	1.02
CZ13	17.9%	507	21.5	7.1%	\$1,650	\$161	10.2	1.79
CZ14	17.1%	458	26.4	7.3%	\$1,650	\$133	12.4	1.48
CZ15	15.2%	896	4.7	8.1%	\$728	\$209	3.5	5.26
CZ16	17.6%	58	123.7	12.6%	\$999	\$207	4.8	3.80

*2016 Energy Efficiency Ordinance Cost Effectiveness Study*

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings <sup>2</sup>	Package Cost <sup>3</sup>	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
Tier 2, Cases with PV Credit								
CZ1	32.2%	2,947	111.8	35.7%	\$10,576	\$781	13.5	1.36
CZ2	31.4%	3,227	132.7	46.9%	\$10,158	\$809	12.6	1.46
CZ3	21.8%	3,190	40.1	40.3%	\$8,644	\$731	11.8	1.55
CZ4	30.4%	3,353	21.8	36.6%	\$8,801	\$677	13.0	1.41
CZ5	22.0%	3,392	35.6	43.7%	\$8,413	\$737	11.4	1.61
CZ6	N/A - No PV Credit							
CZ7	N/A - No PV Credit							
CZ8	36.4%	3,290	10.2	44.0%	\$8,721	\$617	14.1	1.30
CZ9	35.0%	3,333	13.2	41.5%	\$8,333	\$595	14.0	1.31
CZ10	32.2%	3,517	15.4	42.3%	\$8,721	\$612	14.2	1.29
CZ11	31.2%	3,698	35.8	34.7%	\$9,420	\$752	12.5	1.47
CZ12	32.4%	3,386	27.9	33.8%	\$8,721	\$684	12.8	1.44
CZ13	31.3%	3,584	25.4	33.2%	\$9,189	\$715	12.9	1.43
CZ14	30.9%	4,366	26.4	39.4%	\$9,265	\$801	11.6	1.59
CZ15	32.2%	4,610	4.7	39.0%	\$9,265	\$767	12.1	1.52
CZ16	31.5%	3,881	80.4	31.8%	\$9,606	\$852	11.3	1.63
<sup>1</sup> Shaded rows reflect those cases which are not cost effective.								
<sup>2</sup> Based on CA electricity production and equivalent CO <sub>2</sub> emission rates of 0.724 lbCO <sub>2</sub> e / kWh & 11.7 lb-CO <sub>2</sub> e / therm.								
<sup>3</sup> Includes 10% markup for builder profit and overhead.								



Table 7: Single Family PV Performance Package Cost Effectiveness Results<sup>1</sup>

Climate Zone	Compliance Margin	PV Capacity (kW)	Elec Savings (kWh)	Gas Savings (therms)	GHG % Savings <sup>2</sup>	Package Cost <sup>3</sup>	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
<b>PV-Plus Package</b>									
CZ1	32.2%	3.0	4,178	111.8	45.0%	\$14,146	\$889	15.9	1.15
CZ2	31.4%	2.5	3,798	132.7	51.9%	\$11,575	\$872	13.3	1.38
CZ3	21.8%	2.6	4,082	40.1	49.7%	\$10,836	\$784	13.8	1.33
CZ4	30.4%	2.3	3,619	21.8	39.2%	\$9,441	\$716	13.2	1.39
CZ5	22.0%	2.3	3,838	35.6	48.6%	\$9,441	\$768	12.3	1.49
CZ6	10.8%	2.5	3,912	17.1	48.9%	\$10,294	\$604	17.0	1.08
CZ7	10.6%	2.2	3,556	9.7	51.5%	\$9,602	\$655	14.7	1.25
CZ8	36.4%	2.6	4,026	10.2	53.4%	\$10,525	\$693	15.2	1.21
CZ9	35.0%	2.5	4,092	13.2	50.3%	\$10,137	\$713	14.2	1.29
CZ10	32.2%	2.5	4,202	15.4	50.0%	\$10,351	\$733	14.1	1.30
CZ11	31.2%	3.5	5,728	35.8	51.1%	\$14,368	\$1,097	13.1	1.40
CZ12	32.4%	2.9	4,673	27.9	45.2%	\$11,903	\$799	14.9	1.23
CZ13	31.3%	3.7	5,863	25.4	52.1%	\$14,913	\$1,111	13.4	1.37
CZ14	30.9%	2.5	4,941	26.4	44.1%	\$10,507	\$900	11.7	1.57
CZ15	32.2%	4.6	8,600	4.7	72.2%	\$18,521	\$1,497	12.4	1.48
CZ16	31.5%	2.5	4,501	80.4	35.6%	\$11,022	\$866	12.7	1.44
<b>Zero-TDV Package</b>									
CZ1	32.2%	4.8	6,560	111.8	62.9%	\$21,054	\$987	21.3	0.86
CZ2	31.4%	4.0	6,200	132.7	72.9%	\$17,532	\$960	18.3	1.01
CZ3	21.8%	3.5	5,557	40.1	65.2%	\$14,465	\$845	17.1	1.07
CZ4	30.4%	3.9	6,252	21.8	65.3%	\$15,786	\$808	19.5	0.94
CZ5	22.0%	3.2	5,411	35.6	65.9%	\$13,070	\$821	15.9	1.15
CZ6	10.8%	3.5	5,530	17.1	68.3%	\$14,271	\$644	22.2	0.83
CZ7	10.6%	3.1	5,083	9.7	72.4%	\$13,221	\$686	19.3	0.95
CZ8	36.4%	3.7	5,821	10.2	76.3%	\$14,930	\$705	21.2	0.87
CZ9	35.0%	4.3	7,090	13.2	85.4%	\$17,258	\$756	22.8	0.80
CZ10	32.2%	4.3	7,103	15.4	82.5%	\$17,258	\$776	22.2	0.83
CZ11	31.2%	6.1	9,908	35.8	85.0%	\$24,555	\$1,269	19.3	0.95
CZ12	32.4%	5.1	8,094	27.9	75.4%	\$20,363	\$944	21.6	0.85
CZ13	31.3%	6.4	10,075	25.4	87.1%	\$25,488	\$1,299	19.6	0.94
CZ14	30.9%	5.5	10,295	26.4	88.0%	\$22,072	\$1,068	20.7	0.89
CZ15	32.2%	7.7	13,811	4.7	115.5%	\$30,610	\$1,762	17.4	1.06
CZ16	31.5%	5.2	9,147	80.4	64.2%	\$21,636	\$1,061	20.4	0.90

<sup>1</sup> Shaded rows reflect those cases which are not cost effective.<sup>2</sup> Based on CA electricity production and equivalent CO<sub>2</sub> emission rates of 0.724 lbCO<sub>2</sub>e / kWh & 11.7 lb-CO<sub>2</sub>e / therm.<sup>3</sup> Includes 10% markup for builder profit and overhead.

### 3.1.2 Single Family Package Recommendations

Based on the single family cost effective analysis, two reach code packages were developed, an efficiency package and a PV package as described below. Table 8 and Table 9 summarize the measures used to cost effectively meet the performance targets for each package.

**Tier 1 Efficiency only:** Where cost effective packages were identified, the 15% compliance margin target, consistent with CALGreen Tier 1 were used. As stated earlier, a cost effective 15% package was not identified for climate zone 4, so a 10% compliance margin target was used. No cost effective efficiency only packages were identified for climate zones 6 through 8.

**Table 8: Single Family Efficiency Only: Cost Effective Measures Summary**

Climate Zone	Compliance Margin Target	QII	ACH50	Window U-value / SHGC	Door U-value	AH Fan W/cfm	HW Pipe Insul.
CZ1	15%	Y		.30/.50	0.20		Y
CZ2	15%	Y	3	.30/.23	0.20	0.30	Y
CZ3	15%	Y		.30/.50	0.20		Y
CZ4	10%	Y		.30/.23		0.30	
CZ5	15%	Y		.30/.50			Y
CZ6		No package					
CZ7		No package					
CZ8		No package					
CZ9	15%	Y		.30/.23		0.30	
CZ10	15%	Y		.30/.23		0.30	
CZ11	15%	Y		.30/.23		0.30	
CZ12	15%	Y		.30/.23		0.30	
CZ13	15%	Y		.30/.23		0.30	
CZ14	15%	Y		.30/.23		0.30	
CZ15	15%	Y				0.30	
CZ16	15%	Y	3	.30/.23	0.20	0.3	

**PV-Plus:** Cost effective packages with efficiency and PV were identified in all 16 climate zones, but the compliance margin targets were lowered to 20% for climates 3 and 5, and to 10% for 6 and 7. Table 9 summarizes the measures used in each climate zone to cost effectively meet the targets. It is assumed that the PV compliance credit can be used to meet all these targets, except in climate zones 6 and 7. It is also assumed that a PV system is installed per the methodology described in Table 3 and consistent with the CEC Solar PV Ordinance.

**Table 9: Single Family PV-Plus: Cost Effective Measures Summary**

Climate Zone	Compliance Margin Target	QII	ACH50	Window U-value / SHGC	Door U-value	HPA	AH Fan W/cfm	HW Pipe Insul.	PV Capacity (kW)
CZ1	30%	Y	3	.30/.50	0.20	Y		Y	3.0
CZ2	30%	Y		.30/.50	0.20	Y		Y	2.5
CZ3	20%	Y		.30/.50	0.20				2.6
CZ4	30%	Y		.30/.23					2.3
CZ5	20%	Y		.30/.50					2.3
CZ6	10%	Y					0.30		2.5
CZ7	10%	Y		.30/.23	0.20		0.30	Y	2.2
CZ8	30%	Y							2.6
CZ9	30%	Y							2.5
CZ10	30%	Y							2.5
CZ11	30%	Y		.30/.23	0.20				3.5
CZ12	30%	Y							2.9
CZ13	30%	Y		.30/.23					3.7
CZ14	30%	Y					0.30		2.5
CZ15	30%	Y					0.30		4.6
CZ16	30%	Y	3	.30/.23	0.20		0.30		2.5

### 3.2 Multifamily Results

It is generally more challenging to achieve equivalent savings targets for the multifamily cases than for the single family cases. With less exterior surface area per floor area the impact of envelope measures is diminished in multifamily buildings. The PV credit is also much smaller because it is offsetting only high performance walls; high performance attic is not applied to the multifamily prescriptive design because ducts are already assumed to be within conditioned space. Shaded rows in the tables below indicate cases that don't meet the 15% target for Tier 1 or don't have feasible Tier 2 packages.

#### 3.2.1 Multifamily Cost Effectiveness Analysis

A comparison of cost effectiveness for the multi-family prototype is presented in Figure 2. Table 10 and Table 11 provide the results in tabular form, along with energy and greenhouse gas savings for the efficiency and PV performance tiers, respectively. *All multifamily results are presented on a per dwelling unit basis.* Cost effectiveness results are presented for all of the three efficiency packages described previously (envelope, equipment, and PV compliance credit) as well as for the two PV performance packages (PV-Plus and TDV-Zero). A summary of measures included in each package is listed in Appendix B.2. The lifecycle benefit-to-cost ratio threshold of one is roughly equivalent to a simple payback of 18 years. Shaded rows in the tables reflect those cases which aren't cost effective. While using high efficiency equipment is shown to result in an improved return on investment in many climates, it was necessary to find cost effective packages that do not require specification of equipment with efficiencies better than federally mandated values. It can be noted that since rental rates are determined primarily by location, tenants may not experience increased rents due to the cost of efficiency measures. If this is the case, the tenants have no costs and only the benefit of lower energy utility costs.

Tier 1, Envelope packages were found to be cost effective in climate zones 1, and 10 through 16, although the threshold for climate zone 10 was lowered to 10% to meet the cost effectiveness criteria. QII alone was found to be cost effective in climate zone 2 but a cost effective 10% package requires using the PV

compliance credit. No cost effective Tier 1, Envelope efficiency packages were identified in climate zones 3 through 9 without the addition of high efficiency equipment or PV.

Table 11 summarizes the cost effectiveness of the PV performance packages. PV capacity required to meet the required TDV energy offset for each case is also included. The PV capacity for the PV-Plus packages are sized the same as for the single family analysis and based upon the values in Table 3. The required TDV-Zero PV capacity per apartment ranges from 1.9 kW DC in the mild climates to 3.7 kW DC in hot climates (CZ15). For the multifamily prototype 8-unit apartment building, this is equivalent to 15.2 to 29.6 kW for the building. In all cases the measures in these packages reflect those in the Tier 2 package, with the exception of climate zones 6 & 7 where they are based on the Tier 1 envelope package.

The PV-Plus cases demonstrate cost effectiveness with a benefit-to-cost ratio ranging from 1.01 to 1.66. Similar to the single family analysis, while PV is cost effective in offsetting electricity use, adding PV to meet a zero TDV design reduces cost effectiveness in all cases with only two climates having a value greater than 1.

Greenhouse gas (GHG) savings range from 2.2% to 8.6% for the envelope and equipment Tier 1 packages. Including the PV compliance credit increases GHG reductions to 34% on average. GHG reductions for the two PV packages average 49% and 78% for the PV-Plus and ZN-TDV cases, respectively.

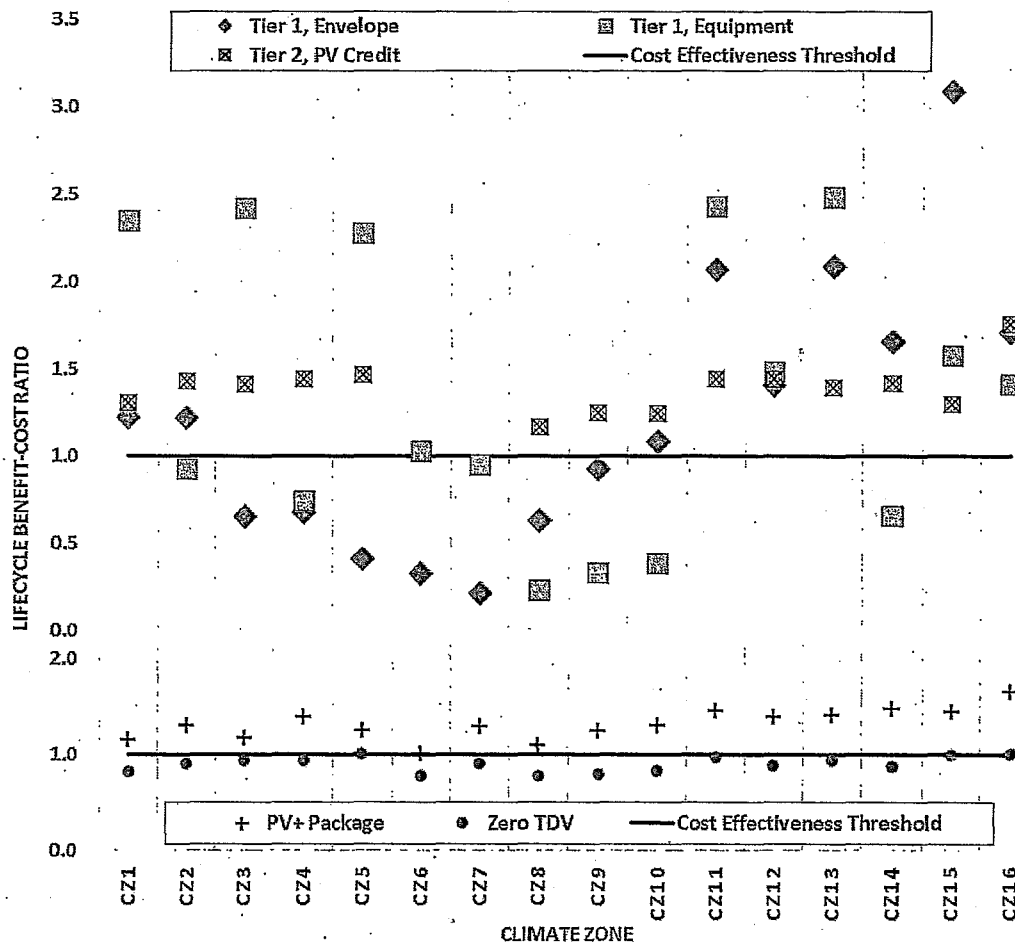


Figure 2: Multifamily cost effectiveness comparison

Table 10: Multifamily Efficiency Cost Effectiveness Results<sup>1</sup>

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings <sup>2</sup>	Package Cost <sup>3</sup>	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
Tier 1, Envelope Cases								
CZ1	16.5%	31	28.0	8.0%	\$559	\$37	15.0	1.22
CZ2	4.8%	7	7.3	2.2%	\$146	\$10	15.0	1.22
CZ3	10.9%	-3	14.3	4.5%	\$444	\$16	28.1	0.65
CZ4	10.9%	45	4.6	2.3%	\$364	\$14	26.9	0.68
CZ5	10.2%	-4	13.3	4.2%	\$641	\$14	45.1	0.41
CZ6	11.7%	19	7.7	3.0%	\$559	\$10	55.7	0.33
CZ7	10.2%	10	4.3	1.7%	\$641	\$7	87.3	0.21
CZ8	10.5%	55	1.2	1.5%	\$282	\$10	29.0	0.63
CZ9	12.3%	79	2.0	2.2%	\$282	\$14	19.7	0.93
CZ10	10.1%	92	2.5	2.6%	\$282	\$17	16.9	1.08
CZ11	17.7%	186	13.2	6.5%	\$436	\$49	8.9	2.07
CZ12	17.1%	103	12.6	5.4%	\$436	\$33	13.1	1.41
CZ13	18.1%	200	11.3	6.3%	\$436	\$50	8.8	2.09
CZ14	17.8%	176	12.9	6.3%	\$436	\$39	11.1	1.66
CZ15	17.7%	426	0.6	6.8%	\$436	\$73	5.9	3.09
CZ16	16.3%	91	29.9	8.0%	\$559	\$52	10.7	1.71
Tier 1, Equipment Cases								
CZ1	16.7%	8	31.7	8.6%	\$290	\$37	7.8	2.35
CZ2	15.0%	7	27.3	8.0%	\$642	\$32	19.8	0.93
CZ3	12.4%	1	16.9	5.4%	\$146	\$19	7.6	2.42
CZ4	16.3%	11	25.5	8.0%	\$765	\$31	24.8	0.74
CZ5	11.8%	-3	16.6	5.3%	\$146	\$18	8.1	2.28
CZ6	12.1%	1	16.4	5.6%	\$269	\$15	17.8	1.03
CZ7	12.5%	-1	15.9	5.5%	\$379	\$20	19.3	0.95
CZ8	15.2%	83	1.2	2.1%	\$1,133	\$14	80.4	0.23
CZ9	15.7%	106	2.0	2.8%	\$1,029	\$19	55.4	0.33
CZ10	15.5%	124	2.5	3.2%	\$1,029	\$22	47.2	0.39
CZ11	16.5%	202	6.3	5.0%	\$333	\$44	7.5	2.43
CZ12	15.0%	109	6.1	3.6%	\$333	\$27	12.4	1.48
CZ13	15.4%	199	5.1	4.6%	\$311	\$42	7.4	2.48
CZ14	16.5%	201	6.1	4.9%	\$1,029	\$37	27.7	0.66
CZ15	20.4%	515	0.4	8.2%	\$1,029	\$89	11.6	1.58
CZ16	15.7%	86	29.8	7.9%	\$668	\$51	13.0	1.41

*2016 Energy Efficiency Ordinance Cost Effectiveness Study*

Climate Zone	T-24 Comp. Margin	Elec Savings (kWh)	Gas Savings (therms)	% GHG Savings <sup>2</sup>	Package Cost <sup>3</sup>	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
<b>Tier 2, Cases with PV Credit</b>								
CZ1	21.0%	1,370	28.0	30.2%	\$4,085	\$291	14.1	1.31
CZ2	20.4%	<b>1,608</b>	17.2	33.7%	\$4,085	\$318	12.8	1.43
CZ3	15.3%	1,585	14.1	35.7%	\$4,085	\$315	13.0	1.41
CZ4	26.9%	1,654	13.6	35.6%	\$4,085	\$321	12.7	1.44
CZ5	12.4%	1,677	13.3	37.7%	\$4,085	\$326	12.5	1.46
CZ6	N/A - No PV credit							
CZ7	N/A - No PV credit							
CZ8	21.0%	1,622	5.7	35.3%	\$4,085	\$260	15.7	1.17
CZ9	26.8%	1,719	4.0	35.4%	\$3,963	\$270	14.7	1.25
CZ10	26.2%	1,734	4.9	35.2%	\$3,963	\$269	14.7	1.25
CZ11	26.5%	1,778	13.2	32.6%	\$3,963	\$311	12.7	1.44
CZ12	26.5%	1,673	12.6	32.8%	\$3,963	\$312	12.7	1.44
CZ13	27.3%	1,746	11.3	31.8%	\$3,963	\$301	13.2	1.39
CZ14	26.0%	1,973	12.9	36.0%	\$3,963	\$307	12.9	1.42
CZ15	25.4%	2,100	0.6	33.0%	\$3,963	\$281	14.1	1.30
CZ16	25.7%	1,734	42.4	33.8%	\$3,848	\$369	10.4	1.76
<sup>1</sup> Shaded rows reflect those cases which are not cost effective.								
<sup>2</sup> Based on CA electricity production and equivalent CO <sub>2</sub> emission rates of 0.724 lbCO <sub>2</sub> e / kWh & 11.7 lb-CO <sub>2</sub> e / therm.								
<sup>3</sup> Includes 10% markup for builder profit and overhead.								

Table 11: Multifamily PV Performance Cost Effectiveness Results<sup>1</sup>

Climate Zone	Compliance Margin	PV Capacity (kW)	Elec Savings (kWh)	Gas Savings (therms)	GHG % Savings <sup>2</sup>	Package Cost <sup>3</sup>	Utility Cost Savings	Simple Payback	Lifecycle Benefit-Cost Ratio
<b>PV-Plus Package</b>									
CZ1	21.0%	1.6	2,172	28.0	43.5%	\$6,201	\$393	15.8	1.16
CZ2	20.4%	1.4	2,234	17.2	44.9%	\$5,496	\$393	14.0	1.31
CZ3	15.3%	1.5	2,374	14.1	51.2%	\$5,849	\$377	15.5	1.18
CZ4	26.9%	1.3	2,137	13.6	44.8%	\$5,143	\$391	13.1	1.40
CZ5	12.4%	1.4	2,350	13.3	51.1%	\$5,496	\$375	14.7	1.25
CZ6	11.7%	1.5	2,388	7.7	52.5%	\$5,849	\$322	18.1	1.01
CZ7	10.2%	1.3	2,139	4.3	48.0%	\$5,226	\$369	14.2	1.30
CZ8	21.0%	1.5	2,413	5.7	51.6%	\$5,849	\$350	16.7	1.10
CZ9	26.8%	1.4	2,372	4.0	48.4%	\$5,373	\$369	14.6	1.26
CZ10	26.2%	1.4	2,386	4.9	47.9%	\$5,373	\$383	14.0	1.31
CZ11	26.5%	1.7	2,893	13.2	50.8%	\$6,431	\$514	12.5	1.47
CZ12	26.5%	1.5	2,457	12.6	46.5%	\$5,726	\$437	13.1	1.40
CZ13	27.3%	1.8	2,982	11.3	52.2%	\$6,784	\$525	12.9	1.42
CZ14	26.0%	1.3	2,512	12.9	44.9%	\$5,021	\$406	12.4	1.49
CZ15	25.4%	2.1	3,940	0.6	61.8%	\$7,842	\$618	12.7	1.45
CZ16	25.7%	1.3	2,244	42.4	40.9%	\$4,906	\$444	11.1	1.66
<b>Zero-TDV Package</b>									
CZ1	21.0%	2.5	3,415	28.0	64.2%	\$9,476	\$424	22.3	0.82
CZ2	20.4%	2.3	3,674	17.2	70.7%	\$8,741	\$433	20.2	0.91
CZ3	15.3%	2.0	3,233	14.1	68.1%	\$7,767	\$400	19.4	0.94
CZ4	26.9%	2.2	3,587	13.6	72.4%	\$8,320	\$429	19.4	0.95
CZ5	12.4%	1.9	3,189	13.3	67.8%	\$7,254	\$399	18.2	1.01
CZ6	11.7%	2.1	3,356	8.0	72.7%	\$8,011	\$341	23.5	0.78
CZ7	10.2%	2.1	3,383	4.0	75.0%	\$7,903	\$394	20.0	0.92
CZ8	21.0%	2.4	3,768	5.7	79.6%	\$8,869	\$379	23.4	0.78
CZ9	26.8%	2.5	4,124	4.0	83.1%	\$9,154	\$403	22.7	0.81
CZ10	26.2%	2.5	4,115	4.9	81.5%	\$9,115	\$415	22.0	0.84
CZ11	26.5%	3.0	4,979	13.2	84.9%	\$11,052	\$586	18.9	0.97
CZ12	26.5%	2.8	4,509	12.6	82.3%	\$10,336	\$503	20.6	0.89
CZ13	27.3%	3.2	5,129	11.3	87.6%	\$11,681	\$603	19.4	0.95
CZ14	26.0%	2.7	5,056	12.9	86.8%	\$10,014	\$482	20.8	0.88
CZ15	25.4%	3.7	6,571	0.6	102.9%	\$13,389	\$726	18.4	0.99
CZ16	25.7%	2.6	4,398	42.4	71.0%	\$9,379	\$514	18.2	1.01

<sup>1</sup> Shaded rows reflect those cases which are not cost effective.<sup>2</sup> Based on CA electricity production and equivalent CO<sub>2</sub> emission rates of 0.724 lbCO<sub>2</sub>e / kWh & 11.7 lb-CO<sub>2</sub>e / therm.<sup>3</sup> Includes 10% markup for builder profit and overhead.

### 3.2.2 Multifamily Package Recommendations

Based on the multifamily cost effective analysis, two reach code packages were developed, similar to the single family packages. Table 12 and Table 13 summarize the measures used to cost effectively meet the performance targets for each multifamily package.

**Tier 1 Efficiency only:** Where cost effective packages were identified, the 15% compliance margin target, consistent with CALGreen Tier 1 were used. As stated earlier, a cost effective 15% package was not identified for climate zone 10, so a 10% compliance margin target was used, and only QII was cost effective in climate zone 2. Additionally, no cost effective efficiency only packages were identified for climate zones 3 through 9.

**Table 12: Multifamily Efficiency Only: Cost Effective Measures Summary**

Climate Zone	Compliance Margin Target	QII	Window U-value / SHGC	Door U-value	AH Fan W/cfm	Refrigerant Charge	HW Comp. Dist.
CZ1	15%	Y	0.30/0.50	0.20	0.3		Y
CZ2	QII Only	Y					
CZ3				No package			
CZ4				No package			
CZ5				No package			
CZ6				No package			
CZ7				No package			
CZ8				No package			
CZ9				No package			
CZ10	10%	Y	0.30/0.23		0.3		
CZ11	15%	Y	0.30/0.23	0.20	0.3		
CZ12	15%	Y	0.30/0.23	0.20	0.3		
CZ13	15%	Y	0.30/0.23	0.20	0.3		
CZ14	15%	Y	0.30/0.23	0.20	0.3		
CZ15	15%	Y	0.30/0.23	0.20	0.3		
CZ16	15%	Y	0.30/0.23	0.20	0.3		Y

**PV-Plus:** Cost effective packages with efficiency and PV were identified in all 16 climate zones, but the compliance margin targets in all climates were lowered below 30% in all cases to be cost effective. Table 13 summarizes the compliance margin targets in each climate zone and the measures used to cost effectively meet the targets. As with the single family packages, with the exception of climate zones 6 and 7, it is assumed that the PV compliance credit can be used to meet these targets. It is also assumed that a PV system is installed per the methodology developed for the proposed Solar PV ordinance (Table 3).



**Table 13: Multifamily PV-Plus: Cost Effective Measures Summary**

Climate Zone	Compliance Margin Target	QII	Window U-value / SHGC	Door U-value	AH Fan W/cfm	HW Comp. Dist.	PV Capacity (kW)
CZ1	20%	Y	0.30/0.50	0.20	0.3	Y	1.6
CZ2	20%	Y	0.30/0.23	0.20	0.3	Y	1.4
CZ3	15%	Y	0.30/0.50	0.20	0.3	Y	1.5
CZ4	25%	Y	0.30/0.23	0.20	0.3	Y	1.3
CZ5	10%	Y	0.30/0.50	0.20	0.3	Y	1.4
CZ6	10%	Y	0.30/0.23	0.20			1.5
CZ7	10%	Y	0.30/0.23	0.20			1.3
CZ8	20%	Y	0.30/0.23	0.20	0.3	Y	1.5
CZ9	25%	Y	0.30/0.23	0.20	0.3		1.4
CZ10	25%	Y	0.30/0.23	0.20	0.3		1.4
CZ11	25%	Y	0.30/0.23	0.20	0.3		1.7
CZ12	25%	Y	0.30/0.23	0.20	0.3		1.5
CZ13	25%	Y	0.30/0.23	0.20	0.3		1.8
CZ14	25%	Y	0.30/0.23	0.20	0.3		1.3
CZ15	25%	Y	0.30/0.23	0.20	0.3		2.1
CZ16	25%	Y	0.30/0.23	0.20			1.3

## 4 Conclusions & Summary

This report evaluated the feasibility and cost effectiveness of “above code” ordinance performance tiers through the application of both efficiency measures and PV in all 16 California climates zones. For this analysis, PG&E rates were used for gas and electricity in climate zones 1 through 5, 11 through 13, and 16. SCE electricity rates and Southern California Gas rates were used for climate zones 6, 8 through 10, 14 and 15. SDG&E rates were used for electricity and gas for climate zone 7.

The following describes the recommended performance levels for the above-code ordinance packages. The original intent was to develop packages that align with the tiers as defined in the 2016 CALGreen code. Based on the analysis results, performance thresholds were reduced in some climates and eliminated altogether in other climates. Identifying cost effective efficiency (only) packages was particularly challenging in multifamily buildings. Table 14 and Table 15 summarize recommended cost effective ordinance criteria by climate zone for single family and multifamily buildings, respectively. Where cost effective packages exist, there is both a Tier 1 efficiency only package and the efficiency with PV (PV-Plus) package. The tables include the Title 24 compliance target needed to meet the criteria for each package. Tier 1 compliance targets are compliance margins for efficiency measures only and are designed to be met without using the PV Compliance Credit. The PV-Plus compliance targets are for projects that include PV. The efficiency targets are set higher, but assume that the PV compliance credit (PVCC) is used to meet the performance targets. The efficiency targets are set lower for climate zones 6 and 7 because projects built in these climate zones are not eligible to take the PVCC.

Following is a summary of the differences between the two packages defined in this analysis and the tiers defined in CALGreen.

**Tier 1 Packages:** CALGreen defines Tier 1 as showing a 15% or greater Title 24 compliance margin compared to the Standard Design. The intent of the Efficiency tier in this study was to find cost effective packages of measures that meet the CALGreen Tier 1 criteria without mandating the installation of PV or high efficiency equipment that exceed federal minimum levels. To encourage adoption of efficiency measures in preparation for the 2019 Title-24 code, the authors recommend that PV not be allowed as a means to meet the Tier 1 compliance requirements. Based on the lifecycle benefit-to-cost ratio metric applied in this analysis, cost effectiveness results for the single family and low-rise multifamily homes show that there exist multiple cost effective packages to meet Tier 1. There are several climates where the compliance margin targets are lowered to maintain the cost effectiveness criteria and other climates where no cost effective efficiency packages were identified.

**PV-Plus Packages:** CALGreen defines both Tier 2 and ZNE Tier performance levels. The ZNE Tier requires that the building meet the required efficiency targets as defined in Section A4.203.1.2.3 of 2016 CALGreen and size a PV system to offset 100% of the TDV energy of the building (achieve an Energy Design Rating of 0). The results of this work, based on dwellings with gas and electricity, found that sizing the PV system to meet the ZNE Tier criteria was generally not cost effective or in some limited cases, marginally cost effective. Instead a PV and efficiency package (PV-Plus) was developed that limited the size of the PV system to no larger than the annual estimated electricity use of the building and combine it with efficiency measures that are cost effective in all climate zones. Lifecycle benefit-to-cost ratio for the PV-Plus cases for both the single family and multifamily prototypes are all above one. In cases where PV capacity in the PV-Plus package is less than the minimum to meet the PV compliance credit, it's recommended that jurisdictions allow the smaller PV capacity be installed and still qualify for the PVCC to avoid sizing the PV systems larger than the estimated electricity use.

**Table 14: Single Family Reach Code Package Recommendations**

Packages	Climate Zones	T-24 Compliance Target	PVCC Allowed	PV
Tier 1 Efficiency Only Package	1-3, 5, 9-16	15%	No	n/a
	4	10%	No	n/a
PV-Plus Package	1,2,4, 8-16	30%	Yes	Yes
	3,5	20%	Yes	Yes
	6-7	10%	n/a	Yes

**Table 15: Multifamily Reach Code Package Recommendations**

Packages	Climate Zones	T-24 Compliance Target	PVCC Allowed	PV
Tier 1 Efficiency Only Package	1, 11-16	15%	No	n/a
	10	10%	No	n/a
	2	QII	No	n/a
PV-Plus Package	4, 9-16	25%	Yes	Yes
	1-2, 8	20%	Yes	Yes
	3	15%	Yes	Yes
	5	10%	Yes	Yes
	6-7	10%	n/a	Yes

Consistent with CALGreen, a pre-requisite for all packages includes HERS verification of Quality Insulation Installation (QII).

The recommended packages do not include a TDV-Zero option because these packages were generally not found to be cost effective. Lifecycle benefit-to-cost ratios for the single family TDV-Zero packages are 0.78 to 1.07. Limited cost effectiveness is largely a result of oversizing the PV systems relative to the house electricity load. With mixed fuel homes, PV electricity generation offsets natural gas consumption when sizing relative to zero TDV. The consumer is compensated by the utility for electricity generation in excess of annual consumption, but only at the wholesale rate which is substantially lower than the retail rate. Consideration of dwellings without gas was not in the scope of this study.

In conclusion, this report has identified cost effective options to meet above-code performance levels for dwellings using natural gas and electricity which can be adopted by cities and counties within investor-owned utility territories across California. Including PV to the level of offsetting electricity loads was found to be cost effective in all sixteen climate zones evaluated as summarized above.

## 5 References

CEC. 2016a. 2016 Alternative Calculation Method Approval Manual. CEC-400-2015-039-CMF. June 2015. California Energy Commission. <http://www.energy.ca.gov/2015publications/CEC-400-2015-039/CEC-400-2015-039-CMF.pdf>

CEC. 2016b. 2016 Building Energy Efficiency Standards for Residential and Nonresidential Buildings. CEC-400-2015-037-CMF. June 2015. California Energy Commission.

<http://www.energy.ca.gov/2015publications/CEC-400-2015-037/CEC-400-2015-037-CMF.pdf>

CEC. 2016c. 2016 Reference Appendices. CEC-400-2015-038-CMF. June 2015. California Energy Commission. <http://www.energy.ca.gov/2015publications/CEC-400-2015-038/CEC-400-2015-038-CMF.pdf>

CEC. 2016d. 2016 Residential Alternative Calculation Method Reference Manual. CEC-400-2015-024-CMF-REV. June 2017. California Energy Commission.

<http://www.energy.ca.gov/2015publications/CEC-400-2015-024/CEC-400-2015-024-CMF-REV.pdf>

Horii, B., E. Cutter, N. Kapur, J. Arent, and D. Conotyannis. 2014. "Time Dependent Valuation of Energy for Developing Building Energy Efficiency Standards."

[http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09\\_workshop/2017\\_TDV\\_Documents/](http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09_workshop/2017_TDV_Documents/)

## Appendix A – Prescriptive Package

The following presents the residential prescriptive package as printed in the 2016 Building Energy Efficiency Standards (CEC, 2016b).

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN

			C																	
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16		
Building Envelope Insulation	Roofs/ Ceilings	Option A (meets §150.1(c)9A)	Continuous Insulation Above Roof Rafter	Roofing Type	No Air Space <sup>1</sup>	NR	NR	NR	R 8	NR	NR	NR	R 8	R 8	R 8	R 8	R 8	R 8	R 8	R 8
				With Air Space <sup>2</sup>	NR	NR	NR	R 6	NR	NR	NR	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6	R 6
			Ceiling Insulation	R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Option B (meets §150.1(c)9A)	Below Roof Deck Insulation	Roofing Type	No Air Space	NR	NR	NR	R 18	NR	NR	NR	R 18	R 18	R 18	R 18	R 18	R 18	R 18	R 18
				With Air	NR	NR	NR	R 13	NR	NR	NR	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13	R 13
			Ceiling Insulation	R 38	R 38	R 30	R 38	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant Barrier	NR	REQ	REQ	NR	REQ	REQ	REQ	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
		Option C (meets	Ceiling Insulation	R 38	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 30	R 38	R 38	R 38	R 38	R 38	R 38	R 38
			Radiant	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

				Climate Zone															
				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Building Envelope Insulation	Walls	Above Grade	Framed <sup>4</sup>	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.065	U 0.065	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051	U 0.051
			Mass Wall Interior <sup>5</sup>	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.059 R 17
			Mass Wall Exterior <sup>6</sup>	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.125 R 8.0	U 0.1025 R 8.0	U 0.125 R 8.0	U 0.070 R 13
		Below Grade	Below Grade Interior <sup>7</sup>	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.070 R 13	U 0.066 R 15
			Below Grade Exterior	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.200 R 5.0	U 0.100 R 10	U 0.100 R 10	U 0.053 R 19
	Floors	Slab Perimeter		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	U 0.58 R 7.0
		Raised		U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19	U 0.037 R 19
		Concrete Raised		U 0.092 R 8.0	U 0.092 R 8.0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.269 R 0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0	U 0.092 R 8.0	U 0.138 R 4.0	U 0.092 R 8.0
Building Envelope	Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.63	NR	0.63	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR
		Steep Sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
			Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
Building Envelope	Fenestration	Maximum U-factor		0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
		Maximum SHGC		NR	0.25	NR	0.25	NR	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
		Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
		Maximum West Facing Area		NR	5%	NR	5%	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%

TABLE 150.1-A COMPONENT PACKAGE-A STANDARD BUILDING DESIGN (CONTINUED)

			Climate Zone																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
HVAC SYSTEM	Space Heating <sup>11</sup>	Electric-Resistance Allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
		If gas, AFUE		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
		If Heat Pump, HSPF <sup>9</sup>		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
	Space cooling	SEER		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
		Refrigerant Charge Verification or Fault Indicator Display		NR	REQ	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
		Whole House Fan <sup>10</sup>		NR	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR	NR
	Central System Air Handlers	Central Fan Integrated Ventilation System Fan Efficacy		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	
	Ducts <sup>12</sup>	Roof/Ceiling Options A & B	Duct Insulation	R-8	R-8	R-6	R-8	R-6	R-6	R-6	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	
			\$150.1(c)9A	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
		Roof/Ceiling	Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6	R-6
			\$150.1(c)9B	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Water Heating	All Buildings		System Shall meet Section 150.1(c)8																

**Footnote requirements to TABLE 150.1-A:<sup>10</sup>**

1. Install the specified R-value with no air space present between the roofing and the roof deck.
2. Install the specified R-value with an air space present between the roofing and the roof deck. Such as standard installation of concrete or clay tile.
3. R-values shown for below roof deck insulation are for wood-frame construction with insulation installed between the framing members.
4. Assembly U-factors can be met with cavity insulation alone or with continuous insulation alone, or with both cavity and continuous insulation that results in an assembly U-factor equal to or less than the U-factor shown. Use Reference Joint Appendices JA4 Table 4.3.1, 4.3.1(a), or Table 4.3.4 to determine alternative insulation products to meet the required maximum U-factor.
5. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. "Interior" denotes insulation installed on the inside surface of the wall.
6. Mass wall has a thermal heat capacity greater than or equal to 7.0 Btu/h-ft<sup>2</sup>. "Exterior" denotes insulation installed on the exterior surface of the wall.
7. Below grade "interior" denotes insulation installed on the inside surface of the wall.
8. Below grade "exterior" denotes insulation installed on the outside surface of the wall.
9. HSPF means "heating seasonal performance factor."
10. When whole house fans are required (REQ), only those whole house fans that are listed in the Appliance Efficiency Directory may be installed. Compliance requires installation of one or more WHFs whose total airflow CFM is capable of meeting or exceeding a minimum 1.5 cfm/square foot of conditioned floor area as specified by Section 150.1(c)12.
11. 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 kilowatts or 7,000 Btu/hr and is controlled by a timelimiting device not exceeding 30 minutes.
12. For duct and air handler location: REQ denotes location in conditioned space. When the table indicates ducts and air handlers are in conditioned space, a HERS verification is required as specified by Reference Residential Appendix RA3.1.4.3.8.

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<sup>10</sup> Single family buildings are modeled with Option B and multifamily buildings are modeled with Option C.



## Appendix B.1 – Single Family Package Summaries

Table 16: Single Family Tier Packages

Climate Zone	QII	ACH50	Window U-value / SHGC	Door U-value	HPA	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	DHW EF	HW Pipe Insul.	PV Credit Size (kW)	T-24 Comp. Margin
<b>Tier 1, Envelope Cases</b>												
CZ1	Y		.30/.50	0.20						Y		16.1%
CZ2	Y	3	.30/.23	0.20				0.30		Y		15.8%
CZ3	Y		.30/.50	0.20						Y		15.5%
CZ4	Y		.30/.23					0.30				12.0%
CZ5	Y		.30/.50							Y		15.2%
CZ6	Y											8.7%
CZ7	Y											7.0%
CZ8	Y											8.9%
CZ9	Y		.30/.23					0.30				17.2%
CZ10	Y		.30/.23					0.30				17.2%
CZ11	Y		.30/.23					0.30				16.9%
CZ12	Y		.30/.23					0.30				16.4%
CZ13	Y		.30/.23					0.30				17.4%
CZ14	Y		.30/.23					0.30				16.4%
CZ15	Y							0.30				15.2%
CZ16	Y	3	.30/.23	0.20				0.30				15.8%
<b>Tier 1, Equipment Cases</b>												
CZ1	Y					0.92						19.3%
CZ2	Y					0.92						16.8%
CZ3	Y								0.94			15.3%
CZ4	Y					0.92		0.30				17.0%
CZ5	Y								0.94			16.9%
CZ6	Y								0.94	Y		15.5%
CZ7	Y								0.94			15.6%
CZ8	Y							0.30	0.94			17.4%
CZ9	Y						15/12.5	0.30				16.9%
CZ10	Y						15/12.5	0.30				16.6%
CZ11	Y						15/12.5	0.30				17.3%
CZ12	Y						15/12.5	0.30				16.0%
CZ13	Y						15/12.5	0.30				17.9%
CZ14	Y						15/12.5	0.30				17.1%
CZ15	Y							0.30				15.2%
CZ16	Y					0.92						17.6%

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Climate Zone	QII	ACH50	Window U-value / SHGC	Door U-value	HPA	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	DHW EF	HW Pipe Insul.	PV Credit Size (kW)	T-24 Comp. Margin
Tier 2, Cases with PV Credit												
CZ1	Y	3	.30/.50	0.20	Y					Y	2.1	32.2%
CZ2	Y		.30/.50	0.20	Y					Y	2.1	31.4%
CZ3	Y		.30/.50	0.20							2.0	21.8%
CZ4	Y		.30/.23								2.1	30.4%
CZ5	Y		.30/.50								2.0	22.0%
CZ6						N/A -- No PV Credit						
CZ7						N/A -- No PV Credit						
CZ8	Y										2.1	36.4%
CZ9	Y										2.0	35.0%
CZ10	Y										2.1	32.2%
CZ11	Y		.30/.23	0.20							2.2	31.2%
CZ12	Y										2.1	32.4%
CZ13	Y		.30/.23								2.2	31.3%
CZ14	Y							0.30			2.2	30.9%
CZ15	Y							0.30			2.2	32.2%
CZ16	Y	3	.30/.23	0.20				0.30			2.1	31.5%

## Appendix B.2 – Multifamily Package Summaries

Table 17: Multifamily Tier 1 Packages

Climate Zone	QI	Window U-value / SHGC	Door U-value	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	Refrigerant Charge	DHW EF	HW Comp. Dist.	PV Credit Size (kW)	T-24 Comp. Margin
<b>Tier 1, Envelope Cases</b>											
CZ1	Y	0.30/0.50	0.20			0.3			Y		16.5%
CZ2	Y										4.8%
CZ3	Y	0.30/0.50	0.20						Y		10.9%
CZ4	Y	0.30/0.23				0.3	Y				10.9%
CZ5	Y	0.30/0.50	0.20			0.3	Y		Y		10.2%
CZ6	Y	0.30/0.23	0.20			0.3			Y		11.7%
CZ7	Y	0.30/0.23	0.20			0.3	Y		Y		10.2%
CZ8	Y	0.30/0.23				0.3					10.5%
CZ9	Y	0.30/0.23				0.3					12.3%
CZ10	Y	0.30/0.23				0.3					10.1%
CZ11	Y	0.30/0.23	0.20			0.3					17.7%
CZ12	Y	0.30/0.23	0.20			0.3					17.1%
CZ13	Y	0.30/0.23	0.20			0.3					18.1%
CZ14	Y	0.30/0.23	0.20			0.3					17.8%
CZ15	Y	0.30/0.23	0.20			0.3					17.7%
CZ16	Y	0.30/0.23	0.20			0.3			Y		16.3%
<b>Tier 1, Equipment Cases</b>											
CZ1	Y	0.30/0.50						94	Y		16.7%
CZ2	Y			92				96			15.0%
CZ3	Y							94			12.4%
CZ4	Y			92				96	Y		16.3%
CZ5	Y							94			11.8%
CZ6	Y							94	Y		12.1%
CZ7	Y							96	Y		12.5%
CZ8	Y	0.30/0.23			16/13	0.3	Y				15.2%
CZ9	Y				16/13	0.3					15.7%
CZ10	Y				16/13	0.3					15.5%
CZ11	Y	0.30/0.23			15/12.5	0.3					16.5%
CZ12	Y	0.30/0.23			15/12.5	0.3					15.0%
CZ13	Y				15/12.5	0.3					15.4%
CZ14	Y				16/13	0.3					16.5%
CZ15	Y				16/13	0.3					20.4%
CZ16	Y	0.30/0.23		92		0.3					15.7%

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Climate Zone	QII	Window U-value / SHGC	Door U-value	Furnace AFUE	AC SEER/EER	AH Fan W/cfm	Refrigerant Charge	DHW EF	HW Comp. Dist.	PV Credit Size (kW)	T-24 Comp. Margin
Tier 2, Cases with PV Credit											
CZ1	Y	0.30/0.50	0.20			0.3			Y	1.0	21.0%
CZ2	Y	0.30/0.23	0.20			0.3			Y	1.0	20.4%
CZ3	Y	0.30/0.50	0.20			0.3			Y	1.0	15.3%
CZ4	Y	0.30/0.23	0.20			0.3			Y	1.0	26.9%
CZ5	Y	0.30/0.50	0.20			0.3			Y	1.0	12.4%
CZ6					N/A – No PV Credit						
CZ7					N/A – No PV Credit						
CZ8	Y	0.30/0.23	0.20			0.3			Y	1.0	21.0%
CZ9	Y	0.30/0.23	0.20			0.3				1.0	26.8%
CZ10	Y	0.30/0.23	0.20			0.3				1.0	26.2%
CZ11	Y	0.30/0.23	0.20			0.3				1.0	26.5%
CZ12	Y	0.30/0.23	0.20			0.3				1.0	26.5%
CZ13	Y	0.30/0.23	0.20			0.3				1.0	27.3%
CZ14	Y	0.30/0.23	0.20			0.3				1.0	26.0%
CZ15	Y	0.30/0.23	0.20			0.3				1.0	25.4%
CZ16	Y	0.30/0.23	0.20							1.0	25.7%

## Appendix C - Utility Rate Tariffs

Following are the PG&E electricity, both standard and time-of-use, and natural gas tariffs applied in this study. The PG&E monthly gas rate in \$/therm was applied on a monthly basis for the 12-month period ending March 2016.



Pacific Gas and Electric Company  
San Francisco, California  
U 39

Cancelling

Revised  
Revised

Cal. P.U.C. Sheet No.  
Cal. P.U.C. Sheet No.

36708-E  
36470-E

### ELECTRIC SCHEDULE E-1 RESIDENTIAL SERVICES

Sheet 1

**APPLICABILITY:** This rate is applicable to single-phase and polyphase residential service in single-family dwellings and in flats and apartments separately metered by PG&E; to single-phase and polyphase service in common areas in a multifamily complex (see Special Condition 8); and to all single-phase and polyphase farm service on the premises operated by the person whose residence is supplied through the same meter.

The provisions of Schedule S—Standby Service Special Conditions 1 through 6 shall also apply to customers whose premises are regularly supplied in part (but not in whole) by electric energy from a nonutility source of supply. These customers will pay monthly reservation charges as specified under Section 1 of Schedule S, in addition to all applicable Schedule E-1 charges. See Special Conditions 11 and 12 of this rate schedule for exemptions to standby charges.

**TERRITORY:** This rate schedule applies everywhere PG&E provides electric service.

**RATES:** Total bundled service charges are calculated using the total rates below. Customers on this schedule are subject to the delivery minimum bill amount shown below applied to the delivery portion of the bill (i.e. to all rate components other than the generation rate). In addition, total bundled charges will include applicable generation charges per kWh for all kWh usage.

Customers receiving a medical baseline allowance shall pay for all usage in excess of 200 percent of baseline at a rate \$0.04000 per kWh less than the applicable rate for usage in excess of 200 percent of baseline. No portion of the rates paid by customers that receive a Medical Baseline allowance shall be used to pay the DWR Bond charge. For these customers, the Conservation Incentive Adjustment is calculated residually based on the total rate less the sum of Transmission, Transmission Rate Adjustments, Reliability Services, Distribution, Generation, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges (CTC), New System Generation Charges,<sup>1</sup> and Energy Cost Recovery Amount. Customers receiving a medical baseline allowance shall also receive a 50 percent discount on the delivery minimum bill amount shown below.

Direct Access (DA) and Community Choice Aggregation (CCA) charges shall be calculated in accordance with the paragraph in this rate schedule titled Billing.

#### TOTAL RATES

Total Energy Rates (\$ per kWh)	
Baseline Usage	\$0.18212
101% - 130% of Baseline	\$0.24080 (1)
131% - 200% of Baseline	\$0.24080 (2)
201% - 300% of Baseline	\$0.39999 (1)
Over 300% of Baseline	\$0.39999 (1)
Delivery Minimum Bill Amount (\$ per meter per day)	\$0.32854
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	(\$28.14)

<sup>1</sup> Per Decision 11-12-031, New System Generation Charges are effective 1/1/2012.

(Continued)

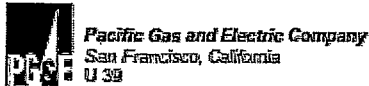
Advice Letter No. 4810-E-A  
Decision No. 15-07-001 and E-4792

Issued by  
Steven Malnight  
Senior Vice President  
Regulatory Affairs

Date Filed May 31, 2016  
Effective June 1, 2016  
Resolution No.

1C8

2016 Energy Efficiency Ordinance Cost Effectiveness Study



Cancelling Revised  
Revised

Cal. P.U.C. Sheet No. 36713-E  
Cal. P.U.C. Sheet No. 36500-E

**ELECTRIC SCHEDULE E-TOU  
RESIDENTIAL TIME-OF-USE SERVICE**

Sheet 2

**RATES  
(Cont'd.):**

**OPTION A TOTAL RATES**

Total Energy Rates (\$ per kWh)	PEAK	OFF-PEAK
<b>Summer</b>		
Total Usage	\$0.40327 (I)	\$0.32769 (I)
Baseline Credit (Applied to Baseline Usage Only)	(\$0.11709) (R)	(\$0.11709) (R)
<b>Winter</b>		
Total Usage	\$0.28530 (I)	\$0.27100 (I)
Baseline Credit (Applied to Baseline Usage Only)	(\$0.11709) (R)	(\$0.11709) (R)
Delivery Minimum Bill Amount (\$ per meter per day)	\$0.32854	
California Climate Credit (per household, per semi-annual payment occurring in the April and October bill cycles)	(\$28.14)	

Total bundled service charges shown on customer's bills are unbundled according to the component rates shown below. Where the delivery minimum bill amount applies, the customer's bill will equal the sum of (1) the delivery minimum bill amount plus (2) for bundled service, the generation rate times the number of kWh used. For revenue accounting purposes, the revenues from the delivery minimum bill amount will be assigned to the Transmission, Transmission Rate Adjustments, Reliability Services, Public Purpose Programs, Nuclear Decommissioning, Competition Transition Charges, Energy Cost Recovery Amount, DWR Bond, and New System Generation Charges<sup>1</sup> based on kWh usage times the corresponding unbundled rate component per kWh, with any residual revenue assigned to Distribution.\*

<sup>1</sup> Per Decision 11-12-031, New System Generation Charges are effective 1/1/2012.

\* This same assignment of revenues applies to direct access and community choice aggregation customers.

(Continued)

Advice Letter No. 4810-E-A  
Decision No. 15-07-001 and E-4782

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**Steven Malnight**  
Senior Vice President  
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2C9

# 2016 Energy Efficiency Ordinance Cost Effectiveness Study



Pacific Gas and Electric Company  
San Francisco, California  
U 39

Revised  
Revised  
Cat. P.U.C. Sheet No. 32582-G  
Cat. P.U.C. Sheet No. 32520-G

## GAS SCHEDULE G-1 RESIDENTIAL SERVICE

Sheet 1

**APPLICABILITY:** This rate schedule\* applies to natural gas service to Core End-Use Customers on PG&E's Transmission and/or Distribution Systems. To qualify, service must be to individually-metered single family premises for residential use, including those in a multifamily complex, and to separately-metered common areas in a multifamily complex where Schedules GM, GS, or GT are not applicable. Common area accounts that are separately metered by PG&E have an option of switching to a core commercial rate schedule. Common area accounts are those accounts that provide gas service to common use areas as defined in Rule 1.

**TERRITORY:** Schedule G-1 applies everywhere within PG&E's natural gas Service Territory.

**RATES:** Customers on this schedule pay a Procurement Charge and a Transportation Charge, per meter, as shown below. The Transportation Charge will be no less than the Minimum Transportation Charge, as follows:

	Minimum Transportation Charge**		Per Day	
			\$0.09563	
			Per Therm	
Procurement	Baseline	Excess		
	\$0.20960 (R)	\$0.20960 (R)		
Transportation Charge	\$0.81592	\$1.30547		
Total:	\$1.02552 (R)	\$1.51507 (R)		

### Public Purpose Program Surcharge:

Customers served under this schedule are subject to a gas Public Purpose Program (PPP) Surcharge under Schedule G-PPPS.

See Preliminary Statement, Part B for the Default Tariff Rate Components.

The Procurement Charge on this schedule is equivalent to the rate shown on informational Schedule G-CP—Gas Procurement Service to Core End-Use Customers.

### BASELINE QUANTITIES:

The delivered quantities of gas shown below are billed at the rates for baseline use.

Baseline Territories***	BASELINE QUANTITIES (Therms Per Day Per Dwelling Unit)	
	Summer Effective Apr. 1, 2016	Winter Effective Nov. 1, 2015
P	0.46	2.15
Q	0.60	1.98
R	0.46	1.79
S	0.46	1.92
T	0.60	1.79
V	0.60	1.79
W	0.46	1.69
X	0.60	1.98
Y	0.85	2.55

\* PG&E's gas tariffs are available online at [www.pge.com](http://www.pge.com).

\*\* The Minimum Transportation charge does not apply to submetered tenants of master-metered customers served under gas rate Schedules GS and GT.

\*\*\* The applicable baseline territory is described in Preliminary Statement, Part A.

(Continued)

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Steven Mainight  
Senior Vice President  
Regulatory Affairs

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106

# 2016 Energy Efficiency Ordinance Cost Effectiveness Study

Following are the SCE electricity tariffs, both standard and time-of-use, and SoCalGas natural gas tariffs applied in this study.



Southern California Edison  
Rosemead, California (U 338-E)

Revised Cal. PUC Sheet No. 59026-E  
Cancelling Revised Cal. PUC Sheet No. 58237-E

Schedule D		Sheet 2	
DOMESTIC SERVICE			
(Continued)			
RATES			
	Delivery Service Total <sup>1</sup>	Generation <sup>2</sup>	
		UG <sup>3,4</sup>	DWREC <sup>3</sup>
Energy Charge - \$/kWh/Meter/Day			
Baseline Service			
Summer	0.00799 (1)	0.00919 (1)	(0.00022)
Winter	0.00799 (1)	0.00919 (1)	(0.00022)
Nonbaseline Service <sup>*</sup>			
101% - 200% of Baseline - Summer	0.13997 (1)	0.00919 (1)	(0.00022)
Winter	0.13997 (1)	0.00919 (1)	(0.00022)
Over 200% of Baseline - Summer	0.22305 (R)	0.00919 (1)	(0.00022)
Winter	0.22305 (R)	0.00919 (1)	(0.00022)
Basic Charge - \$/Meter/Day			
Single-Family Accommodation	0.031		
Mult-Family Accommodation	0.024		
Minimum Charge <sup>**</sup> - \$/Meter/Day			
Single-Family Accommodation	0.329		
Mult-Family Accommodation	0.329		
Minimum Charge (Medical Baseline) <sup>***</sup> - \$/Meter/Day			
Single-Family Accommodation	0.164		
Mult-Family Accommodation	0.164		
California Climate Credit <sup>4</sup>	(35.00)		
Peak Time Rebate - \$/kWh		(0.75)	
Peak Time Rebate			
Weathering Technology - \$/kWh		(1.25)	

- \* Nonbaseline Service includes all kWh in excess of applicable Baseline allocations as described in Preliminary Statement, Part H, Baseline Service.
- \*\* The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.
- \*\*\* The ongoing Competition Transition Charge (CTC) of \$0.00015 per kWh is recovered in the UG component of Generation.
- 1 Total = Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWREC rate component of this Schedule but instead pay the DWREC as provided by Schedule DA-CRS or Schedule CCA-CRS.
- 2 Generation = The Generation rates are applicable only to Bundled Service Customers.
- 3 DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.
- 4. Applied on an equal basis, per household semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 3401-E  
Decision 16-03-030

2016

Issued by

R. O. Nichols  
Senior Vice President

(To be inserted by Cal. PUC)

Date Filed May 2, 2016  
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Resolution



2016 Energy Efficiency Ordinance Cost Effectiveness Study



Southern California Edison  
Rosemead, California (U 338-E)

Revised / Cal. PUC Sheet No. 59059-E  
Cancelling Revised Cal. PUC Sheet No. 58249-E

**Schedule TOU-D-T**  
**TIME-OF-USE TIERED DOMESTIC**

Sheet 2

(Continued)

**RATES**

27

	Delivery Service Total <sup>1</sup>	Generation <sup>2</sup>	
		UG <sup>3</sup>	DWREC <sup>4</sup>
<b>Energy Charge - \$/kWh/Meter/Day</b>			
Summer Season - On-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.21665 (R)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.21660 (R)	(0.00022)
Summer Season - Off-Peak			
Level I (up to 130% of Baseline)	0.10525 (I)	0.05311 (I)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.05311 (I)	(0.00022)
Winter Season - On-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.09965 (R)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.09960 (R)	(0.00022)
Winter Season - Off-Peak			
Level I (up to 130% of Baseline)	0.10523 (I)	0.04749 (I)	(0.00022)
Level II (More than 130% of Baseline)	0.10352 (R)	0.04749 (I)	(0.00022)
<b>Basic Charge - \$/Meter/Day</b>			
Single-Family Accommodation	0.031		
Multi-Family Accommodation	0.024		
<b>Minimum Charge<sup>1</sup> - \$/Meter/Day</b>			
Single-Family Accommodation	0.329		
Multi-Family Accommodation	0.329		
<b>Minimum Charge (Medical Baseline)<sup>1*</sup> - \$/Meter/Day</b>			
Single-Family Accommodation	0.164		
Multi-Family Accommodation	0.164		
California Climate Credit <sup>4</sup>	(30.00)		
California Attendance Rates for Energy Discount - %	100.00 <sup>4</sup>		
Peak Time Rebate - \$/kWh		(0.75)	
Peak Time Rebate Vibrating Technology - \$/kWh		(1.25)	

<sup>1</sup> The Minimum Charge is applicable when the Delivery Service Energy Charge, plus the applicable Basic Charge is less than the Minimum Charge.

<sup>2</sup> Represents 100% of the discount percentage as shown in the applicable Special Condition of this Schedule.

<sup>3</sup> The ongoing Competition Transition Charge (CTC) of \$(0.00015) per kWh is recovered in the UG component of Generation.

<sup>4</sup> Total - Total Delivery Service rates are applicable to Bundled Service, Direct Access (DA) and Community Choice Aggregation Service (CCA Service) Customers, except DA and CCA Service Customers are not subject to the DWREC rate component of this Schedule but instead pay the DWREC as provided by Schedule DA-CRS or Schedule CCA-CRS.

<sup>2</sup> Generation - The Gen rates are applicable only to Bundled Service Customers.

<sup>3</sup> DWREC = Department of Water Resources (DWR) Energy Credit - For more information on the DWR Energy Credit, see the Billing Calculation Special Condition of this Schedule.

<sup>4</sup> Applied on an equal basis, per household, semi-annually. See the Special Conditions of this Schedule for more information.

(Continued)

(To be inserted by utility)

Advice 3401-E  
Decision 16-03-030

Issued by

R. O. Nichols  
Senior Vice President

(To be inserted by Cal. PUC)

Date Filed May 2, 2016  
Effective Jun 1, 2016  
Resolution \_\_\_\_\_

3012

2016 Energy Efficiency Ordinance Cost Effectiveness Study

SOUTHERN CALIFORNIA GAS COMPANY Revised CAL P.U.C. SHEET NO. 52782-G  
LOS ANGELES, CALIFORNIA CANCELING Revised CAL P.U.C. SHEET NO. 52751-G

Schedule No. GR  
**RESIDENTIAL SERVICE**  
(Includes GR, GR-C and GT-R Rates)

Sheet 1

**APPLICABILITY**

The GR rate is applicable to natural gas procurement service to individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GT-R rate is applicable to Core Aggregation Transportation (CAT) service to individually metered residential customers, as set forth in Special Condition 11.

The California Alternate Rates for Energy (CARE) discount of 20%, reflected as a separate line item on the bill, is applicable to income-qualified households that meet the requirements for the CARE program as set forth in Schedule No. G-CARE.

**TERRITORY**

Applicable throughout the service territory.

<b>RATES</b>	<b>GR</b>	<b>GR-C</b>	<b>GT-R</b>
Customer Charge, per meter per day:	16.438¢	16.438¢	16.438¢
For "Space Heating Only" customers, a daily Customer Charge applies during the winter period from November 1 through April 30 <sup>1</sup> :	33.149¢	33.149¢	33.149¢
Baseline Rate, per therm (baseline usage defined in Special Conditions 3 and 4):			
Procurement Charge:	34.536¢	34.536¢	N/A
Transmission Charge:	56.280¢	56.280¢	55.758¢
Total Baseline Charge:	90.816¢	90.816¢	55.758¢
Non-Baseline Rate, per therm (usage in excess of baseline usage):			
Procurement Charge:	34.536¢	34.536¢	N/A
Transmission Charge:	82.280¢	82.280¢	81.758¢
Total Non-Baseline Charge:	116.816¢	116.816¢	81.758¢

<sup>1</sup> For the summer period beginning May 1 through October 31, with some exceptions, usage will be accumulated to at least 20 Ccf (100 cubic feet) before billing.

(Footnotes continue next page.)

(Continued)


(TO BE INSERTED BY UTILITY)  
ADVICE LETTER NO. 4989  
DECISION NO.  
102

(ISSUED BY)  
**Dan Skopce**  
Vice President  
Regulatory Affairs

(TO BE INSERTED BY CAL PUC)  
DATE FILED Jul 7, 2016  
EFFECTIVE Jul 10, 2016  
RESOLUTION NO. G-3351

*2016 Energy Efficiency Ordinance Cost Effectiveness Study*

Following are the SDG&E electricity, both standard and time-of-use, and natural gas tariffs applied in this study.



**San Diego Gas & Electric Company**  
San Diego, California

Revised Cal. P.U.C. Sheet No. 27650-E

Canceled Revised Cal. P.U.C. Sheet No. 26948-E

**SCHEDULE DR**  
**RESIDENTIAL SERVICE**  
**(Includes Rates for DR-LI)**

Sheet 1

**APPLICABILITY**

Applicable to domestic service for lighting, heating, cooking, water heating, and power, or combination thereof, in single family dwellings, flats, and apartments, separately metered by the utility; to service used in common for residential purposes by tenants in multi-family dwellings under Special Condition 8; to any approved combination of residential and nonresidential service on the same meter; and to incidental farm service under Special Condition 7.

This schedule is also applicable to customers qualifying for the California Alternate Rates for Energy (CARE) Program and/or Medical Baseline, residing in single-family accommodations, separately metered by the Utility, and may include Non-profit Group Living Facilities and Qualified Agricultural Employee Housing Facilities, if such facilities qualify to receive service under the terms and conditions of Schedule E-CARE. The rates for CARE and Medical Baseline customers are identified in the rates tables below as DR-LI and DR-MB rates, respectively.

Customers on this schedule may also qualify for a semi-annual California Climate Credit \$(17.44) per Schedule GHG-ARR.

**TERRITORY**

Within the entire territory served by the Utility.

**RATES**

**Total Rates:**

Description - DR Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
<b>Summer</b>				
Baseline Energy (\$/kWh)	0.05480 I	0.00339	0.12965	0.18784 I
Above 150% of Baseline	0.25545 R	0.00339	0.12965	0.38849 R
<b>Winter</b>				
Baseline Energy (\$/kWh)	0.10256 I	0.00339	0.06604	0.17239 I
Above 150% of Baseline	0.25737 R	0.00339	0.06604	0.32680 R
Minimum Bill (\$/day)	0.329			0.329

Description - DR-LI Rates	UDC Total Rate	DWR-BC Rate	EECC Rate + DWR Credit	Total Rate
<b>Summer - CARE Rates:</b>				
Baseline Energy (\$/kWh)	0.05225 I	0.00000	0.12965	0.18190 I
Above 150% of Baseline	0.25350 R	0.00000	0.12965	0.38315 R
<b>Winter - CARE Rates:</b>				
Baseline Energy (\$/kWh)	0.10001 I	0.00000	0.06604	0.16605 I
Above 150% of Baseline	0.25452 R	0.00000	0.06604	0.32056 R
Minimum Bill (\$/day)	0.164			0.164

1010

Advice Ltr. No. 2861-E-A

Decision No. 15-07-001

(Continued)

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**Dan Skopec**  
Vice President  
Regulatory Affairs

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San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 26982-E

Canceling Revised Cal. P.U.C. Sheet No. 26908-E

### SCHEDULE DR-SES

Sheet 1

#### DOMESTIC TIME-OF-USE FOR HOUSEHOLDS WITH A SOLAR ENERGY SYSTEM

#### APPLICABILITY

Service under this schedule is available on a voluntary basis for individually metered residential customers with Solar Energy Systems. Service is limited to individually metered residential customers with a Solar Energy System with domestic service for lighting, heating, cooking, water heating, and power, or combination thereof, in single family dwellings and flats. Qualifying California Alternative Rates for Energy (CARE) customers are eligible for service on this schedule, as further described under Special Condition 8 of this schedule.

Customers on this schedule may also qualify for a semi-annual California Climate Credit \$(17.44) per Schedule GHG-ARR.

#### TERRITORY

Within the entire territory served by the Utility.

#### RATES

##### Total Rates

Description - DR-SES Rates	UDG Total Rate	DWR-SC Rate	EECC Rate + DWR Credit	Total Rate
<b>Energy Charges (\$/kWh)</b>				
On-Peak - Summer	0.12035 I	0.08539 I	0.33023 R	0.46397 R
Semi-Peak - Summer	0.12030 I	0.08539 I	0.03530 R	0.22504 R
Off-Peak - Summer	0.12030 I	0.08539 I	0.07332 R	0.26795 R
Semi-Peak - Winter	0.12035 I	0.08539 I	0.03139 R	0.21533 R
Off-Peak - Winter	0.12035 I	0.08539 I	0.08826 R	0.26200 R
Minimum Bill (\$/day)	0.329			0.329

- (1) Total Rates consist of UDG, Schedule DWR-SC (Department of Water Resources Bond Charge), and Schedule EECC (Electric Energy Commodity Cost) rates, with the EECC rates reflecting a DWR Credit of \$(0.00021) that customers receive on their monthly bills.
- (2) Total Rates presented are for customers that receive commodity supply and delivery service from Utility. Differences in total rates paid by Direct Access (DA) and Community Choice Aggregation (CCA) customers are identified in Schedule DA-CRS and CCA-CRS, respectively.
- (3) DWR-SC charges do not apply to CARE or Medical Baseline customers.

##### UDG Rates

Description-DR-SES	Transm	Distr	PPF	ND	CTC	LGC	RS	TRAC	UDG Total
<b>Energy Charges (\$/kWh)</b>									
On-Peak - Summer	0.02943 I	0.08367 R	0.01241 I	0.00032 I	0.00100 I	0.00039 I	0.00013 R	0.00000 I	0.12035 I
Semi-Peak - Summer	0.02943 I	0.08367 R	0.01241 I	0.00032 I	0.00100 I	0.00039 I	0.00013 R	0.00000 I	0.12030 I
Off-Peak - Summer	0.02943 I	0.08367 R	0.01241 I	0.00032 I	0.00100 I	0.00039 I	0.00013 R	0.00000 I	0.12030 I
Semi-Peak - Winter	0.02943 I	0.08367 R	0.01241 I	0.00032 I	0.00100 I	0.00039 I	0.00013 R	0.00000 I	0.12035 I
Off-Peak - Winter	0.02943 I	0.08367 R	0.01241 I	0.00032 I	0.00100 I	0.00039 I	0.00013 R	0.00000 I	0.12035 I
Minimum Bill (\$/day)		0.329							0.329

(Continued)

YCS

Advice Ltr. No. 2840-E

Decision No. \_\_\_\_\_

Issued by  
**Dan Skopec**  
Vice President  
Regulatory Affairs

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Resolution No. \_\_\_\_\_

*2016 Energy Efficiency Ordinance Cost Effectiveness Study*



San Diego Gas & Electric Company  
San Diego, California

Revised Cal. P.U.C. Sheet No. 21921-G  
Canceling Revised Cal. P.U.C. Sheet No. 21908-G

**SCHEDULE GR**

Sheet 1

**RESIDENTIAL NATURAL GAS SERVICE**  
**(Includes Rates for GR, GR-C, GTC/GTCA)**

**APPLICABILITY**

The GR rate is applicable to natural gas procurement service for individually metered residential customers.

The GR-C, cross-over rate, is a core procurement option for individually metered residential core transportation customers with annual consumption over 50,000 therms, as set forth in Special Condition 10.

The GTC/GTCA rate is applicable to intrastate gas transportation-only services to individually metered residential customers, as set forth in Special Condition 11.

Customers taking service under this schedule may be eligible for a 20% California Alternate Rate for Energy (CARE) program discount, reflected as a separate line item on the bill, if they qualify to receive service under the terms and conditions of Schedule G-CARE.

**TERRITORY**

Within the entire territory served natural gas by the utility.

**RATES**

	<u>GR</u>	<u>GR-C</u>	<u>GTC/GTCA<sup>1</sup></u>
<b>Baseline Rate, per therm (baseline usage defined in Special Conditions 3 and 4):</b>			
Procurement Charge: <sup>2</sup>	\$0.34561	\$0.34561 I	N/A
Transmission Charge:	\$0.90805	\$0.90805	\$0.90805
Total Baseline Charge:	\$1.25366	\$1.25366 I	\$0.90805
<b>Non-Baseline Rate, per therm (usage in excess of baseline usage):</b>			
Procurement Charge: <sup>2</sup>	\$0.34561	\$0.34561 I	N/A
Transmission Charge:	\$1.08354	\$1.08354	\$1.08354
Total Non-Baseline Charge:	\$1.42915	\$1.42915 I	\$1.08354

<sup>1</sup> The rates for core transportation-only customers, with the exception of customers taking service under Schedule GT-NGV, include any FERC Settlement Proceeds Memorandum Account (FSPMA) credit adjustments.

<sup>2</sup> This charge is applicable to Utility Procurement Customers and includes the GFC and GPC-A Procurement Charges shown in Schedule GPC which are subject to change monthly as set forth in Special Condition 7.

(Continued)

rcs	Issued by	Date Filed
Advice Ltr. No. <u>2489-G</u>	<b>Dan Skopece</b>	<u>Jul 7, 2016</u>
Decision No. _____	Vice President	Effective <u>Jul 10, 2016</u>
	Regulatory Affairs	Resolution No. _____



# **Report on Cost-Effectiveness and Other Analyses for Proposed Solar Ordinance**

Prepared for the Department of the Environment of the City  
and County of San Francisco

by

Ari Halberstadt

December 31, 2014









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## 1 Executive Summary

The San Francisco Department of the Environment is exploring the possibility of an ordinance that would require installation of photovoltaic systems on newly constructed residential and commercial buildings. The Department commissioned this study to inform its work and to provide supporting documentation to the California Energy Commission for approval of the ordinance.

This study examined several main outcomes:

1. The cost-effectiveness of rooftop photovoltaic systems installed on newly constructed residential and commercial buildings in the City and County of San Francisco.
2. The effects of different input values on the outcome were studied using a sensitivity analysis.
3. The potential impact on carbon emissions.
4. Aggregate city-wide effects.

This executive summary will give an overview of the study's framework and will then summarize the results of the above analyses.

### 1.1 Framework

This study analyzed outcomes in two future years: 2015 and 2017. The year 2015 was selected because it is the earliest year in which the ordinance could come into effect. The second year, 2017, was selected due to the expected reduction in the federal investment tax credit, which is a significant factor affecting the cost of photovoltaic systems. The credit will be 30% through 2016, but in 2017 the credit is expected to be reduced to 10% for commercial systems and eliminated for residential systems.

A few main assumptions guided this study:

- The roof area available for a photovoltaic system would correspond to the solar ready area required by California's building energy code, which is 250 ft<sup>2</sup> for single-family residential buildings or 15% of roof area for most commercial buildings.
- A single owner would derive the full benefits, and pay the full costs, associated with a photovoltaic system.
- The only incentive available would be the federal investment tax credit.

Further assumptions are described in this report as appropriate.

This study modeled projects in several prototypical building models. Different building models were used to represent types of buildings that may be encountered in San Francisco. The building models specify physical features of the buildings and the end uses of the occupied space, for instance, hotel or office. This information was used to estimate energy usage in the buildings and to provide a constraint on the size of the photovoltaic systems that could be installed on each building.

A variety of additional parameters were needed to specify the modeled projects, including:

- general parameters specifying the location and analysis period;





- parameters affecting initial purchase cost and ongoing maintenance costs of the photovoltaic systems;
- parameters specifying the performance of the photovoltaic systems;
- financial parameters, including debt terms, taxes, insurance, inflation, discount rate, incentives, and depreciation;
- utility rates and annual escalation rates.

Appropriate values for the parameters were researched and were used to specify a reference scenario. These parameters are discussed in further detail in this report.

This report is divided into several main sections, described briefly below.

Section 2, **Introduction**, discusses the basis for the study, the cost-effectiveness evaluation framework, considerations due to uncertainty in input parameter values and simulation results, main assumptions associated with the study, and the general modeling framework and tools used for the study.

Section 3, **Building Models and Projects**, discusses the various building models and photovoltaic systems associated with each building model. This section includes information on the energy consumption of the building models and the photovoltaic systems' sizes.

Section 4, **Input Parameters**, discusses in detail the input parameters used in the study. This section includes the methodology used to forecast future photovoltaic system costs, and discusses the values used for photovoltaic system performance, financial parameters, and utility rates.

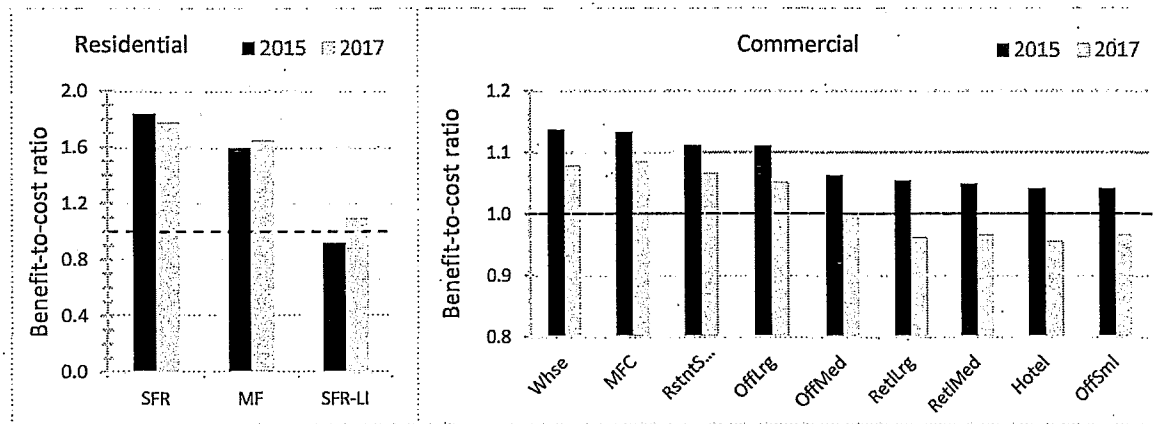
Section 5, **Results**, presents the results of the analyses. The results section includes the results of the cost-effectiveness analysis, discussion of a sample cash flow, results of the sensitivity analysis, estimated per-project carbon emissions impacts, and estimated additional building costs for installation of a photovoltaic system. Section 5.6, **Aggregate Results**, presents an analysis of the potential effects had the proposed systems been installed in all relevant buildings currently in San Francisco's building pipeline.

## 1.2 Cost Effectiveness

A project is considered to be cost-effective if its benefits are greater than its costs. This study used a participant cost test, which considers the benefits and costs to a participant in a project. The participants considered were the owners of newly constructed buildings with rooftop solar photovoltaic systems that provide electric energy which is consumed on-site.



The figure below shows the main results of the cost-effectiveness analysis.



*Figure 1 Results of cost-effectiveness analysis. The vertical axis shows the ratio of benefits to costs. The results shown are for the reference scenario; additional scenarios were also analyzed. (SFR=single-family residential, MF=multifamily, SFR-LI=single-family low income, Whse=warehouse, MFC=multifamily common area, RstntSml=small restaurant, OffLrg=large office, OffMed=medium office, RetLrg=large retail, RetMed=medium retail, Hotel=small hotel, OffSml=small office.)*

The benefit-to-cost ratios, shown in the figure above, could be interpreted as precise single values. When interpreted in this manner, a ratio greater than 1.0 would indicate that the outcome is cost-effective, while a ratio less than 1.0 would indicate that the outcome is not cost-effective. With this interpretation, the proposed solar requirement is cost-effective for nearly all projects installed in 2015, except for single-family low income households. The requirement, however, is cost-effective for only some projects installed in 2017; it is not cost-effective for the medium office, large retail, medium retail, small hotel, and small office building models.

Alternatively, the benefit-to-cost ratios could be interpreted as point estimates drawn from a population of possible values having some probability distribution. This interpretation is more representative of the uncertainty inherent in forecasting future conditions. However, interpretation of the results when considering uncertainty is less clear cut, since the results could take on a range of values, depending on the possible input values and modeling assumptions. It is possible, though, to make some inferences about the likelihood of a result indicating cost-effectiveness. The greater the difference of a result from the cost-effectiveness threshold, the more likely it is that the result represents a true outcome (cost-effective or not cost-effective). The results in Figure 1 above are ordered from left to right in decreasing benefit-to-cost ratio for the year 2015. Thus, the results that are closer to the left end of the charts represent a higher likelihood of a cost-effective outcome than the results that are closer to the right end of the charts. The single-family and multifamily building models, with benefit-to-cost ratios above 1.6, are most likely to be cost-effective. For the commercial building models, the order of likelihood of cost-effectiveness for projects installed in 2015 is: warehouse, multifamily common, small restaurant, large office, medium office, large retail, medium retail, small hotel, and small office. The results for 2017 have essentially the same order of decreasing cost-effectiveness, except that all of the commercial projects are less cost effective than in 2015, and the small hotel is less cost-effective than the small office.



### 1.3 Sensitivity Analysis

A sensitivity analysis was done to gauge the effect of varying the values of several input parameters. Performing simulations while varying input parameters over reasonable expected ranges helps explore the sensitivity of the outcomes to particular choices of values. This also provides insight into the range of outcomes that could be encountered in real-world projects. The effects of variation of individual parameters are summarized below. Additional analysis was done by constructing scenarios in which the values of multiple input parameters were varied together; these results can be found in the detailed results in section 5.1, Cost Effectiveness, on page 35.

Overall results of the sensitivity analysis are shown in Figure 2 below. This figure shows the average decrease or increase in the benefit-to-cost ratio relative to the reference scenario, as well as the minimum and maximum change. The simulation results for all buildings in both modeled years (2015 and 2017) were combined to calculate these summary values. The results were then sorted in decreasing order of average range of effect.

Debt fraction had the largest average impact on the ratio, followed by the cost per watt, and then debt rate. The cost per watt and debt rate both have a significant impact on the cost of owning a photovoltaic system. Azimuth (compass orientation) and availability resulted in decreased ratios, which was expected given that 100% availability and a near-optimal azimuth were assumed in the reference scenario, so that any change in those values could only reduce the benefits of the system. The ratio varied the least due to changes in federal tax rate, discount rate, and system size. The small change in the ratio due to varying system size suggests that systems could be sized to occupy more or less of the roof area, not just the 250 ft<sup>2</sup> or 15% of roof area that were assumed for this study, without too great an effect on cost-effectiveness.

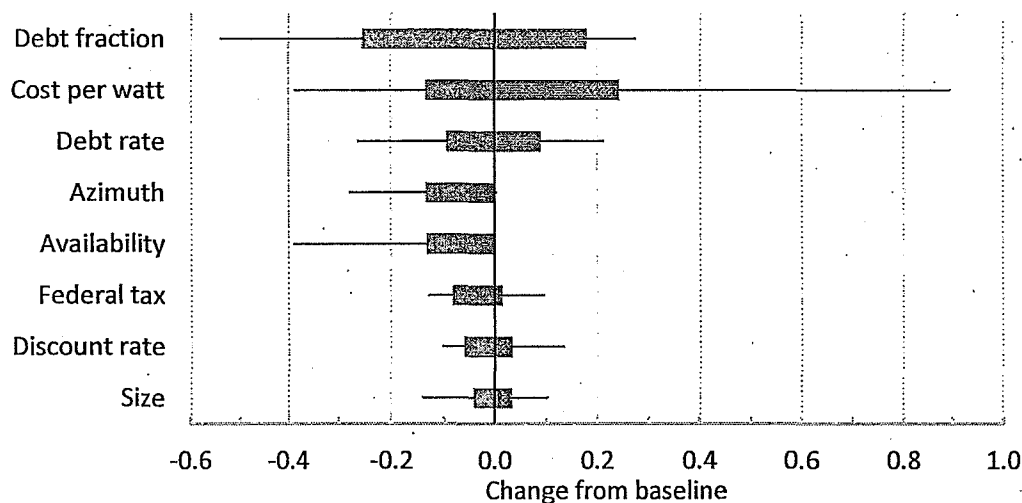


Figure 2 Sensitivity analysis results showing the average decrease or increase in the benefit-to-cost ratio relative to the reference scenario as well as the minimum and maximum change.



## 1.4 Carbon Emissions Impact

An analysis was done of the potential carbon emission reductions for each individual project (see figure below). Lifetime avoided emissions ranged from 5.7 to 2,150 metric tons CO<sub>2</sub> (MT CO<sub>2</sub>) for projects installed in 2015. Avoided emissions depended on year of installation and were proportional to system size. Each 1 kW of photovoltaic capacity installed in 2015 could avoid emissions of 3.6 MT CO<sub>2</sub>. A larger system offsetting a small portion of a building's electric energy consumption could have a greater impact on carbon emissions than a smaller system offsetting a large portion of consumption. This can be seen in the results for the warehouse (Whse) versus the large retail building models (RetlLrg) in the figure below. A 95 kW photovoltaic system on the warehouse building model could offset 94% of electric energy consumption in the building over the typical 25 year lifetime of the photovoltaic system. This would result in an estimated 306 MT CO<sub>2</sub> in avoided emissions. In contrast, a 600+ kW photovoltaic system on the large retail building model could offset just 44% of the building's electric energy consumption, but would avoid 7 times more emissions, or 2,153 MT CO<sub>2</sub>.

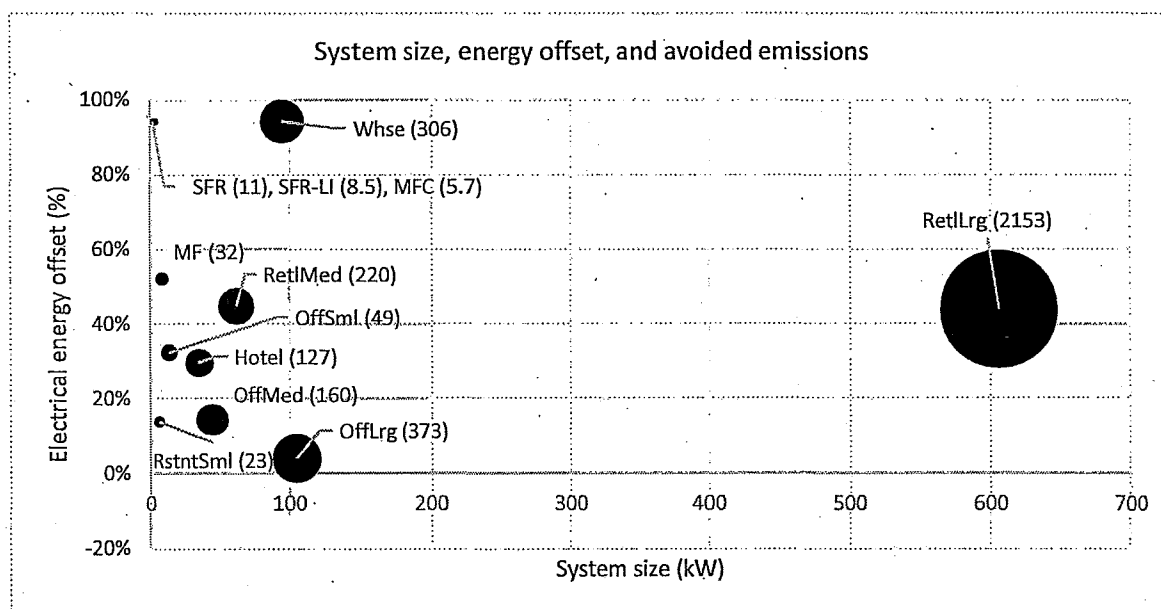


Figure 3 System size, electrical energy offset, and avoided emissions of projects installed in 2015. The sizes of the circles are proportional to the amount of avoided carbon emissions over the lifetime of the projects, while the numbers in parentheses give the estimated amounts of avoided emissions.

## 1.5 Aggregate Results

An analysis of aggregate results was done to estimate overall potential effects of the proposed ordinance. San Francisco's development pipeline, which tracks buildings for which permits have been applied for and for which construction has not been completed, was analyzed for the years 2008-2014. If all 200 of the analyzed projects were to install solar photovoltaic systems on 15% of their roof area, they would generate 10.5 GWh/yr of electricity, offsetting 16% of the projects' energy consumption over the lifetime of the photovoltaic panels. Assuming installation in 2015, they would also avoid 26.3 MT of CO<sub>2</sub> emissions over the projects' lifetimes. Stated another way, 15% of the rooftops of the relevant buildings





in the city's building pipeline represent 434,000 square feet of potential solar area, or nearly 10 acres. This is sufficient area to install a total of almost 7.4 MW of solar generating capacity, providing 10.5 GWh of electric energy per year.



## 2 Introduction

The Commission on the Environment of the City and County of San Francisco passed resolution 009-14-COE in July 2014 supporting development of policies by the Department of the Environment "that would require the inclusion of solar energy systems on newly constructed buildings" (COE 2014). As part of its policy work, the Department has explored the possibility of an ordinance that would require photovoltaic systems on newly constructed residential and commercial buildings.

The Department sought to study the cost-effectiveness and other aspects of requiring photovoltaic systems in all new residential and commercial construction in the city. An ordinance that would require photovoltaic systems on buildings would require approval by the California Energy Commission (CEC). The CEC requires, as part of the approval process, that the city provide "findings and supporting analyses on the energy savings and cost effectiveness of the proposed energy standards" (CEC 2014). The Department commissioned this study to inform its work and to provide supporting documentation to the California Energy Commission for approval of the ordinance.

This study examined the cost-effectiveness of rooftop photovoltaic systems installed on newly constructed buildings in the City and County of San Francisco (CCSF). In addition, this study performed sensitivity analyses to assess alternative system sizes and the effects of different input values, evaluated the potential impact on carbon emissions, and estimated aggregate city-wide effects.

### 2.1 Cost Effectiveness

A project is considered to be cost-effective if its benefits are greater than its costs. This study used a participant cost test (PCT), which considers the benefits and costs to a participant in a project. The participants considered were the owners of newly constructed buildings with rooftop solar photovoltaic systems that provide electric energy which is consumed on-site. The components of the benefits and costs used in this study were consistent with those specified in California's Standard Practice Manual (OPR 2002).

The benefits to the participants were defined as the sum of:

- the value of the electricity generated by a photovoltaic system
- federal tax savings
- state tax savings

For residential systems, the federal tax savings consist of the Investment Tax Credit (ITC) and home mortgage deduction. For commercial systems, federal and state tax savings include accelerated depreciation and tax deductions due to expenses related to paying for and operating the system. Federal tax savings for commercial systems also include the value of the ITC. The cost of electricity to a commercial entity is normally deductible from its taxes. A photovoltaic system, however, reduces expenditure on electricity, and thus also reduces the tax deduction. Therefore, for commercial entities, the value of the generated electricity is reduced by the lost tax deduction.

The costs were defined as the sum of:

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- purchase cost
- debt repayment (principal and interest)
- operation and maintenance expenditures
- insurance costs

All costs and benefits were discounted back to the initial project year using a nominal discount rate before the benefit-to-cost ratios were calculated.

Equation 1 shows the calculation of the benefit-to-cost ratio (BCR):

$$BCR = B/C$$

$$B = EV_{after\ tax} + TS_{federal} + TS_{state}$$

$$C = C_{O+M} + C_{insurance} + C_{debt}$$

$$EV_{after\ tax} = \begin{cases} EV & \text{if residential} \\ EV_{energy} \times (1 - TR_{effective}) & \text{if commercial} \end{cases}$$

$BCR$	Benefit-to-cost ratio
$B$	Sum of benefits to participant
$EV_{after\ tax}$	After-tax value of generated energy
$EV$	Before-tax value of generated energy
$TS_{federal}$	Federal tax savings
$TS_{state}$	State tax savings
$TR_{effective}$	Effective tax rate
$C$	Sum of costs to participant
$C_{O+M}$	Operations and maintenance costs
$C_{insurance}$	Insurance costs
$C_{debt}$	Debt repayment costs (principal and interest)

Equation 1 Calculation of benefit-to-cost ratio.

## 2.2 Uncertainty

The results of this study depend on a variety of inputs and modeling assumptions with a range of possible values and approaches. No single benefit-to-cost ratio can represent all potential scenarios. There is uncertainty and variability in the value of all of the input parameters. This uncertainty is magnified when dealing with projections of future conditions. For instance, the cost of purchasing a photovoltaic system depends on a variety of factors, including overall price trends and project and installer characteristics. Some of these factors depend on project characteristics, such as size, shading, and orientation of roof, which would affect the performance of a photovoltaic system. Other factors depend on global and local economic trends, such as debt-finance rates and solar panel costs.



Several approaches were taken in this study to address these limitations<sup>1</sup>. First, the values of the input parameters were chosen to reasonably reflect expected real-world conditions. Second, a variety of building models were used to represent some of the variability that is due to different energy consumption patterns and physical constraints. Third, approved and widely used software was used to generate the results. Fourth, sensitivity analyses were performed by varying the values of several parameters that were considered likely to affect the benefit-to-cost ratio. Fifth, the presentation of the results is meant to convey some of the range of uncertainty in this study.

### 2.3 Primary Assumptions

It was assumed that a single entity derives the full benefits, and pays the full costs, associated with owning and operating the modeled photovoltaic systems. This assumption is correct only for some situations. For instance, this assumption is accurate for a photovoltaic system installed on a single-family residence that is owner occupied, and where the system was purchased by the owner of the home. This assumption is not accurate when describing buildings with separately metered tenants who are not the owners of the photovoltaic system. In this situation, the owner of the photovoltaic system pays the cost of owning and operating the system. The owner should also benefit from tax deductions associated with paying for the system and from tax credits for installing the system. However, the owner would only benefit from the portion of energy used for common areas and owner-occupied areas. Excess generation would receive, at best, only relatively low net surplus compensation rates.

The analysis under the single-owner assumption could show whether it is cost-effective to install a photovoltaic system. Whether it is cost-effective for other cost/benefit allocation arrangements would depend on how those arrangements function and the extent to which any added overhead can be covered by the overall benefits of the system. There are some mechanisms, such as virtual net metering, that would allow tenants to benefit from reduced energy costs on their electric bills as a result of renewable generation. These alternative mechanisms, however, would not necessarily benefit the system's owner. It is possible that a third-party owned system could address these limitations, though such systems generally have higher costs (Barbour et al 2013).

This study is limited to exploring building models and photovoltaic systems. No actual project is modeled. Instead, this study examined a variety of prototypical buildings that were representative of some buildings in San Francisco, and which could therefore provide information to support work on the proposed ordinance. In addition, the building models were treated as single-use structures. Thus, for instance, the multifamily building model is treated as containing residential units only. Similarly, the large office building model is treated as if it were used only for typical office activities. In contrast, mixed-use buildings in San Francisco are not uncommon. These buildings could have a variety of uses, such as retail, residential, and office. Mixed-use buildings would have a different electric load profile compared to single use buildings, and this would affect the amount and timing of energy consumed as well as the value of that energy.

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<sup>1</sup> Additional approaches, which were outside the scope of this study, could use statistical methods, such as Monte Carlo simulations, to model system and financial performance.





It was assumed that the only incentive available would be the federal ITC. Several state and local incentive programs were assumed to not be applicable for systems installed under the proposed ordinance. The California Solar Initiative (CSI) has provided incentives in past years for photovoltaic system installations (CSI 2014a). The CSI program, however, is not accepting new applications, and therefore would not apply to projects built in the future. CSI's Multifamily Affordable Solar Housing (MASH) program is also closed to new applications (MASH 2014). The California New Solar Homes Partnership (NSHP) program was assumed to be unavailable (NSHP 2014). Finally, following initial stakeholder feedback, it was assumed that San Francisco's GoSolarSF incentive program would also not be extended to include projects that would be required under the proposed ordinance (SFPUC 2014).

## 2.4 Modeling Framework

Analyses were performed for two future years in which photovoltaic systems might be required under the proposed ordinance. The first year selected was 2015, which was the earliest year in which it could be expected that the ordinance would come into effect. The second year was 2017, which was selected due to the expected change in the ITC. The ITC is a significant factor affecting the cost of photovoltaic systems. The ITC will be 30% through 2016, but in 2017 the ITC is expected to be reduced to 10% for commercial systems, and to be eliminated entirely for residential systems (NCSC 201a, NCSC 2014b).

Several data sets, sources, and components were used to perform the cost-effectiveness analysis, including:

- Prototypical building models
- Electric energy consumption profiles for each building
- Input parameters specifying model assumptions
- Simulation software
- Analysis process

Figure 4 shows an overview of the modeling framework.

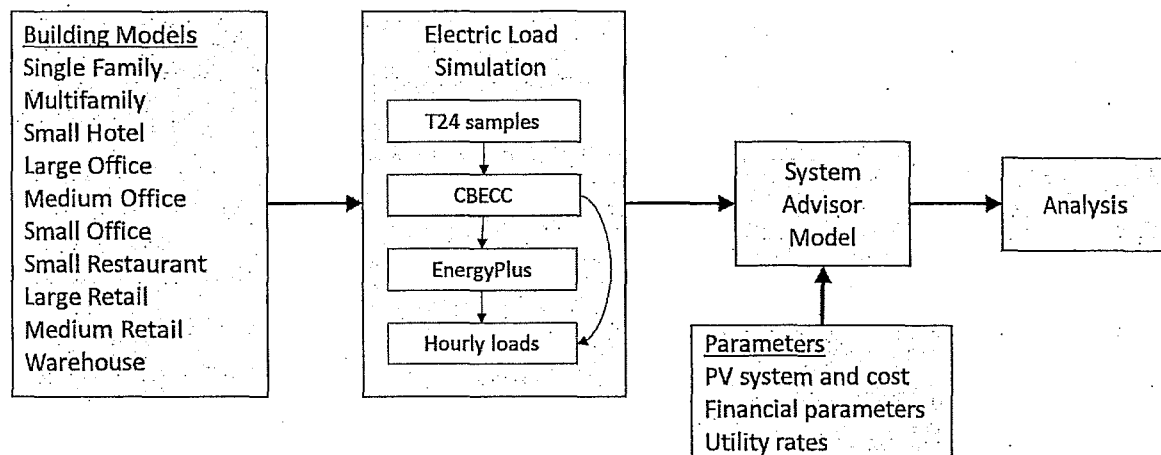


Figure 4 Overview of modeling framework.



A set of prototypical building models was selected to evaluate the cost-effectiveness of systems installed in future construction. These buildings were intended to be representative of a range of new construction that meets the current energy code standards in California, though they do not represent actual buildings or projects. Electric energy consumption profiles for each building were generated using building energy simulation software. In addition, a variety of other parameters affect the cost-effectiveness of photovoltaic systems. These parameters include first-costs, electric utility rate forecasts, and financial and tax parameters. Research was conducted to determine reasonable values for these parameters.

The energy consumption profiles and parameter values were input into the National Renewable Energy Laboratory's (NREL) System Advisor Model (SAM) software (NREL 2014 SAM). SAM "is a performance and financial model designed to facilitate decision making for people involved in the renewable energy industry". Version 2014.1.14 of SAM was used for this study. SAM performs simulations based on input parameters and its internal models to calculate output values associated with renewable energy projects. SAM generates a cash flow prediction for the specified analysis period, which includes the values needed to calculate the benefits and costs of a solar photovoltaic system. The output from SAM was summarized and analyzed in Excel.



### 3 Building Models and Projects

#### 3.1 Buildings Models

This study models energy use in prototypical buildings. Several building types were selected to represent a range of uses and sizes of buildings that may be encountered in San Francisco. The building models specify physical features of the buildings and the end use of the occupied space, for instance, hotel or office. This information was used to estimate hourly energy usage in the buildings. The models also provide a constraint on the roof area relative to the building's total energy consumption, which is then used to set a limit on the size of the photovoltaic systems that could be installed on each building. The hourly energy usage is used in calculations of the amount of energy consumed and the value of the generated energy.

California's building energy codes specify requirements for energy use in buildings. The CEC has certified software to model compliance of buildings with its standards. Two software packages are freely available. CBECC-Res models compliance of residential buildings, while CBECC-Com models compliance of commercial buildings with the 2013 building energy standards (Wilcox B 2013, AEC 2013). Each program is provided with several sample input files that describe buildings that are compliant with the building energy standards. These sample files were used for the building models and to produce the electricity consumption models for this study.

Table 1 summarizes the physical characteristics of the modeled buildings, based on the sample files included with CBECC Com and Res.

Building	Abbr.	Type	Floor area (ft <sup>2</sup> )	Floors	Roof area (ft <sup>2</sup> )
Single Family	SFR	Residential	2,100	1	2,100
Single Family Low Income	SFR-LI	Residential	2,100	1	2,100
Multifamily	MF	Hybrid	6,960	2	3,480
Multifamily Common	MFC	Commercial	6,960	2	3,480
Small Hotel	Hotel	Commercial	42,554	3	14,185
Large Office	OffLrg	Commercial	498,589	12	41,549
Medium Office	OffMed	Commercial	53,628	3	17,876
Small Office	OffSml	Commercial	5,502	1	5,502
Small Restaurant	RstntSml	Commercial	2,501	1	2,501
Large Retail	RetLrg	Commercial	240,000	1	240,000
Medium Retail	RetMed	Commercial	24,563	1	24,563
Warehouse	Whse	Commercial	49,495	1	49,495

Table 1 Model buildings analyzed in this study.

Both commercial and residential buildings were modeled. Residential building models used residential electric rates (E1, EL1), residential Title 24 solar area requirements, and input parameters and tax considerations appropriate to residential owners. Commercial building models used commercial electric



rates (A1, A10, E19), commercial Title 24 solar area requirements, and input parameters and tax considerations (including depreciation) appropriate to commercial owners.

Multifamily buildings were modeled as a hybrid of residential and commercial buildings. In multifamily buildings, rates are residential, but the ownership structure is commercial. The tenants in multifamily buildings are billed using residential rates. The financing and ownership of a multifamily building, however, are structured as commercial enterprises. Therefore, for this study, the residential electric utility rate was used for multifamily buildings, but all other simulation parameters (taxes, depreciation, etc.) used commercial values. In addition, the Multifamily Common building model broke out just the common area load of a multifamily building, which was then treated as a pure commercial model.

Table 2 summarizes the energy consumption characteristics of the building models. This table shows estimated annual total electric energy consumption for each building, as well as consumption normalized to the conditioned space and total roof area. It was assumed that electric load and hourly consumption patterns remained constant from year-to-year. In practice, electric load may be expected to vary over time as changes occur in the building, occupants, equipment, weather, etc.

Building	Electric energy (kWh/yr)	Electric energy per unit floor area (kWh/ft <sup>2</sup> /yr)	Electric energy per unit roof area (kWh/ft <sup>2</sup> /yr)
Single Family	4,560	2.2	2.2
Single Family Low Income	3,420	1.6	1.6
Multifamily	22,844	3.3	6.6
Multifamily Common	2,284	0.3	0.7
Small Hotel	161,971	3.8	11.4
Large Office	3,435,150	6.9	82.7
Medium Office	417,967	7.8	23.4
Small Office	57,479	10.4	10.4
Small Restaurant	61,427	24.6	24.6
Large Retail	1,847,380	7.7	7.7
Medium Retail	185,647	7.6	7.6
Warehouse	134,926	2.7	2.7

*Table 2 Estimated annual electric energy consumption in modeled buildings.*

Low income households were expected to have lower energy consumption than moderate and higher income households. Statewide household annual electricity consumption for moderate-income households (\$25-\$75K/yr) was reported as 5,887 kWh/yr, while for low-income households (<\$25K) it was 4,313 kWh/yr, or 73% of moderate-income household consumption (KEMA 2010, Table ES-7, p33). To approximate the difference between low-income and moderate-income households, annual electricity consumption for the Single Family Low Income building model was scaled to 75% of the Single Family building model. For the Multifamily Common building model, which includes only estimated common area load, electricity consumption was scaled to 10% of the multifamily base case.





### 3.2 Hourly Energy Consumption

Electric energy costs and benefits depend on the time of generation and consumption of the energy due to a variety of factors, including:

- tiered and time of use rate structures, which depend on time of day and day of year;
- variable energy use in buildings, which vary by time, weather, and occupant behavior;
- photovoltaic energy output, which depends on insolation and weather.

To model costs and benefits, hourly resolution of energy consumption and generation was needed. This resolution provided a standard level of analysis, approximately matching utility rate structures and solar energy generation.

The programs CBECC-Res, CBECC-Com, and EnergyPlus were used to model total facility electric energy consumption at hourly resolution for the sample input files. EnergyPlus is an "energy analysis and thermal load simulation program" which, given a building's description, can model hourly facility electric energy usage (EERE 2014). CBECC-Res version 2013-3 (650), CBECC-Com version 2013-3 (653), and EnergyPlus version 8.1 were used in this study. To model total electricity consumption, software must make assumptions about installed equipment and occupant behavior that go beyond the loads and equipment regulated under California's energy codes. CBECC-Res provides as output total facility electric energy use. CBECC-Com does not provide total hourly electric energy consumption as an output. It does, however, generate data files that can be read by EnergyPlus ("IDF" files), which can then generate the needed consumption data.

The programs calculate energy consumption based on a model of the building and the location of the building. The location input is based on a typical meteorological year. For the residential buildings, which were analyzed with CBECC-Res, the CEC's climate data files for the San Francisco climate zone were used (CZ3). For commercial buildings, for which energy consumption data were generated with EnergyPlus, the closest typical meteorological year station was San Francisco International Airport (NREL 2014c). The sample files included with CBECC-Com were modified to refer to the San Francisco climate zone and to use ZIP code 94103. The orientation of buildings also affects their energy profile. It was assumed that the buildings were all south facing for purposes of this study.

### 3.3 Modeled Projects

Each building was modeled using a corresponding reference case. For the reference case, it was assumed that the roof area available for a solar photovoltaic system matches the area specified in the Title 24 2013 Solar Ready regulations (CEC 2013). The Solar Ready zone is a roof area that must meet certain requirements to facilitate installation of solar energy systems. These include size, orientation, and freedom from penetration and shading by equipment. For single-family residential buildings the solar ready zone is 250 ft<sup>2</sup>, while for multifamily and commercial buildings it is 15% of total roof area. Title 24 allows for exemptions from the solar ready requirements, for instance, some commercial buildings over three stories are exempt. For purposes of this study, the basic Solar Ready area guidelines were applied to all buildings, without regard for possible exemptions. In addition, the area available for solar photovoltaic installation in commercial buildings was assumed to be 15% of total roof area,



notwithstanding adjustments in the solar ready regulations (such as exclusion of skylights from the total area).

Table 3 summarizes the system sizes for each modeled building. The amount of energy offset by the systems over the course of a year ranges from 4% for the Large Office building model to 100% for the Single-Family Residential and Warehouse building models. The area of the systems in square feet and as a percentage of total roof area are also shown. For each system, the azimuth (orientation) of the system is shown, as well as total generation per year and generation per square foot of floor space per year.

The azimuth of a photovoltaic system has a significant impact on its energy generation. In addition, the azimuth affects the benefits from the energy because of the time-dependent nature of energy generation, consumption, and pricing. Depending on the building type, the optimal azimuth was either (approximately) 180° or 210°. The best value was determined empirically by running the simulation over several orientations and selecting the one with the greatest benefit-to-cost ratio. In practice, the Title 24 solar ready regulations allow a wider range of orientations, so that systems installed in the solar ready area may not be optimally oriented and therefore could have reduced cost-effectiveness.

Building	Size (kW)	Electric energy offset	Area (ft <sup>2</sup> )	Area (% roof)	Azimuth (°)	Tilt (°)	Per floor space (W/ft <sup>2</sup> )	Generation (kWh/yr)	Generation per floor space (kWh/ft <sup>2</sup> /yr)
Single Family	3.2	100%	192	9.1%	180	20	1.5	4,560	2.2
Single Family Low Income	2.4	100%	144	6.9%	180	20	1.1	3,420	1.6
Multifamily	8.9	55%	522	15.0%	180	33	1.3	12,651	1.8
Multifamily Common	1.6	100%	94	2.7%	180	33	0.2	2,284	0.3
Small Hotel	36	31%	2128	15.0%	210	33	0.8	51,000	1.2
Large Office	105	4%	6232	15.0%	210	33	0.2	149,386	0.3
Medium Office	45	15%	2681	15.0%	210	33	0.8	64,271	1.2
Small Office	14	34%	825	15.0%	210	33	2.5	19,782	3.6
Small Restaurant	6.4	15%	375	15.0%	180	33	2.6	9,092	3.6
Large Retail	606	47%	36000	15.0%	210	33	2.5	862,896	3.6
Medium Retail	62	48%	3684	15.0%	210	33	2.5	88,314	3.6
Warehouse	95	100%	5567	11.2%	180	33	1.9	134,926	2.7

Table 3 Photovoltaic system sizes and related parameters for the modeled projects.



### 3.3.1 System Sizing

For each building model, a photovoltaic system size was specified based on the available roof space, the energy density of the photovoltaic system (see 4.2 Photovoltaic System Performance on page 26), and the modeled electric energy consumption of the building. The system size was limited to the lesser of the available space and the total electric energy consumption of the building, as shown in Equation 2.

$$S = A_{system} \times D_{DC}$$

$$A_{system} = \min(C/D_{AC}, A_{available})$$

$$A_{available} = \begin{cases} 250 \text{ ft}^2 & \text{if single-family residential} \\ 15\% \text{ roof area} & \text{if commercial} \end{cases}$$

$S$	Rated (DC) system size (kW)
$A_{system}$	Area of system (ft <sup>2</sup> )
$A_{available}$	Available roof area (ft <sup>2</sup> )
$C$	Building energy consumption (kWh/yr)
$D_{DC}$	DC power density of photovoltaic system (kW/ft <sup>2</sup> )
$D_{AC}$	AC power density of photovoltaic system (kWh/ft <sup>2</sup> /yr)

Equation 2 Calculation of photovoltaic system size.



## 4 Input Parameters

A variety of parameters were needed to specify the modeled projects, in addition to the building models described previously. The building models provided constraints on roof area and, through simulations, hourly electric energy consumption data. The additional parameters included:

- general parameters specifying the location and analysis period;
- parameters affecting initial purchase cost and ongoing maintenance costs of the photovoltaic systems;
- parameters specifying the performance of the photovoltaic systems;
- financial parameters, including debt terms, taxes, insurance, inflation, discount rate, incentives, and depreciation;
- utility rates and annual escalation rates.

Table 4 summarizes the input parameters used in this study for the reference scenario. Several parameters, such as azimuth and discount rate, were specific to individual building models. The following sections describe these parameters in more detail and the derivation of their values.





Category	Parameter	Residential (single-family)	Residential (low income)	Commercial	Sources and notes
General	Location and weather	SF Intl. Airport, CEC CZ3	SF Intl. Airport, CEC CZ3	SF Intl. Airport	NREL TMY3, CEC CZ3
	Analysis period	25	25	25	Various
PV Cost	\$/W in 2015	\$5.20 (<10 kW) \$4.50 (≥10 kW)	\$5.20 (<10 kW) \$4.50 (≥10 kW)	\$4.58 (<10 kW) \$4.64 (≥10 kW)	CSI, forecast
		\$4.53 (<10 kW) \$3.85 (≥10 kW)	\$4.53 (<10 kW) \$3.85 (≥10 kW)	\$3.90 (<10 kW) \$4.01 (≥10 kW)	CSI, forecast
	Inverter replacement	10%	10%	10%	10% of initial cost at 10 and 20 years, inflation adjusted
PV System	DC→AC derate	0.77	0.77	0.77	PV Watts
	Module efficiency	17%	17%	17%	Estimate
	Annual degradation	0.50%	0.50%	0.50%	SAM
	Sun hours per year	1850	1850	1850	PV Watts
	Sun hours per day	5.07	5.07	5.07	PV Watts
	Tilt	20°	20°	33°	SAM
	Azimuth	180°	180°	180° or 210°	Most cost-effective azimuth depends on building
	Availability	100%	100%	100%	
PV Output	AC power (W/ft²)	12.8	12.8	13.1	At 180°
	AC energy (kWh/ft²/yr)	23.7	23.7	24.2	At 180°
Financial	Debt proportion	80%	80%	70%	Realty Rates
	Debt term	25	25	25	Same as analysis period
	Debt rate	5.00%	5.00%	5.00-6.72%	Realty Rates
	Federal tax rate	25%	15%	35%	Tax tables, median income
	State tax rate	8%	4%	8.84%	Tax tables, median income
	Sales tax rate	8.75%	8.75%	8.75%	SF tax
	Insurance rate	0.50%	0.50%	0.50%	SAM
	Inflation rate	2.50%	2.50%	2.50%	SAM
	Real discount rate	8.00%	8.00%	6.5-7.9% (2015) 6.9-8.2% (2017)	IRR survey
	ITC in 2015	30%	0%	30%	
	ITC in 2017	0%	0%	10%	
	Depreciation	N/A	N/A	5 yr MACRS	
	Utility rates	E1 Region T	EL1	A1, A10, E19 TOU primary	PG&E
	Escalation	2.11% real through 2020, 1.42% thereafter			E3
	NSC at end of 2015		0.06278		PG&E, forecast
	NSC at end of 2017		0.08341		PG&E, forecast

Table 4 Summary of input parameters.



## 4.1 Photovoltaic System Cost

The cost of the photovoltaic systems has a significant impact on cost effectiveness. There is a first cost to purchase and install a system, which is represented as a normalized cost per watt. This is then multiplied by the nameplate (DC) rating of the modeled systems to arrive at a purchase cost. In addition, periodic maintenance costs due to inverter replacement were also modeled.

### 4.1.1 Cost Per Watt

This study uses forecasted costs of solar systems to estimate the cost of installing solar systems in new construction. Price forecasts were estimated for the residential and commercial sectors for small (<10 kW) and medium-size (10 - 100 kW) photovoltaic systems. The forecasted prices for 2015 and 2017 are shown in the table below.

Year	Residential		Commercial	
	< 10 kW	10-100 kW	< 10 kW	10-100 kW
2015	\$5.20	\$4.50	\$4.58	\$4.64
2017	\$4.53	\$3.85	\$3.90	\$4.01

*Table 5 Forecasted cost per watt for the initial study years.*

Past system prices from the California Solar Initiative (CSI) were analyzed for the residential and commercial sectors. The historic price changes were used to forecast prices in subsequent years by fitting an exponential growth curve to the historic data. Data for commercial and medium-sized systems in San Francisco were lacking, so an adjustment factor was derived to account for differences between statewide costs and the cost of solar in San Francisco. A new construction adjustment factor was also added to each forecasted price, to account for the expected reduced cost of installation in new construction.

#### 4.1.1.1 Analysis of statewide cost per watt

Data from the CSI were analyzed to determine the average cost per watt of solar systems (CSI 2014b). The September 30, 2014 CSI working data set was used in this study. Average costs per watt were calculated for small residential systems in San Francisco and for small and midsize residential and commercial systems throughout California for the years 2007 through 2014. Data for completed systems ranging in size from 0-10 kW and 10-100 kW were used. Outliers, defined as costs per watt more than three standard deviations from the annual mean of the statewide commercial or residential data, were also excluded. Data for third-party systems were excluded due to reported irregularities in these data and reporting of third-party prices based on appraised value (E3 2011, Barbose et al 2013). In addition, this study examined single-owner photovoltaic systems, so that third-party pricing models were less applicable. The average statewide costs per watt for each year are shown in Table 6 below.



	Year	Residential (<10 kW)	Residential (10-100 kW)	Commercial (<10 kW)	Commercial (10-100 kW)
Average cost	2007	\$8.03	\$7.81	\$7.70	\$8.13
	2008	\$8.11	\$7.66	\$8.29	\$7.53
	2009	\$7.93	\$7.40	\$7.86	\$7.45
	2010	\$7.39	\$6.40	\$6.83	\$6.24
	2011	\$6.89	\$5.99	\$5.77	\$5.71
	2012	\$6.13	\$5.07	\$5.26	\$5.15
	2013	\$5.03	\$4.53	\$4.62	\$4.43
	2014	\$4.78	\$4.33	\$4.44	\$4.85
Forecast	2015	\$4.61	\$3.92	\$4.00	\$4.06
	2016	\$4.25	\$3.57	\$3.63	\$3.71
	2017	\$3.92	\$3.25	\$3.29	\$3.40

*Table 6 Average statewide costs per watt and forecasted costs for 2015-2017.*

Only small sample sizes were available for commercial and midsize residential systems in San Francisco. In addition, the data for commercial systems in San Francisco were much less consistent than the data for the other sectors and geographic regions. Data for only a few commercial systems were available for San Francisco, and there were years for which data were available for only one system. In addition, the commercial data exhibited erratic rises and falls that were not consistent with overall solar market behavior. Therefore, the data for commercial and midsize residential systems in San Francisco were not used for forecasting.

#### **4.1.1.2 Calculation of statewide to San Francisco adjustment factor**

To derive a cost for the commercial and for midsize residential systems in San Francisco, the assumption was made that the difference between the average statewide small residential costs to San Francisco small residential costs in each year would be representative of the difference in costs for installations in San Francisco overall. The difference in each year was then added to the forecasted costs for the four categories (small/midsize commercial and small/midsize residential) to derive a value for San Francisco. The calculation of these adjustment factors for each year is shown in Table 7 below.



	Year	San Francisco residential (<10 kW)	California residential (<10 kW)	CA to SF adjustment
Average cost	2007	\$9.08	\$8.03	\$1.05
	2008	\$8.89	\$8.11	\$0.78
	2009	\$8.53	\$7.93	\$0.60
	2010	\$8.25	\$7.39	\$0.86
	2011	\$7.85	\$6.89	\$0.96
	2012	\$8.07	\$6.13	\$1.94
	2013	\$6.34	\$5.03	\$1.31
	2014	\$5.83	\$4.78	\$1.05
Forecast	2015	\$5.95	\$4.61	\$1.33
	2016	\$5.60	\$4.25	\$1.35
	2017	\$5.28	\$3.92	\$1.36

Table 7 Calculation of California to San Francisco adjustment factor.

#### 4.1.1.3 Calculation of new construction adjustment factor

An additional adjustment factor was used to account for installation in new construction. The analyzed cost per watt based on the CSI data reflects the cost of installation in existing buildings. The proposed ordinance under study, however, was for new construction. Installation of solar systems on new residential construction is expected to be less costly than retrofit installation (Barbose et al 2013). Data on solar system costs in new construction are not readily available. Therefore, an estimate was derived of the difference in costs between retrofit and new construction, and this estimate was used to adjust all forecasted retrofit prices to forecasted new construction prices.

Tracking the Sun VI provides cost data for new versus retrofit construction based on California's New Solar Home Partnership (Barbose et al 2013, figure 28, p35). The table below shows the costs per watt for new construction and retrofit construction in new homes, along with their differences. The average difference of the cost per watt for new versus retrofit installation from 2008-2012 was -\$0.75. This average was added to the forecasted cost per watt in existing construction to determine the cost in new construction. In addition, since data for installation on new commercial systems was not available, the same value was used for both residential and commercial costs.

Year	New	Retrofit	Difference
2008	\$8.00	\$8.70	-\$0.70
2009	\$7.40	\$8.50	-\$1.10
2010	\$7.00	\$7.50	-\$0.50
2011	\$6.10	\$6.80	-\$0.70
2012	\$5.30	\$6.00	-\$0.70
Average			-\$0.75

Table 8 Difference of average cost per watt for residential new construction and retrofit installation for the years 2008-2012.





The Title 24 2013 Solar Ready requirements reduce the cost of retrofit installation of solar systems on solar ready buildings. These solar ready requirements were estimated to reduce the costs of solar installations in new single-family residential construction from \$2,687 to \$182, a savings of \$2,505 (CASE 2011, figure 45, p90). The NSHP data, which were available through 2012, apply to structures that were not solar ready. Therefore, the difference in cost may be less significant, reducing the cost advantage of installation in new construction. This adjustment was not factored into the adjustment used for this study.

#### **4.1.2 Maintenance Costs**

SAM's default annual maintenance costs of \$20/kW/yr were retained for this study. SAM does not, however, include the cost of inverter replacement. Inverters were assumed to require replacement 10 years after being placed in service. For the 25 year analysis period, inverter replacement was expected to occur in years 10 and 20 and it was assumed that new inverters represent 10% of a total PV project's cost (see, e.g., Borenstein S 2011). As an estimate of the maintenance cost due to inverter replacement, 10% of the projects' initial cost were inflated to current dollars at years 10 and 20, and applied as a cost in the simulations in SAM for those years.

For instance, assuming a \$20,000 total initial system cost in year 0, the cost of the inverter would be  $10\% \times \$20,000 = \$2,000$ . At an inflation rate of 2.50%, after 10 years inverter replacement would cost 28% more in current dollars (1.28x) or \$2,560 and after 20 years it would cost 64% more (1.64x) or \$3,280.

While it is entirely possible that the future price of inverters will be lower given improvements in inverter technology, no attempt was made to derive a value based on future market changes. A reduction in price in real terms of 2%/yr may be reasonable (Borenstein S 2011). In addition, inverter replacement should result in an increase in efficiency. The model in SAM assumes a constant percent degradation in system output year-to-year. This study does not include an offset to increase system production following inverter replacement.

## **4.2 Photovoltaic System Performance**

Generic photovoltaic systems were modeled using NREL's PV Watts model and System Advisor Model (SAM) software (NREL 2014a,b). PV Watts provides information on solar power and energy based on location, system tilt, azimuth, and system performance characteristics. Values for San Francisco were calculated for the tilt and azimuth combinations that were modeled for this study. As a simplifying assumption, it was also assumed that all of the roof area allocated for the systems was covered in panels. Table 9 below summarizes the system performance parameters.



Parameter	Values
Tilt (°)	20, 33
Azimuth (°)	180, 210
Panel efficiency	0.17
AC to DC derate	0.77
Annual degradation	0.5%

*Table 9 Summary of parameters for the modeled photovoltaic systems' tilt, azimuth, and efficiency.*

SAM's defaults for tilt were used, with 20° assumed for residential systems and 33° for commercial systems. The azimuth was either 180° or 210°. An azimuth of 180° results in more cost-effective systems for some buildings, while an azimuth of 210° is more cost-effective for other buildings. The choice of azimuth was initially set at 180°, and then changed to 210° for those buildings where sensitivity analysis showed a more cost-effective outcome at 210°.

Panels vary in the efficiency with which they convert solar radiation to electricity. Higher efficiencies yield greater power density, such that a smaller area covered with solar panels can generate the same amount of energy as a system using lower efficiency panels. A panel efficiency of 17%, which is within the range of systems currently available on the market, was used for this study.

Solar systems also vary in the efficiency with which they convert the DC electricity produced by the panels into AC electricity, known as the DC to AC derate factor. This factor depends on a variety of system characteristics. A default value of 0.77 was used for this study, which is the default value in both PV Watts and SAM.

Photovoltaic systems degrade over time, producing less energy with each passing year. The SAM-default system degradation rate of 0.5%/yr was used for the model.

Table 10 shows the insolation, power, and energy densities for the modeled generic systems, which were calculated using PV Watts and the above parameters. The power and energy densities determine the amount of generation that can be installed in a given area of a roof.

Azimuth (°)	Tilt (°)	Insolation (W/ft <sup>2</sup> )	DC power (W/ft <sup>2</sup> )	AC power (W/ft <sup>2</sup> )	DC energy (kWh/ft <sup>2</sup> /yr)	AC energy (kWh/ft <sup>2</sup> /yr)
180	37.6	99.9	17.0	13.1	31.4	24.2
180	33	100.1	17.0	13.1	31.5	24.2
180	20	98.1	16.7	12.8	30.8	23.7
210	37.6	98.6	16.8	12.9	31.0	23.9
210	33	99.0	16.8	13.0	31.1	24.0
210	20	97.3	16.5	12.7	30.6	23.6

*Table 10 Power and energy densities for the modeled systems' azimuths and tilts.*

### 4.3 Financial Parameters

A variety of financial parameters affect the analysis results and are required as inputs to SAM. The financial parameters specific to the individual model buildings used in this study are summarized in Table 11 below.



Building	Discount rate in 2014 (real)	Discount rate change per year (%/yr)	Loan interest rate	Debt proportion	Federal tax rate	State tax rate	ITC (2015)	ITC (2017)
Single Family	8%	0%	5.00	80%	25%	8%	30%	0%
Single Family Low Income	8%	0%	5.00	80%	15%	4%	0%	0%
Multifamily	6.3%	0.21%	5.00	70%	35%	8.84%	30%	10%
Multifamily Common	6.3%	0.21%	5.00	70%	35%	8.84%	30%	10%
Hotel Small	7.5%	0.12%	5.80	70%	35%	8.84%	30%	10%
Office Large	6.5%	0.21%	5.38	70%	35%	8.84%	30%	10%
Office Medium	6.5%	0.21%	5.38	70%	35%	8.84%	30%	10%
Office Small	6.5%	0.21%	5.38	70%	35%	8.84%	30%	10%
Restaurant Small	7.0%	0.12%	6.72	70%	35%	8.84%	30%	10%
Retail Large	7.8%	0.12%	5.25	70%	35%	8.84%	30%	10%
Retail Medium	7.0%	0.12%	5.25	70%	35%	8.84%	30%	10%
Warehouse	6.8%	0.12%	5.25	70%	35%	8.84%	30%	10%

Table 11 Summary of financial parameters used for each building model type.

Additional financial parameters common to all modeled projects are summarized in Table 12.

Parameter	Value
Inflation rate	2.50%
Insurance rate	0.5%
Property tax rate	0%
Debt term	25 years
Depreciation schedule (commercial only)	5 year MACRS

Table 12 Summary of financial parameters applicable to all buildings.

#### 4.3.1 Financial Parameter Alternatives

Individual parameter values can have a range of plausible values. Several parameters in particular may have significant impact on the cost-effectiveness outcome. These include the:

- debt fraction, which is the proportion of a project funded by debt
- debt rate, which is the interest rate charged on the debt



- discount rate

Table 13 lists five groups of options for these parameters for commercial buildings. These options are described below.

- **Reference scenario:** For the reference scenario the intent was to use values for the parameters that represent typical real world conditions. Therefore, the reference scenario uses recent market-specific industry survey data as a basis for these parameters. Industry surveys provided values for the debt rate and discount rate for different property types. For the debt fraction, an approximate average of surveyed values was used.
- **Industry surveys:** Integra Realty Resources (IRR) and Realty Rates (RR) each publish industry surveys on financing of commercial properties (Integra Realty Resources 2014a-e, Realty Rates 2014). IRR's data are further specified for particular property types in San Francisco. These data were used in the reference scenario.
- **E3 study:** Energy and Environmental Economics (E3) performed a study on the cost-effectiveness of rooftop photovoltaic systems in California (E3 2013).
- **NREL (System Advisor Model):** NREL based the default financial parameters in SAM on a variety of sources, with a focus on national long-term averages (NREL 2014a). The values listed in Table 13 were the defaults in SAM.
- **SF Environment staff proposal:** The San Francisco Department of the Environment proposed values that staff believes are appropriate for evaluating the cost-effectiveness of the proposed ordinance.

	Reference scenario	Industry surveys	E3 study	NREL (System Advisor Model)	SF Environment staff proposal
<b>Source focus</b>	New construction	Commercial real estate financing	Rooftop PV in new construction	Analysis software	New construction
<b>Debt fraction</b>	70%	70%	40 - 55%	100%	100%
<b>Debt rate</b>	5.0-6.7%	5.0-6.7%	6.80%	7.5%	5%
<b>Discount rate</b>	6.5-7.9% (2015) 6.9-8.2% (2017)	6.3-7.8% (2014) +0.12-0.21%/yr	6.13%	5.2%	4%
<b>Inflation rate</b>	2.5%			2.5%	2%

Table 13 Alternatives for several financial parameters. Industry surveys from Realty Rates and Integra Realty Resources. E3 study specified equity fraction of 45 to 60%, depending on year. NREL SAM values are defaults for new commercial model files. Discount rates are real rates.

#### 4.3.2 Discount Rates

The discount rate is "used to calculate the present value of a future payment" (Short et al 1995). The specific discount rate used in an analysis can have a significant impact on the cost effectiveness of financial decisions. There is no single discount rate used by all individuals, and there are a variety of





methods for calculating or selecting a discount rate. Ultimately, the choice of discount rate is highly dependent on individual circumstances and decisions. This study uses different discount rates for the residential and commercial models. The residential discount rate used in this study was 8%, which was the default value in SAM. For the commercial models, the discount rates were based on industry surveys and depended on the type of building being modeled.

The commercial discount rates used in this study were based on a survey of firms involved in the real estate industry. Integra Realty Resources (IRR) publishes industry surveys for the San Francisco commercial real estate market (Integra Realty Resources 2014a-e). Surveys for the industrial, lodging, multifamily, office, and retail real estate sectors are published annually and mid-year. The survey data include real discount rates for several property classes and types. The discount rates for the highest-class (i.e., class A) property types that most closely matched the types of buildings modeled in this study were used. In addition, the surveys included a range of forecasted changes in the discount rate over a 36 month period. The midpoint of the forecasted change was used to forecast discount rates in the modeled years 2015 and 2017. Table 14 summarizes the discount rates used in this study to model commercial systems.

Building name	IRR property type	Discount rate (real, mid-2014)	Change per year (%/yr)
Multifamily	Multifamily Urban Class A	6.3%	0.21%
Multifamily Common	Multifamily Urban Class A	6.3%	0.21%
Hotel Small	Lodging Full service	7.5%	0.12%
Office Large	Office CBD Class A	6.5%	0.21%
Office Medium	Office CBD Class A	6.5%	0.21%
Office Small	Office CBD Class A	6.5%	0.21%
Restaurant Small	Retail Community	7.0%	0.12%
Retail Large	Retail Mall	7.8%	0.12%
Retail Medium	Retail Community	7.0%	0.12%
Warehouse	Industrial Class A	6.8%	0.12%

*Table 14 Real discount rates and forecasted change per year used for each commercial building model. Rates are based on those reported in Integra Realty Resources (IRRs) midyear viewpoints for the San Francisco market for several commercial real estate types.*

### 4.3.3 Debt Parameters

A debt term of 25 years was used for both residential and commercial systems, the same as the analysis period, which corresponds to the typical expected lifetime of a photovoltaic system. The residential debt rate used was 5%, corresponding to typical long-term mortgage rates. This was also the default rate in SAM. The residential debt proportion was 80%, which corresponds to standard mortgage practices.

For commercial properties, published survey data were used for debt parameters. Realty Rates' publishes an Investor Survey (RRIS, Realty Rates 2014) with data on permanent financing for several



commercial real estate property types. The data include interest rates and loan-to-value ratios. The property types in the RRIS were assigned to the most closely matching building models used in this study, along with the corresponding loan-to-value ratio and interest rate. The proportion of debt to system cost for commercial properties is based on an average loan to value ratio from the RRIS. An approximate average loan to value ratio of 70% was used as the debt proportion.

Building name	RRIS property type	Loan interest rate	RRIS Loan to value ratio
Multifamily	Apt	5.00	0.73
Multifamily Common	Apt	5.00	0.73
Hotel Small	Lodging	5.80	0.67
Office Large	Office	5.38	0.73
Office Medium	Office	5.38	0.73
Office Small	Office	5.38	0.73
Restaurant Small	Restaurant	6.72	0.64
Retail Large	Retail	5.25	0.70
Retail Medium	Retail	5.25	0.70
Warehouse	Self storage	5.25	0.69

*Table 15 Debt parameters for each building model. The rates are based on survey data from the Realty Rates Investor Survey (RRIS). A debt fraction of 70% was used for all buildings, which is close to the average RRIS loan-to-value ratio.*

#### 4.3.4 Tax Parameters

Marginal tax rates have a significant impact on cost-effectiveness, as they affect the tax deductions available to individuals and companies. Commercial entities can deduct expenses for purchasing and operating a system. Residential owners pay for a system that is included in new construction as part of their home mortgage, and interest payments on home mortgages are tax deductible (IRS 2014).

For residential customers who are not low income, the federal and state tax rates were based on the tax rate for the median family income in San Francisco. The median family income in San Francisco for 2008-2012 was \$73,802 (U.S. Census Bureau 2014). The marginal federal tax rate for couples filing jointly and earning the median income was 25% (Bankrate 2014). The marginal state tax rate for couples filing jointly was 6% for taxable income between \$57,990 and \$80,500 (FTB 2014).

For low income residential customers, tax rates were based on the tax rate for families qualifying for CARE electric rates in PG&E's service territory. For a four person household, the maximum gross annual income to qualify for CARE rates is \$47,700 (PGE 2014a). At this income level, the marginal federal tax rate was 15% in 2014. The marginal state tax rate for couples filing jointly was 4% for taxable income between \$36,742 and \$57,900 (FTB 2014).



For commercial customers, a marginal federal tax rate of 35% was used. This is also the default value in SAM. The California state tax for corporations other than banks and financials was 8.84% (FTB 2014).

The sales tax rate for San Francisco was 8.75%, and applies to residential and commercial owners (BOE 2014).

#### **4.3.5 Investment Tax Credit (ITC)**

The investment tax credit (ITC) has a significant impact on the cost-effectiveness of systems, as it represents a large reduction in the cost of the system. The ITC is received as a credit against taxes in the first year that a system is installed. The ITC is 30% of system cost through 2016, and is expected to be reduced in 2017: to 10% for commercial systems and eliminated entirely for residential systems (NCSC 2014a, NCSC 2014b). To fully realize the value of the ITC requires that the beneficiary have sufficient tax liability. For this study, for both residential and commercial customers, the ITC rate used was 30% for systems installed in 2015. For systems installed in 2017, the commercial rate was 10% and the residential rate was 0%. It was also assumed that low income residential customers would not benefit from the ITC since they would not have sufficient tax liability, so an ITC rate of 0% was used for those customers in both 2015 and 2017.

#### **4.3.6 Other Financial Parameters**

Several additional financial parameters were used (see Table 12 on page 28 for a summary of these values):

- An inflation rate of 2.50% per year is assumed for the analysis (SAM default). A long-term average is used for the inflation rate since it applies to the full analysis period. For comparison, the average inflation rate for 2010-2012 was 2.29% (Inflation Data 2014).
- For commercial customers, a 5 year Modified Accelerated Cost Recovery System (MACRS) tax depreciation schedule was used for both federal and state tax purposes.
- An insurance rate of 0.5% per year was used (SAM default).
- Photovoltaic systems are exempt from property taxes in California (NCSC 2014c), so a rate of 0% was used for property taxes.

### **4.4 Utility Rates**

#### **4.4.1 Utility Rate Schedules**

Table 16 above summarizes the rate schedules and options used for each building for PG&E electrical service (PGE 2014b). The rates used were based on those current as of October 1, 2014. Annual building electricity consumption is shown for reference, since the applicability of commercial schedules depends on annual consumption. For purposes of this study, it was assumed that utility rate structures would remain unchanged for the analysis period, but that utility rates would escalate annually at a rate greater than inflation.



Building	Consumption (kWh/yr)	Rate schedule	Rate options
Single Family	4560	E1	Baseline region T
Single Family Low Income	3420	EL1	
Multifamily	22844	E1	Baseline region T
Multifamily Common	2284	A1	Time of use
Hotel Small	161971	A10	Time of use, primary voltage
Office Large	3435150	E19	Time of use, primary voltage
Office Medium	417967	A10	Time of use, primary voltage
Office Small	57479	A10	Time of use, primary voltage
Restaurant Small	61427	A1	Time of use
Retail Large	1847380	E19	Time of use, primary voltage
Retail Medium	185647	A10	Time of use, primary voltage
Warehouse	134926	A1	Time of use

Table 16 Utility rates and options for each building model.

Electric rates were escalated annually at a real rate of 2.11%/yr from 2012-2020, and at a real rate of 1.42%/yr thereafter (E3 2013). These escalation rates were based on an analysis using the E3 RES Calculator by Energy and Environmental Economics (E3) for the California Air Resources Board. The October 2014 utility rates were then inflated to the modeled years (2015 and 2017) using the nominal escalation rate, before being imported into SAM.

#### 4.4.2 Net Energy Metering Rates

Net Energy Metering (NEM) provides a monthly bill credit, at retail rates, for power generation in excess of consumption. In addition, there is an annual payment at the Net Surplus Compensation rate (NSC) for excess generation. The NSC rate is set by the utility for all customers. NEM rules currently limit participation based on capacity. For purposes of this study, it was assumed that all customers would be able to participate in NEM. In addition, it was assumed that the NEM and NSC structure would remain unchanged. The NEM rate schedule used was the same as the customers' regular rate schedule.

NSC payments are modeled by SAM using a calendar year; therefore, forecasts of the NSC rate were done for December of the first year of the simulations. PG&E provides past NSC rates for January 2012 through October 2014 (PGE 2014c). For the period January 2012 through December 2012 the NSC rates declined. From January 2013 through October 2014 the rates increased at a near linear rate. A linear trend line was fitted to the data from January 2013 through October 2014 ( $R^2$  0.9681), and used to forecast the NSC rate in December of the modeled years. These data were plotted in Figure 5 below, which also shows the NSC rate forecasts. In this study, it is unlikely that there would be excess generation at the end of the simulated years since the modeled systems are sized up to maximum annual consumption.





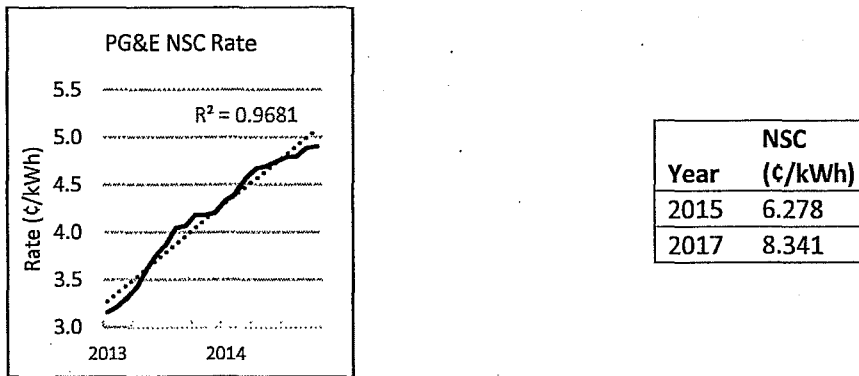


Figure 5 The graph on the left shows the Net Surplus Compensation (NSC) rates for the period January 2013 through October 2014. A linear trendline (dotted) was fitted to the data. The table on the right shows the forecasted NSC rates for December of each of the initial simulation years. The forecast was extrapolated using the linear regression line.



## 5 Results

### 5.1 Cost Effectiveness

Several scenarios were analyzed for cost-effectiveness, as summarized in Table 17 below. The scenarios were selected to represent different potential conditions as well as perceptions of market conditions. The scenarios cover only a small subset of all possible values, and are not presented as exhaustive of all foreseeable conditions.

Scenario	Description
Reference	Parameter values were as described previously.
All Debt	The entire project was funded with debt.
< Cost	Lower cost scenario. The debt rate and cost per watt were decreased by 10%.
> Cost	Higher cost scenario. The debt rate and cost per watt were increased by 10%, while system availability was decreased by 10%.
SFE	Values for debt fraction (100%), debt rate (5%), and discount rate (4%) were specified by the San Francisco Department of the Environment.

Table 17 Scenarios analyzed for cost-effectiveness.

Simulations were run using SAM for each building, scenario, and year, and the resulting benefit-to-cost ratios (BCRs) were calculated. The results of the simulations are presented in the tables below for the simulation years 2015 and 2017, respectively. The BCRs are color-coded to indicate some of the uncertainty in the results. Values that are more cost-effective ( $>1.0$ ) are colored in deeper shades of green, values that are close to 1.0 (breakeven) are yellow, and values that are less cost-effective ( $<1.0$ ) are colored in deeper shades of red. The results were sorted in decreasing BCR order for the 2015 reference case.

Building (2015)	Reference	All Debt	< Cost	> Cost	SFE
Single Family	1.84	2.11	2.03	1.56	1.95
Multifamily	1.60	1.81	1.72	1.43	1.69
Single Family Low Income	0.92	1.06	1.04	0.75	1.03
Warehouse	1.14	1.31	1.19	1.06	1.20
Multifamily Common	1.13	1.30	1.19	1.06	1.19
Small Restaurant	1.11	1.25	1.17	1.03	1.21
Large Office	1.11	1.27	1.16	1.03	1.17
Medium Office	1.06	1.22	1.11	1.00	1.12
Large Retail	1.05	1.25	1.10	1.00	1.09
Medium Retail	1.05	1.22	1.09	0.99	1.09
Small Hotel	1.04	1.21	1.09	0.98	1.09
Small Office	1.04	1.19	1.09	0.98	1.10

Table 18 Benefit-to-cost ratios (BCRs) for each building and scenario for the year 2015. Color coding indicates approximate degree of cost-effectiveness. Values sorted by BCR of reference scenario in 2015.



Building (2017)	Reference	All Debt	< Cost	> Cost	SFE
Single Family	1.78	2.04	2.00	1.44	1.98
Multifamily	1.65	1.88	1.79	1.44	1.77
Single Family Low Income	1.09	1.26	1.23	0.89	1.22
Warehouse	1.08	1.25	1.14	0.99	1.16
Multifamily Common	1.08	1.26	1.15	1.00	1.16
Small Restaurant	1.07	1.21	1.13	0.97	1.19
Large Office	1.05	1.22	1.11	0.96	1.14
Medium Office	0.99	1.15	1.05	0.91	1.07
Large Retail	0.96	1.15	1.01	0.90	1.03
Medium Retail	0.97	1.13	1.02	0.89	1.04
Small Hotel	0.96	1.12	1.00	0.89	1.03
Small Office	0.97	1.12	1.02	0.89	1.04

Table 19 Benefit-to-cost ratios (BCRs) for each building and scenario for the year 2017. Values sorted by BCR of reference scenario in 2015.

The ranking of the BCRs remained fairly consistent across the scenarios and the two modeled years, even as the BCRs varied. Thus, the residential buildings (single- and multifamily) have the highest BCRs, driven mainly by the higher retail rates residential customers pay for electricity. The commercial buildings varied in their energy consumption patterns, utility rates, financial parameters, and system sizes, all of which drove the variation in their BCRs. The Warehouse building model consistently had the highest BCR of the commercial buildings, while the Small Office and Small Hotel building models had the lowest BCRs, and thus present the greatest challenge to ensuring cost-effectiveness.

Figure 6 shows the BCR ratios for the residential (left) and commercial (right) building models for the reference scenario in 2015 and 2017, showing the BCRs for the individual building models.

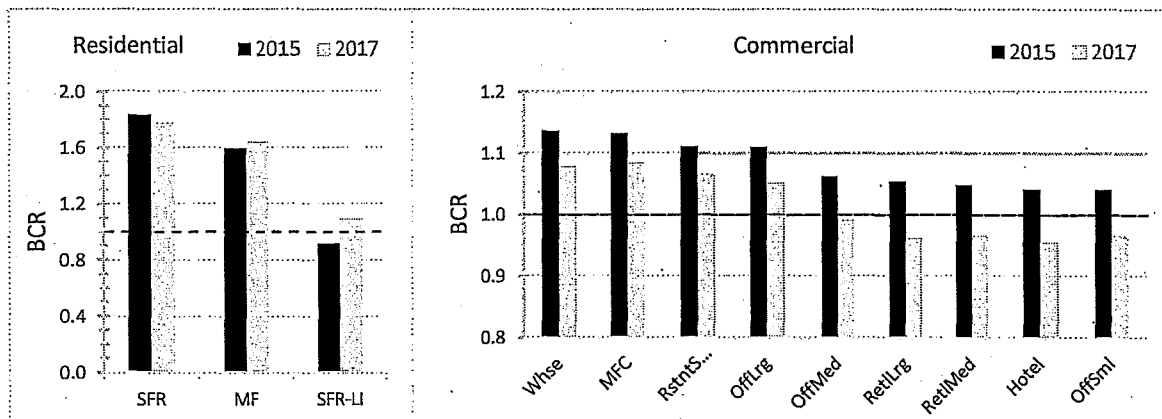


Figure 6 Benefit-to-cost ratios for the residential (left) and commercial (right) building models for the reference scenario in 2015 and 2017.



### 5.1.1 Interpretation of cost-effectiveness results

The results presented above do not provide a clear-cut answer to the question of cost-effectiveness for all building models. The cost-effectiveness threshold and BCRs could be interpreted as precise single values. Alternatively, they could be interpreted as point estimates drawn from a population of possible values having some probability distribution. The latter interpretation is more representative of the uncertainty inherent in forecasting future conditions.

When interpreted as precise single values, any BCR that is greater than 1.0 would be interpreted as indicating that the outcome is cost-effective, while any BCR less than 1.0 would be interpreted as indicating that the outcome is not cost-effective. Using this interpretation, the results for some of the model buildings are cost-effective while others are not, when evaluated using the reference scenario for 2017. Specifically, all of the residential building models—Single Family, Single Family Low Income, and Multifamily—would be cost-effective. In addition, the Warehouse, Multifamily Common, Small Restaurant, and Large Office commercial building models would be cost-effective. The Medium Office, Large Retail, Medium Retail, Hotel, and Small Office commercial building models would not be cost-effective.

Interpretation of the results when considering uncertainty is less clear cut. While the results are shown as single BCR values, they could take on a range of possible values, depending on the range of possible input values and modeling assumptions. The input values, which depend on a large number of factors and assumptions, could be significantly different from the values selected for this study. Different values for inputs including the cost per watt, interest rate on debt, and building energy use are quite possible. The results of the sensitivity analysis and alternate scenarios suggest some of the range of variability that is possible. For instance, the BCRs of the commercial building models in the reference scenario in 2017 ranged from 0.96 to 1.08. In the higher-cost scenario in 2017 they dropped to 0.89 to 1.00. Without further analysis, it is not clear whether a difference of -0.04, +0.08, or even -0.11 relative to the threshold is statistically significant. Does a result of 0.97 indicate that a project is not cost-effective, while a result of 1.05 indicates cost-effectiveness? To interpret the BCRs as being associated with a probability distribution would require information about that distribution.

However, even without a more detailed level of analysis, it is possible to make some inferences about the likelihood of a result indicating cost-effectiveness. The greater the difference of a result from the cost-effectiveness threshold, the more likely it is that the result represents a true outcome (cost-effective or not cost-effective). The BCRs for the single- and multifamily residential building models in the reference scenario in 2017 were significantly above the cost-effectiveness threshold, at 1.78 and 1.65, respectively. These results are therefore more likely to represent a true cost-effective result for these building models, compared to the other building models that have lower BCRs. For the commercial building models, the Warehouse building model had a BCR of 1.08 in the 2017 reference scenario. This represents an outcome that is more likely to be cost-effective than the results for the Small Hotel building model, which had a BCR 0.97 in the 2017 reference scenario.

The single-family low income (SFR-LI) model is somewhat unique, due to a combination of low utility rates and limited tax benefits. The SFR-LI model for the reference scenario had a BCR of just 0.92 in





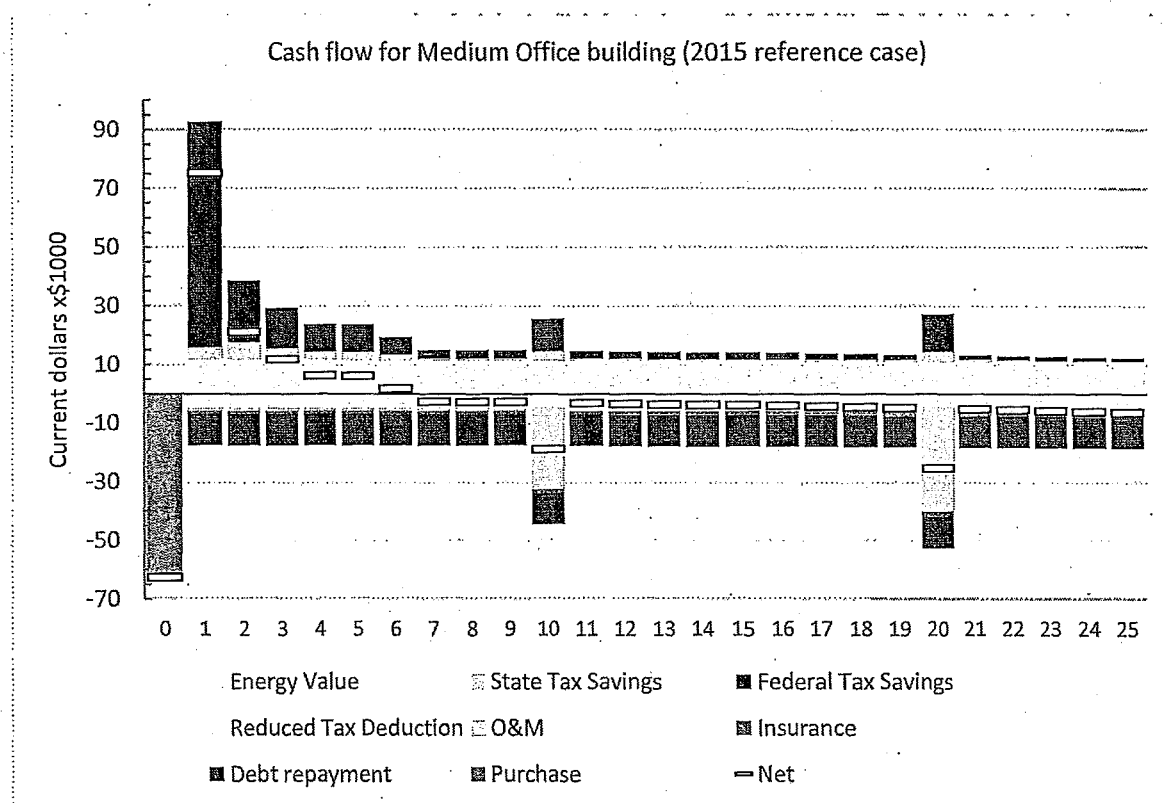
2015, which increased to 1.09 in 2017 due to the forecasted decrease in the cost per watt. In the low income model, it was assumed that the residents do not benefit from the federal investment tax credit. At the same time, they pay lower electric rates under the CARE program, so that their cost of grid electricity is lower, while their net energy metering benefit is also reduced. The SFR-LI model also fared poorly in the higher cost scenario in 2015, with a BCR of just 0.75, and 0.89 in 2017. It should be noted that very few single-family residences are built in San Francisco. In contrast, there are many more low-income residences in multifamily buildings. Therefore, issues of low-income affordability in single-family residences should be less prevalent than those in multifamily buildings. The Multifamily building model, however, does not consider issues of low-income ratepayers, such as those paying CARE rates. The Multifamily building model is represented as one large aggregate system paying standard residential rates. Therefore, these building models provide limited insight into issues associated with low-income residents.



## 5.2 Cash Flow

The net lifetime benefits and costs for each project were used to calculate the projects' overall benefit-to-cost ratio. Individual project cash flows, showing the annual benefits and costs, provide additional detail that can assist in understanding the calculation of the ratio. For instance, one of the results of the sensitivity analysis (see 5.3 Sensitivity Analysis on page 41) was that an increase in discount rate can result in a higher benefit-to-cost ratio. Examining a representative cash flow in more detail will provide insight into this outcome.

The undiscounted (current-dollar) cashflow for the Medium Office building model for the reference scenario in 2015 is shown in Figure 7 below, while the corresponding discounted cash flow is shown in Figure 8 on page 41. This sample cashflow shows the breakdown of the components of the benefits and costs, as well as how a change in discount rate can affect the benefit-to-cost ratio.



*Figure 7 Current-dollar annual cash flow for the Medium Office building model for the 2015 reference case. This shows the net after-tax cash flow, as well as the individual benefits and costs that contribute to the net value. The horizontal axis shows years flow is negative in year zero due to the purchase of the photovoltaic system, then turns positive as a result of tax credits and deductions, before going negative after year 6 due to debt repayment, maintenance costs, and the reduced tax deductibility of energy costs. The large costs in years 10 and 20 are due to inverter replacement.*

In the initial project year, the cost is dominated by the purchase costs of the system for the portion not financed with debt. Then, in the first few years of the project the federal tax benefits are significant, composed primarily of the investment tax credit (in year 1) and the value of the accelerated



depreciation (years 1-5). State tax benefits, comprised mainly of the value of the accelerated depreciation, also contribute to overall benefits. Throughout the analysis period the value of the energy generated remains relatively constant, affected mainly by system degradation and utility rate escalation. In years 10 and 20 there are large maintenance costs due to inverter replacement. In the remaining years costs are composed mainly of debt repayment and the reduction in the tax deduction due to lower spending on energy. While the reduced tax deduction is shown in the figure as a cost, in the cost benefit calculation it is treated as a reduction in the energy value, and thus a reduction in benefits (not an increase in costs).

An apparently unusual result of the sensitivity analysis is an increase in net present value (NPV) and of the benefit-to-cost ratio with increasing discount rate. Yet, a higher discount rate results in a lower (absolute) value of future payments. An examination of the cash flow helps explain these results. In Figure 7 above, which shows cash flows in current dollars, there is a large positive balance in year 1 of the project due to a combination of the investment tax credit and accelerated depreciation. The net after-tax cash flow is positive in years 1-6. From year 7 onward, however, the net cash flow remains negative. Thus, after year 7, the annual costs are greater than the annual benefits of the project. A higher discount rate will discount these future costs more than a lower discount rate. When calculating the NPV, the large positive cash flows in the first few years of the project will therefore be more significant than the discounted future negative cash flows. The corresponding discounted cash flow is shown in Figure 8 below. Comparing Figure 7 with Figure 8, it is apparent that the future cash flows are discounted, with the negative cash flows becoming less significant over time.



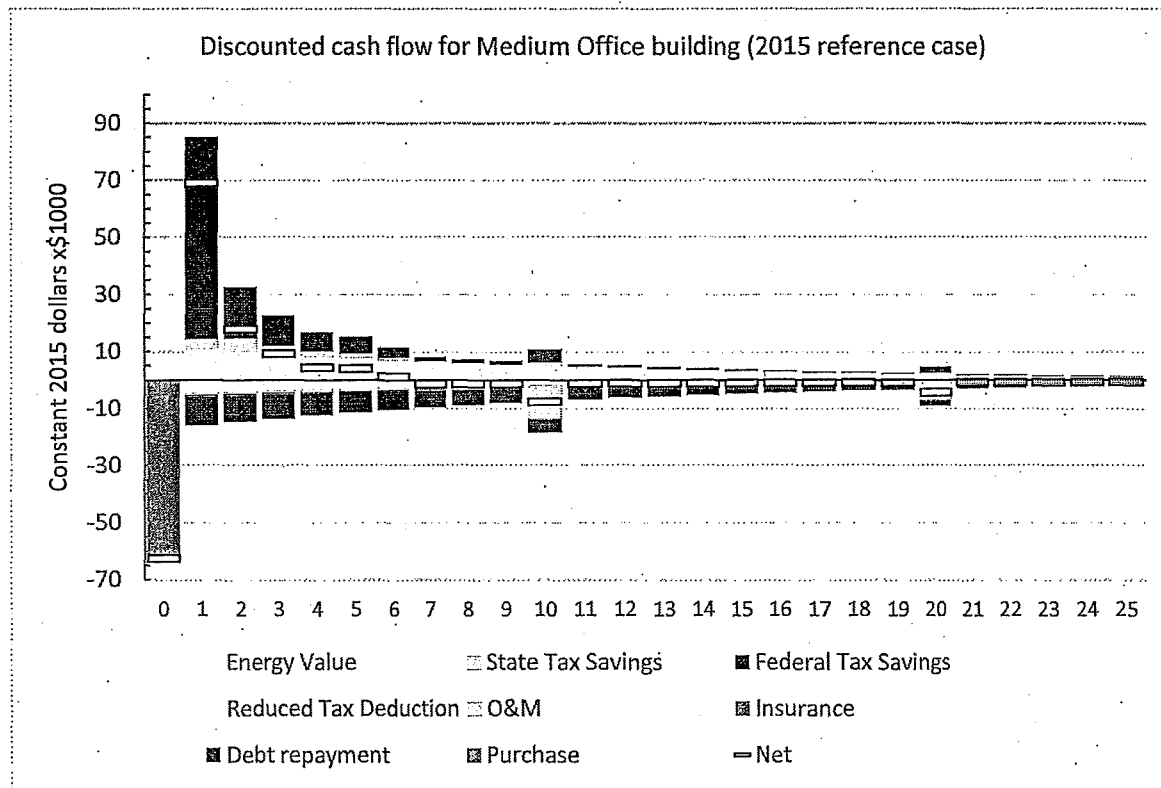


Figure 8 Discounted annual cash flow for the Medium Office building model for the 2015 reference scenario.

### 5.3 Sensitivity Analysis

A sensitivity analysis was done to gauge the effect of varying the values of several input parameters. Performing analyses while varying input parameters over reasonable expected ranges helps explore the sensitivity of the outcomes to particular choices of values. This also provides insight into the range of uncertainty that could be encountered in real-world projects. Table 20 shows the input parameters for which sensitivity analysis was done, along with the range of values tested and the amount by which the values were varied.





Parameter	Range	Increment	Notes
Debt fraction	20% - 100%	20%	The amount borrowed to finance projects depends on particular project circumstances and access to financing.
Cost per watt	\$3.00 - \$6.00	\$0.50	The range covers reasonable possible forecasts for the cost per watt.
Debt rate	3% - 8%	1%	The interest rate depends on a variety of uncertain factors, including borrower credit risk and macro economic conditions.
Azimuth	90° - 270°	30°	Varied from due east to due west.
Availability	75% - 100%	5%	Lower availability means reduced energy output. May be affected by weather, shading, soiling, equipment failure, etc.
Federal tax rate	15% - 35%	5%	Varied over range of plausible federal income tax rates.
Discount rate	2% - 12%	2%	Discount rate variability was discussed previously. The chosen range covers a wide range of plausible values. Values are real discount rates.
Size	1 kW - 100% kW	1/10 of maximum size	Maximum size was limited to 100% energy offset.

*Table 20 Inputs for individual parameter sensitivity analysis.*

Overall results of the sensitivity analysis are shown in Figure 9 below. This figure shows the average decrease or increase in the BCR relative to the reference scenario, as well as the minimum and maximum ranges. The simulation results for all buildings in both modeled years (2015 and 2017) were combined to calculate these summary values. The results were then sorted in decreasing order of average range of effect. Debt fraction had the largest impact on the BCR, followed by the cost per watt, and then debt rate. Both availability and azimuth resulted in decreased BCRs, which is expected given that 100% availability and the optimal azimuth were assumed in the reference scenario, so that any change in those values could only reduce the benefits of the system. The BCR varied the least due to changes in federal tax rate, discount rate, and system size.



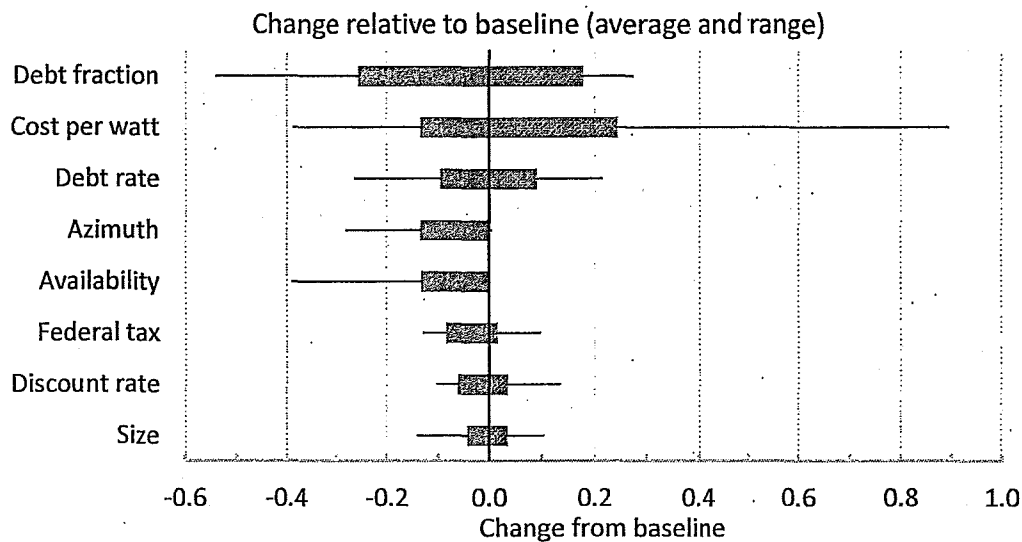


Figure 9 Sensitivity analysis results showing the average decrease or increase in the BCR relative to the reference scenario as well as the minimum and maximum ranges.

Individual plots of the sensitivity analysis results were also generated. Two examples are shown in Figure 10 below. The cost per watt, shown in the figure on the left, was varied over a range of \$3 to \$6. System availability, shown in the figure on the right, was varied from 75% to 100%. The reference scenario's value is marked with a circle in each figure. From the effect of varying the cost per watt it is apparent that the change in BCR is not necessarily linear across the full range, a result that can be seen more clearly in the plots of the BCR against varying azimuth (see Table 22 on page 45).

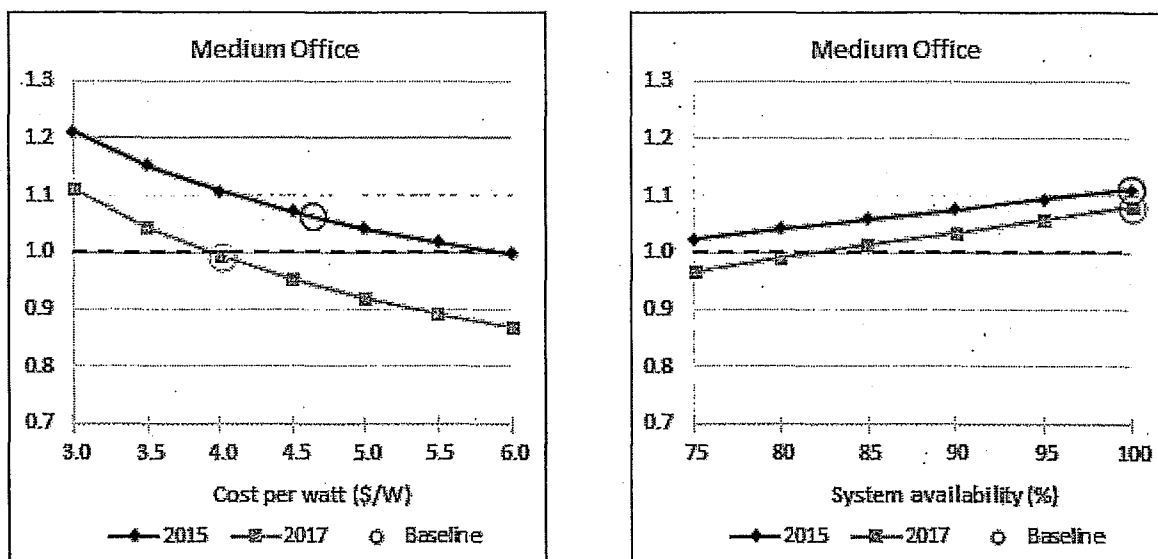


Figure 10 Sensitivity plots of cost per watt and system availability for the Medium Office building model. The circles mark the value of the reference scenario.



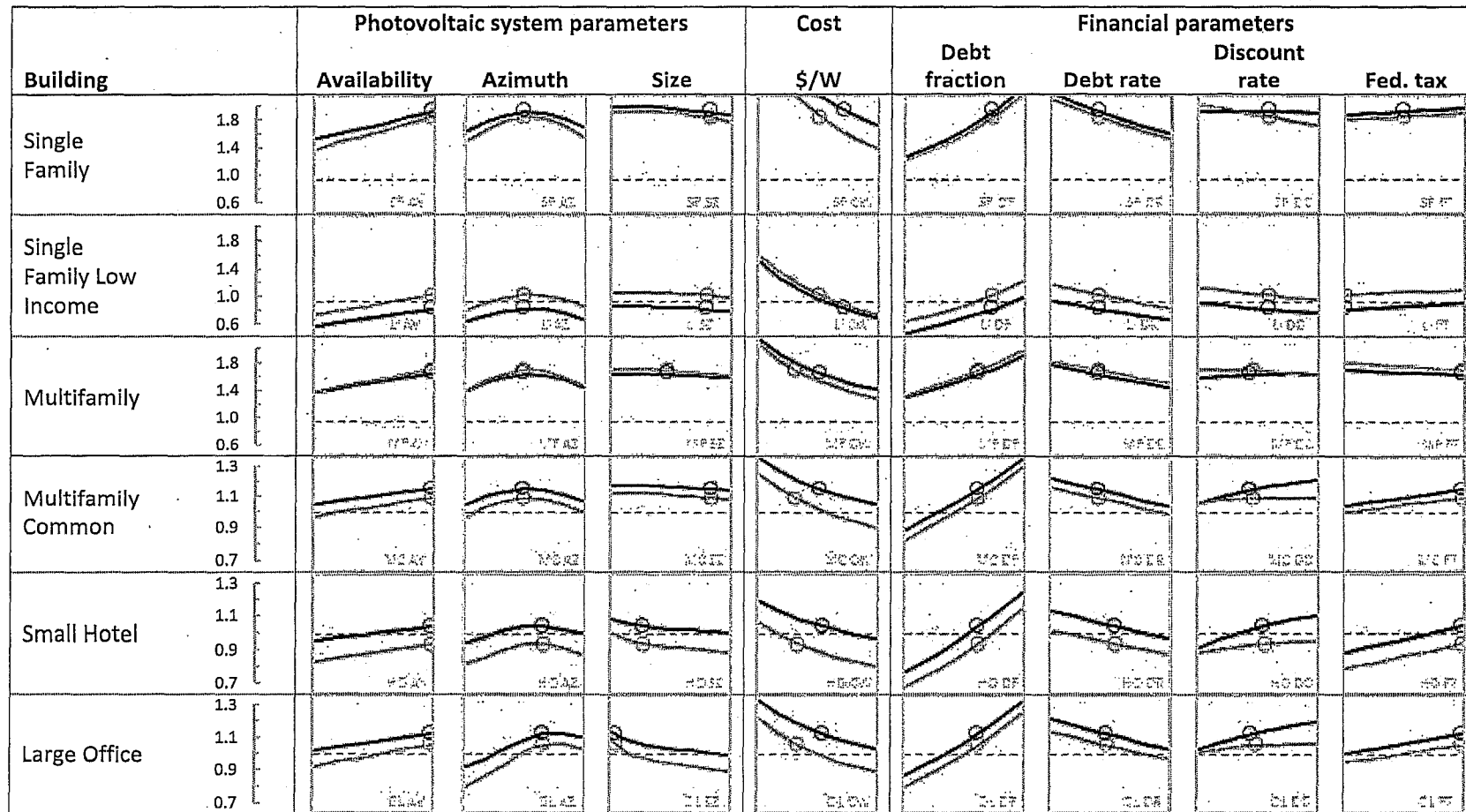
A qualitative summary of the sensitivity analysis results is presented in Table 21. The correlation, positive (+), negative (-), or mixed (+/-), between the input variables and the BCRs is shown, along with a brief interpretation of the overall results for each input variable. Table 22 on page 45 shows the individual plots of the sensitivity analysis results.

Parameter	Correlation	Discussion
Debt fraction	+	Higher debt fractions resulted in more cost-effective outcomes.
Cost per watt	-	Cost per watt had a significant negative correlation: the more expensive the system, the lower its cost-effectiveness.
Debt rate	-	Lower-cost debt resulted in more cost-effective outcomes.
Azimuth		The output varied by the orientation of the solar panels. Cost-effectiveness decreased as the azimuth was varied in either direction from the optimal midpoint.
Availability	+	Higher availability resulted in higher cost-effectiveness. Reduced availability resulted in reduced energy output, making the systems less cost-effective.
Federal tax rate	+	The federal tax rate had a slight positive correlation with the BCR, so that higher marginal federal tax rates resulted in more cost-effective outcomes. (Except for the Multifamily building model, where a slight negative correlation is seen.)
Discount rate	+/-	Varying the discount rate had variable effects on the outcome, including positive, negative, or no correlation, depending on the building model.
Size	-	Increasing size typically resulted in slightly decreasing cost-effectiveness.

Table 21 Qualitative summary of sensitivity analysis.

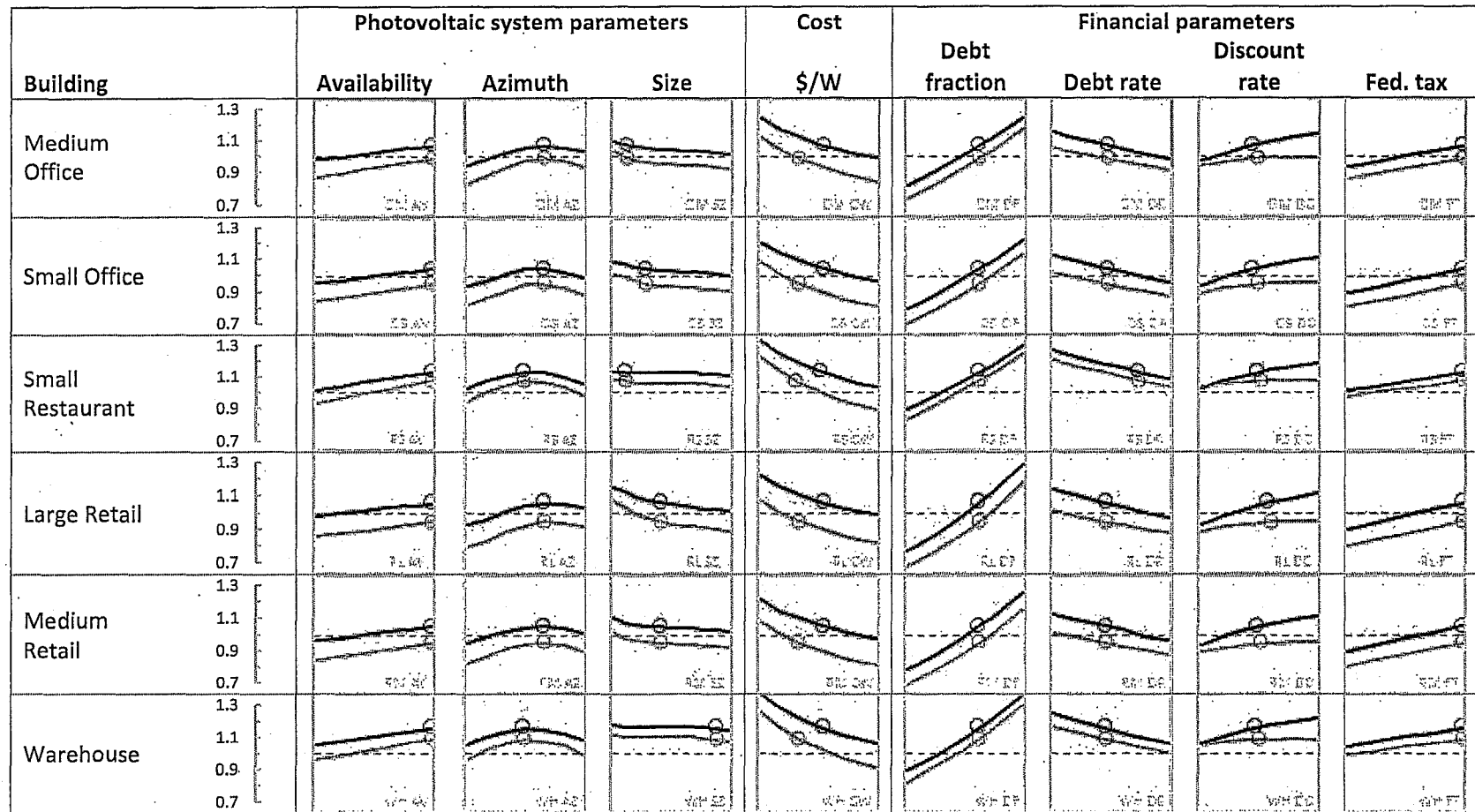


Table 22 Graphs of all individual sensitivity analyses. Input values, plotted on the X axis, were varied as described in Table 20 on page 42. The vertical axis shows the benefit to cost ratio. The black line shows the results for the year 2015, while the gray line shows the results for 2017. The circles indicate the values for the reference scenario. The X axis scale varies with each parameter and building model. The Y axis scale has two ranges, one for the residential buildings (single- and multifamily), and another for the commercial buildings.









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## 5.4 Carbon Emissions

A reduction in the emissions of greenhouse gases (GHGs) is a goal of the proposed ordinance. Photovoltaic systems are a clean energy source that does not produce emissions once installed. In addition, lifecycle emissions are low (Hertwich et al 2014). In contrast, grid power is provided through a combination of sources, including fossil fuels that result in emission of greenhouse gases. Each unit of energy produced by a photovoltaic system displaces energy that would otherwise be provided by grid power, thus reducing greenhouse gas emissions. Lifetime avoided CO<sub>2</sub> emissions were estimated for the modeled projects to assess their possible contribution to the goal of reducing emissions of greenhouse gases.

PG&E publishes estimated CO<sub>2</sub> emissions per MWh of electric energy consumed for the period 2003 to 2020 (PGE 2013). The CO<sub>2</sub> emissions due to PG&E's electric generation mix have been declining over this period. The average rate of decline was used to forecast estimated emissions for the full period of the study. Total avoided emissions were then calculated as the sum of the forecasted emissions in each year multiplied by the expected annual energy generation from the modeled systems in each year; see Equation 3 below for details of the calculation. These results are intended to provide a general sense of the expected CO<sub>2</sub> emission reductions. The calculations do not account for all sources of variability, for instance they do not take into account hourly variability in emissions.

$C_{avoided} = \sum_{i=1}^n C_i \times E_i$	Total avoided CO <sub>2</sub> emissions in metric tons (MT).
$C_i$	Metric tons of CO <sub>2</sub> emissions per megawatt hour (MT/MWh) in year i. Forecast for 2015 to 2020 is based on PG&E's published forecast, after 2020 emissions are reduced by forecasted decline.
$E_i = \frac{E_0}{(1 + R_E)^{i-1}}$	Energy output in year 0 is scaled by compounded annual degradation rate (MWh).
$R_E = 0.005$	Annual degradation rate of photovoltaic system.

Equation 3 Calculation of lifetime avoided CO<sub>2</sub> emissions.

Figure 11 below shows lifetime avoided CO<sub>2</sub> emissions for systems installed in 2015. Avoided emissions range from 5.7 MT for the Multifamily Common building model and up to 2150 MT for the Large Retail building model. Avoided emissions depend on year of installation and are proportional to system size, not percent of energy offset. For systems installed in 2015, each 1 kW of capacity avoids 3.6 MT CO<sub>2</sub>, while for systems installed in 2017 each 1 kW avoids 3.2 MT CO<sub>2</sub>. For instance, considering systems installed in 2015, the system for the Warehouse building model can offset 94% of the electric energy consumption, while the system for the Large Office building model can offset just 4%. Despite these differences in percent of energy offset, the Warehouse system can avoid emission of 306 MT CO<sub>2</sub> while the Large Office system can avoid emission of 373 MT CO<sub>2</sub>.



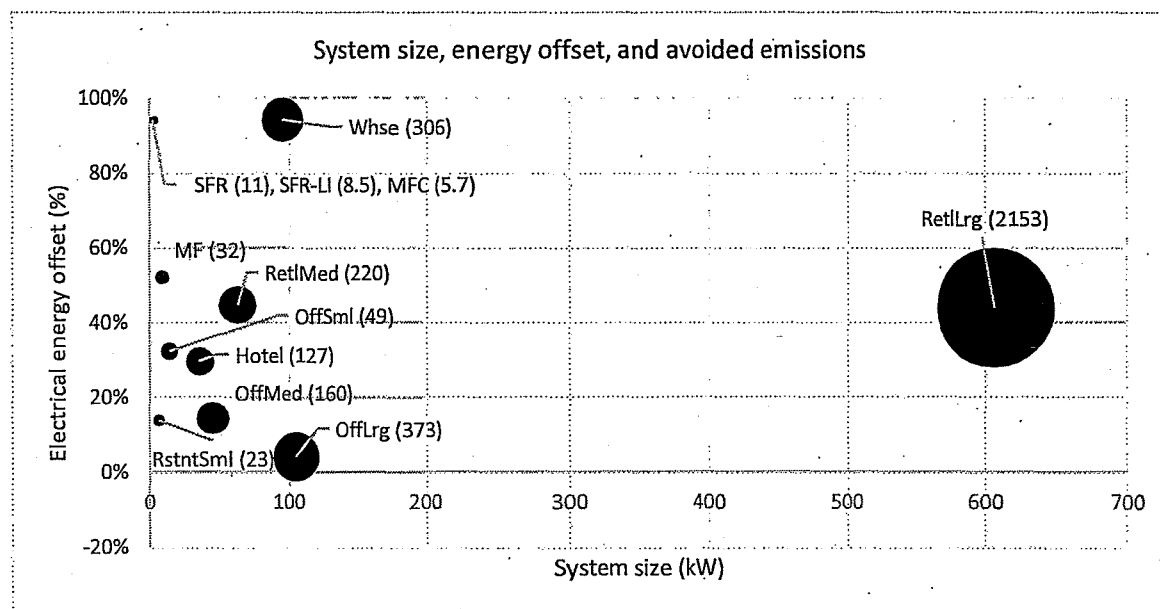


Figure 11 Avoided emissions are proportional to system size, not percent of energy offset. Circle size is proportional to lifetime avoided CO<sub>2</sub> emissions. Labels show building name and avoided lifetime CO<sub>2</sub> emissions. Values are for systems installed in 2015.

Converting the avoided emissions per year to a carbon price provides another way to measure the benefits associated with photovoltaic systems. A price forecast for carbon was constructed from several sources and converted to constant 2015 dollars. The CEC has developed a price forecast for carbon in its update of the TDV metric for the 2016 code cycle, which provided a forecast of carbon prices in current dollars from 2017 through 2046 (CEC 2014b). Carbon prices were extracted from the CEC Title 24 TDV Calculator and deflated using a 2% inflation rate to 2015 dollars (CEC 2014c, worksheets "Emissions" and "Base Inputs"). To determine a price for 2015-2016, the current price of carbon (as of November 16, 2014) trading in California was escalated by 5% per year in real terms (State of California 17 CCR § 95911). The two sequences were combined to build an approximate carbon price forecast from 2015 to 2046.

Figure 12 below shows the benefit or cost of avoided CO<sub>2</sub> emissions for the residential and commercial model buildings, respectively. These costs and benefits could be compared to the cost of greenhouse gas mitigation actions undertaken through other measures and policies. The benefit or cost was calculated by dividing the net present value (NPV) of the projects by their lifetime avoided emissions. Where the NPV was positive, customers essentially earned an excess return while reducing emissions. Where the NPV was negative, customers incurred a cost for each unit of avoided emissions. The Single Family Low Income building model incurred a cost of \$85 in 2015, but this shifted to a benefit of \$100/MT CO<sub>2</sub> in 2017. For the other residential categories—single-family and multifamily—there were significant benefits per avoided ton. The commercial building models had a benefit for each avoided ton in 2015, but in 2017 several commercial building models incurred costs of between \$9 and \$53/MT CO<sub>2</sub>.



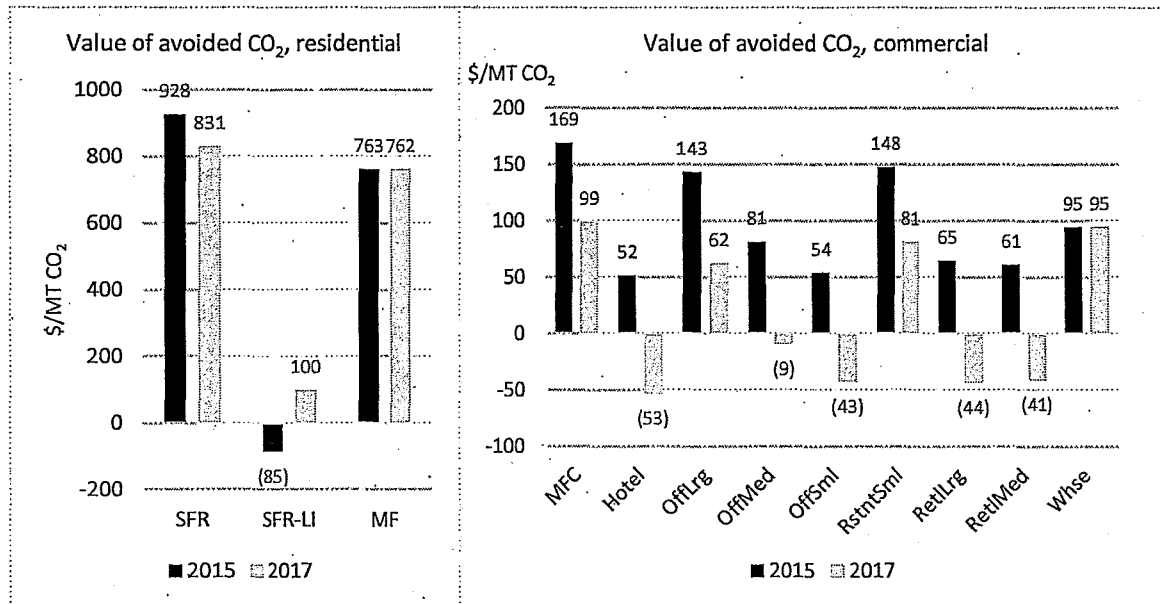


Figure 12 Benefit (or cost) of avoided CO<sub>2</sub> emissions.

For photovoltaic systems installed in 2015, the lifetime value of avoided CO<sub>2</sub> emissions for each 1 kW of generating capacity was estimated at \$114, while in 2017 the value was estimated at \$125. Figure 13 below shows the relative value of the avoided emissions for the commercial projects compared to the projects' overall net present values for systems installed in 2015. The value of the avoided CO<sub>2</sub> emissions ranged from 7% to 23% of the projects' NPVs.

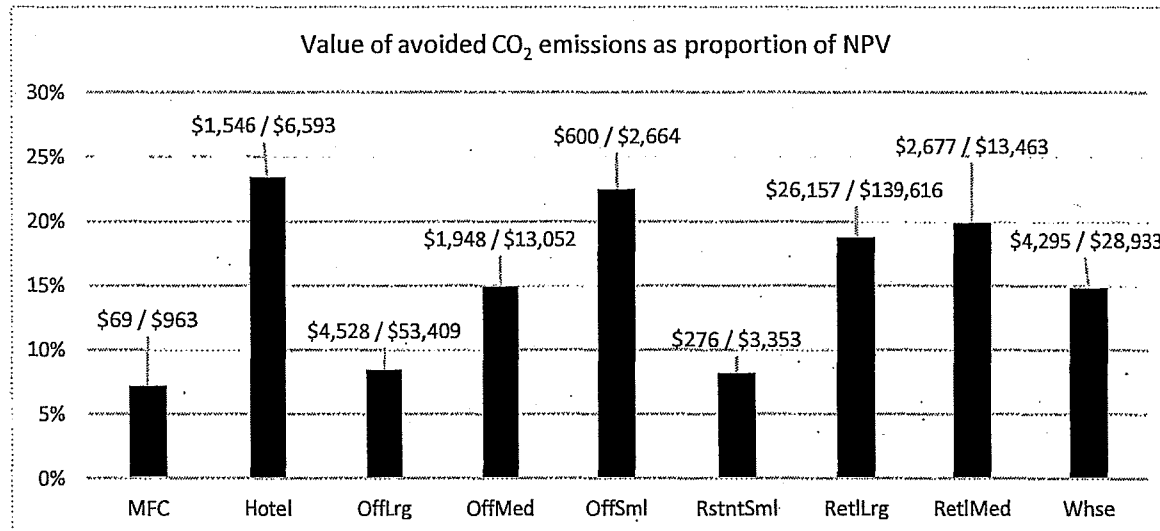


Figure 13 Lifetime value of avoided CO<sub>2</sub> emissions as proportion of overall project net present value (NPV). The labels above each column show the present value of the lifetime avoided carbon emissions along with the project's total NPV.





## 5.5 Building Costs

Inclusion of photovoltaic systems in new building construction adds an additional upfront cost to existing construction costs. The table below shows estimated added construction costs due to the installation of photovoltaic systems in the commercial building models. Construction costs, in dollars per square foot, were obtained from various sources (CRES 2014, CMD Group 2013). Estimated additional construction costs ranged from 0.4% to 8.4%. These data provide only a rough approximation of actual construction costs; real-world project costs would be expected to differ from these estimates.

Building	Floor Area (ft <sup>2</sup> )	Construction cost (\$/ft <sup>2</sup> )	Construction cost (x\$1000)	System cost (x\$1000)	Added cost (%)	Source
Multifamily	6960	263	1829	41	2.2%	CRES
Multifamily Common	6960	263	1829	7	0.4%	CRES
Small Hotel	42554	196	8341	167	2.0%	CRES
Large Office	498589	185	92239	487	0.5%	CRES
Medium Office	53628	196	10511	209	2.0%	Estimated
Small Office	5502	222	1221	65	5.3%	CMD
Small Restaurant	2501	273	683	29	4.3%	CMD
Large Retail	240000	140	33600	2812	8.4%	Estimated
Medium Retail	24563	140	3439	288	8.4%	CMD
Warehouse	49495	140	6929	441	6.4%	Estimated

Table 23 Estimated additional construction costs due to installation of the modeled photovoltaic systems.

## 5.6 Aggregate Results

An analysis of aggregate results was done to estimate the overall potential energy generation, energy offset, and carbon emission reduction that the proposed installation of photovoltaic systems could have in San Francisco. This was a retrospective analysis, in which solar generation was applied to buildings already in the pipeline, to provide a measure of the effect had these buildings all included the proposed solar generation capability. The analysis was done on buildings in the Planning Department's building pipeline for the years 2008-2014, where the year is based on the year that the first filing was made.

### 5.6.1 Aggregate Analysis Methods

San Francisco maintains a database of projects in its building pipeline (SF 2014). The "pipeline consists of development projects that would add residential units or commercial space, applications for which have been formally submitted". Completed projects are taken out of the pipeline. For this analysis, the most recent available data set, for the third quarter of 2014, was used. The data included information about construction projects, including descriptive text, filing dates, and other parameters. In addition, the planning department provided a Department of Building Inspection (DBI) data set, which contained data on area allocated by end use category as well as building lot area (Aksel Olsen, Planning Department, private communication). The datasets were cross-referenced using a common case number.

The most recent proposal from the Department of the Environment was to exclude buildings over 10 stories in height from the requirement for solar generation. Therefore, the aggregate analysis excluded



any buildings greater than 10 stories. In addition, the relevance of each project to the analysis was determined using several criteria: additions were excluded, since they will be excluded by the proposed ordinance; and complex projects involving many buildings or general redevelopment plans were excluded due to the difficulty in estimating building parameters.

The number of floors and roof area were estimated using several methods. Estimated roof area was calculated by dividing project area by an estimated number of floors, limited to a maximum of 80% of total lot area. Some project entries included the number of floors and building heights in the descriptive text associated with each project. Where they were provided, the number of floors and heights of the buildings were determined based on the text. Where only height information was provided, an average floor height of 11.5 ft for mixed-use buildings was used and the number of floors was estimated by dividing the buildings' heights by this average floor height (CTBUH 2014). The average number of floors for all included projects was then calculated. The average number of floors was used for the remaining projects if both number of floors and height were unavailable.

Electric energy consumption was estimated by assigning end-use intensity (EUI) values in kWh/ft<sup>2</sup>/yr to each of the end-use types (see Table 24 below). The EUIs were then multiplied by the area of each end-use. The EUIs were based on the prototypical building models, and thus represent estimates appropriate for buildings compliant with the 2013 energy standards. Where no corresponding category was available, the end-use intensity for the Medium Office building model was used. This end-use intensity is not completely accurate for the projects in the pipeline. Many of those projects predate the 2013 energy standards and would be expected to have higher EUIs.

Code	Description	Building model	kWh/ft <sup>2</sup> /yr
CIE	Cultural, institutional, and educational	Medium Office	7.79
MIPS	Office	Medium Office	7.79
PDR	Production, distribution, repair/light industry	Medium Office	7.79
RES	Residential	Multifamily	3.28
RET	Retail or entertainment	Large Retail	7.70
VIS	Hotels and motels	Small Hotel	3.81

*Table 24 End use intensities for electric energy consumption.*

Energy generation potential was estimated from the available roof area and the solar panel efficiency parameters. The solar ready area was set at 15% of estimated roof area. Generation potential in kW DC and in kWh/yr AC was then calculated using the photovoltaic system energy density parameters developed for the reference scenario (see 4.2 Photovoltaic System Performance on page 26). Lifetime avoided CO<sub>2</sub> emissions potential was estimated by multiplying the generation potential by the lifetime avoided emissions for projects installed in 2015 and having an azimuth of 180° and a tilt of 33° (see 5.4 Carbon Emissions on page 47).



### 5.6.2 Aggregate Analysis Results

Aggregate totals for all projects<sup>2</sup>, shown in Table 25 below, were calculated for each year from 2008 to 2014. If all 200 of the analyzed projects in the pipeline were to install solar photovoltaic systems on 15% of their roof area, they would generate 10.5 GWh/yr of electricity, offsetting 16% of the projects' energy consumption over the lifetime of the photovoltaic panels. Assuming installation in 2015, they would also avoid 26.3 MT of CO<sub>2</sub> emissions over the projects' lifetimes. Stated another way, 15% of the rooftops of the relevant buildings in the city's building pipeline represent 434,000 square feet of potential solar area, or nearly 10 acres. This is sufficient area to install a total of almost 7.4 MW of solar generating capacity providing 10.5 GWh per year.

Year	Count	Area (M ft <sup>2</sup> )	Consumption (GWh/yr)	Roof area (M ft <sup>2</sup> )	Solar area (M ft <sup>2</sup> )	Generation potential (MW)	Generation potential (GWh/yr)	Offset potential	Lifetime avoided emissions (MT CO <sub>2</sub> )
2008	19	0.33	1.12	0.07	0.01	0.17	0.25	22%	612
2009	16	1.50	7.64	0.30	0.05	0.77	1.10	14%	2750
2010	15	2.72	9.98	0.55	0.08	1.41	2.00	20%	4995
2011	8	0.25	0.86	0.05	0.01	0.13	0.18	22%	460
2012	32	1.87	8.17	0.38	0.06	0.97	1.38	17%	3439
2013	66	5.97	30.78	1.21	0.18	3.09	4.40	14%	10966
2014	44	1.65	7.70	0.33	0.05	0.85	1.22	16%	3038
Total	200	14.29	66.24	2.90	0.43	7.39	10.52	16%	26259

Table 25 Aggregate totals for all projects and all years (2008-2014).

<sup>2</sup> The data for 2014 included only the first three quarters, so the final 2014 numbers are expected to be higher.



## 6 References

- State of California 17 CCR § 95911; Format for Auction of California GHG Allowances;  
<https://govt.westlaw.com/calregs/Document/I21648F10056D11E4B04E9CE1A98BFBC7?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=%28sc.Default%29>
- AEC 2013; Architectural Energy Corporation; CBECC-Com 2013;  
<http://bees.archenergy.com/software.html>
- Bankrate 2014; 2013 Tax Brackets (for taxes due April 15, 2014);  
<http://www.bankrate.com/finance/taxes/tax-brackets.aspx>
- Barbose et al 2013; Tracking the Sun VI: An Historical Summary of the Installed Price of Photovoltaics in the United States from 1998 to 2012; Lawrence Berkeley National Laboratory; July 2013;  
<http://emp.lbl.gov/publications/tracking-sun-vi-historical-summary-installed-price-photovoltaics-united-states-1998-201>
- BOE 2014; California State Board of Equalization; California City & County Sales & Use Tax Rates (effective October 1, 2014); <http://www.boe.ca.gov/cgi-bin/rates.cgi?LETTER=S&LIST=COUNTY>.
- Borenstein S 2011; The Private and Public Economics of Renewable Electricity Generation; Energy Institute at HAAS; 2011;  
[http://ei.haas.berkeley.edu/pdf/working\\_papers/WP221.pdf#page=27&zoom=auto,-20,711](http://ei.haas.berkeley.edu/pdf/working_papers/WP221.pdf#page=27&zoom=auto,-20,711)
- CASE 2011; Codes and Standards Enhancement Initiative, California Energy Commission; Solar Ready Homes and Solar Oriented Development, 2013 California Building Energy Efficiency Standards; September 2011;  
[http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Residential/Water\\_Heating/2013\\_CASE\\_R\\_Solar\\_Ready\\_Solar\\_Oriented\\_Developments\\_Sept\\_2011.pdf](http://www.energy.ca.gov/title24/2013standards/prerulemaking/documents/current/Reports/Residential/Water_Heating/2013_CASE_R_Solar_Ready_Solar_Oriented_Developments_Sept_2011.pdf).
- CEC 2013a; California Energy Commission; 2013 Residential Compliance Manual: Solar Ready; CEC-400-2013-001; p7-1 to 7-13; [http://www.energy.ca.gov/2013publications/CEC-400-2013-001/chapters/07\\_Solar\\_Ready.pdf](http://www.energy.ca.gov/2013publications/CEC-400-2013-001/chapters/07_Solar_Ready.pdf)
- CEC 2013b; Demand Forecast Forms: Form 2.3, California Energy Demand 2014-2024 Baseline Final Forecast - Mid Demand Case; [http://www.energy.ca.gov/2013\\_energypolicy/documents/](http://www.energy.ca.gov/2013_energypolicy/documents/)
- CEC 2014a; California Energy Commission; Process for Adopting Local Standards;  
<http://www.energy.ca.gov/title24/2013standards/ordinances/>
- CEC 2014b; Energy and Environmental Economics for the California Energy Commission; Time Dependent Valuation of Energy for Developing Building Standards; July 2014;  
[http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09\\_workshop/2017\\_TDV\\_Documents/2016\\_TDV\\_Methodology\\_Report\\_Final.docx](http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09_workshop/2017_TDV_Documents/2016_TDV_Methodology_Report_Final.docx)
- CEC 2014c; Energy and Environmental Economics for the California Energy Commission; CEC Title 24 TDV Calculator; [http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09\\_workshop/2017\\_TDV\\_Documents/2016\\_TDV\\_Update\\_2014-07-07.xlsm](http://www.energy.ca.gov/title24/2016standards/prerulemaking/documents/2014-07-09_workshop/2017_TDV_Documents/2016_TDV_Update_2014-07-07.xlsm)
- CMD Group 2013; RSMeans' dollar-per-square-foot construction costs for four small commercial types of structure; <http://www.reedconstructiondata.com/Market-Intelligence/Articles/2013/8/RSMeans-dollar-per-square-foot-construction-costs-for-four-small-commercial-types-of-structure-RCD012973W/>





- COE 2014; San Francisco Commission on the Environment; Commission on the Environment Resolution in Support of San Francisco Solar Policy for New Construction, Resolution 009-14-COE; July 22, 2014; [http://www.sfenvironment.org/sites/default/files/agenda/attach/resolution\\_support\\_sf\\_solar\\_requirements.pdf](http://www.sfenvironment.org/sites/default/files/agenda/attach/resolution_support_sf_solar_requirements.pdf)
- CRES 2014; Commercial Real Estate Specialists; Cost Per Square Foot For New Commercial Construction (based on EVstudio); <http://www.thecommercialrealestatespecialists.com/cpsf.html>
- CSI 2014a; California Solar Initiative, California Public Utilities Commission; About the California Solar Initiative; <http://www.cpuc.ca.gov/PUC/energy/Solar/aboutsolar.htm>
- CSI 2014b; Go Solar California; Download Current CSI Data; [http://www.californiasolarstatistics.ca.gov/current\\_data\\_files/](http://www.californiasolarstatistics.ca.gov/current_data_files/)
- CTBUH 2014; Council on Tall Buildings and Urban Habitat; Height Calculator; <http://www.ctbuh.org/HighRiseInfo/TallestDatabase/Criteria/HeightCalculator/tabid/1007/language/en-GB/Default.aspx>
- E3 2011; Energy and Environmental Economics for the California Public Utilities Commission; California Solar Initiative Cost-Effectiveness Evaluation; April 2011; p60; [ftp://ftp.cpuc.ca.gov/gopher-data/energy\\_division/csi/CSI%20Report\\_Complete\\_E3\\_Final.pdf](ftp://ftp.cpuc.ca.gov/gopher-data/energy_division/csi/CSI%20Report_Complete_E3_Final.pdf)
- E3 2013; Energy and Environmental Economics for the California Energy Commission; Cost-Effectiveness of Rooftop Photovoltaic Systems for Consideration in California's Building Energy Efficiency Standards (draft); May 2013; CEC-400-2013-005-D; <http://www.energy.ca.gov/2013publications/CEC-400-2013-005/CEC-400-2013-005-D.pdf>
- EERE 2014; Office of Energy Efficiency and Renewable Energy, U.S. Department of Energy; EnergyPlus Energy Simulation Software; [http://apps1.eere.energy.gov/buildings/energyplus/energyplus\\_about.cfm](http://apps1.eere.energy.gov/buildings/energyplus/energyplus_about.cfm)
- EPA 2008; U.S. Environmental Protection Agency; Understanding Cost-Effectiveness of Energy Efficiency Programs; <http://www.epa.gov/cleanenergy/documents/suca/cost-effectiveness.pdf>
- FTB 2014; State of California Franchise Tax Board; 2014 California Tax Rates and Exemptions; [https://www.ftb.ca.gov/forms/2014\\_California\\_Tax\\_Rates\\_and\\_Exemptions.shtml](https://www.ftb.ca.gov/forms/2014_California_Tax_Rates_and_Exemptions.shtml)
- Hertwich et al 2014; Integrated life-cycle assessment of electricity-supply scenarios confirms global environmental benefit of low-carbon technologies; Proceedings of the National Academy of Sciences; <http://www.pnas.org/cgi/doi/10.1073/pnas.1312753111>
- Inflation Data 2014; Average Annual Inflation by Decade, updated 4/15/2013; <http://inflationdata.com/Inflation/Inflation/DecadeInflation.asp>
- Integra Realty Resources 2014a; Integra Realty Resources 2014 Mid-year Viewpoint, San Francisco, CA, Industrial; [http://www.irr.com/\\_FileLibrary/Office/M1040/2014%20Mid-Year%20Viewpoint\\_San%20Francisco\\_Industrial.pdf](http://www.irr.com/_FileLibrary/Office/M1040/2014%20Mid-Year%20Viewpoint_San%20Francisco_Industrial.pdf)
- Integra Realty Resources 2014b; Integra Realty Resources 2014 Mid-year Viewpoint, San Francisco, CA, Lodging; [http://www.irr.com/\\_FileLibrary/Office/M1041/2014%20Mid-Year%20Viewpoint\\_San%20Francisco\\_Lodging.pdf](http://www.irr.com/_FileLibrary/Office/M1041/2014%20Mid-Year%20Viewpoint_San%20Francisco_Lodging.pdf)
- Integra Realty Resources 2014c; Integra Realty Resources 2014 Mid-year Viewpoint, San Francisco, CA, Multifamily; [http://www.irr.com/\\_FileLibrary/Office/M1042/2014%20Mid-Year%20Viewpoint\\_San%20Francisco\\_Multifamily.pdf](http://www.irr.com/_FileLibrary/Office/M1042/2014%20Mid-Year%20Viewpoint_San%20Francisco_Multifamily.pdf)

\_\_\_\_\_

- Integra Realty Resources 2014d; Integra Realty Resources 2014 Mid-year Viewpoint, San Francisco, CA, Office; [http://www.irr.com/\\_FileLibrary/Office/M1043/2014%20Mid-Year%20Viewpoint\\_San%20Francisco\\_Office.pdf](http://www.irr.com/_FileLibrary/Office/M1043/2014%20Mid-Year%20Viewpoint_San%20Francisco_Office.pdf)
- Integra Realty Resources 2014e; Integra Realty Resources 2014 Mid-year Viewpoint, San Francisco, CA, Retail; [http://www.irr.com/\\_FileLibrary/Office/M1044/2014%20Mid-Year%20Viewpoint\\_San%20Francisco\\_Retail.pdf](http://www.irr.com/_FileLibrary/Office/M1044/2014%20Mid-Year%20Viewpoint_San%20Francisco_Retail.pdf)
- IRS 2014; U.S. Internal Revenue Service; Publication 936; <http://www.irs.gov/publications/p936/ar02.html>
- KEMA 2010; KEMA, Inc. for the California Energy Commission; 2009 California Residential Appliance Saturation Study, Executive Summary; CEC-200-2010-004-ES; October 2010; <http://www.energy.ca.gov/2010publications/CEC-200-2010-004/CEC-200-2010-004-ES.PDF>
- MASH 2014; CSI Multifamily Affordable Solar Housing (MASH) Program, California Public Utilities Commission;; <http://www.cpuc.ca.gov/PUC/energy/Solar/mash.htm>
- NCSC 2014a; North Carolina Solar Center; Database of State Incentives for Renewables and Efficiency, Business Energy Investment Tax Credit (ITC); March 13, 2014; [http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=US02F](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US02F)
- NCSC 2014b; North Carolina Solar Center; Database of State Incentives for Renewables and Efficiency, Residential Renewable Energy Tax Credit; October 6, 2014; [http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=US37F&re=1&ee=1](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=US37F&re=1&ee=1)
- NCSC 2014c; North Carolina Solar Center; Database of State Incentives for Renewables and Efficiency, Property Tax Exclusion for Solar Energy Systems; November 6, 2014; [http://www.dsireusa.org/incentives/incentive.cfm?Incentive\\_Code=CA25F](http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=CA25F)
- NREL 2014a; National Renewable Energy Laboratory; A Performance Calculator for Grid-Connected PV Systems (PV Watts); <http://rredc.nrel.gov/solar/calculators/pvwatts/version1/>.
- NREL 2014b; National Renewable Energy Laboratory; System Advisor Model (SAM); <https://sam.nrel.gov/>
- NREL 2014c; National Renewable Energy Laboratory; National Solar Radiation Data Base 1991- 2005 Update: Typical Meteorological Year 3, 724940 San Francisco Intl AP; [http://rredc.nrel.gov/solar/old\\_data/nsrdb/1991-2005/tmy3/](http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/)
- NSHP 2014; New Solar Homes Partnership, California Energy Commission; <http://www.gosolarcalifornia.ca.gov/about/nshp.php>
- OPR 2002; Governor's Office of Planning and Research, State of California; California Standard Practice Manual: Economic Analysis of Demand-Side Programs and Projects; [http://www.calmac.org/events/SPM\\_9\\_20\\_02.pdf](http://www.calmac.org/events/SPM_9_20_02.pdf)
- PGE 2013; Pacific Gas & Electric Company; Greenhouse Gas Emission Factors: Guidance for PG&E Customers; April 2013; [http://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge\\_ghg\\_emission\\_factor\\_info\\_sheet.pdf](http://www.pge.com/includes/docs/pdfs/shared/environment/calculator/pge_ghg_emission_factor_info_sheet.pdf)
- PGE 2014a; Pacific Gas and Electric Company; CARE Program Guidelines; <http://www.pge.com/en/myhome/saveenergymoney/financialassistance/care/eligibility/index.page>
- PGE 2014b; Pacific Gas and Electric Company; Electric Rates; <http://www.pge.com/tariffs/electric.shtml>



PGE 2014c; Pacific Gas and Electric Company; Net Surplus Compensation Rates for Energy;  
[http://www.pge.com/includes/docs/pdfs/shared/solar/AB920\\_RateTable.pdf](http://www.pge.com/includes/docs/pdfs/shared/solar/AB920_RateTable.pdf)

Realty Rates 2014; Investor Survey, 4th quarter of 2014, Permanent Financing;  
<http://www.realtyrates.com/commercial-mortgage-rates.html>

SF 2014; City and County of San Francisco Planning Department; The Pipeline Report; <http://sf-planning.org/index.aspx?page=1691>.

SFPUC 2014; San Francisco Public Utilities Commission; GoSolarSF Incentive;  
<http://sfwater.org/index.aspx?page=133>

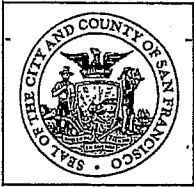
Short et al 1995; Short, W. et al; A Manual for the Economic Evaluation of Energy Efficiency and Renewable Energy Technologies; National Renewable Energy Laboratory;  
<http://www.nrel.gov/docs/legosti/old/5173.pdf>

Tax-Brackets.org 2013; California Income Tax Brackets; <http://www.tax-brackets.org/californiataxtable>

U.S. Census Bureau 2014; State & County QuickFacts, San Francisco County, California;  
<http://quickfacts.census.gov/qfd/states/06/06075.html>

Wilcox B 2013; CBECC-Res 2013; <http://www.bwilcox.com/BEEES/BEEES.html>





## BUILDING INSPECTION COMMISSION (BIC)

Department of Building Inspection

Voice (415) 558-6164 - Fax (415) 558-6509

1660 Mission Street, San Francisco, California 94103-2414

August 26, 2016

Edwin M. Lee  
Mayor

COMMISSION

Angus McCarthy  
President

Myrna Melgar  
Vice-President

Kevin Clinch  
Gail Gilman  
John Konstin  
Frank Lee  
Debra Walker

Ms. Angela Calvillo  
Clerk of the Board  
Board of Supervisors, City Hall  
1 Dr. Carlton B. Goodlett Place, Room 244  
San Francisco, CA 94102-4694

**RE: Code amendments to the 2016 California Building Standards Code, including the Building, Existing Building, Residential, Mechanical, Plumbing, Electrical, and Green Building Codes and recommend approval to the Board of Supervisors.**

Sonya Harris  
Secretary

Dear Ms. Calvillo:

Tom C. Hui  
Director

On August 17, 2016 the Building Inspection Commission held a public hearing on the proposed Code amendments referenced above.

The Commission voted unanimously (7-0) to recommend that the Board of Supervisors approve the amendments.

The Commissioners voted as follows:

President McCarthy	Aye	Vice-President Melgar	Aye
Commissioner Clinch	Aye	Commissioner Gilman	Aye
Commissioner Konstin	Aye	Commissioner Lee	Aye
Commissioner Walker	Aye		

Enclosed please find the Code Advisory Committee's recommendation to the BIC. Under separate cover, copies of the proposed amendments will follow from the Technical Services Division of the Department of Building Inspection.

Should you have any questions, please do not hesitate to call me at 558-6164.

Sincerely,

  
Sonya Harris  
Commission Secretary





cc: Tom C. Hui, Director  
Mayor Edwin M. Lee  
Supervisor John Avalos  
Supervisor London Breed  
Supervisor David Campos  
Supervisor Malia Cohen  
Supervisor Mark Farrell  
Supervisor Jane Kim  
Supervisor Eric Mar  
Supervisor Aaron Peskin  
Supervisor Katy Tang  
Supervisor Scott Wiener  
Supervisor Norman Yee  
Deputy City Attorney John Malamut



## **EXHIBIT A**

### **STANDARD FINDINGS FOR SAN FRANCISCO BUILDING STANDARDS CODE AMENDMENTS:**

1. Certain buildings/occupancies in San Francisco are at increased risk for earthquake-induced failure and consequent fire due to local hazardous microzones, slide areas, and local liquefaction hazards.  
(Geology)
2. Certain buildings/occupancies in San Francisco are at increased risk of fire due to high density of buildings on very small lots, with many buildings built up to the property lines. (Topography)
3. Topography of San Francisco has led to development of a high density of buildings on small lots, necessitating special provisions for exiting, fire separation, or fire-resistive construction. (Topography)
4. Many buildings are built on steep hills and narrow streets, requiring special safety consideration. (Topography)
5. Additional fire, structural and other protection is required due to high building density and crowded occupancy. (Topography)
6. San Francisco has narrow, crowded sidewalks due to building and population density and unusual topography. (Topography)
7. All rain water in San Francisco drains to the building drains and sewer; unusual geology, occasional extremely high local rainfall amounts, and the configuration of the City as a peninsula restrict the installation of separate storm water and sewer systems. (Topography, Climate, Geology)
8. Moist, corrosive atmosphere of salt-laden fog in San Francisco necessitates additional requirements. (Climate)
9. Not a building standard; no local findings required.
10. Soil conditions in this region induce adverse reactions with some materials, leading to premature failures and subsequent unsanitary conditions. (Climate)
11. The region is subject to fluctuating rainfall due to changes in climatic conditions.  
(Climate)
12. San Francisco is a peninsula surrounded on three sides by water at sea level;



mitigation of climate change impacts, including sea level rise, is critical to the long term protection of the local built environment and local infrastructure.  
(Topography)

13. Climate and potential climate change impacts San Francisco's water resources, including reservoirs and distribution facilities. (Climate)
14. Organic material in San Francisco's waste breaks down into methane gas which is a significant contributor to climate change. (Climate)
15. San Francisco is topographically constrained and its built environment occupies most available land, requiring minimization of debris and solid waste.  
(Topography)
16. Prevailing winds, coastal mountain ranges, and periodic seasonal high temperatures contribute to photochemical reactions that produce smog and ozone; limiting the emission of smog's chemical precursors - volatile organic chemicals and oxides of nitrogen - is necessary to health and safety. (Climate, Topography)
17. The aquifers underlying San Francisco are small relative to local population, necessitating ongoing water imports and special provisions to ensure efficient use of water in local buildings. (Geology)



**BOARD of SUPERVISORS**



City Hall  
Dr. Carlton B. Goodlett Place, Room 244  
San Francisco 94102-4689  
Tel. No. 554-5184  
Fax No. 554-5163  
TDD/TTY No. 554-5227

October 6, 2016

Lisa Gibson  
Acting Environmental Review Officer  
Planning Department  
1650 Mission Street, Ste. 400  
San Francisco, CA 94103

Dear Ms. Gibson:

On September 6, 2016, Building Inspection Commission introduced the following proposed legislations:

**File No. 160944**

Ordinance repealing the 2013 Building Code in its entirety and enacting a 2016 Building Code consisting of the 2016 California Building Code and the 2016 California Residential Code, as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160945**

Ordinance adding the provisions of the 2016 California Residential Code with local amendments into various chapters of the 2016 San Francisco Building Code, and adding Chapter 36 to the Building Code to serve as a directory of where such provisions may be found; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160946**

Ordinance repealing the 2013 Electrical Code in its entirety and enacting a 2016 Electrical Code consisting of the 2016 California Electrical Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.





**File No. 160947**

Ordinance enacting a 2016 San Francisco Existing Building Code consisting of the 2016 California Existing Building Code with San Francisco amendments; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160948**

Ordinance repealing the 2013 Green Building Code in its entirety and enacting a 2016 Green Building Code consisting of the 2016 California Green Building Standards Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing for an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160949**

Ordinance repealing the 2013 Mechanical Code in its entirety and enacting a 2016 Mechanical Code consisting of the 2016 California Mechanical Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

**File No. 160950**

Ordinance repealing the 2013 Plumbing Code in its entirety and enacting a 2016 Plumbing Code consisting of the 2016 California Plumbing Code as amended by San Francisco; adopting environmental findings and findings of local conditions under the California Health and Safety Code; providing an operative date of January 1, 2017; and directing the Clerk of the Board of Supervisors to forward the legislation to the California Building Standards Commission as required by State law.

This legislation is being transmitted to you for environmental review.

Angela Calvillo, Clerk of the Board



By: Alisa Somera, Legislative Deputy Director  
Land Use and Transportation Committee

Attachment

c: Joy Navarrete, Environmental Planning  
Jeanie Poling, Environmental Planning





August 26, 2016

Angela Calvillo, Clerk of the Board  
Board of Supervisors  
#1 Dr. Carlton B. Goodlett Place, Room 244  
San Francisco, CA 94102-4689

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Dear Ms. Calvillo:

Attached please find an original and two copies (1 electronic CD) of seven proposed ordinances (approved by the Building Inspection Commission on August 17, 2016) for the Board of Supervisors approval, which repeal the San Francisco amendments to the 2013 California Building Standards Codes and adopt replacement amendments to the new 2016 California Building Standards Codes effective January 1, 2017. (One copy of these 2016 California Building Standards Codes are hereby provided for your reference in the form of each California adopted model code and their associated California amendments to them.)

The following is a list of accompanying documents:

- 1) Approval letter from the Building Inspection Commission
- 2) Exhibit A, Standard Findings
- 3) San Francisco Building Code Ordinance, Legislative Digest (Includes Residential Code below), Findings, proposed amendment text (Building)
- 4) San Francisco Building Code; Residential Building Requirements Ordinance, Legislative Digest (included in Building Code above). Findings, proposed amendment text. (Residential)
- 5) San Francisco Existing Building Code Ordinance, Legislative Digest, Findings, proposed amendment text. (Existing Building)
- 6) San Francisco Electrical Code Ordinance, Legislative Digest, Findings, proposed amendment text (Electrical)
- 7) San Francisco Mechanical Code Ordinance, Legislative Digest, Findings, proposed amendment text (Mechanical)
- 8) San Francisco Plumbing Code Ordinance, Legislative Digest, Findings, proposed amendment text (Plumbing)
- 9) San Francisco Green Building Code Ordinance, Legislative Digest, Findings, proposed amendment text (Green), Cost effectiveness study.

In order for the San Francisco code amendments to coordinate with the California codes, which have an effective date of January 1, 2017, the timeline for approval and adoption requires that the codes be submitted to the Board of Supervisors on or before August 29, 2016 for introduction and assignment to the Land Use Committee (on September 6, 2016), a thirty-day review and comment period follows prior to hearing at the Land Use Committee on October 17, 2016. When approved, it is proposed that



the Board of Supervisor agenda Readings on October 25, 2016 and November 1, 2016. Upon their approval, the ordinances will be forwarded to the Mayor for signature within 10 days, followed by a 30-day wait period (ending approximately December 12, 2016) before filing with the California Building Standards Commission to become effective for an implementation date of January 1, 2017.

The following person may be contacted regarding this matter:



Kirk Means, Building Inspector  
Technical Services Division  
Department of Building Inspection  
Phone: (415) 575-6832  
Fax: (415) 558-6401

Attachments: As stated



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