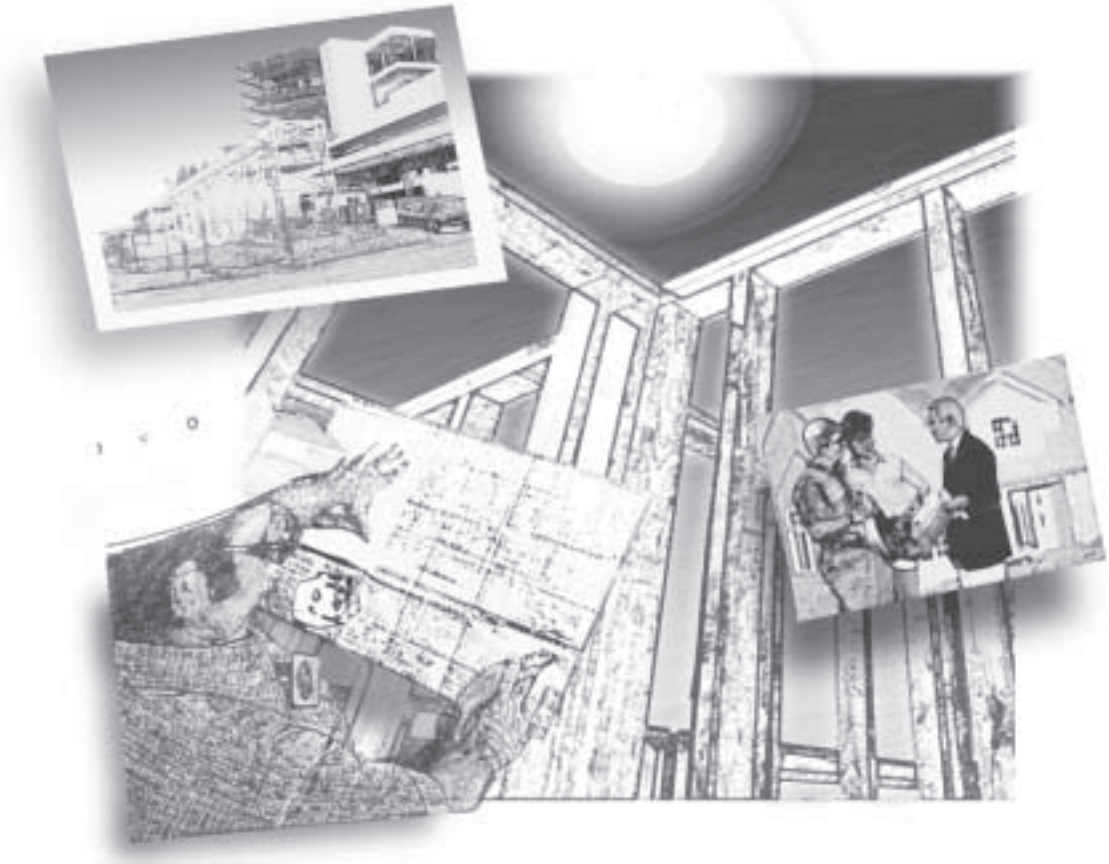
DRAFT 2 – NOVEMBER 2002

2005 ENERGY EFFICIENCY STANDARDS



for RESIDENTIAL and NONRESIDENTIAL BUILDINGS

CALIFORNIA ENERGY COMMISSION

CONSULTANT DRAFT REPORT

Workshop Draft 2
November 18, 2002
P400-03-001D2
Contract 400-00-061 &
Contract 400-01-023

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November 18, 2002

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ADMINISTRATIVE REGULATIONS

CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 1

ARTICLE 1 – ENERGY BUILDING REGULATIONS

SECTION 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.

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

SECTION 10-102 – DEFINITIONS

In this article the following definitions apply:

ALTERNATIVE CALCULATION METHOD APPROVAL MANUAL or **ACM MANUAL** is the Alternative Calculation Method (ACM) Approval Manual for the 2001 Energy Efficiency Standards for Nonresidential Buildings, (P400-01-011) for nonresidential buildings, hotels, and multi-family residential buildings with four or more stories and the Alternative Calculation Method (ACM) Approval Manual for the 2001 Energy Efficiency Standards for Residential Buildings, , (P400-01-012) for all single family and low-rise multi-family residential buildings.

APPLIANCE STANDARDS are the California Code of Regulations, Title 20, Chapter 2, Subchapter 4, Article 4, Sections 1601 to 1608.

APPROVED CALCULATION METHOD is a Public Domain Computer Program approved under Section 10-109 (a), or any Alternative Calculation Method approved under Section 10-109 (b).

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.

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

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 (d) 2 of Part 6.

CONDITIONED FLOOR AREA is the "conditioned floor area" as defined in Section 101 (b) of Part 6.

ENERGY BUDGET is the "energy budget" as defined in Section 101 (b) of Part 6.

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

EXECUTIVE DIRECTOR is the executive director of the commission.

HVAC SYSTEM is the "HVAC system" as defined in Section 101 (b) of Part 6.

MANUFACTURED DEVICE is the "manufactured device" as defined in Section 101 (b) of Part 6.

PART 6 is the California Code of Regulations, Title 24, Part 6.

PUBLIC ADVISER is the Public Adviser of the commission.

R-VALUE is the measure of the resistance of a material or building component to the passage of heat in [hr. x ft.^{2} x ºF] ÷ Btu.

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

SECTION 10-103 – PERMIT, CERTIFICATE, INFORMATIONAL, AND ENFORCEMENT REQUIREMENTS FOR DESIGNERS, INSTALLERS, BUILDERS, MANUFACTURERS, AND SUPPLIERS

(a) Documentation.

1. **Certificate of compliance.** The Certificate(s) of Compliance described in Section 10-103 shall be signed by the person(s) responsible for the building design to certify conformance with Part 6. The signer(s) shall be eligible under Division 3 of the Business and Professions Code to sign such documents. If more than one person has responsibility for building design, each person may sign the document or documents applicable to that portion of the design for which the person is responsible. Alternatively, the person with chief responsibility for design may prepare and sign the document for the entire design.

   Subject to the preceding paragraph, persons who prepare energy compliance documentation shall sign a statement that the documentation is accurate and complete.

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 listed in Sections 10-103 (a) 2 A, 10-103 (a) 2 B, and 10-103 (a) 2 C.

   A. For all new buildings designated to allow a conditioned use of an occupancy group or type regulated by Part 6, the applicant shall file the appropriate Certificate(s) of Compliance on the plans. The certificate(s) shall indicate the features and performance specifications needed to comply with Part 6, and shall be approved by the local enforcement agency by stamp or authorized signature. The Certificate(s) of Compliance and supporting documentation shall be readily legible and of substantially similar format and informational order and content to the appropriate Certificate(s) of Compliance and supporting documentation in the appropriate Residential or Nonresidential Manual, as defined in Part 6.

   B. Plans and specifications submitted with each application for a building permit shall show the characteristics of each feature, material, component, and manufactured device proposed to be installed in order to have the building meet the requirements of Part 6, and of any other feature, material, component, or manufactured device that Part 6 requires be indicated on the plans and specifications. If any characteristic is materially changed before final construction and 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 and shall be submitted to the enforcement agency. Such characteristics shall include the efficiency (or other characteristic regulated by Part 6) of each device.

   C. All documentation necessary to demonstrate compliance for the building, and of the sections of Part 6 with which the building is intended to comply shall be submitted with each application for a building permit. The forms used to demonstrate compliance shall be readily legible and of substantially similar format and informational order and content to the appropriate forms in the Residential or Nonresidential Manual, as defined in Part 6.

3. **Installation certificate.**

   A. The person with overall responsibility for construction or the person or persons responsible for the installation of regulated manufactured devices shall post, or make available with the building permit(s) issued for the building, the Installation Certificate(s) for manufactured devices regulated by the appliance standards or Part 6. Such Installation Certificate(s) shall be made available to the enforcement agency for all appropriate inspections.

      These certificates shall:

      i. Identify features required to verify compliance with the appliance standards and Part 6.

      ii. Include a statement indicating that the installed devices conform to the appliance standards and Part 6 and the requirements for such devices given in the plans and specifications approved by the local enforcement agency.

      iii. State the number of the building permit under which the construction or installation was performed.

      iv. Be signed by the individual eligible under Division 3 of the Business and Professions Code to accept responsibility for construction, or their authorized representative. If more than one person has

responsibility for building construction, each person may prepare and sign the part of the document applicable to the portion of construction for which they are responsible; alternatively, the person with chief responsibility for construction may prepare and sign the document for the entire construction.

B. The enforcement agency may require the person with overall responsibility for the construction to provide any other reasonable information to determine that the building as constructed is consistent with approved plans and specifications and complies with Part 6.

C. 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 Installation Certificate(s) to be posted upon completion of that portion.

4. **Insulation certificate.** After installing wall, ceiling, or floor insulation, the installer shall make available to the enforcement agency or post in a conspicuous location in the building a certificate signed by the installer stating that the installation is consistent with the plans and specifications described in Section 10-103 (a) 2 A and for which the building permit was issued and conforms with the requirements of Part 6. The certificate shall also state the manufacturer's name and material identification, the installed R-value, and (in applications of loose fill insulation) the minimum installed weight per square foot consistent with the manufacturer's labeled installed design density for the desired R-value.

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) Operating and Maintenance Information to be provided by Builder.

1. **Operating information.** The builder shall provide the building owner at occupancy the appropriate Certificate(s) of Compliance and a list of the features, materials, components, and mechanical devices installed in the building and instructions on how to operate them efficiently. The instructions shall be consistent with specifications set forth by the executive director.

   For residential buildings, such information shall, at a minimum, include information indicated on forms Certificate of Compliance (CF-1R), Mandatory Measures (MF-1R), Installation Certificate (CF-6R), Insulation Certificate (IC-1), and a manual which provides all information specified in this Section 10-103 (b). The *Home Energy Manual* (P400-92-031, July 1992) may be used to meet the requirement for providing this manual.

   For nonresidential buildings, such information shall, at a minimum, include information required by the Certificates of Compliance, forms ENV-1, MECH-1 and LTG-1, an Installation Certificate and an Insulation Certificate.

   For dwelling units, buildings or tenant spaces which 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.

2. **Maintenance information.** The builder shall provide to 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 dwelling units, buildings or tenant spaces which 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.

3. **Ventilation information.** For nonresidential buildings, the builder shall 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 which 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.

(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).

(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.

   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.

   "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 new construction to determine whether it is consistent with the agency's approved plans and specifications, and complies with Part 6. Final occupancy permits shall not be issued until such consistency is verified. For Occupancy Group R-3, final inspection shall not be complete until such consistency is verified.

   Such verification shall include determining that all installed manufactured devices, regulated by the appliance standards or Part 6, are indicated on the Installation Certificate and are consistent with approved plans. This certificate shall include information specified in Section 10-103 (a) (3) (A).

NOTE: Authority cited: Section 25402, Public Resources Code. Reference: Section 25402, Public Resources Code.

SECTION 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 specifications required by Section 10-103 (a) 2 A;
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 cited: Sections 25402 and 25402.1, Public Resources Code. Reference: Sections 25402 and 25402.1, Public Resources Code.

SECTION 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, and on any proposed governmental agency building for which there is no enforcement agency, the executive director must 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 Section 10-103 (a) 2 and 10-103 (a) 3 to the executive director when such a determination is sought.

(b) **Where the Local Enforcement Agency Fails to Enforce.** If a local 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) 2 and 10-103 (a) 3 to the executive director and on his or her written determination that proposed construction conforms to the requirements of Part 6.

NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 10-106 – LOCALLY ADOPTED ENERGY STANDARDS

(a) **Requirements.** Local governmental agencies may adopt and enforce energy standards for new buildings, provided the 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. Local adoption of the requirements of Part 6 before their effective date is a sufficient showing that the local standards meet the requirements of this section and Section 25402.1 (f) (2) of the Public Resources Code; in such a case only the documentation listed in Section 10-106 (b), and a statement that the standards are those in Part 6, need be submitted.

(b) **Documentation Application.** Local governmental agencies wishing to enforce locally adopted energy conservation standards shall submit four copies of an application with the following materials to the executive director:

1. The proposed local energy standards.
2. A study with supporting analysis showing how the local agency determined energy savings.
3. A statement that the local standards will require buildings to be designed to consume no more energy than permitted by Part 6.
4. The basis of the agency's determination that the standards are cost effective.

NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 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 cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 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.
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 cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 10-109 – CALCULATION METHODS AND ALTERNATIVE COMPONENT PACKAGES

NOTE: See Section 10-104 for approval of exceptional designs.

(a) **Public Domain Computer Programs.** In addition to the present approved public domain computer programs, 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.

1. The commission shall ensure that users' manuals or guides for each approved program are available.
2. The commission shall approve a program only if, when it models building designs or features, it predicts energy consumption substantially equivalent to that predicted by the public domain computer program ~~used by the commission to set energy budgets~~.

(b) **Alternative Calculation Methods (All Occupancies).** In addition to public domain computer programs, the commission may approve alternative calculation methods (ACMs) that applicants for building permits may then use to demonstrate compliance with the performance standards (energy budgets) in Part 6.

1. **General requirements.** To obtain approval for an ACM, the proponent shall submit an application that demonstrates that the ACM:
   A. Makes no changes in any input parameter values specified by the commission in Item 2 below;
   B. Provides input and output documentation that facilitates the enforcement agency's review and meets the formatting and content criteria found in the ~~appropriate~~ Residential and Nonresidential ACM Manual;
   C. Is supported by clear and concise instructions for using the method to demonstrate that the energy budget requirements of Part 6 are met;
   D. Is reliable and accurate relative to the appropriate public domain computer program; and
   ~~E. Establishes factors that, when applied to the method's outputs, result in energy budgets for that alternative calculation method that are equivalent to those in Part 6, when the buildings used to develop the energy budgets in Part 6 are modeled.~~[1]
2. **Procedural requirements for alternative calculation methods.** In order to obtain approval of an ACM, the applicant must comply with the requirements, specifications, and criteria set forth in the ~~appropriate~~ Residential and Nonresidential ACM Manual. The ACM Manuals ~~specifies~~ specify application requirements, minimum modeling capabilities, required output forms and instructions, input assumptions, testing requirements, test approval criteria, vendor requirements, and other related requirements. The requirements, specifications, and

[1] This paragraph is deleted because it is no longer relevant with custom budgets.

criteria in the 2005 Residential and Nonresidential ACM Manuals ~~for the *2001 Energy Efficiency Standards for Residential and Nonresidential Buildings*~~ are hereby incorporated by reference. Specific portions of the ACM Manuals are also included in Appendix A-1 of the Standards.

NOTE: Interested persons may obtain copies of the ACM Manuals from the Energy Commission's Publications Unit.

3. **Application.** The applicant shall submit four copies of a signed application form specified by the executive director. The application shall include the following materials:

   A. The method's analytical capabilities and limitations with respect to the occupancies, designs, materials, and devices covered by Part 6; and

   B. A demonstration that the criteria in Section 10-109 (b) are met.

   C. Each of the items on the "Application Checklist" in the ~~appropriate~~ Residential or Nonresidential ACM Manual.

   D. An initial fee of one thousand dollars ($1000). The total fee shall cover the commission's cost of reviewing and analyzing the proposed method. After the commission determines the total costs, if the costs exceed the initial fee, the commission shall assess additional fees to cover those costs; if the costs are less than the initial fee, the commission shall refund the difference to the applicant.

4. **Exceptional methods.** If the alternative calculation method analyzes designs, materials, or devices that cannot be adequately modeled using the public domain computer programs, the method may be approved as an exceptional method. Applications for approval of exceptional methods shall include theoretical and empirical information that verify the method's accuracy, and shall also include the other documentation and fees required by Subsection 10-109 (b).

5. **Approval.** The commission may approve a method unconditionally, may restrict approval to specified occupancies, designs, materials, or devices, or may reject the application.

6. **Resubmittal.** An applicant may resubmit a rejected method or may request modification of a restricted approval. Such application shall include the information specified in Section 10-109 (b) and shall indicate how the method has been changed to enhance its accuracy or capabilities.

7. **Modification.** Whenever an approved calculation method is changed in any way, the method shall be resubmitted under this section for reapproval. The executive director may waive any of the requirements of this paragraph for nonsubstantive changes.

(c) The commission may modify or withdraw certification of a program or method under Section 10-109 (a) or 10-109 (b) based on approval of other programs or methods that are more suitable.

(d) **Alternative Component Packages.** The commission may approve any alternative component package, in addition to the packages in Sections 143 (a) and 151 (f) of Part 6, which it determines will meet the energy budgets and is likely to apply to a significant percentage of new buildings or to a significant segment of the building construction and design community. Applications for approval of packages shall use application forms specified by the executive director and shall be subject to the same fee requirements set forth in Subsection (b).

(e) **Publication of Commission Determinations.** The executive director shall annually publish a manual, newsletter, or other administrative guide containing determinations made by the commission pursuant to this section on or before December 31 of the calendar year.

NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 10-110 – PROCEDURES FOR CONSIDERATION OF APPLICATIONS UNDER SECTIONS 10-104, 10-106, 10-108, AND 10-109

(a) If the application is complete, the executive director shall make ~~a copy or copies of~~ the application available to interested parties. Comments from interested parties must be submitted within 60 days after acceptance of the application.

(b) Within 75 days of receipt of an application, the executive director may request any additional information needed to evaluate the application. If the additional information is incomplete, consideration of the application will be delayed until the applicant submits complete information.

(c) Within 75 days of receipt of the application, 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 after the executive director receives the application, or within 30 days after receipt of complete additional information requested under Section 10-110 (b), or within 30 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 application 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.

(g) All applicants have the burden of proof to establish that their applications should be granted.

NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 10-111 – CERTIFICATION AND LABELING OF FENESTRATION PRODUCT U-FACTORS, SOLAR HEAT GAIN COEFFICIENT AND AIR LEAKAGE

This section establishes rules for implementing labeling and certification requirements relating to U-factors (also known as U-values), solar heat gain coefficients and air leakage for fenestration products under Section 116 (a) of Title 24, California Code of Regulations, 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.** Every fenestration product or fenestration system installed in construction subject to Title 24, Part 6 shall have attached to it a clearly visible temporary label or have an associated label certificate that lists the U-factor, the solar heat gain coefficient (SHGC) of that product and the method used to derive those values, and certifies compliance with air leakage requirements of Section 116 (a) 1. To meet this set of requirements, products shall comply with subsections "A," "B," or "C," subsections "D," or "E," and subsection "F."

   A. If the product U-factor rating is taken from the commission's default table, then placing the words “CEC Default U-factor,” followed by the appropriate default U-factor on the temporary label meets the U-factor labeling requirement of paragraph 1. The commission’s default table for U-factor values shall be those shown in Table 1-D or, for skylights, those default values shown in Appendix I of the Nonresidential ACM Manual.

   B. If the product U-factor rating is derived from the NFRC Rating Procedure, then placing the words “Manufacturer stipulates that this rating was determined in accordance with applicable NFRC procedures” followed by the rating procedure number and certified U-factor on the temporary label meets the requirement of paragraph 1.

      The “NFRC Rating Procedure” as used in this subparagraph B means the National Fenestration Rating Council's NFRC 100: Procedure for Determining Fenestration Product U-factors (1997) also known as “NFRC 100,” incorporated herein by reference.

   C. If the fenestration system U-factor is from the NFRC rating procedure and the system is a vertical glazing that is site-built, then issuance of a complete and valid NFRC Label Certificate for Site-Built Products, containing the words "Manufacturer stipulates that this rating was determined in accordance with applicable NFRC procedures" (or equivalent language) followed by the rating procedure number and certified U-factor on the label certificate, meets the requirements of Paragraph 1. The “NFRC Rating Procedure" as used in

this subparagraph C, means the National Fenestration Rating Council's NFRC 100-SB, Procedure for Determining Site-Built Fenestration U-Factors and Thermal Performance Characteristics (2000), also known as NFRC 100-SB, incorporated herein by reference.

D. If the product SHGC is taken from the Commission's default table, then placing the words "CEC Default SHGC" followed by the appropriate default SHGC from Section 116, Table 1-E on the temporary label meets the requirement of Paragraph 1.

E. If the product SHGC rating is derived from the NFRC Rating Procedure, placing the words "Manufacturer stipulates that this rating was determined in accordance with applicable NFRC procedures" followed by the rating procedure number and certified SHGC on the temporary label meets the requirement of paragraph 1.

If the fenestration system SHGC is derived from the NFRC rating procedure and the system is a vertical glazing that is site-built, then issuance of a complete and valid NFRC Label Certificate for Site-Built Products, containing the words "Manufacturer stipulates that this rating was determined in accordance with applicable NFRC procedures" (or equivalent language) followed by the rating procedure number and certified SHGC on the label certificate, meets the requirements of Paragraph 1.

The "NFRC Rating Procedure" as used in this subparagraph E means the National Fenestration Rating Council's NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence (1995), also known as "NFRC 200", or for vertical glazing that is site-built the National Fenestration Rating Council's NFRC 100-SB, Procedure for Determining Site-Built Fenestration U-Factors and Thermal Performance Characteristics (2000), also known as "NFRC 100-SB," incorporated herein by reference.

F. The temporary label shall also certify that the product complies with the air leakage requirements of Section 116 (a) 1 of the standards.

2. **Permanent labels.** If a product is rated using the NFRC Rating Procedure, it shall be permanently labeled with either a single label or series of marks on the frame, glass, and/or spacer which can be used to trace the product to certification information on file with the certifying organization or to a directory of certified products, published by the supervisory entity, containing the name of the manufacturer, the product type and description of relevant features, the U-factor rating, solar heat gain coefficient, and the year of certification. A completed NFRC Label Certificate for Site-Built Products meets the requirements of this paragraph.

EXCEPTION 1 to Section 10-111 (a): Site-assembled vertical glazing in buildings covered by the nonresidential standards with less than 100,000 square feet of conditioned floor area or less than 10,000 square feet of vertical glazing.

EXCEPTION 2 to Section 10-111 (a): Horizontal glazing in buildings covered by the nonresidential standards.

(b) **Certification Requirements.**

1. **Certification to default ratings.** If a product's U-factor and SHGC are taken from the commission's default tables (Section 116, Tables 1-D and 1-E), the U-factor and SHGC shall be certified by either the manufacturer or an independent certifying organization approved by the commission.

A. A temporary label, affixed to the product, that contains the terms "CEC Default U-factor" and "CEC Default SHGC," followed by the appropriate values from the commission's default tables 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 temporary label meets this requirement.

2. **Certification to NFRC rating procedure.** If a product's U-factor or SHGC is based on the NFRC Rating Procedure, the U-factor or SHGC shall be certified only by an independent certifying organization approved by the commission.

A. A temporary label, affixed to the product or label certificate for Site-Built Products, meeting the requirements of Section 10-111 (a)1B or 10-111 (a)1C, and 10-111 (a)1D or 10-111 (a)1E 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 and solar heat gain coefficient 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 paragraph (c) 1.

EXCEPTION 1 to Section 10-111 (b): Site-assembled vertical glazing in buildings covered by the nonresidential standards with less than 100,000 square feet of conditioned floor area or less than 10,000 square feet of vertical glazing.

EXCEPTION 2 to Section 10-111 (b): Horizontal glazing in buildings covered by the nonresidential standards.

(c) **Designation of Supervisory Entity.** The National Fenestration Rating Council shall be the supervisory entity to administer the certification program relating to U-factors and solar heat gain coefficient ratings for fenestration products, provided the commission determines that the NFRC meets the criteria in paragraph (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 paragraph (d). Such other supervisory entity shall meet the criteria in paragraph (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 paragraph (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 only laboratories accredited by the supervisory entity to perform simulations and tests under the NFRC Rating Procedure.

5. The entity shall maintain appropriate guidelines for testing and simulation laboratories, manufacturers, and certifying agencies, including requirements for adequate:

   Possession and calibration of equipment;

   Education, competence, and training of personnel;

   Quality control;

   Record keeping and reporting;

   Periodic review (including, but not limited to, blind testing by laboratories; inspections of products; and inspections of laboratories, manufacturing facilities, and certifying agencies);

   Challenges to certified ratings; and

   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 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 Site-Built Products that can be used to meet the requirements of Section 116 (a) 1 and 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, between testing labs, between simulation labs, and between independent certifying organizations.

(e) **Certification for Other Factors.** Nothing in this section shall preclude any entity, whether associated with a U-factor and SHGC certification program or not, from providing certification services relating to factors other than U-factors and SHGC for fenestration products.

NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 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 using 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, including testing and simulation.

(b) The commission shall periodically review and revise the default tables as necessary to ensure that the criteria are met.

NOTE: Authority cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 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 141, 142, and 151(b) 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.**

~~Effective January 1, 2003, e~~Every roofing product installed in construction to take compliance credit for reflectance and emittance under Sections 141, 142, and 151(b) shall have a clearly visible packaging label that lists the reflectance and emittance tested in accordance with CRRC-1 ~~the following ASTM Standards. Product reflectance and emittance ratings determined through these testing procedures shall be placed on a label on all packaging which contains the product. The words "Manufacturer stipulates that this rating was determined in accordance with applicable CRRC procedures" followed by the rating procedure number and certified reflectance and emittance shall~~

~~be placed on the packaging of the roofing products. The label shall also state any limitations or conditions of the applicability of the rating to installed roofing products.~~

~~*ASTM E408-71(1996)e1* – Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.~~

~~*ASTM E903-96* – Standard Test Method for Solar Absorptance, Reflectance and Transmittance of Materials Using Integrating Spheres.~~

~~*ASTM E1918-97* – Standard Test Method for Measuring Solar Reflectance of Horizontal and Low Sloped Surfaces in the Field~~

Packaging for liquid applied acrylic roof coatings shall state that they meet the minimum performance requirements set forth in ASTM D6083-97a ~~– Standard Specification for Liquid Applied Acrylic Coating Used in Roofing,~~ for initial tensile strength, initial elongation, elongation after 1000 hours accelerated weathering, permeance, and accelerated weathering.[2]

(b) **Certification Requirements.**

~~Effective January 1, 2003 e~~Every roofing product installed in construction to take compliance credit for reflectance and emittance under Sections 141, 142, and 151(b) shall be certified ~~only~~ 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 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 paragraph (d).

1. The commission may consider designating a supervisory entity other than CRRC only if the commission determines that the CRRC cannot meet the criteria in paragraph (d) ~~by January 1, 2002~~. Such other supervisory entity shall meet the criteria in paragraph (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 paragraph (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 ~~ASTM Standards E408, E903, E1918, D6083~~ testing and rating procedures, labeling and certification, and such other rating procedures for other factors 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;

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[2] The intent is to provide similar durability requirements for other liquid applied roof membranes, similar to acrylic. Standards for other coatings are under development, but are not available at the time of this draft. We are also investigating the applicability of ASTM 6083 to other types of coatings.

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; inspections of laboratories, and manufacturing facilities);

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 141, 142, and 151(b), 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 cited: Section 25402.1, Public Resources Code. Reference: Section 25402.1, Public Resources Code.

SECTION 10-114 – DETERMINATION OF OUTDOOR LIGHTING ZONES AND ADMINISTRATIVE RULES FOR USE[3]

This section establishes rules for implementing outdoor lighting zones to show compliance with Section 133 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 ambient illumination in 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 by one zone 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

[3] This change based on Eley Associates, "Lighting Zones," Outdoor Lighting Research: California Outdoor Lighting Standards, June 6, 2002, p. 7-10. Presented at the June 18, 2002 workshop.

TABLE 10-114-A LIGHTING ZONE CHARACTERISTICS AND RULES FOR AMENDMENTS BY LOCAL JURISDICTIONS[4]

Zone	**Ambient Illumination**	**State Default Location**	**Moving Up to the Next Zone**	**Moving Down to the Previous Zone**
LZ1	Dark	State and national parks, recreation areas, and wildlife preserves.	A state or national park or recreation area, or portions thereof, can be designated as LZ2 or LZ3 if they are contained within or adjacent to such a zone.	Not applicable.
LZ2	Low	Rural areas, as defined by the Year 2000 U.S. Census.	Special districts within a default LZ2 zone may be designated as LZ3 by a local jurisdiction. Examples include special commercial or industrial districts located within a rural area. Special LZ3 areas must be at least one half mile away from any LZ1 area, and may not exceed a dimension of more than 8 miles in direction.	Special districts within a default LZ2 zone maybe designated as LZ1 by the local jurisdiction for lower illumination standards. No size or adjacency limits.
LZ3	Medium	Urban areas, as defined by the Year 2000 U.S. Census.	Special districts may be designated by local jurisdiction for high intensity nighttime use, such as adult entertainment districts. Individual LZ4 areas must be at least 1 miles from any LZ2 area and 2 miles from any LZ1 area. LZ4 areas shall not exceed a dimension of more than 8 miles in any direction. No city shall designate more than 20% of its total dry land area as LZ4.	Special districts within a default LZ3 zone may be designated as LZ2 by the local jurisdiction. No size or adjacency limits.
LZ4	High	None.	Not applicable.	Not applicable.

(d) **Commission Notification.** 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 and map of the boundaries of the adopted Lighting Zones.
2. A description of the public process that was conducted in adopting the Lighting Zone changes.
3. An explanation of how the adopted Lighting Zone changes are consistent with the specifications of Table 10-114-A.

The Commission shall have the authority to not allow Lighting Zone changes which the Commission finds to be inconsistent with the specifications of Table 10-114-A.

[4] This change based on Eley Associates, "Lighting Zones," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 7-10. Presented at the June 18, 2002 workshop, modified per Energy Commission staff analysis.

EFFICIENCY STANDARDS

CALIFORNIA CODE OF REGULATIONS
TITLE 24, PART 6

SUBCHAPTER 1
ALL OCCUPANCIES—GENERAL PROVISIONS

SECTION 100 – SCOPE

(a) **Buildings Covered.** The provisions of Title 24, 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:[5]
   - A. Unconditioned, ~~D~~indirectly or ~~in~~directly conditioned by mechanical heating or mechanical cooling; or[6].
   - B. Low-rise residential buildings that are heated with a wood heater or another nonmechanical heating system; or
   - C. Semiconditioned nonresidential occupancies.

EXCEPTION 1 to Section 100 (a): Specific provisions which the building official determines would damage the historical value of ~~Q~~qualified historic buildings, as defined in the ~~State~~ California Historical Building Code (Title 24, Part 8).[7]

EXCEPTION 2 to Section 100 (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 Title 24, Part 6, apply to the building envelope, space-conditioning systems, water-heating systems, and lighting systems of buildings covered by Section 100 (a) as set forth in TABLE 100-A~~Table 1-A~~.

(c) **Floors and Habitable Stories.**

1. Only habitable floors that have at least 50 percent of their volume above grade as defined in the UBC shall be counted in determining how many habitable stories a building has.
2. All conditioned space in a floor shall comply with Title 24, Part 6, whether or not the floor is above grade and whether or not it is habitable.

(d) **Outdoor Lighting**. The provisions of Title 24, Part 6, apply to outdoor lighting systems as set forth in TABLE 100-A.[8]

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[5] This paragraph can probably be deleted or substantially modified. The standards apply to all nonresidential buildings whether they are heated or not, as shown in Table 100A. Residential buildings are required by law to be heated. The only issue to deal with is wood heat. Changes will be proposed in the next draft.

[6] SB 5x, Docket Number 02-OLS-1, established authority in PRC Section 25402.5 (3) (c) for the California Energy Commission to adopt lighting standards for outdoor lighting.

[7] This change is intended to limit the historic buildings exception to only those measures that would damage the historical value or integrity of the building. It is left to interpretation about which measures might potentially be a problem, since this will change for each historic building. For most historic buildings, the building shell or envelope is most significant, but for many, historical value may also include interior spaces.

[8] SB 5x, Docket Number 02-OLS-1, established authority in PRC Section 25402.5 (3) (c) for the California Energy Commission to adopt lighting standards for outdoor lighting.

TABLE 100-A APPLICATION OF STANDARDS

Occupancies	Application	Mandatory	Prescriptive	Performance	Additions/Alterations
General Provisions		100, 101, 102, 110, 111			
Nonresidential, High-Rise Residential, And Hotels/Motels	General	140	142	141	149
	Envelope (conditioned)	116, 117, 118	143		
	Envelope (unconditioned)	116, 117, 118	143 (c)		
	HVAC	112, 115, 120-124	144		
	Water Heating	113, 123	145		
	Interior Lighting	119, 130, 131	146		
	Outdoor Lighting	119, 130	133		
Low-Rise Residential	General	150	151 (a, f)	151 (a-e)	152
	Envelope	116, 117, 118, 150 (a-g, l)			
	HVAC	112, 115, 150 (h, I, m)			
	Water heating	113, 150 (j)			
	Interior Lighting	119, 150 (k)			
	Outdoor Lighting	119, 150 (k)			

~~*TABLE 1-A APPLICATION OF STANDARDS*~~

~~BUILDING TYPE~~	~~MANDATORY~~	~~PERFORMANCE~~	~~PRESCRIPTIVE~~	~~ADDITIONS/ ALTERATIONS~~
~~All Occupancies~~	~~100 through 109 and 118~~	~~—~~	~~—~~	~~—~~
~~Nonresidential, high-rise residential, and hotels/motels~~ ~~All~~ ~~Envelope~~ ~~Mechanical~~ ~~Lighting~~	~~102, 110 through 139~~ ~~—~~ ~~120 through 129~~ ~~130 through 139~~	~~141~~ ~~141~~ ~~141~~ ~~141~~	~~142 through 146~~ ~~143~~ ~~144 and 145~~ ~~146~~	~~149~~ ~~149~~ ~~149~~ ~~149~~
~~Semiconditioned nonresidential buildings of an occupancy group listed in Section 100~~	~~119, 130 through 139~~	~~—~~	~~146~~	~~149 (b) 3~~
~~Low-rise residential~~	~~102, 110 through 118 and 150~~	~~151 (a) through (e)~~	~~151 (a), (f)~~	~~152~~

(~~d~~e) **Sections Applicable to Particular Buildings.** -TABLE 100-A ~~Table 1-A~~ and this subsection list the provisions of Title 24, Part 6, that are applicable to different types of buildings covered by Section 100 (a).

1. **All buildings**. Sections 100 through 109 and 118 apply to all buildings.
2. **New buildings**.
   A. **All new buildings**. Sections 110 through 119 apply to all new buildings within the scope of Section 100 (a). In addition, new buildings shall meet the requirements of B, ~~or~~ C or D, as applicable.
   B. **Nonresidential, high-rise residential, and hotel/motel buildings that are mechanically heated or mechanically cooled**.
      i. **Sections applicable**. Sections 120 through 146 apply to new nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled.

ii. **Compliance approaches**. In order to comply with Title 24, Part 6, new nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled must meet the requirements of:

a. Mandatory measures: The applicable provisions of Sections 120 through 139; and

b. Either:

Performance approach: Section 141; or

Prescriptive approach: Sections 142 through 146.

C. ~~**Semiconditioned**~~ **Unconditioned nonresidential buildings.** Sections 119, 130 through ~~132~~133, 143 (c), and 146 apply to all new unconditioned buildings within the scope of Section 100 (a).

D. **Low-rise residential buildings~~ that are heated or mechanically cooled~~.**

i. **Sections applicable**. Sections 150 through 151 apply to new low-rise residential buildings~~ that are heated or mechanically cooled~~.

ii. **Compliance approaches**. To comply with Title 24, Part 6, new low-rise residential buildings ~~that are heated or mechanically cooled~~ must meet the requirements of:

a. Mandatory measures: The applicable provisions of Sections 110 through 119, and 150; and

b. Either:

Performance approach: Section 151 (a) through (e); or

Prescriptive approach: Sections 151 (a) and (f).

EXCEPTION 1 to Section 100 (d) 2 D ~~(ii)~~ ~~(b)~~: 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 (d) 2 D ~~(ii)~~ ~~(b)~~: 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.

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

A. **Nonresidential, high-rise residential, and hotel/motel buildings.** Section 149 applies to new construction in existing buildings that will be nonresidential, high-rise residential, and hotel/motel occupancies.

~~**Semiconditioned nonresidential buildings.** Section 149 (b) 3 applies to new construction in an existing semiconditioned building. If new construction results in newly conditioned space, Section 149 (a) shall apply.~~[9]

B. **Low-rise residential buildings.** Section 152 applies to new construction in existing buildings that will be low-rise residential occupancies.

4. **Installation of insulation in existing buildings**. Section 118 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 119, 133 and 150 apply to new outdoor lighting systems, and section 149 applies to outdoor lighting alterations.

(~~e~~f) **Mixed Occupancy**. When a building is designed and constructed for more than one type of occupancy, the space for each occupancy shall meet the provisions of Title 24, Part 6, applicable to that occupancy.

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[9] Section 149 is clear about how it applies to unconditioned spaces. This section is no longer needed.

EXCEPTION to Section 100 (ef): If one occupancy constitutes at least 90 percent of the conditioned floor area of the building, the entire building may comply with the provisions of Title 24, Part 6 applicable to that occupancy, provided that the applicable mandatory measures in Sections 110 through 139, and 150, are met for each occupancy.

(gf) **Administrative Requirements**. Administrative requirements relating to permit requirements, enforcement by the commission, locally adopted energy standards, interpretations, claims of exemption, approved calculation methods, and 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 10-114112.

(gh) **Certification Requirements for Manufactured Devices.** Title 24, Part 6, limits the installation of the following manufactured devices to those that have been certified by their manufacturer to meet or exceed minimum specifications or efficiencies adopted by the commission.

1. Central air-conditioning heat pumps and other central air conditioners (Sections 111 and 112).
2. Combination equipment: space heating and cooling, or space heating and water heating [Section 112 (a) 3].
3. Fenestration products (Section 116).
4. Fluorescent lamp ballasts (Section 111).
5. Gas space heaters (Sections 111 and 112).
6. Insulating materials and cool roofs (Section 118).
7. Lighting control devices (Section 119).
8. Oil-fired storage water heaters (Section 113).
9. Other heating and cooling equipment (Sections 111 and 112).
10. Plumbing fittings (Section 111).
11. Pool heaters (Section 114).
12. Refrigerators, refrigerator-freezers, and freezers (Section 111).
13. Room air conditioners (Section 111).
14. Slab floor perimeter insulation [Section 150 (l)].
15. Water heaters (Section 113).

The certification status of any such manufactured device may be confirmed only by reference to:

1. A directory published or approved by the commission; or
2. A copy of the application for certification from the manufacturer and the letter of acceptance from the commission staff; or
3. Written confirmation from the publisher of a commission-approved directory that a device has been certified; or
4. A commission-approved label on the device.

NOTE to Section 100 (hg): Title 24, 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.

SECTION 101 – 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 Title 24, Part 6, shall be defined as specified in Section 101. Terms, phrases, words and their derivatives not found in Section 101 shall be defined as specified in Title 24, Part 2, Chapter 2 of the California Code of Regulations. Terms, phrases, words and their derivatives not found in either Title 24, Part 6, or Chapter 2 shall be defined as specified in Title 24, Part 2, Chapter 2 of the *Uniform Building Code*. 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* (1987 edition), unless the context requires otherwise.

ACCA is the Air-conditioning Contractors of America.

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."

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

ALTERATION is any change to a building's water-heating system, space-conditioning system, lighting system, or envelope that is not an addition.

ALTERNATIVE CALCULATION METHODS (ACMs) are the commission's Public Domain Computer Programs, one of the commission's Simplified Calculation Methods, or any other calculation method approved by the 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 112.

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

ANSI is the American National Standards Institute.

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

APPROVED BY THE COMMISSION means approval under Section 25402.1 of the Public Resources Code.

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

ARI is the Air-conditioning and Refrigeration Institute.

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

ASME is the American Society of Mechanical Engineers.

ASTM is the American Society for Testing and Materials.

ATRIUM is an opening through two or more floor levels other than enclosed stairways, elevators, hoistways, escalators, plumbing, electrical, air-conditioning or other equipment, which is enclosed space and not defined as a mall.

AUTOMATIC is capable of operating without human intervention.

AUTOMATIC MULTI-LEVEL DAYLIGHTING CONTROL is a multi-level lighting control that automatically reduces lighting in multiple steps in response to available daylight. This control uses one or more photoelectric sensors to detect changes in daylight illumination and then change the electric lighting level in response to the daylight changes.[10]

AUTOMATIC TIME SWITCH CONTROL DEVICES are devices capable of automatically turning loads off and on based on time schedules.

BATHROOM is a room containing a shower, tub, toilet or a sink that is used for personal hygiene.[11]

BELOW-GRADE WALL is the portion of a wall, enclosing conditioned space, that is below the grade line.

BUILDING is any structure or space for which a permit is sought.

BUILDING ENVELOPE is the ensemble of exterior and demising partitions of a building that enclose conditioned space.

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.

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.

CHANDELIERS (see "ornamental chandeliers.")

CLIMATE CONTROL SYSTEM (See "space-conditioning system.")

CLIMATE ZONES are the 16 geographic areas of California for which the commission has established typical weather data, prescriptive packages and energy budgets. Climate zone boundary descriptions are in the document "California Climate Zone Descriptions" (July 1995), incorporated herein by reference. FIGURE 101-A~~Figure 1-A~~ is an approximate map of the 16 climate zones.

CMC is the 1998 California Mechanical Code prior to the effective date designated by the California Building Standards Commission for the 2000 California Mechanical Code. On and after the effective date designated by the California Building Standards Commission for the 2000 California Mechanical Code, CMC is the 2000 *California Mechanical 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 112.

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 112.

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

COMPLETE BUILDING is an entire building with one occupancy making up 90 percent of the conditioned floor area (see also "entire building").

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, indirectly conditioned or semiconditioned.

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[10] This change is based on Pacific Gas and Electric Company, *Updates to Title 24 Treatment of Skylights*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 14, 2002. Presented at the May 30, 2002 workshop.

[11] This change is based on Pacific Gas and Electric Company, *Residential Hardwired Lighting*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 7, 2002. Presented at the May 30, 2002 workshop.

CONDITIONED VOLUME is the total volume (in cubic feet) of the conditioned space within a building.

COOL ROOF is a roofing material with ~~high solar reflectance and high emittance~~ high thermal emittance and high solar reflectance, or low thermal emittance and exceptionally high solar reflectance as specified in Section 118 (g), that reduces heat gain through the roof.[12]

COOLING EQUIPMENT is equipment used to provide mechanical cooling for a room or rooms in a building.

COVERED PRODUCT is an appliance regulated by the efficiency standards established under the National Appliance Energy Conservation Act, 42 U.S.C., Section 6291 et seq.

CRAWL SPACE is a space immediately under the first floor of a building adjacent to grade.

CRRC-1 is the Cool Roof Rating Council's document entitled "Product Rating Program Manual."

CTI is the Cooling Tower Institute.

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.^{2} x °F). It is not the same as K-value or K-factor.

DAYLIT AREA is the space on the floor that is the area illuminated by sunlight through vertical glazing as specified in Section 131(c) plus the area illuminated through horizontal glazing, as specified in 143(c)1 or the daylit area calculated using a method approved by the commission, whichever is larger.~~larger of 1 plus 2, or 3;~~

~~(a) For areas daylit by vertical glazing, the daylit area has a length of 15 feet, or the distance on the floor, perpendicular to the glazing, to the nearest 60-inch or higher opaque partition, whichever is less; and a width of the window plus either 2 feet on each side, the distance to an opaque partition, or one half the distance to the closest skylight or vertical glazing, whichever is least.~~

~~(b) For areas daylit by horizontal glazing, the daylit area is the footprint of the skylight plus, in each of the lateral and longitudinal dimensions of the skylight, the lesser of the floor-to-ceiling height, the distance to the nearest 60-inch or higher opaque partition, or one half the horizontal distance to the edge of the closest skylight or vertical glazing.~~

~~(c) The daylit area calculated using a method approved by the commission.~~

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 Residential Manual. For those localities not listed in the Residential Manual, the number of degree days is as determined by the applicable enforcing agency.

DEMISING PARTITIONS are barriers that separate conditioned space from enclosed unconditioned space.

DEMISING WALL is a wall that is a demising partition.

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 144 (b) for nonresidential, high-rise residential, and hotel/motel buildings and in Section 150 (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.

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[12] The justification for this change appears in Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

DIRECTLY CONDITIONED SPACE is an enclosed space that is provided with wood heating, is provided with mechanical heating that has a capacity exceeding 10 Btu/(hr.×ft.²), or is provided with mechanical cooling that has a capacity exceeding 5 Btu/(hr.×ft.²), unless the space-conditioning system is designed and 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 unless the space-conditioning system is 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.

DISPLAY LIGHTING is lighting confined to the area of a display that provides a higher level of illuminance than the level of surrounding ambient illuminance.

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.

DISPLAY, PUBLIC AREA, is an area for the display of artwork, theme displays, and architectural surfaces in dining and other areas of public access, excluding restrooms and separate banquet rooms.

DISPLAY, SALES FEATURE, is an item or items that requires special highlighting to visually attract attention and that is visually set apart from the surrounding area.

DISPLAY, SALES FEATURE FLOOR, is a feature display in a retail store, wholesale store, or showroom that requires display lighting.

DISPLAY, SALES FEATURE WALL, is the wall display area, in a retail or wholesale space, that is in the vertical plane of permanent walls or partitions, and that is open shelving feature display or face of internally illuminated transparent feature display case within the gross sales wall area.

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 conditioned air. Minimum specifications for installation procedures, materials, diagnostic testing and field verification are contained in the Residential and Nonresidential ACM Approval Manuals.

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).

ECONOMIZER, AIR, is a ducting arrangement and 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.

EFFECTIVE APERTURE (EA) is a quantification of the effectiveness that glazing has in illuminating the space that the glazing has a potential to illuminate. For windows, it is as specified in Exception 1 to 131(c); for skylights, it is as specified in 143(c)3A.~~(1) for windows, the visible light transmittance (VLT) times the window wall ratio; and (2) for skylights, the well index times the VLT times the skylight area times 0.85 divided by the gross exterior roof area.~~

~~**EFFICACY** is the ratio of light from a lamp to the electrical power consumed (including ballast losses), expressed in lumens per watt.~~[13]

EFFICACY, LAMP is the quotient of rated initial lamp lumens divided by the rated lamp power (watts), without including auxiliaries such as ballasts.

EFFICACY, LIGHTING SYSTEM is the quotient of rated initial lamp lumens times the ballast factor, divided by the input power (watts) to the ballast or other auxiliary device (e.g. transformer); expressed in lumens per watt.

[13] Efficacy is used in two different ways in the Standard. For clarity, this single definition is deleted and replaced by separate definitions for lamp efficacy and system efficacy.

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.[14]

ENCLOSED SPACE is space that is substantially surrounded by solid surfaces.

ENERGY BUDGET is the maximum amount of ~~source~~ 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 Title 24, Part 6.

ENERGY EFFICIENCY RATIO (EER) is the ratio of net cooling capacity (in Btu/hr.) to total rate of electrical energy (in watts), of a cooling system under designated operating conditions, as determined using the applicable test method in the Appliance Efficiency Regulations or Section 112.

ENERGY FACTOR (EF) is the ratio of energy output to energy consumption of a water heater, expressed in equivalent units, under designated operating conditions over a 24-hour use cycle, as determined using the applicable test method in the Appliance Efficiency Regulations.

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.

ENFORCING 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 means "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 DOOR is a door through an exterior partition that is opaque or has a glazed area that is less than or equal to one-half of the door area. Doors with a glazed area of more than one half of the door area are treated as a fenestration product.

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 that is not enclosed. 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.

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[14] This definition was requested in the August 8th workshop to support the prescriptive requirement for ECM motors on series style fan-powered terminal units. See Eley Associates, "Electronically-Commutated Motors in Series Terminal Units," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 8-14. Presented at the August 27, 2002 workshop.

FENESTRATION PRODUCT is any transparent or translucent material plus any sash, frame, mullions and dividers, in the envelope of a building, including, but not limited to, windows, sliding glass doors, french doors, skylights, curtain walls, garden windows, and other doors with a glazed area of more than one half of the door area.

FENESTRATION SYSTEM means a collection of fenestration products included in the design of a building. (See "fenestration product")

FIELD-FABRICATED FENESTRATION PRODUCT OR EXTERIOR DOOR is a fenestration product or exterior door whose frame is made at the construction site of standard dimensional lumber or other materials that were not previously cut, or otherwise formed with the specific intention of being used to fabricate a fenestration product or exterior door. Field fabricated does not include site-assembled frame components that were manufactured elsewhere with the intention of being assembled on site (such as knocked-down products, sunspace kits, and curtain walls).

FIREPLACE is a hearth and firechamber or similar prepared place in which a solid-fuel fire may be burned, as defined in UBC Section 3102.2 and as further clarified in UBC Section 3102.7; these include, but are not limited to, factory-built fireplaces, masonry fireplaces, and masonry heaters.

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

FRAMED PARTITION or **ASSEMBLY** is a partition or assembly constructed using separate structural members spaced not more than 32 inches on center.

GAS COOLING EQUIPMENT[15] 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 natural gas or liquefied petroleum gas heating system.

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.

GENERAL LIGHTING is lighting designed to provide a substantially uniform level of illumination throughout an area, exclusive of any provision for special visual tasks or decorative effect. When designed for lower-than-task illuminance used in conjunction with other specific task lighting systems, it is also called "ambient" lighting.

GLAZING (See "fenestration product.")

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.

GROSS SALES FLOOR AREA is the total area (in square feet) of retail store floor space that is (1) used for the display and sale of merchandise; or (2) associated with that function, including, but not limited to, sales transactions areas, fitting rooms, and circulation areas and entry areas within the space used for display and sale.

GROSS SALES WALL AREA is the area (in square feet) of the inside of exterior walls and permanent full-height interior partitions within the gross sales floor area of a retail store that is used for the presentation of merchandise for sale, less the area of openings, doors, windows, baseboards, wainscots, mechanical or structural elements, and other obstructions preventing the use of the area for the presentation of merchandise.

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) of an assembly is the amount of heat necessary to raise the temperature of all the components of a unit area in the assembly 1°F. It is calculated as the sum of the average thickness times the density times the specific heat for each component, and is expressed in Btu per square foot per °F.

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[15] The justification for this change appears in Southern California Gas Company, *Gas Cooling Compliance Options for Residential and Nonresidential Buildings, Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update*, August 12, 2002. Presented at the August 27, 2002 workshop.

HEAT PUMP is a device that is capable of heating by refrigeration, and that may include a capability for cooling.

HEATED SLAB is a concrete slab floor or a lightweight concrete topping slab laid over a raised floor, with embedded space heating hot water pipes. The heating system using the heated slab is sometimes referred to as radiant slab floors or radiant heating.[16]

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 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.

HIGH BAY is a space with luminaires 25 feet or more above the floor.

HIGH-RISE RESIDENTIAL BUILDING is a building, other than a hotel/motel, of Occupancy Group R, Division 1 with four or more habitable stories.

HORIZONTAL GLAZING (See "skylight.")

HOTEL/MOTEL is a building or buildings incorporating 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 (See "space-conditioning system.")

ICBO is the International Conference of Building Officials.

ILLUMINATED FACE is a side of an exit sign that has the word "EXIT" on it.

INDIRECTLY CONDITIONED SPACE 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) ~~an area-weighted heat transfer coefficient~~ 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.[17]

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.

INTEGRATED PART LOAD VALUE (IPLV) is a single-number figure of merit based on part load EER or COP expressing part load efficiency for air-conditioning and heat pump equipment on the basis of weighted operation at various load capacities for the equipment as determined using the applicable test method in the Appliance Efficiency Regulations or Section 112.

ISOLATION DEVICE is a device that prevents the conditioning of a zone or group of zones in a building while other zones of the building are being conditioned.

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[16] This addition and clarification to the standard is included at the recommendation of: Gary Farber, "Nonresidential Radiant Slab Floors," *Some Outstanding Title 24 Issues for the Next Generation Building Energy Standards (2003/2005),* October 11, 2001. Presented at the October 22, 2001 workshop.

[17] This change is based on Pacific Gas and Electric Company, *Nonresidential Duct Sealing and Insulation*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, July 2, 2002. Presented at the July 18, 2002 workshop.

LIGHTING ZONE, in outdoor lighting, is a geographic area designated by the California Energy Commission that determines certain requirements for outdoor lighting, including lighting power densities and specific control, equipment or performance requirements. Lighting zones are numbered LZ1, LZ2, LZ3 and LZ4.[18]

LOW BAY is a space with luminaires less than 25 feet above the floor.

LOW-RISE ENCLOSED SPACE is an enclosed space located in a building with 3 or fewer stories.

LOW-RISE RESIDENTIAL BUILDING is a building, other than a hotel/motel that is of Occupancy Group R, Division 1, and is three stories or less, or that is of Occupancy Group R, Division 3.

LOW-SLOPED ROOF is a roof that has a ratio of rise to run of 2:12 or less.[19]

LPG is liquefied petroleum gas.

LUMINAIRE is a complete lighting unit consisting of a lamp and the parts designed to distribute the light, to position and protect the lamp, and to connect the lamp to the power supply; commonly referred to as "lighting fixtures" or "instruments."

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 through 119 of Title 24, Part 6.

MANUFACTURED FENESTRATION PRODUCT is a fenestration product typically assembled before delivery to a job site. A “knocked-down” or partially assembled product sold as a fenestration product must be considered a manufactured fenestration product and meet the rating and labeling requirements for manufactured fenestration products.

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.

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 and that are in the Alternative Calculation Methods Manuals.

MOVABLE SHADING DEVICE (See “operable shading device.”)

MULTI-LEVEL LIGHTING CONTROL is a lighting control that reduces lighting power in multiple steps while maintaining a reasonably uniform level of illuminance throughout the area controlled.[20]

MULTISCENE DIMMING SYSTEM is a lighting control device that has the capability of setting light levels throughout a continuous range, and that has pre-established settings within the range.

NEWLY CONDITIONED SPACE is any space being converted from unconditioned to directly conditioned or indirectly conditioned space, or any space being converted from semiconditioned to directly conditioned or indirectly

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[18] This change based on Eley Associates, “Lighting Zones,” *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 7-10. Presented at the June 18, 2002 workshop.

[19] The justification for this change appears in Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

[20] This change is based on Pacific Gas and Electric Company, *Updates to Title 24 Treatment of Skylights*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 14, 2002. Presented at the May 30, 2002 workshop.

conditioned space. Newly conditioned space must comply with the requirements for an addition. See Section 149 for nonresidential occupancies and Section 152 for residential occupancies.

NONRESIDENTIAL BUILDING is any building which is a Group A, B, E, F, H, M, or S Occupancy

NOTE: Requirements for high-rise residential buildings and hotels/motels are included in the nonresidential sections of Title 24, Part 6.

NONRESIDENTIAL 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.

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).

OCCUPANCY SENSOR, LIGHTING, is a device that automatically turns lights off soon after an area is vacated.

OCCUPANCY TYPE is one of the following:

Auditorium is the part of a public building where an audience sits in fixed seating, or a room, area, or building with fixed seats used for public meetings or gatherings not specifically for the viewing of dramatic performances.

Auto repair is the portion of a building used to repair automotive equipment and/or vehicles, exchange parts, and may include work using an open flame or welding equipment.

Bank/financial institution is an area in a public establishment used for conducting financial transactions including the custody, loan, exchange, or issue of money, for the extension of credit, and for facilitating the transmission of funds.

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

Commercial and industrial storage is a room, area, or building used for storing items.

Convention, conference, multipurpose and meeting centers is an assembly room, area, or building that is used for meetings, conventions and multiple purposes, including, but not limited to, dramatic performances, and that has neither fixed seating nor fixed staging.

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

Dining is a room or rooms in a restaurant or hotel/motel (other than guest rooms) where meals that are served to the customers will be consumed.

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

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

Exhibit is a room or area that is used for exhibitions that has neither fixed seating nor fixed staging.

General commercial and industrial work is a room, area, or building in which an art, craft, assembly or manufacturing operation is performed.

High bay: Luminaires 25 feet or more above the floor.

Low bay: Luminaires less than 25 feet above the floor.

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

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

Hotel lobby is the contiguous spaces in a hotel/motel between the main entrance and the front desk, including waiting and seating areas, and other spaces encompassing the activities normal to a hotel lobby function.

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

Laundry is a place where laundering activities occur.

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

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

Lounge/recreation is a room used for leisure activities which may be associated with a restaurant or bar.

Main entry lobby/reception/waiting is the lobby of a building that is directly located by the main entrance of the building and includes the reception area, sitting areas, and public areas.

Malls, arcades and atria are public passageways or concourses that provides access to rows of stores or shops.

Medical and clinical care is a room, area, or building that does not provide overnight patient care and that is used to promote the condition of being sound in body or mind through medical, dental, or psychological examination and treatment, including, but not limited to, laboratories and treatment facilities.

Museum is a space in which works of artistic, historical, or scientific value are cared for and exhibited.

Office is a room, area, or building of UBC Group B Occupancy other than restaurants.

Precision commercial or industrial work is a room, area, or building in which an art, craft, assembly or a manufacturing operation is performed involving visual tasks of small size or fine detail such as electronic assembly, fine woodworking, metal lathe operation, fine hand painting and finishing, egg processing operations, or tasks of similar visual difficulty.

Reception/waiting area is an area where customers or clients are greeted prior to conducting business.

Religious worship is a room, area, or building for worship.

Restaurant is a room, area, or building that is a food establishment as defined in Section 27520 of the Health and Safety Code.

Restroom is a room or suite of rooms providing personal facilities such as toilets and washbasins.

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

School is a building or group of buildings that is predominately classrooms and that is used by an organization that provides instruction to students.

Stairs, active/inactive, is a series of steps providing passage from one level of a building to another.

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.

Theater, motion picture, is an assembly room, a hall, or a building with tiers of rising seats or steps for the showing of motion pictures.

Theater, performance, is an assembly room, a hall, or a building with tiers of rising seats or steps for the viewing of dramatic performances, lectures, musical events and similar live performances.

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

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

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.

OPTIMAL OVERHANG is an overhang that completely shades the glazing at solar noon on August 21 and substantially exposes the glass at solar noon on December 21.

ORNAMENTAL CHANDELIERS are ceiling-mounted, close-to-ceiling, or suspended decorative luminaires that use glass, crystal, ornamental metals, or other decorative material and that typically are used in hotel/motels, restaurants, or churches as a significant element in the interior architecture.

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

OUTDOOR LIGHTING refers to all electrical lighting for parking lots, buildings and grounds, signs, building entrances, outdoor sales areas, outdoor canopies. Outdoor lighting is sometimes referred to as exterior lighting.[21]

OVERALL HEAT GAIN is the value obtained in Section 143 (b) 2 for determining compliance with the component envelope approach.

OVERALL HEAT LOSS is the value obtained in Section 143 (b) 1 for determining compliance with the component envelope approach.

PARKING GARAGE is a building or structure. A parking garage consists of at least a roof over the parking area, often with walls on one or more sides. It may have fences or rails in place of one or more walls. The structure has entrance(s) and exit(s), and includes areas for vehicle maneuvering to reach the parking spaces. If the roof of a parking structure is also used for parking, the section without an overhead roof is considered a parking lot instead of a parking garage.[22]

PHOTOELECTRIC SWITCH is an electric switch that detects changes in illumination then switches its electric load at predetermined illumination levels. Also called a "photocell."[23]

POOR QUALITY LIGHTING TASKS are visual tasks that require Illuminance Category E or greater, because of the choice of a writing or printing method that produces characters that are of small size or lower contrast than good quality alternatives that are regularly used in offices.

PRIVATE OFFICE or **WORK AREA** is an office bounded by ~~30~~72-inch or higher permanent partitions and is no more than 200 square feet.

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 LOAD is a load resulting from a process.

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.

PUBLIC FACILITY RESTROOM is a restroom designed for use by the public.

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

RADIANT BARRIER is any reflective material that has an emittance of 0.05 or less, tested in accordance with ASTM C-1371-98 or ASTM E408-71(1996)e1, and that is certified to the California Department of Consumer Affairs as required by CCR, Title 24, Part 12, Chapter 12-13, Standards for Insulating Material.

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 mechanically 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.

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[21] Senate Bill 5X gives the CEC authority of develop outdoor lighting standards. This bill defines outdoor lighting as lighting that is not not subject to standards adopted pursuant to Section 25402.

[22] Eley Associates, "Measure 1 – Unconditioned Buildings," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 11-16. Presented at the June 18, 2002 workshop. The standards apply to garages that have more than eight vehicles, but this is included in the standards, not in the definition of a parking garage.

[23] This change is based on Pacific Gas and Electric Company, *Updates to Title 24 Treatment of Skylights*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 14, 2002. Presented at the May 30, 2002 workshop.

REDUCED FLICKER OPERATION is the operation of a light, in which the light has a visual flicker less than 30 percent for frequency and modulation.

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

RELATIVE SOLAR HEAT GAIN is the ratio of solar heat gain through a fenestration product (corrected for external shading) to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

RELOCATABLE CLASSROOM (RC) is any classroom in a relocatable building as defined by Title 24, Part 1, Section 4-314.[24]

REPAIR is the reconstruction or renewal of any part of an existing building for the purpose of its maintenance. **Note:** Repairs to low-rise residential buildings are not within the scope of these standards.

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

RESIDENTIAL 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.

ROOF/CEILING TYPE is a roof/ceiling assembly having a specific framing type and U-factor.

~~**ROOM CAVITY RATIO (RCR)** is:~~

~~(a) For rectangular rooms~~ $\frac{5H(L+H)}{LW}$

~~or~~

~~(b) For irregular-shaped rooms~~ $\frac{2.5H \times P}{A}$

~~**WHERE:**~~

~~*L* = Length of room.~~

~~*W* = Width of room.~~

~~*H* = Vertical distance from the work plane to the center line of the lighting fixture.~~

~~*P* = Perimeter of room.~~

~~*A* = Area of room.~~

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

SCONCE is a wall mounted decorative light fixture.

SERIES FAN-POWERED TERMINAL UNIT is a terminal unit that combines a VAV damper in series with a downstream fan which runs at all times that the terminal unit is supplying air to the space.[25]

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[24] The justification for this change appears in: Pacific Gas and Electric Company, *High Performance Relocatable Classrooms*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, June 28, 2002. Presented at the July 18, 2002 workshop.

[25] This definition was requested in the August 8th workshop to support the prescriptive requirement for ECM motors on series style fan-powered terminal units. See Eley Associates, "Electronically-Commutated Motors in Series Terminal Units," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 8-14. Presented at the August 27, 2002 workshop.

SEASONAL ENERGY EFFICIENCY RATIO (SEER) means the total cooling output of a central 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.

SEMICONDITIONED SPACE is an enclosed nonresidential space that is provided with wood heating, cooling by direct or indirect evaporation of water, mechanical heating that has a capacity of 10 Btu/(hr.×ft.²) or less, mechanical cooling that has a capacity of 5 Btu/(hr.×ft.²) or less, or is maintained for a process environment as set forth in the definition of "directly conditioned space."

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. Permanently attached means (a) attached with fasteners that require additional tools to remove (as opposed to clips, hooks, latches, snaps, or ties); or (b) required by the UBC for emergency egress to be removable from the interior without the use of tools.

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 AREA is the illuminated area of a sign. The area of a panel sign includes all the area of the message panel. The area of a multifaceted sign is calculated at 90° to each face or planar surface.[26]

SIGN, CHANNEL is an internally illuminated sign with multiple components, each built in the shape of an individual letter or symbol, with a separate translucent panel over the light source for each element. The completed sign consists of an assemblage of individual letters or symbols, each independently illuminated.

SIGN, EXTERNALLY ILLUMINATED is any sign that is lit by a light source that is external to the sign.

SIGN, INTERNALLY ILLUMINATED is a sign with an internal light source where the message area is luminous.

SIGN, PANEL is an internally illuminated sign, with a continuous translucent message panel.

SIGN, UNFILTERED is an internally illuminated sign where the viewer perceives the light source directly as the message, without any colored filter between the viewer and the light source. Examples include simple neon, cold cathode, and LED signs.

SITE-ASSEMBLED FENESTRATION includes both field-fabricated fenestration and site-built fenestration.

SITE-BUILT FENESTRATION PRODUCTS are fenestration products designed to be field-glazed or field assembled units comprised of specified framing and glazing components. Site-built fenestration is eligible for certification under NFRC 100-SB, and may include both vertical glazing and horizontal glazing.

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

SKYLIGHT is glazing having a slope less than 60 degrees from the horizontal with conditioned space below.

SKYLIGHT AREA ~~is the area of the surface of a skylight, plus the area of the frame, sash, and mullions~~ is the area of the rough opening for the skylight.

SKYLIGHT TYPE is a type of skylight assembly having a specific solar heat gain coefficient and U-factor whether glass mounted on a curb, glass not mounted on a curb or plastic (assumed to be mounted on a curb).

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.

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[26] The Sign definitions are based on Eley Associates, "Measure 8 – Outdoor Signs and Billboards," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 45-48. Presented at the June 18, 2002 workshop.

~~**SOURCE**~~ **TIME DEPENDENT VALUATION (TDV) ENERGY**[27] ~~is the energy that~~ is the time varying energy caused to be used at ~~a~~ by the building to provide space conditioning and water heating and for specified buildings lighting, accounting for ~~site~~the energy used at the building site and ~~and~~ consumed in producing and in delivering energy to a site, including, but not limited to, power generation, transmission and distribution losses~~, and that is used to perform a specific function, such as space conditioning, lighting or water heating~~. ~~Table 1-B contains the conversion factors for converting site to source energy.~~

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).

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 either collectively or individually heating, ventilating, or cooling within or associated with conditioned spaces in a building.

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

SYSTEM is a combination of equipment, controls, accessories, interconnecting means, or terminal elements by which energy is transformed to perform a specific function, such as space conditioning, service water heating, or lighting.

TASK-ORIENTED LIGHTING is lighting that is designed specifically to illuminate a task location, and that is generally confined to the task location.

TEMPORARY LIGHTING is a lighting installation where temporary connections, such as cord and plug, are used for electric power.[28]

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

THERMAL RESISTANCE (R) is the resistance of a material or building component to the passage of heat in (hr. x ft.² x ºF)/Btu.

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

THROW DISTANCE is the distance between the luminaire and the center of the plane lit by the luminaire on a display.

TUNING is a lighting control device that allows authorized personnel only to select a single light level within a continuous range.

UBC is the 1994 edition of the state-adopted *Uniform Building Code*™.

UL® is the Underwriters Laboratory®.

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

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.

U-FACTOR is the overall coefficient of thermal transmittance of a construction assembly, in Btu/(hr. x ft.² x ºF), including air film resistance at both surfaces.

VAPOR BARRIER is a material that has a permeance of one perm or less and that provides resistance to the transmission of water vapor.

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[27] This change is documented in Pacific Gas and Electric Company, *Time Dependent Valuation (TDV) – Economics Methodology, Code Change Proposal*, April 2, 2002. Presented at the April 2, 2002 workshop.

[28] This change is based on Eley Associates, *Outdoor Lighting Research: California Outdoor Light ing Standards*, June 6, 2002. Presented at the June 18, 2002 workshop.

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

VERTICAL GLAZING (See "window")

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

VISIBLE LIGHT TRANSMITTANCE (VLT) is the ratio (expressed as a decimal) of visible light that is transmitted through a glazing material to the light that strikes the material.

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

~~**WELL INDEX** is the ratio of the amount of visible light leaving a skylight well to the amount of visible light entering the skylight well and is calculated as follows:~~

~~(a) For rectangular wells:~~

$$\left(\frac{\text{Well height}\left(\text{well length} + \text{well width}\right)}{2 \times \text{well length} \times \text{well width}}\right);$$

~~**or**~~

~~(b) For irregular-shaped wells:~~

$$\left(\frac{\text{Well height} \times \text{well perimeter}}{4 \times \text{well area}}\right)$$

~~Where the length, width, perimeter, and area are measured at the bottom of the well, and *R* is the weighted average reflectance of the walls of the well.~~

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).

WINDOW is glazing that is not a skylight.

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

WINDOW TYPE is a window assembly having a specific solar heat gain coefficient, relative solar heat gain, and U-factor.

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

WOOD HEATER is an enclosed wood-burning appliance used for space heating and/or domestic water heating, and which meets the definition in Federal Register, Volume 52, Number 32, February 18, 1987.

WOOD STOVE (See "wood heater.")

ZONE, LIGHTING, is a space or group of spaces within a building that has sufficiently similar requirements so that lighting can be automatically controlled in unison throughout the zone by an illumination-controlling device or devices, and does not exceed one floor.

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 144 (b) 3 or 150 (h), as applicable, can be maintained throughout the zone by a single controlling device.

FIGURE 101-A—CALIFORNIA CLIMATE ZONES

Climate Zones for Residential and Nonresidential Occupancies

SECTION 102 – CALCULATION OF ~~SOURCE~~ TIME DEPENDENT VALUATION (TDV) ENERGY ~~CONSUMPTION~~

Time Dependent Valuation (TDV) energy shall be used to compare proposed designs to their energy budget when using the performance approach. TDV energy is calculated by multiplying the site Btu for each energy type times the 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 published in the nonresidential ACM Approval Manual. ~~When calculating source energy consumption, consumption of electricity, natural gas, fuel oil, and LPG shall be converted to Btu at the rates shown in Table 1-B.~~

~~*TABLE 1-B – SOURCE ENERGY CONVERSION RATES*~~

~~ENERGY SOURCE~~	~~BTU PER UNIT CONSUMPTION~~
~~Electricity~~	~~10,239 Btu/kilowatt-hour~~
~~Natural Gas~~	~~100,000 Btu/therm~~
~~Fuel Oil~~	~~138,400 Btu/gallon~~
~~LPG~~	~~91,080 Btu/gallon~~

SECTION 103 — RESERVED.

SECTION 104 — RESERVED.

SECTION 105 — RESERVED.

SECTION 106 — RESERVED.

SECTION 107 — RESERVED.

SECTION 108 — RESERVED.

SECTION 109 — RESERVED.

SUBCHAPTER 2
ALL OCCUPANCIES—MANDATORY REQUIREMENTS FOR THE MANUFACTURE, CONSTRUCTION AND INSTALLATION OF SYSTEMS, EQUIPMENT AND BUILDING COMPONENTS

SECTION 110 – SYSTEMS AND EQUIPMENT—GENERAL

Sections 111 through 119 establish requirements for the manufacture, construction, and installation of certain systems, equipment and building components that are installed in buildings regulated by Title 24, Part 6. Systems, equipment and building components listed below may be installed only if:

(a) The manufacturer has certified that the system, equipment or building component complies with the applicable manufacture provisions of Sections 111 through 119; and

(b) The system, equipment or building component complies with the applicable installation provisions of Sections 111 through 119.

No system, equipment or building component covered by the provisions of Sections 111 through 119 that is not certified or that fails to comply with the applicable installation requirements may be installed in a building regulated by Title 24, Part 6.

The systems, equipment and building components covered are:

Appliances regulated by the Appliance Efficiency Regulations (Section 111).

Other space-conditioning equipment (Section 112).

Other service water-heating systems and equipment (Section 113).

Pool and spa heating systems and equipment (Section 114).

Gas appliances (Section 115).

Doors, windows, and fenestration products (Section 116).

Joints and other openings (Section 117).

Insulation and Cool Roofs (Section 118).

Lighting control devices (Section 119).

SECTION 111 – MANDATORY REQUIREMENTS FOR APPLIANCES REGULATED BY THE APPLIANCE EFFICIENCY REGULATIONS

Any appliance for which there is a California standard established in the Appliance Efficiency Regulations may be installed only if the manufacturer has certified to the commission, as specified in those regulations, that the appliance complies with the applicable standard for that appliance. See Appendix 1-A for availability of directories of certified appliances.

SECTION 112 – 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 that the equipment complies with all the applicable requirements of this section.

(a) **Efficiency**. Equipment shall meet the applicable requirements of TABLE 112-A~~Tables 1-C1~~ through TABLE 112-K~~TABLE 1-1-C7~~, subject to the following:

1. If more than one standard is listed in TABLE 112-A~~Tables 1-C1~~ through TABLE 112-K~~1-C7~~, the equipment shall meet all the standards listed; and

2. If more than one test method is listed in TABLE 112-A~~Tables 1-C1~~ through TABLE 112-K~~1-C7~~, 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.
5. ~~Dates shown in column headings in Tables 1-C1 through 1-C7 indicate new efficiency levels are required for equipment manufactured on and after October 29, 2001.~~ [29]

EXCEPTION to Section 112 (a): Water-cooled centrifugal water-chilling packages that are not designed for operation at ARI Standard 550 test conditions of 44°F leaving chilled water temperature and 85°F entering condenser water temperature shall have a minimum full load COP and IPLV rating as shown in TABLE 112-I~~Tables 1-C8~~, TABLE 112-J ~~1-C9~~, and TABLE 112-K~~1-C10~~. The table values are only applicable over the following full load design ranges:

A.	Leaving Chiller Water Temp.	40 to 48°F
B.	Entering Condenser Water Temp.	75 to 85°F
C.	Condensing Water Temp. Rise	5 to 15°F

(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 to Section 112 (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.

(c) **Gas- and Oil-Fired Furnace Standby Loss Controls**. Gas-fired and oil-fired forced air furnaces with input ratings ≥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 ≥225,000 Btu/h, including electric furnaces, that are not located within the conditioned space shall have jacket losses not exceeding 0.75% of the input rating.

[29] The exception for equipment manufactured on or before 10/29/2001 is not relevant for the 2005 Standard. This was provided to give the manufacturers 3 years to gear up their manufacturing processes from the publication of ASHRAE/IES Standard 90.1-1999.

TABLE 112-A~~C1~~ ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS AND CONDENSING UNITS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**~~Efficiency prior to 10/29/2001a~~**	**Efficiency ~~as of 10/29/2001~~ [a]**	**Test Procedure**
Air Conditioners, Air Cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	~~8.9 EER and 8.3 IPLV~~	10.3 EER[b]	ARI 210/240
	≥ 135,000 Btu/h and < 240,000 Btu/h	~~8.5 EER and 7.5 IPLV~~	9.7 EER[b]	ARI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	~~8.5 EER and 7.5 IPLV~~	9.5 EER[b] and 9.7 IPLV[b]	
	≥ 760,000 Btu/h	~~8.2 EER and 7.5 IPLV~~	9.2 EER[b] and 9.4 IPLV[b]	
Air Conditioners, Water and Evaporatively Cooled	> 65,000 Btu/h and < 135,000 Btu/h	~~10.5 EER and 9.7 IPLV~~	11.5 EER[b]	ARI 210/240
	≥ 135,000 Btu/h and ≤ 240,000 Btu/h	~~9.6 EER and 9.0 IPLV~~	11.0 EER[b]	ARI 340/360
	> 240,000 Btu/h	~~9.6 EER and 9.0 IPLV~~	11.0 EER[b] and 10.3 IPLV[b]	
Condensing Units, Air Cooled	≥ 135,000 Btu/h	~~9.9 EER and 11.0 IPLV~~	10.1 EER and 11.2 IPLV	ARI 365
Condensing Units, Water or Evaporatively Cooled	≥ 135,000 Btu/h	~~12.9 EER and 12.9 IPLV~~	13.1 EER and 13.1 IPLV	

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

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

TABLE 112-B~~C2~~ UNITARY AND APPLIED HEAT PUMPS, ~~ELECTRICALLY OPERATED~~ MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**Subcategory or Rating Condition**	**~~Efficiency prior to 10/29/2001~~**	**Efficiency ~~as of 10/29/2001~~[a]**	**Test Procedure**
Air Cooled (Cooling Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Split System and Single Package	~~8.9 EER~~ ~~8.3 IPLV~~	10.1 EER[b]	ARI 210/240
	≥ 135,000 Btu/h and <240,000 Btu/h	Split System and Single Package	~~8.5 EER~~ ~~7.5 IPLV~~	9.3 EER[b]	ARI 340/360
	≥ 240,000 Btu/h and <760,000 Btu/h	Split System and Single Package	~~8.5 EER~~ ~~7.5 IPLV~~	9.0 EER[b] 9.2 IPLV[b]	
	≥ 760,000 Btu/h	Split System and Single Package	~~8.2 EER~~ ~~7.5 IPLV~~	9.0 EER[b] 9.2 IPLV[b]	
Water-Source (Cooling Mode)	< 17,000 Btu/h	85°F Entering Water	~~10.0 EER~~		ARI 320
		86°F Entering Water		11.2 EER	ARI/ISO-13256-1
	≥ 17,000 Btu/h and <65,000 Btu/h	85°F Entering Water	~~10.0 EER~~		ARI 320
		86°F Entering Water		12.0 EER	ARI/ISO-13256-1
	≥ 65,000 Btu/h and < 135,000 Btu/h	85°F Entering Water	~~10.5 EER~~		ARI 320
		86°F Entering Water		12.0 EER	ARI/ISO-13256-1
Groundwater-Source (Cooling Mode)	< 135,000 Btu/h	70°F Entering Water	~~11.0 EER~~		ARI 325
		59°F Entering Water		16.2 EER	ARI/ISO-13256-1
Ground Source (Cooling Mode)	< 135,000 Btu/h	77°F Entering Water	~~N/A~~	13.4 EER	ARI/ISO-13256-1
Air Cooled (Heating Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling Capacity)	47°F db/43°F wb Outdoor Air	~~3.0 COP~~	3.2 COP	ARI 210/240
	≥ 135,000 Btu/h (Cooling Capacity)	47°F db/43°F wb Outdoor Air	~~2.9 COP~~	3.1 COP	ARI 340/360
Water-Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	70°F Entering Water	~~3.8 COP~~		ARI 320
		68°F Entering Water		4.2 COP	ARI/ISO-13256-1
Groundwater-Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	70°F Entering Water	~~3.5 COP~~		ARI 325
		50°F Entering Water		3.6 COP	ARI/ISO-13256-1
Ground Source (Heating Mode)	< 135,000 Btu/h (Cooling Capacity)	32°F Entering Water	~~N/A~~	3.1 COP	ARI/ISO-13256-1

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

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

TABLE 112-C AIR-COOLED GAS-ENGINE HEAT PUMPS[30]

Equipment Type	**Size Category**	**Subcategory or Rating Condition**	**Efficiency**	**Test Procedure**
Air-Cooled Gas-Engine Heat Pump (Cooling Mode)	All Capacities	95° F db Outdoor Air	0.60 COP	ANSI Z21.40.4
Air-Cooled Gas-Engine Heat Pump (Heating Mode)	All Capacities	47° F db/43 F wb OutdoorAir	0.72 COP	ANSI Z21.40.4

TABLE 112-D~~C3~~ WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**~~Efficiency prior to 10/29/2001~~**	**Efficiency ~~as of 10/29/2001~~**	**Test Procedure**
Air Cooled, With Condenser,	< 150 Tons	~~2.70 COP~~ ~~2.80 IPLV~~	2.80 COP	ARI 550
Electrically Operated	≥ 150 Tons	~~2.50 COP~~ ~~2.50 IPLV~~	2.80 IPLV	or ARI 590
Air Cooled, Without Condenser, Electrically Operated	All Capacities	~~3.10 COP~~ ~~3.20 IPLV~~	3.10 COP 3.10 IPLV	As appropriate
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	~~3.80 COP~~ ~~3.90 IPLV~~	4.20 COP 4.65 IPLV	ARI 590
Water Cooled,	< 150 Tons	~~3.80 COP~~ ~~3.90 IPLV~~	4.45 COP 4.50 IPLV	ARI 550 or
Electrically Operated,	≥ 150 Tons and < 300 Tons	~~4.20 COP~~ ~~4.50 IPLV~~	4.90 COP 4.95 IPLV	ARI 590 As appropriate
Positive Displacement (Rotary Screw and Scroll)	≥ 300 Tons €	~~5.20 COP~~ ~~5.30 IPLV~~	5.50 COP 5.60 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	~~3.80 COP~~ ~~3.90 IPLV~~	5.00 COP 5.00 IPLV	ARI 550
	≥ 150 Tons and < 300 Tons	~~4.20 COP~~ ~~4.50 IPLV~~	5.55 COP 5.55 IPLV	
	≥ 300 Tons €	~~5.20 COP~~ €	6.10 COP 6.10 IPLV	
Air Cooled Absorption Single Effect	All Capacities	~~N/A~~	0.60 COP	
Water Cooled Absorption Single Effect	All Capacities	~~N/A~~	0.70 COP	
Absorption Double Effect,	All Capacities	~~N/A~~	1.00 COP	ARI 560

[30] The justification for this change appears in Southern California Gas Company, *Gas Cooling Compliance Options for Residential and Nonresidential Buildings, Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update*, August 12, 2002. Presented at the August 27, 2002 workshop.

Equipment Type	**Size Category**	**~~Efficiency prior to 10/29/2001~~**	**Efficiency ~~as of 10/29/2001~~**	**Test Procedure**
Indirect-Fired		~~N/A~~	1.05 IPLV	
Absorption Double Effect,	All Capacities	~~N/A~~	1.00 COP	
Direct-Fired		~~N/A~~	1.00 IPLV	
Water Cooled Gas Engine Driven Chiller	All Capacities		1.2 COP 2.0 IPLV	ANSI Z21.40.4

TABLE 112-E~~C4~~ PACKAGED TERMINAL AIR CONDITIONERS AND PACKAGED TERMINAL HEAT PUMPS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category (Input)**	**Subcategory or Rating Condition**	**~~Efficiency prior to 10/29/2001 a~~**	**Efficiency ~~as of 10/29/2001~~[a]**	**Test Procedure**
PTAC (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	~~10.0 - (0.16 x Cap/1000)a EER~~	12.5 - (0.213 x Cap/1000)[a] EER	
PTAC (Cooling Mode) Replacements[b]	All Capacities	95°F db Outdoor Air	~~10.0 - (0.16 x Cap/1000)a EER~~	10.9 - (0.213 x Cap/1000)[a] EER	ARI 310/380
PTHP (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	~~10.0 - (0.16 x Cap/1000)a EER~~	12.3 - (0.213 x Cap/1000)[a] EER	
PTHP (Cooling Mode) Replacements[b]	All Capacities	95°F db Outdoor Air	~~10.0 - (0.16 x Cap/1000)a EER~~	10.8 - (0.213 x Cap/1000)[a] EER	
PTHP (Heating Mode) New Construction	All Capacities		~~2.9 - (0.026 x Cap/1000)a COP~~	3.2 - (0.026 x Cap/1000)[a] COP	
PTHP (Heating Mode) Replacements[b]	All Capacities		~~2.9 - (0.026 x Cap/1000)a COP~~	2.9 - (0.026 x Cap/1000)[a] COP	

[a] 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.

[b] Replacement units must be factory labeled as follows: "MANUFACTURED FOR REPLACEMENT APPLICATIONS ONLY; NOT TO BE INSTALLED IN NEW CONSTRUCTION PROJECTS." Replacement efficiencies apply only to units with existing sleeves less than 16 inches high and less than 42 inches wide.

TABLE 112-F~~C5~~ WARM-AIR FURNACES AND COMBINATION WARM-AIR FURNACES/AIR-CONDITIONING UNITS, WARM-AIR DUCT FURNACES AND UNIT HEATERS – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category (Input)**	**Subcategory or Rating Condition**	**~~Efficiency prior to 10/29/2001a~~**	**Efficiency ~~as of 10/29/2001~~**	**Test Procedure**
Warm-Air Furnace, Gas-Fired	≥ 225,000 Btu/h	Maximum Capacity	~~80% Et~~	80% Ec[b]	ANSI Z21.47
		Minimum Capacity[c]	~~78% Et~~		
Warm-Air Furnace, Oil-Fired	≥ 225,000 Btu/h	Maximum Capacity	~~81% Et~~	81% Et[a]	UL 727
		Minimum Capacity[c]	~~81% Et~~		
Warm-Air Duct Furnaces, Gas-Fired	All Capacities	Maximum Capacity	~~80% Et~~	80% Ec[b]	ANSI Z83.9
		Minimum Capacity[c]	~~75% Et~~		
Warm-Air Unit Heaters, Gas-Fired	All Capacities	Maximum Capacity	~~80% Et~~	80% Ec[b]	ANSI Z83.8
		Minimum Capacity[c]	~~74% Et~~		
Warm-Air Unit Heaters, Oil-Fired	All Capacities	Maximum Capacity	~~81% Et~~	80% Ec[b]	UL 731
		Minimum Capacity[c]	~~81% Et~~		

[a] Et = Thermal efficiency. See test procedure for detailed discussion.

[b] Ec = Combustion efficiency (100% less flue losses). See test procedure for detailed discussion.

[c] Minimum ratings as provided for and allowed by unit's controls.

TABLE 112-G~~C6~~ BOILERS, GAS- AND OIL-FIRED – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**Subcategory or Rating Condition**	**~~Efficiency prior to 10/29/2001d~~**	**Efficiency[d] ~~as of 10/29/2001~~**	**Test Procedure**
Boilers, Gas-Fired	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Maximum Capacity[a]	~~80% Ec b~~	75% Et [c]	H.I. Htg Boiler Standard
		Minimum Capacity[a]	~~80% Ec b~~		
	> 2,500,000 Btu/he	Hot Water	~~80% Ec b~~	80% Ec [b]	
	> 2,500,000 Btu/he	Steam	~~80% Ec b~~	80% Ec [b]	
Boilers, Oil-Fired	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Maximum Capacity[a]	~~83% Ec b~~	78% Et [c]	
		Minimum Capacity[a]	~~83% Ec b~~		H.I. Htg Boiler Standard
	> 2,500,000 Btu/he	Hot Water	~~83% Ec b~~	83% Ec [b]	
	> 2,500,000 Btu/he	Steam	~~83% Ec b~~	83% Ec [b]	
Oil-Fired (Residual)	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Maximum Capacity[a]	~~83% Ec b~~	78% Et [c]	
		Minimum Capacity[a]	~~83% Ec b~~		H.I. Htg Boiler Standard
	> 2,500,000 Btu/h[e]	Hot Water	~~83% Ec b~~	83% Ec [b]	
	> 2,500,000 Btu/h[e]	Steam	~~83% Ec b~~	83% Ec [b]	

[a] Minimum and maximum ratings as provided for and allowed by the unit's controls.

[b] Ec = Combustion efficiency (100% less flue losses). See test procedure for detailed information.

[c] Et = Thermal efficiency. See test procedure for detailed information.

[d] Alternate test procedures used at the manufacturer's option are ASME PTC-4.1 for units over 5,000,000 Btu/h input, or ANSI Z21.13 for units greater than or equal to 300,000 Btu/h and less than or equal to 2,500,000 Btu/h input.

[e] These requirements apply to boilers with rated input of 8,000,000 Btu/h or less that are not packaged boilers, and to all packaged boilers.

TABLE 112-HC7 PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Type	**Total System Heat Rejection Capacity at Rated Conditions**	**Subcategory or Rating Condition**	**Performance Required ~~as of 10/29/2001~~[a,b]**	**Test Procedure**
Propeller or Axial Fan Cooling Towers	All	95°F Entering Water 85°F Leaving Water 78°F wb Outdoor Air	≥ 38.2 gpm/hp	CTI ATC-105 and CTI STD-201
Centrifugal Fan Cooling Towers	All	95°F Entering Water 85°F Leaving Water 78°F wb Outdoor Air	≥ 20.0 gpm/hp	CTI ATC-105 and CTI STD-201
Air Cooled Condensers	All	125°F Condensing Temperature R22 Test Fluid 190°F Entering Gas Temperature 15°F Subcooling 95°F Entering Drybulb	≥ 176,000 Btu/h·hp	ARI 460

[a] For purposes of this table, cooling tower performance is defined as the maximum flow rating of the tower divided by the fan nameplate rated motor power.

[b] For purposes of this table air-cooled condenser performance is defined as the heat rejected from the refrigerant divided by the fan nameplate rated motor power.

TABLE 112-IC8 COPS AND IPLVS FOR NON-STANDARD CENTRIFUGAL CHILLERS < 150 TONS

Centrifugal Chillers < 150 Tons

COPstd = 5.4

			Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT[a] (°F)	Required COP and IPLV (IPLV=COP)					
46	75	29	6.00	6.27	6.48	6.80	7.03	7.20
45	75	30	5.92	6.17	6.37	6.66	6.87	7.02
44	75	31	5.84	6.08	6.26	6.53	6.71	6.86
43	75	32	5.75	5.99	6.16	6.40	6.58	6.71
42	75	33	5.67	5.90	6.06	6.29	6.45	6.57
41	75	34	5.59	5.82	5.98	6.19	6.34	6.44
40	75	35	5.50	5.74	5.89	6.10	6.23	6.33
46	80	34	5.59	5.82	5.98	6.19	6.34	6.44
45	80	35	5.50	5.74	5.89	6.10	6.23	6.33
44	80	36	5.41	5.66	5.81	6.01	6.13	6.22
43	80	37	5.31	5.57	5.73	5.92	6.04	6.13
42	80	38	5.21	5.48	5.64	5.84	5.95	6.04
41	80	39	5.09	5.39	5.56	5.76	5.87	5.95
40	80	40	4.96	5.29	5.47	5.67	5.79	5.86
46	85	39	5.09	5.39	5.56	5.76	5.87	5.95
45	85	40	4.96	5.29	5.47	5.67	5.79	5.86
44	85	41	4.83	5.18	5.40	5.59	5.71	5.78
43	85	42	4.68	5.07	5.28	5.50	5.62	5.70
42	85	43	4.51	4.94	5.17	5.41	5.54	5.62
41	85	44	4.33	4.80	5.05	5.31	5.45	5.53
40	85	45	4.13	4.65	4.92	5.21	5.35	5.44
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature

[b] Condenser DT = Leaving Condenser Water Temperature (°F) – Entering Condenser Water Temperature (°F)

K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)2 - 0.000045595(X)3

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 112-J~~C9~~ COPS AND IPLVS FOR NON-STANDARD CENTRIFUGAL CHILLERS > 150 TONS, ≤ 300 TONS

Centrifugal Chillers > 150 Tons, ≤ 300 Tons

COP_{std} = 5.55

			Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT[a] (°F)	Required COP and IPLV (IPLV=COP)					
46	75	29	6.17	6.44	6.66	6.99	7.23	7.40
45	75	30	6.08	6.34	6.54	6.84	7.06	7.22
44	75	31	6.00	6.24	6.43	6.71	6.9	7.05
43	75	32	5.91	6.15	6.33	6.58	6.76	6.89
42	75	33	5.83	6.07	6.23	6.47	6.63	6.75
41	75	34	5.74	5.98	6.14	6.36	6.51	6.62
40	75	35	5.65	5.90	6.05	6.26	6.40	6.51
46	80	34	5.74	5.98	6.14	6.36	6.51	6.62
45	80	35	5.65	5.90	6.05	6.26	6.40	6.51
44	80	36	5.56	5.81	5.97	6.17	6.30	6.40
43	80	37	5.46	5.73	5.89	6.08	6.21	6.30
42	80	38	5.35	5.64	5.80	6.00	6.12	6.20
41	80	39	5.23	5.54	5.71	5.91	6.03	6.11
40	80	40	5.10	5.44	5.62	5.83	5.95	6.03
46	85	39	5.23	5.54	5.71	5.91	6.03	6.11
45	85	40	5.10	5.44	5.62	5.83	5.95	6.03
44	85	41	4.96	5.33	5.55	5.74	5.86	5.94
43	85	42	4.81	5.21	5.42	5.66	5.78	5.86
42	85	43	4.63	5.08	5.31	5.56	5.69	5.77
41	85	44	4.45	4.93	5.19	5.46	5.60	5.69
40	85	45	4.24	4.77	5.06	5.35	5.50	5.59
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature

[b] Condenser DT = Leaving Condenser Water Temperature (°F) - Entering Condenser Water Temperature (°F)

K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)2 - 0.000045595(X)3

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

TABLE 112-~~KC10~~ COPS AND IPLVS FOR NON-STANDARD CENTRIFUGAL CHILLERS > 300 TONS

Centrifugal Chillers > 300 Tons

COP_{std} = 6.1

			Condenser Flow Rate					
			2 gpm/ton	2.5 gpm/ton	3 gpm/ton	4 gpm/ton	5 gpm/ton	6 gpm/ton
Leaving Chilled Water Temperature (°F)	Entering Condenser Water Temperature (°F)	LIFT[a] (°F)	Required COP and IPLV (IPLV=COP)					
46	75	29	6.80	7.11	7.35	7.71	7.97	8.16
45	75	30	6.71	6.99	7.21	7.55	7.78	7.96
44	75	31	6.61	6.89	7.09	7.40	7.61	7.77
43	75	32	6.52	6.79	6.98	7.26	7.45	7.60
42	75	33	6.43	6.69	6.87	7.13	7.31	7.44
41	75	34	6.33	6.60	6.77	7.02	7.18	7.30
40	75	35	6.23	6.50	6.68	6.91	7.06	7.17
46	80	34	6.33	6.60	6.77	7.02	7.18	7.30
45	80	35	6.23	6.50	6.68	6.91	7.06	7.17
44	80	36	6.13	6.41	6.58	6.81	6.95	7.05
43	80	37	6.02	6.31	6.49	6.71	6.85	6.94
42	80	38	5.90	6.21	6.40	6.61	6.75	6.84
41	80	39	5.77	6.11	6.30	6.52	6.65	6.74
40	80	40	5.63	6.00	6.20	6.43	6.56	6.65
46	85	39	5.77	6.11	6.30	6.52	6.65	6.74
45	85	40	5.63	6.00	6.20	6.43	6.56	6.65
44	85	41	5.47	5.87	6.10	6.33	6.47	6.55
43	85	42	5.30	5.74	5.98	6.24	6.37	6.46
42	85	43	5.11	5.60	5.86	6.13	6.28	6.37
41	85	44	4.90	5.44	5.72	6.02	6.17	6.27
40	85	45	4.68	5.26	5.58	5.90	6.07	6.17
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature – Leaving Chilled Water Temperature

[b] Condenser DT = Leaving Condenser Water Temperature (°F) - Entering Condenser Water Temperature (°F)

$K_{adj} = 6.1507 - 0.30244(X) + 0.0062692(X)^2 - 0.000045595(X)^3$

where X = Condenser DT + LIFT

$COP_{adj} = K_{adj} * COP_{std}$

SECTION 113 – 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 45 of the 1995 ASHRAE Handbook, HVAC Applications Volume.

   EXCEPTION to Section 113 (a) 1: Residential occupancies.

(b) **Efficiency**. Equipment shall meet the applicable requirements of TABLE 113-A~~Table 1-C11~~, subject to the following:

1. If more than one standard is listed in TABLE 113-A~~Table 1-C11~~, the equipment shall meet all the standards listed; and
2. If more than one test method is listed in TABLE 113-A~~Table 1-C11~~, 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.
5. ~~Dates shown in column headings in Table 1-C11 indicate new efficiency levels are required for equipment manufactured on and after October 29, 2001.~~[31]

(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 1995 ASHRAE Handbook, HVAC Applications Volume, shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature.
2. **Pumps for circulating systems**. Circulating service water-heating systems shall have a control capable of automatically turning off the circulating pump when hot water is not required.

   EXCEPTION to Section 113 (c) 2: Residential occupancies.
3. **Temperature controls for public lavatories**. The controls shall limit the outlet temperature to 110°F.
4. **Insulation**. Unfired service water heater storage tanks and backup tanks for solar water-heating systems shall have:
   A. External insulation with an installed R-value of at least R-12; or
   B. Internal and external insulation with a combined R-value of at least R-16; or
   C. The heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.

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[31] The exception for equipment manufactured on or before 10/29/2001 is not relevant for the 2005 Standard. This was provided to give the manufacturers 3 years to gear up their manufacturing processes from the publication of ASHRAE/IES Standard 90.1-1999.

5. **Service water heaters in state buildings**. Any new 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 113 (c) 5: Buildings for which the state architect determines that service water heating from site solar energy or recovered energy is economically or physically infeasible.

TABLE 113-A~~C11~~ MINIMUM EFFICIENCY REQUIREMENTS FOR WATER HEATING EQUIPMENT

Equipment Type	**Size Category**	**Sub-Category or Rating Condition**	**~~Performance Required prior to 10/29/2001a~~**	**Performance Required[a] ~~as of 10/29/2001b~~**	**Test Procedure**
Gas Storage Water Heaters	> 75,000 Btu/h and ≤ 155,000 Btu/h	< 4,000 Btu/h/gal	~~78% Et~~ ~~7.47V + 655 SL, Btu/h~~	80% Et (Q/800 + 110√V) SL, Btu/h	ANSI Z21.10.3
	> 155,000 Btu/h	< 4,000 Btu/h/gal	~~78% Et~~ ~~7.47V + 546 SL, Btu/h~~	80% Et (Q/800 + 110√V)SL, Btu/h	
Gas Instantaneous Water Heaters	> 200,000 Btu/h[b]	≥ 4,000 Btu/h/gal and < 10 gal	~~80% Et~~	80% Et	ANSI Z21.10.3
	> 200,000 Btu/h[b]	≥ 4,000 Btu/h/gal and ≥ 10 gal	~~77% Et~~ ~~13.22V + 385 SL, Btu/h~~	80% Et (Q/800 + 110√V) SL, Btu/h	
Oil Storage Water Heaters	> 105,000 Btu/h and ≤ 155,000 Btu/h	< 4,000 Btu/h/gal	~~78% Et~~ ~~7.47V + 655 SL, Btu/h~~	78% Et (Q/800 + 110√V) SL, Btu/h	ANSI Z21.10.3
	> 155,000 Btu/h	< 4,000 Btu/h/gal	~~78% Et~~ ~~7.47V + 546 SL, Btu/h~~	78% Et (Q/800 + 110√V) SL, Btu/h	
Oil Instantaneous Water Heaters	> 210,000 Btu/h[b]	≥ 4,000 Btu/h/gal and < 10 gal	~~80% Et~~	80% Et	ANSI Z21.10.3
	> 210,000 Btu/h[b]	≥ 4,000 Btu/h/gal and ≥ 10 gal	~~77% Et~~ ~~13.22V + 385 SL, Btu/h~~	78% Et (Q/800 + 110√V) SL, Btu/h	

~~a Thermal efficiency (Et) is a minimum requirement, while standby loss (SL) is a maximum Btu/h based on a 70□F temperature difference between stored water and ambient requirements. In the SL equation, V is the measured volume in gallons~~.

~~b~~[a] Thermal efficiency (Et) is a minimum requirement, while standby loss (SL) is a maximum Btu/h based on a 70□ temperature difference between stored water and ambient requirements. In the SL equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h.

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

SECTION 114 – MANDATORY REQUIREMENTS FOR POOL AND SPA HEATING 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 for gas-fired systems of at least 78 percent, when tested according to ANSI Standard Z21.56-1994; 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 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 114 (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 114 (a) 4: Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.
5. **Pilot light**. No pilot light.

(b) **Installation**. Any pool or spa heating system or equipment shall be installed with all of the following:

1. **Piping**. At least 36 inches of pipe between the filter and the heater to allow for the future addition of solar heating equipment; and
2. **Covers**. A cover for outdoor pools or outdoor spas; and

   EXCEPTION to Section 114 (b) 2: Pools or spas deriving at least 60 percent of the annual heating energy from site solar energy or recovered energy.
3. **Directional inlets and time switches for pools**. If the system or equipment is for a pool:

   The pool shall have directional inlets that adequately mix the pool water; and

   The circulation pump shall have a time switch that allows the pump to be set to run in 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.

   EXCEPTION to Section 114 (b) 3 ~~B~~: Where applicable public health standards require on-peak operation.

SECTION 115 – 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 115 (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.

SECTION 116 – MANDATORY REQUIREMENTS FOR FENESTRATION PRODUCTS AND EXTERIOR DOORS

(a) **Certification of Fenestration Products and Exterior Doors.** 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.² of window area, 0.3 cfm/ft.² of door area for residential doors, 0.3 cfm/ft.² of door area for nonresidential single doors (swinging and sliding), and 1.0 cfm/ft.² for nonresidential double doors (swinging), when tested according to NFRC-400-95 or ASTM E 283-91 at a pressure differential of 75 pascals or 1.57 pounds/ft.², incorporated herein by reference.

2. **U-factor and SHGC.** Fenestration products shall:

   A. Be certified for overall U-factors as rated in accordance with the National Fenestration Rating Council's NFRC 100 (1997) and be certified for overall SHGC, as rated in accordance with the National Fenestration Rating Council's NFRC 200 (1995), incorporated herein by reference, or such values shall be certified in accordance with TABLE 116-A~~Tables 1-D~~ and TABLE 116-B~~1-E~~ and labeled as set forth in Section 10-111; and

   B. Have a temporary label or label certificate (for site-built products) meeting the requirements of Section 10-111 (a) 1, not to be removed before inspection by the enforcement agency, listing the certified U-factor and SHGC, and certifying that the air leakage requirements of Section 116 (a) 1 are met for each product line; and

   C. Have a permanent label or label certificate (for site-built products) meeting the requirements of Section 10-111 (a) 2 if the product is rated using NFRC procedures.

   EXCEPTION 1 to Section 116 (a) 2: Site-assembled vertical glazing in buildings covered by the nonresidential standards with less than 100,000 square feet of conditioned floor area or less than 10,000 square feet of vertical glazing shall have U-factors determined in accordance with NFRC 100-SB procedures or default values set forth in Appendix I of the Nonresidential ACM Manual. Temporary and permanent labels are not required.

   EXCEPTION 2 to Section 116 (a) 2: Site-assembled vertical glazing in buildings covered by the nonresidential standards shall have SHGC values determined in accordance with NFRC 100-SB procedures or shall calculate the SHGC value for each vertical glazing as:

   i. $SHGC = 0.08 + 0.86 \times SHGC_c$

   ii. Where

   iii. SHGC is the solar heat gain coefficient for the fenestration including glass and frame

   iv. $SHGC_c$ is the center of glass solar heat gain coefficient for the glass alone as documented in the glazing manufacturer's literature. Documentation shall be provided as set forth in Appendix I of the Nonresidential ACM Manual.

   EXCEPTION 3 to Section 116 (a) 2: Skylights and site-assembled horizontal glazing shall have SHGC values and U-factors determined in accordance with NFRC procedures or default values set forth in Appendix I of the Nonresidential ACM Manual. Documentation shall be provided as set forth in Appendix I of the Nonresidential ACM Manual.

EXCEPTION to Section 116 (a): Fenestration products removed and reinstalled as part of a building alteration or addition.

(b) **Installation of Field-fabricated Fenestration Products and Exterior Doors.** Field-fabricated fenestration products and exterior doors shall be caulked between the fenestration products or exterior door and the building, and shall be weatherstripped.

EXCEPTION to Section 116 (b): Unframed glass doors and fire doors.

TABLE 116-A~~D~~ —DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME TYPE[1]	PRODUCT TYPE	SINGLE PANE U-FACTOR	DOUBLE PANE U-FACTOR[2]
Metal	Operable	1.28	0.87
Metal	Fixed	1.19	0.72
Metal	Greenhouse/garden window	2.26	1.40
Metal	Doors	1.25	0.85
Metal	Skylight	1.72	0.94
Metal, Thermal Break	Operable		0.71
Metal, Thermal Break	Fixed		0.60
Metal, Thermal Break	Greenhouse/garden window		1.12
Metal, Thermal Break	Doors		0.64
Metal, Thermal Break	Skylight		0.80
Nonmetal	Operable	0.99	0.60
Nonmetal	Fixed	1.04	0.57
Nonmetal	Doors	0.99	0.55
Nonmetal	Greenhouse/garden windows	1.94	1.06
Nonmetal	Skylight	1.47	0.68

[1] Metal includes any field-fabricated product with metal cladding. Nonmetal-framed manufactured fenestration products with metal cladding must add 0.04 to the listed U-factor. Nonmetal frame types can include metal fasteners, hardware, and door thresholds. Thermal break product design characteristics are:

a. The material used as the thermal break must have a thermal conductivity of not more than 3.6 Btu-inch/hr/ft^2/°F,

b. The thermal break must produce a gap of not less than 0.210 inch, and

c. All metal members of the fenestration product exposed to interior and exterior air must incorporate a thermal break meeting the criteria in Items a. and b. above.

In addition, the fenestration product must be clearly labeled by the manufacturer that it qualifies as a thermally broken product in accordance with this standard.

[2]For all dual-glazed fenestration products, adjust the listed U-factors as follows:

a. Subtract 0.05 for spacers of 7/16 inch or wider.

b. Subtract 0.05 for products certified by the manufacturer as low-E glazing.

c. Add 0.05 for products with dividers between panes if spacer is less than 7/16 inch wide.

d. Add 0.05 to any product with true divided lite (dividers through the panes).

TABLE 116-B~~E~~ —DEFAULT SOLAR HEAT GAIN COEFFICIENT

FRAME TYPE	PRODUCT	GLAZING	TOTAL WINDOW SHGC[2]	
			Single Pane	Double Pane
Metal	Operable	Clear	0.80	0.70
Metal	Fixed	Clear	0.83	0.73
Metal	Operable	Tinted	0.67	0.59
Metal	Fixed	Tinted	0.68	0.60
Metal, Thermal Break	Operable	Clear	0.72	0.63
Metal, Thermal Break	Fixed	Clear	0.78	0.69
Metal, Thermal Break	Operable	Tinted	0.60	0.53
Metal, Thermal Break	Fixed	Tinted	0.65	0.57
Nonmetal	Operable	Clear	0.74	0.65
Nonmetal	Fixed	Clear	0.76	0.67
Nonmetal	Operable	Tinted	0.60	0.53
Nonmetal	Fixed	Tinted	0.63	0.55

[2] SHGC = Solar Heat Gain Coefficient.

SECTION 117 – MANDATORY REQUIREMENTS FOR JOINTS AND OTHER OPENINGS

Joints and other openings in the building envelope that are potential sources of air leakage shall be caulked, gasketed, weatherstripped, or otherwise sealed to limit infiltration and exfiltration.

SECTION 118 – MANDATORY REQUIREMENTS FOR INSULATION AND COOL ROOFS

(a) **Certification by Manufacturers**. Any insulation of the type and form listed below may be installed only if the manufacturer has certified that the insulation complies with the California Code of Regulations, Title 24, Part 12, Chapter 12-13, Standards for Insulating Material.

TABLE 118-A INSULATION REQUIRING CERTIFICATION TO STANDARDS FOR INSULATING MATERIALS

TYPE	FORM
Aluminum foil	Reflective foil
Cellular glass	Board form
Cellulose fiber	Loose fill and spray applied
Mineral aggregate	Board form
Mineral fiber	Blankets, board form, loose fill
Perlite	Loose fill
Phenolic	Board form
Polystyrene	Board form, molded extruded
Polyurethane	Board form and field applied
Polyisocyanurate	Board form and field applied
Urea formaldehyde	Foam field applied
Vermiculite	Loose fill

(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 barrier or equivalent plastic sheeting vapor barrier is installed between the urea formaldehyde foam insulation and the interior space in all applications.

(c) **Flamespread Rating**. All insulating material shall be installed in compliance with the flamespread rating and smoke density requirements of Section 707 of the UBC.

(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 this subsection. If a contractor installs the insulation, the contractor shall certify to the customer, in writing, that the insulation meets the applicable requirements of this subsection.

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 be at least R-30, if the building is located in an area that has less than 5,000 heating degree days, or R-38 if the building is located in an area that has 5,000 heating degree days or more.

   EXCEPTION to Section 118 (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 1505.3 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 604 of the CMC[32].

(e) **Placement of roof/ceiling insulation in nonresidential and high-rise residential buildings.** Insulation installed to limit heat loss and gain through the top of conditioned spaces shall be placed:

1. Below the waterproof layer;[33] and

2. In direct contact with a continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 117, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling. 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 Section 1505.3. Insulation placed on top of a suspended ceiling with removable ceiling panels shall be deemed to have no affect on envelope heat loss.

   EXCEPTION to Section 118(e) 2: 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. [34]

(~~e~~f) **Demising Walls in Nonresidential Buildings**. The opaque portions of framed demising walls in nonresidential buildings shall have insulation with an installed R-value of no less than R-11 between framing members

(~~f~~g) **Mandatory Requirements for Cool Roofs.** ~~Effective January 1, 2003, a~~ A roof shall be considered a cool roof if the roofing product is certified and labeled according to requirements of Section 10-113 and if the roofing product meets conditions 1 or 2 and, for liquid applied roofing products with 100% acrylic binders, 3 below. ~~Prior to January 1, 2003, manufacturer's published performance data shall be acceptable to show compliance with 1 or 2 and, for liquid applied roofing products, 3 below.~~

~~1. Concrete tile (as defined in ASTM C55-99) and clay tile (as defined in ASTM C1167-96) roofing products shall have a minimum initial total solar reflectance of 0.40 when tested in accordance with ASTM E903 or E1918, and a minimum thermal emittance of 0.75 when tested in accordance with ASTM E408.~~

~~2. All other roofing products shall have a minimum initial total solar reflectance of 0.70 when tested in accordance with ASTM E903 or E1918, and a minimum thermal emittance of 0.75 when tested in accordance with ASTM E408.~~

1. Any roofing product with an initial thermal emittance not less than 0.75 when tested in accordance with CRRC-1 shall have a minimum initial solar reflectance of 0.70 when tested in accordance with CRRC-1.

   EXCEPTION to Section 118 (g) 1: For low-rise residential buildings, concrete tile (as defined in ASTM C55-99) and clay tile (as defined in ASTM C1167-96) roofing products shall have a minimum initial thermal emittance of 0.75 and a minimum initial solar reflectance of 0.40 when tested in accordance with CRRC-1.

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[32] On and after the effective date designated by the California Building Standards Commission for the 2000 CMC, duct insulation shall comply with Section 605 of the 2000 CMC.

[33] This change is based on: Gary Farber, "Wet Insulation Systems," *Some Outstanding Title 24 Issues for the Next Generation Building Energy Standards (2003/2005),* October 11, 2001. Presented at the October 22, 2001 workshop.

[34] The justification for this change appears in: Eley Associates, "Limitation of the Use of Lay-In Insulation In Nonresidential Buildings," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 27-63. Presented at the August 27, 2002 workshop.

2. Any roofing product with a minimum initial thermal emittance $\varepsilon_{initial}$ less than 0.75 when tested in accordance with CRRC-1, including but not limited to roof products with metallic surfaces, shall have a minimum initial solar reflectance of $0.70 + 0.34 * (0.75 - \varepsilon_{initial})$ when tested in accordance with CRRC-1.[35]

3. Liquid applied roofing products with 100% acrylic binders (elastomeric)[36] shall be applied at a minimum dry mil thickness of 20 mils across the entire roof surface, and meet the minimum performance requirements of ASTM D6083-97 when tested in accordance with ASTM D6083-97 for the following key properties:

   A. Initial Tensile Strength; and

   B. Initial Elongation; and

   C. Elongation After 1000 Hours Accelerated Weathering; and

   D. Permeance; and

   E. Accelerated Weathering.

(h) **Insulation Requirements for Heated Slabs.** Heated slabs shall be insulated according to the requirements in TABLE 118-B.

TABLE 118-B SLAB INSULATION REQUIREMENTS FOR HEATED SLABS

Insulation Location	**Insulation Orientation**	**Installation Requirements**	**Climate Zone**	**Insulation R-Factor**
Outside edge of heated slab, either inside or outside the foundation wall	Vertical	From the level of the top of the slab, down 16" 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

1. Insulation materials in ground contact must:

   A. Comply with the certification requirements of Section 118 (a); and

   B. Have a water absorption rate no greater than 0.3% when tested in accordance with ASTM C272.

2. Insulation installation must:

   A. Cover the insulation 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.[37]

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[35] The justification for this change appears in: Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

[36] This change is based on a review of ASTM D6083-97, which applies to roofing products with 100% acrylic binders. Minimum performance requirements for other liquid applied roofing products are being researched for the next draft of the Standard.

[37] This is a clarification of the current standard for residential buildings and a change for non-residential buildings based on: Gary Farber, "Nonresidential Radiant Slab Floors," *Some Outstanding Title 24 Issues for the Next Generation Building Energy Standards (2003/2005),* October 11, 2001. Presented at the October 22, 2001 workshop.

SECTION 119 – MANDATORY REQUIREMENTS FOR LIGHTING CONTROL DEVICES

Any automatic time switch control device, occupant-sensing device, automatic daylighting control device, or ~~interior photocell~~photoelectric switch sensor device may be installed only if the manufacturer has certified to the commission, that the device complies with all of the applicable requirements of Subsections (a) through (g), and if the device is installed in compliance with Subsection (h).

(a) **All Devices: Instructions for Installation and Calibration**. The manufacturer shall provide step-by-step instructions for installation and start-up calibration of the device.

(b) **All Devices: Status Signal**. The device shall have an indicator that visibly or audibly informs the device operator that it is operating properly, or that it has failed or malfunctioned.

EXCEPTION to Section 119 (b): ~~Photocell sensors~~Photoelectric switch or other devices where a status signal is infeasible because of inadequate power.

(c) **Automatic Time Switch Control Devices**. Automatic time switch control devices shall:

1. Be capable of programming different schedules for weekdays and weekends; and
2. Have program backup capabilities that prevent the loss of the device's program and time setting for at least 10 hours if power is interrupted.

(d) **~~Occupant-sensing Devices~~Motion-sensing Devices**. ~~Occupant~~Motion-sensing devices shall be capable of automatically turning off all the lights in an area no more than 30 minutes after the area has been vacated. In addition, ultrasonic and microwave devices shall have a built-in mechanism that allows calibration of the sensitivity of the device to room movement in order to reduce the false sensing of occupants, and shall comply with either Item 1 or 2 below, as applicable:

1. If the device emits ultrasonic radiation as a signal for sensing occupants within an area, the device shall:
   A. Have had a Radiation Safety Abbreviated Report submitted to the Center for Devices and Radiological Health, Federal Food and Drug Administration, under 21 Code of Federal Regulations, Section 1002.12 (1996), and a copy of the report shall have been submitted to the California Energy Commission; and
   B. Emit no audible sound; and
   C. Not emit ultrasound in excess of the following decibel (dB) values, measured no more than five feet from the source, on axis:

TABLE 119-A ULTRASOUND MAXIMUM DECIBEL VALUES

MIDFREQUENCY OF SOUND PRESSURE THIRD-OCTAVE BAND (in kHz)	MAXIMUM dB LEVEL WITHINTHIRD-OCTAVE BAND (in dB reference 20 micropascals)
Less than 20	80
20 or more to less than 25	105
25 or more to less than 31.5	110
31.5 or more	115

2. If the device emits microwave radiation as a signal for sensing occupants within the area, the device shall:
   A. Comply with all applicable provisions in 47 Code of Federal Regulations, Parts 2 and 15 (1996), and have an approved Federal Communications Commission Identifier that appears on all units of the device and that has been submitted to the commission; and
   B. Not emit radiation in excess of one milliwatt per square centimeter measured at no more than five centimeters from the emission surface of the device; and
   C. Have permanently affixed to it installation instructions recommending that it be installed at least 12 inches from any area normally used by room occupants.

~~3. For Sensors used to qualify for the Power Adjustment Factor in small office spaces greater than 250 sq. ft., the motion sensor must have either an automatic or a manually controlled ON function, and have wiring capabilities so that each switch function activates half of the lights. The control must be capable of the following operating sequence:~~

~~a) the first stage activates no more than 50% of the lights in a room either through an automatic action or the pressing of a switch by occupant. After that event occurs the following actions shall be assigned to occur when manually called to do so by the occupant;~~

~~b) activating the alternate set of lights;~~

~~d)activating 100% of the lights;~~

~~d) deactivating all lights.~~

(e) **Automatic Multi-Level Daylighting Control Devices**[38]. Automatic multi-level daylighting control devices shall:

1. Be capable of reducing the light output of the general lighting of the controlled area by at least one half in response to the availability of daylight while maintaining a uniform level of illuminance throughout the area; and
2. If the device is a dimmer, provide electrical outputs to lamps for reduced flicker operation through the dimming range and without causing premature lamp failure; and
3. If the device is a stepped dimming or a stepped switching system, incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes; and
4. If the device uses step switching or step dimming ~~with separate on and off settings for the steps~~, the device shall have sufficient separation (deadband) of on and off points -for each control step to prevent cycling; and

~~5.Have provided by the manufacturer step-by-step instructions for installation and start-up calibration to design footcandle levels.~~

5. If the device has a time delay, the time delay shall be capable of being over ridden or set to less than 5 seconds time delay for the purpose of commissioning. After no more than 60 minutes, the device shall automatically restore its time delay settings to normal operation programmed time delays; and
6. The setpoint control shall be configured so that settings can be easily distinguished to within 10% of full scale adjustment.
7. The light sensor shall have a linear response with 5% accuracy over the range of illuminances measured by the light sensor; and
8. Step switching control devices shall annunciate the status of lights in the controlled zone by an indicator on the control device; and
9. Dimming control device shall display the light level measured by the photosensor, if the controlled electric lighting cannot be viewed from where setpoint adjustments are made.

Exemption to Section 119(e) items 8 and 9: If the control device is part of a networked system with a central display of each control zone status, the status readout (on/off or photosensor light level) on each individual control device is not required if control setpoint adjustments can be made on the same screen as the status readout.

(f) **Interior ~~Photocell Sensor Devices~~Photoelectric Switches**. Interior photoelectric switches~~photocell sensors~~ shall not have a mechanical slide cover or other device that permits easy unauthorized disabling of the control, and shall not be incorporated into a wall-mounted occupant-sensing device.

~~Exterior Photocell Sensor Devices shall meet all of the requirements for Interior Photocell Sensor Devices and be rated for exterior weather applications.~~

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[38] The changes to Section 119 (e) are based on Pacific Gas and Electric Company, *Updates to Title 24 Treatment of Skylights*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 14, 2002. Presented at the May 30, 2002 workshop.

(g) **Installation in Accordance with Manufacturer's Instructions**. If an automatic time switch control device, occupant-sensing device, automatic daylighting control device, or interior ~~photocell~~photoelectric switch ~~sensor~~ device is installed, it shall comply with both Items 1 and 2 below.

1. The device shall be installed in accordance with the manufacturer's instructions; and
2. Automatic daylighting control devices shall:
   A. Be installed so that automatic daylighting control devices control only luminaires within the daylit area; and
   B. Have ~~photocell~~photoelectric switch sensors that are either ceiling mounted or located so that they are accessible only to authorized personnel, and that are located so that they maintain adequate illumination in the area according to the designer's or manufacturer's instructions.

(h) **Multi-level Astronomical Time-switch Controls.** Multi-level astronomical time-switch controls shall:

1. Contain at least 2 separately programmable channels (relays) per zone that reduces illuminance in a relatively uniform manner as described in Section 131(b); and
2. Have a separate offset control for each channel of 1 to 240 minutes; and
3. Be accurate within +/- 15 minutes (sunrise/sunset prediction); and
4. Store longitude and latitude in non-volatile memory; and
5. Display date/time, sunrise and sunset, and switching times for each channel; and
6. Have back-up and scheduling capabilities in accordance with Section 119(c).

SUBCHAPTER 3
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS FOR SPACE-CONDITIONING AND SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT

SECTION 120 – SPACE-CONDITIONING AND SERVICE WATER-HEATING SYSTEMS AND EQUIPMENT — GENERAL

Sections 121 through 129 establish requirements for the design and installation of space-conditioning and service water-heating systems and equipment in nonresidential, high-rise residential, and hotel/motel buildings subject to Title 24, Part 6. All such buildings shall comply with the applicable provisions of Sections 121 through 129.

SECTION 121 – REQUIREMENTS FOR VENTILATION

(a) **General Requirements.**

1. All enclosed spaces in a building that are normally used by humans shall be ventilated in accordance with the requirements of this section.

   NOTE: In addition to meeting the requirements of this section, for those occupancies where unusual contaminants are present or anticipated (such as commercial dry cleaners, coin-operated dry cleaners, bars and cocktail lounges, auto repair workshops, smoking lounges, barber shops, beauty shops), it is recommended to use local exhaust ventilation and enclosure to capture the contaminants and discharge them directly outdoors.

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**. Natural ventilation may be provided for spaces that:

   A. Are within 20 feet of an operable wall or roof opening through which outdoor air flows, which has an openable area more than five percent of the conditioned floor area of the space, and which is readily accessible to occupants of the space at all times when the space is occupied; and

   B. Have a direct outdoor air flow from the operable wall or roof opening, unobstructed by walls or doors.

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 121-A~~Table 1-F~~; or

   B. 15 cfm per person times the expected number of occupants. For spaces without fixed seating, the expected number of occupants shall be assumed to be no less than one half the maximum occupant load assumed for exiting purposes in Chapter 10 of the UBC. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with Chapter 10 of the UBC.

   EXCEPTION to Section 121 (b) 2: Transfer air. The rate of outdoor air required by Section 121 (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. Enough outdoor air is supplied to all spaces combined to meet the requirements of Section 121 (b) 2 for each space individually.

TABLE 121-A~~F~~ – 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	1.50
Beauty shops	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Per UBC Section 1203
Hotel guest rooms (less than 500 sq. ft.)	30 cfm/guest room
Hotel guest rooms (500 sq. ft. or greater)	0.15
Retail stores	0.20
Smoking lounges	1.50
All others	0.15

(c) Operation and Control Requirements for Minimum Quantities of Outdoor Air.

1. **Times of occupancy**. The minimum rate of outdoor air required by Section 121 (b) 2 shall be supplied to each space at all times when the space is usually occupied.

   EXCEPTION 1 to Section 121 (c) 1: Demand control ventilation. The rate of outdoor air provided to an intermittently occupied space may be reduced to 0.15 cfm per square foot of conditioned floor area if the ventilation system serving the space is controlled by a demand control ventilation device complying with 121 (c) 4.

   EXCEPTION 2 to Section 121 (c) 1: Temporary reduction. The rate of outdoor air provided to a space may be reduced below the level required by Section 121 (b) 2 for up to five minutes each hour if the average rate each hour is the required rate.

2. **Pre-occupancy.** The lesser of the minimum rate of outdoor air required by Section 121 (b) 2 or three complete air changes shall be supplied to the entire building during the one-hour period immediately before the building is normally occupied.

3. **Required Demand Control Ventilation**[39]. HVAC single zone systems with the following characteristics shall have demand ventilation controls complying with 121 (c) 4:

   A. They have an outdoor air economizer; and

   B. They serve a space with a design occupant density greater than or equal to 25 people per 1000 ft^2 (40 square foot per person), or a space whose occupancy type per Chapter 10 of the UBC is "Assembly Areas," "Concentrated Use (without fixed seats)," "Auction Rooms," "Assembly Areas, Less-Concentrated Use," or "Classrooms."~~That primarily serve areas with fixed seating and occupant densities less than or equal to 10 square foot per person, or identified in Chapter 10 of the UBC as either "Assembly Areas, Concentrated Use (without fixed seats)" or "Auction Rooms."; and~~

   ~~B. That have design outdoor air capacities equal to or exceeding 3,000 cfm.~~

4. **Demand Control Ventilation Devices shall:**

[39] The justification for this change appears in Eley Associates, "Demand Controlled Ventilation (DVC)," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part I*, April 11, 2002, p. 12-23. Presented at the April 23, 2002 workshop.

A. Be a CO_2 sensor that has an accuracy of no less than 75 ppm, that is factory calibrated or calibrated at start-up, and that requires calibration no more frequently than once every 5 years. The sensor shall be located in the room between 1 ft and 6 ft above the floor;

B. Reduce outdoor air ventilation rates below the design outdoor air ventilation rate when the number of occupants in the space is below the design occupancy. The controls shall be set to provide no less than 15 cfm per person of outdoor air as calculated by EQUATION 121-A;

C. Maintain outdoor air ventilation rates no less than the rate listed in TABLE 121-A times the conditioned floor area, regardless of occupancy, when the system is operating during hours of expected occupancy; and

D. Supply the design outdoor air ventilation rate when the sensor fails or provides a reading out of normal range.

EQUATION 121-A

$$R_p = \frac{8{,}400 \times m}{C_R - C_{OA}}$$

WHERE

R_p	=	The rate of outdoor air per person (cfm/person)
m	=	The metabolic rate (1 met = 58.2 W/m^2). The default metabolic rate is 1.2 mets.
C_{OA}	=	The outdoor air CO_2 concentration (ppm). The default outdoor air CO_2 concentration is 400 ppm.
C_R	=	The room CO_2 concentration (ppm) measured by the sensor.

~~A. Allow the rate of outdoor air to be reduced to 0.15 cfm per square foot of conditioned floor area if the demand control ventilation device indicates that the space conditions are acceptable; and~~

~~B. Be approved by the commission; and~~

~~C. If the device is a carbon dioxide sensor, limit the carbon dioxide level to no more than 800 ppm while the space is occupied; and~~

~~**NOTE:** control to 800 ppm is not required when the ventilation rate is equal to or greater than that required by Section 121 (b) 2.~~

~~D. Include a sensor for the device located (1) in the space; or (2) in a return-air stream from the space with no less than one sensor for every 25,000 square feet of habitable space, or no more space than is recommended by the manufacturer, whichever is less.~~

(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 121 (b) 2, the outdoor air shall be ducted to discharge either:

1. Within five 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**. 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 121 (b) 2; or (2) the rate required for make-up of exhaust systems that are required for a process, for control of odors, or for the removal of contaminants within the space.

(f) **Outside Air Acceptance.** Before an occupancy permit is granted for a new building or space, or a new space-conditioning or ventilating system serving a building or space is operated for normal use, all ventilation systems serving

the building or space shall be certified as meeting the ACM NJ-2005 Acceptance Requirements. A Certificate of Acceptance shall be submitted to the building department that: [40]

1. Certifies plans, specifications, installation certificates, and operating and maintenance information meet the requirements of Part 6.
2. Certifies plans and specifications meet the requirements of Section 121 (a) 2, and
3. Certifies measured outside air is within ten (10) percent of the minimum ventilation rate specified in the plans and specifications.

~~**Completion and Balancing**. Before an occupancy permit is granted for a new building or space, or a new space-conditioning or ventilating system serving a building or space is operated for normal use, all ventilation systems serving the building or space shall be documented in accordance with Title 8, Section 5142 (b) of the California Safety Code (1987) to be providing the minimum ventilation rate specified in Section 121 (b) 2, as determined using one of the following procedures:~~

~~1. **Balancing.** The system shall be balanced in accordance with the National Environmental Balancing Bureau (NEBB) Procedural Standards (1983) or Associated Air Balance Council (AABC) National Standards (1989); or~~

~~2. **Outside air certification.** The system shall provide the minimum outside air as shown on the mechanical drawings, and shall be measured by the installing licensed C-20 mechanical contractor and certified by (1) the design mechanical engineer, (2) the installing licensed C-20 mechanical contractor, or (3) the person with overall responsibility for the design of the ventilation system; or~~

~~3. **Outside air measurement.** The system shall be equipped with a calibrated local or remote device capable of measuring the quantity of outside air on a continuous basis and displaying that quantity on a readily accessible display device; or~~

~~4. Another method approved by the commission.~~

SECTION 122 – REQUIRED CONTROLS FOR SPACE-CONDITIONING SYSTEMS

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

(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 Subsection (b).

EXCEPTION 1 to Section 122 (a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if all zones are also served by an interior cooling system.

EXCEPTION 2 to Section 122 (a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if the perimeter system is designed solely to offset envelope heat losses or gains.

EXCEPTION 3 to Section 122 (a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if the perimeter system has at least one thermostatic control for each building orientation of 50 feet or more.

EXCEPTION 4 to Section 122 (a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if the perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

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[40] The justification for this change appears in New Buildings Institute, Inc., *Acceptance Requirements for Nonresidential Buildings, Nonresidential Quality Assurance Project*, April 8, 2002. Presented at the April 22, 2002 workshop.

(b) **Criteria for Zonal Thermostatic Controls**. The individual thermostatic controls required by Subsection (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, by adjustment or selection of sensors, 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, by adjustment of selection of sensors, up to 85°F or higher.
3. Where used to control both comfort heating and comfort cooling, the thermostatic controls shall meet Items 1 and 2 and shall be capable of providing a temperature range or dead band of at least 5°F within which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.

   EXCEPTION 1 to Section 122 (b) 3: Systems with thermostats that require manual changeover between heating and cooling modes.

   EXCEPTION 2 to Section 122 (b) 1, 2, and 3: Systems serving zones that must have constant temperatures to prevent degradation of materials, a process, or plants or animals.

(c) Hotel/Motel Guest Room and High-rise Residential Dwelling Unit Thermostats. Hotel/motel guest room thermostats shall have:

1. Numeric temperature setpoints in °F; and
2. Setpoint stops accessible only to authorized personnel, to restrict over-heating and over-cooling.

High-rise residential dwelling unit thermostats shall meet the control requirements of Section 150 (i).

(d) **Heat Pump Controls**. All heat pumps with supplementary electric resistance heaters shall be installed with controls that comply with Section 112 (b).

(e) **Shut-off and Reset Controls for Space-conditioning Systems**. Each space-conditioning system shall be installed with controls that comply with Items 1 and 2 below:

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 119 (c), with an accessible manual override that allows operation of the system for up to four hours; or

   B. An occupancy sensor; or

   C. A four-hour timer that can be manually operated.

   EXCEPTION to Section 122 (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 122 (e) 2 A: Thermostat setback controls are not required in areas where the Winter Median of Extremes outdoor air temperature determined in accordance with Section 144 (b) 4 is greater than 32°F.

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

   EXCEPTION to Section 122 (e) 2 B: Thermostat setup controls are not required in areas where the Summer Design Dry Bulb 0.5 percent temperature determined in accordance with Section 144 (b) 4 is less than 100°F.

EXCEPTION 1 to Section 122 (e): 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 Section 122 (e): 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 Section 122 (e): Systems with full load demands of 2 kW or less, if they have a readily accessible manual shut-off switch.

EXCEPTION 4 to Section 122 (e): Systems serving hotel/motel guest rooms, if they have a readily accessible manual shut-off switch.

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

EXCEPTION 1 to Section 122 (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 122 (f): Gravity and other nonelectrical equipment that has readily accessible manual damper controls.

EXCEPTION 3 to Section 122 (f): At combustion air intakes and shaft vents.

EXCEPTION 4 to Section 122 (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 setback or shut-off independently of other isolation areas.
3. Each isolation area shall be controlled by a device meeting the requirements of Section 122 (e) 1.

EXCEPTION to Section 122 (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) Space Conditioning Controls Acceptance. Before an occupancy permit is granted for a new building or space, or a new space-conditioning or ventilating system serving a building or space is operated for normal use, all space-conditioning controls serving the building or space shall be certified as meeting the Acceptance Requirements for Code Compliance. A Certificate of Acceptance shall be submitted to the building department that:[41]

1, Certifies plans, specifications, installation certificates, and operating maintenance information meet the requirements of Part 6.

2. Certifies that the space-conditioning system meets the requirements of Section 121 (c) 1.

3. Certifies that space-conditioning controls meet the requirements of Section 122 (a) through Section 122 (g).

SECTION 123 – REQUIREMENTS FOR PIPE INSULATION

The piping for all space-conditioning and service water-heating systems with fluid temperatures listed in TABLE 123-A~~Table 1-G~~ shall have the amount of insulation specified in Subsection (a) or (b). Insulation conductivity shall be determined in accordance with ASTM C 335-95 at the mean temperature listed in TABLE 123-A~~Table 1-G~~, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F.

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

Insulation exposed to weather shall be suitable for outdoor service 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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[41] The justification for this change appears in New Buildings Institute, Inc., *Acceptance Requirements for Nonresidential Buildings, Nonresidential Quality Assurance Project*, April 8, 2002. Presented at the April 22, 2002 workshop.

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

EXCEPTION 1 to Section 123: Factory-installed piping within space-conditioning equipment certified under Section 111 or 112.

EXCEPTION 2 to Section 123: Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

EXCEPTION 3 to Section 123: Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

EXCEPTION 4 to Section 123: Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

(a) For insulation with a conductivity in the range shown in TABLE 123-A~~Table 1-G~~ for the applicable fluid temperature range, the insulation shall have the applicable thickness shown in TABLE 123-A~~Table 1-G~~.

-TABLE 123-A~~G~~ PIPE INSULATION THICKNESS

FLUID TEMPERATURE RANGE, (°F)	**CONDUCTIVITYRANGE (in Btu-inch per hour per square foot per °F)**	**INSULATION MEAN RATING TEMPERATURE (°F)**	**NOMINAL PIPE DIAMETER (in inches)**					
			Runouts up to 2	**1 and less**	**1.25-2**	**2.50-4**	**5-6**	**8 and larger**
			INSULATION THICKNESS REQUIRED (in inches)					
Space heating systems (steam, steam condensate and hot water)								
Above 350	0.32-0.34	250	1.5	2.5	2.5	3.0	3.5	3.5
251-350	0.29-0.31	200	1.5	2.0	2.5	2.5	3.5	3.5
201-250	0.27-0.30	150	1.0	1.5	1.5	2.0	2.0	3.5
141-200	0.25-0.29	125	0.5	1.5	1.5	1.5	1.5	1.5
105-140	0.24-0.28	100	0.5	1.0	1.0	1.0	1.5	1.5
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 105	0.24-0.28	100	0.5	1.0	1.0	1.5	1.5	1.5
Space cooling systems (chilled water, refrigerant and brine)								
40-60	0.23-0.27	75	0.5	0.5	0.5	1.0	1.0	1.0
Below 40	0.23-0.27	75	1.0	1.0	1.5	1.5	1.5	1.5

(b) For insulation with a conductivity outside the range shown in TABLE 123-A~~Table 1-G~~ for the applicable fluid temperature range, the insulation shall have a minimum thickness as calculated with EQUATION 123-A:

EQUATION 123-A~~(1-A)~~ 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 123-A~~Table 1-G~~, inches.

K = Conductivity of alternate material at the mean rating temperature indicated in TABLE 123-A~~Table 1-G~~ 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 123-A~~Table 1-G~~ for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

SECTION 124 – REQUIREMENTS FOR AIR DISTRIBUTION SYSTEM DUCTS AND PLENUMS

(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 ~~1998~~ 2001 CMC Sections 601, 602, 603, 604, 605, and Standard 6-~~3~~5[42], incorporated herein by reference. ~~Portions conveying conditioned air shall either be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 604[43]) or be enclosed entirely in conditioned space. 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 ductwork 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.

(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 UL labeled.
   - B. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181.
   - C. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 or 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, or UL 181B.
   - B. Mastic sealants and mesh.
     - i. Sealants shall comply with UL 181, UL 181A, or UL 181B, and be nontoxic and water resistant.

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[42] On and after the effective date designated by the California Building Standards Commission for the 2000 CMC, duct installation, sealing and insulation shall comply with Sections 601, 602, 604, 605 and Standard 6-5 of the 2000 CMC.

[43] On and after the effective date designated by the California Building Standards Commission for the 2000 CMC, duct insulation shall comply with Section 605 of the 2000 CMC.

ii. Sealants for interior applications shall pass ASTM tests C 731 (extrudability after aging) and D 2202 (slump test on vertical surfaces), incorporated herein by reference.

iii. Sealants for exterior applications shall pass ASTM tests C 731, C 732 (artificial weathering test), and D 2202, incorporated herein by reference.

iv. Sealants and meshes shall be rated for exterior use.

C. Pressure-sensitive tape. Pressure-sensitive tapes shall comply with UL 181, UL 181A, or 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 applicable requirements of UL 181, 181A, or 181B 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 barriers, or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C 518-85 or ASTM C 177-85, incorporated herein by reference, and certified pursuant to Section 118.

(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 barriers, or other duct components), based on the tests in Section 124 (c) and the installed thickness determined by Section 124 (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.

SECTION 125 — RESERVED.

SECTION 126 — RESERVED.

SECTION 127 — RESERVED.

SECTION 128 — RESERVED.

SECTION 129 — RESERVED.

SUBCHAPTER 4
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—MANDATORY REQUIREMENTS FOR LIGHTING SYSTEMS AND EQUIPMENT

SECTION 130 – LIGHTING CONTROLS AND EQUIPMENT—GENERAL

(a) Except as provided in Subsection (b), the design and installation of all lighting systems and equipment in nonresidential, high-rise residential, ~~and~~ hotel/motel buildings, and outdoor lighting subject to Title 24, Part 6, shall comply with the applicable provisions of Sections 131 through 139.

(b) **Interior Lighting in High-rise Residential Living Quarters and Hotel/Motel Guest Rooms.** The design and installation of all lighting systems and equipment in high-rise residential living quarters and in hotel/motel guest rooms shall comply with the ~~following:~~ ~~1.~~applicable provisions of section 150(k).[44]

~~Luminaires for general lighting in kitchens shall have lamps with an efficacy of not less than 40 lumens per watt. A luminaire which is the only lighting in a kitchen will be considered general lighting. General lighting shall be controlled by the most accessible switch(es) in the kitchen. Additional luminaires to be used only for specific decorative effects need not meet this requirement.~~

~~2. Each room containing a water closet shall have at least one luminaire with lamps with an efficacy of not less than 40 lumens per watt. If there is more than one luminaire in the room, the high efficacy luminaire shall be switched at an entrance to the room. The efficacy requirement may be met by installing the luminaire meeting this requirement in an adjacent room that has complementary plumbing fixtures.~~

~~3. Luminaires installed to meet the 40 lumens per watt requirements of Subsection 1 or 2 shall not contain medium base incandescent lamp sockets, and shall be on separate switches from any incandescent lighting.~~

~~4. All incandescent lighting fixtures recessed into insulated ceilings shall be approved for zero-clearance insulation cover (IC) by Underwriters Laboratories or other testing/rating laboratories recognized by the International Conference of Building Officials.~~

EXCEPTION to Section 130 (b): Up to 10 percent of the guest rooms in a hotel/motel need not comply.

(c) ~~**Exterior**~~ **Outdoor Building Lighting.** All permanently installed exterior luminaires ~~attached to or powered by the electrical service in buildings that contain conditioned space(s), and~~ employing lamps rated over 100 watts shall either: have a *lamp~~source~~ efficacy*~~, determined by dividing the rated initial lamp lumens by the rated lamp watts,~~ of at least 60 lumens per watt; or be controlled by a motion sensor.

EXCEPTION 1 to Section 130 (c): Lighting required by a health or life safety statute, ordinance, or regulation, including but not limited to, emergency lighting.

~~**EXCEPTION 2 to Section 130 (c):** Lighting that is integral to advertising signage.~~[45]

EXCEPTION 2~~3~~ to Section 130 (c): Lighting used in or around swimming pools, water features, or other locations subject to Article 680 of the 1998 California Electrical Code

EXCEPTION 3~~4~~ to Section 130 (c): Searchlights. ~~and~~

EXCEPTION 4 to Section 130 (c): Theme lighting for use in theme parks.

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[44] This change is recommended by Pacific Gas & Electric Company, *Code Change Proposal for Residential Hardwired Lighting*, May 17, 2002 and presented at the May 30, 2002 Workshop.

[45] This change is based on Eley Associates, "Measure 8 – Outdoor Signs and Billboards," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 45-48. Presented at the June 18, 2002 workshop.

EXCEPTION 5 to Section 130 (c): Temporary outdoor lighting, ~~Outdoor theatrical equipment, provided it is for temporary or periodic use and is not for continuous use.~~

EXCEPTION 6 to Section 130 (c): Outdoor theatrical equipment for live performances, provided that it is not for continuous use.

EXCEPTION 7 to Section 130 (c): Light emitting diode, neon, and cold cathode lighting.

(d) **Luminaire Cutoff Requirements**.[46]

All outdoor luminaires that use lamps rated 175 watts or greater in parking lots, building grounds, building entrances and entrance canopies, and outdoor sales canopies and outdoor sales areas shall be designated Cutoff for light distribution. To comply with this requirement the luminaire shall be rated Cutoff in a photometric test report that includes any tilt or other non-level mounting condition of the installed luminaire. Cutoff is a luminaire light distribution classification where the candela per 1000 lamp lumens does not numerically exceed 25 at or above a vertical angle of ninety degrees above nadir, and 100 at or above a vertical angle of eighty degrees above nadir.[47]

EXCEPTION 1 to Section 130 (d): Luminaires mounted so that they are shielded by building, canopy or other features to eliminate all direct light from a luminaire at 80 degrees and higher vertical angle above nadir need not have a cutoff luminaire classification. A luminaire that meets the criteria of this exception shall be located so that any luminous part of that luminaire is within four feet of the shielding component.

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

1. The wattage of incandescent or tungsten-halogen luminaires with medium screw base sockets and not containing permanently installed ballasts shall be the maximum labeled wattage of the luminaire.
2. The wattage of luminaires with permanently installed or remotely installed ballasts shall be the operating input wattage of the specified lamp/ballast combination based on values from manufacturer's catalogs or values from independent testing lab reports.
3. The wattage of line-voltage lighting track and plug-in busway which allows the addition or relocation of luminaires without altering the wiring of the system shall be the volt-ampere rating of an integral current limiter controlling the luminaires, or the higher of the specified wattage of the luminaires included in the system, or 45 Watts per linear foot.
4. The wattage of low-voltage lighting track, cable conductor, rail conductor, and other low voltage flexible lighting systems, which allows the addition or relocation of luminaires without altering the wiring of the system, shall be the specified wattage of the transformer supplying the system.
5. The wattage of all other miscellaneous lighting equipment shall be the specified wattage of the lighting equipment.

SECTION 131 – LIGHTING CONTROLS THAT MUST BE INSTALLED

(a) Area Controls.

1. Each area enclosed by ceiling-height partitions shall have an independent switching or control device. This switching or control device shall be:

   A. Readily accessible; and

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[46] This change is recommended by Eley Associates, *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 7-48. Presented at the June 18, 2002 workshop.

[47] Illuminating Engineering Society, ANSI/IESNA RP-8-00, "American National Standard Practice for Roadway Lighting,"1999,page 6.

B. Located so that a person using the device can see the lights or area controlled by that switch, or so that the area being lit is annunciated; and

C. Manually operated, or automatically controlled by an occupant-sensing device that meets the requirements of Section 119 (d).

2. Other devices may be installed in conjunction with the switching or control device provided that they:

A. Permit the switching or control device to override the action of all other devices; and

B. Reset the mode of any automatic system to normal operation without further action.

C. The area is designated a security or emergency egress area on the plans and specifications submitted to the enforcement agency under Section 10-103 (a) (2) of Title 24, Part 1; and

~~B~~D. The area is controlled by switches accessible only to authorized personnel.

EXCEPTION 1 to Section 131 (a): Up to one-half watt per square foot of lighting in any area within a building that must be continuously illuminated for reasons of building security or emergency egress, if:

A. The area is designated a security or emergency egress area on the plans and specifications submitted to the enforcement agency under Section 10-103 (a) 2 A of Title 24, Part 1; and

B. The area is controlled by switches accessible only to authorized personnel.

EXCEPTION 2 to Section 131 (a): Public areas with switches that are accessible only to authorized personnel.

(b) **Controls to Reduce Lighting**. The general lighting of any enclosed space 100 square feet or larger in which the connected lighting load exceeds 0.8~~0.8~~ watts per square foot for the space as a whole, and that has more than one light source (luminaire), shall ~~be controlled so that the load for the lights may be reduced by at least one half while maintaining a reasonably uniform level of illuminance throughout the area~~employ multi-level lighting controls. ~~A reasonably uniform reduction of illuminance shall be achieved by:~~ A multi-level lighting control is a lighting control that reduces lighting power in multiple steps while maintaining a reasonably uniform level of illuminance throughout the area controlled. Multilevel controls shall have at least one control step that is between 70% and 50% of design lighting power and at least one step of minimum light output operating at less than 35% of full rated lighting system power. A reasonably uniform level of illuminance in an area shall be achieved by any of the following:

1. Dimming all lamps or luminaires; or

2. Switching alternate lamps in luminaries, alternate luminaires, alternate rows of luminaires; or

3. Switching the middle lamps of three lamp luminaires independently of the outer lamps.[48]

~~1.1. Controlling all lamps or luminaires with dimmers; or~~

~~2.2. Dual switching of alternate rows of luminaires, alternate luminaires, or alternate lamps; or~~

~~3.3. Switching the middle lamps of three lamp luminaires independently of the outer lamps; or~~

~~4.4. Switching each luminaire or each lamp.~~

EXCEPTION to Section 131 (b): Lights in corridors.

(c) **Daylit Area**s[49]. Luminaires providing general lighting that are in or are partially in the daylit area shall be controlled according to the applicable requirements in items 1 and 2 below. The daylit area under skylights shall be calculated as specified in 143(c)1. The daylit area illuminated by vertical glazing shall be the daylit depth multiplied by the daylit width, where the daylit depth is 15 feet, or the distance on the floor, perpendicular to the glazing, to the nearest 60-

[48] This change is based on Pacific Gas and Electric Company, *Updates to Title 24 Treatment of Skylights*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 14, 2002. Presented at the May 30, 2002 workshop.

[49] Ibid.

inch or higher permanent opaque partition, whichever is less; and the daylit width is the width of the window plus, on each side, either 2 feet, the distance to a permanent opaque partition, or one half the distance to the closest skylight or vertical glazing, whichever is least.

~~**Daylit Areas**. Daylit areas in any enclosed space greater than 250 square feet shall meet the requirements of Items 1 and 2 below~~

~~1. Such areas shall have at least one control that:~~

~~A. Controls only luminaires in the daylit area; and~~

~~B. Controls at least 50 percent of the lamps or luminaires in the daylit area, in a manner described in Section 131 (b) 1 through 4, independently of all other lamps or luminaires in the enclosed space. The other luminaires in the enclosed space may be controlled in any manner allowed by Section 131 (b) 1 through 4.~~

~~2. Such areas shall have controls that control the luminaires in each vertically daylit area separately from the luminaires in each horizontally daylit area.~~

1. Daylit areas greater than 250 square feet in any enclosed space shall have at least one additional multi-level lighting control that:

   A. Controls at least 50% of the luminaires in the daylit areas separately from other lighting in the enclosed space; and

   B. Controls luminaires in vertically daylit areas separately from horizontally daylit areas.

   C. Has at least one control step that shall reduce power of general lighting by 30% to 50% of rated power; and

   D. Shall maintain a reasonably uniform level of illuminance in the daylit area as described in Section 131(b)1 through 3.

2. When the daylit area in any enclosed space is under skylights and has a total area greater than 2,500 square feet, the general lighting in the daylit area under skylights shall be controlled separately by either an automatic multi-level daylighting control as described in subsection A or a multi-level astronomical time switch as described in subsection B.:

   A. An automatic multi-level daylighting control shall meet the following requirements

      i. Meets all the requirements of section 119(e) for automatic daylighting control devices.

      ii. If the control is a switching control, it shall provide at least two control channels (relays) per zone and be installed in a manner such that at least one control step shall reduce power of general lighting in the daylit zone by 30% to 50% of rated power and another control step shall reduce lighting power by 65% to 100%. This control shall be capable of automatically reducing the general lighting in the daylit area in multiple steps in response to available daylight while maintaining a reasonably uniform level of illuminance as described in Section 131(b) 2 through 3.

      iii. If the control is a dimming control, it shall automatically reduce the power consumption of general lighting in response to available daylight in the daylit zone to less than 35% of rated power at minimum light output; and

      iv. The light sensor shall be separate from where setpoint adjustments are made; and

      v. The controls for calibration adjustments to the lighting control device shall be readily accessible to authorized personnel.

   B. A multi-level astronomical time-switch control that complies with the specifications in 119(h) and has an override switches that comply with section 131(d)2.

EXCEPTION 1 to 131 (c): Daylit areas where the effective aperture of glazing is less than 0.1 for vertical glazing and less than 0.006 ~~0.01~~ for horizontal glazing. The effective aperture for windows is the visible light transmittance (VLT) times the window wall ratio; and for skylights is as calculated in Section 143(c)3A.

EXCEPTION 2 to 131 (c): Daylit areas where existing adjacent structures or natural objects obstruct daylight to the extent that effective use of daylighting is not feasible.

(d) **Shut-off Controls**.

1. For every floor, all interior lighting systems shall be equipped with a separate automatic control to shut off the lighting. This automatic control shall meet the requirements of Section 119 and may be a~~n occupancy sensor~~motion sensor, automatic time switch, or other device capable of automatically shutting off the lighting.

   EXCEPTION 1 to Section 131 (d) 1: Where the system is serving an area that must be continuously lit, or lit in a manner requiring manual operation of the lighting.

   EXCEPTION 2 to Section 131 (d) 1: Lighting in corridors, guest rooms, and lodging quarters of high-rise residential buildings and hotel/motels.

   EXCEPTION 3 to Section 131 (d) 1: Up to one-half watt per square foot of lighting in any area within a building that must be continuously illuminated for reasons of building security or emergency egress, if:

2. If an automatic time switch control device is installed to comply with Section 131 (d) 1, it shall incorporate an override switching device that:

   A. Is readily accessible; and

   B. Is located so that a person using the device can see the lights or the area controlled by that switch, or so that the area being lit is annunciated; and

   C. Is manually operated; and

   D. Allows the lighting to remain on for no more than two hours when an override is initiated; and

      EXCEPTION to Section 131 (d) 2 D: In malls and arcades, auditoriums, single tenant retail spaces, industrial facilities, and arenas, where captive-key override is utilized, override time may exceed two hours.

   E. Controls an area not exceeding 5,000 square feet.

      EXCEPTION to Section 131 (d) 2 E: In malls and arcades, auditoriums, single tenant retail spaces, industrial facilities, and arenas, the area controlled may not exceed 20,000 square feet.

3. If an automatic time switch control device is installed to comply with Section 131 (d) 1, it shall incorporate an automatic holiday "shut-off" feature that turns off all loads for at least 24 hours, then resumes the normally scheduled operation.

   EXCEPTION to Section 131 (d) 3: Retail stores and associated malls, restaurants, grocery stores, churches, and theaters.

(e) **Display Lighting**. Display lighting shall be separately switched on circuits that are 20 amps or less.

(f) **Controls for Outdoor Lighting.**

1. All permanently installed outdoor lighting shall be controlled by a photoelectric switch or astronomical time switch that automatically turns off the exterior lighting when daylight is available.[50]

   EXCEPTION to Section 131 (f)-1.: Lighting in parking garages, tunnels, and large covered areas that require illumination during daylight hours.

2. For lighting of building facades, signs, parking lots, garages, outdoor sales areas, and outdoor sales canopies, an automatic time switch shall be installed that (1) turns off the lighting when not needed and (2) reduces the lighting power (in watts) by at least 50% but not exceeding 67%. This control must comply with the requirements of Section 119 (c).[51]

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[50] This section moved from Section 131 (f).

[51] This change is recommended by Eley Associates, *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 7-48. Presented at the June 18, 2002 workshop.

EXCEPTION 1 TO Section 131 (f) 2.: Lighting required by a health or life safety statute, ordinance, or regulation, including but not limited to, emergency lighting.

EXCEPTION 2 TO Section 131 (f) 2.: Lighting for steps or stairs that require illumination during daylight hours.

EXCEPTION 3 TO Section 131 (f) 2.: Lighting that is controlled by a motion sensor and photoelectric switch.

EXCEPTION 4 TO Section 131 (f) 2.: Lighting for facilities that operate continuously and have equal lighting requirements at all hours. Such requirements shall be demonstrated to the satisfaction of the inspecting authority.

EXCEPTION 5 to Section 131 (f)2: Temporary outdoor lighting,.

EXCEPTION 6 to Section 131 (f)2: Outdoor theatrical equipment for live performances, provided that it is not for continuous use.

~~**Exterior Lighting**. All permanently installed exterior lighting attached to or powered by the electrical service in buildings that contain conditioned space(s) shall be controlled by a directional photocell or astronomical time switch that automatically turns off the exterior lighting when daylight is available.~~

~~**EXCEPTION to Section 131 (f):** Lighting in parking garages, tunnels, and large covered areas that require illumination during daylight hours.~~

(g) **Lighting Control Acceptance[52].** Before an occupancy permit is granted for a new building or space, or a new lighting system serving a building or space is operated for normal use, all lighting controls serving the building or space shall be certified as meeting the ACM NJ-2005 Acceptance Requirements for Code Compliance. A Certificate of Acceptance shall be submitted to the building department that:

1. Certifies plans, specifications, installation certificates, and operating and maintenance information meet the requirements of Part 6.
2. Certifies that automatic daylighting controls meet the requirements of Section 119(e) through Section 119 (g).
3. Certifies that lighting controls meet the requirements of Section 131(a) through Section 131 (c) and Sections 131 (e) and (f).
4. Certifies that automatic lighting controls meet the requirements of Section119 (c) and 131 (d).
5. Certifies that occupant-sensing devices meet the requirements of Section119 (d) and 131 (d).

SECTION 132 – ~~REQUIREMENTS FOR LIGHTING CIRCUITING~~RESERVED[53]

~~The following shall be tandem wired and shall not use single lamp ballasts:~~

~~(a) Pairs of one-lamp or three-lamp recessed fluorescent luminaires that are (1) on the same switch control, (2) in the same area, and (3) within 10 feet of each other in accessible ceiling spaces; and~~

~~(b) Continuous mounted pendant and continuous surface mounted luminaires.~~

~~**EXCEPTION 1 to Section 132:** Fluorescent lighting luminaires that use electronic high frequency ballasts.~~

~~**EXCEPTION 2 to Section 132:** Single lamp ballasts may be used for odd lamp quantities or in conjunction with emergency battery-ballast units in even-numbered lamp luminaires.~~

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[52] This change is recommended by the New Buildings Institute, Inc., *Acceptance Requirements for Nonresidential Buildings, Nonresidential Quality Assurance Project*, April 8, 2002. Presented at the April 22, 2002 workshop.

[53] Due to California and Federal energy and fluorescent lamp ballast regulations, electronic fluorescent ballasts are very predominant. This requirement is therefore no longer necessary.

~~**EXCEPTION to Sections 131 and 132:** Exit signs and illumination subject to Section 1012 or 1013 of the California Building Code, and lighting whose switching is regulated by Article 700 of the California Electrical Code (Title 24, Part 3).~~

SECTION 133 —REQUIREMENTS FOR OUTDOOR LIGHTING[54]

(a) This section applies to externally illuminated and internally illuminated panel signs, parking lots, building grounds, landscape lighting, building entrances and entrance canopies, outdoor sales canopies and sales areas, and building facades.

EXCEPTIONS TO Section 133 (a)

1. Temporary lighting strings.
2. Lighting required and regulated by the Federal Aviation Administration, and t he Coast Guard.
3. Public Streets, roadways, and highways.
4. Lighting for sports and athletic fields.
5. Lighting for industrial sites, including but not limited to, rail yards, shipyards and docks, chemical and petroleum processing plants, and aviation facilities.

~~Carports for less than 8 vehicles~~

(b) **Outdoor Lighting Power.** An outdoor lighting installation for each application for a building permit complies with this section if the actual outdoor lighting power calculated under Subsection (c) is no greater than the allowed outdoor lighting power calculated under Subsection (d). The allowed outdoor lighting shall be calculated by Lighting Zone as defined in TABLE 133-A. Local governments may amend lighting zones in compliance with Section 10-114.

TABLE 133-A LIGHTING ZONE CHARACTERISTICS AND RULES FOR AMENDMENTS BY LOCAL JURISDICTIONS[55]

Zone	Ambient Illumination	State Default Location	Moving Up to the Next Zone	Moving Down to the Previous Zone
LZ1	Dark	State and national parks, recreation areas, and wildlife preserves.	A state or national park or recreation area, or portions thereof, can be designated as LZ2 or LZ3 if they are contained within or adjacent to such a zone.	Not applicable.
LZ2	Low	Rural areas, as defined by the Year 2000 U.S. Census.	Special districts within a default LZ2 zone may be designated as LZ3 by a local jurisdiction. Examples include special commercial or industrial districts located within a rural area. Special LZ3 areas must be at least one half mile away from any LZ1 area, and may not exceed a dimension of more than 8 miles in direction.	Special districts within a default LZ2 zone maybe designated as LZ1 by the local jurisdiction for lower illumination standards. No size or adjacency limits.

[54] This change is based on SB 5x, Docket Number 02-OLS-1, established authority in PRC Section 25402.5 (3) (c) for the California Energy Commission to adopt lighting standards for outdoor lighting.

[55] This change based on Eley Associates, "Lighting Zones," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 7-10. Presented at the June 18, 2002 workshop, modified per Energy Commission staff analysis.

LZ3	Medium	Urban areas, as defined by the Year 2000 U.S. Census.	Special districts may be designated by local jurisdiction for high intensity nighttime use, such as adult entertainment districts. Individual LZ4 areas must be at least 1 miles from any LZ2 area and 2 miles from any LZ1 area. LZ4 areas shall not exceed a dimension of more than 8 miles in any direction. No city shall designate more than 20% of its total dry land area as LZ4.	Special districts within a default LZ3 zone may be designated as LZ2 by the local jurisdiction. No size or adjacency limits.
LZ4	High	None.	Not applicable.	Not applicable.

(c) **Calculation of Actual Lighting Power**. The actual lighting power of the proposed outdoor lighting is the total watts of all planned permanent lighting systems (with ballasts) for signs, parking lots, building grounds, façades, entrances, sales areas and point of sale canopies.

(d) **Calculation of Allowed Lighting Power**. Power is allowed only for the illuminated area of the site. The allowed lighting power shall be calculated as follows:

1. For each application listed in TABLE 133-B, determine the illuminated area. Multiply the illuminated area by the allowed lighting power density. The product is the total allowed lighting power for that application.

2. For each application listed in TABLE 133-C, determine the illuminated area. Multiply the illuminated area by the allowed lighting power density. The total allowed lighting power for that application is the smaller of this product or the actual lighting power used for the application.

3. Add the totals for all areas calculated in (1.) and (2.) above. Each illuminated area may only be counted once and for only one application, even if the intended lighting affects more than one illuminated area. Areas that are not illuminated shall not be counted. The total is the allowed outdoor lighting power.

4. For each application of outdoor lighting, trading off lighting power allowances between any indoor areas is not permitted.

5. Determine illuminated area as follows:

   A. For this section the following items mean:

      i. Area of Influence (of a luminaire): As measured in plan view (horizontal plane), the surface area of ground, hardscape or landscape within a pattern established by producing a square around a luminaire or pole that is six times the luminaire mounting height, with the luminaire in the middle of the pattern, less any area that is within a building, sign or structure or shadowed by such structure.

      ii. Vertical Area of Influence (of a luminaire): The surface area of a building, sign or structure that can be illuminated by indicated façade or sign lighting equipment without obstruction. Areas illuminated only by luminaires also used for lighting Hardscape Plazas, Parking Lots, Sales Lots, Building Entrances, Canopies or Building Grounds are NOT considered vertical areas of influence.

      iii. Building Grounds is the outdoor area surrounding a building, including driveways and walkways (covered or open), ramps, stairs, plazas and other pedestrian areas.

      iv. Canopy is a structure consisting of a waterproof 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.[56]

[56] Eley Associates, "Measure 4 – Building Entrance and Entrance Canopies," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 27-29 and Eley Associates, "Measure 6 – Outdoor Sales Canopies," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 35-39. Presented at the June 18, 2002 workshop.

v. Hardscape is an outdoor, paved, or unpaved nonresidential area, designed for or functioning as walkways, stairs, ramps, drop-off zones, service yards, ramps or plazas.[57]

vi. Landscape Lighting includes the following: lights recessed into the ground or paving; lights mounted onto the ground and intended to be aimed at landscape features; bollard or stem mounted lights less than 42" tall; or lights mounted onto trees or trellises.

vii. Parking Lot is an outdoor nonresidential area, paved or unpaved, designed for or functioning as parking for motor vehicles, including access drives, lot entrances, .[58]

viii. Entrance Canopy is a canopy attached to a building, and leading to a building entrance.[59]

ix. Entry is any operable doorway in or out of a building, including overhead doors.[60]

x. Entry Area is the larger of:

1. 8 ft in front of the operable door(s) width, plus 3 ft on either side of the operable door(s) or

2. The area under the entrance canopy.[61]

xi. Frontage is the portion of the perimeter of an outdoor sales area facing a street, road, or public sidewalk. For individual displays, such as an auto ramp, the frontage shall be two times the actual width of the display as measured in the vertical plane parallel to the street, road, or sidewalk.[62]

B. The Illuminated Area of Hardscape, Parking Lots or Sales Lots is the total area of the yard, plaza or lot in square feet, including internal walkways or planting islands, plus a perimeter area of 10 feet around it, less any area within 5 feet of a building, that is within the area of influence of one or more luminaires and within the property line of the site.

C. The Illuminated Area of a Canopy is the area of the canopy in plan view (horizontal plane) including any area within 5 feet of a building, plus an area on the adjacent ground or hardscape within 5 feet of the canopy's projected area on the ground or hardscape, less any area within 5 feet of a building, that is within the area of influence of one or more luminaires and within the property line of the site.

D. The Illuminated Area of a Building Entrance without Canopy is an area 8 ft in front of the operable door(s) width, plus 3 ft on either side of the operable door(s), and shall be within the area of influence of one or more luminaires.

E. The Illuminated Area of Building Grounds is the area created along an internal site driveway, walkway, bikeway or trail 25 feet in width and in which the driveway, walkway, bikeway or trail shall be fully within the area and within the area of influence of one or more luminaires. The walkway, bikeway or trail may be located anywhere within the 25-foot wide area. If an area of the site is included within the 25-foot area of Building Grounds, it may not be counted in the area allowed for other lighting power allowance.

F. The Illuminated Area of a Building Façade or Externally Illuminated Sign is the surface area of the façade or sign that is within the vertical area of influence of one or more luminaires.

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[57] This change based on Eley Associates, "Measure 3 – Building Grounds," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 23-26. Presented at the June 18, 2002 workshop.

[58] This change based on Eley Associates, "Measure 2 – Parking Lot Lighting," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 17-22. Presented at the June 18, 2002 workshop.

[59] This change based on Eley Associates, "Measure 4 – Building Entrance and Entrance Canopies," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 27-29. Presented at the June 18, 2002 workshop.

[60] Ibid.

[61] Ibid.

[62] This change based on Eley Associates, "Measure 7 – Outdoor Sales Areas," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 40-44. Presented at the June 18, 2002 workshop.

G. The Illuminated Area of Landscape Lighting is the ground area of planters or planting beds in which landscape lighting is installed plus 200 square feet for each tree not located in planters for which landscape lighting is provided.

TABLE 133-B[63] LIGHTING POWER ALLOWANCES (W/FT² UNLESS OTHERWISE NOTED)

Lighting Application	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Parking Lots and Hardscape Plazas[64]	0.04[65]	0.06	0.08	0.15
Building Grounds (linear feet)[66]	1.0 w/lf	1.5 w/lf	2.5 w/lf	5.0 w/lf
Building Entrances (with and without canopy)	0.50	0.50	.70	1.00
Non-sales canopies	0.12[67]	0.25	0.50	0.70
Vehicle and Retail Sales Lots	Not allowed	0.70	1.25	2.00

TABLE 133-C LIGHTING POWER ALLOWANCES (W/FT² UNLESS OTHERWISE NOTED)

Lighting Application	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Building Facades	Not allowed	0.18	0.35	0.50
Outdoor Sales Frontage (Frontage in linear feet)	Not allowed	22.5 w/lf	38.5 w/lf	55 w/lf
Retail Gas and Vehicle Service Station Canopies	0.70	1.00	1.25	2.00
Retail Gas and Vehicle Service Station without Canopy (area within 25' of any pump)	0.70	0.70	1.25	2.00
All Other Sales Canopies	Not allowed	0.70	1.00	1.25
Landscape Lighting	0.25	0.50	1.00	2.00
Internally Illuminated Panel Signs	2.0	4.0	6.0	8.0
Externally Illuminated Signs	1.0	1.8	2.3	2.3

EXCEPTION 1 to 133 (d). For parking lot and building grounds lighting, if a local ordinance[68] sets minimum illumination requirements, that corresponds to a higher lighting zone, the LPDs for the higher lighting may be used to calculate the lighting power allowance, according to TABLE 133-C.

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63 The changes to Table 133-B and 133-C are recommended by Eley Associates, *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 7-48. Presented at the June 18, 2002 workshop.

64 Plaza light levels will correspond to parking lots in the applicable lighting zone.

65 Corresponds to classical values as follows: Zone 1, 0.5 fc average/5:1 or better; Zone 2, 1 fc average,/5:1 or better; Zone 3, 2 fc average/4:1 or better; and 3 fc average, 3:1 or better. Values have been confirmed to be easily met with ordinary lighting equipment and ordinary probe start metal halide including an appropriate loss factor for lumen maintenance.

66 Revised approach. Building grounds have been revised to include walks, bikeways, paths and drives. The definition of grounds power density is now proposed to be based on a linear power. We are suggesting these values to match the previous criteria.

67 Using lens compact fluorescent luminaires 18 watt triple tube under a 12' high canopy. Uniformity under the canopy is less than 20:1 max:min.

TABLE 133-D ALTERNATIVE POWER ALLOWANCE FOR ORDINANCE REQUIREMENTS

Required Average Light Level by Law Local Ordiance (horizontal foot-candles, average)	**Allowed Lighting Power Density (w/sf)**
0.5	0.04
1.0	0.06
1.5	0.08
2.0	0.10
3.0 or greater	0.15

SECTION 134 — RESERVED.

SECTION 135 — RESERVED.

SECTION 136 — RESERVED.

SECTION 137 — RESERVED.

SECTION 138 — RESERVED.

SECTION 139 — RESERVED.

[68] An ordinance is a local statute passed by a town, city, or county government.

SUBCHAPTER 5
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES FOR ACHIEVING ENERGY EFFICIENCY

SECTION 140 – CHOICE OF PERFORMANCE AND PRESCRIPTIVE APPROACHES

The envelope and the space-conditioning, lighting, and service water-heating systems of all nonresidential, high-rise residential, and hotel/motel buildings subject to Title 24, Part 6, shall be designed, constructed, and installed either:

(a) **Performance Approach** — to use no more ~~source~~ TDV energy from depletable sources than the energy budget, calculated according to Section 141; or

(b) **Prescriptive Approach** — in accordance with all the applicable requirements of Sections 142 through 146.

SECTION 141 – PERFORMANCE APPROACH: ENERGY BUDGETS.

In order to meet the energy budget, a proposed building's use of ~~source~~ TDV energy calculated under Subsection (b) must be no greater than the TDV energy budget calculated under Subsection (a).

(a) **Energy Budget**. The energy budget for a proposed building is the sum of the space-conditioning, lighting, and service water-heating budgets in Subdivisions 1, 2, and 3 of this subsection, expressed in Btu per square foot of conditioned floor area per year.

1. **Space-conditioning budget**. The space-conditioning budget is the ~~source~~ TDV energy used for space conditioning in a standard building in the climate zone in which the proposed building is located, calculated with a method approved by the commission (expressed in ~~Btu~~ TDV energy per square foot of conditioned floor area per year), and assuming that:

   A. The standard building has space heating, space cooling, and ventilation systems that meet, but do not exceed, the minimum efficiency requirements of Sections 111 and 112, and the requirements of Section 144; and

   B. The performance of the roof/ceiling, walls, floors and soffits, windows, and skylights is equal to an applicable value using the same assembly type from Table ~~1-I or 1-J~~ 143-B, 143-C, or 143-D, and for nonresidential buildings with low-sloped roofs, the roof initial solar reflectance and initial thermal emittance is equal to the values specified in Section 118(g)1;[69] and

   C. The zoning, the orientation of each building feature, and the gross envelope areas of the standard building are the same as in the proposed building; and

   D. The window area of the west-facing wall is the greater of: 1) the window area of the proposed building excluding the window area in demising walls, or 40 percent of the gross exterior west-facing wall area of the standard building, whichever is less; or 2) six feet time the west-facing display perimeter;[70] and the window area of the standard building is the greater of (1) or (2): (1) the window area of the proposed building

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[69] The justification for this change appears in: Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

[70] This change is based on recommendations appearing in: Gary Farber, "Nonres West Glazing," *Some Outstanding Title 24 Issues for the Next Generation Building Energy Standards (2003/2005),* October 11, 2001. Presented at the October 22, 2001 workshop.

excluding the window area in demising walls, or 40 percent of the gross exterior wall area of the standard building, whichever is less; or (2) six feet times the display perimeter; and

E. For buildings covered by Section 143(c), the skylight area of the standard building shall be equal to the minimum area required by Section 143(c). For all other buildings, ~~T~~the skylight area of the standard building is the same as in the proposed building, or is five percent of the gross exterior roof/ceiling area of the standard building, whichever is less. [71]

F. For relocatable classrooms, when the manufacturer/builder certifies that the relocatable classroom is manufactured for use in all orientations, the space conditioning budget shall be the lowest determined by simulating the building in each of the cardinal orientations and in increments of 30 degrees between each cardinal orientation.[72]

2. Lighting budget. The lighting budget is the ~~source~~ TDV energy used for lighting in a standard building calculated with a method approved by the commission (expressed in Btu per square foot of conditioned floor area per year), and assuming that:

A. The lighting power density of the standard building, for areas where no lighting plans or specifications are submitted for permit and the occupancy of the building is known, is the maximum allowed lighting power density calculated according to Section 146 (b) 1; and

B. The lighting power density of the standard building, for areas where no lighting plans or specifications are submitted for permit, and the occupancy of the building is not known, is 1.2 watts per square foot; and

C. The lighting power density of the standard building, for areas where lighting plans and specifications are being submitted for permit, is the maximum allowed lighting power density calculated according to Section 146 (b) 1, 2, or 3; and

D. The lighting power density of the standard building, for areas required by Section 131(b) to have either a multi-level astronomical time-switch control or an automatic multi-level daylighting control, shall be reduced by one half of the automatic multi-level daylighting control power adjustment factor, calculated according to Table 146-B.

3. **Service water-heating budget**. The service water-heating budget is the ~~source~~ TDV energy used for service water heating in a standard building in the climate zone in which the proposed building is located, calculated with a method approved by the commission (expressed in Btu per square foot of conditioned floor area per year), and assuming that the standard building has a service water-heating system that meets, but does not exceed, the applicable requirements of Sections 111, 113, and 123.

(b) **TDV ~~Source~~ Energy Use of Proposed Building**. The ~~source~~ TDV energy use of a proposed building is the sum of the space-conditioning, lighting, and service water-heating ~~source~~ TDV energy use calculated in Subdivisions 1, 2, and 3 of this subsection, using the same ACM used to calculate the budget under Subsection (a), and expressed in Btu per square foot of conditioned floor area per year. If any feature of the proposed building, including, but not limited to, the envelope or the space-conditioning, lighting, or service water-heating system, is not included in the building permit application, the energy performance of the feature shall be assumed to be that of the corresponding feature calculated in Subsection (a).

1. **Space-conditioning TDV ~~source~~ energy use**. The space-conditioning ~~source~~ TDV energy use shall be calculated by:

A. Using a method approved by the commission; and

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[71] The justification for this change appears in Pacific Gas and Electric Company, *Updates to Title 24 Treatment of Skylights*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 14, 2002. Presented at the May 30, 2002 workshop.

[72] The justification for this change appears in Pacific Gas and Electric Company, *High Performance Relocatable Classrooms*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, June 28, 2002. Presented at the July 18, 2002 workshop.

B. Using the proposed building's space heating, space cooling, lighting, and ventilation systems, roof and ceiling, walls, floors and soffits, opaque envelope areas, windows, skylights, zoning, and orientation, as shown on the plans and specifications submitted in the building permit application under Section 10-103 of Title 24, Part 1.

C. For relocatable classrooms, when the manufacturer/builder certifies that the relocatable classroom is manufactured for use in all orientations, the space conditioning energy use shall be the lowest determined by simulating the proposed building in each of the cardinal orientations and in increments of 30 degrees between each cardinal orientation.

2. **Lighting ~~source~~ TDV energy use**. The lighting ~~source~~ TDV energy use shall be calculated using a method approved by the commission, and using the actual lighting power density calculated under Section 146 (a), including reduction of wattage through controls. For areas required by Section 131(b) to have either a multi-level astronomical time-switch control or an automatic multi-level daylighting control, a multi-level astronomical time-switch control shall qualify for one half of the automatic multi-level daylighting control power adjustment factor, calculated according to Table 146-B.

3. **Service water-heating ~~source~~ TDV energy use**. The service water-heating ~~source~~ TDV energy use shall be calculated using a method approved by the commission, and using the proposed building's actual service water-heating system.

(c) **Calculation of Budget and Energy Use**. When calculating the energy budget under Subsection (a) and the ~~source~~ TDV energy use under Subsection (b), all of the following rules shall apply:

1. **Methodology**. The methodology, computer programs, inputs, and assumptions approved by the commission shall be used.

2. **Energy included**. All energy, from depletable sources and recovered from space conditioning equipment[73], ~~sources~~ used for space conditioning, lighting, and service water heating shall be included.

3. **Energy excluded**. The following energy shall be excluded:

A. Process loads; and

B. Loads of redundant or backup equipment, if the plans submitted under Section 10-103 of Title 24, Part 1, show controls that will allow the redundant or backup equipment to operate only when the primary equipment is not operating, and if such controls are installed; and

C. Recovered energy; and

D. Additional energy use caused solely by outside air filtration and treatment for the reduction and treatment of unusual outdoor contaminants with final pressure drops more than one-inch water column. Only the energy accounted for by the amount of the pressure drop that is over one inch may be excluded.

4. **U-factors**. U-factors shall be calculated as follows:[74]

A. **All building components**. The U-factor of all building components shall be calculated to three decimal places; the calculations shall assume still inside air and a 15 miles per hour outside air velocity, or other assumptions approved by the commission.

B. **Wood-framed assemblies**. U-factors for wood-framed assemblies shall be calculated using the parallel path method listed in ASHRAE Handbook, 1993, Fundamentals Volume, Chapter 22, with framing factors approved by the commission.

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[73] The justification for this change appears in Southern California Gas Company, *Gas Cooling Compliance Options for Residential and Nonresidential Buildings, Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update*, August 12, 2002. Presented at the August 27, 2002 workshop.

[74] The Commission is considering referring to ANSI/ASHRAE/IESNA Standard 90.1-2001 Appendix A for U-factor calculation methods for opaque assemblies.

C. **Metal-framed assemblies**. U-factors for metal-framed assemblies shall be calculated using the zone method listed in ASHRAE Handbook, 1993, Fundamentals Volume, Chapter 22, or a method approved by the commission.

D. **Fenestration**. U-factors for fenestration shall be determined as follows:

i. For site-assembled fenestration products, U-factors shall include the effects of framing and shall be determined using NFRC procedures or default values as set forth in Section 116; or

ii. For manufactured windows, U-factors shall be as certified under Section 116; or

iii. Using a method approved by the commission.

E. **Masonry assemblies**. U-factors for masonry assemblies shall be calculated using the transverse isothermal planes method listed in ASHRAE Handbook, 1993, Fundamentals Volume, Chapter 22, or a method approved by the commission.

F. **Other**. U-factors for components not listed in this subsection shall be calculated using a method approved by the commission.

5. **Solar heat gain coefficients.** Solar heat gain coefficients shall be determined using National Fenestration Rating Council's NFRC 200 (1995), or NFRC 100-SB as set forth in Section 116, and shall not be adjusted for the effects of interior or exterior shading devices.

6. **Visible light transmittance**. Visible light transmittance shall be determined using the values listed in ASHRAE Handbook, 1993, Fundamentals Volume, Chapter 27, or manufacturers literature, and shall be adjusted for the effects of framing and interior or exterior shading devices.

SECTION 142 – PRESCRIPTIVE APPROACH

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

(a) A building envelope that complies with Section 143 (a) or 143 (b)~~;~~, and for applicable buildings Section 143(c);

(b) A space-conditioning system that complies with Section 144;

(c) A service water-heating system that complies with Section 145; and

(d) A lighting system that complies with Section 146.

SECTION 143 – PRESCRIPTIVE REQUIREMENTS FOR BUILDING ENVELOPES

A building complies with this section by being designed with and having constructed and installed either (1) envelope components that comply with each of the requirements in Subsection (a) for each individual component and the requirements of Subsection (c) where they apply, or (2) an envelope that complies with the overall requirements in Subsection (b) and the requirements of Subsection (c) where they apply. When making calculations under Subsection (a) or (b), all of the rules listed in Section 141 (c) 1, 4, and 5 shall apply.

(a) Envelope Component Approach.

1. **Exterior roofs and ceilings.** Exterior roofs and ceilings shall: ~~have either an installed insulation R-value no less than, or an overall assembly U-factor no greater than, the applicable value in~~

A. For nonresidential buildings with low-sloped roofs, have a minimum initial solar reflectance of 0.70 when tested in accordance with CRRC-1 and an initial thermal emittance not less than 0.75 when tested in accordance with CRRC-1; and [75]

EXCEPTION to Section 143 (a) 1 A: Any roofing product with a minimum initial thermal emittance $\varepsilon_{initial}$ less than 0.75 when tested in accordance with CRRC-1, including but not limited to roof products with metallic surfaces, with a minimum initial solar reflectance of $0.70 + 0.34 * (0.75 - \varepsilon_{initial})$ when tested in accordance with CRRC-1.

B. Have insulation placed at the roof deck where required by Section 118 (e); and [76]

C. Either:

i. Have an overall assembly U-factor no greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C ; or

ii. If the roof does not have metal framing members or a metal deck, have an installed insulation R-value no less than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C .[77]

EXCEPTION to Section 143 (a) 1 C ii: A roof with metal framing members or a metal deck may comply with Section 143 (a) 1 C. if:

A. A continuous layer of rigid insulation with a minimum R-value equal to or greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C is installed either above the roof deck or between the roof deck and the structural members supporting the roof deck; or

B. (1) A continuous layer of rigid insulation with a minimum R-value of R-10 is installed either above the roof deck or between the roof deck and the structural members supporting the roof deck; and (2) insulation with a minimum R-value equal to or greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C is installed between the structural members.

2. **Exterior walls.** Exterior walls shall have either an installed insulation R-value no less than, or an overall assembly U-factor no greater than, the applicable value in ~~Table 1-H, or~~ TABLE 143-A, TABLE 143-B, or TABLE 143-C ~~1-I~~.[78]

3. **Demising walls.** The opaque portions of framed demising walls in nonresidential buildings shall have insulation with an installed insulation R-value no less than R-11 between framing members.

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[75] The justification for this change appears in Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

[76] The justification for this change appears in: Eley Associates, "Limitation of the Use of Lay-In Insulation In Nonresidential Buildings," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 27-63. Presented at the August 27, 2002 workshop.

[77] This change is a clarification of the Standard. The installed insulation R-value method of complying with the insulation requirement is a simplification allowing an assembly to be used without submitting an ENV-3 Form describing the specific details of the proposed assembly. The installed insulation R-value is the amount of insulation needed in a standard construction practice assembly to meet the u-factor requirement. The limitation on metal buildings clarifies that using the R-value in a standard construction practice assembly results in a u-factor significantly greater than allowed.

[78] The justification for this change appears in Pacific Gas and Electric Company, *High Performance Relocatable Classrooms*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, June 28, 2002. Presented at the July 18, 2002 workshop. TABLE 143-C holds the new prescriptive envelope criteria for relocatable classrooms.

4. **External floors and soffits.** External floors and soffits shall have either an installed insulation R-value no less than, or an overall assembly U-factor no greater than, the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C ~~Table 1-H or 1-I~~.

5. **Windows**. Windows shall:

   A. Have (1) a west-facing area no greater than 40 percent of the gross west-facing exterior wall area, or six feet times the west-facing display perimeter, whichever is greater; and (2) ~~an~~ total area no greater than 40 percent of the gross exterior wall area, or six feet times the display perimeter, whichever is greater; and[79]

   EXCEPTION to Section 143 (a) 5 A: 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.

   B. Have a U-factor no greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C ~~Table 1-H or 1-I~~; and

   C. Have a relative solar heat gain, excluding the effects of interior shading, no greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C ~~Table 1-H or 1-I~~. The relative solar heat gain of windows is:

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

      ii. Relative solar heat gain as calculated by EQUATION 143-A~~Equation (1-B~~), if an overhang extends beyond both sides of the window jamb a distance equal to the overhang projection.

      ~~**EXCEPTION to Section 143 (a) 5 C:** The applicable "north" value for relative solar heat gain in Table 1-H or 1-I or 0.56, whichever is greater, 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 to Section 143 (a) 5 C: The applicable "north" value for relative solar heat gain in TABLE 143-A, TABLE 143-B, or TABLE 143-C or 0.56, whichever is greater, shall be used for windows:

EQUATION ~~(1-B)~~ 143-A RELATIVE SOLAR HEAT GAIN EQUATION

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

WHERE:

RSHG	=	Relative solar heat gain.
$SHGC_{win}$	=	Solar heat gain coefficient of the window.
H	=	Horizontal projection of the overhang from the surface of the window in feet, but no

[79] This change in west-facing glazing limitation is added at the recommendation of: Gary Farber, "Nonres West Glazing," *Some Outstanding Title 24 Issues for the Next Generation Building Energy Standards (2003/2005),* October 11, 2001. Presented at the October 22, 2001 workshop.

The change is a further clarification of changes justified in: Eley Associates, "Fenestration," *Measure Analysis: Assembly Bill 970 Emergency Rulemaking – 2001 Update of California Nonresidential Energy Standards,* November 17, 2000. Presented at the November 28, 2000 workshop. The model used in the analysis assumes that the window area is equally distributed between each orientation. The analysis showed the heat gain coefficients for west-facing windows to be greater than for other orientations, indicating that the prescriptive u-factors and RSHG requirements based on 40% window wall ratio on the west-facing wall would optimally be improved to accommodate an increase in west-facing glazing.

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.

~~*RSHG* = Relative solar heat gain.~~

~~$SHGC_{win}$ = Solar heat gain coefficient of the window.~~

~~*H* = Horizontal projection of the overhang from the surface of the window in feet, but no greater than *V*.~~

~~*V* = Vertical distance from the window sill to the bottom of the overhang, in feet.~~

~~*a* = 0.41 for north-facing windows, 1.22 for south-facing windows, and 0.92 for east- and west-facing windows.~~

~~*b* = 0.20 for north-facing windows, 0.66 for south-facing windows, and 0.35 for east- and west-facing windows.~~

6. **Skylights**. Skylights shall:

   A. Have an area no greater than five percent of the gross exterior roof area; and

      EXCEPTION to Section 143 (a) 6 A: Atria over 55 feet high shall have a skylight area no greater than 10 percent of the gross exterior roof area.

   B. Have a U-factor no greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C ~~Table 1-H or 1-I~~; and

   C. Have a solar heat gain coefficient no greater than the applicable value in TABLE 143-A, TABLE 143-B, or TABLE 143-C ~~Table 1-H or 1-I~~.

7. **Exterior doors**. Exterior doors have no R-value, U-factor, or area requirements.

8. **Relocatable Classrooms.** In complying with Sections 143(a) 1. to 7., relocatable classrooms shall comply either with TABLE 143-A when the manufacturer/builder certifies that the relocatable classroom is manufactured only for use in a specific climate zone(s) and that the relocatable classroom can not be lawfully used in other climate zones or with TABLE 143-C when the manufacturer/builder certifies that the relocatable classroom is manufactured for use in any climate zone. When the relocatable classroom complies with TABLE 143-A for use in more than one climate zone, the relocatable classroom shall meet the most stringent requirements for each building component in all of the climate zones for which the relocatable classroom is certified. When the manufacturer/builder certifies that the relocatable classroom is manufactured for use in only one specific orientation and cannot be lawfully used in other orientations, the applicable north and non-north window RSHG and skylight SHGC requirements in TABLE 143-A shall be met. When the manufacturer/builder certifies that the relocatable classroom is manufactured for all orientations, all windows shall meet the non-north window RSHG and skylight SHGC requirements in TABLE 143-A.

   The manufacturer/builder shall place two metal identification labels on each relocatable classroom module, one mechanically fastened and visible from the exterior and the other mechanically fasted to the interior frame above the ceiling, at the end of the module. In addition to information required by the Division of the State Architect (DSA), the labels shall state either "Complies with Title 24, Part 6 for all Climate Zones" or "Complies with Title 24, Part 6 for Climate Zones" and then list all of the climate zones for which the manufacturer has manufactured the relocatable classroom to comply. If the manufacturer/builder certifies that the relocatable classroom is manufactured for all orientations, the statement on the label shall also state "for all orientations." If the manufacturer/builder certifies that the relocatable classroom is manufactured for only one specific orientation, the statement on the label shall also state "for only the specific orientation approved by DSA." The location of the identification label shall be shown on the building plans.

TABLE 143-A~~H~~ PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (including relocatable classrooms where manufacturer certifies use only in specific climate zone; not including ~~except~~ high-rise residential buildings, ~~and~~ guest rooms of hotel/motel buildings)[80]

		CLIMATE ZONES									
		1, 16		**3-5**		**6-9**		**2, 10-13**		**14, 15**	
Roof/Ceiling											
R-value or		19		19		11		19		19	
U-factor		0.057		0.057		0.078		0.057		0.057	
Wall											
R-value or											
U-factor		13		11		11		13		13	
Wood frame		0.084		0.092		0.092		0.084		0.084	
Metal frame		0.182		0.189		0.189		0.182		0.182	
Mass/7.0≤ HC<15.0		0.340		0.430		0.430		0.430		0.430	
Mass/15.0≤HC		0.360		0.650		0.690		0.650		0.400	
Other		0.084		0.092		0.092		0.084		0.084	
Floor/Soffit											
R-value or											
U-factor		19		11		11		11		11	
Mass/7.0≤HC		0.097		0.158		0.158		0.097		0.158	
Other		0.050		0.076		0.076		0.076		0.076	
Windows											
U-factor		0.49		0.81		0.81		0.49		0.49	
Relative solar heat gain											
		Non-North	North	Non-North	North	Non-North	North	Non-North	North	Non-North	North
0-10% WWR		0.49	0.72	0.61	0.61	0.61	0.61	0.47	0.61	0.46	0.61
11-20% WWR		0.43	0.49	0.55	0.61	0.61	0.61	0.36	0.51	0.36	0.51
21-30% WWR		0.43	0.47	0.41	0.61	0.39	0.61	0.36	0.47	0.36	0.47
31-40% WWR		0.43	0.47	0.41	0.61	0.34	0.61	0.31	0.47	0.31	0.40
Skylights											
U-factor	Glass w/Curb	0.99		1.18		1.18		0.99		0.99	
	Glass wo/Curb	0.57		0.68		0.68		0.57		0.57	
	Plastic w/Curb	0.87		1.30		1.30		1.10		1.10	
SHGC Glass	0-2%	0.68		0.79		0.79		0.46		0.46	
	2.1-5%	0.46		0.40		0.40		0.36		0.36	
SHGC Plastic	0-2%	0.77		0.79		0.77		0.77		0.71	
	2.1-5%	0.58		0.65		0.62		0.62		0.58	

[80] The justification for this change appears in Pacific Gas and Electric Company, *High Performance Relocatable Classrooms*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, June 28, 2002. Presented at the July 18, 2002 workshop. A new table has been added for relocatable classrooms.

TABLE 143-B1 PRESCRIPTIVE ENVELOPE CRITERIA FOR HIGH-RISE RESIDENTIAL BUILDINGS AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS

		CLIMATE ZONES									
		1, 16		**3-5**		**6-9**		**2,10-13**		**14, 15**	
Roof/Ceiling											
R-value or		30		19		19		30		30	
U-factor		0.037		0.051		0.051		0.037		0.037	
Wall											
R-value or											
U-factor		19		11		11		13		13	
Wood frame		0.063		0.092		0.092		0.084		0.084	
Metal frame		0.140		0.181		0.181		0.175		0.175	
Mass/7.0≤ HC<15.0		0.340		0.430		0.430		0.430		0.430	
Mass/15.0≤HC		0.360		0.650		0.690		0.650		0.400	
Other		0.063		0.092		0.092		0.084		0.084	
Floor/Soffit											
R-value or											
U-factor		19		11		11		11		11	
Mass/7.0≤HC		0.097		0.158		0.158		0.097		0.097	
Other		0.050		0.076		0.076		0.076		0.076	
Raised concrete R-value		8		*		*		*		*	
Windows											
U-factor		0.49		0.49		0.49		0.49		0.49	
Relative solar heat gain											
		Non-North	North	Non-North	North	Non-North	North	Non-North	North	Non-North	North
0-10% WWR		0.46	0.68	0.41	0.61	0.47	0.61	0.36	0.49	0.36	0.47
11-20% WWR		0.46	0.68	0.40	0.61	0.40	0.61	0.36	0.49	0.31	0.43
21-30% WWR		0.36	0.47	0.31	0.61	0.36	0.61	0.31	0.40	0.26	0.43
31-40% WWR		0.30	0.47	0.26	0.55	0.31	0.61	0.26	0.40	0.26	0.31
Skylights											
U-factor	Glass w/Curb	0.99		1.18		1.18		0.99		0.99	
	Glass wo/Curb	0.57		0.68		0.68		0.57		0.57	
	Plastic w/Curb	0.87		1.30		1.30		1.10		0.87	
SHGC Glass	0-2%	0.46		0.58		0.61		0.46		0.46	
	2.1-5%	0.36		0.32		0.40		0.32		0.31	
SHGC Plastic	0-2%	0.71		0.65		0.65		0.65		0.65	
	2.1-5%	0.55		0.39		0.65		0.34		0.27	

* Required insulation levels for concrete raised floors are R-8 in Climate Zones 2, 11, 13, and 14; R-4 in Climate Zones 12 and 15, and R-0 in Climate Zones 3 through 10.

TABLE 143-C PRESCRIPTIVE ENVELOPE CRITERIA FOR RELOCATABLE CLASSROOMS[81]

		ALL CLIMATE ZONES
Roof/Ceiling R-value or U-factor		 19 0.057
Wall R-value or U-factor Wood frame Metal frame		 13 0.084 0.182 0.340
Floor/Soffit R-value or U-factor		 19 0.050
Windows U-factor Relative solar heat gain		 0.49
0-10% WWR		0.46
11-20% WWR		0.36
21-30% WWR		0.36
31-40% WWR		0.31
Skylights		
U-factor	Glass w/Curb Glass wo/Curb Plastic w/Curb	0.99 0.57 0.87
SHGC Glass	0-2%	0.46
	2.1-5%	0.36
SHGC Plastic	0-2%	0.71
	2.1-5%	0.58

[81] The justification for this change appears in Pacific Gas and Electric Company, *High Performance Relocatable Classrooms*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, June 28, 2002. Presented at the July 18, 2002 workshop.

(b) Overall Envelope Approach[82]

1. **Roof thermal emittance.** The thermal emittance of all roof surfaces shall be greater than or equal to 0.75. Building envelopes which use roof surfaces with a thermal emittance of less than 0.75, including but not limited to metallic surfaces such as bare metal, galvanized steel, and aluminum coating, may not use the Overall Envelope Approach. [83]

~~1~~2. **Overall heat loss**. The overall heat loss (HL) of the overall envelope of the proposed building, HL_{prop} as calculated with EQUATION 143-C~~Equation (1-D)~~, shall be no greater than the overall heat loss of a standard building, HL_{std} as calculated with EQUATION 143-B. In making the calculations, it shall be assumed that the orientation and area of each envelope component is the same as in the proposed building.

EQUATION 143-B— STANDARD BUILDING HEAT LOSS EQUATION

$$HL_{std} = \sum_{i=1}^{nW}\left(A_{Wi} \times U_{Wi_{std}}\right) + \sum_{i=1}^{nF}\left(A_{Fi} \times U_{Fi_{std}}\right) + \sum_{i=1}^{nR}\left(A_{Ri} \times U_{Ri_{std}}\right) + \sum_{i=1}^{nG}\left(A_{Gi} \times U_{Gi_{std}}\right) + \sum_{i=1}^{nS}\left(A_{Si} \times U_{Si_{std}}\right)$$

WHERE:

HL_{std}	=	Overall heat loss of the standard building (in Btu/h-°F).
i	=	Each wall type and orientation, floor/soffit type, roof/ceiling type, window (glazing) type and orientation, or skylight type for the standard building.
nW, nR, nG, nF nS	=	Number of components of the applicable envelope feature.
A_{Wi}	=	Exterior wall area on the north, east, south, and west orientations of the proposed building (in ft.^{2}) including the window area on that orientation of the proposed building, minus A_{Gi}. The standard building has as many walls in each orientation as there are HC categories in that orientation of the proposed building.
A_{Fi}	=	Exterior floor/soffit area of the proposed building (in ft^2). The standard building has as many floors/soffits as there are HC categories in the floors/soffits of the proposed building.
A_{Ri}	=	Exterior roof/ceiling area of the proposed building (in ft^2) plus the skylight area of the proposed building, less A_{Si}.
A_{Gi}	=	Window (glazing) area of each type on the north, east, south, and west orientations of the standard building (in ft.^{2}). If the window wall ratio of the west orientation of the proposed building is less than 40 percent, and the total window wall ratio of the proposed building is more than 40 percent, the total window area is the greater of (a) 40 percent of the gross exterior wall area, or (b) six feet times the display perimeter. The window area of each type and on each orientation of the standard design shall be decreased in proportion to the area in the proposed design according to one of the following formulas as applicable:

82 A limitation to 40% on the use of west-facing glazing will be added to the overall envelope approach. Methodology is not yet confirmed.

83 The justification for this change appears in Eley Associates, "Limitation of the Use of Lay-In Insulation In Nonresidential Buildings," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 27-63. Presented at the August 27, 2002 workshop.

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}} \right) \times 0.40 \times A_{Wtotal-prop}$$

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}} \right) \times \left(6 \times \text{Display Perimeter}_{\text{total}} \right)$$

WHERE:

A_{Gi-adj} = Adjusted window area of each type on the north, east, south, and west orientations (in ft.^{2}).

$A_{Gi-prop}$ = Actual proposed window area of each type in the respective orientation (in ft^2).

$A_{Gtotal-prop}$ = Total actual proposed window area of the proposed building (in ft^2).

$A_{Wtotal-prop}$ = Total actual proposed gross exterior wall area of the proposed building (in ft^2).

~~HL_{std} = Overall heat loss of the standard building (in Btu/h °F).~~

~~i = Each wall type and orientation, floor/soffit type, roof/ceiling type, window (glazing) type and orientation, or skylight type for the standard building.~~

~~nW, nR,~~

~~nG, nF~~

~~nS = Number of components of the applicable envelope feature.~~

~~A_{Wi} = Exterior wall area on the north, east, south, and west orientations of the proposed building (in ft.^{2}) including the window area on that orientation of the proposed building, minus A_{Gi}. The standard building has as many walls in each orientation as there are HC categories in that orientation of the proposed building.~~

~~A_{Fi} = Exterior floor/soffit area of the proposed building (in ft^2). The standard building has as many floors/soffits as there are HC categories in the floors/soffits of the proposed building.~~

~~A_{Ri} = Exterior roof/ceiling area of the proposed building (in ft^2) plus the skylight area of the proposed building, less A_{Si}.~~

~~A_{Gi} = Window (glazing) area of each type on the north, east, south, and west orientations of the standard building (in ft.^{2}). If the total window wall ratio of the proposed building is more than 40 percent, the total window area is the greater of (a) 40 percent of the gross exterior wall area, or (b) six feet times the display perimeter. The window area of each type and on each orientation of the standard design shall be decreased in proportion to the area in the proposed design according to one of the following formulas as applicable:~~

~~A. $A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}} \right) \times 0.40 \times A_{Wtotal-prop}$~~

~~B. $A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}} \right) \times \left(6 \times \text{Display Perimeter}_{\text{total}} \right)$~~

~~If the total window area of the proposed building is less than 10 percent of the gross exterior wall area, the window area of each type and on each orientation of the standard design shall be increased in proportion to the area in the proposed design according to the following formula:~~ [84]

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}} \right) \times 0.10 \times A_{Wtotal-prop}$$

WHERE:

A_{Gi-adj} = Adjusted window area of each type on the north, east, south, and west orientations (in ft.^{2}).

$A_{Gi-prop}$ = Actual proposed window area of each type in the respective orientation (in ft^2).

$A_{Gtotal-prop}$ = Total actual proposed window area of the proposed building (in ft^2).

$A_{Wtotal-prop}$ = Total actual proposed gross exterior wall area of the proposed building (in ft^2).

A_{Si} =Skylight area of the standard building for each skylight type (in ft^2). The total skylight area in the standard building is equal to the total skylight area of the proposed building or five percent of the gross exterior roof area (or, for atria over 55 feet high, 10 percent of the gross exterior roof area), whichever is less. If the total skylight area of the proposed building is more than five percent of the gross exterior roof area or more than 10 percent of the gross exterior roof area for atria over 55 feet high, the skylight area of each type of the standard building shall be decreased in proportion to the area in the proposed design according to the following formula:

$$A_{Si-adj} = \left(\frac{A_{Si-prop}}{A_{Stotal-prop}} \right) \times 0.10 \times A_{Rtotal-prop}$$

for atria over 55 feet high, and

$$A_{Si-adj} = \left(\frac{A_{Si-prop}}{A_{Stotal-prop}} \right) \times 0.05 \times A_{Rtotal-prop}$$

for others,

WHERE:

$A_{Si\ adj}$ = Adjusted skylight area of each type (in ft^2).

$A_{Si\ prop}$ = Actual proposed skylight area of each type (in ft^2).

$A_{Stotal\ prop}$ = Total actual proposed skylight area of the proposed building (in ft^2).

$A_{Rtotal\ prop}$ = Total actual proposed gross exterior roof area of the proposed building (in ft^2).

U_{Wistd} = The applicable wall U-factor for the corresponding A_{Wi} from TABLE 143-B, TABLE 143-B, or TABLE 143-C .

U_{Fistd} = The applicable floor/soffit U-factor for the corresponding A_{Fi} from TABLE 143-B, TABLE

[84] This change is based on recommendations in Pacific Gas and Electric Company, *High Performance Relocatable Classrooms*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, June 28, 2002. Presented at the July 18, 2002 workshop. However, rather than making an exception for relocatable classrooms, it is recommended that the credit for using less than 10 percent fenestration in the gross exterior wall be eliminated. The credit allows a building to avoid cost effective measures, by giving the credit to either (1) buildings that would have limited fenestration in any case, such as a big box retail space; or (2) buildings that decrease the quality of the indoor environment by limiting daylight, such as a portable classroom.

143-B, or TABLE 143-C .

U_{Ristd} = The applicable roof/ceiling U-factor for the corresponding A_{Ri} from TABLE 143-B, TABLE 143-B, or TABLE 143-C .

U_{Gistd} = The applicable window U-factor for the corresponding A_{Gi} from TABLE 143-B, TABLE 143-B, or TABLE 143-C .

U_{Sistd} = The applicable skylight U-factor for the corresponding A_{Si} from TABLE 143-B, TABLE 143-B, or TABLE 143-C .

~~A_{Si} = Skylight area of the standard building for each skylight type (in ft^2). The total skylight area in the standard building is equal to the total skylight area of the proposed building or five percent of the gross exterior roof area (or, for atria over 55 feet high, 10 percent of the gross exterior roof area), whichever is less. If the total skylight area of the proposed building is more than five percent of the gross exterior roof area or more than 10 percent of the gross exterior roof area for atria over 55 feet high, the skylight area of each type of the standard building shall be decreased in proportion to the area in the proposed design according to the following formula:~~

$$A_{Si-adj} = \left(\frac{A_{Si-prop}}{A_{Stotal-prop}}\right) \times 0.10 \times A_{Rtotal-prop}$$

~~for atria over 55 feet high, and~~

$$A_{Si-adj} = \left(\frac{A_{Si-prop}}{A_{Stotal-prop}}\right) \times 0.05 \times A_{Rtotal-prop}$$

~~for others, **WHERE**:~~

~~A_{Si-adj} = Adjusted skylight area of each type (in ft^2).~~

~~$A_{Si-prop}$ = Actual proposed skylight area of each type (in ft^2).~~

~~$A_{Stotal-prop}$ = Total actual proposed skylight area of the proposed building (in ft^2).~~

~~$A_{Rtotal-prop}$ = Total actual proposed gross exterior roof area of the proposed building (in ft^2).~~

~~U_{Wistd} = The applicable wall U-factor for the corresponding A_{Wi} from Table 1-H or 1-I.~~

~~U_{Fistd} = The applicable floor/soffit U-factor for the corresponding A_{Fi} from Table 1-H or 1-I.~~

~~U_{Ristd} = The applicable roof/ceiling U-factor for the corresponding A_{Ri} from Table 1-H or 1-I.~~

~~U_{Gistd} = The applicable window U-factor for the corresponding A_{Gi} from Table 1-H or 1-I.~~

~~U_{Sistd} = The applicable skylight U-factor for the corresponding A_{Si} from Table 1-H or 1-I.~~

EQUATION ~~(1-D)~~ 143-C PROPOSED BUILDING HEAT LOSS EQUATION

$$HL_{prop} = \sum_{j=1}^{nW}\left(A_{Wj} \times U_{Wj_{prop}}\right) + \sum_{j=1}^{nF}\left(A_{Fj} \times U_{Fj_{prop}}\right) + \sum_{j=1}^{nR}\left(A_{Rj} \times U_{Rj_{prop}}\right) + \sum_{j=1}^{nG}\left(A_{Gj} \times U_{Gj_{prop}}\right) + \sum_{j=1}^{nS}\left(A_{Sj} \times U_{Sj_{prop}}\right)$$

WHERE:

HL_{prop}	=	Overall heat loss of the proposed building (in Btu/h-°F).
j	=	Each wall type and orientation, floor/soffit type, roof/ceiling type, window type and orientation, or skylight type for the proposed building.
nW, nR, nG, nF, nS	=	As determined in EQUATION 143-A.
A_{Wj}	=	Exterior wall area on the north, east, south, and west orientations of the proposed building (in ft^2). Each orientation has as many walls as there are HC categories.
A_{Fj}	=	Exterior floor/soffit area of the proposed building (in ft^2). There are as many floors/soffits as there are HC categories.
A_{Rj}	=	Exterior roof/ceiling area of the proposed building (in ft^2).
A_{Gj}	=	Window (glazing) area for each window type and orientation of the proposed building (in ft^2).
A_{Sj}	=	Skylight area for each skylight type of the proposed building (in ft^2).
U_{Wjprop}	=	The wall U-factor for the corresponding A_{Wj}.
U_{Fjprop}	=	The floor/soffit U-factor for the corresponding A_{Fj}.
U_{Rjprop}	=	The roof/ceiling U-factor for the corresponding A_{Rj}.
U_{Gjprop}	=	The window U-factor for the corresponding A_{Gj}.
U_{Sjprop}	=	The skylight U-factor for the corresponding A_{Sj}.

~~**WHERE:**~~

~~HL_{prop} = Overall heat loss of the proposed building (in Btu/h-°F).~~

~~j = Each wall type and orientation, floor/soffit type, roof/ceiling type, window type and orientation, or skylight type for the proposed building.~~

~~nW, nR,~~

~~nG, nF,~~

~~nS = As determined in Equation 1-C.~~

~~A_{Wj} = Exterior wall area on the north, east, south, and west orientations of the proposed building (in ft^2). Each orientation has as many walls as there are HC categories.~~

~~A_{Fj} = Exterior floor/soffit area of the proposed building (in ft^2). There are as many floors/soffits as there are HC categories.~~

~~A_{Rj} = Exterior roof/ceiling area of the proposed building (in ft^2).~~

~~A_{Gj} = Window (glazing) area for each window type and orientation of the proposed building (in ft^2).~~

~~A_{Sj} = Skylight area for each skylight type of the proposed building (in ft^2).~~

~~U_{Wjprop} = The wall U-factor for the corresponding A_{Wj}.~~

~~U_{Fjprop} = The floor/soffit U-factor for the corresponding A_{Fj}.~~

~~U_{Rjprop} = The roof/ceiling U-factor for the corresponding A_{Rj}.~~

~~U_{Gjprop} = The window U-factor for the corresponding A_{Gj}.~~

~~U_{Sjprop} = The skylight U-factor for the corresponding A_{Sj}.~~

~~2~~3. **Overall heat gain.** The overall heat gain of the overall envelope of the proposed building, HG_{prop} as calculated with EQUATION 143-E~~Equation (1-F)~~, shall be no greater than the overall heat gain of the overall envelope of a standard building, HG_{std} as calculated with EQUATION 143-D~~Equation (1-E)~~. In making the calculations, it shall be assumed that the orientation and area of each envelope component of the standard building are the same as in the proposed building.

EQUATION ~~(1-E)~~ 143-D STANDARD BUILDING HEAT GAIN EQUATION

$$HG_{std} = \sum_{i=1}^{nW}\left(A_{Wi} \times U_{Wi_{std}} \times TF_i\right) + \sum_{i=1}^{nF}\left(A_{Fi} \times U_{Fi_{std}} \times TF_i\right) + \sum_{i=1}^{nR}\left(A_{Ri} \times U_{Ri_{std}} \times TF_i\right)$$

$$\cancel{+ \sum_{i=1}^{nG}\left(A_{Gi} \times U_{Gi_{std}} \times TF_i\right) + \sum_{i=1}^{nS}\left(A_{Si} \times U_{Si_{std}} \times TF_i\right) + \sum_{i=1}^{nG}\left(WF_{Gi} \times A_{Gi} \times RSHG_{Gi_{std}}\right) \times SF}$$

$$+ \sum_{i=1}^{nS}\left(\mathrm{WF_{Si}} \times A_{Si} \times SHGC_{Si_{std}}\right) \times SF + \sum_{i=1}^{nR}\left(\mathrm{WF_{Ri}} \times A_{Ri} \times U_{Ri_{std}} \times \alpha_{Ri_{std}}\right) \times SF$$

$$HG_{std} = \sum_{i=1}^{nW}\left(A_{Wi} \times U_{Wi_{std}} \times TF_i\right) + \sum_{i=1}^{nF}\left(A_{Fi} \times U_{Fi_{std}} \times TF_i\right) + \sum_{i=1}^{nR}\left(A_{Ri} \times U_{Ri_{std}} \times TF_i\right)$$

$$+ \sum_{i=1}^{nG}\left(A_{Gi} \times U_{Gi_{std}} \times TF_i\right) + \sum_{i=1}^{nS}\left(A_{Si} \times U_{Si_{std}} \times TF_i\right) + \sum_{i=1}^{nG}\left(A_{Gi} \times RSHG_{Gi_{std}}\right) \times SF$$

$$+ \sum_{i=1}^{nS}\left(\mathrm{WF_{Si}} \times A_{Si} \times SHGC_{Si_{std}}\right) \times SF + \sum_{i=1}^{nR}\left(\mathrm{WF_{Ri}} \times A_{Ri} \times U_{Ri_{std}} \times \underline{\left[1 - \left(0.2 + 0.7\left[\rho_{Ri_{std}} - 0.2\right]\right)\right]}\right) \times SF$$

WHERE:

HG_{std}	=	Overall heat gain of the standard building (Btu/h).
i	=	As determined in EQUATION 143-B.
nW, nR, nG, nF, nS	=	As determined in EQUATION 143-B
A_{Wi}	=	As determined in EQUATION 143-B
A_{Fi}	=	As determined in EQUATION 143-B
A_{Ri}	=	As determined in EQUATION 143-B
A_{Gi}	=	As determined in EQUATION 143-B
A_{Si}	=	As determined in EQUATION 143-B
U_{Wistd}	=	As determined in EQUATION 143-B
U_{Fistd}	=	As determined in EQUATION 143-B
U_{Ristd}	=	As determined in EQUATION 143-B
U_{Gistd}	=	As determined in EQUATION 143-B
U_{Sistd}	=	As determined in EQUATION 143-B
$RSHG_{Gistd}$~~=~~	=	The applicable relative solar heat gain for the corresponding A_{Gi}, from TABLE 143-A,

TABLE 143-B, or TABLE 143-C (unitless).

WF_{Gi} = The applicable weighting factor for glazing for each orientation of the standard building, from TABLE 143-E (unitless).

WF_{Si} = The applicable weighting factor for skylight of the standard building, from TABLE 143-E (unitless).

WF_{Ri} = The applicable weighting factor for roof of the standard building, from TABLE 143-E (unitless).

$\rho_{Ri_{std}}$ = Initial solar reflectance of the roofing product for the corresponding A_{Ri}. The standard building has an initial solar reflectance of 0.70 for nonresidential buildings with low-sloped roofs and an initial solar reflectance of 0.30 for nonresidential buildings with high-sloped roofs, for high-rise residential buildings, and for guest rooms of hotel/motel buildings. [85]

$SHGC_{Sistd}$ = The applicable solar heat gain coefficient for the corresponding A_{Si}, from TABLE 143-A, TABLE 143-B, or TABLE 143-C (unitless).

SF = The solar factor from TABLE 143-D.

TF_j = The temperature factor from TABLE 143-D.

~~**WHERE:**~~

~~HG_{std} = Overall heat gain of the standard building (Btu/h).~~

~~i = As determined in Equation 1-C.~~

~~$nW, nR,$~~

~~$nG, nF,$~~

~~nS = As determined in Equation 1-C.~~

~~A_{Wi} = As determined in Equation 1-C.~~

~~A_{Fi} = As determined in Equation 1-C.~~

~~A_{Ri} = As determined in Equation 1-C.~~

~~A_{Gi} = As determined in Equation 1-C.~~

~~A_{Si} = As determined in Equation 1-C.~~

~~U_{Wistd} = As determined in Equation 1-C.~~

~~U_{Fistd} = As determined in Equation 1-C.~~

~~U_{Ristd} = As determined in Equation 1-C.~~

~~U_{Gistd} = As determined in Equation 1-C.~~

~~U_{Sistd} = As determined in Equation 1-C.~~

~~$RSHG_{Gistd}$ = The applicable relative solar heat gain for the corresponding A_{Gi}, from Table 1-H or 1-I (unitless).~~

~~WF_{Gi} = The applicable weighting factor for glazing for each orientation of the standard building, from Table 1-K (unitless).~~

[85] The justification for this change appears in Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

~~WF_{Si} = The applicable weighting factor for skylight of the standard building, from Table 1-K (unitless).~~

~~WF_{Ri} = The applicable weighting factor for roof of the standard building, from Table 1-K (unitless).~~

~~α_{Ristd} = A standard roof absorptivity of 0.70 for the corresponding A_{Ri}.~~

~~$SHGC_{Sistd}$ = The applicable solar heat gain coefficient for the corresponding A_{Si}, from Table 1-H or 1-I (unitless).~~

~~SF = The solar factor from Table 1-J.~~

~~TF_i = The temperature factor from Table 1-J.~~

EQUATION ~~(1-F)~~ 143-E PROPOSED BUILDING HEAT GAIN EQUATION

$$HG_{prop} = \sum_{j=1}^{nW}\left(A_{Wj} \times U_{Wj_{prop}} \times TF_j\right) + \sum_{j=1}^{nF}\left(A_{Fj} \times U_{Fj_{prop}} \times TF_j\right) + \sum_{j=1}^{nR}\left(A_{Rj} \times U_{Rj_{prop}} \times TF_j\right)$$

$$\cancel{+ \sum_{j=1}^{nG}\left(A_{Gj} \times U_{Gj_{prop}} \times TF_j\right) + \sum_{j=1}^{nS}\left(A_{Sj} \times U_{Sj_{prop}} \times TF_j\right) + \sum_{j=1}^{nG}\left(WF_{Gj} \times A_{Gj} \times SHGC_{Gj_{prop}} \times OHF_j\right) \times SF}$$

$$+ \sum_{j=1}^{nS}\left(WF_{Sj} \times A_{Sj} \times SHGC_{Sj_{prop}}\right) \times SF + \sum_{j=1}^{nR}\left(WF_{Rj} \times A_{Rj} \times U_{Rj_{prop}} \times \alpha_{Rj_{prop}}\right) \times SF$$

$$HG_{prop} = \sum_{j=1}^{nW}\left(A_{Wj} \times U_{Wj_{prop}} \times TF_j\right) + \sum_{j=1}^{nF}\left(A_{Fj} \times U_{Fj_{prop}} \times TF_j\right) + \sum_{j=1}^{nR}\left(A_{Rj} \times U_{Rj_{prop}} \times TF_j\right)$$

$$+ \sum_{j=1}^{nG}\left(A_{Gj} \times U_{Gj_{prop}} \times TF_j\right) + \sum_{j=1}^{nS}\left(A_{Sj} \times U_{Sj_{prop}} \times TF_j\right) + \sum_{j=1}^{nG}\left(WF_{Gj} \times A_{Gj} \times SHGC_{Gj_{prop}} \times OHF_j\right) \times SF$$

$$+ \sum_{j=1}^{nS}\left(WF_{Sj} \times A_{Sj} \times SHGC_{Sj_{prop}}\right) \times SF + \sum_{j=1}^{nR}\left(WF_{Rj} \times A_{Rj} \times U_{Rj_{prop}} \times \underline{\left[1 - \left(0.2 + 0.7\left[\rho_{Ri_{std}} - 0.2\right]\right)\right]}\right) \times SF$$

WHERE:

HG_{prop}	=	Overall heat gain of the proposed building (Btu/h).
j	=	As determined in EQUATION 143-C.
nW, nR, nG, nF, nS	=	As determined in EQUATION 143-C.
A_{Wj}	=	As determined in EQUATION 143-C.
A_{Fj}	=	As determined in EQUATION 143-C.
A_{Rj}	=	As determined in EQUATION 143-C.
A_{Gj}	=	As determined in EQUATION 143-C.
A_{Sj}	=	As determined in EQUATION 143-C.
U_{Wjprop}	=	As determined in EQUATION 143-C.

U_{Fjprop} = As determined in EQUATION 143-C.

U_{Rjprop} = As determined in EQUATION 143-C.

U_{Gjprop} = As determined in EQUATION 143-C.

U_{Sjprop} = As determined in EQUATION 143-C.

$SHGC_{Gj}$ = The solar heat gain coefficient for the corresponding A_{Gj} (unitless)

$SHGC_{Sj}$ = The solar heat gain coefficient for the corresponding A_{Sj} (unitless).

OHF_{Gj} = The overhang factor for the corresponding A_{Gj} (unitless).

OHF_{Gj} = $1 + aH/V + b(H/V)^2$

WHERE:

H = Horizontal projection of an overhang from the surface of the window, no greater than V, in feet.

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.

WF_{Gj} = The applicable weighting factor for each orientation of the building, from TABLE 143-F(unitless).

WF_{Skyj} = The applicable weighting factor for skylight of the proposed building, from TABLE 143-F (unitless).

WF_{Rj} = The applicable weighting factor for roof of the proposed building, from TABLE 143-F (unitless).

α_{Rjstd} = The applicable roof absorptivity for the corresponding A_{Rj}. An absorptivity of 0.45 for cool roofs (as defined in Section 118). An absorptivity of 0.7 for all other roofs.

$\rho_{Ri_{prop}}$ = The proposed initial solar reflectance of the roofing product for the corresponding A_{Rj}, as certified and labeled according to requirements of Section 10-113. If the proposed roofing product used has not been certified and labeled, the proposed initial solar reflectance shall be 0.10 for nonresidential buildings with low-sloped roofs, or 0.30 for nonresidential buildings with high-sloped roofs, high-rise residential buildings, and guest rooms in hotel/motel buildings.[86]

SF = The solar factor from TABLE 143-E.

TF_j = The temperature factor fromTABLE 143-D.

~~**WHERE:**~~

~~HG_{prop} = Overall heat gain of the proposed building (Btu/h).~~

~~j = As determined in Equation 1-D.~~

[86] The justification for this change appears in Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

~~$nW, nR,$~~

~~$nG, nF,$~~

~~nS = As determined in Equation 1-D.~~

~~A_{Wj} = As determined in Equation 1-D.~~

~~A_{Ej} = As determined in Equation 1-D.~~

~~A_{Rj} = As determined in Equation 1-D.~~

~~A_{Gj} = As determined in Equation 1-D.~~

~~A_{Sj} = As determined in Equation 1-D.~~

~~U_{Wjprop} = As determined in Equation 1-D.~~

~~U_{Ejprop} = As determined in Equation 1-D.~~

~~U_{Rjprop} = As determined in Equation 1-D.~~

~~U_{Gjprop} = As determined in Equation 1-D.~~

~~U_{Sjprop} = As determined in Equation 1-D.~~

~~$SHGC_{Gj}$ = The solar heat gain coefficient for the corresponding A_{Gj} (unitless)~~

~~$SHGC_{Sj}$ = The solar heat gain coefficient for the corresponding A_{sj} (unitless).~~

~~OHF_{Gj} = The overhang factor for the corresponding A_{Gj} (unitless).~~

~~$OHF_{Gj} = 1 + aH/V + b(H/V)^2$~~

~~**WHERE:**~~

~~H = Horizontal projection of an overhang from the surface of the window, no greater than V, in feet.~~

~~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.~~

~~WF_{Gj} = The applicable weighting factor for each orientation of the building, from -TABLE 143-F(unitless).~~

~~WF_{Skyj} = The applicable weighting factor for skylight of the proposed building, from -TABLE 143-F (unitless).~~

~~WF_{Rj} = The applicable weighting factor for roof of the proposed building, from -TABLE 143-F (unitless).~~

~~α_{Rjstd} = The applicable roof absorptivity for the corresponding A_{Rj}. An absorptivity of 0.45 for cool roofs (as defined in Section 118). An absorptivity of 0.7 for all other roofs.~~

~~$\rho_{Ri_{prop}}$ = The proposed initial solar reflectance of the roofing product for the corresponding A_{Rj}, as certified and labeled according to requirements of Section 10-113. If the proposed roofing product used has not been certified and~~

~~labeled, the proposed initial solar reflectance shall be 0.10 for nonresidential buildings with low-sloped roofs, or 0.30 for nonresidential buildings with high-sloped roofs, high-rise residential buildings, and guest rooms in hotel/motel buildings.~~[87]

~~*SF* = The solar factor from Table TABLE 143-E.~~

~~*TF*, = The temperature factor from Table TABLE 143-E.~~

TABLE 143-D~~J~~ —TEMPERATURE AND SOLAR FACTORS

CLIMATE ZONE	TEMPERATURE FACTOR (TF) Envelope Construction			SOLAR FACTOR (SF) (Btu/hr. x ft^2)
	Light Mass	Medium Mass	Heavy Mass	
1	14	3	1	128
2	40	30	28	126
3	28	18	16	126
4	32	22	20	125
5	27	17	15	124
6	28	18	16	123
7	27	17	15	123
8	33	23	21	123
9	42	31	29	123
10	45	35	33	123
11	49	38	36	127
12	45	34	32	126
13	45	35	33	125
14	52	42	40	125
15	55	45	43	123
16	34	23	21	128
Light Mass: Heat Capacity < 7 Btu/ft.²-°F Medium Mass: Heat Capacity >= 7 and <15 Btu/ft.²-°F Heavy Mass: Heat Capacity >= 15 Btu/ft²-°F				

[87] The justification for this change appears in Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

TABLE 143-E~~1 K~~ —GLAZING ORIENTATION WEIGHTING FACTORS (WF_G), (WF_R) & (WF_S)

Climate Zone	WF_{north}	WF_{south}	WF_{west}	WF_{east}	WF_{sky}	WF_{roof}
NON-RESIDENTIAL						
1	0.56	1.25	1.16	1.03	1.48	0.93
2	0.56	1.30	1.18	0.96	2.34	1.12
3	0.51	1.28	1.24	0.97	2.42	0.84
4	0.55	1.20	1.24	1.01	2.53	0.96
5	0.58	1.25	1.18	0.98	2.48	0.80
6	0.56	1.23	1.21	1.00	2.40	0.84
7	0.57	1.30	1.17	0.97	2.36	0.87
8	0.60	1.26	1.14	1.00	2.47	0.98
9	0.56	1.36	1.11	0.97	2.29	0.97
10	0.60	1.38	1.07	0.95	2.19	1.02
11	0.55	1.19	1.17	1.10	2.37	0.89
12	0.55	1.17	1.21	1.07	2.40	0.92
13	0.58	1.15	1.17	1.10	2.39	1.04
14	0.57	1.17	1.20	1.07	2.46	1.13
15	0.61	1.27	1.05	1.07	2.29	0.92
16	0.51	1.27	1.15	1.07	2.20	1.03
HIGH-RISE RESIDENTIAL						
1	0.50	1.24	1.23	1.03	1.36	0.82
2	0.55	1.29	1.23	0.94	2.30	1.08
3	0.47	1.28	1.29	0.96	2.42	0.80
4	0.54	1.17	1.33	0.96	2.53	0.96
5	0.49	1.28	1.25	0.97	2.48	0.77
6	0.55	1.20	1.26	0.99	2.37	0.79
7	0.55	1.28	1.21	0.96	2.37	0.88
8	0.57	1.26	1.20	0.97	2.44	0.96
9	0.53	1.39	1.14	0.94	2.24	0.93
10	0.59	1.34	1.12	0.94	1.92	1.00
11	0.53	1.14	1.27	1.06	2.23	0.88
12	0.55	1.14	1.29	1.03	2.31	0.91
13	0.57	1.12	1.27	1.05	2.27	1.02
14	0.57	1.13	1.28	1.02	2.38	1.08
15	0.59	1.26	1.12	1.03	2.26	0.90
16	0.49	1.24	1.25	1.01	2.02	0.95

(c) **Minimum Skylight Area for Large Enclosed Spaces in Low-Rise Buildings.** Low rise enclosed spaces that are greater than 25,000 ^{ft2}; directly under a roof; with ceiling heights greater than 15 ft; and having a lighting power density for general lighting equal to or greater than 0.5 W/^{ft2} shall meet subsections 1-4 below:

1. **Daylit Area.** Have at least one half of the floor area in the daylit zone area under skylights. The daylit area under skylights is the area on the floor illuminated by horizontal glazing, and is calculated to be the footprint of the skylight plus, in each of the lateral and longitudinal dimensions of the skylight, the lesser of 70% of the floor-to-ceiling height, the distance to the nearest 60-inch or higher permanent opaque partition, or one half the horizontal distance to the edge of the closest skylight or vertical glazing.

2. **Controls.** Electric lighting in the daylit area shall be controlled by with multi-level automatic daylighting controls as described in Section 131c.

2. **Minimum Skylight Area.** The minimum skylight area in the daylit area under skylights shall be a function of the lighting power density (LPD) of general lighting in the daylit area under skylights. The minimum skylight area shall be the minimum skylight area required to meet the minimum skylight to floor area ratio or the minimum effective aperture as shown in TABLE 143-F. The methodology for calculating effective aperture for skylights is described in subsection A below.

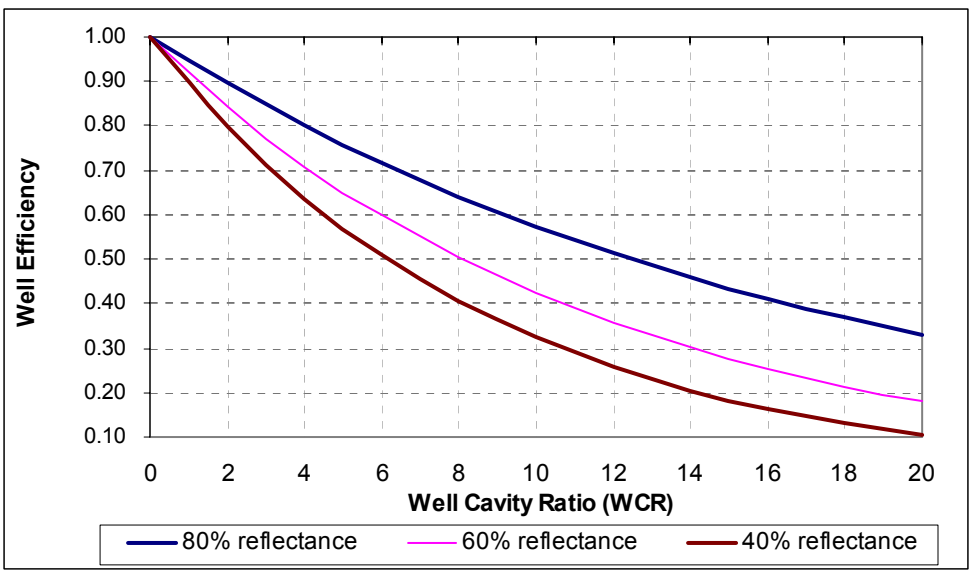
TABLE 143-F MINIMUM SKYLIGHT TO FLOOR AREA IN LOW-RISE ENCLOSED SPACES >25,000 FT^2 DIRECTLY UNDER A ROOF

General Lighting Power Density in the Daylit Zone (W/ft^2)	Minimum Skylight to Floor Area Ratio	Minimum Effective Aperture (EA)
1.0 W/ft^2 ≤ LPD	4.0%	2.0%
0.5 W/ft^2 ≤ LPD < 1.0 W/ft^2	3.0%	1.5%

A. **Effective Aperture Calculation for Skylights.** The effective aperture for skylights is the well efficiency times the visible light transmittance (VLT) times the skylight area times 0.85 divided by the daylit area under the skylights.

The well efficiency is the ratio of the amount of visible light leaving a skylight well to the amount of visible light entering the skylight well and is calculated from the nomograph in FIGURE 143-A using the weighted average reflectance of the walls of the well and the well cavity ratio (WCR).

FIGURE 143-A WELL EFFICIENCY NOMOGRAPH



The well cavity ratio (WCR) characterizes the geometry of the skylight well and is used for calculating the skylight well efficiency. It is calculated as follows:

i. For rectangular wells:

$$\text{WCR} = \left(\frac{5 \times \text{well height}\left(\text{well length} + \text{well width}\right)}{\text{well length} \times \text{well width}} \right) \text{; or}$$

ii. For irregular-shaped wells:

$$\text{WCR} = \left(\frac{2.5 \times \text{well height} \times \text{well perimeter}}{\text{well area}} \right)$$

Where the length, width, perimeter, and area are measured at the bottom of the well.

4. **Skylight Characteristics.** Skylights shall comply with items A and B below:

   A. The skylights shall have a glazing material or diffuser that has been tested according to ASTM D1003 (notwithstanding its scope or other test method approved by the Commission) and has a measured haze value greater than 90%.

   B. If the space is conditioned, have a tested U-factor and SHGC equal to or less than the values in TABLE 143-A. If the space is unconditioned, the skylights may be single glazed.

EXCEPTION 1 to Section 143 (c): Buildings in climate zones 1 or 16.

EXCEPTION 2 to Section 143 (c): Auditoriums, movie theaters, museums, and refrigerated warehouses.

SECTION 144 – 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 requirements of Subsections (a) through (h).

(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 144 (a): Where it can be demonstrated to the satisfaction of the enforcing agency that oversizing will not increase building ~~source~~ TDV energy use.

EXCEPTION 2 to Section 144 (a): Standby equipment with controls that allow the standby equipment to operate only when the primary equipment is not operating.

EXCEPTION 3 to Section 144 (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, 1993, 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 ANSI/ASHRAE 55-1992 or Chapter 8 of the ASHRAE Handbook, 1993, Fundamentals Volume, except that winter humidification and summer dehumidification shall not be required.

4. **Outdoor design conditions**. Outdoor design conditions shall be selected from ASHRAE publication SPCDX: Climatic Data for Region X, Arizona, California, Hawaii, and Nevada, 1982. Heating design temperatures shall be no lower than the temperature listed in the Winter Median of Extremes column. Cooling design dry bulb temperatures shall be no greater than the temperature listed in the Summer Design Dry Bulb 0.5 percent column. Cooling design wet bulb temperatures shall be no greater than the temperature listed in the Summer Design Wet Bulb 0.5 percent column.

5. **Ventilation**. Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section 121.

6. **Envelope**. Envelope heating and cooling loads shall be calculated using envelope characteristics, including square footage, thermal conductance, solar heat gain coefficient or shading coefficient, and air leakage, consistent with the proposed design.
7. **Lighting**. Lighting loads shall be based on actual design lighting levels or power densities consistent with Section 146.
8. **People**. Occupant density shall be based on the expected occupancy of the building and shall be the same as determined under Section 121 (b) 2 B, if used. Sensible and latent heat gains shall be as listed in ASHRAE Handbook, 1993, Fundamentals Volume, Chapter 26, Table 3.
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 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 and from technical societies, such as the ASHRAE Handbook, 1995; HVAC 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. The steady-state load may include a safety factor in accordance with Section 144 (b) 12.

(c) **Power Consumption of Fans.** Each fan system used for comfort space conditioning ~~with a total fan power index over 25 horsepower~~ shall meet the requirements of Item 1 or 2 below, as applicable. 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 the additional power demand caused solely by air treatment or filtering systems with final pressure drops more than one-inch water column (only the energy accounted for by the amount of pressure drop that is over one inch may be excluded), or fan system power caused solely by process loads.

1. **Constant volume fan systems.** The total fan power index at design conditions of each fan system ~~at design conditions~~with total horsepower over 25 horsepower 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 horsepower ~~at design conditions~~ shall not exceed 1.25 watts per cfm of supply air; and
    B. Individual VAV fans with motors 10 horsepower or larger[88] ~~over 25 horsepower~~ shall meet one of the following:
        i. The fan motor shall be driven by a mechanical or electrical variable speed drive.
        ii. The fan shall be a vane-axial fan with variable pitch blades.

[88] The justification for this change appears in Eley Associates, "Size Threshold for Variable Speed Drives," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 15-26. Presented at the August 27, 2002 workshop.

iii. For prescriptive compliance, 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 when static pressure set point equals 1/3 of the total design static pressure, based on certified manufacturer's test data.

3. **Air-treatment or filtering systems.** For systems with air-treatment or filtering systems, calculate the adjusted fan power index using the following equation:

EQUATION 144-A ADJUSTED FAN POWER INDEX

Adjusted fan power index = Fan power index x Fan Adjustment

$$\text{Fan Adjustment} = \cancel{1 - \left(\frac{SP_a}{SP_f}\right)} \; \underline{1 - \left(\frac{SP_a - 1}{SP_f}\right)}$$

WHERE:

SP_a	=	Air pressure drop across the air-treatment or filtering system.
SP_f	=	Total pressure drop across the fan.

4. Fan motors of series fan-powered terminal units 1 horsepower or less in shall be electronically-commutated motors or shall have a minimum motor efficiency of 70% when rated in accordance with NEMA Standard MG 1-1998 Rev. 2 at full load rating conditions.[89]

(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 144 (d): Zones served by a variable air-volume system that is designed and controlled to reduce, to a minimum, the volume of reheated, recooled, or mixed air supply. For each zone, this minimum volume shall be no greater than the largest of the following:

A. 30 percent of the peak supply volume; or

B. The minimum required to meet the ventilation requirements of Section 121; or

C. 0.4 cubic feet per minute (cfm) per square foot of conditioned floor area of the zone; or

D. 300 cfm.

EXCEPTION 2 to Section 144 (d): Zones with special pressurization relationships or cross-contamination control needs.

EXCEPTION 3 to Section 144 (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 144 (d): Zones in which specific humidity levels are required to satisfy process needs.

EXCEPTION 5 to Section 144 (d): Zones with a peak supply-air quantity of 300 cfm or less.

(e) Economizers.

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[89] The justification for this change appears in Eley Associates, "Electronically-Commutated Motors in Series Terminal Units," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part IV*, August 13, 2002, p. 8-14. Presented at the August 27, 2002 workshop.

1. Each individual cooling fan system that has a design supply capacity over 2,500 cfm and a total mechanical cooling capacity over 75,000 Btu/hr. shall include either:

   A. An air economizer capable of modulating outside-air and return-air dampers to supply 100 percent of the design supply air quantity as outside-air; or

   B. A water economizer capable of providing 100 percent of the expected system cooling load as calculated in accordance with a method approved by the commission, at outside air temperatures of 50°F dry-bulb/45°F wet-bulb and below.

   EXCEPTION 1 to Section 144 (e) 1: Where it can be shown to the satisfaction of the enforcing agency that special outside air filtration and treatment, for the reduction and treatment of unusual outdoor contaminants, makes compliance infeasible.

   EXCEPTION 2 to Section 144 (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 ~~source~~ TDV energy use.

   EXCEPTION 3 to Section 144 (e) 1: Systems serving high-rise residential living quarters and hotel/motel guest rooms.

   EXCEPTION 4 to Section 144 (e) 1: Where it can be shown to the satisfaction of the enforcing agency that the use of outdoor air is detrimental to equipment or materials in a space or room served by a dedicated space-conditioning system, such as a computer room or telecommunications equipment room.

   EXCEPTION 5 to Section 144 (e) 1: Where electrically operated unitary air conditioners and heat pumps have cooling efficiencies that meet or exceed the efficiency requirements of TABLE 144-A ~~X1~~ and TABLE 144-B ~~X2~~.

2. If an economizer is required by Subparagraph 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 144 (e) 2 A: 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. Air-side economizers shall have high limit shutoff controls complying with TABLE 144-C ~~X3~~.

4. Economizer Acceptance.[90] Before an occupancy permit is granted for a new building or space, or a new space-conditioning system serving a building or space is operated for normal use, all economizers serving the building or space shall be certified as meeting the Acceptance Requirements for Code Compliance. A Certificate of Acceptance shall be submitted to the building department that:

   A. Certifies plans, specifications, installation certificates, and operating and maintenance information meet the requirements of Part 6.

   B. Certifies that the economizers meet the requirements of Section 144 (e) 1, 2, and 3.

[90] This change is recommended by the New Buildings Institute, Inc., *Acceptance Requirements for Nonresidential Buildings, Nonresidential Quality Assurance Project*, April 8, 2002. Presented at the April 22, 2002 workshop.

TABLE 144-A~~X1~~ ECONOMIZER TRADEOFF TABLE FOR ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS

Climate Zone	Size Category			
	≥760,000	**≥240,000 and <760,000**	**≥135,000 and <240,000**	**≥65,000 and <135,000**
1	N/A	N/A	N/A	N/A
2	N/A	N/A	N/A	N/A
3	N/A	N/A	N/A	N/A
4	11.9	12.2	12.4	N/A
5	N/A	N/A	N/A	N/A
6	N/A	N/A	N/A	N/A
7	N/A	N/A	N/A	N/A
8	11.9	12.2	12.4	N/A
9	11.6	11.9	12.1	N/A
10	11.4	11.7	11.9	12.4
11	11.5	11.8	12.0	N/A
12	11.7	12.0	12.2	N/A
13	11.2	11.5	11.7	12.3
14	11.7	12.0	12.2	N/A
15	10.0	10.4	10.6	11.3
16	N/A	N/A	N/A	N/A

TABLE 144-B~~X2~~ ECONOMIZER TRADEOFF TABLE FOR ELECTRICALLY OPERATED UNITARY HEAT PUMPS

Climate Zone	Size Category		
	≥240,000	**≥135,000 and <240,000**	**≥65,000 and <135,000**
1	N/A	N/A	N/A
2	N/A	N/A	N/A
3	N/A	N/A	N/A
4	11.7	12.1	N/A
5	N/A	N/A	N/A
6	N/A	N/A	N/A
7	12.3	N/A	N/A
8	11.7	12.0	N/A
9	11.3	11.7	12.5
10	11.1	11.5	12.3
11	11.3	11.6	12.4
12	11.5	11.8	N/A
13	10.9	11.3	12.1
14	11.5	11.8	N/A
15	9.8	10.1	11.1
16	N/A	N/A	N/A

TABLE 144-C~~X3~~ AIR ECONOMIZER HIGH LIMIT SHUT OFF CONTROL REQUIREMENTS

Device Type	**Climate Zones**	**Required High Limit (Economizer Off When):**	
		Equation	**Description**
Fixed Dry Bulb	1, 2, 3, 5, 11, 13, 14, 15 & 16	T_{OA} > 75°°F	Outside air temperature exceeds 75°F
	4, 6, 7, 8, 9, 10 & 12	T_{OA} > 70°°F	Outside air temperature exceeds 70°F
Differential Dry Bulb	All	$T_{OA} > T_{RA}$	Outside air temperature exceeds return air temperature
Fixed Enthalpy[a]	4, 6, 7, 8, 9, 10 & 12	h_{OA} > 28 Btu/lb[b]	Outside air enthalpy exceeds 28 Btu/lb of dry air[b]
Electronic Enthalpy	All	$(T_{OA}, RH_{OA}) > A$	Outside air temperature/RH exceeds the "A" set-point curve[c]
Differential Enthalpy	All	$h_{OA} > h_{RA}$	Outside air enthalpy exceeds return air enthalpy

[a] Fixed Enthalpy Controls are prohibited in climate zones 1, 2, 3, 5, 11, 13, 14, 15 & 16.

[b] 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 6000 foot elevation the fixed enthalpy limit is approximately 30.7 Btu/lb.

[c] Set point "A" corresponds to a curve on the psychometric chart that goes through a point at approximately 75°F and 40% relative humidity and is nearly parallel to dry bulb lines at low humidity levels and nearly parallel to enthalpy lines at high humidity levels.

(f) **Supply Air Temperature Reset Controls**. Mechanical space-conditioning systems supplying heated or cooled air to multiple zones shall include controls that automatically reset supply-air temperatures:

1. In response to representative building loads or to outdoor air temperature; and
2. By at least 25 percent of the difference between the design supply-air temperature and the design room air temperature.

Air distribution to zones that are likely to have constant loads, such as interior zones, shall be designed for the fully reset supply temperature.

EXCEPTION 1 to Section 144 (f): Systems that meet the requirements of Section 144 (d), without using Exception 1 or 2 to that section.

EXCEPTION 2 to Section 144 (f): Where supply-air temperature reset would increase overall building energy use.

EXCEPTION 3 to Section 144 (f): Zones in which specific humidity levels are required to satisfy process needs.

(g) **Electric Resistance Heating**. Electric resistance heating systems shall not be used for space heating.

EXCEPTION 1 to Section 144 (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 144 (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 144 (a) at the design outdoor temperature specified in Section 144 (b) 4.

EXCEPTION 3 to Section 144 (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 144 (g): Where the total capacity of all electric-resistance heating systems serving the building, excluding those allowed under Exception 2, is no more than 3 kW.

EXCEPTION 5 to Section 144 (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 System ~~Controls~~s.

1 **General.** Subsection 144(h) applies to heat rejection equipment used in comfort cooling systems such as air-cooled condensers, open cooling towers, closed-circuit cooling towers, and evaporative condensers.

2 **Fan Speed Control.** Each fan powered by a motor of 7.5 hp (5.6 kW) or larger shall have the capability to operate that fan at two-thirds of full speed or less, and shall have controls that automatically change the fan speed to control the leaving fluid temperature or condensing temperature/pressure of the heat rejection device.

EXCEPTION 1 to Section 144 (h) 2: Heat rejection devices included as an integral part of the equipment listed in Tables 1-C1 through 1-C4.

EXCEPTION 2 to Section 144 (h) 2: Condenser fans serving multiple refrigerant circuits.

EXCEPTION 3 to Section 144 (h) 2: Condenser fans serving flooded condensers.

EXCEPTION 4 to Section 144 (h) 2: Up to 1/3 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**.[91] 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's produced by the smallest pump, or

B. 33% of the design flow for the cell.

4 **Limitation on Centrifugal Fan Cooling Towers.**[92] Open cooling towers serving cooling loads 300 tons and greater shall use propeller fans not centrifugal fans.

EXCEPTION 1 to Section 144 (h) 4: Cooling towers that are ducted (inlet or discharge) or have an external sound trap that requires external static pressure capability. [93]

EXCEPTION 2 to Section 144 (h) 4: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 112, TABLE 112-H.

(i) **Limitation of Air-Cooled Chillers**[94]

1. Chilled water plants with more than 300 tons total capacity shall not have more than 100 tons provided by air-cooled chillers.

EXCEPTION 1 to Section 144 (i): The water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled equipment, as demonstrated by the designer.

EXCEPTION 2 to Section 144 (i): Plants that employ a cooling thermal energy storage system.

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91 The justification for this change appears in Pacific Gas and Electric Company, *Cooling Towers*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, April 8, 2002. Presented at the April 23, 2002 workshop.

92 The justification for this change appears in New Buildings Institute, Inc., *Acceptance Requirements for Nonresidential Buildings, Nonresidential Quality Assurance Project*, April 8, 2002. Presented at the April 22, 2002 workshop.

93 This wording was changed to clarify unavoidable design reasons for the application of centrifugal fan towers.

94 The justification for this change appears in Pacific Gas and Electric Company, *Cooling Towers*, *Codes and Standards Enhancement Report, 2005 Title 24 Building Energy Efficiency Standards Update*, April 8, 2002. Presented at the April 23, 2002 workshop.

(j) **Hydronic System Measures**[95]

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% 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 to Section 144 (j) 1: Systems that include no more than three control valves.

2. **Chiller Isolation.** When a chilled water plant 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.** Chilled and hot water systems with a design capacity exceeding 500,000 Btu/h supplying chilled or heated water (or both) shall include controls that automatically reset supply water temperatures as a function of representative building loads or outside air temperature.

   EXCEPTION to Section 144 (j) 4: Hydronic systems that use variable flow to reduce pumping energy in accordance with 144(j) 1.

5. **Water Loop Heat Pump Systems.** Water-Loop Heat Pump Systems having a total pump system power exceeding 5 hp shall have flow controls that meet the requirements of 144(j) 6. Each heat pump shall have a two-position automatic valve interlocked to shut off water flow when the compressor is off.

6. **Variable Speed Drives**. Individual pumps serving variable flow systems and having a motor horsepower exceeding 5 hp shall have controls and/or devices (such as variable speed control) that will result in pump motor demand of no more than 30% of design wattage at 50% of design water flow. The controls or devices shall be controlled as a function of desired flow or to maintain a minimum required differential pressure. Differential pressure shall be measured at or near the most remote heat exchanger or the heat exchanger requiring the greatest differential pressure.

   EXCEPTION 1 to Section 144 (j) 6:[96] Heating hot water systems.

   EXCEPTION 2 to Section 144 (j) 6: Condenser water systems serving only water-cooled chillers.

(k) **Air Distribution System Duct Leakage Sealing.**[97] All duct systems shall be sealed to a leakage rate not to exceed 6% of the total measured fan flow if the duct system:

1. Is connected to a constant volume, single zone, air conditioners, heat pumps or furnaces, and
2. Serving less than 5,000 square feet of floor area; and
3. Having more than 25% duct surface area located in one or more of the following spaces:

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95 The justification for the changes in Section 144 (j) appear in Eley Associates, "Hydronic System Measures," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part II*, May 16, 2002, p. 14-33. Presented at the May 30, 2002 workshop.

96 These exceptions were added in response to comments received by Mark Hydeman in presentations to ASHRAE groups after the May 30th workshop. Variable speed drives do no pay back on heating systems as the additional pump heat of riding the curve provides a beneficial heat gain to the hot water that reduces boiler usage. The exception for condenser water systems for chillers recognizes the need to maintain higher flows on chiller condenser water systems to maintain equipment flow limits and to prevent deposits from settling out in the condenser barrels.

97 The justification for this change appears in Pacific Gas and Electric Company, *Nonresidential Duct Sealing and Insulation*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, July 2, 2002. Presented at the July 18, 2002 workshop.

A. Outdoors, or

B. In a space between the roof and an insulated ceiling, or

C. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces, or

D. In an unconditioned crawlspace; or

E. In other unconditioned spaces.

The leakage rate shall be confirmed through field verification and diagnostic testing, in accordance with procedures set forth in the Nonresidential ACM Manual.[98]

(l) **Air Distribution System Duct and Plenum Acceptance[99].** Before an occupancy permit is granted for a new building or space, or a new space-conditioning or ventilating system serving a building or space is operated for normal use, all air distribution system ducts and plenums serving the building or space shall be certified as meeting the Acceptance Requirements for Code Compliance. A Certificate of Acceptance shall be submitted to the building department that:

1. Certifies plans, specifications, installation certificates, and operating and maintenance information meet the requirements of Part 6.

2. Certifies that air distribution ducts and plenums meet the requirements of Section 124 (a) through Section 124 (j).

3. Certifies that air distribution ducts meet the requirements of Section 144(k).

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[98] The justification for this change appears in New Buildings Institute, Inc., *Acceptance Requirements for Nonresidential Buildings, Nonresidential Quality Assurance Project*, April 8, 2002. Presented at the April 22, 2002 workshop.

[99] Ibid.

SECTION 145 – PRESCRIPTIVE REQUIREMENTS FOR SERVICE WATER-HEATING SYSTEMS

(a) **Nonresidential and Hotel/Motel Occupancies**. A service water-heating system installed in a nonresidential or hotel/motel building complies with this section if it complies with the applicable requirements of Sections 111, 113, and 123.

(b) **High-rise Residential Occupancies**. A service-water heating system installed in a high-rise residential building complies with this section if it complies with Section 151 (f) 8.

SECTION 146 – PRESCRIPTIVE REQUIREMENTS FOR INTERIOR LIGHTING

A building complies with this section if either the building employs specific interior lighting systems applied in the manner specified by Subsection (a); or if the building's actual interior lighting power calculated under Subsection (b) is no greater than the allowed interior lighting power calculated under Subsection (c).

(a) **Specific Common Lighting Systems**.[100] All luminaries; lamps and lighting systems used in the building shall comply with Subsections 1 through 6.

1. Allowed Building Types. This method shall only be used to demonstrate compliance for a building or project under the same building permit for building types listed in TABLE 146-C having a minimum allowed power of 1.0 w/ft^2.

2. Allowed Luminaries. Luminaires shall consist of any one type of luminaire, plus exit signs, installed as described in TABLE 146-A. Spacing measurements are taken from the plan view center of the luminaire. Luminaires shall be mounted at least 1/3 of the indicated mounting distance away from any ceiling-high partition.

3. More than One Type of Luminaire. If more than one type of luminaire (excluding exit signs) is to be located within one space enclosed with ceiling high partitions, the spacing between different luminaires shall be the larger of the required spacings for the two luminaires in TABLE 146-A.

4. Prohibited luminaires. None of the following luminaires shall be employed in the building:

   A. Luminaires employing Edison base line voltage sockets.

   B. Luminaires designed for low voltage lamps, incandescent or halogen, exceeding 75 watts.

   C. Track lighting systems of any kind or voltage of operation.

   D. Line voltage monopoints permitting the installation of track luminaires.

   EXCEPTION 1 to Section 146 (a) 4: Normally off emergency lighting systems required by code and not used except under a power outage or in emergency conditions.

   EXCEPTION 2 to Section 146 (a) 4: Up to 5% of the total luminaires of the project (by count) may be hardwired luminaires of any type rated not more than 150 watts. Track lighting shall not be permitted.

5. Permanent Lighting. A complete and permanent lighting system shall be installed. Additional lighting, such as lighting within furniture systems, shall not be installed in the space.

   EXCEPTION to Section 146 (a) 5: Undercabinet luminaires when attached to the underside of modular furniture overhead cabinets, bins or shelves and complying with the requirements for undercabinet luminaires in TABLE 146-A.

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[100] Proposed in MEASURE IDENTIFICATION and ANALYSIS PLAN, Eley Associates November 8, 2001. For these changes, reference the Proposal Template from the November 15 & 16 workshops.

TABLE 146-A LIGHTING SYSTEMS PERMITTED UNDER SECTION 146 (A)

Luminaire Type	**Maximum Lamp Watts**	**Spacing between luminaires in plan view (OC = on centers)[101]**	**Other limits**
Single lamp fluorescent with electronic ballast	32	One luminaire in a closet, electric room, or other small space	Maximum 35 input watts to luminaire
Two lamp fluorescent with electronic ballast	32 each	One luminaire per vanity in a toilet room or locker room; or one luminaire per landing in a stairwell.	Maximum 60 input watts to luminaire
Nominal 4ft recessed or surface mounted fluorescent troffer, wraparound, strip lights, with electronic ballast	1 or 2 lamps totaling 64 rated watts or less	No less than 8 ft OC	Maximum 60 input watts to luminaire
Recessed, surface or suspended fluorescent uplights, industrials, wraparounds, strip lights, consisting of nominal 4ft sections in continuous rows with electronic ballast(s)	1 or 2 lamps totaling 64 watts or less	Continuous rows no closer than 15 ft apart	Maximum 60 input watts per 4 ft unit
High intensity discharge or induction lamp lighting systems (or multiple compact fluorescent lamp systems of equivalent lamp watts with electronic ballasts)	1 lamp 100 watts or less 1 lamp 150 watts or less 1 lamp 250 watts or less 1 lamp 400 watts or less	No less than 12 ft OC No less than 15 ft OC No less than 18 ft OC Not less than 22 ft OC	
Compact fluorescent (including twin tube) or metal halide downlights, wallwashers, monopoints and similar directional luminaires	1 lamp 40 watts or less 1 lamp 60 watts or less 1 lamp 80 watts or less 1 lamp 100 watts or less	No less than 6 ft OC No less than 8 ft OC Not less than 10 ft OC No less than 12 ft OC	
Hardwired undercabinet or undershelf fluorescent luminaires nominal 2 ft, 3 ft or 4 ft in length and employing an electronic ballast	No greater than 8.5 watts per foot of luminaire	When mounted underneath permanent overhead cabinets.	Luminaires may be mounted end-to-end if needed to accommodate cabinet length
Low-voltage downlights, accent lights or monopoint lights having an integral transformer	Rated at 50 watts or less	No less than 8 ft OC	
Sconces, pendants and other decorative lighting employing compact fluorescent, metal halide or fluorescent lamps and electronic ballasts	Total lamp watts 90 or less Total lamp watts 175 or less	No less than 10 ft OC No less than 15 ft OC	
Exit signs	Rated 5 watts or less	As required	

~~A building complies with this section if its actual lighting power density calculated under Subsection (a) is no greater than the allowed lighting power density calculated under Subsection (b).~~

(~~a~~b) Calculation of Actual Interior[102] Lighting Power Density. The actual interior lighting power of the proposed building area is the total watts of all planned permanent and portable lighting systems (including but not limited to, track and flexible lighting systems, lighting that is integral with modular furniture, workstation task lights, portable freestanding lights, lights attached to workstation panels, movable displays and cabinets, and internally illuminated case work for task or display purposes), subject to the following specific requirements and adjustments under Subsections 1 through 6.

1. In office areas, if the actual watts of portable lighting are not known at the time of permitting, the actual lighting power for portable and integral lighting shall be determined using either A or B following. However, upon installation of the portable lighting systems the building official may require resubmittal of compliance documentation using installed lighting and equipment data.

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[101] Luminaires shall be mounted at least 1/3 of the specified mounting distance away from any ceiling-high partition.

[102] This change is based on Eley Associates, *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002. Presented at the June 18, 2002 workshop.

A. In office areas greater than 250 square feet with permanently installed lighting systems, a portable lighting power of 0.2 watts per square foot shall be included in calculation of actual lighting power density.

B. In office areas of 250 square feet or less, no additional task lighting power will be required in the calculation of actual lighting power.

2. In office areas greater than 250 square feet with permanently installed lighting systems, if sufficient supporting evidence is submitted and accepted by the building official, the actual lighting power for portable lighting shall be included in the calculation of actual lighting power. The individual signing the lighting plans, pursuant to Division 3 of the California Business and Professions Code, must clearly indicate on the plans the actual lighting power for the portable lighting systems in the area.

3. Multiple interlocked lighting systems serving a space. When multiple interlocked lighting systems serve a space, the watts of all systems except the system with the highest wattage may be excluded if:

A. The lighting systems are interlocked to prevent simultaneous operation; or

B. The lighting systems are controlled by a preset dimming system or other device that prevents simultaneous operation of more than one lighting system, except under the direct control of authorized personnel.

4. Reduction of wattage through controls. The controlled watts of any luminaire ~~that is controlled~~ may be reduced by the number of controlled watts times the applicable factor from TABLE 146-B~~Table 1-L~~ if:

A. The control complies with Section 119; and

B. At least 50 percent of the light output of the luminaire is within the applicable space listed in TABLE 146-B~~Table 1-L~~; and

C. Except as noted in TABLE 146-B~~Table 1-L~~, only one power adjustment factor is used for the luminaire; and

D. For daylighting control credits, the luminaire is controlled by the daylighting control, and the luminaire is located within the daylit area. For areas required by Section 131(b) to have either a multi-level astronomical time-switch control or an automatic multi-level daylighting control, only one half of the automatic multi-level daylighting control power adjustment factor may be taken.

E. For motion sensors used to qualify for the Power Adjustment Factor in small office spaces greater than 250 square feet, the motion sensor shall have either an automatic or a manually controlled ON function, and have wiring capabilities so that each switch function activates half of the lights. The control shall be capable of the following operating sequence.

i. The first stage activates no more than 50% of the lights in a room either through an automatic action or the pressing of a switch by occupant. After that event occurs the following actions shall be assigned to occur when manually called to do so by the occupant;

ii. Activating the alternate set of lights;

iii. Activating 100% of the lights;

iv. Deactivating all lights.

5. Lighting wattage excluded. The watts of the following lighting applications may be excluded from the actual lighting power ~~density~~ of the building:

A. In theme parks: l~~L~~ighting for ~~theme parks and~~ themes and special effects; ~~lighting for dance floors;~~

B. Lighting for film, video or photography studios

C. Lighting for dance floors, lighting for theatrical and other live performances, provided that these lighting systems are additions to a general lighting system and are controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators ~~performances~~;

D. In exhibit, convention, and hotel function areas: lighting for exhibits, if the lighting is an addition to a general lighting system and is separately controlled from a panel accessible only to authorized operators ~~and if the lighting is controlled by a multiscene or theatrical cross-fade control station accessible only to authorized operators~~;

~~D~~E. Specialized local lighting installed in nonlighting equipment by its manufacturer;

~~E~~F. In medical and clinical buildings:~~,~~ examination and surgical lights, low-level night lights, and lighting integral to medical equipment;

~~F~~G. In restaurant buildings and areas:~~,~~ lighting for food warming or integral to food preparation equipment;

~~G~~H. Interior lighting in refrigerated cases;

~~H~~I. Lighting for plant growth or maintenance, if it is equipped with an automatic 24-hour time switch that has program backup capabilities that prevent the loss of the switch's program and time setting for at least 10 hours if power is interrupted;

~~I~~J. Lighting equipment that is for sale;

~~J~~K. Lighting demonstration equipment in lighting education facilities;

~~K~~L. Lighting that is required for exit signs subject to Section 1013 of the UBC if it has an input power rating of five watts per illuminated face or less;

~~L~~M. Exitway or egress illumination that is normally off and that is subject to Section 1012 of the UBC;

~~M. Exitway or egress lighting whose switching is regulated by Article 3-700 of the California Electrical Code (Title 24, Part 3;~~

N. In hotel/motel buildings: lighting in guest rooms;

O. In high-rise residential buildings: lighting in living quarters;

P. The lighting system using the least wattage in a redundant lighting system interlocked or otherwise controlled to prohibit simultaneous operation of more than one lighting system.

Q. Lighting in occupancy group U buildings less than 1000 square feet.

R. Lighting in unconditioned agricultural buildings less than 2500 square feet.

S. Lighting systems in qualified historic buildings, as defined in the State Historic Building Code (Title 24, Part 8), are exempt from the lighting power allowances in Title 24 part 6, 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 from Title 24 part 6. All other lighting systems in qualified historic buildings shall comply with the lighting power requirements of Title 24 part 6.

6. Lighting fixtures. The watts of track and other lighting fixtures that allow the substitution of low efficacy sources for high efficacy sources without altering the wiring of the fixture shall be determined in accordance with Section 130 (d) or by a method approved by the commission.

(~~b~~c) Calculation of Allowed Interior[103] Lighting Power Density. The allowed interior lighting power density for each application for a building permit shall be calculated using one and only one of the methods in Subsection 1, 2, or 3, as applicable.

1. Complete building method. The Complete Building Method may be used only on projects involving entire buildings with one occupancy type or mixed occupancy buildings where one occupancy makes up 90 percent ~~of the conditioned floor area~~ of the entire building. This approach may only be used when the applicant is applying for a lighting permit for, and submits plans and specifications for, the entire building. Under this approach, the allowed lighting power density is the lighting power density value in TABLE 146-C ~~Table 1-M~~ times the ~~conditioned~~ floor area of the entire building. Hotel/motel and high-rise residential buildings shall not use this method. Retail and wholesale buildings may use this method only if the sales area is 30% or greater of the building area.

[103] This change is based on Eley Associates, *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002. Presented at the June 18, 2002 workshop.

EXCEPTION to 146 (c) 1:. The Complete Building Method may be used on a project meeting the requirements above but including covered parking. In such case, the allowed lighting power for the parking area shall be separately calculated from the allowed power for the remainder of the building.[104]

2. Area category method. -Under the Area Category Method, the total allowed lighting power for the building is the sum of all allowed lighting powers for all areas in the building. For purposes of the area Category Method, an "area" shall be defined as all contiguous spaces which accommodate or are associated with a single one of the primary functions listed in TABLE 146-D~~Table 1-N~~. Where areas are bounded or separated by interior partitions, the floor space occupied by those interior partitions shall be included in any area. When the Area Category Method is used to calculate the allowed total lighting power for an entire building, main entry lobbies, corridors, restrooms, and support functions shall be treated as separate areas.

   EXCEPTION to Section 146 (~~b~~c) 2: ~~:~~ The tailored method [Section 146 (b) 3] may be used for up to 10 percent of the floor area of a building that is otherwise using the Area Category Method. The two lighting methods cannot be used for the same floor area. The floor area for calculations based on the Tailored Method must be subtracted from the floor area for the remainder of the building lighting calculations. Trade-offs of lighting between the two methods is not allowed.

3. Tailored method. Under the Tailored Method, the allowed interior lighting power shall be calculated as specified in Subsections (c)3. A. ("Method A") or B ("Method B") according to building type as permitted in column 1 of TABLE 146-E. If TABLE 146-E permits "A or B" for the building type being designed, the lighting power for each space may use either Method A or Method B.

   A. IESNA Illuminance Category Method (Method A). Calculate the allowed interior lighting power as follows:

      i. Determine the category for each lighting task according to categories specified in the IESNA Lighting Handbook, Ninth Edition, using the "Design Guide" for horizontal illumination. It is permissible to have more than one task type in a space. For spaces employing tasks E, F, or G, submit plans under Section 10-103 of Title 24, Part 1 clearly identifying all task spaces for such categories and the lighting designed to illuminate them. Tasks that are performed less than two hours a day may not be employed to justify use of E, F, or G.

      ii. Determine the area of each task. Areas without tasks shall be identified as non-task. The total of all task areas and non-task areas shall be equal to the area of the space.

      iii. Determine the room cavity ratio (RCR) and area of each space. The RCR shall be calculated using the heights and dimensions of the perimeter walls and ceiling of the space and the height of the task surface.

      For rectangular rooms, RCR is $\frac{5H(L+H)}{LW}$

      or

      For irregular-shaped rooms, RCR is $\frac{2.5H \times P}{A}$

      WHERE:

      L = Length of room.

      W = Width of room.

      H = Vertical distance from the work plane to the center line of the lighting fixture.

      P = Perimeter of room.

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[104] This change is based on Eley Associates, *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002. Presented at the June 18, 2002 workshop.

A = Area of room.

iv. Multiply the area of each task by the allowed lighting power density for the task according to TABLE 146-G. The product, or the actual installed lighting power for the task, whichever is less, is the allowed lighting power for the task.

v. For non-task areas, the allowed lighting power density shall be 50% of the adjacent task area or that permitted for Category D, whichever is lower. Multiply the non-task area by the allowed lighting power density.

vi. Add the allowed lighting power of all tasks and non-task areas. This is the Allowed Lighting Power for the Space.

B. Display Lighting Method (Method B). Calculate the allowed interior lighting power as follows:

i. Determine the room cavity ratio (RCR) and area of each space. The RCR shall be calculated using the heights and dimensions of the perimeter walls and ceiling of the space and assuming a task height of 30" above finished floor.

ii. Determine the allowed general interior lighting power by multiplying the area of the space by 1.2 w/sf for rooms with RCR<3.5; by 1.4 w/sf for rooms with RCR between 3.5 and 7.0; and by 1.6 w/sf for rooms with RCR > 70.

iii. Separate wall display lighting power is permitted. The allowed wall display lighting power is the smaller of:

a. The product of the room wall lengths and the listed allowed power density (w/ft) in column 2 of TABLE 146-E, if applicable, or

b. The actual power of wall lighting systems.

The length of display walls shall include the length of the perimeter walls, including closable openings, permanent full height interior partitions[lb165]. For mounting height of display [CEC166]lighting 13' above the finished floor or higher, this amount may be increased by multiplying the product by the appropriate factor from TABLE 146-F. Qualifying wall lighting systems shall be mounted within 72" of the wall[CEC167] and shall be of a lighting system type appropriate for wall lighting including a lighting track, wallwasher, valance, cove, or adjustable accent light.

iv. Separate general display lighting power is allowed. The allowed general display lighting power is the smaller of:

1) The product of the area of the space and the allowed general display lighting power density listed in column 3 of TABLE 146-E, if applicable, or

2) The actual power of general display lighting systems.

For mounting height of display lighting 13' above finished floor or higher, this amount may be increased by multiplying the product by the appropriate factor from TABLE 146-F. Qualifying general display lighting systems shall be mounted no closer than 72" to a wall[105] and shall be a lighting system type such as track lighting, adjustable or fixed luminaires with PAR, R, MR, AR, or other projector lamp types or employing optics providing directional display light from non-directional lamps. Except for lighting for very valuable merchandise as defined below, lighting mounted inside of display cases shall also be considered general display lighting.

v. Separate ornamental/special effects lighting power is permitted if allowed by column 4 of TABLE 146-E. If so, the allowed ornamental/special effects lighting power is the smaller of: [106]

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[105]. Coordinates with iii. Defines the perimeter 6 ft band as "wall lighting" and the interior as "general display lighting".

[106] This permits retailers and others to substitute "special effects" lighting for ornamental. Special effects lighting includes theatrical lighting and other non-display lighting.

a. 0.7 watt per square foot and the area of the space, or

b. The actual power of allowed ornamental/special effects lighting luminaires.

Qualifying ornamental luminaires include chandeliers, sconces, lanterns, neon and cold cathode, unfiltered light emitting diodes, theatrical projectors, moving lights, and light color panels when used in a decorative manner that does not serve as display lighting. Ornamental/special effects lighting cannot be the only light source in the space.

vi. Separate lighting power for very valuable displays is allowed. The allowed lighting power for very valuable displays is the smaller of:

a. The product of the area of the display case and the allowed very valuable lighting power density according to column 5 of TABLE 146-E, if applicable, or

b. The actual power of lighting for very valuable displays.

Qualifying lighting includes internal display case lighting or external lighting employing highly directional luminaires specifically designed to illuminate the case without spill light. To qualify for this allowance, cases shall contain jewelry, fine china or crystal, precious stones, sterling silver, art and artifacts, and/or valuable collections. Additional power for very valuable merchandise may be obtained by trading off against the general display lighting power allowance.

vii. Only the general portion of the lighting power determined in (ii) above may be used for tradeoffs among the various occupancy or task types of the permitted space. The allowed wall display lighting power, the allowed general display lighting power, the allowed ornamental/special effect lighting power, and the allowed lighting power for very valuable displays are "use it or lose it" power allowances that may not be traded off.

~~3.3. **Tailored method**. Under the Tailored Method, the allowed lighting power density shall be calculated as specified in Subsections (b) 3 A through I. Figure 1-B provides a flow chart of the calculations.~~

~~A. Determine the illuminance category of each task space according to Table 1-P or, if the task is not listed in the table, according to the IES Handbook, Applications Volume (1987 edition), incorporated herein by reference.~~

~~Selection of each illuminance category shall be justified on the plans submitted under Section 10-103 of Title 24, Part 1. Categories E through I may be used only if the plans submitted under Section 10-103 of Title 24, Part 1 clearly identify all task spaces for such categories and the lighting designed to illuminate them.~~

~~B. Determine the lighting power density value of each task space for Categories A through D according to Table 1-S.~~

~~C. Determine the lighting power density value of each task space for Categories E through I according to Table 1-S.~~

~~D. Determine the area, in square feet and as measured from the middle of interior partitions, of each task space that has a separate illuminance requirement. The illuminance category of the following spaces shall be limited as stated:~~

~~i. **Gross sales floor area.** The gross sales floor area shall be no more than 2.0 watts per square foot, plus the allocation for sales feature floor displays.~~

~~ii. **Sales feature floor displays.** Illuminance Category G may be used for no more than 10 percent of the gross sales floor area of the building.~~

~~**EXCEPTION to Section 146 (b) 3 D ii:** For sales feature floor display lighting in stores with less than 800 square feet of gross sales area, 1000 watts may be used.~~

~~iii. **Gross sales wall area.** Gross sales wall areas shall be no more than 2.0 watts per square foot, plus the allocation for sales feature wall displays.~~

~~iv. **Sales feature wall displays.** Illuminance Category G may be used for no more than 10 percent of the gross sales wall area.~~

~~v. **Private offices and work areas.** Illuminance Category E may be used for up to 50 percent of the actual private office or work area; the rest of the private office or work area shall be no more than 0.4 watts per square foot.~~

~~vi. **Public area displays.** Illuminance Category G may be used for no more than 10 percent of the public display area of the building.~~

~~E. Multiply the lighting power density value of each task space for Illuminance Categories A through D (from Item B) times the area of each task space (from Item D). For tasks where luminaires must be at or above a 15-foot mounting height, the result may be multiplied by the applicable figure from Table 1-R.~~

~~F. Multiply the lighting power density value of each task space for Illuminance Categories E through I (from Item C) times the area of each task space (from Item D). For tasks where luminaires must be at or above a 15-foot mounting height, the result may be multiplied by the applicable figure from Table 1-R.~~

~~G. For each task space, choose the smaller of:~~

~~i. The result in Item E plus the result in Item F; or~~

~~ii. The result in Item E plus the actual design watts of the lighting equipment used for task spaces for Illuminance Categories E through I and the gross sales wall area.~~

~~H. The values obtained in Item G may be increased by the following:~~

~~i. **Very valuable merchandise**. For lighting of very valuable merchandise, the smaller of:~~

~~a. 20 watts per square foot times the area of lighted case top; or~~

~~b. The actual design wattage of the lighting equipment for the merchandise.~~

~~ii. **Ornamental chandeliers and sconces**. For ornamental chandeliers and sconces in performance theater, religious worship, auditorium, mall, hotel function area, and lobby occupancy types, the smaller of:~~

~~a. 20 watts per cubic foot times the volume of the chandelier or sconce; or~~

~~b. One watt per square foot times the area of the task space that the chandelier or sconce is in; or~~

~~c. The actual design wattage of the chandelier or sconce.~~

~~I. Add the results in Item G for all task spaces in the building plus the additional watts allowed in Item H. The result is the allowed lighting power of the building under the Tailored Method.~~

TABLE 146-B~~L~~ LIGHTING POWER ADJUSTMENT FACTORS[107][108]

TYPE OF CONTROL	TYPE OF SPACE	FACTOR
Occupant sensor with "manual ON" or bi-level 50% automatic ON combined with multi-level circuitry and switching from a single switch point ~~Occupant sensor~~ ~~With separate sensor for each space~~	Any space ≤ 250 square feet enclosed by opaque floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room ~~Rooms of any size that are used exclusively for storage~~ ~~Greater than 250 square feet~~	0.20 ~~0.60~~ ~~0.10~~
Occupant sensor controlled multi-level switching or dimming system that reduces lighting power at least 50% when no persons are present	Hallways of hotels/motels Commercial and Industrial Storage stack areas (max. 2 aisles per sensor) Library Stacks (maximum 2 aisles per sensor)	.25 .15 .15
Dimming system Manual Multiscene programmable	 Hotels/motels, restaurants, auditoriums, theaters Hotels/motels, restaurants, auditoriums, theaters	 0.10 0.20
Manual dimming with automatic load control[109] of dimmable electronic ballasts[110].	All building types	.25
~~Tuning~~	~~Any space~~	~~0.10~~
~~Automatic time switch control device~~	~~< 250 square feet and with a timed manual override at each switch location required by Section 131 (a), and controlling only the lights in the area enclosed by ceiling-height partitions.~~	~~0.05~~
~~Combined controls~~ ~~Occupant sensor with programmable multiscene dimming system~~ ~~Occupant sensor with a separate sensor for each space used in conjunction with daylighting controls and separate sensor for each space~~	 ~~Hotels/motels, restaurants, auditoriums, theaters~~ ~~Any space ≤ 250 square feet within a daylit area and enclosed by opaque floor-to-ceiling partitions~~	 ~~0.35~~ ~~0.10 (may be added to daylighting control credit)~~
Combined controls Occupant sensor With "manual ON" or bi-level 50% automatic ON combined with multi-level circuitry and switching from a single switch point in conjunction with daylighting controls Manual Dimming with Dimmable Electronic Ballasts and Occupant sensor with "manual ON" or automatic ON to less than 50% power and	 Any space ≤ 250 square feet within a daylit area and enclosed by opaque floor-to-ceiling partitions Any space ≤ 250 square feet enclosed by opaque floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room	 0.10 (may be added to daylighting control credit) 0.25

[107] This change based on Pacific Gas and Electric Company, *Bi-Level Lighting Control Credits*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, June 27, 2002. Presented at the July 18, 2002 workshop, plus additional research in Eley Associates, "Nonresidential Lighting Power Density," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part I*, April 11, 2002, p. 3-11. Presented at the April 23, 2002 workshop.

[108] This change is based on Group 4 changes from the November 15 & 16 workshops.

[109] Manual dimmers installed to meet Section 131(a) with central override of all dimmers through that will respond to a single contact closure.

[110] Dimmable electronic ballasts shall provide electrical outputs to lamps for reduced flicker operation through the dimming range without causing premature lamp failure and shall consume no more than 35% of rated power at minimum light output. The ballast shall be a high frequency electronic type and operate lamps above 20 kilohertz.

TYPE OF CONTROL	TYPE OF SPACE		FACTOR
switching from a single switch point			
Automatic Daylighting Controls with Windows (Stepped/Dimmed~~ing~~)			
	~~WINDOWS~~Window Wall Ratio		
Glazing Type - Windows	< 20%	20% to 40%	> 40%
VLT ≥ 60% VLT ≥ 35 and < 60% VLT < 35%	0.20/0.30 0/0 0/0	0.30/0.40 0.20/0.30 0/0	0.40/0.40 0.30/0.40 0.20/0.40
	~~SKYLIGHTSPercentage of Gross Exterior Roof Area~~		
~~Glazing Type~~	~~< 1%~~	~~1% to 3%~~	~~> 3%~~
~~VLT ≥ 60%~~ ~~VLT ≥ 35 and < 60%~~ ~~VLT < 35%~~	~~0/0.30~~ ~~0/0.20~~ ~~0/0.10~~	~~0.15/0.40~~ ~~0/0.30~~ ~~0/0.20~~	~~0.30/0.40~~ ~~0.15/0.40~~ ~~0/0.30~~
Automatic Multi-Level Daylighting Controls with Skylights			
Glazing Type - Skylights	Factor		
Glazing material or diffuser with ASTM D1003 haze measurement greater than 90%[111]	$\frac{20 \times \text{Effective Aperture} - \frac{\text{Lighting Power Density}}{10} + 0.2}{}$ WHERE Effective Aperture is as defined in Section 143(c)3A Lighting Power Density$_G$ is the lighting power density of general lighting		

TABLE 146-C~~A1~~ COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES (WATTS/FT²)[112]

TYPE OF USE	ALLOWED LIGHTING POWER
General commercial and industrial work buildings	
High bay	~~1.2~~1.1
Low bay	1.0
Precision	1.5
Grocery stores	1.5
Hotel	1.7
Industrial and commercial storage buildings	0.7
Medical buildings and clinics	~~1.2~~1.0
Office buildings	~~1.2~~1.1
Religious facilities	~~1.8~~1.6
Auditoriums	1.5
Convention centers	~~1.4~~1.3
Parking Garages	0.4[113]

[111] ASTM D1003-00 Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics, notwithstanding its scope or other test method approved by the California Energy Commission

[112] This change is based on Eley Associates, "Nonresidential Lighting Power Density," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part I*, April 11, 2002, p. 3-11. Presented at the April 23, 2002 workshop.

TYPE OF USE	ALLOWED LIGHTING POWER
Restaurants	1.2
Retail and wholesale stores*	~~1.7~~1.5
Schools	~~1.4~~1.2
Theaters	1.3
All others	0.6
* For retail and wholesale stores, the complete building method may only be used when the sales area is 30% or greater of the building space.	

TABLE 146-D~~N~~ AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)[114]

PRIMARY FUNCTION	ALLOWED LIGHTING POWER
Auditorium	~~2.0*~~1.7*
Auto repair	1.1~~1.2~~
~~Bank/financial institution~~	~~1.4~~
Financial Transactions	1.2*[115]
~~Classrooms, lecture, training, vocational room~~	~~1.6~~
Classrooms, lecture, training, vocational room	1.2
Civic Facilities	1.4*
Commercial and industrial storage	0.6
Convention, conference, multipurpose and meeting centers	1.4*~~1.5*~~
Corridors, restrooms, stairs and support areas	0.6
Dining	1.1*
Electrical, mechanical rooms	0.7
Exercise center, gymnasium	1.0
Exhibit, museum	2.0
General commercial and industrial work	
High bay	1.1~~1.2~~
Low bay	1.0
Precision	1.3
Grocery store	1.6
Housing, Public and Commons Areas	
Multi-family	1.0
Dormitory, Senior Housing	1.5
Hotel function area	2.0*~~2.2*~~

113 This change is based on Eley Associates, "Measure 1 – Unconditioned Buildings," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 11-16. Presented at the June 18, 2002 workshop. However the original model submitted 6/6/02 was based on using T8/T5 technologies and open strip lights. The model has been adjusted to utilize 70 MLPW lamps which include T5 twin, induction, and low wattage HID lamps which are more common in covered parking and operate at a wider temperature range. No change has been made to the CU of the luminaire – the CU of the SL strip in the model is similar in the application to the CU of a garage luminaire.

114 This change is based on Eley Associates, "Nonresidential Lighting Power Density," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part I*, April 11, 2002, p. 3-11. Presented at the April 23, 2002 workshop.

115 A chandelier allowance was added to Bank/Financial institution in consideration of design trends.

PRIMARY FUNCTION	ALLOWED LIGHTING POWER
Kitchen, food preparation	1.6~~1.7~~
Laundry	0.9
Library	
Reading areas	1.2
Stacks	1.5
Lobbies:	
Hotel lobby	1.7*
Main entry lobby	1.5*
Reception/waiting	1.1*
Locker/dressing room	0.8
Lounge/recreation	1.1
Malls, arcades and atria	1.2*
Medical and clinical care	1.2~~1.4~~
Office	1.2~~1.3~~
~~Precision commercial or industrial work~~	~~1.5~~
Parking garage	0.4
Religious worship (church)	1.9*
Retail sales, wholesale showrooms	1.8~~2.0~~
Transportation Facilities	1.2
Theaters	
Motion picture	0.9*[116]
Performance	1.4*
All other	0.6
* The smallest of the following values may be added to the allowed lighting power listed in TABLE 146-D ~~Table 1-N~~ for ornamental chandeliers and sconces that are switched or dimmed on circuits different from the circuits for general lighting: a. 20 watts per cubic foot times the volume of the chandelier or sconce; or b. One watt per square foot times the area of the task space that the chandelier or sconce is in; or c. The actual design wattage of the chandelier or sconce.	

[116] A chandelier allowance was added to the motion picture theater in consideration of design trends.

TABLE 146-E TAILORED METHOD SPECIAL LIGHTING POWER ALLOWANCES[117]

	1	2	3	4	5
Primary Function	Allowed Tailored Method	B Method Allowed Wall Display Power (W/ft)	B Method Allowed General Display Power (W/ft²)	B Method Allowed Ornamental /Special Effect Lighting (Y or N)	B Method Allowed Very Valuable Display Power (W/sf)
Auditorium	B	-	-	Y	-
Auto repair	A	-	-	-	-
Financial Transactions	A or B	3.5	.5	Y	-
Civic facilities	A or B	3.5	.5	Y	-
Classrooms, lecture, training, vocational room	A or B	7	-	N	-
Commercial and industrial storage	A	-	-	-	-
Convention, conference, multipurpose and meeting centers	A or B	7	.5	Y	
Corridors, restrooms, stairs and support areas	A	-	-	-	-
Dining	B	7	.5	Y	-
Electrical, mechanical rooms	A	-	-	-	-
Exercise center, gymnasium	A	-	-	-	-
Exhibit, museum	B	21.0	1.7	Y	1.4
General commercial and industrial work:					
High bay	A	-	-	-	-
Low bay	A	-	-	-	-
Precision	A	-	-	-	-
Grocery store	B	14	1.0	N	-
Housing, Public and Commons Areas					
Multi-family	A	-	-	Y	-
Dormitory, Senior Housing	A or B	-	-	Y	-
Hotel function area	B	3.5	.5	Y	-
Kitchen, food preparation	A	-	-	-	-
Laundry	A	-	-	-	-
Library					
Reading areas	A or B	-	-	Y	-
Stacks	A	-	-	-	-
Lobbies:					
Hotel lobby	B	7	.2	Y	-
Main entry lobby	B	7	.2	N	-
Reception/waiting	B	7	.2	Y	-
Locker/dressing room	A	-	-	-	-

[117] The changes to Tables 146-E, F, and G are based on Eley Associates, "Revised Tailored Method for Allowed Lighting Power," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 80-90. Presented at the July 18, 2002 workshop.

	1	2	3	4	5
Primary Function	Allowed Tailored Method	B Method Allowed Wall Display Power (W/ft)	B Method Allowed General Display Power (W/ft²)	B Method Allowed Ornamental /Special Effect Lighting (Y or N)	B Method Allowed Very Valuable Display Power (W/sf)
Lounge/recreation	B	7	-	Y	-
Malls, arcades and atria	A or B	3.5	.5	Y	-
Medical and clinical care	A	-	-	-	-
Office	A	-	-	-	-
Prisoner holding cell or jail	A	-	-	-	-
Police or fire stations	A	-	-	-	-
Post office	A	-	-	-	-
Religious worship (church)	B	7	.5	Y	0.4
Retail sales, wholesale showrooms	B	21.0	1.8	Y	1.4
Transportation facilities	A or B	3.5	-	Y	-
Theaters:					
Motion picture	B	7	-	Y	-
Performance	B	7	-	Y	-
All other	A	-	-	-	-

TABLE 146-F ADJUSTMENTS FOR MOUNTING HEIGHT ABOVE FLOOR

Height in feet above finished floor and bottom of luminaire(s)~~Height in feet above finished floor of luminaire(s)~~	**Multiply by**
12 or less	1.0
13	1.05
14	1.10
15	1.15
16	1.21
17	1.47
18	1.65
19	1.84
20 or more	2.04

TABLE 146-G ILLUMINANCE CATEGORIES A THROUGH G LIGHTING POWER DENSITY VALUES (WATTS/FT^2) [118]

IESNA Illuminance Category	**Description**	**RCR<3.5**	**3.5<RCR<7.0**	**RCR>7.0**
A	Public spaces	0.2	0.3	0.4
B	Simple orientation for short visits	0.4	0.5	0.7
C	Working spaces where simple visual tasks are performed	0.6	0.7	1.1
D	Performance of visual tasks of high contrast and large size	0.9	1.2	1.7
E	Performance of visual tasks of high contrast and small size, or of low contrast and large size	1.3	1.8	2.5
F	Performance of visual tasks of low contrast and small size	2.7	3.5	4.7
G	Visual tasks at or near threshold	8.1	10.5	13.7

~~*TABLE 1-S ILLUMINANCE CATEGORIES A THROUGH I LIGHTING POWER DENSITY VALUES (WATTS/FT.²)*~~

~~ILLUMINANCE CATEGORY~~	~~ROOM CAVITY RATIO~~		
	~~0 to < 3.5~~	~~≥ 3.5 to < 7~~	~~≥ 7 +~~
~~A~~ ~~B~~ ~~C~~ ~~D~~ ~~E~~	~~0.2~~ ~~0.4~~ ~~0.6~~ ~~0.99~~ ~~2.31~~	~~0.3~~ ~~0.5~~ ~~0.7~~ ~~1.24~~ ~~2.97~~	~~0.4~~ ~~0.7~~ ~~1.1~~ ~~1.49~~ ~~3.88~~
	~~Task area ≤ 2 ft.2 or throw distance > 8 ft.~~	~~Task area > 2 ft.2 or throw distance ≤ 8 ft.~~	
~~F~~ ~~G~~ ~~H~~ ~~I~~	~~9.0~~ ~~23.4~~ ~~56.7~~ ~~117.0~~	~~4.5~~ ~~11.7~~ ~~29.7~~ ~~58.5~~	

SECTION 147 — RESERVED.

SECTION 148 — RESERVED.

[118] Further revised in categories D and E to represent high efficacy general lighting systems. Category D using medium efficiency lighting systems (compact fluorescent downlights) used specifically only for general illumination allowance in Method B.

SUBCHAPTER 6
NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES—ADDITIONS, ALTERATIONS, AND REPAIRS

SECTION 149 – ADDITIONS, ALTERATIONS, AND REPAIRS TO EXISTING BUILDINGS THAT WILL BE NONRESIDENTIAL, HIGH-RISE RESIDENTIAL, AND HOTEL/MOTEL OCCUPANCIES

(a) **Additions**. Additions shall meet either Item 1 or 2 below.

1. **Prescriptive approach**. The envelope and lighting of the addition, and any newly installed space-conditioning or water-heating system serving the addition, shall meet the applicable requirements of Sections 110 through 139, and Sections 142 through 146.

2. **Performance approach**.

   A. The envelope and lighting of the addition, and any newly installed space-conditioning or water-heating system serving the addition, shall meet the applicable requirements of Sections 110 through 139; and

   B. Either:

      i. The addition alone shall comply with Section 141; or

      ii. The energy efficiency of the existing building shall be improved so that the entire building meets the energy budget in Section 141 that would apply to the entire building, if the existing building was unchanged and the addition alone complied with Item 1.

EXCEPTION 1 to Section 149 (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 through 129, or Sections 144 through 145.

EXCEPTION 2 to Section 149 (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 not to exceed 50 percent of the existing installed electric heating capacity in any one permit and the system need not comply with Section 144 (g). Additional electric reheat capacity in excess of 50 percent may be added subject to the requirements of the Section 144 (g).

(b) **Alterations.** Alterations to existing nonresidential, high-rise residential, or hotel/motel buildings or alterations in conjunction with a change in building occupancy to a nonresidential, high-rise residential, or hotel/motel occupancy not subject to Subsection (a) shall meet either Item 1, 2, or 3 below.

1. **Prescriptive approach.** The altered envelope, space conditioning, lighting and water heating components, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110 through 139~~2~~; and

   A. Alterations to the building envelope shall:

      i. Neither increase the overall heat gain nor increase the overall heat loss of the building envelope for which a permit is sought; or

      ii. Meet the requirements of Section 143 for the altered component; and

      EXCEPTION to Section 149 (b) 1 A (ii): When a portion of an entire building's fenestration is repaired or replaced, or 50 square feet or less of glass is added, compliance with the solar heat gain coefficient requirements of Section 143 is not required.

B. Replacements of the exterior surface of existing nonresidential low-sloped roofs where more than fifty percent of the roof or more than 2,000 square feet of roof, whichever is less, is being replaced shall meet the solar reflectance and thermal emittance requirements of Section 143 (a) 1. Roof replacements subject to this requirement shall include replacement of recovering of the exterior surface of the roof.[119]

EXCEPTION to Section 149 (b) 1 B: Built-up roof with rock or gravel surface.

~~B~~C. New space-conditioning systems shall meet the requirements of Section 144; and

~~C~~D. New lighting systems ~~installed in conjunction with an increase in conditioned floor area, such as adding a mezzanine,~~ [120]shall meet the requirements of Section 146; and

~~D~~E. Alterations to existing interior lighting systems that increase the connected lighting load or replace more than 50 percent of the lighting fixtures shall meet the requirements of Section 146; and

F. Alterations to existing outdoor lighting systems that increase the connected lighting load or replace more than 50 percent of the lighting fixtures shall meet the requirements of Section 133; and

~~E~~G. New service water-heating systems shall meet the requirements of Section 145.

~~**EXCEPTION to Section 149 (b) 1 A ii:** When a portion of an entire building's fenestration is repaired or replaced, or 50 square feet or less of glass is added, compliance with the solar heat gain coefficient requirements of Section 143 is not required.~~

2. **Performance approach.**

A. The altered envelope, spacing conditioning, lighting and water heating components, and any newly installed equipment serving the alteration, shall meet the applicable requirements of Sections 110 through 139; and

B. Either:

i. The permitted space alone shall comply with Section 141; or

ii. The energy efficiency of the existing building shall be improved so that the entire building meets the energy budget in Section 141 that would apply to the entire building, if the existing building was unchanged and the permitted space alone complied with Item i above.

~~3. **Semiconditioned nonresidential buildings.** The altered lighting components and any newly installed lighting equipment serving the alteration within an existing semiconditioned space, shall meet the applicable requirements of Sections 119, and 130 through 132. Alterations to existing lighting systems that increase the connected lighting load or replace more than 50 percent of the lighting fixtures shall meet the requirements of Section 146.~~[121]

EXCEPTION 1 to Section 149 (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 through 129 and Section 144 or 145.

EXCEPTION 2 to Section 149 (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 through 129 and Section 144 or 145.

EXCEPTION 3 to Section 149 (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 144

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[119] The justification for this change appears in: Pacific Gas and Electric Company, *Inclusion of Cool Roofs in Nonresidential Title 24 Prescriptive Requirements*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update,* August 18, 2002. Presented at the August 27, 2002 workshop.

[120] The CEC has the authority to set lighting standards for unconditioned buildings, per SB 5X.

[121] This is no longer needed because (b) applies to all buildings.

(g). Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of the Section 144 (g).

(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.

SUBCHAPTER 7
LOW-RISE RESIDENTIAL BUILDINGS –MANDATORY FEATURES AND DEVICES

SECTION 150 – MANDATORY FEATURES AND DEVICES

Any new construction in a low-rise residential building shall meet the requirements of this section.

(a) **Ceiling Insulation**. The opaque portions of ceilings separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of either Item 1 or 2 below:

1. Ceilings shall be insulated between wood-framing members with insulation resulting in an installed thermal resistance of R-19 or greater for the insulation alone.

   ALTERNATIVE to Section 150 (a) 1: Insulation which is not penetrated by framing members may meet an R-value equivalent to installing R-19 insulation between wood-framing members and accounting for the thermal effects of framing members.

2. The weighted average U-factor of ceilings shall not exceed the U-factor that would result from installing R-19 insulation between wood-framing members in the entire ceiling and accounting for the effects of framing members.

(b) **Loose-fill Insulation**. When loose-fill insulation is installed, the minimum installed weight per square foot shall conform with the insulation manufacturer's installed design weight per square foot at the manufacturer's labeled R-value.

(c) **Wall Insulation**. The opaque portions of frame walls separating conditioned spaces from unconditioned spaces or ambient air shall meet the requirements of either Item 1 or 2 below:

1. Wood-framed walls shall be insulated between framing members with insulation having an installed thermal resistance of R-13 or greater. Framed foundation walls of heated basements or heated crawl spaces shall be insulated above the adjacent outside ground line with insulation having an installed thermal resistance of at least R-13.

   ALTERNATIVE to Section 150 (c) 1: Insulation which is not penetrated by framing members may meet an R-value equivalent to installing R-13 insulation between wood-framing members and accounting for the thermal effects of framing members.

2. The weighted average U-factor of walls shall not exceed the U-factor that would result from installing R-13 insulation between wood-framing members and accounting for the effects of framing members.

(d) **Raised-floor Insulation.** Raised floors separating conditioned space from unconditioned space shall meet the requirements of either Item 1 or 2 below:

1. Floors shall be insulated between wood-framing members with insulation having an installed thermal resistance of R-13 or greater.

2. The weighted average U-factor of floor assemblies shall not exceed the U-factor that would result from installing R-13 insulation between wood-framing members and accounting for the effects of framing members.

   ALTERNATIVE to Section 150 (d) 1 and 2: Raised floor insulation may be omitted if the foundation walls are insulated to meet the wall insulation minimums shown in TABLE 151-B through TABLE 151-Q, a vapor barrier is placed over the entire floor of the crawl space, and vents are fitted with automatically operated louvers that are temperature actuated.

(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;

B. A combustion air intake to draw air from the outside of the building directly into the firebox, which is at least six 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 (e) 1 B: 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 (e) 1 C: 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 manufacturer's installation instructions or the California Mechanical Code.

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) **Infiltration Barrier**. If an infiltration barrier is installed to meet the requirements of Section 151, it must have an air porosity of less than 5 ft.³ per hour per square foot per inch of mercury pressure difference when tested in accordance with the requirements of ASTM E 283-91. If a vapor barrier functions as an infiltration barrier it shall be located on the conditioned side of the exterior framing.

(g) **Vapor Barriers**. In Climate Zones 14 and 16 shown in FIGURE 1~~0~~1-A, a vapor barrier shall be installed on the conditioned space side of all insulation in all exterior walls, unvented attics, and unvented crawl spaces to protect insulation from condensation.

If a building has a control ventilation crawl space, a vapor barrier shall be placed over the earth floor of the crawl space to reduce moisture entry and protect insulation from condensation, as specified in the alternative to Section 150 (d).

(h) **Space-conditioning Equipment.**[122]

1. **Building cooling and heating loads.**

Building heating and cooling loads ~~design heat loss rate and design heat gain rate~~ shall be determined using a method based on any one of the following:

A. The American Society of Heating, Refrigeration, and Air-conditioning Engineers (ASHRAE) Handbook and Product Directory, Equipment Volume (2000~~1996~~), HVAC Applications Volume (1999~~5~~), and Fundamentals Volume (2001~~1993~~), or

B. The Sheet Metal Air Conditioning Contractors National Association (SMACNA) Residential Comfort System Installation Standards Manual, 7th edition (1998) ~~Installation Standards for Residential Heating and Air Conditioning Systems~~, or

C. The Air Conditioning Contractors of America (ACCA) Manual J, Version 8 (2002).

The ~~design heat loss rate and design heat gain rate~~ cooling and heating loads are two of the criteria that shall be used for equipment sizing and selection.

NOTE to Section 150 (h) 1: Heating systems must meet the minimum heating capacity required by UBC Section 310.11. 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 70°F for heating and 75~~8~~°F for cooling. The outdoor design temperatures for heating shall be no lower than the Winter Median of Extremes column. The outdoor design temperatures for cooling shall be from the 0.5 percent Summer

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[122] The justification for changes in this section related to sizing appears in Eley Associates, "Maximum Allowable Cooling Capacity," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 6-16. Presented at the July 18, 2002 workshop.

Design Dry Bulb and the 0.5 percent Wet Bulb columns for cooling, based on percent-of-year in ASHRAE publication *SPCDX: Climate Data for Region X, Arizona, California, Hawaii, and Nevada*, 1982, and its supplement, 1994, incorporated herein by reference.

3. **Maximum allowable cooling capacity.**[123]

The maximum allowable cooling capacity shall be determined in accordance with procedures set forth in ACM RM-2005. If the maximum allowable cooling capacity is calculated for the entire building, the total installed cooling capacity shall not exceed the maximum allowable cooling capacity. If the maximum allowable cooling capacity is calculated for each zone or dwelling within a building that is served by its own cooling system, the installed cooling capacity for each cooling system shall not exceed the maximum allowable cooling capacity calculated for the cooling system. For buildings demonstrating compliance using the multiple orientation alternative of Section 151(c), the maximum allowable cooling capacity is the highest of the four cardinal orientations.

EXCEPTION 1 to Section 150 (h) ~~2~~3: If no cooling system is installed or if the installed system is not an electrically driven compression cooling system, the requirements of the section do not apply and the calculation of the maximum allowable cooling capacity is not required.

EXCEPTION 2 to Section 150 (h) ~~2~~3: The installed cooling capacity shall be permitted to exceed the maximum allowable cooling capacity if the electrical input of the oversized cooling system is less than or equal to the electrical input of a standard cooling system determined in accordance with ACM RM-2005.

(i) Setback Thermostats. All heating and/or cooling systems other than wood stoves shall have an automatic thermostat with a clock mechanism or other setback mechanism approved by the executive director that shuts the system off during periods of nonuse and that allows the building occupant to automatically set back the thermostat set points for at least two periods within 24 hours. Setback thermostats for heat pumps shall meet the requirements of Section 112(b).

EXCEPTION to Section 150 (i): Gravity gas wall heaters, gravity floor heaters, gravity room heaters, noncentral electric heaters, room air conditioners, and room air-conditioner heat pumps need not comply with this requirement. Additionally, room air-conditioner heat pumps need not comply with Section 112 (b). The resulting increase in energy use due to elimination of the setback thermostat shall be factored into the compliance analysis in accordance with a method prescribed by the executive director.

(j) Pipe and Tank Systems.

1. Storage tank insulation.

   A. Storage gas water heaters with an energy factor < 0.58 shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater.[124]

   B. Unfired hot water tanks, such as storage tanks and backup storage tanks for solar water-heating systems, shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater or have internal insulation of at least R-16 and a label on the exterior of the tank showing the insulation R-value.

2. Piping, whether buried or unburied, for recirculating sections of domestic hot water systems, piping from the heating source to the storage tank for an indirect-fired domestic water-heating system, cooling system piping

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[123] The justification for this change appears in Eley Associates, "Maximum Allowable Cooling Capacity," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 6-16. Presented at the July 18, 2002 workshop.

[124] The requirement for exterior insulation on water heaters for equipment with an EF less than or equal to 0.58 is retained. However, a new federal standard takes effect in 2004, prior to the effective date of the proposed standard and the standard for gas storage water heaters becomes EF = 0.67 - .0019 V. A 40 gallon gas water heater will be required to have a minimum EF of 0.59 and a 50 gallon water heater will be required to have a minimum EF of 0.58. The new federal requirement, for all intent and purpose, will make the exterior insulation requirement mute.

below 55°F, and the first five feet of hot and cold water pipes from the storage tank for nonrecirculating systems shall be thermally insulated in accordance with TABLE 150-A~~Table 1-T~~.[125]

TABLE 150-A~~T~~ PIPE INSULATION REQUIREMENTS MINIMUM R-VALUE

SYSTEM	PIPE DIAMETER	
	Less than or Equal to 2 inches	**Greater than 2 inches**
Domestic hot water	R-4	R-6
Hydronic heating supply lines	R-4	R-6
Cooling systems (pipes below 55°F)	R-3	R-4

EXCEPTION to Section 150 (j) 2: The following piping does not have to be thermally insulated:

A. Factory-installed piping within space-conditioning equipment; and

B. Piping that conveys fluids that have a design operating temperature range between 55°F and 105°F.

NOTE to Section 150 (j) 2: Where the executive director approves a water heater calculation method for a particular water heating recirculation system, piping insulation requirements shall be those specified in the approved calculation method.

3. 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:

A. 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.

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

4. Solar water-heating systems and/or collectors shall be certified by the Solar Rating and Certification Corporation.

(k) Residential Lighting.[126]

1. High efficacy residential luminaires should contain only high efficacy lamps and shall not contain a medium screw base socket (E24/E26). High efficacy luminaires containing lamps rated 18 Watts or greater shall contain electronic high efficacy residential ballasts. A high efficacy lamp has a lamp efficacy that is no lower than the efficacies contained in TABLE 150-B. An electronic high efficacy residential ballast shall comply with the requirements for electromagnetic interference (EMI) and radio frequency interference (RFI) contained in FCC Part 18; and the ballast shall have an output frequency no less than 20 kHz.

TABLE 150-B HIGH EFFICACY LAMP REQUIREMENTS

Lamp Power Rating	**Minimum Lamp Efficacy**
15 watts or less	40 lumens per watt
over 15 watts to 40 watts	50 lumens per watt
over 40 watts	60 lumens per watt

[125] A change has been proposed to better align Table 150-A with the standard for non-residential buildings. The change will be introduced in the next draft.

[126] Lighting changes are based on Pacific Gas and Electric Company, *Residential Hardwired Lighting*, *Codes and Standards Enhancement Initiative, 2005 Title 24 Building Energy Efficiency Standards Update*, May 7, 2002. Presented at the May 30, 2002 workshop.

~~1. Luminaires for general lighting in kitchens shall have lamps with an efficacy of not less than 40 lumens per watt. General lighting must provide a sufficient light level for basic kitchen tasks and provide a uniform pattern of illumination. A luminaire(s) that is (are) the only lighting in a kitchen will be considered general lighting. General lighting shall be controlled by a switch on a readily accessible lighting control panel at an entrance to the kitchen.~~

~~Additional luminaires to be used only for specific decorative effects need not meet this requirement.~~

~~2. Each room containing a shower or bathtub shall have at least one luminaire with lamp(s) with an efficacy of 40 lumens per watt or greater. If there is more than one luminaire in the room, the high-efficacy luminaire shall be switched at an entrance to the room.~~

~~**ALTERNATIVE to Section 150 (k) 2:** A high-efficacy luminaire need not be installed in a bathroom if:~~

~~A. A luminaire with lamps with an efficacy of 40 lumens per watt or greater is installed in a utility room, laundry room, or garage; and~~

~~B. All luminaires permanently mounted to the residence providing outdoor lighting shall be installed with the following characteristics:~~

~~i. Luminaires with lamps with 40 lumens per watt or greater; or~~

~~ii. Luminaires with lamps with an efficacy of less than 40 lumens per watt shall be equipped with a motion sensor.~~

~~**NOTE:** When using this alternative for multiple bathrooms, after complying with Item B above for the first bathroom, each additional bathroom in which a high-efficacy luminaire is not installed must comply with Item A above alone.~~

~~3. Luminaires installed to meet the 40 lumens per watt requirements of Section 150 (k) 1 or 2 shall not contain medium base incandescent lamp sockets, and shall be on separate switches from any incandescent lighting.~~

~~4. All incandescent lighting fixtures recessed into insulated ceilings shall be approved for zero-clearance insulation cover (IC) by Underwriters Laboratories or other testing/rating laboratories recognized by the International Conference of Building Officials.~~

2. Lighting in Kitchens: Permanently installed luminaires in kitchens shall be high efficacy luminaires.

   EXCEPTION to Section 150 (k) 2 Up to 50 percent of the total rated wattage of permanently installed luminaires in kitchens may be in luminaires that are not high efficacy luminaires, provided that these luminaires are controlled by switches separate from those controlling the high efficacy luminaires.

3. Lighting in Bathroom and Support Spaces: Permanently installed luminaires in bathrooms, laundry rooms, utility rooms and garages shall be high efficacy luminaires.

   EXCEPTION to Section 150 (k) 3: Permanently installed luminaires that are controlled by motion sensor(s) certified per section 119. Such motion sensors must not have a control that allows the luminaire to be turned on automatically or that has an override allowing the luminaire to be always on.

4. Pendant, Track and Recessed Luminaire: Each ceiling-mounted pendant luminaire, track luminaire, or recessed downlight shall be a high efficacy luminaire.

   EXCEPTION to Section 150 (k) 4: In locations other than kitchens and bathrooms, pendant, track and recessed luminaires that are not high efficacy luminaires shall be allowed provided they are controlled by a dimmer switch.

5. Recessed Luminaires in Insulated Ceilings: Luminaires recessed into insulated ceilings shall be approved for zero clearance insulation cover (IC) by Underwriters Laboratories or other testing/rating laboratories recognized by the International Conference of Building Officials, and shall include a label certifying air tight (AT) or similar designation to show air leakage less than 2.0 CFM at 75 Pascals (or 1.57 lbs/ft2) using ASTM E283 testing standards and shall be sealed with a gasket or caulk between the housing and ceiling.

6. Exterior Lighting: Luminaires providing outdoor lighting and permanently mounted to a residential building or its surrounding structures shall be high efficacy luminaires.

EXCEPTION 1 to Section 150 (k) .6: Exterior luminaires controlled by a motion sensor with integral photosensor need not be high efficacy luminaires.

EXCEPTION 2 to Section 150 (k) .6: Permanently installed luminaires in or around swimming pools, water features, or other locations subject to Article 680 of the 1998 California Electric Code need not be High Efficacy Luminaires.

EXCEPTION 3 to Section 150 (k) .6: Low voltage lighting, for any lamp of 50 watts or less per luminaire.[127].

7. If a low-rise residential building includes a parking garage for eight or more vehicles, the garage shall comply with lighting requirements in Sections §130, 131 and §146[128].

(l) **Slab Edge Insulation.** Material used for slab edge insulation shall meet the following minimum specifications:

1. Water absorption rate no greater than 0.3 percent when tested in accordance with ASTM C 271-94.
2. Water vapor permeance no greater than 2.0 perm/inch when tested in accordance with ASTM E 96-95.
3. Concrete slab perimeter insulation must be protected from physical damage and ultraviolet light deterioration.

(m) **Air-distribution 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 -2001 ~~1998~~ CMC Sections 601, 602, 603, ~~and~~ 604, 605 and Standard 6-5~~3~~, incorporated herein by reference. Portions conveying conditioned air shall either be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 604) or be enclosed entirely in conditioned space. 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 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 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 (m) 1: The requirements do not apply to 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.
   B. All pressure-sensitive tapes, heat-activated tapes, and mastics used in the manufacture of rigid fiberglass ducts shall comply with UL 181.
   C. All pressure-sensitive tapes and mastics used with flexible ducts shall comply with UL 181 or 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.

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[127] This change is based on the need for energy-efficient building grounds, accent and other exterior residential lighting. The low voltage requirement tends to limit the total power use due to the additional transformer needs for low voltage lighting compared to line voltage lighting.

[128] This change is based on Eley Associates, "Measure 1 – Unconditioned Buildings," *Outdoor Lighting Research: California Outdoor Lighting Standards*, June 6, 2002, p. 11-16. Presented at the June 18, 2002 workshop.

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, or UL 181B.

B. **Mastic sealants and mesh.**

i. Sealants shall comply with UL 181, UL 181A, or UL 181B, and be nontoxic and water resistant.

ii. Sealants for interior applications shall pass ASTM tests C 731(extrudability after aging) and D 2202 (slump test on vertical surfaces), incorporated herein by reference.

iii. Sealants for exterior applications shall pass ASTM tests C 731, C 732 (artificial weathering test), and D 2202, incorporated herein by reference.

iv. Sealants and meshes shall be rated for exterior use.

C. **Pressure-sensitive tape.** Pressure-sensitive tapes shall comply with UL 181, UL 181A, or 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 ~~applicable~~ requirements of ~~UL 181, 181A, or 181B~~ 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. All duct insulation product R-values shall be based on insulation only (excluding air films, vapor barriers, or other duct components) and tested C-values at 75°F mean temperature at the installed thickness, in accordance with ASTM C 518-85 or ASTM C 177-85, incorporated herein by reference, and certified pursuant to Section 118.

5. 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. 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 barriers, or other duct components), based on the tests in Section 150 (m) 4 and the installed thickness determined by Section 150 (m) 5 C.

7. All fan systems, regardless of volumetric capacity, that exhaust air from the building to the outside shall be provided with backdraft or automatic dampers to prevent air leakage.

8. 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.

~~**EXCEPTION to Section 150 (m) 1:** The requirements do not apply to ducts and fans integral to a wood heater or fireplace.~~

10. Porous Inner Core Flex Duct. Flexible ducts having porous inner cores shall not be used.[129]

NOTE: Authority cited: Public Resources Code, Sections 25218(e), 25402, and 25402.1. Reference: Public Resources Code, Section 25402.

[129] The justification for this change appears in "Residential Ducts," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 17-66. Presented at the July 18, 2002 workshop.

SUBCHAPTER 8
LOW-RISE RESIDENTIAL BUILDINGS—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

SECTION 151 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

(a) **Basic Requirements**. New low-rise residential buildings shall meet all of the following:

1. The requirements of Sections 111 through 118 applicable to new residential buildings.
2. The requirements of Section 150 (mandatory features).
3. Either the performance standards (energy budgets) or the prescriptive standards (alternative component packages) set forth in this section for the climate zone in which the building will be located. Climate zones are shown in Figure 1-A.

   ALTERNATIVE to Section 151 (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 which contains 50 percent or more of the dwelling units.

   NOTE to Section 151 (a) 3: The California Energy Commission shall periodically update, publish, and make available to interested persons and local building departments a document entitled *California Climate Zone Descriptions for New Buildings,* (July 1995), which shall contain a precise description of the metes and bounds for climate zone boundaries depicted in FIGURE 1~~0~~1-A and a list of the communities in each zone.

4. For other provisions applicable to new low-rise residential buildings, refer to Section 100 (c).

(b) **Performance Standards**. A building complies with the performance standard if ~~its~~ the combined ~~calculated~~ depletable TDV energy use for water heating [Section 151 (b) 1] and space conditioning [Section 151 (b) 2] is less than or equal to the combined maximum allowable energy use for both water heating and space conditioning, even if the building fails to meet either the water heating or space conditioning budget alone.

1. **Water heating budgets**. The water heating budgets for each climate zone shall be the calculated consumption of energy from depletable sources required for water heating in buildings in which the basic requirements of Section 151 (a) and the measures in Alternative Component Package D are installed. To determine the water heating budget, use an approved calculation method.

~~1. **Water-heating budgets.** The budgets for water-heating systems are those calculated from Equation (1-N).~~

~~EQUATION (1-N)—ANNUAL WATER HEATING BUDGET (AWB) EQUATION~~

~~For dwelling units less than 2500 ft.²:~~

$$\cancel{AWB\left(kBtu/yr.\text{-}ft.^2\right) = \frac{(16370)}{CFA} + 4.85}$$

~~For dwelling units equal to or greater than 2500 ft.²:~~

$$\cancel{AWB\left(kBtu/yr.\text{-}ft.^2\right) = \frac{(26125)}{CFA}}$$

~~**WHERE**~~

~~*CFA* = The building's conditioned floor area in square feet.~~

~~The annual water-heating budget calculated from Equation (1-N) may be met by either:~~

~~A. Calculating the energy consumption of the proposed water-heating system using an approved calculation method without an external insulation wrap; or~~

~~B. Installing any gas storage-type nonrecirculating water-heating system that does not exceed 50 gallons of capacity, and that meets the minimum standards specified in the Appliance Efficiency Standards.~~

~~**NOTE:** Storage gas water heaters with an energy factor of less than 0.58 must be externally wrapped with insulation having an installed thermal resistance of R-12 or greater in accordance with Section 150 (j).~~

2. **Space-conditioning budgets**. The space-conditioning budgets for each climate zone shall be the calculated consumption of energy from depletable sources required for space conditioning in buildings in which the basic requirements of Section 151 (a) and the measures in Alternative Component Package D are installed. To determine the space-conditioning budget, use an approved calculation method.

(c) **Compliance Demonstration Requirements for Performance Standards**. The application for a building permit shall include documentation which demonstrates, using an approved calculation method, that the new 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 appropriate climate zone.

1. To demonstrate compliance, the applicant's documentation shall:

A. Determine the combined energy budget for the proposed building by adding the following:

i. The annual water-heating budget (kBtu/yr-ft²) as determined pursuant to Section 151 (b) 1~~calculated from Equation (1-N) (kBtu/yr. ft.²)~~ and

ii. The annual space-conditioning budget (kBtu/yr-ft²) as determined pursuant to Section 151 (b) 2.

B. Calculate the ~~source~~ TDV energy consumption total of the proposed building, using the proposed building's actual glazing area, orientation, and distribution, and its actual energy conservation and other features, including the actual water-heating, space-conditioning equipment and duct conditions and locations.

Include in the calculation the energy required for building cooling even if the building plans do not indicate that air conditioning will be installed.

2. The proposed building design complies if the energy consumption calculated pursuant to Section 151 (c) 1 B is equal to or less than the combined energy budget established in Section 151 (c) 1 A.

MULTIPLE ORIENTATION ALTERNATIVE to Section 151 (c): A permit applicant may demonstrate compliance with the energy budget requirements of Section 151 (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.

(d) **Compliance Methods for Performance Standards**. Compliance with the energy budget requirements of Section 151 (a) 3 and 151 (b) must be demonstrated by using the compliance version of the commission's Public Domain Computer Program or any alternative calculation method approved by the commission for use in complying with Section 151 (a) and 151 (b).

~~**NOTE:** Compliance with the water-heating budget need not be demonstrated using any of the calculation methods referred to in Section 151 (d), if all the requirements of Section 151 (b) 1 B are met.~~

(e) **Required Calculation Assumptions.** The commission shall publish the assumptions and calculation methods it used to develop the standards for low-rise residential buildings, including those specified in Section 151. In determining the water-heating and space-conditioning budgets and calculating the energy use of the proposed building design, the applicant shall use only these assumptions and calculation methods (or alternative assumptions and methods approved by the commission or its executive director).

1. Such assumptions shall include, but not be limited to, the following:

A. The operating conditions regarding indoor temperature; occupancy loads and schedules; equipment loads and operation schedules, including lighting, HVAC, and miscellaneous electrical; and outdoor weather conditions;

B. The physical characteristics of building pressurization, interior heat transfer, film coefficients, solar heat gain coefficient and operation of installed shading devices, ground temperatures, and the method of determining slab heat loss;

C. The applicable modeling procedures for the assumptions, design conditions, and physical characteristics described in Section 151 (e) 1.

D. Water heating use schedules, cold water inlet temperatures, and average outdoor temperatures for calculating water heating loads and losses.

EXCEPTION to Section 151 (e~~d~~) 1: The commission may approve alternative schedules, assumptions, and performance modeling procedures that may be used in lieu of those described in Section 151 (e) 1, provided such alternatives do not alter the efficiency level required by these standards.

2. The total calculated annual energy consumption shall include all energy used for comfort heating, comfort cooling, ventilation for the health and comfort of occupants, and service water heating.

3. Heat transfers within the same building to adjacent spaces that are not covered by the permit and that are independently provided with space conditioning may be considered to be zero. Heat transfers to spaces not yet provided with space conditioning may be modeled as separate unconditioned zones, or as outdoor conditions.

4. The total calculated annual energy consumption need not include energy from any nondepletable sources, regardless of the purpose of the energy consumed.

~~5. The U-factor of installed manufactured fenestration products shall be those certified by an approved independent certification organization in accordance with Section 116. The U-factor of field-fabricated fenestration products shall be those values from Section 116, Table 1-D, based on an approved method that determines the area weighted average U-factor for generic types of products.~~

[130]5~~6~~. Solar heat gain coefficients for interior shading devices used with fenestration products shall be 0.68 for vertical fenestration products and 1.0 for non-vertical fenestration products. No other solar heat gain coefficients shall be used for interior shading. The calculations for vertical fenestration products include the effects of draperies and insect screens without installation being verified at the time of final inspection.

(f) **Prescriptive Standards/Alternative Component Packages**. Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements of one of the alternative packages of components shown in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~ for the appropriate climate zone shown in FIGURE 101-A. Installed components shall meet the following requirements:

1. Insulation.

A. Ceiling, wall, slab floor perimeter, and raised-floor insulation which has an R-value equal to or higher than that shown in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~ shall be installed. The minimum opaque ceiling, wall (including heated basements and crawl spaces), and raised-floor R-values shown are for insulation installed between wood-framing members.

ALTERNATIVE to Section 151 (f) 1 A: The insulation requirements of TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~ may also be met by ceiling, wall, or floor assemblies that meet equivalent minimum R-values that consider the effects of all elements of the assembly, using a calculation method approved by the executive director.

EXCEPTION to Section 151 (f) 1 A: Raised-floor insulation may be omitted if the foundation walls are insulated to meet the wall insulation minimums shown in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~, a vapor barrier is placed over the entire floor of the crawl space, and the vents are fitted with automatically operated louvers.

B. 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.

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[130] The justification for this change appears in Eley Associates, "Residential Fenestration," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part II*, May 16, 2002, p. 4-13. Presented at the May 30, 2002 workshop

EXCEPTION to Section 151 (f) 1 B: Perimeter insulation is not required along the slab edge between conditioned space and the concrete slab of an attached unconditioned enclosed space, covered porches, or covered patios.

2. **Radiant Barrier**. A radiant barrier required in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~ is any reflective material that has an emittance of 0.05 or less, tested according to ASTM C-1371-98 or ASTM E408-71(1996)e1, and that is certified to the Department of Consumer Affairs as required by CCR, Title 24, Part 12, Chapter 12-13, Standards for Insulating Material. Installation criteria are contained in the Section 4.24 of the Residential ACM Manual.

3. **Fenestration**~~Glazing.~~[131]~~**Glazing**~~**.**

   A. Installed fenestration products shall have an area weighted average U-factor~~s~~ equal to or lower than those shown in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~. The U-factor of installed fenestration products shall be determined in accordance with Section 116~~pursuant to Section 151 (e) 5~~.

   B. Total ~~glazing~~ fenestration area shall not exceed the percentage of conditioned floor area specified in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~.

   C. For Package D, the west-facing fenestration area shall not exceed the percentage of conditioned floor area specified in TABLE 151-B through TABLE 151-Q. West-facing fenestration area includes skylights tilted to the west or tilted in any other direction at a pitch of less than 1:12.

4. **Shading**[132]**.** Where TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~ require a solar heat gain coefficient (SHGC),~~of 0.40 or lower,~~ the requirements shall be met by either:

   A. Installing fenestration products, except for skylights, that have an area weighted average SHGC equal to or lower than those shown in TABLE 151-B through TABLE 151-Q. Skylights shall have an SHGC equal to or lower than those shown in TABLE 151-B through TABLE 151-Q. The solar heat gain coefficient of installed fenestration products shall be determined in accordance with Section 116~~A fenestration product listed by the manufacturer to have the required solar heat gain coefficient~~; or

   B. An exterior operable louver or other exterior shading device that meets the required solar heat gain coefficient; or

   C. A combination of exterior shading device and fenestration product to achieve the same performance as achieved in Item A.

   D. For south-facing glazing by optimal overhangs 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.

   Except where the UBC requires emergency egress, exterior shading devices must be permanently attached to the outside of the structure with fasteners that require additional tools to remove (as opposed to clips, hooks, latches, snaps, or ties).

5. Thermal mass. Thermal mass required for Package C in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~ shall meet or exceed the minimum interior mass capacity specified in TABLE 151-A~~Table 1-U~~.

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[131] The justification for the changes in Section 151 f 3 appear in Eley Associates, "Residential Fenestration," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part II*, May 16, 2002, p. 4-13. Presented at the May 30, 2002 workshop

[132] The justification for the changes in Section 151 f 4 appear in Eley Associates, "Residential Ducts," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 17-66. Presented at the July 18, 2002 workshop.

TABLE 151-A~~U~~ INTERIOR MASS CAPACITY REQUIREMENTS FOR PACKAGE C

FLOOR TYPE	MINIMUM INTERIOR MASS CAPACITY
slab floor	2.36 x ground floor area (ft^2)
raised floor	0.18 x ground floor area (ft^2)

The mass requirements in TABLE 151-A~~Table 1-U~~ may be met by calculating the combined interior mass capacity of the mass materials using EQUATION 151-A~~Equation 1-P~~.

EQUATION ~~(~~151-A~~P~~ ~~)~~ CALCULATION OF INTERIOR MASS CAPACITY EQUATION

$$IMC = \left[\left(A_1 \times UIMC_1\right) + \left(A_2 \times UIMC_2\right).....+\left(A_n \times UIMC_n\right)\right]$$

WHERE:

A_n = Area of mass material, *n.*

$UIMC_n$ = Unit interior mass capacity of mass material, *n.*

NOTE: The commission's Residential Manual shall list the unit interior mass capacity (UIMC) of various mass materials.

6. **Heating system type.** Heating system types shall be installed as required in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~. A gas-heating system is a natural or liquefied petroleum gas-heating system.

7. **Space heating and space cooling.** When refrigerant charge and airflow measurement or thermostatic expansion valves are shown as required by TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~, ducted split system central air conditioners and ducted split system heat pumps shall either have refrigerant charge and airflow measurement confirmed through field verification and diagnostic testing in accordance with procedures set forth in the ACM Manual or shall be equipped with a thermostatic expansion valve (TXV) with an access door or removable panel to verify installation of the TXV. All TXVs shall be confirmed through field verification and diagnostic testing as specified in the ACM Manual. All space-heating and space-cooling systems must comply with minimum appliance efficiency standards as specified in Sections 110 through 112.[133]

8. **Water-heating systems.** ~~All water-heating systems must meet the water-heating budgets calculated from Equation (1-N).~~Water heating systems shall meet the requirements of either A or B. [134]

   A. ~~NOTE to Section 151 (f) 8:~~ For systems serving individual dwelling units, a single gas storage type water heater shall be installed that has a tank capacity of ~~Any gas-type domestic water heater of~~ 50 gallons or less and no recirculation pumps, which is certified as meeting the Appliance Efficiency Standards, and which meets tank insulation requirements of Section 150 (j)~~ may be assumed to meet the water heating budget~~.

   B. For systems serving multiple dwelling units, a central recirculating water heatng system shall be installed with a single water heater that meets the minimum efficiency requirements of Section 113 and distribution system controls capable of automatically turning off the circulating pump when hot water is not required. Distribution system piping shall be installed in accordance with Section 123, TABLE 123-A.

9. **Setback thermostats.** All heating systems shall have an automatic thermostat with a clock mechanism or other setback mechanism approved by the executive director, which the building occupant can manually program to

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[133] New appliance standards pursuant to Section 111 for small federally-regulated water heaters become effective January 20, 2004.

[134] New appliance standards pursuant to Section 111 for single phase air-cooled air conditioners and single phase air-source heat pumps with cooling capacity less than 65,000 Btu per hour become effective January 23, 2006.

automatically set back the thermostat set points for at least two periods within 24 hours. The exception to Section 150 (i) shall not apply to any heating system installed in conjunction with the packages specified in TABLE 151-B~~Tables 1-Z1~~ through TABLE 151-Q~~1-Z16~~.

10. **Space conditioning ducts.** All ~~supply~~ ducts shall either be in conditioned space or be insulated to a minimum installed level of R-4.2 and constructed to meet minimum mandatory requirements of Section 150(m). Where TABLE 151-B through 1-Z16 require R-8 duct insulation all ducts outside of the insulated envelope shall be insulated to R-8.[135]

    All duct systems shall be sealed, as confirmed through field verification and diagnostic testing, in accordance with procedures set forth in the ACM Manual.

[135] The justification for this change appears in Eley Associates, "Residential Ducts," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 17-66. Presented at the July 18, 2002 workshop.

-TABLE 151-B ~~Z1~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 1

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R21
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R8
Radiant Barrier			NR	NR
FENESTRATION[136]~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65[137]
Maximum Solar Heat Gain Coefficient (SHGC)			NR	NR
Maximum total area			14%	20%~~16%~~
Maximum West facing area			NR	NR
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~NR~~	~~NR~~
~~West-facing glazing~~			~~NR~~	~~NR~~
~~East-facing glazing~~			~~NR~~	~~NR~~
~~North-facing glazing~~			~~NR~~	~~NR~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

136 For TABLE 151-B through TABLE 151-Q, the justification for the changes appears in Eley Associates, "Residential Fenestration," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part II*, May 16, 2002, p. 4-13. Presented at the May 30, 2002 workshop

137 For TABLE 151-B through TABLE 151-Q, the U-factors shown will be revised to reflect recent changes in the NFRC rating procedure. The intent is to not change the window technology required.

*As an alternative under Package D, glazing with a maximum 0.55 U-factor and a 90% AFUE furnace or a 7.6 HSPF heat pump may~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable
REQ = Required MIN = Minimum

See notes following ~~Table~~ TABLE 151-Q~~1 Z16~~

TABLE 151-C~~Z2~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 2

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R30
Wood-frame walls			R29	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R8
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			16%	20%
Maximum West facing area			5%	5%~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-factor may~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-D~~Z3~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 3

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]			R38	R30
Ceiling			R25	R13
Wood-frame walls			NA	(R2.44)
"Heavy mass" walls			NA	NA
"Light mass" walls			NA	R0
Below-grade walls			R7	NR
Slab floor perimeter			R30	R19[2]
Raised floors			NA	R0
Concrete raised floors			NR	NR
Radiant Barrier				
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			NR	NR
Maximum total area			14%	20%
Maximum West facing area			NR	NR
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~NR~~	~~NR~~
~~West-facing glazing~~			~~NR~~	~~NR~~
~~East-facing glazing~~			~~NR~~	~~NR~~
~~North-facing glazing~~			~~NR~~	~~NR~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-factor may~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-E~~Z4~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 4

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R38	R30
Wood-frame walls			R25	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			14%	20%
Maximum West facing area			5%	5%
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient may~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-F~~Z5~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 5

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R38	R30
Wood-frame walls			R25	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			NR	NR
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			NR	NR
Maximum total area			16%R	20%
Maximum West facing area			NR	NR~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~NR~~	~~NR~~
~~West-facing glazing~~			~~NR~~	~~NR~~
~~East-facing glazing~~			~~NR~~	~~NR~~
~~North-facing glazing~~			~~NR~~	~~NR~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-factor may~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-G~~Z6~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 6

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R38	R30
Wood-frame walls			R21	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R21	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			NR	NR
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.50	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			NR	NR
Maximum total area			14%	20%
Maximum West facing area			NR	NR
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~NR~~	~~NR~~
~~West-facing glazing~~			~~NR~~	~~NR~~
~~East-facing glazing~~			~~NR~~	~~NR~~
~~North-facing glazing~~			~~NR~~	~~NR~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-factor may ~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-H~~Z7~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 7

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R38	R30
Wood-frame walls			R21	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R21	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			NR	NR
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.50	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			14%	20%
Maximum West facing area			5%	5%
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient may ~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-IZ8 ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 8

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R38	R30
Wood-frame walls			R21	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R21	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			REQ	REQ
FENESTRATIONGLAZING				
Maximum U-factor[3]			0.50	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			14%	20%
Maximum West facing area			5%	5%
SOLAR HEAT GAIN COEFFICIENT[4]				
South-facing glazing			0.40	0.40
West-facing glazing			0.40	0.40
East-facing glazing			0.40	0.40
North-facing glazing			0.40	0.40
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN78%	MIN
If heat pump, split system HSPF[8] =			MIN6.8	MIN
Single package system HSPF =			MIN6.6	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any9	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient mayean be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-QTable 1-Z16

TABLE 151-J~~Z9~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 9

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R38	R30
Wood-frame walls			R21	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R21	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.50	0.75
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			14%	20%
Maximum West facing area			5%	5%
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient, and either refrigerant charge and airflow measurement or an 11.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-K~~Z10~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 10

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R30
Wood-frame walls			R25	R13
"Heavy mass" walls			NA	(R2.44)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R0
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			16%	20%
Maximum West facing area			5%	5%
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any9	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient, and an 11.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-L~~Z11~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 11

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R19
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R8
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			16%	20%
Maximum West facing area			5%	5%~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any9	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient, and a 11.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-M~~Z12~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 12

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R19
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R4
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			16%	20%
Maximum West facing area			5%	5%~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient, and an 11.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-N~~Z13~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 13

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R19
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R8
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			16%	20%
Maximum West facing area			5%	5%~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.35 Solar Heat Gain Coefficient, and a 12.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-Q~~Z14~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 14

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R21
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R30	R19[2]
Concrete raised floors			NA	R8
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			14%	20%
Maximum West facing area			5%	5%~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any9	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.30 Solar Heat Gain Coefficient, and a 12.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1 Z16~~

-TABLE 151-P~~Z15~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 15

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R21
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R0
Slab floor perimeter			R7	NR
Raised floors			R21	R19[2]
Concrete raised floors			NA	R4
Radiant Barrier			REQ	REQ
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.65
Maximum Solar Heat Gain Coefficient (SHGC)			0.40	0.40
Maximum total area			16%	20%
Maximum West facing area			5%	5%~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~0.40~~	~~0.40~~
~~West-facing glazing~~			~~0.40~~	~~0.40~~
~~East-facing glazing~~			~~0.40~~	~~0.40~~
~~North-facing glazing~~			~~0.40~~	~~0.40~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes[7]	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			REQ	REQ*
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any9	Any

*As an alternative under Package D, glazing with a maximum 0.40 U-factor and maximum 0.30 Solar Heat Gain Coefficient, and a 13.0 SEER space-cooling system may~~can~~ be substituted for duct sealing and either refrigerant charge and airflow measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

-TABLE 151-Q~~Z16~~ ALTERNATIVE COMPONENT PACKAGES FOR CLIMATE ZONE 16

COMPONENT	PACKAGE[1]			
			C[1]	D
BUILDING ENVELOPE				
Insulation minimums[2]				
Ceiling			R49	R38
Wood-frame walls			R29	R21
"Heavy mass" walls			NA	(R4.76)
"Light mass" walls			NA	NA
Below-grade walls			NA	R13
Slab floor perimeter			R7	R7
Raised floors			R30	R19[2]
Concrete raised floors			NA	R8
Radiant Barrier			NR	NR
FENESTRATION~~GLAZING~~				
Maximum U-factor[3]			0.40	0.60
Maximum Solar Heat Gain Coefficient (SHGC)			NR	NR
Maximum total area			14%	20%
Maximum West facing area			NR	NR~~16%~~
~~SOLAR HEAT GAIN COEFFICIENT[4]~~				
~~South-facing glazing~~			~~NR~~	~~NR~~
~~West-facing glazing~~			~~NR~~	~~NR~~
~~East-facing glazing~~			~~NR~~	~~NR~~
~~North-facing glazing~~			~~NR~~	~~NR~~
THERMAL MASS[5]			REQ	NR
SPACE-HEATING SYSTEM[6]				
Electric-resistant allowed			Yes7	No
If gas, AFUE =			MIN~~78%~~	MIN
If heat pump, split system HSPF[8] =			MIN~~6.8~~	MIN
Single package system HSPF =			MIN~~6.6~~	MIN
SPACE-COOLING SYSTEM				
If split system A/C, SEER =			10.0	MIN
Refrigerant charge and airflow measurement or Thermostatic expansion valve			NR	NR
If single package A/C, SEER =			9.7	MIN
SPACE CONDITIONING DUCTS				
Duct sealing			REQ	REQ*
Duct Insulation			R-8	R-8
DOMESTIC WATER-HEATING TYPE				
System must meet budget, see Section 151 (b) 1 and (f) 8			Any[9]	Any

*As an alternative under Package D, glazing with a maximum 0.55 U-factor and a 90% AFUE furnace or a 7.6 HSPF heat pump may~~can~~ be substituted for duct sealing. All other requirements of Package D must be met.

Legend:

NR = Not Required NA = Not Applicable REQ = Required MIN = Minimum

See notes following TABLE 151-Q~~Table 1-Z16~~

NOTES TO THE LOW-RISE RESIDENTIAL PACKAGES IN TABLES 151-A~~Z1~~ THROUGH 151-Q~~Z16~~

1 Package C is the only package that allows electric-resistance space heating. Package C may be used only if the building is in an area (1) where natural gas is not currently available and (2) where extension of natural gas service is impractical, as determined by the natural gas utility. Package D allows more glazing area in some zones with moderately high insulation levels; slab edge insulation is required in Climate Zone 16.

2 The R-values shown for ceiling, wood frame wall and raised floor are for wood-frame construction with insulation installed between the framing members. For alternative construction assemblies, see Section 151 (f) 1 A.

The heavy mass wall R-value in parentheses is the minimum R-value for the entire wall assembly if the wall weight exceeds 40 pounds per square foot. The light mass wall R-value in brackets is the minimum R-value for the entire assembly if the heat capacity of the wall meets or exceeds the result of multiplying the bracketed minimum R-value by 0.65. Any insulation installed on heavy or light mass walls must be integral with, or installed on the outside of, the exterior mass. The inside surface of the thermal mass, including plaster or gypsum board in direct contact with the masonry wall, shall be exposed to the room air. The exterior wall used to meet the R-value in parentheses cannot also be used to meet the thermal mass requirement.

3 The installed fenestration products shall meet the requirements of Section 151(f)3 and 151(f)4.[138] ~~For glazing U-factor rating procedures and labeling requirements see Section 116 (a) 2.~~

~~4 Values specified are maximum allowable values. If the package specifies a solar heat gain coefficient the builder shall meet the requirements of Section 151 (f) 4.~~

~~5~~4 If the package requires thermal mass, meet the requirements of Section 151 (f) 5.

~~6~~5 Automatic setback thermostats must be installed in conjunction with all space-heating systems in accordance with Section 151 (f) 9.

6~~7~~ Ducts in Package C shall be insulated to an installed value of at least R-8.

7~~8~~ HSPF means "heating seasonal performance factor."

8~~9~~ Electric-resistance water heating is allowed as the main water heating source in Package C only if the water heater is located within the building envelope and a minimum of 25 percent of the energy for water heating is provided by a passive or active solar system or a wood stove boiler. The wood stove boiler credit is not allowed in Climate Zones 8, 10, and 15, nor in localities that do not allow wood stoves.

NOTE: Authority cited: Public Resources Code, Sections 25218(e), 25402, and 25402.1. Reference: Public Resources Code, Section 25402

[138] The justification for this change appears in Eley Associates, "Residential Fenestration," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part II*, May 16, 2002, p. 4-13. Presented at the May 30, 2002 workshop.

SUBCHAPTER 9
LOW-RISE RESIDENTIAL BUILDINGS—ADDITIONS AND ALTERATIONS IN EXISTING LOW-RISE RESIDENTIAL BUILDINGS

SECTION 152 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS IN EXISTING BUILDINGS THAT WILL BE LOW-RISE RESIDENTIAL OCCUPANCIES[139]

(a) **Additions**. Additions to existing residential buildings shall meet the requirements of Sections 111 through 118, Section 150, and either Section 152 (a) 1 or 2. Electric-resistance water-heating or space-conditioning systems may be installed in or in conjunction with an addition only if the electric-resistance system meets the applicable energy budget(s) from Section 151 (b) pursuant to Section 152 (a) 2.

1. **Prescriptive approach**. Additions to existing buildings shall meet the following additional requirements:

   A. Glazing in a~~A~~dditions up to 100 square feet shall not exceed 50 square feet~~ of glazing~~, and ~~the g~~shall meet the ~~lazing~~ U-factor requirements of sections 151(f)3A and the ~~shall not exceed 0.75, and the glazing~~ Solar Heat Gain Coefficient requirements of section 151(f)4. ~~shall not exceed the value specified in Alternative Component Package D (Tables 1-Z1 through 1-Z16); or~~

   B. Additions less than 1000 square feet shall meet all the requirements of Package D (Section 151 (f) and TABLE 151-B through TABLE 151-B), except that the addition's total glazing area limit is the maximum allowed in Package D plus the glazing area that was removed by the addition, and the wall insulation value need not exceed R-13.

   ~~**EXCEPTION to Section 152 (a) 1 B:** If an addition is less than 500 square feet, glazing may have a U-factor not to exceed 0.75 in lieu of any lower U-factor required by the package.~~

   C. Additions of 1000 square feet or greater shall meet all the requirements of Package D (Section 151 (f) and TABLE 151-B through TABLE 151-Q).

2. **Performance approach**. Performance calculations shall meet the requirements of Section 151 (a) through (e), pursuant to either Item A or B, below.

   A. The addition complies if the addition alone meets the combined water-heating and space-conditioning energy budgets.

   B. The addition complies if the energy efficiency of the existing building is improved such that the ~~source~~ TDV energy consumption of the improved existing building and the addition is equal to or less than that of the unimproved existing building plus an addition that complies with the applicable energy budget.

EXCEPTION 1 to Section 152 (a): Existing structures with R-11 framed walls showing compliance with Section 152 (a) 2 (Performance Approach) are exempt from Section 150 (c).

EXCEPTION 2 to Section 152 (a): Any dual-glazed greenhouse window and dual-glazed skylight installed in an addition complies with the U-factor requirements in Section 151 (f) 3 A.

EXCEPTION 3 to Section 152 (a): If the addition will increase the total number of water heaters in the building, one of the following types of water heaters may be installed to comply with Section 152 (a) 1 or Section 152 (a) 2 A, and Section 152 (c):

1. A gas storage nonrecirculating water-heating system that does not exceed 50 gallons capacity; or

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[139] The justification for the changes in this section appear in Pacific Gas and Electric Company, *Window Efficiency Requirements Upon Window Replacement*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update*, March 15, 2002. Presented at the April 23, 2002 workshop.

2. If no natural gas is connected to the building, an electric storage water heater that does not exceed 50 gallons capacity, has an energy factor not less than 0.90; or

3. 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.

   For prescriptive compliance with Section 152 (a) 1, the water-heating systems requirement in Section 151 (f) 8 shall not apply. For performance compliance for the addition alone, only the space-conditioning budgets of Section 151 (b) 2 shall be used; the water-heating budgets of Section 151 (b) 1 shall not apply.

   The performance approach for the existing building and the addition in Section 152 (a) 2 B may be used to show compliance, regardless of the type of water heater installed.

EXCEPTION 4 to Section 152 (a): When heating and/or cooling will be extended to an addition from the existing system(s), the existing equipment need not comply with Title 24, Part 6. The heating system capacity must be adequate to meet the minimum requirements of UBC Section 310.11.

(b) **Alterations**. Alterations to existing 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 through 118 and 150; and

   A. Alterations that add fenestration area ~~to a building~~ shall meet the ~~be limited to a maximum 0.75~~ U-factor requirements of section 151(f)3A, the total fenestration area requirements of section 151(f)3B and the ~~the~~ Solar Heat Gain Coefficient requirements of section 151(f)4.

      EXCEPTION to Section 152 (b) 1 A: Any dual-glazed greenhouse window and dual-glazed skylight installed as part of an alteration complies with the U-factor requirements in section 151(f)3A.

      NOTE: Fenestration products repaired or replaced, not as part of an alteration, need not comply with the U-factor and Solar Heat Gain Coefficient requirements applicable to alterations.

   B Replacement fenestration, where all the glazing in an existing fenestration opening is replaced with a new manufactured fenestration product, shall not exceed the U-factor and Solar Heat Gain Coefficient requirements of sections 151(f)3A and 151(f)4

   Note: Glass replaced in an existing sash and frame, or replacement of a single sash in a multi-sash fenestration product are considered repairs.

   ~~for new fenestration products as specified in Alternative Component Package D (Tables 1-Z1 through 1-Z16).~~

   ~~B~~C. New space-conditioning systems or components shall:

      i. Meet the requirements of Section 150 (h) and (i) and Section 151(f)7; and

      ii. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type unless it can be demonstrated that the ~~source~~ TDV energy use of the new system is more efficient than the existing system.

   ~~C.C~~D. New service water-heating systems or components shall:

      (i) Meet the requirements of Section 150; and

      (ii) Be limited to natural gas, liquefied petroleum gas, or the existing fuel type unless it can be demonstrated that the ~~source~~ TDV energy use of the new system is more efficient than the existing system.

2. Performance approach.

   A. The altered components shall meet the applicable requirements of Sections 110 through 118 and 150; and

   B. Either:

      i. The permitted space alone, which shall be a minimum of the square footage of the room in which the alteration is made, shall comply with Section 151; or

ii. The energy efficiency of the existing building shall be improved so that the building meets the energy budget in Section 151 that would apply if the existing building was unchanged and the permitted space alone complied with Item i. The permitted space shall be a minimum of the square footage of the room in which the alteration is made.

EXCEPTION to 152 (b) 2 B: When the existing fuel type is electric, the existing or replacement equipment for heating, cooling and/or domestic water heating of the proposed building shall be assumed to be the same fuel type as the standard building.

~~(c) Electric-resistance water-heating or space-conditioning systems may be installed in or in conjunction with an addition only if the electric-resistance system meets the applicable energy budget(s) from Section 151 (b) pursuant to Section 152 (a) 2.~~

~~D.~~ (c) Any addition or alteration may comply with the requirements of Title 24, Part 6 by meeting the requirements for new buildings for the building as a whole.

NOTE: Authority cited: Public Resources Code, Sections 25218(e), 25402, and 25402.1. Reference: Public Resources Code, Section 25402.

CALIFORNIA MECHANICAL CODE
PART 4, TITLE 24
CALIFORNIA CODE OF REGULATIONS
CHAPTER 6
DUCTS

~~ADOPTION~~ TABLE P4-~~10~~A ADOPTION

CODE SECTION	CEC	CEC
Entire CMC as noted in this table	1998 CMC[1]	2000 CMC[2]
601	X[1]	
603	X[1]	
604	X[1]	
Standard 6-3	X[1]	
601		X[3]
602		X[3]
604		X[3]
605		X[3]
Standard 6-5		X[3]

[1] Prior to the effective date designated by the California Building Standards Commission for the 2000 CMC.
[2] On and after the effective date designated by the California Building Standards Commission for the 2000 CMC.
[3] Adopted by reference for Occupancies A, B, E, F, M, R, and S; see Sections 118, 124, 150, and 151.

APPENDIX 1-A
STANDARDS REFERENCED IN ENERGY EFFICIENCY REGULATIONS

STATE OF CALIFORNIA

Appliance Efficiency Regulations

Quality Standards for Insulating Material

Nonresidential Manual

Residential Manual

Various Directories for Certified Appliances

Available from: California Energy Commission
Publications Office
1516 Ninth Street, MS-13
Sacramento, California 95814-5512
(916) 654-5200

CONSUMER GUIDE TO CERTIFIED INSULATING MATERIALS

Available from: Consumer Affairs
Insulation Quality Standards
(916) 574-2060

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

Uniform Building Code, 1997 Edition

California Mechanical Code, 1998 Edition

Available from: International Conference of Building Officials
5360 South Workman Mill Road
Whittier, California 90601
(562) 699-0541

AIR-CONDITIONING AND REFRIGERATION INSTITUTE

ARI 210/240-94	Standard for Unitary Air Conditioning and Air-Source Heat Pump Equipment
ARI 310/380-93	Standard for Packaged Terminal Air-Conditioners and Heat Pumps
ARI 320-98	Standard for Water-Source Heat Pumps
ARI 325-98	Standard for Ground Water-Source Heat Pumps
ARI 330-98	Ground Source Closed-Loop Heat Pumps
ARI 340/360-93	Standard for Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment
ARI 365-94	Standard for Commercial and Industrial Unitary Air-Conditioning Condensing Units
ARI 460-2000	Standard for Remote Mechanical-Draft Air-Cooled Refrigerant Condensers
ARI 550-92	Standard for Centrifugal or Rotary Screw Water-Chilling Packages
ARI 560-92	Standard for Absorption Water Chilling and Water Heating Packages
ARI 590-1992	Standard for Positive Displacement Compressor Reciprocating Water-Chilling Packages

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

Available from: Air Conditioning Contractors of America, Inc.
1712 New Hampshire Avenue, NW
Washington, DC 20009
www.acca.org/catalog/product.asp
(202) 483-9370
FAX (202) 232-8545

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR-CONDITIONING ENGINEERS (NATIONAL PUBLICATIONS)[140]

Handbook and Product Directory

Equipment Volume, 2000 Edition

HVAC Applications Volume, Chapter 48, 1999 Edition

Fundamentals Volume, ~~1993 and 1997~~ 2001 Edition

STANDARDS

ANSI/ASHRAE 55-1992 Thermal Environment Conditions for Human Occupancy

ASHRAE 62-89 Standards for Natural and Mechanical Ventilation and Ventilation for Acceptable Indoor Air Quality

Available from: ASHRAE
1791 Tullie Circle N.E.
Atlanta, Georgia 30329
(404) 636-8400 or (800) 527-4723

AMERICAN SOCIETY OF HEATING, REFRIGERATION, AND AIR-CONDITIONING ENGINEERS (REGIONAL PUBLICATIONS)[141]

~~Recommended Outdoor Design Temperatures for Northern California, 1977~~

~~Available from: ASHRAE~~
~~Golden Gate Chapter~~
~~370 Brannan Street~~
~~San Francisco, California 94102~~
~~(415) 495-4552~~

~~Climatic Data For Region X, Arizona, California, Hawaii, and Nevada, Publication SPCDX, 1982~~

~~Available from: ASHRAE - Climatic Data~~
~~Southern California Chapter~~
~~Post Office Box 6306~~
~~Alhambra, California 91802~~

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[140] The justification for this change appears in Eley Associates, "Maximum Allowable Cooling Capacity," *Measure Analysis and Life-Cycle Cost: 2005 California Building Energy Efficiency Standards, Part III*, July 3, 2002, p. 6-16. Presented at the July 18, 2002 workshop.

[141] Ibid.

Climatic Data for Region X Arizona, California, Hawaii, Nevada, Publication SPCDX, 1982, ISBN #20002196
Supplement to Climatic Data for Region X Arizona, California, Hawaii, Nevada, 1994, ISBN #20002596
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10 CFR, Part 430, Appendix N

21 CFR, Section 1002.2 (1996)

47 CFR, Parts 2 and 15 (1996)

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[142] The justification for this change appears in Pacific Gas and Electric Company, *Window Efficiency Requirements Upon Window Replacement*, *Code Change Proposal, 2005 Title 24 Building Energy Efficiency Standards Update*, March 15, 2002. Presented at the April 23, 2002 workshop.