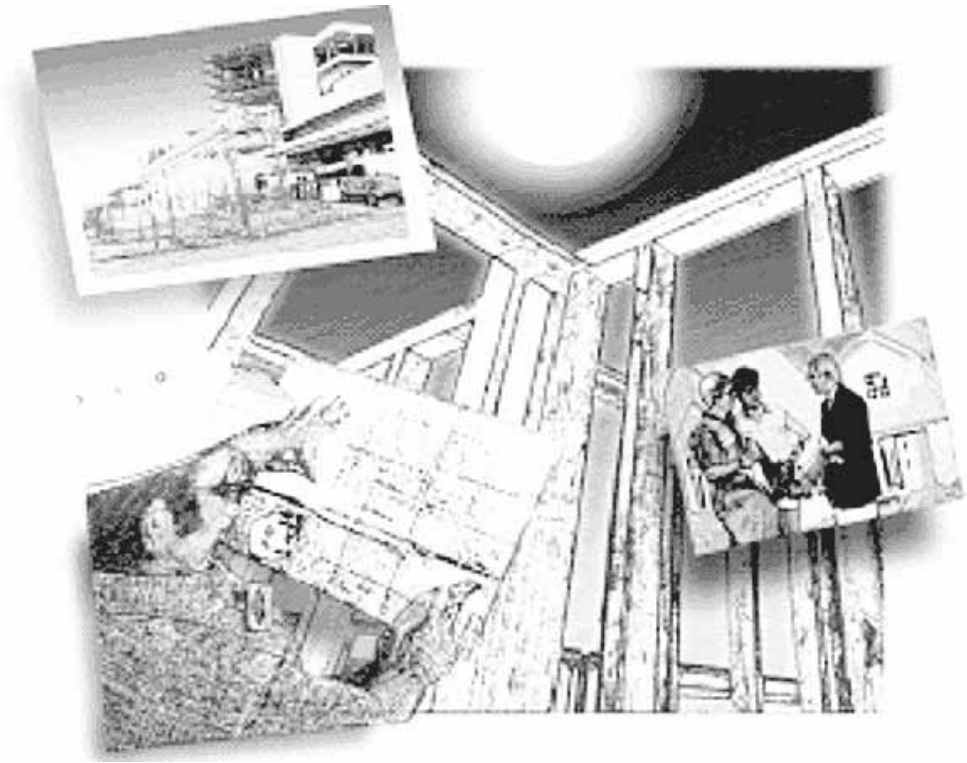
CALIFORNIA
ENERGY COMMISSION

2005 BUILDING ENERGY EFFICIENCY STANDARDS

FOR RESIDENTIAL AND NONRESIDENTIAL BUILDINGS



STANDARDS/REGULATIONS

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NOTICE

This version of the revised 2005 Building Energy Efficiency Standards is an "unmarked" version; that is, it contains no underlined or struck-out text showing changes from the original 2005 Standards. A marked version is available on the Energy Commission's website at www.energy.ca.gov/title24/2005standards/. For more information, call the Title 24 Energy Efficiency hotline at 800/772-3300 (toll-free from within California) or 916/654-5106, or send email to title24@energy.state.ca.us.

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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:

ACCEPTANCE REQUIREMENTS are "acceptance requirements for code compliance" as defined in Section 101 (b) of Part 6.

ALTERNATIVE CALCULATION METHOD APPROVAL MANUAL or **ACM MANUAL** is the Alternative Calculation Method (ACM) Approval Manual for the 2005 Energy Efficiency Standards for Nonresidential Buildings, (P400-03-001F) for nonresidential buildings, hotels, and multifamily residential buildings with four or more stories and the Alternative Calculation Method (ACM) Approval Manual for the 2005 Energy Efficiency Standards for Residential Buildings, (P400-03-003) for all single family and low-rise multifamily residential buildings.

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

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 (e) 2 of Part 6.

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

CRRC-1 is the Cool Roof Rating Council document entitled “Product Rating Program”.

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

ENFORCEMENT 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.

NFRC 100 is the National Fenestration Rating Council document entitled "NFRC 100: Procedure for Determining Fenestration Product U-factors." (1997 or November 2002, NFRC 100 includes procedures for site built fenestration formerly included in a separate document, NFRC 100-SB)[1]

NFRC 200 is the National Fenestration Rating Council document entitled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (1995 or November 2002)[2]

NFRC 400 is the National Fenestration Rating Council document entitled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (1995 or January 2002)[3]

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

PUBLIC ADVISER is the Public Adviser of the commission.

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

RECORD DRAWINGS are drawings that document the as installed location and performance data on all lighting and space conditioning system components, devices, appliances and equipment, including but not limited to wiring sequences, control sequences, duct and pipe distribution system layout and sizes, space conditioning system terminal device layout and air flow rates, hydronic system and flow rates, and connections for the space conditioning system. Record drawings are sometimes called "as builts."

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 newly constructed buildings additions, alterations or repairs 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

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[1] Either the 1997 edition or the November 2002 edition may be used for product rating prior to April 1, 2004. Product ratings authorized by NFRC prior to April 1, 2004 are valid for the full certification period. Beginning April 1, 2004 only the November 2002 edition may be used for new product rating.

[2] Either the 1995 edition or the November 2002 edition may be used for product rating prior to April 1, 2004. Product ratings authorized by NFRC prior to April 1, 2004 are valid for the full certification period. Beginning April 1, 2004 only the November 2002 edition may be used for new product rating.

[3] Either the 1995 edition or the January 2002 edition may be used for product rating prior to April 1, 2004. Product ratings authorized by NFRC prior to April 1, 2004 are valid for the full certification period. Beginning April 1, 2004 only the January 2002 edition may be used for new product rating.

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. Plans and specifications submitted with each application for a building permit for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall provide acceptance requirements for code compliance of each feature, material, component or manufactured device when acceptance requirements are required under Part 6. Plans and specifications for Nonresidential buildings, High-rise Residential buildings and Hotels and Motels shall require that within 90 days after the Enforcement Agency issues a final occupancy permit, record drawings be provided to the building owner. 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 Efficiency Regulations 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 Efficiency Regulations and Part 6.

ii. Include a statement indicating that the installed devices conform to the Appliance Efficiency Regulations 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) **Certificate of Acceptance.** For all new Nonresidential buildings, High-rise Residential buildings and Hotels and Motels designated to allow use of an occupancy group or type regulated by Part 6, the applicant shall file Certificate(s) of Acceptance with the enforcement agency prior to receiving a final occupancy permit. The signer (s) shall be eligible under Division 3 of the Business and Professions code to sign such documents. The Certificate(s) shall be readily legible and of substantially similar format and informational order and content to the Certificate(s) of Acceptance in the Nonresidential Manual, as defined in Part 6. The Certificate(s) shall be approved by the local enforcement agency by stamp or authorized signature and shall indicate that:

1. The applicant has demonstrated acceptance requirements as indicated in the plans and specifications submitted under section 10-103(a);
2. Installation certificates described in section 10-103(a)3 are posted, or made available with the building permit(s) issued for the building; and
3. That operating and maintenance information described in sections 10-103(b) and 10-103(c) were provided to the building owner.

(c) **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 low-rise 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, high-rise residential buildings and hotels and motels, such information shall, at a minimum, include information required by the Certificates of Compliance, Certificate of Acceptance, 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.

(d) **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).

(e) **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 Efficiency Regulations 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).

   For buildings that have used a compliance option that requires field verification and diagnostic testing, the building department shall not approve the building until the building department has received a Certificate of Field Verification and Diagnostic Testing that has been signed and dated by the HERS Rater.

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 newly constructed buildings, addition, alterations, and repairs 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.

(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 Residential or 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; and

   D. Is reliable and accurate relative to the appropriate public domain computer program;

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 Residential or Nonresidential ACM Manual. The ACM Manuals 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 criteria in the 2005 Residential or Nonresidential ACM Manuals are hereby incorporated by reference.

   NOTE: Copies of the ACM Manuals may be obtained from the Energy Commission's website at www.energy.ca.gov.

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;

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

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

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 newly constructed 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 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 COEFFICIENTS AND AIR LEAKAGE

This section establishes rules for implementing labeling and certification requirements relating to U-factors, solar heat gain coefficients (SHGCs) 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 manufactured and site-built 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.

   A. Fenestration products rated and certified using NFRC 100, NFRC 200 or NFRC 400 Rating Procedures. The manufacturer shall stipulate that the ratings were determined in accordance with applicable NFRC procedures. For manufactured fenestration products, a temporary label approved by the supervisory entity meets the requirements of this section. For site-built fenestration products, a label certificate approved by the supervisory entity meets the requirements of this section.

   B. Fenestration products rated using a default value approved by the commission. For manufactured fenestration products, a temporary label with the words “CEC Default U-factor,” followed by the appropriate default U-factor specified in section 116 (a) 2 and with the words “CEC Default SHGC,” followed by the appropriate default SHGC specified in section 116 (a) 3 meets the requirements of this section. For site-built fenestration products, a default label certificate approved by the commission meets the requirements of this section.

   C. 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 have a permanent label that is either a stand-alone label, an extension or tab of an existing permanent certification label being used by the manufacturer/responsible party, or series of marks on the product. The permanent label, coupled with observable product characteristics, can be used to trace the product to certification information on file with the supervisory entity or to a directory of certified products, published by the supervisory entity. For site-built fenestration products, a label certificate approved by the supervisory entity meets the requirements of this section.

EXCEPTION to Section 10-111 (a): Field-fabricated fenestration products.

(b) Certification Requirements.

1. **Certification to default ratings.** If a product's U-factor and SHGC are default values approved by the commission as specified in sections 116 (a) 2 and 116 (a) 3), the U-factor and SHGC shall be certified by the manufacturer.

   A. A temporary label, affixed to the product, that meets the requirements of Section 10-111 (a) 1 B meets this requirement.

   B. If the product claims the default U-factor for a thermal-break product, the manufacturer shall also certify on the label that the product meets the thermal-break product criteria, specified on the default table, on which

the default value is based. Placing the terms "Meets Thermal-Break Default Criteria" on the default temporary label or default label certificate meets this requirement.

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

   A. A temporary label, affixed to the product or label certificate for site-built fenestration, meeting the requirements of Section 10-111 (a) certified by the independent certifying organization complies with this requirement.

   B. An "independent certifying organization approved by the commission" means any organization authorized by the supervisory entity to certify U-factor ratings 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 to Section 10-111 (b): Field-fabricated fenestration products.

(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:

   A. Possession and calibration of equipment;

   B. Education, competence, and training of personnel;

   C. Quality control;

   D. Record keeping and reporting;

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

F. Challenges to certified ratings; and

G. Guidelines to maintain the integrity of the program, including, but not limited to, provisions to avoid conflicts of interest within the rating and certification process.

6. The entity shall be a nonprofit organization and shall maintain reasonable, nondiscriminatory fee schedules for the services it provides and shall make its fee schedules, the financial information on which fees are based, and financial statements available to its members for inspection.

7. The entity shall provide hearing processes that give laboratories, manufacturers, and certifying agencies a fair review of decisions that adversely affect them.

8. The entity shall maintain a certification policy committee whose procedures are designed to avoid conflicts of interest in deciding appeals, resolving disputes, and setting policy for the certifying organizations 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 fenestration 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.**

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.

Packaging for liquid applied roof coatings shall state the product meets the requirements specified in Section 118 (i) 3.

(b) **Certification Requirements.**

Every roofing product installed in construction to take compliance credit for reflectance and emittance under Sections 141, 142, and 151 (b) shall be certified by CRRC or another supervisory entity approved by the commission pursuant to Section 10-113 (c).

(c) **Designation of Supervisory Entity.** The Cool Roof Rating Council 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). 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 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;
   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

This section establishes rules for implementing outdoor lighting zones to show compliance with Section 147 of Title 24, California Code of Regulations, Part 6.

(a) **Lighting Zones**. Exterior lighting allowances in California vary by Lighting Zones (LZ).

(b) **Lighting Zone Characteristics**. TABLE 10-114-A specifies the relative ambient illumination level and the statewide default location for each lighting zone.

(c) **Amending the Lighting Zone Designation**. A local jurisdiction may officially adopt changes to the lighting zone designation of an area by following a public process that allows for formal public notification, review, and comment about the proposed change. The local jurisdiction may determine areas where Lighting Zone 4 is applicable and may increase or decrease the lighting zones for areas that are in State Default Lighting Zones 1, 2 and 3, as specified in TABLE 10-114-A

(d) **Commission Notification.** Local jurisdictions who adopt changes to the State Default Lighting Zones shall notify the Commission by providing the following materials to the executive director:

1. A detailed specification of the boundaries of the adopted Lighting Zones, consisting of the county name, the city name if any, the zip code(s) of the redesignated areas, and a description of the physical boundaries within each zip code.
2. A description of the public process that was conducted in adopting the Lighting Zone changes.
3. An explanation of how the adopted Lighting Zone changes are consistent with the specifications of Section 10-114.

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

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

Zone	Ambient Illumination	State wide Default Location	Moving Up to Higher Zones	Moving Down to Lower Zones
LZ1	Dark	Government designated parks, recreation areas, and wildlife preserves. Those that are wholly contained within a higher lighting zone may be considered by the local government as part of that lighting zone.	A government designated park, recreation area, wildlife preserve, or portions thereof, can be designated as LZ2 or LZ3 if they are contained within such a zone.	Not applicable.
LZ2	Low	Rural areas, as defined by the 2000 U.S. Census.	Special districts within a default LZ2 zone may be designated as LZ3 or LZ4 by a local jurisdiction. Examples include special commercial districts or areas with special security considerations located within a rural area.	Special districts and government designated parks within a default LZ2 zone maybe designated as LZ1 by the local jurisdiction for lower illumination standards, without any size limits.
LZ3	Medium	Urban areas, as defined by the 2000 U.S. Census.	Special districts within a default LZ3 may be designated as a LZ4 by local jurisdiction for high intensity nighttime use, such as entertainment or commercial districts or areas with special security considerations requiring very high light levels.	Special districts and government designated parks within a default LZ3 zone may be designated as LZ1 or LZ2 by the local jurisdiction, without any size limits.
LZ4	High	None.	Not applicable.	Not applicable.

(blank)

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:
   - A. Unconditioned, indirectly or directly conditioned by mechanical heating or mechanical cooling or process spaces; or
   - B. Low-rise residential buildings that are heated with a wood heater or another non-mechanical heating system.

EXCEPTION 1 to Section 100 (a): Qualified historic buildings, as defined in the State Historic Building Code (Title 24, Part 8).

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 indoor lighting systems of buildings, and outdoor lighting systems and signs located either indoors or outdoors that are covered by Section 100 (a) as set forth in TABLE 100-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 CBC 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 and Indoor and Outdoor Signs**. The provisions of Title 24, Part 6, apply to outdoor lighting systems and to signs located either indoors or outdoors as set forth in TABLE 100-A.

(e) **Sections Applicable to Particular Buildings.** TABLE 100-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 119 apply to all buildings.
2. **Newly constructed buildings**.
   - A. All newly constructed buildings. Sections 110 through 119 apply to all newly constructed buildings within the scope of Section 100 (a). In addition, newly constructed buildings shall meet the requirements of B, 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 147 apply to newly constructed nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled.
     - ii. Compliance approaches. In order to comply with Title 24, Part 6, newly constructed nonresidential buildings, high-rise residential buildings, and hotels/motels that are mechanically heated or mechanically cooled must meet the requirements of:

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

b. Either:

Performance approach: Section 141; or

Prescriptive approach: Sections 142 through 148.

C. Unconditioned nonresidential buildings and process spaces. Sections 119, 130 through 132, 143 (c), 146, 147, and 148 apply to all newly constructed unconditioned buildings and process spaces within the scope of Section 100 (a).

D. Low-rise residential buildings.

i. Sections applicable. Sections 150 through 151 apply to newly constructed low-rise residential buildings.

ii. Compliance approaches. To comply with Title 24, Part 6, newly constructed low-rise residential buildings 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 (e) 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 (e) 2 D ii b: Low-rise residential buildings that are heated with a wood heater or another non-mechanical 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.

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 (d) applies to buildings in which insulation is being installed in existing attics, or on existing water heaters, or existing space conditioning ducts.

5. **Outdoor Lighting**. Sections 119, 130, 132, 147, and 150 apply to newly constructed outdoor lighting systems, and Section 149 applies to outdoor lighting additions and alterations.

6. **Signs**. Sections 130, 132 and 148 apply to newly constructed signs located either indoors or outdoors and Section 149 applies to sign alterations located either indoors or outdoors.

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

EXCEPTION to Section 100 (f): 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.

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

(h) **Certification Requirements for Manufactured 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: 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.

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, process spaces)		143 (c)		
	HVAC (conditioned)	112, 115, 120-125	144		
	Water Heating (conditioned)	113, 123	145		
	Indoor Lighting (conditioned, process spaces)	119, 130, 131	143 (c), 146		
	Indoor Lighting (unconditioned)	119, 130, 131	143 (c), 146	N.A.	
	Outdoor Lighting	119, 130, 132	147		
Signs	Indoor and Outdoor	130, 132	148		
Low-Rise Residential	General	150	151 (a, f)	151 (a-e)	152
	Envelope (conditioned)	116, 117, 118, 150 (a-g, l)			
	HVAC (conditioned)	112, 115, 150 (h, i, m)			
	Water heating (conditioned)	113, 150 (j)			
	Indoor Lighting (conditioned and parking garages)	119(d), 150 (k)			
	Outdoor Lighting	119(d), 150 (k)			

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 *California 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.

ACCA MANUAL J is the Air Conditioning Contractors of America document entitled "Manual J - Residential Load Calculation, Eighth Edition" (2003).

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

ACCENT (LIGHT) is a directional luminaire designed to highlight or spotlight objects. It can be recessed, surface mounted, or mounted to a pendant, stem or track.

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

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

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

AIR-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. Alteration is also any change to an outdoor lighting system that is regulated by Part 6 that is not an addition. Alteration is also any change to signs located either indoors or outdoors that is regulated by Part 6.

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

ANSI is the American National Standards Institute.

ANSI Z21.10.3 is the American National Standards Institute document entitled "Gas Water Heaters, Volume I, Storage Water Heaters with input ratings above 75,000 Btu per hour," 2001 (ANSI Z21.10.3-2001).

ANSI Z21.13 is the American National Standards Institute document entitled "Gas-Fired Low Pressure Steam and Hot Water Boilers," 2000 (ANSI Z21.13-2000).

ANSI Z21.40.4 is the American National Standards Institute document entitled "Performance Testing and Rating of Gas-Fired, Air Conditioning and Heat Pump Appliances," 1996 (ANSI Z21.40.4-1996).

ANSI Z21.47 is the American National Standards Institute document entitled "Gas-Fired Central Furnaces," 2001 (ANSI Z21.47-2001).

ANSI Z83.8 is the American National Standards Institute document entitled "Gas Unit Heaters and Gas-Fired Duct Furnaces," 2002 (ANSI Z83.8 -2002).

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.

ARI 210/240 is the Air-conditioning and Refrigeration Institute document entitled "Unitary Air-Conditioning and Air-Source Heat Pump Equipment," 2003 (ARI 210/240-2003).

ARI 310/380 is the Air-conditioning and Refrigeration Institute document entitled "Packaged Terminal Air-Conditioners and Heat Pumps," 1993 (ARI 310/380-93).

ARI 320 is the Air-conditioning and Refrigeration Institute document entitled "Water-Source Heat Pumps," 1998 (ARI 320-98).

ARI 325 is the Air-conditioning and Refrigeration Institute document entitled "Ground Water-Source Heat Pumps," 1998 (ARI 325-98).

ARI 340/360 is the Air-conditioning and Refrigeration Institute document entitled "Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment," 2000 (ARI 340/360-2000).

ARI 365 is the Air-conditioning and Refrigeration Institute document entitled, "Commercial and Industrial Unitary Air-Conditioning Condensing Units," 2002 (ARI 365-2002).

ARI 460 is the Air-conditioning and Refrigeration Institute document entitled "Remote Mechanical-Draft Air-Cooled Refrigerant Condensers," 2000 (ARI 460-2000).

ARI 550/590 is the Air-conditioning and Refrigeration Institute document entitled "Standard for Water Chilling Packages Using the Vapor Compression Cycle," 1998 (ARI 550/590-98).

ARI 560 is the Air-conditioning and Refrigeration Institute document entitled "Absorption Water Chilling and Water Heating Packages," 2000 (ARI 560-2000).

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

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

ASHRAE HANDBOOK, APPLICATIONS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document entitled "ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Applications" (2003).

ASHRAE HANDBOOK, EQUIPMENT VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document entitled "ASHRAE Handbook: Heating, Ventilating, and Air-Conditioning Systems and Equipment" (2000).

ASHRAE HANDBOOK, FUNDAMENTALS VOLUME is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document entitled "ASHRAE Handbook: Fundamentals" (2001).

ASHRAE 55 is the American Society of Heating, Refrigerating and Air-Conditioning Engineers document entitled " Thermal Environmental Conditions for Human Occupancy," 1992 (ASHRAE Standard 55-1992).

ASME is the American Society of Mechanical Engineers.

ASTM is the American Society for Testing and Materials.

ASTM C55 is the American Society for Testing and Materials document entitled "Standard Specification for Concrete Brick," 2001 (ASTM C55-01).

ASTM C177 is the American Society for Testing and Materials document entitled "Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus," 1997 (ASTM C177-97).

ASTM C272 is the American Society for Testing and Materials document entitled "Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions," 2001 (ASTM C272-01).

ASTM C335 is the American Society for Testing and Materials document entitled "Standard Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulation," 1995 (ASTM C335-95).

ASTM C518 is the American Society for Testing and Materials document entitled "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus," 2002 (ASTM C518-02).

ASTM C731 is the American Society for Testing and Materials document entitled "Standard Test Method for Extrudability, After Package Aging of Latex Sealants," 2000 (ASTM C731-00).

ASTM C732 is the American Society for Testing and Materials document entitled "Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants," 2001 (ASTM C732-01).

ASTM C836 is the American Society of Testing and Materials document entitled, "Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course," 2005 (ASTM C836-05).

ASTM C1167 is the American Society for Testing and Materials document entitled "Standard Specification for Clay Roof Tiles," 1996 (ASTM C1167-96).

ASTM C1371 is the American Society for Testing and Materials document entitled "Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers," 1998 (ASTM C1371-98).

ASTM C1583 is the American Society of Testing and Materials document entitled, "Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension" (Pull-off Method)," 2004 (ASTM C1583-04).

ASTM D522 is the American Society of Testing and Materials document entitled, "Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings," 2001 [ASTM D522-93a (2001)].

ASTM D822 is the American Society of Testing and Materials document entitled, "Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings," 2001 (ASTM D822-01).

ASTM D1003 is the American Society for Testing and Materials document entitled "Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics," 2000 (ANSI/ASTM D1003-00).

ASTM D1653 is the American Society of Testing and Materials document entitled, "Standard Test Methods for Water Vapor Transmission of Organic Coating Films," 2003 (ASTM D1653-03).

ASTM D2370 is the American Society of Testing and Materials document entitled, "Standard Test Method for Tensile Properties of Organic Coatings," 2002 [ASTM D2370-98 (2002)].

ASTM D2824 is the American Society of Testing and Materials document entitled "Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos," 2002 (ASTM D2824-02).

ASTM D3468 is the American Society of Testing and Materials document entitled, "Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing," 1999 (ASTM D3468-99).

ASTM D3805 is the American Society of Testing and Materials document entitled "Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings," 1997 [ASTM D3805-97 (reapproved 2003)].

ASTM D4798 is the American Society for Testing and Materials document entitled "Standard Test Method for Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method)," 2001 (ASTM D4798-01).

ASTM D5870 is the American Society of Testing and Materials document entitled, "Standard Practice for Calculating Property Retention Index of Plastics," 2003 [ASTM D5870-95 (2003)].

ASTM D6083 is the American Society of Testing and Materials document entitled, "Standard Specification for Liquid Applied Acrylic Coating Used in Roofing," 2005 (ASTM D6083-05e1).

ASTM D6694 is the American Society of Testing and Materials document entitled, "Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing," 2001 (ASTM D6694-01).

ASTM D6848 is the American Society of Testing and Materials document entitled "Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing," 2002 (ASTM D6848-02).

ASTM E96 is the American Society for Testing and Materials document entitled "Standard Test Methods for Water Vapor Transmission of Materials," 200 (ASTM E96-00).

ASTM E283 is the American Society for Testing and Materials document entitled "Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen," 1991 (ASTM E283-91(1999)).

ASTM E408 is the American Society for Testing and Materials document entitled, "Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques," 1971 (ASTM E408-71(2002)).

ATRIUM is a large-volume space created by openings connecting two or more stories and is used for purposes other than an enclosed stairway, an elevator hoistway, an escalator opening, or as a utility shaft for plumbing, electrical, air-conditioning or other equipment and is not 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 or continuous dimming in response to available daylight. This control uses one or more photosensors to detect changes in daylight illumination and then change the electric lighting level in response to the daylight changes.

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.

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.

CALIFORNIA ELECTRICAL CODE is the 2001 California Electrical Code.

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.

CBC is the 2001 California Building Code.

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 is an approximate map of the 16 climate zones.

CMC is the 2001 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 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 or indirectly conditioned.

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

CONTINUOUS DIMMING is a lighting control method that is capable of varying the light output of lamps over a continuous range from full light output to minimum light output.

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

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

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

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

CTI is the Cooling Tower Institute.

CTI ATC-105 is the Cooling Tower Institute document entitled "Acceptance Test Code for Water Cooling Towers," 2000 (CTI ATC-105-00).

CTI STD-201 is the Cooling Tower Institute document entitled "Certification Standard for Commercial Water Cooling Towers," 2002 (CTI STD-201-02).

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 floor area that is illuminated by daylight through vertical glazing or skylights as specified in Section 131 (c).

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.

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 for a process space. (See "Process space")

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.

DUAL-GLAZED GREENHOUSE WINDOWS are a type of dual-glazed fenestration product which adds conditioned volume but not conditioned floor area to a building.

DUCT SEALING is a procedure for installing a space conditioning distribution system that minimizes leakage of air from or to the distribution system. Minimum specifications for installation procedures, materials, diagnostic testing and field verification are contained in the 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 the extent that vertical glazing or skylights are effective for providing daylighting. The effective aperture for vertical glazing is specified in Exception 1 to Section 131 (c). The effective aperture for skylights is specified in Section 146 (a) 4 E.

EFFICACY, LAMP is the quotient of rated initial lamp lumens divided by the rated lamp power (watts), without including auxiliaries such as ballasts, measured at 25°C according to IESNA and ANSI Standards.

EFFICACY, LIGHTING SYSTEM is the quotient of rated initial lamp lumens measured at 25°C according to IESNA and ANSI Standardstimes the ballast factor, divided by the input power (watts) to the ballast or other auxiliary device (e.g. transformer); expressed in lumens per watt.

ELECTRONICALLY-COMMUTATED MOTOR is a brushless DC motor with a permanent magnet rotor that is surrounded by stationary motor windings, and an electronic controller that varies rotor speed and direction by sequentially supplying DC current to the windings.

EMITTANCE, THERMAL is the ratio of the radiant heat flux emitted by a sample to that emitted by a blackbody radiator at the same temperature.

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

ENERGY BUDGET is the maximum amount of Time Dependent Valuation (TDV) energy that a proposed building, or portion of a building, can be designed to consume, calculated with the approved procedures specified in 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.

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

ENTIRE BUILDING is the ensemble of all enclosed space in a building, including the space for which a permit is sought, plus all existing conditioned and unconditioned space within the structure.

ENVELOPE 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.

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

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

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

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- built fenestration with a label certificate or products required to have temporary or permanent labels.

FIREPLACE is a hearth and firechamber or similar prepared place in which a solid-fuel fire may be burned, as defined in CBC Section 3102.2 and as further clarified in the CBC, factory-built fireplaces, masonry fireplaces, and masonry heaters.

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

FLUX is the rate of energy flow per unit area.

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

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 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.

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) is the amount of heat necessary to raise the temperature of all the components of a unit area in an assembly by 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.

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

HEATED SLAB FLOOR 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 floor is sometimes referred to as radiant slab floors or radiant heating.

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 of the Gas Appliance Manufacturers Association (GAMA).

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

HIGH-RISE RESIDENTIAL BUILDING is a building, other than a hotel/motel, of Occupancy Group R, 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.")

IESNA HB (See "IESNA Lighting Handbook)

IESNA LIGHTING HANDBOOK is the Illuminating Engineering Society National Association document entitled "The IESNA Lighting Handbook: Reference and Applications, Ninth Edition" (2000).

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) 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.

INDUSTRIAL EQUIPMENT is manufactured equipment used in industrial processes.

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.

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

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.

KITCHEN in a residential dwelling unit is a room or area used for cooking, food storage and preparation and washing dishes, including associated counter tops and cabinets, refrigerator, stove, ovens, and floor area. Adjacent areas are considered kitchen if the lighting for the adjacent areas is on the same switch as the lighting for the kitchen.

LOW-RISE ENCLOSED SPACE is an enclosed space located in a building with three 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.

LPG is liquefied petroleum gas. Propane is one type of LPG.

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."

MALL BUILDING is a single building enclosing a number of tenants and occupants wherein two or more tenants have a main entrance into one or more malls.

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 constructed of materials which are factory cut or otherwise factory formed with the specific intention of being used to fabricate a fenestration product. A manufactured fenestration product is typically assembled before delivery to a job site. However a “knocked-down” or partially assembled product sold as a fenestration product is also a manufactured fenestration product when provided with temporary and permanent labels as described in Section 10-111; otherwise it is a site-built fenestration product.

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.

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

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

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

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.

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

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

NFRC 100 is the National Fenestration Rating Council document entitled "NFRC 100: Procedure for Determining Fenestration Product U-factors." (1997 or November 2002; NFRC 100 includes procedures for site fenestration formerly included in a separate document, NFRC 100-SB)[4]

NFRC 200 is the National Fenestration Rating Council document entitled "NFRC 200: Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence." (1995 or November 2002)[5]

NFRC 400 is the National Fenestration Rating Council document entitled "NFRC 400: Procedure for Determining Fenestration Product Air Leakage." (1995 or January 2002)[6]

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

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

NORTH-FACING 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 TYPE is one of the following:

> **Atria** (see "atrium.")
>
> **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.
>
> **Civic meeting space** is a city council or board of supervisors meeting chamber, courtroom, or other official meeting space accessible to the public.
>
> **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.

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[4] Either the 1997 edition or the November 2002 edition may be used for product rating prior to April 1, 2004. Product ratings authorized by NFRC prior to April 1, 2004 are valid for the full certification period. Beginning April 1, 2004 only the November 2002 edition may be used for new product rating.

[5] Either the 1995 edition or the November 2002 edition may be used for product rating prior to April 1, 2004. Product ratings authorized by NFRC prior to April 1, 2004 are valid for the full certification period. Beginning April 1, 2004 only the November 2002 edition may be used for new product rating.

[6] Either the 1995 edition or the January 2002 edition may be used for product rating prior to April 1, 2004. Product ratings authorized by NFRC prior to April 1, 2004 are valid for the full certification period. Beginning April 1, 2004 only the January 2002 edition may be used for new product rating.

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.

Dormitory is a building consisting of multiple sleeping quarters and having interior common areas such as dining rooms, reading rooms, exercise rooms, toilet rooms, study rooms, hallways, lobbies, corridors, and stairwells, other than high-rise residential, low-rise residential, and hotel/motel occupancies.

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.

Financial institution is 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.

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 sales 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.

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.

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

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

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.

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

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 CBC Group B Occupancy other than restaurants.

Parking garage is a covered building or structure for the purpose of parking vehicles, which consists of at least a roof over the parking area, often with walls on one or more sides. Parking garages may have fences or rails in place of one or more walls. The structure has an 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.

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.

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 merchandise 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.

Senior housing is housing other than Occupancy Group I that is specifically for habitation by seniors, including but not limited to independent living quarters, and assisted living quarters. Commons areas may include dining, reading, study, library or other community spaces and/or medical treatment or hospice facilities.

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.

Tenant lease space is a portion of a building intended for lease for which a specific tenant is not identified at the time of permit application.

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.

Transportation function is the ticketing area, waiting area, baggage handling areas, concourse, or other areas not covered by primary functions in Table 146-C in an airport terminal, bus or rail terminal or station, subway or transit station, or a marine terminal.

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

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

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

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

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.

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 definitions include the following:

Building entrance is any operable doorway in or out of a building, including overhead doors.

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

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

Hardscape is an improvement to a site that is paved and has other structural features, including but not limited to, curbs, plazas, entries, parking lots, site roadways, driveways, walkways, sidewalks, bikeways, water features and pools, storage or service yards, loading docks, amphitheaters, outdoor sales lots, and private monuments and statuary.

Landscape lighting is lighting that is recessed into the ground or paving; mounted on the ground; mounted less than 42" above grade; or mounted onto trees or trellises, and that is intended to be aimed only at landscape features.

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

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

Marquee lighting is a permanent lighting system consisting of one or more rows of many small lights attached to a canopy.

Ornamental lighting is post-top luminaires, lanterns, pendant luminaires, chandeliers, and marquee lighting.

Outdoor lighting is all electrical lighting for parking lots, signs, building entrances, outdoor sales areas, outdoor canopies, landscape lighting,, lighting for building facades and hardscape lighting.

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

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

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

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

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

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

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

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

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

Vehicle service station is a gasoline or diesel dispensing station.

OVERALL HEAT GAIN is the total heat gain through all portions of the building envelope calculated as specified in Section 143 (b) 3 for determining compliance with the Overall Envelope Approach.

OVERALL HEAT LOSS is the total heat loss through all portions of the building envelope calculated as specified in Section 143 (b) 2 for determining compliance with the Overall Envelope Approach.

PHOTOCONTROL is an electric device that detects changes in illumination then controls its electric load at predetermined illumination levels.

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

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.

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

RADIANT BARRIER is a highly reflective, low emitting material installed at the underside surface of the roof deck and the inside surface of gable ends or other exterior vertical surfaces in attics to reduce solar heat gain into the attic, as specified by Section 151(f)2.

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.

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.

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

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

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

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

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

REPAIR is the reconstruction or renewal 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 type of roof/ceiling assembly that has a specific framing type and U-factor.

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

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

SCONCE is a wall mounted ornamental luminaire.

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.

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.

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

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

SHADING COEFFICIENT (SC) is the ratio of the solar heat gain through a fenestration product to the solar heat gain through an unshaded 1/8-inch-thick clear double strength glass under the same set of conditions. For nonresidential, high-rise residential, and hotel/motel buildings, this shall exclude the effects of mullions, frames, sashes, and interior and exterior shading devices.

SIGN definitions include the following:

> **Illuminated face** is a side of a sign that has the message on it. For an exit sign it is the side that has the word "EXIT" on it.
>
> **Sign, cabinet** is an internally illuminated sign consisting of frame and face(s), with a continuous translucent message panel, also referred to as a panel sign
>
> **Sign, channel letter** is an internally illuminated sign with multiple components, each built in the shape of an individual three dimensional letter or symbol that are each independently illuminated, with a separate translucent panel over the light source for each element.
>
> **Sign, double-faced** is a sign with two parallel opposing faces.
>
> **Sign, externally illuminated** is any sign or a billboard that is lit by a light source that is external to the sign directed towards and shining on the face of the sign.
>
> **Sign, internally illuminated** is a sign that is illuminated by a light source that is contained inside the sign where the message area is luminous, including cabinet signs and channel letter signs.
>
> **Sign, traffic** is a sign for traffic direction, warning, and roadway identification.
>
> **Sign, unfiltered** is a sign where the viewer perceives the light source directly as the message, without any colored filter between the viewer and the light source, including neon, cold cathode, and LED signs.

SITE-BUILT FENESTRATION is fenestration designed to be field-glazed or field assembled units using specific factory cut or otherwise factory formed framing and glazing units that are manufactured with the intention of being assembled at the construction site and are provided with an NFRC label certificate for site-built fenestration. Examples of site-built fenestration include storefront systems, curtain walls, and atrium roof systems.

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 or unconditioned space below.

SKYLIGHT AREA 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).

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

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.

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.

STEPPED DIMMING is a lighting control method that varies the light output of lamps in one or more predetermined discrete steps between full light output and off.

STEPPED SWITCHING is a lighting control method that varies the light output of a lighting system with the intent of maintaining approximately the relative uniformity of illumination by turning off alternate groups of lamps or luminaires.

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 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, and for which the installation does not persist beyond 60 consecutive days or more than 120 days per year.

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.

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

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.

UL® is the Underwriters Laboratories.

UL 181 is the Underwriters Laboratories document entitled "Standard for Factory-Made Air Ducts and Air Connectors," 1996.

UL 181A is the Underwriters Laboratories document entitled "Standard for Closure Systems for Use With Rigid Air Ducts and Air Connectors," 1994.

UL 181B is the Underwriters Laboratories document entitled "Standard for Closure Systems for Use With Flexible Air Ducts and Air Connectors," 1995.

UL 723 is the Underwriters Laboratories document entitled "Standard for Test for Surface Burning Characteristics of Building Materials," 1996.

UL 727 is the Underwriters Laboratories document entitled "Standard for Oil-Fired Central Furnaces," 1994.

UL 731 is the Underwriters Laboratories document entitled "Standard for Oil-Fired Unit Heaters," 1995.

UL 1598 is the Underwriters Laboratories document entitled "Standard for Luminaires," 2000.

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

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

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

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.

VENDING MACHINE is a commercial, coin-operated machine for vending of refrigerated or non-refrigerated food and beverages or general merchandise.

VERTICAL GLAZING (See "window")

VERY VALUABLE MERCHANDISE is rare or precious objects, including, but not limited to, jewelry, coins, small art objects, crystal, 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 type of wall assembly having a specific heat capacity, framing type, and U-factor.

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 fenestration 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.

WOOD STOVE (See "wood heater.")

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.

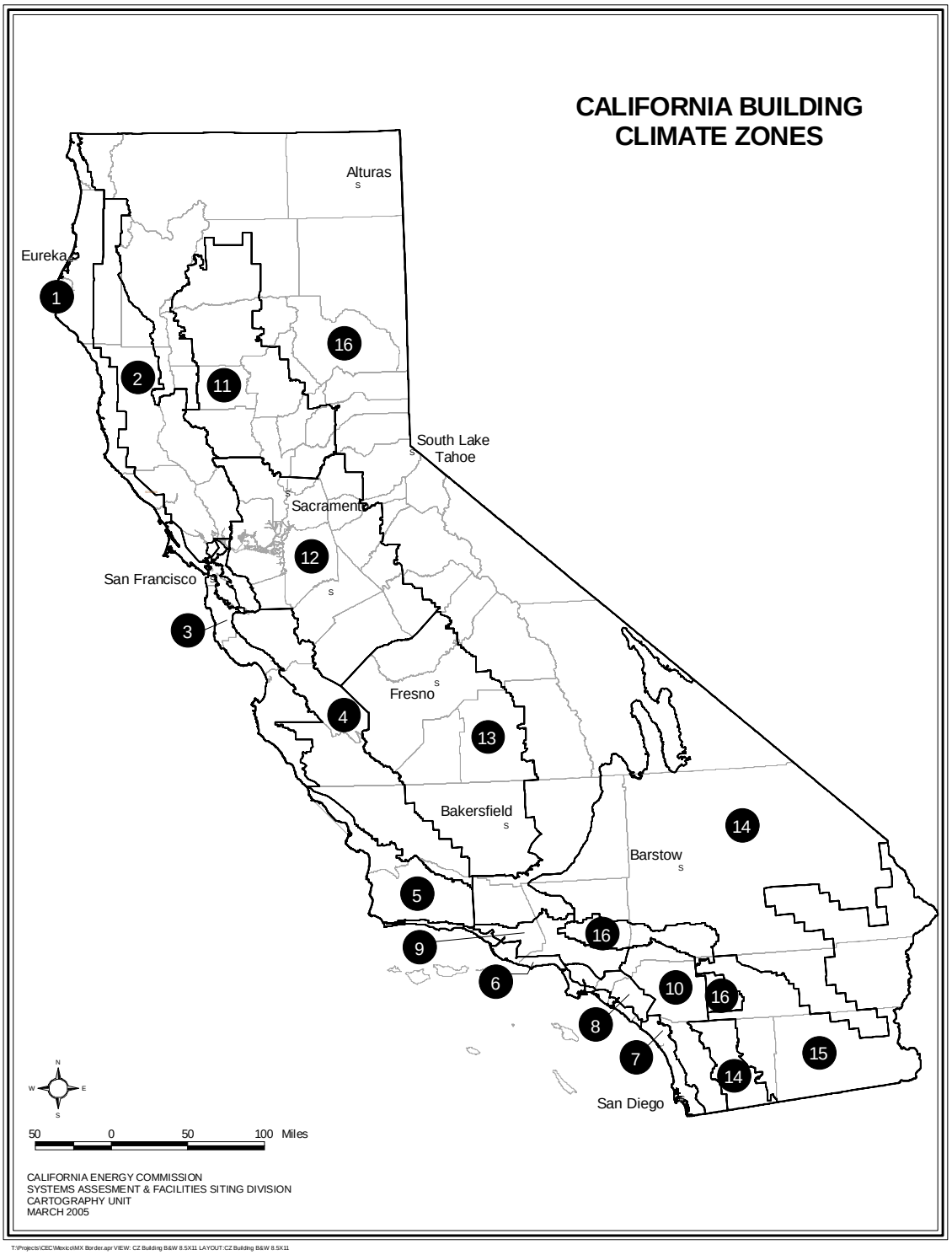

FIGURE 101-A—CALIFORNIA CLIMATE ZONES

Climate Zones for Residential and Nonresidential Occupancies

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

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

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 TABLE 112-A through TABLE 112-M, subject to the following:

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

2. If more than one test method is listed in TABLE 112-A through TABLE 112-M, 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.

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 rating as shown in TABLE 112-H, TABLE 112-I, and TABLE 112-J, and a minimum NPLV rating as shown in TABLE 112-K, TABLE 112-L, and TABLE 112-M. The table values are only applicable over the following full load design ranges:

Leaving Chiller Water Temp.	40 to 48°F
Entering Condenser Water Temp.	75 to 85°F
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.

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

Equipment Type	**Size Category**	**Efficiency [a]**	**Test Procedure**
Air Conditioners, Air Cooled	≥ 65,000 Btu/h and < 135,000 Btu/h	10.3 EER[b]	ARI 340/360
	≥ 135,000 Btu/h and < 240,000 Btu/h	9.7 EER[b]	ARI 340/360
	≥ 240,000 Btu/h and < 760,000 Btu/h	9.5 EER[b] and 9.7 IPLV[b]	
	≥ 760,000 Btu/h	9.2 EER[b] and 9.4 IPLV[b]	
Air Conditioners, Water and Evaporatively Cooled	> 240,000 Btu/h	11.0 EER[b] and 10.3 IPLV[b]	ARI 340/360
Condensing Units, Air Cooled	≥ 135,000 Btu/h	10.1 EER and 11.2 IPLV	ARI 365
Condensing Units, Water or Evaporatively Cooled	≥ 135,000 Btu/h	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 UNITARY AND APPLIED HEAT PUMPS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**Subcategory or Rating Condition**	**Efficiency [a]**	**Test Procedure**
Air Cooled (Cooling Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h	Split System and Single Package	10.1 EER[b]	ARI 340/360
	≥ 135,000 Btu/h and <240,000 Btu/h	Split System and Single Package	9.3 EER[b]	ARI 340/360
	≥ 240,000 Btu/h	Split System and Single Package	9.0 EER[b] 9.2 IPLV[b]	
Air Cooled (Heating Mode)	≥ 65,000 Btu/h and < 135,000 Btu/h (Cooling Capacity)	47°F db/43°F wb Outdoor Air	3.2 COP	ARI 210/240
	≥ 135,000 Btu/h (Cooling Capacity)	47°F db/43°F wb Outdoor Air	3.1 COP	ARI 340/360
[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

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 WATER CHILLING PACKAGES – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**Efficiency**	**Test Procedure**
Air Cooled, With Condenser, Electrically Operated	< 150 Tons	2.80 COP	ARI 550/590
	≥ 150 Tons	3.05 IPLV	
Air Cooled, Without Condenser, Electrically Operated	All Capacities	3.10 COP 3.45 IPLV	
Water Cooled, Electrically Operated, Positive Displacement (Reciprocating)	All Capacities	4.20 COP 5.05 IPLV	ARI 550/590
Water Cooled, Electrically Operated, Positive Displacement (Rotary Screw and Scroll)	< 150 Tons	4.45 COP 5.20 IPLV	ARI 550/590
	≥ 150 Tons and < 300 Tons	4.90 COP 5.60 IPLV	
	≥ 300 Tons €	5.50 COP 6.15 IPLV	
Water Cooled, Electrically Operated, Centrifugal	< 150 Tons	5.00 COP 5.25 IPLV	ARI 550/590
	≥ 150 Tons and < 300 Tons	5.55 COP 5.90 IPLV	
	≥ 300 Tons €	6.10 COP 6.40 IPLV	
Air Cooled Absorption Single Effect	All Capacities	0.60 COP	ARI 560
Water Cooled Absorption Single Effect	All Capacities	0.70 COP	
Absorption Double Effect, Indirect-Fired	All Capacities	1.00 COP 1.05 IPLV	
Absorption Double Effect, Direct-Fired	All Capacities	1.00 COP 1.00 IPLV	
Water Cooled Gas Engine Driven Chiller	All Capacities	1.2 COP 2.0 IPLV	ANSI Z21.40.4

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

Equipment Type	**Size Category (Input)**	**Subcategory or Rating Condition**	**Efficiency [a]**	**Test Procedure**
PTAC (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.5 - (0.213 x Cap/1000)[a] EER	ARI 310/380
PTAC (Cooling Mode) Replacements[b]	All Capacities	95°F db Outdoor Air	10.9 - (0.213 x Cap/1000)[a] EER	
PTHP (Cooling Mode) New Construction	All Capacities	95°F db Outdoor Air	12.3 - (0.213 x Cap/1000)[a] EER	
PTHP (Cooling Mode) Replacements[b]	All Capacities	95°F db Outdoor Air	10.8 - (0.213 x Cap/1000)[a] EER	
PTHP (Heating Mode) New Construction	All Capacities		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	

[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 BOILERS, GAS- AND OIL-FIRED – MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	**Size Category**	**Subcategory or Rating Condition**	**Efficiency**	**Test Procedure**
Boilers, Gas-Fired	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Maximum Capacity	75% Et [a]	H.I. Htg Boiler Standard
Boilers, Oil-Fired	≥ 300,000 Btu/h and ≤ 2,500,000 Btu/h	Maximum Capacity	78% Et [a]	H.I. Htg Boiler

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

TABLE 112-G PERFORMANCE REQUIREMENTS FOR HEAT REJECTION EQUIPMENT

Equipment Type	**Total System Heat Rejection Capacity at Rated Conditions**	**Subcategory or Rating Condition**	**Performance Required [a,b]**	**Test Procedure [c]**
Propeller or Axial Fan Cooling Towers	All	95°F Entering Water 85°F Leaving Water 75 °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 75 °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.[c] Cooling towers shall be tested using the test procedures in CTI ATC-105. Performance of factory assembled cooling towers shall be either certified as base models as specified in CTI STD-201 or verified by testing in the field by a CTI approved testing agency. Factory assembled cooling towers with custom options added to a CTI certified base model for the purpose of safe maintenance or to reduce environmental or noise impact shall be rated at 90% of the CTI certified performance of the associated base model or at the manufacturer's stated performance, whichever is less. Base models of factory assembled cooling towers are cooling towers configured in exact accordance with the Data of Record submitted to CTI as specified by CTI STD-201. There are no certification requirements for field erected cooling towers.

TABLE 112-H COPS FOR NON-STANDARD CENTRIFUGAL CHILLERS < 150 TONS

Centrifugal Chillers < 150 Tons **COPstd = 5.0**								
			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					
46	75	29	5.58	5.83	6.03	6.32	6.54	6.70
45	75	30	5.50	5.74	5.92	6.19	6.38	6.53
44	75	31	5.42	5.65	5.82	6.07	6.24	6.37
43	75	32	5.35	5.57	5.72	5.95	6.11	6.23
42	75	33	5.27	5.49	5.64	5.85	6.00	6.11
41	75	34	5.19	5.41	5.56	5.75	5.89	5.99
46	80	34	5.19	5.41	5.56	5.75	5.89	5.99
40	75	35	5.11	5.33	5.48	5.67	5.79	5.88
45	80	35	5.11	5.33	5.48	5.67	5.79	5.88
44	80	36	5.03	5.26	5.40	5.58	5.70	5.79
43	80	37	4.94	5.18	5.32	5.50	5.62	5.70
42	80	38	4.84	5.10	5.25	5.43	5.53	5.61
41	80	39	4.73	5.01	5.17	5.35	5.46	5.53
46	85	39	4.73	5.01	5.17	5.35	5.46	5.53
40	80	40	4.62	4.92	5.09	5.27	5.38	5.45
45	85	40	4.62	4.92	5.09	5.27	5.38	5.45
44	85	41	4.49	4.82	5.00	5.20	5.30	5.38
43	85	42	4.35	4.71	4.91	5.12	5.23	5.30
42	85	43	4.19	4.59	4.81	5.03	5.15	5.22
41	85	44	4.02	4.46	4.70	4.94	5.06	5.14
40	85	45	3.84	4.32	4.58	4.84	4.98	5.06
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

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

[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-I COPS 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					
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
46	80	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
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
46	85	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
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 (°F) – Leaving Chilled Water Temperature (°F)

[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 COPS 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					
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
46	80	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
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
46	85	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
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 (°F) – Leaving Chilled Water Temperature (°F)

[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-K IPLV/NPLV FOR NON-STANDARD CENTRIFUGAL CHILLERS < 150 TONS

Centrifugal Chillers < 150 Tons **IPLVstd = 5.25**								
			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 IPLV/NPLV					
46	75	29	5.84	6.10	6.30	6.61	6.84	7.00
45	75	30	5.75	6.00	6.19	6.47	6.68	6.83
44	75	31	5.67	5.91	6.08	6.34	6.53	6.67
43	75	32	5.59	5.82	5.99	6.23	6.39	6.52
42	75	33	5.51	5.74	5.90	6.12	6.27	6.39
41	75	34	5.43	5.66	5.81	6.02	6.16	6.26
46	80	34	5.43	5.66	5.81	6.02	6.16	6.26
40	75	35	5.35	5.58	5.73	5.93	6.06	6.15
45	80	35	5.35	5.58	5.73	5.93	6.06	6.15
44	80	36	5.26	5.50	5.65	5.84	5.96	6.05
43	80	37	5.16	5.42	5.57	5.76	5.87	5.96
42	80	38	5.06	5.33	5.49	5.67	5.79	5.87
41	80	39	4.95	5.24	5.41	5.60	5.71	5.78
46	85	39	4.95	5.24	5.41	5.60	5.71	5.78
40	80	40	4.83	5.14	5.32	5.52	5.63	5.70
45	85	40	4.83	5.14	5.32	5.52	5.63	5.70
44	85	41	4.69	5.04	5.25 [c]	5.43	5.55	5.62
43	85	42	4.55	4.93	5.13	5.35	5.47	5.54
42	85	43	4.38	4.80	5.03	5.26	5.38	5.46
41	85	44	4.21	4.67	4.91	5.17	5.30	5.38
40	85	45	4.01	4.52	4.79	5.06	5.20	5.29
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

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

[c] All values shown are NPLV except at conditions of 3 gpn/ton and 41 °F LIFT which is IPLV.

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

where X = Condenser DT + LIFT

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

TABLE 112-L IPLV/NPLV FOR NON-STANDARD CENTRIFUGAL CHILLERS > 150 TONS, < 300 TONS

Centrifugal Chillers > 150 Tons, < 300 Tons IPLVstd = 5.9								
			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 IPLV/NPLV					
46	75	29	6.58	6.87	7.11	7.46	7.71	7.90
45	75	30	6.49	6.76	6.98	7.30	7.53	7.70
44	75	31	6.40	6.66	6.86	7.15	7.36	7.52
43	75	32	6.31	6.56	6.75	7.02	7.21	7.35
42	75	33	6.22	6.47	6.65	6.90	7.07	7.20
41	75	34	6.13	6.38	6.55	6.79	6.95	7.06
46	80	34	6.13	6.38	6.55	6.79	6.95	7.06
40	75	35	6.03	6.29	6.46	6.68	6.83	6.94
45	80	35	6.03	6.29	6.46	6.68	6.83	6.94
44	80	36	5.93	6.20	6.37	6.58	6.72	6.82
43	80	37	5.82	6.11	6.28	6.49	6.62	6.72
42	80	38	5.71	6.01	6.19	6.40	6.53	6.62
41	80	39	5.58	5.91	6.10	6.31	6.44	6.52
46	85	39	5.58	5.91	6.10	6.31	6.44	6.52
40	80	40	5.44	5.80	6.00	6.22	6.35	6.43
45	85	40	5.44	5.80	6.00	6.22	6.35	6.43
44	85	41	5.29	5.68	5.90 [c]	6.13	6.26	6.34
43	85	42	5.13	5.55	5.79	6.03	6.16	6.25
42	85	43	4.94	5.41	5.67	5.93	6.07	6.16
41	85	44	4.74	5.26	5.54	5.82	5.97	6.07
40	85	45	4.52	5.09	5.40	5.71	5.87	5.97
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

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

[c] All values shown are NPLV except at conditions of 3 gpn/ton and 41 °F LIFT which is IPLV.

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

where X = Condenser DT + LIFT

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

TABLE 112-M IPLV/NPLV FOR NON-STANDARD CENTRIFUGAL CHILLERS > 300 TONS

Centrifugal Chillers > 300 Tons **IPLVstd = 6.4**								
			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 IPLV/NPLV					
46	75	29	7.15	7.47	7.72	8.10	8.37	8.58
45	75	30	7.05	7.35	7.58	7.93	8.18	8.36
44	75	31	6.95	7.23	7.45	7.77	8.00	8.16
43	75	32	6.85	7.13	7.33	7.63	7.83	7.98
42	75	33	6.75	7.03	7.22	7.49	7.68	7.82
41	75	34	6.65	6.93	7.12	7.37	7.55	7.67
46	80	34	6.65	6.93	7.12	7.37	7.55	7.67
40	75	35	6.55	6.83	7.01	7.26	7.42	7.54
45	80	35	6.55	6.83	7.01	7.26	7.42	7.54
44	80	36	6.44	6.73	6.92	7.15	7.30	7.41
43	80	37	6.32	6.63	6.82	7.05	7.19	7.30
42	80	38	6.20	6.53	6.72	6.95	7.09	7.19
41	80	39	6.06	6.42	6.62	6.85	6.99	7.08
46	85	39	6.06	6.42	6.62	6.85	6.99	7.08
40	80	40	5.91	6.30	6.52	6.76	6.89	6.98
45	85	40	5.91	6.30	6.52	6.76	6.89	6.98
44	85	41	5.75	6.17	6.40 [c]	6.66	6.79	6.89
43	85	42	5.57	6.03	6.28	6.55	6.70	6.79
42	85	43	5.37	5.88	6.16	6.44	6.59	6.69
41	85	44	5.15	5.71	6.01	6.33	6.49	6.59
40	85	45	4.91	5.53	5.86	6.20	6.37	6.48
Condenser DT[b]			14.04	11.23	9.36	7.02	5.62	4.68

[a] LIFT = Entering Condenser Water Temperature (°F) – Leaving Chilled Water Temperature (°F)

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

[c] All values shown are NPLV except at conditions of 3 gpn/ton and 41 °F LIFT which is IPLV.

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

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 2, Chapter 9 of the ASHRAE Handbook, HVAC Applications Volume.

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

(b) **Efficiency**. Equipment shall meet the applicable requirements of the Appliance Efficiency Regulations as required by Section 111, subject to the following:

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

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

1. **Outlet temperature controls**. On systems that have a total capacity greater than 167,000 Btu/hr., outlets that require higher than service water temperatures as listed in the ASHRAE Handbook, Applications Volume, shall have separate remote heaters, heat exchangers, or boosters to supply the outlet with the higher temperature.
2. **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: Water heating systems serving a single dwelling unit.
3. **Temperature controls for public lavatories**. The controls shall limit the outlet temperature to 110°F.
4. **Insulation**. Unfired service water heater storage tanks and backup tanks for solar water-heating systems shall have:

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

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

   C. The heat loss of the tank surface based on an 80°F water-air temperature difference shall be less than 6.5 Btu per hour per square foot.
5. **Service water heaters in state buildings**. Any newly constructed building constructed by the State shall derive its service water heating from a system that provides at least 60 percent of the energy needed for service water heating from site solar energy or recovered energy.

   EXCEPTION to Section 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.

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 that complies with the Appliance Efficiency Regulations; and
2. **On-off switch**. A readily accessible on-off switch, mounted on the outside of the heater that allows shutting off the heater without adjusting the thermostat setting; and
3. **Instructions**. A permanent, easily readable, and weatherproof plate or card that gives instruction for the energy efficient operation of the pool or spa 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: 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 other than Field-fabricated.** Any fenestration product and exterior door, other than field-fabricated fenestration products and field-fabricated exterior doors, may be installed only if the manufacturer has certified to the commission, or if an independent certifying organization approved by the commission has certified, that the product complies with all of the applicable requirements of this subsection.

1. **Air leakage.** Manufactured fenestration products and exterior doors shall have air infiltration rates not exceeding 0.3 cfm/ft.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 or ASTM E 283 at a pressure differential of 75 pascals or 1.57 pounds/ft.², incorporated herein by reference.

2. **U-factor.** A fenestration product's U-factor shall be rated in accordance with NFRC 100, or the applicable default U-factor set forth in TABLE 116-A.

   EXCEPTION to Section 116 (a) 2: If the fenestration product is site-built fenestration in a building covered by the nonresidential standards with less than 10,000 square feet of site-built fenestration or is a skylight, the default U-factor may be the applicable U-factor as set forth in the Nonresidential ACM Manual.

3. **SHGC.** A fenestration product's SHGC shall be rated in accordance with NFRC 200, or NFRC 100 for site-built fenestration, or the applicable default SHGC set forth in TABLE 116-B.

   EXCEPTION to Section 116 (a) 3: If the fenestration product is site-built fenestration in a building covered by the nonresidential standards with less than 10,000 square feet of site-built fenestration or is a skylight, the default SHGC may be calculated according to Equation 116-A.

EQUATION 116-A DEFAULT SHGC CALCULATION (SUBJECT TO ABOVE EXCEPTION

$$SHGC_{fen} = 0.08 + 0.86 \times SHGC_c$$

WHERE

$SHGC_{fen}$	=	The solar heat gain coefficient for the fenestration including glass and frame.
$SHGC_c$	=	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 specified in the Nonresidential ACM Manual.

4. **Labeling.** Fenestration products shall:

   A. Have a temporary label (or label certificate for site-built fenestration) 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

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

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

(b) **Installation of Field-fabricated Fenestration and Exterior Doors.** Field-fabricated fenestration and field-fabricated exterior doors may be installed only if the compliance documentation has demonstrated compliance for the installation using U-factors from TABLE 116-A and SHGC values from TABLE 116-B. Field-fabricated fenestration and field-fabricated exterior doors shall be caulked between the fenestration products or exterior door and the building, and shall be weatherstripped. Buildings with 10,000 or more square feet of vertical glazing shall have no more than 1,000 square feet of field-fabricated fenestration.

EXCEPTION to Section 116 (b): Unframed glass doors and fire doors need not be weatherstripped or caulked.

TABLE 116-A DEFAULT FENESTRATION PRODUCT U-FACTORS

FRAME TYPE[1]	PRODUCT TYPE	SINGLE PANE U-FACTOR	DOUBLE PANE U-FACTOR[2]
Metal	Operable	1.28	0.79
Metal	Fixed	1.19	0.71
Metal	Greenhouse/garden window	2.26	1.40
Metal	Doors	1.25	0.77
Metal	Skylight	1.98	1.3
Metal, Thermal Break	Operable	N.a	0.66
Metal, Thermal Break	Fixed	N.a	0.55
Metal, Thermal Break	Greenhouse/garden window	N.a	1.12
Metal, Thermal Break	Doors	N.a	0.59
Metal, Thermal Break	Skylight	N.a	1.11
Nonmetal	Operable	0.99	0.58
Nonmetal	Fixed	1.04	0.55
Nonmetal	Doors	0.99	0.53
Nonmetal	Greenhouse/garden windows	1.94	1.06
Nonmetal	Skylight	1.47	0.84

[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. Thermal break values shall not apply to field-fabricated fenestration products.

[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 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	N.a	0.63
Metal, Thermal Break	Fixed	Clear	N.a	0.69
Metal, Thermal Break	Operable	Tinted	N.a.	0.53
Metal, Thermal Break	Fixed	Tinted	N.a.	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.

(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 the CBC.

(d) **Installation of Insulation in Existing Buildings**. Insulation installed in an existing attic, or on an existing duct or water heater, shall comply with the applicable requirements of 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-38 in climate zones 1 and 16; and R-30 in all other climate zones.

   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 605 of the CMC.

(e) **Placement of roof/ceiling insulation.** Insulation installed to limit heat loss and gain through the top of conditioned spaces shall comply with the following:

1. Insulation shall be installed in direct contact with a continuous roof or ceiling which is sealed to limit infiltration and exfiltration as specified in Section 117, including but not limited to placing insulation either above or below the roof deck or on top of a drywall ceiling; and
2. When insulation is installed at the roof in nonresidential buildings, fixed vents or openings to the outdoors or to unconditioned spaces shall not be installed and the space between the ceiling and the roof is either directly or indirectly conditioned space and shall not be considered an attic for the purposes of complying with CBC attic ventilation requirements; and
3. Insulation placed on top of a suspended ceiling with removable ceiling panels shall be deemed to have no affect on envelope heat loss; and

   EXCEPTION to Section 118(e) 3: When there are conditioned spaces with a combined floor area no greater than 2,000 square feet in an otherwise unconditioned building, and when the average height of the space between the ceiling and the roof over these spaces is greater than 12 feet, insulation placed in direct contact with a suspended ceiling with removable ceiling panels shall be an acceptable method of reducing heat loss from a conditioned space and shall be accounted for in heat loss calculations.

4. Insulation shall be installed below the roofing membrane or layer used to seal the roof from water penetration unless the insulation has a maximum water absorption of 0.3 percent by volume when tested according to ASTM Standard C 272.

NOTE: Vents that do not penetrate the roof deck and that are designed for wind resistance for roof membranes are not within the scope of Section 118 (e) 2.

(f) **Demising Walls in Nonresidential Buildings**. The opaque portions of framed demising walls in nonresidential buildings shall be insulated with an installed R-value of no less than R-13 between framing members.

(g) **Insulation Requirements for Heated Slab Floors.** Heated slab floors shall be insulated according to the requirements in

TABLE 118-B.

1. Insulation materials in ground contact must:
   A. Comply with the certification requirements of Section 118 (a); and
   B. Have a water absorption rate for the insulation material alone without facings that is no greater than 0.3% when tested in accordance with Test Method A – 24 Hour-Immersion of 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.

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

(i) **Mandatory Requirements for Cool Roofs.** In order to qualify for compliance credit as a cool roof or meet the requirements of Section 143 (a) 1 or 149 (b) 1 B, a cool roof shall be certified and labeled according to the requirements of Section 10-113 and meet conditions 1 or 2 and, for liquid applied roofing products, 3 below.

1. Any roofing product with an initial thermal emittance greater than or equal to 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 (i) 1: For low-rise residential buildings, concrete tile (as defined in ASTM C55) and clay tile (as defined in ASTM C1167) 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.

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.

3. Liquid applied roof coatings applied to low-sloped roofs in the field as the top surface of a roof covering shall
   A. be applied across the entire roof surface to meet the dry mil thickness or coverage recommended by the coating manufacturer, taking into consideration the substrate on which the coating is applied, and
   B. meet the minimum performance requirements listed in TABLE 118-C or the minimum performance requirements of ASTM C836, D3468, D6083, or D6694, whichever are appropriate to the coating material.

   EXCEPTION 1 to Section 118 (i) 3 B: Aluminum-pigmented asphalt roof coatings shall meet the requirements of ASTM D2824 or ASTM D6848 and be installed as specified by ASTM D3805.

   EXCEPTION 2 to Section 118 (i) 3 B: Cement-based roof coatings shall contain a minimum of 20% cement and shall meet the requirements of ASTM C1583, ASTM D822, and ASTM D5870.

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 or extruded
Polyurethane	Board form and field applied
Polyisocyanurate	Board form and field applied
Urea formaldehyde	Foam field applied
Vermiculite	Loose fill

TABLE 118-B SLAB INSULATION REQUIREMENTS FOR HEATED SLAB-ON-GRADE

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

TABLE 118-C MINIMUM PERFORMANCE REQUIREMENTS FOR LIQUID APPLIED ROOF COATINGS FOR LOW-SLOPED ROOFS

Physical Property	ASTM Test Procedure	Requirement
Initial percent elongation (break)	D 2370	Minimum 200% 73 ºF (23 ºC)
Initial percent elongation (break) OR Initial flexibility	D2370 D522, Test B	Minimum 60% 0ºF (-18ºC) Minimum pass 1" mandrel 0°F (-18°C)
Initial tensile strength (maximum stress)	D 2370	Minimum 100 psi (1.38 Mpa) 73 ºF (23 ºC)
Initial tensile strength (maximum stress) OR Initial flexibility	D2370 D522, Test B	Minimum 200 psi (2.76 Mpa) 0ºF (-18ºC) Minimum pass 1" mandrel 0ºF (-18ºC)
Final percent elongation (break) after accelerated weathering 1000 h	D 2370	Minimum 100% 73 ºF (23 ºC)
Final percent elongation (break) after accelerated weathering 1000 h OR Flexibility after accelerated weathering 1000 h	D2370 D522, Test B	Minimum 40% 0°F (-18°C) Minimum pass 1" mandrel 0°F (-18°C)
Permeance	D 1653	Maximum 50 perms
Accelerated weathering 1000 h	D 4798	No cracking or checking[1]

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

SECTION 119 – MANDATORY REQUIREMENTS FOR LIGHTING CONTROL DEVICES

Any automatic time switch control device, occupant-sensor, motion sensor, photosensor, or automatic daylighting control device shall 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 (f) and Subsections (h) through (j), and if the device is installed in compliance with Subsection (g).

(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): Photosensor 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 Sensors and Motion Sensors**. Occupant sensors and motion sensors 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 decibel (dB) values shown in TABLE 119-A, measured no more than five feet from the source, on axis.
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 California Energy 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.

(e) **Automatic Daylighting Control Devices**. Automatic daylighting control devices used to control lights in daylit zones 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 relatively uniform illumination 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 devices reduce lighting in control steps, incorporate time-delay circuits to prevent cycling of light level changes of less than three minutes and have sufficient separation (deadband) of on and off points for each control step to prevent cycling; and

4. If the devices have a time delay, have the capability for the time delay to be over-ridden or set to less than 5 seconds time delay for the purpose of set up and calibration, and automatically restore its time delay settings to normal operation programmed time delays after no more than 60 minutes; and
5. Have a setpoint control that easily distinguishes settings to within 10% of full scale adjustment; and
6. Have a light sensor that has a linear response with 5% accuracy over the range of illuminances measured by the light sensor; and
7. If the device is a stepped switching control device, show the status of lights in the controlled zone by an indicator on the control device; and
8. If the device is a dimming control device, display the light level measured by the light sensor, if the controlled electric lighting cannot be viewed from where setpoint adjustments are made.

   EXCEPTION to Section 119(e) 7 & 8: If the control device is part of a networked system with a central display of each control zone status, the status indicator or light level display on each individual control device shall not be required if control setpoint adjustments can be made at the central display.

(f) **Interior Photosensors**. Interior photosensor 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-sensor.

(g) **Installation in Accordance with Manufacturer's Instructions**. If an automatic time switch control device, occupant-sensor, automatic daylighting control device, or interior photosensor 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 photosensor 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 in accordance with the designer's or manufacturer's instructions.

(h) **Multi-level Astronomical Time-switch Controls.** Multi-level astronomical time-switch controls used to control lighting in daylit zones shall:

1. Contain at least 2 separately programmable steps (relays) per zone that reduces illuminance in a relatively uniform manner as specified in Section 131(b); and
2. Have a separate offset control for each step of 1 to 240 minutes; and
3. Have sunrise and sunset prediction accuracy within +/- 15 minutes and timekeeping accuracy within 5 minutes per year; and
4. Store time zone, longitude and latitude in non-volatile memory; and
5. Display date/time, sunrise and sunset, and switching times for each step; and
6. Have an automatic daylight savings time adjustment; and
7. Have automatic time switch capabilities specified in Section 119 (c).

(i) **Automatic Multi-Level Daylighting Controls.** An automatic multi-level daylighting control used to control lighting in daylit zones shall:

1. Meet all the requirements of section 119 (e) for automatic daylighting control devices; and
2. Meet all the multi-level and uniformity requirements of section 131 (b); and
3. Have a light sensor that is physically separated from where setpoint adjustments are made; and
4. Have controls for calibration adjustments to the lighting control device that are readily accessible to authorized personnel.

(j) **Outdoor Astronomical Time-switch Controls.** Outdoor astronomical time-switch controls used to control outdoor lighting as specified in Section 132 (c) shall:

1. Contain at least 2 separately programmable channels per function area; and
2. Have the ability to independently offset the on and off times for each channel by 0 to 99 minutes before or after sunrise or sunset; and
3. Have sunrise and sunset prediction accuracy within +/- 15 minutes and timekeeping accuracy within 5 minutes per year; and
4. Store time zone, longitude and latitude in non-volatile memory; and
5. Display date/time, sunrise and sunset; and
6. Have an automatic daylight savings time adjustment; and
7. Have automatic time switch capabilities specified in Section 119 (c).

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

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

(b) **Design Requirements for Minimum Quantities of Outdoor Air**. Every space in a building shall be designed to have outdoor air ventilation according to Item 1 or 2 below:

1. **Natural ventilation**.

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

   EXCEPTION to Section 121 (b) 1. A: Naturally ventilated spaces in high-rise residential dwelling units and hotel/motel guest rooms shall be open to and within 25 feet of operable wall or roof openings to the outdoors.

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

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

   A. The conditioned floor area of the space times the applicable ventilation rate from TABLE 121-A; or

   B. 15 cfm per person times the expected number of occupants.

   For meeting the requirement in Section 121 (b) 2 B for spaces without fixed seating, the expected number of occupants shall be either the expected number specified by the building designer or one half the maximum occupant load assumed for egress purposes in the CBC, whichever is greater. For spaces with fixed seating, the expected number of occupants shall be determined in accordance with the CBC.

   EXCEPTION to Section 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.

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

   NOTE: VAV must comply with Section 121 (c) 1 at minimum supply airflow.

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**. 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, or a maximum occupant load factor for egress purposes in the CBC, greater than or equal to 25 people per 1000 ft^2 (40 square foot per person).

      EXCEPTION 1 to Section 121 (c) 3 B: Classrooms are not required to have demand control ventilation.

      EXCEPTION 2 to Section 121 (c) 3 B: Where space exhaust is greater than the design ventilation rate specified in 121 (b) 2 B minus 0.2 cfm per ft^2 of conditioned area**.**

      EXCEPTION 3 to Section 121 (c) 3 B: Spaces that have processes or operations that generate dusts, fumes, mists, vapors, or gases and are not provided with local exhaust ventilation (such as indoor operation of internal combustion engines or areas designated for unvented food service preparation).

4. **Demand Control Ventilation Devices.**

   A. For each system with demand control ventilation, CO_2 sensors shall be installed in each room that meets the criteria of 121 (c) 3 B;

   B. CO_2 sensors shall be located in the room between 1 ft and 6 ft above the floor;

   C. Demand ventilation controls shall maintain CO_2 concentrations less than or equal to 600 ppm plus the outdoor air CO_2 concentration in all rooms with CO_2 sensors;

      EXCEPTION to Section 121 (c) 4 C: The outdoor air ventilation rate is not required to be larger than the design outdoor air ventilation rate required by Section 121 (b) 2 regardless of CO_2 concentration.

   D. Outdoor air CO_2 concentration shall be determined by one of the following:

      i. CO_2 concentration shall be assumed to be 400 ppm without any direct measurement; or

      ii. CO_2 concentration shall be dynamically measured using a CO_2 sensor located near the position of the outdoor air intake.

   E. When the system is operating during hours of expected occupancy, the controls shall maintain system outdoor air ventilation rates no less than the rate listed in TABLE 121-A times the conditioned floor area for spaces with CO_2 sensors, plus the rate required by 121 (b) 2 for other spaces served by the system, or the exhaust air rate whichever is greater;

F. CO_2 sensors shall be certified by the manufacturer to have an accuracy of no less than 75 ppm, factory calibrated or calibrated at start-up, and certified by the manufacturer to require calibration no more frequently than once every 5 years.

5. **Demand Control Ventilation Acceptance**. Before an occupancy permit is granted for a newly constructed building or space, or a new space-conditioning system serving a building or space is operated for normal use, all demand control ventilation devices 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 demand control ventilation devices meet the requirements of Section 121 (c) 4.

(d) **Ducting for Zonal Heating and Cooling Units**. Where a return plenum is used to distribute outdoor air to a zonal heating or cooling unit which then supplies the air to a space in order to meet the requirements of Section 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) **Ventilation System Acceptance.** Before an occupancy permit is granted for a newly constructed building or space, or a new 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 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; and

2. Certifies plans and specifications meet the requirements of Section121 (b) 2; and

3. Certifies measured outside air is within ten (10) percent of the minimum ventilation rate specified in the plans and specifications.

TABLE 121-A MINIMUM VENTILATION RATES

TYPE OF USE	CFM PER SQUARE FOOT OF CONDITIONED FLOOR AREA
Auto repair workshops	1.50
Barber shops	0.40
Bars, cocktail lounges, and casinos	0.2
Beauty shops	0.40
Coin-operated dry cleaning	0.30
Commercial dry cleaning	0.45
High-rise residential	Ventilation Rates Specified by the CBC
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
All others	0.15

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).

(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 to Section 122 (a): An independent perimeter heating or cooling system may serve more than one zone without individual thermostatic controls if:

A. All zones are also served by an interior cooling system;

B. The perimeter system is designed solely to offset envelope heat losses or gains;

C. The perimeter system has at least one thermostatic control for each building orientation of 50 feet or more; and

D. The perimeter system is controlled by at least one thermostat located in one of the zones served by the system.

(b) **Criteria for Zonal Thermostatic Controls**. The individual thermostatic controls required by 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 to Section 122 (b) 3: Systems with thermostats that require manual changeover between heating and cooling modes.

EXCEPTION to Section 122 (b): 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 newly constructed 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, which is the subject of the building permit, 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 the space-conditioning system meets the requirements of Sections 121 (c) 1 and 121 (c) 2.
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 shall have the amount of insulation specified in Subsection (a) or (b). Insulation conductivity shall be determined in accordance with ASTM C 335 at the mean temperature listed in TABLE 123-A, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F.

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

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

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

EXCEPTION 1 to Section 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.

EXCEPTION 5 to Section 123: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing.

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

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

EQUATION 123-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, inches.
K	=	Conductivity of alternate material at the mean rating temperature indicated in TABLE 123-A for the applicable fluid temperature range, in Btu-inch per hour per square foot per °F.
k	=	The lower value of the conductivity range listed in TABLE 123-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

TABLE 123-A PIPE INSULATION THICKNESS

FLUID	CONDUCTIVITYRANGE	INSULATION	NOMINAL PIPE DIAMETER (in inches)

TEMPERATURE RANGE, (°F)	(in Btu-inch per hour per square foot per °F)	MEAN RATING TEMPERATURE (°F)	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

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 2001 CMC Sections 601, 602, 603, 604, 605, and Standard 6-5, incorporated herein by reference. Connections of metal ducts and the inner core of flexible ducts shall be mechanically fastened. Openings shall be sealed with mastic, tape, aerosol sealant, or other duct-closure system that meets the applicable requirements of UL 181, UL 181A, or UL 181B. If mastic or tape is used to seal openings greater than 1/4 inch, the combination of mastic and either mesh or tape shall be used.

Portions of supply-air and return-air ducts conveying heated or cooled air located in one or more of the following spaces shall be insulated to a minimum installed level of R-8:

1. Outdoors, or
2. In a space between the roof and an insulated ceiling, or
3. In a space directly under a roof with fixed vents or openings to the outside or unconditioned spaces, or
4. In an unconditioned crawlspace; or
5. In other unconditioned spaces.

Portions of supply-air ducts that are not in one of these spaces shall be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 605) or be enclosed in directly conditioned space.

(b) **Duct and Plenum Materials.**

1. **Factory-fabricated duct systems.**

   A. All factory-fabricated duct systems shall comply with UL 181 for ducts and closure systems, including collars, connections and splices, and be 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.

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 requirements of UL 723and 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 or ASTM C 177, 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 – REQUIRED NONRESIDENTIAL MECHANICAL SYSTEM ACCEPTANCE

(a) **Air Distribution System Duct and Plenum Acceptance.** Before an occupancy permit is granted for a newly constructed 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, as specified by the Nonresidential ACM Manual. 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 (f).
3. Certifies that air distribution ducts meet the requirements of Section 144 (k) for duct sealing to comply with the Prescriptive Approach or to comply with Section 141.

EXCEPTION to Section 125(a): Variable air volume (VAV) systems, multiple zone heating and air conditioning equipment, and single zone air conditioners, furnaces and heat pumps for which the criteria in Section 144 (k) 1, 2, and 3 do not apply.

(b) **Economizer Acceptance**. Before an occupancy permit is granted for a newly constructed 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, as specified by the Nonresidential ACM Manual. 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, and
2. Certifies that the economizers meet the requirements of Section 144 (e) for economizers installed to comply with the Prescriptive Approach or to comply with Section 141.

EXCEPTION to Section 125(b): Air economizers installed by the HVAC system equipment manufacturer and certified to the commission as being factory calibrated and tested.

(c) **Variable Air Volume System Acceptance**. Before an occupancy permit is granted for a newly constructed building or space, or a new space-conditioning system serving a building or space is operated for normal use, all variable speed fans serving the building or space shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Nonresidential ACM Manual. 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 the fans meet:
   A. the requirements of Section 144 (c) 2 for variable air volume systems installed to comply with the Prescriptive Approach; or
   B. the requirements of Sections 144 (c) 2 B, 144 (c) 2 C and 144 (c) 2 D for variable air volume systems installed to comply with Section 141.

(d) **Hydronic System Controls Acceptance**. Before an occupancy permit is granted for a newly constructed building or space, or a new space-conditioning system serving a building or space is operated for normal use, all hydronic systems serving the building or space shall be certified as meeting the Acceptance Requirements for Code Compliance, as specified by the Nonresidential ACM Manual. 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 the fans meet the requirements of Section 144 (j) for hydronic systems installed to comply with the Prescriptive Approach or to comply with Section 141.

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, hotel/motel buildings, and outdoor lighting subject to Title 24, Part 6, shall comply with the applicable provisions of Sections 131 through 139.

(b) **Indoor 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 applicable provisions of section 150(k).

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

(c) **Luminaire power.** Luminaire wattage incorporated into the installed 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 relamping rated wattage of the luminaire, as listed on a permanent factory-installed label, as specified by UL 1598.
2. The wattage of luminaires with permanently installed or remotely installed ballasts shall be the operating input wattage of the rated lamp/ballast combination published in manufacturer's catalogs based on independent testing lab reports as specified by UL 1598.
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 the branch circuit feeding the luminaires or an integral current limiter controlling the luminaires, or the higher of the maximum relamping rated wattage of all of the luminaires included in the system, listed on a permanent factory-installed label, as specified by UL 1574, 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 rated wattage of the transformer supplying the system, listed on a permanent factory installed label, as specified by UL 1574 or UL 1598.
5. The wattage of all other miscellaneous lighting equipment shall be the maximum rated wattage of the lighting equipment, or operating input wattage of the system, listed on a permanent factory-installed label, or published in manufacturer's catalogs, based on independent testing lab reports as specified by UL 1574 or UL 1598.

SECTION 131 – INDOOR LIGHTING CONTROLS THAT SHALL 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
   - 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-sensor 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 in each area enclosed by ceiling-height partitions; and

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

EXCEPTIONS to Section 131 (a):

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:

   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) of Title 24, Part 1; and

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

2. Public areas with switches that are accessible only to authorized personnel.

(b) **Multi-Level Lighting Controls**. The general lighting of any enclosed space 100 square feet or larger in which the connected lighting load exceeds 0.8watts per square foot, and that has more than one light source (luminaire), shall have multi-level lighting controls. A multi-level lighting control is a lighting control that reduces lighting power by either continuous dimming, stepped dimming, or stepped switching while maintaining a reasonably uniform level of illuminance throughout the area controlled. Multilevel controls shall have at least one control step that is between 50% and 70% of design lighting power and at least one step of minimum light output operating at less than 35% of full rated lighting system power (this control step could be completely off, creating a bi-level control). 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 luminaires, alternate luminaires, and alternate rows of luminaires.

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

(c) **Daylit Area**s. 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 the rough opening 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 partition, or one half the horizontal distance to the edge of the closest skylight or vertical glazing. 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-inch or higher permanent 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 partition, or one half the distance to the closest skylight or vertical glazing, whichever is least.

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

   A. Controls at least 50% of the power 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. Maintains a reasonably uniform level of illuminance in the daylit area using one of the methods specified in Section 131 (b) items 1 or 2.

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 that meets the requirements of Section 119 (i) or a multi-level astronomical time switch that meets the requirements of section 119 (h) and has override switches that meet the requirements of section 131 (d) 2.

EXCEPTIONS to Section 131 (c)

1. Daylit areas where the effective aperture is less than 0.1 for vertical glazing and less than 0.006 for skylights. The effective aperture for vertical glazing is the visible light transmittance (VLT) times the window wall ratio. The effective aperture for skylights is specified in Section 146 (a) 4 E.

2. 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 indoor 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 an occupant sensor, automatic time switch, or other device capable of automatically shutting off the lighting.

   EXCEPTIONS to Section 131 (d) 1:

   1. Where the system is serving an area that must be continuously lit, 24 hour per day/365 days per year.
   2. Lighting in corridors, guestrooms, and lodging quarters of high-rise residential buildings and hotel/motels.
   3. 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.

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, 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 enclosed by ceiling height partitions not exceeding 5,000 square feet.

      EXCEPTION to Section 131 (d) 2 E: In malls, auditoriums, single tenant retail spaces, industrial facilities, convention centers 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) **Lighting Control Acceptance.** 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 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), Sections 131 (e) and (f), and Section 146(a) 4 D.
4. Certifies that automatic lighting controls meet the requirements of Section 119 (c) and 131 (d).
5. Certifies that occupant-sensors meet the requirements of Section 119 (d) and 131 (d).

SECTION 132 – OUTDOOR LIGHTING CONTROLS AND EQUIPMENT

(a) **Outdoor Lighting.** All permanently installed outdoor luminaires employing lamps rated over 100 watts shall either: have a lamp efficacy of at least 60 lumens per watt; or be controlled by a motion sensor.

EXCEPTIONS to Section 132 (a):

1. Lighting required by a health or life safety statute, ordinance, or regulation, including but not limited to, emergency lighting.
2. Lighting used in or around swimming pools, water features, or other locations subject to Article 680 of the California Electrical Code.
3. Searchlights.
4. Theme lighting for use in theme parks.
5. Lighting for film or live performances.
6. Temporary outdoor lighting.
7. Light emitting diode, neon and cold cathode lighting.

(b) **Luminaire Cutoff Requirements.**. All outdoor luminaires that use lamps rated greater than 175 watts in hardscape areas including parking lots, building entrances, sales and non-sales canopies, and all 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. Nadir is in the direction of straight down, as would be indicated by a plumb line. Ninety degrees above nadir is horizontal. Eighty degrees above nadir is 10 degrees below horizontal.

EXCEPTIONS to Section 132 (b):

1. Internally illuminated, externally illuminated, and unfiltered signs.
2. Lighting for building facades, public monuments, statues, and vertical surfaces of bridges.
3. Lighting required by a health or life safety statute, ordinance, or regulation, including but not limited to, emergency lighting.
4. Temporary outdoor lighting.
5. Lighting used in or around swimming pools, water features, or other locations subject to Article 680 of the California Electrical Code.

(c) **Controls for Outdoor Lighting**

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

   EXCEPTION to Section 132 (c) 1: Lighting in parking garages, tunnels, and large covered areas that require illumination during daylight hours.

2. For lighting of building facades, parking lots, garages, sales and non-sales canopies, and all outdoor sales areas, where two or more luminaires are used, 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 80% or provides continuous dimming through a range that includes 50% through 80% reduction. This control shall meet the requirements of Section 119 (c).

   EXCEPTIONS to Section 132 (c) 2:

   1. Lighting required by a health or life safety statute, ordinance, or regulation, including but not limited to, emergency lighting.
   2. Lighting for steps or stairs that require illumination during daylight hours.
   3. Lighting that is controlled by a motion sensor and photocontrol.
   4. Lighting for facilities that have equal lighting requirements at all hours and are designed to operate continuously.
   5. Temporary outdoor lighting.
   6. Internally illuminated, externally illuminated, and unfiltered signs.

SECTION 133 – RESERVED.

SECTION 134 – RESERVED.

SECTION 135 – RESERVED.

SECTION 136 – RESERVED.

SECTION 137 – RESERVED.

SECTION 138 – RESERVED.

SECTION 139 – RESERVED.

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 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 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 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 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 143-B, TABLE 143-C, or TABLE 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 (i) 1; 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; and the window area of the standard building is the greater of (1) or (2): (1) the window area of the proposed building 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 subject to Section 143 (c), the skylight area of the standard building shall be the minimum area required by Section 143 (c). For all other buildings, 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.

2. **Lighting budget.** The lighting budget is the 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 is adjusted as described in the nonresidential ACM manual for an astronomical timeclock when required by Section 131 (c) 2.

3. **Service water-heating budget**. The service water-heating budget is the 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, 123, and 145.

(b) **TDV Energy Use of Proposed Building**. The TDV energy use of a proposed building is the sum of the space-conditioning, lighting, and service water-heating 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 energy use**. The space-conditioning TDV energy use shall be calculated by:

A. Using a method approved by the commission; and

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.

2. **Lighting TDV energy use**. The lighting TDV energy use shall be calculated using a method approved by the commission, and using the actual lighting power density calculated under Section 146 (b), including reduction of wattage by the applicable lighting power adjustment factors specified in Section 146 (b) 4. The lighting power density shall also be adjusted as described in the nonresidential ACM manual for an astronomical timeclock when required by Section 131 (c) 2.

3. **Service water-heating TDV energy use**. The service water-heating 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 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, 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 other than from space conditioning equipment; 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:

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, Fundamentals Volume, Chapter 23, with framing factors approved by the commission.

C. Metal-framed assemblies. U-factors for metal-framed assemblies shall be calculated using the zone method listed in ASHRAE Handbook, Fundamentals Volume, Chapter 23, or a method approved by the commission.

D. Fenestration. U-factors for fenestration shall be determined as specified in Section 116.

E. Masonry assemblies. U-factors for masonry assemblies shall be calculated using the transverse isothermal planes method listed in ASHRAE Handbook, Fundamentals Volume, Chapter 23, 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 NFRC 200, or NFRC 100 as specified 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, Fundamentals Volume, Chapter 30, or manufacturers literature, and shall be adjusted for the effects of framing and interior or exterior shading devices.

(d) **Relocatable Public School Buildings.** When the manufacturer/builder certifies the relocatable public school building for use in any climate zone, the energy budget shall be met in the most severe climate zones as specified in the Nonresidential ACM manual, assuming the prescriptive envelope criteria in TABLE 143-C. When the manufacturer/builder certifies that the relocatable building is manufactured for use in specific climate zones and that the relocatable building can not be lawfully used in other climate zones, the energy budget shall be met in each climate zone that the manufacturer/building certifies, assuming the prescriptive envelope criteria in TABLE 143-A, including the non-north window RSHG and skylight SHGC requirements for each climate zone. The energy budget and the energy use of the proposed building shall be determined using the multiple orientation approach specified in the Nonresidential ACM manual. The manufacturer/builder shall meet the requirements for identification labels specified in section 143 (a) 1. 8.

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;

(d) A lighting system that complies with Section 146;

(e) An outdoor lighting system that complies with Section 147; and

(f) Interior and exterior signs that comply with Section 148.

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:

   A. For nonresidential buildings with low-sloped roofs, meet the requirements of either 118 (i) 1 or 118 (i) 2 and for liquid applied roof coatings, Section 118 (i) 3; and

   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, if that roofing product has 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 in direct contact with a continuous roof or drywall ceiling where required by Section 118 (e); and

   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.

      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. 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 143-A, TABLE 143-B, or TABLE 143-C .

3. **Demising walls.** Demising walls shall meet the requirements of Section 118(f).

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.

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) a total area no greater than 40 percent of the gross exterior wall area, or six feet times the display perimeter, whichever is greater; and

   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 ; 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 . 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), 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 143-A, TABLE 143-B, or TABLE 143-C 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.

EQUATION 143-A RELATIVE SOLAR HEAT GAIN

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

WHERE:

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

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 ; 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 .

7. **Exterior doors**. Exterior doors have no R-value, U-factor, or area requirements.

8. **RelocatablePublic School Buildings.** In complying with Sections 143 (a) 1 to 7, relocatable public school buildings shall comply either with TABLE 143-A, including the non-north window RSHG and skylight SHGC requirements, when the manufacturer/builder certifies that the relocatable building is manufactured only for use in a specific climate zone(s) and that the relocatable building can not be lawfully used in other climate zones or with TABLE 143-C when the manufacturer/builder certifies that the relocatable building is manufactured for use in any climate zone. When the relocatable building complies with TABLE 143-C for use in more than one climate zone, the relocatable building shall meet the most stringent requirements for each building component in all of the climate zones for which the relocatable building is certified.

The manufacturer/builder shall place two metal identification labels on each relocatable building module, one mechanically fastened and visible from the exterior and the other mechanically fastened to the interior frame above the ceiling, at the end of the module. 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 building to comply. The location of the identification labels shall be shown on the building plans.

NOTE: Section 143 (a) 8 applies to all relocatable buildings for which an application for approval of original construction or for approval of alteration to the building envelope, space conditioning, lighting or water heating components of the relocatable building is submitted after the effective date of the 2004 California Energy Code.

TABLE 143-A PRESCRIPTIVE ENVELOPE CRITERIA FOR NONRESIDENTIAL BUILDINGS (INCLUDING RELOCATABLE PUBLIC SCHOOL BUILDINGS WHERE MANUFACTURER CERTIFIES USE ONLY IN SPECIFIC CLIMATE ZONE; NOT INCLUDING HIGH-RISE RESIDENTIAL BUILDING AND GUEST ROOMS OF HOTEL/MOTEL BUILDINGS)

		CLIMATE ZONES									
		1, 16		**3-5**		**6-9**		**2, 10-13**		**14, 15**	
Roof/Ceiling											
U-factor		0.051		0.051		0.076		0.051		0.051	
R-value[1]		19		19		11		19		19	
Wall											
R-value or		13		11		11		13		13	
U-factor											
Wood frame		0.102		0.110		0.110		0.1024		0.102	
Metal frame		0.217		0.224		0.224		0.217		0.217	
Metal building		0.113		0.123		0.123		0.113		0.113	
Mass/7.0≤ HC<15.0		0.330		0.430		0.430		0.430		0.430	
Mass/15.0≤HC		0.360		0.650		0.690		0.650		0.410	
Other		0.102		0.110		0.110		0.102		0.102	
Floor/Soffit											
R-value or		19		11		11		11		11	
U-factor											
Mass/7.0≤HC		0.090		0.139		0.139		0.090		0.139	
Other		0.048		0.071		0.071		0.071		0.071	
Windows											
U-factor[2]		0.47		0.77		0.77		0.47		0.47	
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[2]	Glass w/Curb	1.18		1.42		1.42		1.18		1.18	
	Glass wo/Curb	0.68		0.82		0.82		0.68		0.68	
	Plastic w/Curb	1.04		1.56		1.56		1.32		1.32	
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	

Note: Construction assembly U-factors shall be calculated in accordance with Appendix IV.

[1] R-value cannot be used for compliance when roof has metal framing members or a metal deck unless additional rigid insulation is installed. See Section 143 (a) 1 C.

[2]U-factor adjustments are made to make the criteria consistent with revised NFRC rating procedures.

TABLE 143-B 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											
U-factor		0.036		0.051		0.051		0.036		0.036	
R-value[1]		30		19		19		30		30	
Wall											
R-value or		19		11		11		13		13	
U-factor											
Wood frame		0.074		0.110		0.110		0.102		0.102	
Metal frame		0.183		0.224		0.224		0.217		0.217	
Metal building		0.061		0.123		0.123		0.113		0.113	
Mass/7.0≤ HC<15.0		0.330		0.430		0.430		0.430		0.430	
Mass/15.0≤HC		0.360		0.650		0.690		0.650		0.410	
Other		0.074		0.110		0.110		0.102		0.102	
Floor/Soffit											
R-value or		19		11		11		11		11	
U-factor											
Mass/7.0≤HC		0.090		0.139		0.139		0.090		0.090	
Other		0.048		0.071		0.071		0.071		0.071	
Raised concrete R-value		8		*		*		*		*	
Windows											
U-factor[2]		0.47		0.47		0.47		0.47		0.47	
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[2]	Glass w/Curb	1.18		1.42		1.42		1.18		1.18	
	Glass wo/Curb	0.68		0.82		0.82		0.68		0.68	
	Plastic w/Curb	1.04		1.56		1.56		1.32		1.04	
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	

Note: Construction assembly U-factors shall be calculated in accordance with Appendix IV.

[1] R-value cannot be used for compliance when roof has metal framing members or a metal deck unless additional rigid insulation is installed. See Section 143 (a) 1 C.

* 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.

[2]U-factor adjustments are made to make the criteria consistent with revised NFRC rating procedures.

TABLE 143-C PRESCRIPTIVE ENVELOPE CRITERIA FOR RELOCATABLE PUBLIC SCHOOL BUILDINGS

		ALL CLIMATE ZONES
Roof/Ceiling		
U-factor		0.051
R-value[1]		19
Wall		
R-value or		13
U-factor		
Wood frame		0.102
Metal frame		0.261
Metal building		0.061
Mass/7.0≤ HC		0.330
Other		0.102
Floor/Soffit		
R-value or		19
U-factor		0.048
Windows		
U-factor		0.49
Relative solar heat gain		
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	0.99
	Glass wo/Curb	0.57
	Plastic w/Curb	0.87
SHGC Glass	0-2%	0.46
	2.1-5%	0.36
SHGC Plastic	0-2%	0.71
	2.1-5%	0.58

Note: Construction assembly U-factors shall be calculated in accordance with Appendix IV.

[1] R-value cannot be used for compliance when roof has metal framing members or a metal deck unless additional rigid insulation is installed. See Section 143 (a) 1 C.

(b) **Overall Envelope Approach**

1. **Overall heat loss**. The overall heat loss (HL) of the overall envelope of the proposed building, HL_{prop} as calculated with

EQUATION 143-C, 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

$$HL_{std} = \sum_{i=1}^{nW}\left(A_{Wi} \times U_{Wi_{std}}\right) + \sum_{i=1}^{nF}\left(A_{Fi} \times U_{Fi_{std}}\right) + \sum_{i=1}^{nR}\left(A_{Ri} \times U_{Ri_{std}}\right) + \sum_{i=1}^{nG}\left(A_{Gi} \times U_{Gi_{std}}\right) + \sum_{i=1}^{nS}\left(A_{Si} \times U_{Si_{std}}\right)$$

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:

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}}\right) \times 0.40 \times A_{Wtotal-prop}$$

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gtotal-prop}}\right) \times \left(6 \times \text{Display Perimeter}_{total}\right)$$

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).

A_{Gi}*(cont.)* = If the window wall ratio of the west orientation of the proposed building is greater than 40 percent, (1) the west-facing window area is the greater of (a) 40 percent of the west-facing gross exterior wall area, or (b) six feet times the west-facing display perimeter; and (2) if the combined window wall ratio of the north, east and south orientations of the proposed building is more than 40 percent, the north, east and south-facing window area is the greater of (a) 40 percent of the north, east and south-facing gross exterior wall area, or (b) six feet times the north, east and south-facing 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:

$$A_{Gw-adj} = 0.40 \times A_{Ww-prop}$$

$$A_{Gw-adj} = (6 \times \text{Display Perimeter}_w)$$

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gnes-prop}}\right) \times 0.40 \times A_{Wnes-prop}$$

$$A_{Gi-adj} = \left(\frac{A_{Gi-prop}}{A_{Gnes-prop}}\right) \times (6 \times \text{Display Perimeter}_{nes})$$

WHERE:

A_{Gw-adj} = Adjusted window area of each type on the west orientation (in ft^2).

$A_{Ww-prop}$ = Total actual proposed gross exterior wall area of the west orientations of the proposed building (in ft^2).

Display Perimeter$_w$ = Display Perimeter of the west orientation of the proposed building.

A_{Gi-adj} = Adjusted window area of each type on the north, east, and south orientations (in ft^2).

$A_{Gi-prop}$ = Actual proposed window area of each type in the respective orientation (in ft^2).

$A_{Gnes-prop}$ = Total actual proposed window area of the north, east and south orientations of the proposed building (in ft^2).

$A_{Wnes-prop}$ = Total actual proposed gross exterior wall area of the north, east and south orientations of the proposed building (in ft^2).

Display Perimeter$_{nes}$ = Display Perimeter of the north, east and south orientations of the proposed building.

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-A, TABLE 143-B, or TABLE 143-C .
U_{Fistd}	=	The applicable floor/soffit U-factor for the corresponding A_{Fi} from TABLE 143-A, TABLE 143-B, or TABLE 143-C .
U_{Ristd}	=	The applicable roof/ceiling U-factor for the corresponding A_{Ri} from TABLE 143-A, TABLE 143-B, or TABLE 143-C .
U_{Gistd}	=	The applicable window U-factor for the corresponding A_{Gi} from TABLE 143-A, TABLE 143-B, or TABLE 143-C .
U_{Sistd}	=	The applicable skylight U-factor for the corresponding A_{Si} from TABLE 143-A, TABLE 143-B, or TABLE 143-C .

EQUATION 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}.

2. **Overall heat gain.** The overall heat gain of the overall envelope of the proposed building, HG_{prop} as calculated with EQUATION 143-E, 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. 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 143-D STANDARD BUILDING HEAT GAIN

$$HG_{std} = \sum_{i=1}^{nW}\left(A_{Wi} \times U_{Wi_{std}} \times TF_i\right) + \sum_{i=1}^{nF}\left(A_{Fi} \times U_{Fi_{std}} \times TF_i\right) + \sum_{i=1}^{nR}\left(A_{Ri} \times U_{Ri_{std}} \times TF_i\right)$$
$$+ \sum_{i=1}^{nG}\left(A_{Gi} \times U_{Gi_{std}} \times TF_i\right) + \sum_{i=1}^{nS}\left(A_{Si} \times U_{Si_{std}} \times TF_i\right) + \sum_{i=1}^{nG}\left(WF_{Gi} \times A_{Gi} \times RSHG_{Gi_{std}}\right) \times SF$$
$$+ \sum_{i=1}^{nS}\left(WF_{Si} \times A_{Si} \times SHGC_{Si_{std}}\right) \times SF + \sum_{i=1}^{nR}\left(WF_{Ri} \times A_{Ri} \times U_{Ri_{std}} \times \left[1 - \left(0.2 + 0.7\left[\rho_{Ri_{std}} - 0.2\right]\right)\right]\right) \times SF$$

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.
$SHGC_{Sistd}$	=	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_i	=	The temperature factor from TABLE 143-D.

EQUATION 143-E PROPOSED BUILDING HEAT GAIN

$$HG_{prop} = \sum_{j=1}^{nW}\left(A_{Wj} \times U_{Wj_{prop}} \times TF_j\right) + \sum_{j=1}^{nF}\left(A_{Fj} \times U_{Fj_{prop}} \times TF_j\right) + \sum_{j=1}^{nR}\left(A_{Rj} \times U_{Rj_{prop}} \times TF_j\right)$$
$$+ \sum_{j=1}^{nG}\left(A_{Gj} \times U_{Gj_{prop}} \times TF_j\right) + \sum_{j=1}^{nS}\left(A_{Sj} \times U_{Sj_{prop}} \times TF_j\right) + \sum_{j=1}^{nG}\left(WF_{Gj} \times A_{Gj} \times SHGC_{Gj_{prop}} \times OHF_j\right) \times SF$$
$$+ \sum_{j=1}^{nS}\left(WF_{Sj} \times A_{Sj} \times SHGC_{Sj_{prop}}\right) \times SF + \sum_{j=1}^{nR}\left(WF_{Rj} \times A_{Rj} \times U_{Rj_{prop}} \times \left[1 - \left(0.2 + 0.7\left[\rho_{Ri_{prop}} - 0.2\right]\right)\right]\right) \times SF$$

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-E (unitless).

WF_{Skyj} = The applicable weighting factor for skylight of the proposed building, from TABLE 143-E (unitless).

WF_{Rj} = The applicable weighting factor for roof of the proposed building, from TABLE 143-E (unitless).

$\rho_{Ri_{prop}}$ = The initial solar reflectance of the proposed design roofing product for the corresponding A_{Rj}, as certified and labeled according to the requirements of Section 10-113. If the roofing product has an emittance less than 0.75 the value shall be calculated by the following equation:

$$\rho_{Ri_{prop}} = -0.448 + 1.121 * R + 0.524 * E$$

Where

R = reflectance of the roofing product

E = emittance of the roofing product

The calculated value of $\rho_{Ri_{prop}}$ from the above equation shall not be larger than R or less than 0.10.

If the proposed design roofing product used has not been certified and labeled according to the requirements of 10-113 and/or does not meet the requirements of Section 118 (i) 3, the

proposed design 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.

SF = The solar factor from TABLE 143-D.

TF_j = The temperature factor from TABLE 143-D.

(c) **Minimum Skylight Area for Large Enclosed Spaces in Low-Rise Buildings.** Low rise conditioned or unconditioned enclosed spaces that are greater than 25,000 ft^2 directly under a roof with ceiling heights greater than 15 ft and have a lighting power density for general lighting equal to or greater than 0.5 W/ft^2 shall meet sections 143 (c) 1-4 below:

1. **Daylit Area.** At least one half of the floor area shall be in the daylit area under skylights.
2. **Minimum Skylight Area or Effective Aperture.** Areas that are daylit shall have a minimum skylight area to daylit area ratio or minimum skylight effective aperture as shown in TABLE 143-F. Skylight effective aperture shall be determined as specified in Equation 146-A.
3. **Skylight Characteristics.** Skylights shall:
   A. Have a glazing material or diffuser that has a measured haze value greater than 90%, tested according to ASTM D1003 (notwithstanding its scope) or other test method approved by the Commission; and
   B. If the space is conditioned, meet the requirements in Section 143 (a) 6 or 143 (b).
4. **Controls.** Electric lighting in the daylit area shall be controlled as described in Section 131 (c) 2.

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.

TABLE 143-D 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

TABLE 143-E 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

TABLE 143-F MINIMUM SKYLIGHT AREA TO DAYLIT FLOOR AREA OR MINIMUM SKYLIGHT EFFECTIVE APERTURE IN LOW-RISE ENCLOSED SPACES >25,000 FT^2 DIRECTLY UNDER A ROOF

General Lighting Power Density in Daylit Areas (W/ft^2)	**Minimum Skylight Area to Daylit Area Ratio**	Minimum Skylight Effective Aperture
1.4 $W/ft^2 \leq$ LPD	3.6%	1.2%
1.0 $W/ft^2 \leq$ LPD < 1.4 W/ft^2	3.3%	1.1%
0.5 $W/ft^2 \leq$ LPD < 1.0 W/ft^2	3.0%	1.0%

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 (k).

(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 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, Fundamentals Volume, or as specified in a method approved by the commission.
3. **Indoor design conditions**. Indoor design temperature and humidity conditions for general comfort applications shall be determined in accordance with ASHRAE 55 or the ASHRAE Handbook, Fundamentals Volume, Chapter 8 except that winter humidification and summer dehumidification shall not be required.
4. **Outdoor design conditions**. Outdoor design conditions shall be selected from Joint Appendix II, which is based on data from the ASHRAE Climatic Data for Region X. Heating design temperatures shall be no lower than the Heating Winter Median of Extremes values. Cooling design temperatures shall be no greater than the 0.5 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.

   EXCEPTION to Section 144 (b) 4: Cooling design temperatures for cooling towers shall be no greater than the 0.5 percent Cooling Design Wet bulb values.
5. **Ventilation**. Outdoor air ventilation loads shall be calculated using the ventilation rates required in Section 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 as specified in 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, Fundamentals Volume, Chapter 29, Table 1.
9. **Process loads.** Loads caused by a process shall be based upon actual information on the intended use of the building.
10. **Miscellaneous equipment**. Equipment loads 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, 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 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 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 shall not exceed 1.25 watts per cfm of supply air; and

B. Individual VAV fans with motors 10 horsepower or larger 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.

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.

C. Static Pressure Sensor Location. Static pressure sensors used to control variable air volume fans shall be placed in a position such that the controller set point is no greater than one-third the total design fan static pressure, except for systems with zone reset control complying with 144 (c) 2 D. If this results in the sensor being located downstream of major duct splits, multiple sensors shall be installed in each major branch with fan capacity controlled to satisfy the sensor furthest below its setpoint.

D. Set Point Reset. For systems with direct digital control of individual zone boxes reporting to the central control panel, static pressure set point shall be reset based on the zone requiring the most pressure; i.e., the set point is reset lower until one zone damper is nearly wide open.

3. **Air-treatment or filtering systems.** For systems with air-treatment or filtering systems, calculate the adjusted fan power index using equation 144-A:

EQUATION 144-A ADJUSTED FAN POWER INDEX

Adjusted fan power index = Fan power index x Fan Adjustment

$$\text{Fan Adjustment} = 1 - \left(\frac{SP_a - 1}{SP_f} \right)$$

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.** Fan motors of series fan-powered terminal units 1 horsepower or less 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.

(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.**

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 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 and

TABLE 144-B.

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.

(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.

EXCEPTION 4 to Section 144 (f): Variable air volume space-conditioning systems with variable speed drives.

(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 Systems.**

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 Table 112-A through Table 112-E.

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**. 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.** Open cooling towers with a combined rated capacity of 900 gpm and greater at 95°F condenser water return, 85°F condenser water supply and 75°F outdoor wet-bulb temperature shall use propeller fans 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.

EXCEPTION 2 to Section 144 (h) 4: Cooling towers that meet the energy efficiency requirement for propeller fan towers in Section 112, **TABLE 112-G**.

(i) **Limitation of Air-Cooled Chillers**

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 144 (i): Where the designer demonstrates that the water quality at the building site fails to meet manufacturer's specifications for the use of water-cooled equipment.

EXCEPTION 2 to 144 (i): Plants that employ a cooling thermal energy storage system.

EXCEPTION 3 to Section 144 (i): Air cooled chillers with minimum efficiencies approved by the Commission pursuant to Section 10-109 (d).

(j) **Hydronic System Measures**

1. **Hydronic Variable Flow Systems.** HVAC chilled and hot water pumping shall be designed for variable fluid flow and shall be capable of reducing pump flow rates to no more than the larger of: a) 50% 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: 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.** All duct systems shall be sealed to a leakage rate not to exceed 6% of the 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:
   A. Outdoors, or
   B. In a space directly under a roof where the U-factor of the roof is greater than the U-factor of the ceiling, or

      EXCEPTION to Section 144(k) 3 B: Where the roof meets the requirements of 143 (a) 1 C.

   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.

TABLE 144-A ECONOMIZER TRADEOFF TABLE FOR ELECTRICALLY OPERATED UNITARY AIR CONDITIONERS

	Size Category			
Climate Zone	**≥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 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 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.

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 INDOOR LIGHTING

A building complies with this section if the actual lighting power density calculated under Subsection (a) is no greater than the allowed indoor lighting power calculated under Subsection (b).

(a) **Calculation of Actual Indoor Lighting Power Density.** The actual indoor 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.

   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, shall 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 may be reduced by the number of controlled watts times the applicable factor from TABLE 146-A 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-A; and

   C. Except as noted in TABLE 146-A, only one power adjustment factor is used for the luminaire; and

   D. For occupant sensors used to qualify for the Power Adjustment Factor in small offices less than or equal to 250 square feet, the occupant sensor shall have an automatic OFF function that turns off all the lights, either an automatic or a manually controlled ON function, and have wiring capabilities so that each switch function activates a portion of the lights. The occupant sensor shall meet all the multi-level and uniformity requirements of Section 131 (b) for the controlled lighting. The first stage shall activate between 50-70% of the lights in a room either through an automatic or manual action. After that event occurs any of the following actions shall be assigned to occur when manually called to do so by the occupant.

i. Activating the alternate set of lights.

ii. Activating 100% of the lights.

iii. Deactivating all lights.

E. For daylighting control credits, the luminaire is controlled by the daylighting control, and the luminaire is located within the daylit area. The power adjustment factor is a function of the lighting power density of the general lighting in the space and the effective aperture of the skylights determined using Equation 146-A.

EQUATION 146-A – EFFECTIVE APERTURE OF SKYLIGHTS

$$\text{Effective Aperture} = \frac{0.85 \text{ x Total Skylight Area x Glazing Visible Light Transmittance x Well Efficiency}}{\text{Daylit Area Under Skylights}}$$

Total skylight area is the sum of skylight areas above the space. The skylight area is defined as the rough opening of the skylight.

Glazing visible light transmitance is the ratio of visible light that is transmitted through a glazing material to the light that is incident on the material. This shall include all skylighting system accessories including diffusers, louvers and other attachments that impact the diffusion of skylight into the space. The visible light transmittance of movable accessories shall be rated in the full open position. When the visible light transmittance of glazing and accessories are rated separately, the overall glazing transmittance is the product of the visible light transmittances of the glazings and accessories.

Daylight area under skylights is as defined in Section 131(c).

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 shall be determined from the nomograph in FIGURE 146-A based on the weighted average reflectance of the walls of the well and the well cavity ratio (WCR), or other test method approved by the Commission.

The well cavity ratio (WCR) is determined by the geometry of the skylight well and shall be determined using either Equation 146-B or Equation 146-C.

EQUATION 146-B WELL CAVITY RATIO FOR RECTANGULAR WELLS

$$\text{WCR} = \left(\frac{5 \times \text{well height} \left(\text{well length} + \text{well width}\right)}{\text{well length} \times \text{well width}} \right) \textbf{;or}$$

EQUATION 146-C WELL CAVITY RATIO FOR NON-RECTANGULAR-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.

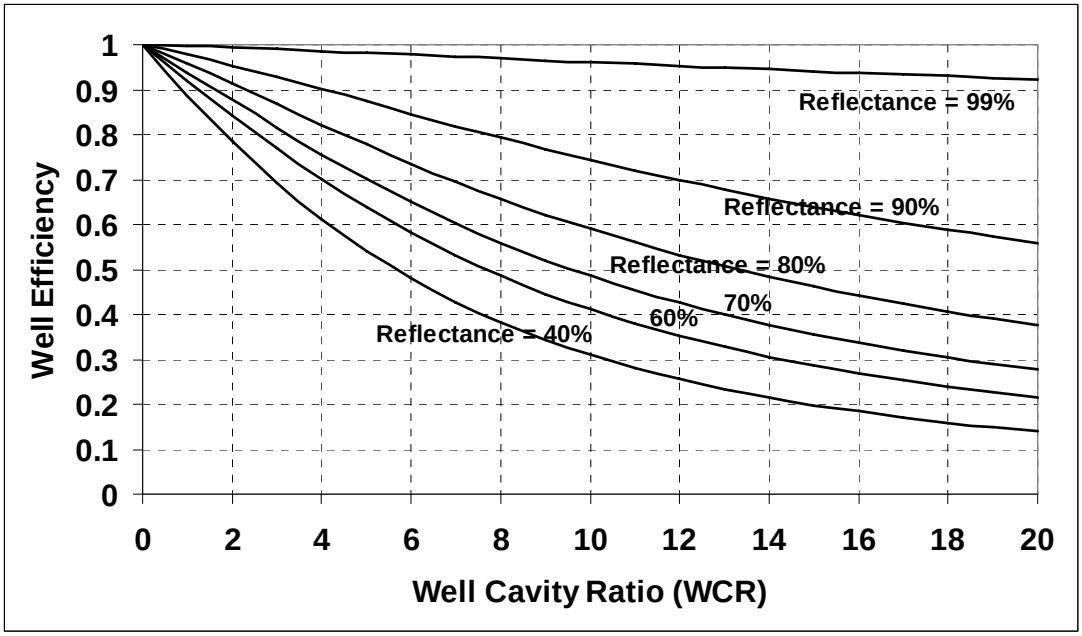

FIGURE 146-A WELL EFFICIENCY NOMOGRAPH

5. **Lighting wattage excluded**. The watts of the following lighting applications may be excluded from the actual lighting power of the building:

   A. In theme parks: lighting for themes and special effects;

   B. Lighting for film, video or photography studios;

   C. Lighting for dance floors and 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;

   D. In civic facilities, transportation facilities, convention centers, and hotel function areas: lighting for temporary exhibits, if the lighting is an addition to a general lighting system and is separately controlled from a panel accessible only to authorized operators;

   E. Lighting installed by the manufacturer in refrigerated cases, walk-in freezers, vending machines, food preparation equipment, and scientific and industrial equipment.;

   F. In medical and clinical buildings: examination and surgical lights, low-level night-lights, and lighting integral to medical equipment;

   G. 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;

   H. Lighting equipment that is for sale;

   I. Lighting demonstration equipment in lighting education facilities;

   J. Lighting that is required for exit signs subject to the CBC if it has a maximum lamp input power rating of five watts per illuminated face;

   K. Exitway or egress illumination that is normally off and that is subject to the CBC;

   L. In hotel/motel buildings: lighting in guestrooms;

   M. In high-rise residential buildings: lighting in living quarters;

   N. Temporary lighting systems;

O. Lighting in occupancy group U buildings less than 1000 square feet;

P. Lighting in unconditioned agricultural buildings less than 2500 square feet;

Q. 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, if they consist solely of historic lighting components or replicas of historic lighting components. If lighting systems in qualified buildings contain some historic lighting components or replicas of historic components, combined with other lighting components, only those historic or historic replica components are exempt. All other lighting systems in qualified historic buildings shall comply with the lighting power allowances;

R. Parking garages for seven or less vehicles;

S. Internally illuminated, externally illuminated, and unfiltered signs.

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 (c) or by a method approved by the commission.

(b) **Calculation of Allowed Indoor Lighting Power Density.** The allowed indoor 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, except as noted in Section 146 (b) 3. The allowed indoor lighting power density for conditioned and unconditioned spaces shall be separate allotments, which shall be met separately without tradeoffs between the separate allotments.

1. **Complete Building Method.** The Complete Building Method shall be used only on projects involving entire buildings with one type of use occupancy or mixed occupancy buildings where one type of use occupancy makes up 90 percent of the entire building. This approach shall 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-B times the floor area of the entire building. Hotel/motel and high-rise residential buildings shall not use this method. The retail and wholesale store type of use lighting power allowance shall be used only for single tenant retail and wholesale buildings, or for buildings with multiple tenants if it is known at the time of permit application that the buildings will be entirely made up of retail and wholesale stores. Retail and wholesale store buildings shall use this method only if the merchandise sales function area is 70% or greater of the building area.

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-C. Where areas are bounded or separated by interior partitions, the floor space occupied by those interior partitions shall be included in any area. If at the time of permitting a tenant is not identified for a multi-tenant space, the tenant leased space allowance from TABLE 146-C shall be used. 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.

3. **Tailored Method**. The Tailored Method shall only be used for spaces whose combined area does not exceed 30 percent of the building that is otherwise using the Area Category Method. The Tailored Method and the Area Category method shall not be used for the same floor area. The floor area for calculations based on the Tailored Method shall be subtracted from the floor area for the remainder of the building lighting calculations. Trade-offs of lighting power between the Tailored Method and Area Category Methods are not allowed.

   EXCEPTION 1 TO 146 (b) 3. The Tailored Method may be used for up to 100% of the building area of Retail Merchandise Sales and Museums.

   EXCEPTION 2 TO 146 (b) 3. If a single function area within the building exceeds 30 percent of the floor area of the entire building, the Tailored Method may be used for that entire function area alone, with the remaining spaces using the Area Category Method.

   Under the Tailored Method, the allowed indoor lighting power shall be calculated according to primary function type as permitted in column 1 of TABLE 146-D.

   A. For all spaces, determine the general lighting allowance according to Sections 146 (b) 3 A i through vi.

i. If a specific IESNA Illuminance Category is listed in Column 2 of TABLE 146-D, then such illuminance Category shall be used. Otherwise, determine the category for each lighting task according to categories specified in the IESNA Lighting Handbook (IESNA HB), using the "Design Guide" for illuminance. 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 equipment designed to illuminate them. Tasks that are performed less than two hours a day, or poor quality tasks that can be improved shall 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 either Equation 146-D or Equation 146-E.

EQUATION 146-D ROOM CAVITY RATIO FOR RECTANGULAR ROOMS,

$$RCR = \frac{5H(L+W)}{LW}$$

EQUATION 146-E ROOM CAVITY RATIO FOR IRREGULAR-SHAPED ROOMS

$$RCR = \frac{2.5H \times P}{A}$$

WHERE:

L = Length of room.

W = Width of room.

H = Vertical distance from the work plane to the centerline of the lighting fixture.

P = Perimeter of room.

A = Area of room.

iv. Multiply the area of each task by the allowed lighting power density for the task according to TABLE 146-F. 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 General Lighting Power for the Space.

B. Determine additional allowed power for display and decorative lighting according to Sections 146 (b) 3 B i through v.

i. Separate wall display lighting power is permitted if allowed by column 3 of TABLE 146-D. The allowed wall display lighting power is the smaller of:

a. The product of the room wall lengths and the listed allowed power density watts per linear foot (w/ft) in column 3 of TABLE 146-D, 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 and permanent full height interior partitions. For mounting height of display 13' above the finished floor or higher, this amount may be increased by multiplying the product by the appropriate factor from TABLE 146-E. Qualifying wall lighting systems shall be mounted within 72" of the wall and shall be of

a lighting system type appropriate for wall lighting including a lighting track, wallwasher, valance, cove, or adjustable accent light.

ii. Separate floor display lighting power is allowed if allowed by column 4 of TABLE 146-D. The allowed floor display lighting power is the smaller of:

a. The product of the area of the space and the allowed floor display lighting power density listed in column 4 of TABLE 146-D, if applicable, or

b. The actual power of floor display lighting systems.

For mounting height display lighting 13' above finished floor or higher, this amount may be increased by multiplying the product by the appropriate factor from TABLE 146-E. Qualifying floor display lighting systems shall be mounted no closer than 72" to a wall 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 floor display lighting.

iii. Separate ornamental/special effects lighting power is permitted if allowed by column 5 of TABLE 146-D. If so, the allowed ornamental/special effects lighting power is the smaller of:

a. The product of the area of the space and the allowed ornamental/special effects lighting power density specified in column 5 of TABLE 146-D, if applicable, or

b. The actual power of allowed ornamental/special effects lighting luminaires.

Qualifying ornamental luminaires include chandeliers, sconces, lanterns, neon and cold cathode, 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 shall not be the only light source in the space.

iv. Separate lighting power for very valuable displays is permitted if allowed by column 6 of TABLE 146-D. The allowed lighting power for very valuable displays is the smallest of:

a. The product of the area of the space and the allowed very valuable lighting power density specified in column 6 of TABLE 146-D, if applicable, or

b. The product of the area of the display case and 20 watts per square foot, or

c. 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, coins, fine china or crystal, precious stones, silver, small art objects and artifacts, and/or valuable collections the selling of which involves customer inspection of very fine detail from outside of a locked case.

v. Only the general portion of the lighting power determined in 146 (b) 3A above shall be used for tradeoffs among the various occupancy or task types of the permitted space. The allowed wall display lighting power, the allowed floor 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 shall not be traded off.

EXCEPTION 1 to 146 (b) 3: The Tailored Method may be used for up to 100% of the entire building area of Retail Merchandise Sales and Museums.

EXCEPTION 2 to 146 (b) 3: If a single function area within the building exceeds 30 percent of the floor area of the entire building, the Tailored Method may be used for that entire function area alone, with the remaining spaces using the Area Category Method.

TABLE 146-A LIGHTING POWER ADJUSTMENT FACTORS

TYPE OF CONTROL	TYPE OF SPACE		FACTOR
Occupant sensor with "manual ON" or bi-level automatic ON combined with multi-level circuitry and switching	Any space ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room		0.20
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		.25
	Commercial and Industrial Storage stack areas (max. 2 aisles per sensor)		.15
	Library Stacks (maximum 2 aisles per sensor)		.15
Dimming system			
Manual	Hotels/motels, restaurants, auditoriums, theaters		0.10
Multiscene programmable	Hotels/motels, restaurants, auditoriums, theaters		0.20
Manual dimming with automatic load control of dimmable electronic ballasts.	All building types		.25
Combined controls			
Occupant sensor With "manual ON" or bi-level automatic ON combined with multi-level circuitry and switching in conjunction with daylighting controls	Any space ≤ 250 square feet within a daylit area and enclosed by floor-to-ceiling partitions, any size classroom, corridor, conference or waiting room.		0.10 (may be added to daylighting control credit)
Manual Dimming with Dimmable Electronic Ballasts and Occupant sensor with "manual ON" or automatic ON to less than 50% power and switching	Any space ≤ 250 square feet enclosed by floor-to-ceiling partitions; any size classroom, corridor, conference or waiting room		0.25
Automatic Daylighting Controls with Windows (Stepped Switching or Stepped Dimming/Continuous Dimmed)			
	Window Wall Ratio		
Glazing Type - Windows	< 20%	20% to 40%	> 40%
VLT ≥ 60%	0.20/0.30	0.30/0.40	0.40/0.40
VLT ≥ 35 and < 60%	0/0	0.20/0.30	0.30/0.40
VLT < 35%	0/0	0/0	0.20/0.40
Automatic Multi-Level Daylighting Controls with Skylights			
Glazing Type - Skylights	Factor		
Glazing material or diffuser with ASTM D1003 haze measurement greater than 90%	$10 \times \text{Effective Aperture} - \frac{\text{Lighting Power Density}}{10} + 0.2$ WHERE Effective Aperture is as calculated in the Equation 146-A. Lighting Power Density is the lighting power density of general lighting		

TABLE 146-B COMPLETE BUILDING METHOD LIGHTING POWER DENSITY VALUES (WATTS/FT²)

TYPE OF USE	ALLOWED LIGHTING POWER
Auditoriums	1.5
Convention centers	1.3
Financial institutions	1.1
General commercial and industrial work buildings	
High bay	1.1
Low bay	1.0
Grocery stores	1.5
Hotel	1.4
Industrial and commercial storage buildings	0.7
Medical buildings and clinics	1.1
Office buildings	1.1
Parking Garages	0.4
Religious facilities	1.6
Restaurants	1.2
Retail and wholesale stores*	1.5
Schools	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 70% or greater of the building space.

TABLE 146-C AREA CATEGORY METHOD - LIGHTING POWER DENSITY VALUES (WATTS/FT²)

PRIMARY FUNCTION	ALLOWED LIGHTING POWER
Auditorium	1.5*
Auto Repair	1.1**
Civic Meeting Place	1.3*
Classrooms, lecture, training, vocational room	1.2
Commercial and industrial storage	0.6
Convention, conference, multipurpose and meeting centers	1.4*
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
Financial transactions	1.2*
General commercial and industrial work	
High bay	1.1**
Low bay	1.0**
Precision	1.3***
Grocery sales	1.6
Hotel function area	1.5*
Housing, Public and Commons Areas	
Dormitory, Senior Housing	1.5
Multifamily	1.0
Kitchen, food preparation	1.6
Laundry	0.9
Library	
Reading areas	1.2
Stacks	1.5
Lobbies	
Hotel lobby	1.1*
Main entry lobby	1.5*
Locker/dressing room	0.8
Lounge/recreation	1.1
Malls and atria	1.2*
Medical and clinical care	1.2
Office	1.2
Parking garage	0.4
Religious worship	1.5*
Retail merchandise sales, wholesale showrooms	1.7
Tenant lease space	1.0
Theaters	
Motion picture	0.9*
Performance	1.4*
Transportation Function	1.2
Waiting area	1.1*
All other	0.6

NOTES FOR TABLE 146-C

* The smallest of the following values may be added to the allowed lighting power for ornamental chandeliers and sconces that are switched or dimmed on circuits different from the circuits for general lighting:

a. One watt per square foot times the area of the task space that the chandelier or sconce is in; or

b. The actual design wattage of the chandelier or sconce.

** The smallest of the following values may be added to the allowed lighting power for specialized task work:

a. 0.5 watt per square foot times the area of the task space required for an art, craft assembly or manufacturing operation; or

b. The actual design wattage of the luminaire(s) providing illuminance to the specialized task area

For spaces employing this allowance, the plans shall clearly identify all task spaces using these tasks and the lighting equipment designed to illuminate these tasks. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for this specialized task work allowance.

*** The smallest of the following values may be added to the allowed power for precision commercial and industrial work:

a. One watt per square foot times the area of the task space required for the precision work; or

b. The actual design wattage of the luminaire(s) providing the illuminance to the precision task area.

For spaces employing this allowance, the plans shall clearly identify all task spaces using these tasks and the lighting equipment designed to illuminate these tasks. Tasks that are performed less than two hours per day or poor quality tasks that can be improved are not eligible for this precision task work allowance.

TABLE 146-D TAILORED METHOD SPECIAL LIGHTING POWER ALLOWANCES

1	2	3	4	5	6
Primary Function	Illumination Category	Wall Display Power (W/ft)	Allowed Floor Display Power (W/ft²)	Allowed Ornamental/ Special Effect Lighting	Allowed Very Valuable Display Power (W/ft^2)
Auditorium	D	2.5	0.3	0.5	0
Civic Meeting Place	D	3.5	0.2	0.5	-
Classrooms, lecture, training, vocational room	D	7	0	0	0
Commercial and industrial storage	IESNA HB	0	0	0	0
Convention, conference, multipurpose and meeting centers	D	2.5	0.4	0.5	0
Corridors, restrooms, stairs and support areas	IESNA HB	0	0	0	0
Dining	B	1.5	0.6	0.6	0
Exercise center, gymnasium	IESNA HB	0	0	0	0
Exhibit, museum	C	20.0	1.4	0.7	1.3
Financial Transactions	D	3.5	0.2	0.6	0
Grocery store	D	11	1.2	0	0
Housing, Public and Commons Areas					
Multifamily	D	0	0	1.0	0
Dormitory, Senior Housing	D	0	0	1.0	0
Hotel function area	D	2.5	0.2	0.5	0
Jail	IESNA HB	0	0	0	0
Kitchen, food preparation	IESNA HB	0	0	0	0
Laundry	IESNA HB	0	0	0	0
Library					
Reading areas	D	0	0	0.7	0
Stacks	D	0	0	0.7	0
Lobbies					
Hotel lobby	C	3.5	0.2	0.7	0
Main entry lobby	C	3.5	0.2	0	0
Locker/dressing room	IESNA HB	0	0	0	0
Lounge/recreation	C	7	0	0.7	0
Malls and atria	D	3.5	0.5	0.7	0
Medical and clinical care	IESNA HB	0	0	0	0
Office	IESNA HB	0	0	0	0
Police or fire stations	IESNA HB	0	0	0	0
Religious worship	D	1.5	0.5	0.5	0.3
Retail merchandise sales, wholesale showrooms	D	21.0	1.5	0.7	1.3
Tenant lease space	C	0	0	0	0
Theaters					
Motion picture	C	3	0	0.6	0
Performance	D	6	0	0.6	0
Transportation Function	D	3.5	0.3	0.7	0
Waiting area	C	3.5	0.2	0.7	0
All other	IESNA HB	0	0	0	0

TABLE 146-E ADJUSTMENTS FOR MOUNTING HEIGHT ABOVE FLOOR

Height in feet above finished floor and bottom 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-F ILLUMINANCE CATEGORIES A THROUGH G LIGHTING POWER DENSITY VALUES (WATTS/FT^2)

IESNA Illuminance Category	RCR<3.5	3.5<RCR<7.0	RCR>7.0
A	0.2	0.3	0.4
B	0.4	0.5	0.7
C	0.6	0.8	1.1
D	0.9	1.2	1.4
E	1.3	1.8	2.5
F	2.7	3.5	4.7
G	8.1	10.5	13.7

SECTION 147 – REQUIREMENTS FOR OUTDOOR LIGHTING

This section applies to all outdoor lighting, whether attached to buildings, poles, structures or self supporting, including but not limited to, hardscape areas including parking lots, lighting for building entrances, sales and non-sales canopies; lighting for all outdoor sales areas; and lighting for building facades.

EXCEPTIONS to Section 147:

1. Temporary outdoor lighting.
2. Lighting required and regulated by the Federal Aviation Administration, and the Coast Guard.
3. Lighting for public streets, roadways, highways, and traffic signage lighting, including lighting for driveway entrances occurring in the public right-of-way.
4. Lighting for sports and athletic fields, and children's playground.
5. Lighting for industrial sites, including but not limited to, rail yards, maritime shipyards and docks, piers and marinas, chemical and petroleum processing plants, and aviation facilities.
6. Automated Teller Machine lighting.
7. Lighting of public monuments.
8. Internally illuminated, externally illuminated, and unfiltered signs.
9. Lighting used in or around swimming pools, water features, or other locations subject to Article 680 of the California Electrical Code.
10. Lighting of tunnels, bridges, stairs, and ramps.
11. Landscape lighting.

(a) **Outdoor Lighting Power.** An outdoor lighting installation complies with this section if the actual outdoor lighting power calculated under Subsection (b) is no greater than the allowed outdoor lighting power calculated under Subsection (c).

The allowed outdoor lighting shall be calculated by Lighting Zone as defined in Section 10-114. Local governments may amend lighting zones in compliance with Section 10-114. Trading off lighting power allowances with any indoor areas shall not be permitted.

(b) **Calculation of Actual Lighting Power**. The actual lighting power of outdoor lighting is the total watts of all lighting systems (including ballast or transformer loss).

(c) **Calculation of Allowed Lighting Power**. The allowed lighting power shall be calculated as follows:

1. Determine the allowed lighting power for general illumination of the site as follows:

   A. In plan view of the site, determine the illuminated area. The illuminated area is defined as any area within a square pattern around each 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, under a canopy, beyond property lines, or obstructed by a sign or structure.

   B. Determine a lighting application from Table 147-A for each portion of the illuminated area. Determine the allowed area for each application. Note that the allowed area only applies to illuminated areas. Only portions of the site that are inside the illuminated area determined in step A qualify for allowed lighting power for general illumination. Multiply the allowed area of each lighting application by the allowed lighting power density from Table 147-A. Only applications listed in Table 147-A shall be included. Each portion of the illuminated area shall only be assigned one lighting application, and the assigned lighting applications shall be consistent with the actual use of the area. The allowed area of a site roadway, driveway, sidewalk, walkway or bikeway shall be determined by either of the following methods.

      i. The actual paved area plus 5 feet on either side of the centerline path of travel; or

      ii. A 25 foot wide area running along the axis of the path of travel and including as much of the paved area of the site roadway, driveway, sidewalk, walkway or bikeway as possible. Any overlapping area of another lighting application shall be subtracted from the area of the other lighting application. In this case the allowed lighting power is the length of the centerline of the path times the allowed power per unit length.

   EXCEPTION 1 to Section 147 (c) 1 B: For hardscape including parking lots, site roadways, driveways, sidewalks, walkways or bikeways, when specific light levels are required by law through a local ordinance, the allowed lighting power densities specified in TABLE 147-C may be used to calculate the allowed lighting power.

   EXCEPTION 2 to Section 147 (c) 1 B: For retail parking lots in lighting zones 1, 2 , and 3, hardscape areas within 100 feet of the entrance of senior housing facilities, and parking lots and walkways within 60 feet of building entrances for law enforcement, fire, ambulance and emergency vehicle facilities, the allowed lighting power densities specified in Table 147-A may be adjusted by applying the multipliers for special security requirements in TABLE 147-D to establish allowed lighting power for these special applications. Luminaires qualifying for these adjusted allowances shall not be used to determine allowed power for general illumination. The adjusted lighting power allowances shall be separate allotments, which shall be complied with separately without tradeoffs.

   C. Determine the sum of the allowed power for all general illuminated areas of the site as determined in Section 147(c)1.B.

2. Determine the allowed lighting power for specific applications as follows:

   A. Determine the allowed lighting power for building façade. The allowed lighting power for lighting the facade shall be the smaller of the product of the area of the façade and the allowed lighting power density for it from Table 147-B, or the actual power used to illuminate the facade. Only areas of the façade that are illuminated without obstruction or interference, by one or more luminaires, shall be used. Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

   B. Determine the allowed lighting power for outdoor sales frontage. The allowed lighting power for outdoor sales frontage shall be the smaller of the product of the frontage (in feet) and the allowed lighting power density per foot from Table 147-B, or the actual power used to illuminate the frontage. Sales frontage shall be immediately adjacent to the principal viewing location and unobstructed for its viewing length. A corner sales lot may include

both sides provided that a different principal viewing location exists for each side. Measured in plan view, only sections of the outdoor sales area that are along the frontage and are within 3 mounting heights of frontage luminaires shall be eligible for this power allowance. Luminaires qualifying for this allowance shall be located in plan view between the principal viewing location and the frontage outdoor sales area, and shall not be used to determine allowed lighting power for general illumination.

C. Determine the allowed lighting power for ornamental lighting. The allowed lighting power for ornamental lighting shall be the smaller of the product of the total area of the site external to buildings, and the allowed lighting power density for ornamental lighting from Table 147-B, or the actual power used for ornamental lighting. Luminaires qualifying for this allowance shall employ lamps rated 100 watts or less, and shall not be used to determine allowed lighting power for general illumination.

D. Determine the allowed lighting power for lighting under canopies. The allowed lighting power for lighting under a canopy shall be the smaller of the product of the area in plan view of the horizontal projection of the canopy and the allowed lighting power density for either a vehicle service station with or without canopies, for all other sales canopies, or for non-sales canopies from Table 147-B or the actual power used for lighting mounted beneath the canopy. Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

E. Determine the allowed lighting power for lighting of vehicle service stations without canopies. The allowed lighting power for a service station without canopy shall be the smaller of the product of the allowed lighting power density for a vehicle service station with or without canopies and 500 square feet per double-sided fuel dispenser, or the actual power used to illuminate this area (in cases where the site only allows fuel to be dispensed on one side of the dispenser, the allowed lighting power shall be the smaller of the product of the allowed lighting power density and 250 square feet per dispenser or the actual power). Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

F. Determine the allowed lighting power for lighting of vehicle service station hardscape areas. The allowed lighting power for vehicle service station hardscape areas shall be the smaller of the product of the area of the vehicle service station hardscape and the allowed lighting power density foot from Table 147-B, or the actual power used to illuminate this area. Vehicle service station hardscape areas include all vehicle service station outdoor hardscape areas beyond the horizontal projection of the canopy in plan view. Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

G. Determine the allowed lighting power for drive-up windows. The allowed lighting power for drive-up windows shall be the smaller of the product of the area of the drive-up window and the allowed lighting power density foot from Table 147-B, or the actual power used to illuminate this area. Drive-up window area is the product of the width of the window plus six feet and the distance 30 feet outward from the window. Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

H. Determine the allowed lighting power for guarded facilities. The allowed lighting power for guarded facilities shall be the smaller of the product of the area for the guarded facility and the allowed lighting power densities specified in Tables 147-B. The guarded facility area includes the guardhouse interior area plus the product of the entrance width of 25 feet and length of 80 feet. Guarded facilities include the entrance driveway, gatehouse, and guardhouse interior areas that provide access to secure areas controlled by security personnel who stop and may inspect vehicles and vehicle occupants including, identification documentation, vehicle license plates, and vehicle contents. Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

I. Determine the allowed lighting power for outdoor dining. The allowed lighting power for outdoor dining shall be the smaller of the product of the outdoor dining area and the allowed lighting power density from Table 147-B, or the actual power used to illuminate this area. Outdoor dining areas are hardscape areas used to serve and consume food and beverages. Luminaires qualifying for this allowance shall not be used to determine allowed lighting power for general illumination.

3. The Allowed Lighting Power shall be the total of the allowed power for general illumination of the site as determined in Section 147 (c) 1 C and the sum of all the allowed power for specific applications determined under Section 147 (c) 2. The allowed outdoor power and the allowed indoor power determined in Section 146 (b) shall be separate allotments, which shall be met separately without tradeoffs between the separate allotments.

TABLE 147-A LIGHTING POWER ALLOWANCES FOR GENERAL SITE ILLUMINATION (W/FT² UNLESS OTHERWISE NOTED)

Lighting Application	Allowed Area	Lighting Zone 1	Lighting Zone 2	Lighting Zone 3	Lighting Zone 4
Hardscape for automotive vehicular use, including parking lots driveways and site roads	Method (i.) Actual paved area plus 5' perimeter of adjacent unpaved land. Includes planters and landscaped areas less than 10' wide that are enclosed by hardscape on at least three sides..	0.05	0.08	0.15	0.19
Hardscape for pedestrian use, including, plazas, sidewalks, walkways and bikeways	Method (i.) Actual paved area plus 5 feet of unpaved land on either side of path of travel. Shall include all continuous paved area before including adjacent grounds.	0.06	0.09	0.17	0.21
Hardscape for driveways, site roads, sidewalks, walkways and bikeways	Method (ii.) 25' wide path incorporating as much of the paved area of the site roadway, driveway, sidewalk, walkway or bikeway as possible.	1.0 w/lf	1.5 w/lf	4.0 w/lf	5.0 w/lf
Building Entrances (without canopy)	Width of doors plus 3 ft on either side times a distance of 18 feet outward.	0.35	0.50	.70	1.00
Outdoor Sales Lot	Actual portion of uncovered outdoor sales lot used exclusively for display of vehicles or other merchandise for sale. All adjacent access drives, walkway areas, customer parking areas, vehicle service or storage areas that are not surrounded on at least three sides by sales area shall be considered hardscape.	0.35	0.70	1.25	2.00

TABLE 147-B LIGHTING POWER ALLOWANCES FOR SPECIFIC APPLICATIONS (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
Vehicle Service Station with or without Canopies	0.70	1.15	1.45	2.40
Vehicle Service Station Hardscape	0.05	0.20	0.40	0.60
All Other Sales Canopies	Not allowed	0.70	1.00	1.25
Non-sales canopies	0.12	0.25	0.50	0.70
Ornamental Lighting	Not allowed	0.01	0.02	0.04
Drive Up Windows	0.12	0.25	0.50	0.70
Guarded Facilities	0.19	0.40	0.80	1.10
Outdoor Dining	0.05	0.18	0.35	0.55

TABLE 147-C ALTERNATIVE POWER ALLOWANCE FOR ORDINANCE REQUIREMENTS

Required light levels by law through a local ordinance (horizontal foot-candles, average)	Allowed Lighting Power Density (W/ft^2)
0.5	0.05
1.0	0.07
1.5	0.10
2.0	0.12
3.0	0.19
4.0 or greater	0.25

TABLE 147-D MULTIPLIERS FOR SPECIAL SECURITY REQUIREMENTS

Function	Multiplier
Retail parking lots in lighting zones 1, 2 and 3	1.25
Hardscape areas within 100 feet of the entrance of senior housing facilities in lighting zones 1, 2, and 3	1.25
Parking lots and walkways within 60 feet of entrances to the building for law enforcement, fire, ambulance and emergency vehicle facilities	2.00

SECTION 148 – REQUIREMENTS FOR SIGNS

This section applies to all internally illuminated and externally illuminated signs, both indoor and outdoor. Each sign shall comply with either subsection (a) or (b), as applicable, or with one of the alternatives that immediately follow subsection (b).

(a) For internally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 12 watts per square foot. For double-faced signs, only the area of a single face shall be used to determine the allowed lighting power.

(b) For externally illuminated signs, the maximum allowed lighting power shall not exceed the product of the illuminated sign area and 2.3 watts per square foot. Only areas of an externally lighted sign that are illuminated without obstruction or interference, by one or more luminaires, shall be used.

ALTERNATIVE to 148(a) and (b): The sign complies with this Section if it is:

1. Equipped only with one or more of the following light sources: high pressure sodium, pulse start and ceramic metal halide, neon, cold cathode, light emitting diodes, barrier coat rare earth phosphor fluorescent lamps, or compact fluorescent lamps that do not contain a medium base socket (E24/E26), or
2. Equipped only with electronic ballasts with a fundamental output frequency not less than 20 kHz.

EXCEPTION 1 to Section 148: Unfiltered signs and traffic signs.

EXCEPTION 2 to Section 148: Exit signs shall meet the requirements of the Appliance Efficiency Regulations.

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 AND TO EXISTING OUTDOOR LIGHTING FOR THESE OCCUPANCIES AND TO INTERNALLY AND EXTERNALLY ILLUMINATED SIGNS

(a) **Additions**. Additions shall meet either Item 1 or 2 below.

1. **Prescriptive approach**. The envelope and lighting of the addition, any newly installed space-conditioning or water-heating system serving the addition, any addition to an outdoor lighting system, and any new sign installed in conjunction with an indoor or outdoor addition shall meet the applicable requirements of Sections 110 through 139 and Sections 142 through 148.

2. **Performance approach**.

   A. The envelope and indoor lighting in the conditioned space 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 alterations to the existing building met the requirements of 149 (b) 2 B, 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).

EXCEPTION 3 to Section 149 (a): When ducts will be extended from an existing duct system to serve the addition, the ducts shall meet the requirements of Section 149(b)1.D.

(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 or 2 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; and

   NOTE: Replacement of parts of an existing luminaire, including installing a new ballast or new lamps, without replacing the entire luminaire is not an alteration subject to the requirements of Section 149 (b) 1.

   A. Alterations to the building envelope other than those subject to 149 (b) 1 B shall:

      i. When there are no changes to fenestration area, meet the requirements of Section 143 (a) for the altered component; or

EXCEPTION to Section 149 (b) 1 A (i): When only a portion of an entire building's fenestration is replaced, or 50 square feet or less of fenestration area is added, compliance may be shown with Section 149 (b) A (i) except that the solar heat gain coefficient requirement of Section 143 is not required.

ii. Neither increase the overall heat gain nor increase the overall heat loss of the building envelope.

B. Replacements, recovering or recoating of the exterior surface of existing nonresidential low-sloped roofs shall meet Subsection i or ii where more than fifty percent of the roof or more than 2,000 square feet of roof, whichever is less, is being replaced, recovered or recoated.

i. The roof shall meet the requirements of either 118 (i) 1 or 118 (i) 2; and for liquid applied roof coatings, Section 118 (i) 3, or

ii. The building envelope, which has a roof replacement subject to this requirement, shall comply with Section 143 (b), where

a. the standard building has a solar reflectance which meets the requirements of Section 143 (a) 1 and the other terms in Equation 143-D correspond to the existing building at the time of the application of the permit, and

b. the proposed building has either:

(1.) the solar reflectance of the replacement roof product, as certified and labeled according to the requirements of Section 10-113 and the roof product meets the requirements of Section 118 (i) 3, or

(2.) a solar reflectance of 0.10 if the product has not been certified and labeled and/or does not meet the requirements of Section 118 (i) 3, and

(3.) has the other improvements to the building envelope necessary to comply.

EXCEPTION to Section 149 (b) 1 B: Roof recoverings allowed by the CBC are not required to meet Section 149 (b) 1 B when all of the following occur:

1. The existing roof has a rock or gravel surface, and
2. The new roof has a rock or gravel surface, and
3. There is no removal of existing layers of roof coverings of more than fifty percent of the roof or more than 2,000 square feet of roof, whichever is less; and
4. There is no recoating with a liquid applied coating; and
5. There is no installation of a recover board, rigid insulation or other rigid, smooth substrate to separate and protect the new roof recovering from the existing roof.

C. New space-conditioning systems or components other than new or replacement space conditioning ducts shall meet the requirements of Section 144 applicable to the systems or components being altered; and

EXCEPTION to Section 149 (b) 1 C: Section 144 (i) applies only to expansions of more than 300 tons to existing chilled water plants

D. When new or replacement space-conditioning ducts are installed to serve an existing building, the new ducts shall meet the requirements of Section 124, and if they meet the criteria of Section 144 (k) 1, 2, and 3, the duct system shall be sealed and labeled as confirmed through field verification and diagnostic testing in accordance with procedures for duct sealing of existing duct systems as specified in the Nonresidential ACM manual, to meet one of the following requirements:

i. If the new ducts form an entirely new duct system directly connected to the air handler, the measured duct leakage shall be less than 6% of fan flow; or

ii. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

a. The measured duct leakage shall be less than 15% of fan flow; or

b. The duct leakage shall be reduced by more than 60% relative to the leakage prior to the equipment having been replaced and a visual inspection shall demonstrate that all accessible leaks have been sealed; or

c. If it is not possible to meet the duct sealing requirements of Subsections a. or b., all accessible leaks shall be sealed and verified through a visual inspection by a certified HERS rater.

EXCEPTION to Section 149 (b) 1 D ii: Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

E. When a space conditioning system is altered by the installation or replacement of space conditioning equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, cooling or heating coil, or the furnace heat exchanger), the duct system that is connected to the new or replaced space conditioning equipment, if the duct system meets the criteria of Section 144 (k) 1, 2., and 3., shall be sealed, as confirmed through field verification and diagnostic testing in accordance with procedures for duct sealing of existing duct systems as specified in the Nonresidential ACM manual, to one of the requirements of Section 149 (b) 1 D; and

EXCEPTION 1 to Section 149 (b) 1. E.: Buildings altered so that the duct system no longer meets the criteria of Section 144 (k) 1, 2, and 3.

EXCEPTION 2 to Section 149 (b) 1 E: Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Nonresidential ACM manual.

EXCEPTION 3 to Section 149 (b) 1 E: Existing duct systems constructed, insulated or sealed with asbestos.

F. Spaces with lighting systems installed for the first time shall meet the requirements of Sections 119, 130, 131, 132, 143 (c), 146, and 147; and

G. New internally and externally illuminated signs shall meet the requirements of Section 148.

H. Alterations to existing indoor lighting systems that increase the connected lighting load or replace more than 50 percent of the luminaires shall meet the requirements of Sections 119, 130, 131, 132, and 146; and

I Alterations to existing outdoor lighting systems that for any lighting application increase the connected lighting load or replace more than 50 percent of the luminaires shall meet the requirements of Section 147; and

J Alterations to existing internally and externally illuminated signs that increase the connected lighting load, replace and rewire more than 50 percent of the ballasts, or relocate the sign to a different location on the same site or on a different site shall meet the requirements of Section 148; and

NOTE: Replacement of parts of an existing sign, including replacing lamps, the sign face or ballasts, that do not require rewiring or that are done at a time other than when the sign is relocated, is not an alteration subject to the requirements of Section 149 (b) 1 J.

K. New service water-heating systems shall meet the requirements of Section 145.

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. The energy efficiency of either the building or permitted space shall be improved so that the building or permitted space meets the energy budget in Section 141 that would apply to the building or permitted space, if the building envelope was unchanged, except for roofs alterations subject to Section 149 (b) 1 B, the roof alteration met the requirements of 149 (b) 1; and for any mechanical system alterations subject to Section 149(b) 1 C, D, and E, the mechanical system alterations met the requirements of Section 149 (b) 1, and for any lighting system alterations subject to Section 149 (b) 1 F, the lighting system alteration met the requirements of Section

149 (b) 1; and for any service water-heating system alteration subject to Section 149 (b) 1 K, the service water-heating system met the requirements of Section 149 (b) 1.

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 (g). Additional electric reheat capacity in excess of 20 percent may be added subject to the requirements of the Section 144 (g).

NOTE: Relocation or moving of a relocatable public school building is not considered an alteration for the purposes of complying with Title 24, Part 6. If an alteration is made to envelope, space conditioning, lighting or water heating components of a relocatable public school building, the alteration is subject to Section 149 (b). A relocatable public school building, for which an application for approval of original construction or for approval of alteration to the building envelope, space conditioning, lighting or water heating components of the relocatable building is submitted after the effective date of the 2004 California Energy Code, is subject to Section 143 (a) 8.

(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 and TABLE 151-C, 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 CMC or the manufacturer's installation instructions .

2. Continuous burning pilot lights and the use of indoor air for cooling a firebox jacket, when that indoor air is vented to the outside of the building, are prohibited.

(f) **Air Retarding Wrap**. If an air retarding wrap is installed to meet the requirements of Section 151, it shall meet the requirements specified in the Residential ACM Manual..

(g) **Vapor Barriers**. In Climate Zones 14 and 16 shown in **FIGURE 101-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.**

1. **Building cooling and heating loads.**

Building heating and cooling loads shall be determined using a method based on any one of the following:

A. The ASHRAE Handbook, Equipment Volume, Applications Volume, and Fundamentals Volume, or

B. The SMACNA Residential Comfort System Installation Standards Manual, or

C. The ACCA Manual J.

The cooling and heating loads are two of the criteria that shall be used for equipment sizing and selection.

NOTE: Heating systems are required to have a minimum heating capacity adequate to meet the minimum requirements of the CBC. The furnace output capacity and other specifications are published in the commission's directory of certified equipment or other directories approved by the commission.

2. **Design conditions.**

For the purpose of sizing the space-conditioning (HVAC) system, the indoor design temperatures shall be 70°F for heating and 75°F for cooling. Outdoor design conditions shall be selected from Joint Appendix II, which is based on data from the ASHRAE Climatic Data for Region X, The outdoor design temperatures for heating shall be no lower than the Heating Winter Median of Extremes values. The outdoor design temperatures for cooling shall be no greater than the 1.0 percent Cooling Dry Bulb and Mean Coincident Wet Bulb values.

(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) **Water System Pipe and Tank Insulation and Cooling Systems Line Insulation.**

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.

   B. Unfired hot water tanks, such as storage tanks and backup storage tanks for solar water-heating systems, shall be externally wrapped with insulation having an installed thermal resistance of R-12 or greater or have internal insulation of at least R-16 and a label on the exterior of the tank showing the insulation R-value.

2. **Water piping and cooling system line insulation thickness and conductivity**. Piping, 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; the first five feet of hot and cold water pipes from the storage tank for nonrecirculating systems; and cooling system lines shall be thermally insulated as specified in Subsection A or B. Piping for steam and hydronic heating systems or hot water systems with pressure above 15 psig shall meet the requirements in **TABLE 123-A**.

   A. For insulation with conductivity in the range shown in TABLE 150-A for the applicable fluid temperature range, the insulation shall have the applicable thickness shown in TABLE 150-B.

   B. For insulating with an alternate material with conductivity outside the range shown in TABLE 150-A for the applicable fluid temperature range, the insulation shall have a minimum thickness as calculated by EQUATION 150-A .

EQUATION 150-A — INSULATION THICKNESS

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

WHERE:

T	=	Minimum insulation thickness for alternate material with conductivity *K*, inches.
PR	=	Pipe actual outside radius, inches.
t	=	Insulation thickness for the applicable system from TABLE 150-B, inches.
K	=	Conductivity of alternate material at the mean rating temperature indicated in TABLE 150-A for the applicable fluid temperature range, in Btu-inch per hour per square foot per °F.
k	=	The lower value of the conductivity range listed in TABLE 150-A for the applicable fluid temperature range, Btu-inch per hour per square foot per °F.

EXCEPTION 1 to Section 150 (j) 2: Factory-installed piping within space-conditioning equipment certified under Section 111 or 112.

EXCEPTION 2 to Section 150 (j) 2: Piping that serves process loads, gas piping, cold domestic water piping, condensate drains, roof drains, vents, or waste piping.

EXCEPTION 3 to Section 150 (j) 2: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing. Insulation shall butt securely against all framing members.

EXCEPTION 4 to Section 150 (j) 2: Piping installed in interior or exterior walls shall not be required to have pipe insulation if all of the requirements are met for compliance with the Insulation Installation Quality compliance option as specified by the Residential ACM Manual.

EXCEPTION 5 to Section 150 (j) 2: Piping installed in attics with a minimum of four inches of attic insulation on top of the piping shall not be required to have pipe insulation.

NOTE: Where the executive director approves a water heater calculation method for a particular water heating recirculation system, piping insulation requirements are 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.**

1. **High Efficacy Luminaires.** High Efficacy Luminaires for residential lighting shall contain only high efficacy lamps and shall not contain a medium screw base socket (E24/E26). A high efficacy lamp has a lamp efficacy that is no lower than the efficacies contained in TABLE 150-C. Ballasts for lamps rated 13 Watts or greater shall be electronic and shall have an output frequency no less than 20 kHz.

   EXCEPTION to Section 150 (k) 1: High intensity discharge luminaires containing hardwired electromagnetic ballasts in medium screw base sockets shall be considered high efficacy luminaires for the purposes of meeting Section 150 (k) 6, provided they meet the efficacies contained in TABLE 150-C.

NOTE: To determine the minimum lamp efficacy category only the watts of the lamp (not the ballast) are to be considered.

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. The wattage of high efficacy luminaires shall be the total nominal rated wattage of the installed high efficacy lamp(s). The wattage of luminaires shall be determined as specified by Section 130 (c).

3. **Lighting in Bathroom, Garages, Laundry Rooms, and Utility Rooms.** Permanently installed luminaires in bathrooms, garages, laundry rooms, and utility rooms shall be high efficacy luminaires.

   EXCEPTION to Section 150 (k) 3: Permanently installed luminaires that are not high efficacy shall be allowed provided that they are controlled by an occupant sensor(s) certified to comply with Section 119 (d). Such motion sensors shall 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. **Lighting other than in Kitchens, Bathrooms, Garages, Laundry Rooms, and Utility Rooms.** Permanently installed luminaires located other than in kitchens, bathrooms, garages, laundry rooms, and utility rooms shall be high efficacy luminaires.

   EXCEPTION 1 to Section 150 (k) 4: Permanently installed luminaires that are not high efficacy luminaires shall be allowed provided they are controlled by a dimmer switch.

   EXCEPTION 2 to Section 150 (k) 4: Permanently installed luminaires that are not high efficacy shall be allowed provided that they are controlled by an occupant sensor(s) certified to comply with Section 119 (d). Such motion sensors shall 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.

   EXCEPTION 3 to Section 150 (k) 4: Permanently installed luminaires that are not high efficacy luminaires shall be allowed in closets less than 70 square feet.

   NOTE: Lighting in areas adjacent to the kitchen, including but not limited to dining and nook areas, are considered kitchen lighting if they are not separately switched from kitchen lighting.

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/ft^2) when tested in accordance with ASTM E283, and shall be sealed with a gasket or caulk between the housing and ceiling.

6. **Outdoor Lighting.** Luminaires providing outdoor lighting and permanently mounted to a residential building or to other buildings on the same lot shall be high efficacy luminaires.

   EXCEPTION 1 to Section 150 (k) 6: Permanently installed outdoor luminaires that are not high efficacy shall be allowed provided that they are controlled by a motion sensor(s) with integral photocontrol certified to comply with Section 119 (d).

   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 California Electric Code need not be high efficacy luminaires.

7. **Parking Lots and Garages.** Lighting for parking lots for eight or more vehicles shall comply with the applicable requirements in Sections 130, 132 and 147. Lighting for parking garages for eight or more vehicles shall comply with the applicable requirements in Sections 130, 131, and 146.

8. **Common Areas of Low-rise Residential Buildings.** Permanently installed lighting in the enclosed, non-dwelling spaces of low-rise residential buildings with four or more dwelling units shall be high efficacy luminaires.

   EXCEPTION to Section 150 (k) 8: Permanently installed luminaires that are not high efficacy shall be allowed provided that they are controlled by an occupant sensor(s) certified to comply with Section 119 (d).

(l) **Slab Edge Insulation.** Material used for slab edge insulation shall meet the following minimum specifications:

1. Water absorption rate for the insulation material alone without facings no greater than 0.3 percent when tested in accordance with Test Method A – 24-Hour-Immersion of ASTM C272.

2. Water vapor permeance no greater than 2.0 perm/inch when tested in accordance with ASTM E 96.

3. Concrete slab perimeter insulation shall 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 CMC Sections 601, 602, 603, 604, 605 and Standard 6-5, incorporated herein by reference. Portions of supply-air and return-air ducts and plenums shall either be insulated to a minimum installed level of R-4.2 (or any higher level required by CMC Section 605) 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, 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.**

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 be tested in accordance with ASTM C 731 and D2202, incorporated herein by reference.

iii. Sealants for exterior applications shall be tested in accordance with ASTM C 731, C 732, 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 requirements of UL 723 and be applied according to manufacturer specifications.

ii. Tapes or mastics used in combination with aerosol sealing shall meet the requirements of this Section.

4. 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 or ASTM C 177, 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 shall 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.
10. **Porous Inner Core Flex Duct.** Flexible ducts having porous inner cores shall not be used.

TABLE 150-A PIPE INSULATION CONDUCTIVITY RANGE

FLUID TEMPERATURE RANGE (°F)	**INSULATION MEAN RATING TEMPERATURE** (°F)	**CONDUCTIVITY RANGE** (Btu-inch per hour per square foot per °F)[1]
201 – 250	150	0.27 – 0.30
105 – 201	100	0.24 – 0.28
below 105	75	0.23 – 0.27

[1] Insulation conductivity shall be determined in accordance with ASTM C 335 at the mean temperature listed in TABLE 150-A, and shall be rounded to the nearest 1/100 Btu-inch per hour per square foot per °F.

TABLE 150-B PIPE INSULATION MINIMUM THICKNESS REQUIREMENTS

SYSTEM	**PIPE DIAMETER**	
	Less than or Equal to 2 inches	**Greater than 2 inches**
	INSULATION THICKNESS REQUIRED (in inches)	
Domestic hot water (above 105°F)	1.0	1.5
Hydronic heating supply lines (above 200°F to 250°F) [1]	1.0	2.0
Hydronic heating supply lines (105°F to 200°F)	1.0	1.5
Cooling system refrigerant suction, chilled water and brine lines	0.75	1.0

[1] Steam hydronic heating systems or hot water systems with pressure above 15 psi shall meet the requirements of **TABLE 123-A**.

TABLE 150-C 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

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 119(d) 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 101-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 that contains 50 percent or more of the dwelling units.

   NOTE: The California Energy Commission shall periodically updates, publishes, and makes available to interested persons and local building departments precise descriptions of the metes and bounds for climate zone boundaries depicted in FIGURE 101-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 the combined 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 TDV 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 requirements of Section 151 (a) and of Section 151 (f) 8 A for systems serving individual dwelling units or of 151 (f) 8 C for systems serving multiple dwelling units are met. To determine the water heating budget, use an approved calculation method.
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 Section 151 (f) applicable to 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 newly constructed 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 (TDV kBtu/yr-ft²) as determined pursuant to Section 151 (b) 1 and

      ii. The annual space-conditioning budget (TDV kBtu/yr-ft²) as determined pursuant to Section 151 (b) 2.

   B. Calculate the 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 (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), 151 (b), 151 (c), and 151 (e).

(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) 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. 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 or TABLE 151-C 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 have an R-value equal to or higher than that shown in TABLE 151-B or TABLE 151-C 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 or TABLE 151-C 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 or TABLE 151-C , 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.

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 or TABLE 151-C shall have an emittance of 0.05 or less, tested in accordance with ASTM C1371 or ASTM E408, shall be certified to the Department of Consumer Affairs as required by Title 24, Part 12, Chapter 12-13, Standards for Insulating Material, and shall meet the installation criteria specified in the Residential ACM Manual.

3. **Fenestration.**

A. Installed fenestration products shall have an area weighted average U-factor equal to or lower than those shown in TABLE 151-B or TABLE 151-C . The U-factor of installed fenestration products shall be determined in accordance with Section 116.

B. Total fenestration area shall not exceed the percentage of conditioned floor area specified in TABLE 151-B or TABLE 151-C .

C. For Package D, the west-facing fenestration area shall not exceed the percentage of conditioned floor area specified in TABLE 151-B or TABLE 151-C . West-facing fenestration area includes skylights tilted to the west or tilted in any direction when the pitch is less than 1:12.

4. **Shading.** Where TABLE 151-B or TABLE 151-C requires a solar heat gain coefficient (SHGC), 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 or TABLE 151-C . Skylights shall have an SHGC equal to or lower than those shown in TABLE 151-B or TABLE 151-C . The solar heat gain coefficient of installed fenestration products shall be determined in accordance with Section 116; 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 CBC 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 shall meet or exceed the minimum interior mass capacity specified in TABLE 151-A.

The mass requirements in TABLE 151-A may be met by calculating the combined interior mass capacity of the mass materials using EQUATION 151-A.

EQUATION 151-A —CALCULATION OF INTERIOR MASS CAPACITY

$$IMC = [(A_1 \times UIMC_1) + (A_2 \times UIMC_2) + ... + (A_n \times UIMC_n)]$$

WHERE:

A_n	=	Area of mass material, *n.*
$UIMC_n$	=	Unit interior mass capacity of mass material, *n.*

NOTE: The commission's Residential Manual lists 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 or TABLE 151-C . A gas-heating system is a natural or liquefied petroleum gas-heating system.

7. **Space heating and space cooling.** When refrigerant charge measurement or thermostatic expansion valves are shown as required by TABLE 151-B or TABLE 151-C , ducted split system central air conditioners and ducted split system heat pumps shall either have refrigerant charge 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 as specified in the ACM Manual. All space-heating and space-cooling systems must comply with minimum Appliance Efficiency Regulations as specified in Sections 110 through 112.[7]

8. **Water-heating systems.** Water heating systems shall meet the requirements of either A, B, or C and D. [8]

   A. For systems serving individual dwelling units, a single gas or propane storage type water heater that has a tank capacity of 50 gallons or less and no recirculation pumps, that is certified as meeting the Appliance Efficiency Regulations, and that meets the tank insulation requirements of Section 150 (j) and the requirements of Sections 111 and 113 shall be installed.

   B. For systems serving individual dwelling units, a single gas (or propane) instantaneous water heater, that meets the efficiency requirements of Sections 111 and 113 and that has no circulation pumps shall be installed.

   C. For systems serving multiple dwelling units, a central recirculating water heating system that has gas (or propane) water heaters that meet the minimum efficiency requirements of Sections 111 and 113 and distribution system controls capable of automatically turning off the circulating pump during times when hot water is not required shall be installed.

   D. All hot water pipes from the heating source to the kitchen fixtures that are ¾ inches or greater in diameter shall be thermally insulated as specified by Section 150 (j) 2 A or 150 (j) 2 B.

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 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 TABLE 151-B or TABLE 151-C .

10. **Space conditioning ducts.** All ducts shall either be in conditioned space or be insulated to a minimum installed level as specified by TABLE 151-B or TABLE 151-C and meet the minimum mandatory requirements of Section 150(m).

    When duct sealing is shown as required by TABLE 151-B or TABLE 151-C duct systems shall be sealed, as confirmed through field verification and diagnostic testing, in accordance with procedures specified in the Residential ACM Manual.

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[7] 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.

[8] New appliance standards pursuant to Section 111 for small federally-regulated water heaters become effective January 20, 2004.

NOTE: Requirements for duct sealing and duct insulation in Tables 151-B and 151-C and the footnote alternative requirements to those tables do not apply to buildings with space conditioning systems that have no ducts.

TABLE 151-A 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)

TABLE 151-B ALTERNATIVE COMPONENT PACKAGE C

Climate Zone	1, 16	3	4	5	6	7	8, 9	10	2, 11-13	14	15
BUILDING ENVELOPE											
Insulation minimums[1]											
Ceiling	R49	R38	R38	R38	R38	R38	R38	R49	R49	R49	R49
Wood-frame walls	R29	R25	R25	R25	R21	R21	R21	R25	R29	R29	R29
"Heavy mass" walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
"Light mass" walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Below-grade walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Slab floor perimeter	R7	R7	R7	R7	R7	R7	R7	R7	R7	R7	R7
Raised floors	R30	R30	R30	R30	R21	R21	R21	R30	R30	R30	R21
Concrete raised floors	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radiant Barrier	NR	NR	REQ	NR	NR	NR	REQ	REQ	REQ	REQ	REQ
FENESTRATION											
Maximum U-factor[2]	0.42	0.42	0.38	0.42	0.42	0.38	0.38	0.38	0.38	0.38	0.38
Maximum Solar Heat Gain Coefficient (SHGC)[3]	NR	NR	0.40	NR	NR	0.40	0.40	0.40	0.40	0.40	0.40
Maximum total area	14%	14%	14%	16%	14%	14%	14%	16%	16%	14%	16%
Maximum West facing area	NR	NR	5%	NR	NR	5%	5%	5%	5%	5%	5%
THERMAL MASS[4]	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
SPACE-HEATING [5]											
Electric-resistant allowed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If gas, AFUE =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
If heat pump, HSPF[6] =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
SPACE-COOLING											
SEER =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
If split system, Refrigerant charge measurement or thermostatic expansion valve	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ
DUCTS											
Duct sealing	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Duct Insulation	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8
WATER-HEATING	System shall meet Section 151 (f) 8 or Section 151 (b) 1 [7]										

TABLE 151-C ALTERNATIVE COMPONENT PACKAGE D

Climate Zone	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
BUILDING ENVELOPE																
Insulation minimums[1]																
Ceiling	R38	R30	R30	R30	R30	R30	R30	R30	R30	R30	R38	R38	R38	R38	R38	R38
Wood-frame walls	R21	R13	R13	R13	R13	R13	R13	R13	R13	R13	R19	R19	R19	R21	R21	R21
"Heavy mass" walls	(R4.76)	(R2.44)	(R2.44)	(R2.44)	(R2.44)	(R2.44)	(R2.44)	(R2.44)	(R2.44)	(R2.44)	(R4.76)	(R4.76)	(R4.76)	(R4.76)	(R4.76)	(R4.76)
"Light mass" walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Below-grade walls	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R13
Slab floor perimeter	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R7
Raised floors	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19
Concrete raised floors	R8	R8	R0	R0	R0	R0	R0	R0	R0	R0	R8	R4	R8	R8	R4	R8
Radiant Barrier	NR	REQ	NR	REQ	NR	NR	NR	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	NR
FENESTRATION																
Maximum U-factor[2]	0.57	0.57	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.57	0.57	0.57	0.57	0.57	0.57	0.55
Maximum Solar Heat Gain Coefficient (SHGC)[3]	NR	0.40	NR	0.40	NR	NR	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	NR
Maximum total area	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
Maximum West facing area	NR	5%	NR	5%	NR	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
THERMAL MASS[4]	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
SPACE-HEATING [5]																
Electric-resistant allowed	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
If gas, AFUE =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
If heat pump, HSPF[6] =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
SPACE-COOLING																
SEER =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
If split system, Refrigerant charge measurement or Thermostatic Expansion valve	NR	REQ[9]	NR	NR	NR	NR	NR	REQ[9]	REQ[9]	REQ[12]	REQ[12]	REQ[12]	REQ[13]	REQ[14]	REQ	NR
DUCTS																
Duct sealing	REQ[8]	REQ[9]	REQ[10]	REQ[11]	REQ[10]	REQ[10]	REQ[10]	REQ[9]	REQ[9]	REQ[12]	REQ[12]	REQ[12]	REQ[13]	REQ[14]	REQ	REQ[8]
Duct Insulation	R-6	R-6	R-6	R-6	R-6	R-4.2	R-4.2	R-4.2	R-6	R-6	R-6	R-6	R-6	R-8	R-8	R-8
WATER-HEATING	System shall meet Section 151 (f) 8 or Section 151 (b) 1															

Footnotes to TABLE 151-B and TABLE 151-C

1 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.

2 The installed fenestration products shall meet the requirements of Section 151 (f) 3.

3 The installed fenestration products shall meet the requirements of Section 151 (f) 4.

4 If the package requires thermal mass, the thermal mass shall meet the requirements of Section 151 (f) 5.

5 Automatic setback thermostats shall be installed in conjunction with all space-heating systems in accordance with Section 151 (f) 9.

6 HSPF means "heating seasonal performance factor."

7 Electric-resistance water heating may be installed 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. A wood stove boiler credit shall not be used in Climate Zones 8, 10, and 15, nor in localities that do not allow wood stoves.

8 As an alternative under Package D in climate zones 1 and 16, glazing with a maximum 0.42 U-factor and a 90% AFUE furnace or a 7.6 HSPF heat pump may be substituted for duct sealing. All other requirements of Package D must be met.

9 As an alternative under Package D in climate zones 2, 8, and 9, glazing with a maximum 0.38 U-factor and maximum 0.31 SHGC may be substituted for duct sealing and either refrigerant charge measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

10 As an alternative under Package D in climate zones 3, 5, 6 and 7, glazing with a maximum 0.42 U-factor may be substituted for duct sealing. All other requirements of Package D must be met.

11 As an alternative under Package D in climate zone 4, glazing with a maximum 0.38 U-factor and maximum 0.36 Solar Heat Gain Coefficient may be substituted for duct sealing. All other requirements of Package D must be met.

12 As an alternative under Package D in climate zones 10, 11, and 12, glazing with a maximum 0.38 U-factor and maximum 0.31 Solar Heat Gain Coefficient, and a minimum 13.0 SEER space cooling system may be substituted for duct sealing and either refrigerant charge measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

13 As an alternative under Package D in climate zone 13, glazing with a maximum 0.38 U-factor and maximum 0.31 Solar Heat Gain Coefficient, and a minimum 15.0 SEER space cooling system may be substituted for duct sealing and either refrigerant charge measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

14 As an alternative under Package D in climate zone 14, glazing with a maximum 0.38 U-factor and maximum 0.31 Solar Heat Gain Coefficient, and a minimum 16.0 SEER space cooling system may be substituted for duct sealing and either refrigerant charge measurement or a thermostatic expansion valve. All other requirements of Package D must be met.

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

(a) **Additions**. Additions to existing residential buildings shall meet the requirements of Sections 111 through 118, Section 119 (d), and Section 150, and either Section 152 (a) 1 or 2.

1. **Prescriptive approach**. Additions to existing buildings shall meet the following additional requirements:

   A. Fenestration in additions up to 100 square feet shall not have more than 50 square feet of fenestration area, and shall meet the U-factor and Solar Heat Gain Coefficient requirements of Package D (Sections 151 (f) 3 A, 151 (f) 4 and TABLE 151-C); or

   B. Additions up to 1000 square feet shall meet all the requirements of Package D (Section 151 (f) and TABLE 151-C), 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.

   C. Additions of more than 1000 square feet shall meet all the requirements of Package D (Section 151 (f) and TABLE 151-C).

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 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. When an improvement is proposed to the existing building to comply with this subsection, the improvement shall meet the requirements of section 152 (b) 2 for that component.

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:

1. A gas storage nonrecirculating water-heating system that does not exceed 50 gallons capacity; or

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 heating and cooling equipment need not comply with Title 24, Part 6. The heating system capacity must be adequate to meet the minimum requirements of CBC Section 310.11.

EXCEPTION 5 to Section 152 (a): When ducts will be extended from an existing duct system to serve the addition, the ducts shall meet the requirements of Section 152 (b) 1 D.

(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, Section 119 (d), and Section 150; and

A. Alterations that add fenestration area shall meet the U-factor requirements of Package D (Section 151 (f) 3 A and **TABLE 151-C**), the total fenestration area requirements of Package D (Section 151 (f) 3 B and **TABLE 151-C**), and the Solar Heat Gain coefficient requirements of Package D (Section 151 (f) 4 and **TABLE 151-C** .)

EXCEPTION to Section 152(b) 1 A.: Alterations that add fenestration area of up to 50 square feet shall not be required to meet the total fenestration area requirements of Section 151 (f) 3. B.

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 Package D (Sections 151 (f) 3 A and 151 (f) 4 and **TABLE 151-C**).

NOTE: Glass replaced in an existing sash and frame, or replacement of a single sash in a multi-sash fenestration product are considered repairs.

C. New space-conditioning systems or components other than new or replacement space conditioning ducts shall:

i. Meet the requirements of Section s150 (h), 150 (i), 150 (j) 2, 151 (f) 7; and 151 (f) 9; and

ii. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type unless it can be demonstrated that the TDV energy use of the new system is more efficient than the existing system.

D. When more than 40 feet of new or replacement space-conditioning ducts are installed in unconditioned space, the new ducts shall meet the requirements of Section 150 (m) and the duct insulation requirements of Package D Section 151 (f) 10, and if in climate zones 2, 9, 10, 11, 12, 13, 14, 15, or 16, and the duct system shall be sealed as confirmed through field verification and diagnostic testing in accordance with procedures for duct sealing of existing duct systems as specified in the Residential ACM manual, to meet one of the following requirements:

i. If the new ducts form an entirely new duct system directly connected to the air handler, the measured duct leakage shall be less than 6% of fan flow; or

ii. If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:

a. The measured duct leakage shall be less than 15% of fan flow; or

b. The measured duct leakage to outside shall be less than 10% of fan flow; or

c. The duct leakage shall be reduced by more than 60% relative to the leakage prior to the installation of the new ducts and a visual inspection including a smoke test shall demonstrate that all accessible leaks have been sealed or

d. If it is not possible to meet the duct sealing requirements of Subsection a, b, or c, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS rater.

EXCEPTION to Section 152 (b) 1 D ii: Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

E. In climate zones 2, 9, 10, 11, 12, 13, 14, 15, and 16, when a space-conditioning system is altered by the installation or replacement of space-conditioning equipment (including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, cooling or heating coil, or the furnace heat

exchanger) the duct system that is connected to the new or replacement space-conditioning equipment shall be sealed, as confirmed through field verification and diagnostic testing in accordance with procedures for duct sealing of existing duct systems as specified in the Residential ACM manual, to one of the following requirements.

i. The measured duct leakage shall be less than 15% of fan flow; or

ii. The measured duct leakage to outside shall be less than 10% of fan flow; or

iii. The measured duct leakage shall be reduced by more than 60% relative to the measured leakage prior to the installation or replacement of the space conditioning equipment and a visual inspection including a smoke test shall demonstrate that all accessible leaks have been sealed; or

iv. If it is not possible to meet the duct requirements of i, ii, or iii, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS rater.

EXCEPTION 1 to Section 152 (b) 1 E: Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Residential ACM manual.

EXCEPTION 2 to Section 152 (b) 1 E: Duct systems with less than 40 linear feet in unconditioned spaces.

EXCEPTION 3 to Section 152 (b) 1 E: Existing duct systems constructed, insulated or sealed with asbestos.

F. 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 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, Section 119 (d), and Section 150; and

B. 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 except those altered components that do not meet the requirements of Section 152 (b) 1 (including improvements proposed to comply with this section) are assumed to be upgraded to comply with Section 152 (b) 1 as specified in the Residential ACM Manual.

EXCEPTION 1 to Section 152 (b): The EXCEPTION to Section 150 (k) 2 applies only for alterations to kitchen lighting where all permanently installed kitchen luminaires are replaced.

EXCEPTION 2 to Section 152 (b): 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) 3 A.

(c) Any addition or alteration may comply with the requirements of Title 24, Part 6 by meeting the requirements for the entire building.

2001 CALIFORNIA MECHANICAL CODE, CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 4 CHAPTER 6, DUCT SYSTEMS

TABLE P4-A ADOPTION TABLE

CODE SECTION		**CEC**
Entire 2001 CMC as noted in this table[1]		
601		X
602		X
604		X
605		X
Standard 6-5		X
[1]Adopted by reference for Occupancies A, B, E, F, H, M, R, and S; see Sections 118 (d), 124, and 150 (m).		

APPENDIX 1-A
STANDARDS AND DOCUMENTS REFERENCED IN THE ENERGY EFFICIENCY REGULATIONS

AIR-CONDITIONING AND REFRIGERATION INSTITUTE

ARI 210/240-2003	Unitary Air Conditioning and Air-Source Heat Pump Equipment (2003)
ARI 310/380-93	Packaged Terminal Air-Conditioners and Heat Pumps (1993)
ARI 320-98	Water-Source Heat Pumps
ARI 325-98	Ground Water-Source Heat Pumps (1998)
ARI 340/360-2000	Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment (2000)
ARI 365-2002	Commercial and Industrial Unitary Air-Conditioning Condensing Units (2002)
ARI 460-2000	Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (2000)
ARI 550/590-98	Standard for Water-Chilling Packages Using the Vapor Compression Cycle (1998)
ARI 560-2000	Absorption Water Chilling and Water Heating Packages (2000)
Available from:	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, Virginia 22203 (703) 524-8800

AIR CONDITIONING CONTRACTORS OF AMERICA

Manual J – Residential Load Calculation, Eighth Edition (2003)

Available from:
Air Conditioning Contractors of America, Inc.
2800 Shirlington Road, Suite 300
Arlington, VA 22206
www.acca.org
(703) 575-4477

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI Z21.10.3-2001	Gas Water Heaters, Volume 1, Storage Water Heaters with Input Ratings above 75,000 Btu/h (2001)
ANSI Z21.13-2000	Gas-Fired Low Pressure Steam and Hot Water Boilers (2000)
ANSI Z21.40.4-1996 (1996)	Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances
ANSI Z21.47-2001	Gas-Fired Central Furnaces (2001)
ANSI Z83.8-2002	Gas Unit Heaters and Gas-Fired Duct Furnaces (2002)
Available from:	American National Standards Institute 25 West 43rd Street, 4th Floor New York, NY 10036 (212) 642-4900

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (NATIONAL PUBLICATIONS)

ASHRAE 55-1992 Thermal Environment Conditions for Human Occupancy (1992)

ASHRAE Handbook

Applications Volume, Heating, Ventilating and Air-Conditioning Applications (2003)

Equipment Volume, Heating, Ventilating and Air-Conditioning Systems and Equipment (2000)

Fundamentals Volume, Fundamentals (2001)

Available from: ASHRAE
1791 Tullie Circle N.E.
Atlanta, Georgia 30329
(404) 636-8400 or (800) 527-4723

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (REGIONAL PUBLICATION)

ASHRAE Climatic Data for Region X Arizona, California, Hawaii, Nevada, Publication SPCDX, 1982, ISBN #20002196 and Supplement, 1994, ISBN #20002596

Available from: Order Desk
Building News
10801 National Boulevard
Los Angeles, CA 90064
(800) 873-6397 or (310) 474-7771
http://www.bnibooks.com/

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM C55-01 Standard Specification for Concrete Brick (2001)

ASTM C177-97 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus (1997)

ASTM C272-01 Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions (2001)

ASTM C335-95 Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation (1995)

ASTM C518-02 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus (2002)

ASTM C731-00 Standard Test Method for Extrudability, After Package Aging, of Latex Sealants (2000)

ASTM C732-01 Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants (2001)

ASTM C836-05 Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course (2005)

ASTM C1167-96 Standard Specification for Clay Roof Tiles

ASTM C1371-98 Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers (1998)

ASTM C1583-04 Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method) (2004)

ASTM D522-93a (2001)	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (2001)
ASTM D822-01	Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings (2001)
ASTM D1003-00	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics (2000)
ASTM D1653-03	Standard Test Methods for Water Vapor Transmission of Organic Coating Films (2003)
ASTM D2370-98 (2002)	Standard Test Method for Tensile Properties of Organic Coatings (2002)
ASTM D2824-02	Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos, 2002
ASTM D3468-99	Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing (1999)
ASTM D3805-97	Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings, 1997 (reapproved 2003)
ASTM D4798-01	Standard Test Method Accelerated Weathering Test Conditions and Procedures for Bituminours Materials (Xenon-Arc Method) (2001)
ASTM D5870-95 (2003)	Standard Practice for Calculating Property Retention Index of Plastics (2003)
ASTM D6083-05e1	Standard Specification for Liquid Applied Acrylic Coating Used in Roofing (2005)
ASTM D6694-01	Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing (2001)
ASTM D6848-02	Standard Specification for Aluminum-Pigmented Emulsified Asphalt Used as a Protective Coating for Roofing Asphalt Roof Coatings, 2002.
ASTM E96-00	Standard Test Methods for Water Vapor Transmission of Materials
ASTM E283-91 (1999)	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E408-71(2002)	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques (2002)
Available from:	American Society for Testing and Materials 100 Barr Harbor Drive West Conshohocken, Pennsylvania 19428-2959 (610) 832-9500

CALIFORNIA BUILDING STANDARDS COMMISSION

2001 California Electrical Code

Available from:	California Building Standards Commission 2525 Natomas Park Drive, Suite 130 Sacramento, CA 95833-2936 (916) 263-0916 www.bsc.ca.gov

CALIFORNIA ENERGY COMMISSION

Appliance Efficiency Standards

Nonresidential Alternative Calculation Method (ACM) Manual

Nonresidential Manual

Residential Alternative Calculation Method (ACM) Manual

Residential Manual

Available from: California Energy Commission
1516 Ninth Street
Sacramento, CA 95814
(916) 654-5106 or
(800) 772-3300 (in California)
http://www.energy.ca.gov/title24

CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS

Standards for Insulating Material

Available from: California Department of Consumer Affairs
Bureau of Home Furnishings and Thermal Insulation
3485 Orange Grove Ave
North Highlands, CA 95660
(916) 574-2041

CODE OF FEDERAL REGULATIONS

21 Code of Federal Regulations, Section 1002.2 (1996)

47 Code of Federal Regulations, Parts 2 and 15 (1996)

Available from: Department of Energy
Washington, DC 20585

COOLING TOWER INSTITUTE

CTI ATC-105-00 Acceptance Test Code for Water Cooling Towers (2000)

CTI STD-201-02 Certification Standard for Commercial Water Cooling Towers (2002)

Available from: Cooling Tower Institute
530 Wells Fargo, Suite 218
Post Office Box 73383
Houston, Texas 77273
(281) 583-4087

COOL ROOF RATING COUNCIL

CRRC-1 Product Rating Program Manual (2002)

Available from: Cool Roof Rating Council
1738 Excelsior Avenue
Oakland, CA 94602
(866) 465-2523
www.coolroofs.org

HYDRONICS INSTITUTE

HI Heating Boiler Standard 86, 6th Edition, (1989)

Available from: Hydronics Institute
35 Russo Place, P.O. Box 218

Berkeley Heights, New Jersey 07922
(908) 464-8200

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA

The IESNA Lighting Handbook, Ninth Edition (2000)

Available from: IESNA
120 Wall Street, 17th Floor
New York, New York 10005-4001
(212) 248-5000
Email: iesna@iesna.org

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

2001 California Mechanical Code

Available from: International Association of Plumbing and Mechanical Officials
2001 E. Walnut Drive South
Walnut, California 91789-2825
800 85-IAPMO (854-2766)
www.iapmo.org

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

2001 California Building Code

Available from: International Conference of Building Officials
International Code Council Los Angeles District Office
5360 South Workman Mill Road
Whittier, California 90601-2298
(800) 284-4406
www.icbo.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO-13256-1 Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps (1998)

Available from: ISO
1, rue de Varembe
Case postale 56
CH-1211
Geneve 20, Switzerland

NATIONAL FENESTRATION RATING COUNCIL

NFRC 100 Procedure for Determining Fenestration Product U-factors (1997, 2002)

NFRC 200 Procedure for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence (1997, 2002)

NFRC 400 Procedure for Determining Fenestration Product Air Leakage (1995, 2002)

Available from: National Fenestration Rating Council
8484 Georgia Avenue, Suite 320
Silver Spring, Maryland 20910
(301) 589-1776
Email: info@nfrc.org

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION

Residential Comfort System Installation Standards Manual (1998)

Available from: Sheet Metal And Air Conditioning Contractors National Association (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1209
(703) 803-2980
www.smacna.org

UNDERWRITERS LABORATORIES

UL 181	Standard for Safety for Factory-made Air Ducts and Connectors (1996)
UL 181A	Standard for Safety for Closure Systems for Use with Rigid Air Ducts and Air Connectors (1994)
UL 181B	Standard for Safety for Closure Systems for Use with Flexible Air Ducts and Air Connectors (1995)
UL 723	Standard for Test for Surface Burning Characteristics of Building Materials (1996)
UL 727	Standard for Oil-Fired Central Furnaces (1994)
UL 731	Standard for Oil-Fired Unit Heaters (1995)
UL 1598	Standard for Luminaires (2000)

Available from: Underwriters Laboratories
333 Pfingsten Road
Northbrook, Illinois 60062-2096
(847) 272-8800