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Energy Conservation Standards for New Nonresidential Buildings

July 1982 Edition

California
Energy
Commission

Foreword (not part of the Regulations)

The California Energy Commission's building regulations consist of five parts identified below. The regulations in this document have, for the most part, been in effect since 1978, but have recently been editorially revised and the order changed. The regulations, as revised, become effective on July 1, 1982, and apply to nonresidential buildings (UBC occupancies A, B, E and H). For regulations applicable to other occupancies, see the documents listed below:

Scope	Nonresidential Buildings	Apartment Buildings with four or more habitable stories and hotels	Other Residential Buildings
Administrative Regulations	Title 20 Chapter 2 Sub. Chap. 4 Article 1 1401 - 1410	Title 20 Chapter 2 Sub. Chap. 4 Article 1 1401 - 1410	Title 20 Chapter 2 Sub. Chap. 4 Article 1 1401 - 1410
Building Regulations	Title 24 Part 2 Chapter 2-53 2-5301 - 2-5307 2-5311 - 2-5344	Title 24 Part 2 Chapter 2-53 2-5301 - 2-5307 2-5361 - 2-5365	Title 24 Part 2 Chapter 2-53 2-5301 - 2-5307 2-5351 - 2-5352
Publication Number	P400-82-054	P400-82-055	P400-81-005

On July 13, 1982, Governor Brown signed into law Assembly Bill 1843 which exempts new residential housing projects which received approval by an advisory agency or other appropriate local agency on or before June 15, 1982, from the provisions of Sections 2-5351 and 2-5352, provided application for the permits to construct single family detached dwellings are submitted or filed on or before June 15, 1983, and the application for all other residential building permits are submitted or filed on or before December 31, 1983. New residential housing projects so exempted are subject to the provisions of 2-5361 through 2-5365. For the purpose of this exemption, "approval" includes approval or conditional approval of a tentative subdivision or tentative parcel map pursuant to the Subdivision Map Act [Division 2 (commencing with Section 66410) of Title 7 of the Government Code], condominium plan, or other permit for a residential housing project.

CALIFORNIA ADMINISTRATIVE CODE

BUILDING REGULATIONS
APPLICABLE TO
NONRESIDENTIAL BUILDINGS
(OCCUPANCIES A, B, E, AND H)

Effective July 1, 1982

<u>Sections</u>	<u>Subject</u>	<u>Pages</u>
1401 through 1410	Administrative Regulations	1-1 through 1-13
2-5301 through 2-5307	Building Regulations applicable to all occupancies	175 through 196
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Appendix 2-53A	Standards Referenced in Energy Conservation Regulations	271 through 273
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CALIFORNIA ADMINISTRATIVE CODE

Title 20

Chapter 2
(California Energy Commission)

Subchapter 4
(Conservation)

Article 1
(Energy Building Regulations)

NOTE: The administrative standards in Title 20 (Sections 1401 through 1410) apply to all new residential and nonresidential buildings.

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ARTICLE 1.--ENERGY BUILDING REGULATIONS

Section 1401. General.

This article contains administrative regulations relating to the energy building regulations found in Title 24, Part 2, Chapter 2-53.

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

Reference: Public Resources Code, Sections 25402 and 25402.1

Section 1402. Definitions.

For the purpose of this article the following definitions shall apply:

"Approved calculation method" means the California Energy Commission's Public Domain Computer Program, one of the Commission's Simplified Calculation Methods, or any other calculation method approved by the Executive Director.

"Commission" means the State Energy Resources Conservation and Development Commission.

"Conditioned floor area" means the floor area of conditioned space on all floors, including basements, intermediate floor tiers, and penthouses, measured from the exterior faces of exterior walls and the exterior face of walls separating conditioned and unconditioned spaces. Conditioned floor area does not include covered walkways, open roofed-over areas, porches, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, parking garages, unheated basements, and closets for central gas forced air furnaces.

"Conditioned space" means the space, within a building, which is provided with a heat supply or a method of cooling, either of which has connected output capacity in excess of 10 Btu/hr per square foot.

"Enforcement agency" means the city, county, or state agency responsible for issuing a building permit.

"Executive Director" means the Executive Director of the Commission.

"Governmental agency" means any public agency or subdivision thereof, including any agency of the state, county, city, district, association of governments, and joint power agency.

"Nonresidential building" means any building which is of an occupancy type A, B, E, and/or H as defined in the Uniform Building Code, 1979 Edition.

"Public Adviser" means the Public Adviser of the Commission.

"Residential building" means a building which is of an occupancy type R as defined in the Uniform Building Code, 1979 edition.

"R Value" means the measure of the resistance of a material or building component to the passage of heat in $\frac{\text{hr} - \text{ft}^2 - ^\circ\text{F.}}{\text{Btu}}$.

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

Section 1403. Permit Requirements for New Buildings.

(a) Design and Compliance Requirements for Nonresidential Buildings.

- (1) Design. With each application for a building permit, in addition to two sets of plans and specifications, the calculations, reports, and other required documentation shall be signed by the particular licensed or registered professional responsible for their preparation. They shall include a civil engineer, mechanical engineer, electrical engineer, architect, building designer, general engineering contractor, general building contractor or specialty contractor, licensed or registered to practice by the State of California.

The designer shall provide a statement on the drawings, over his signature, that these regulations have been reviewed and the design submitted conforms substantially with these regulations.

The enforcement agency may waive any of the requirements of this subsection for buildings having a gross square feet of conditioned floor area not exceeding 1,000 square feet and an occupant load not exceeding 49 persons.

- (2) Construction Compliance. At the time of request for final inspection for any project subject to these regulations, the permittee or his authorized agent for the project shall deliver to the enforcement agency a certificate of construction compliance with these standards based on observation of construction and signed by one or more of the following: the owner, general building contractor, design architect, design engineer, or an approved independent inspector or inspection agency. This report shall indicate, based upon personal knowledge, that the work performed and the materials used and installed appear in every material respect in compliance with the approved plans and specifications for which the building permit was issued.

Such written report shall be filed prior to approval of the building for occupancy by the enforcement agency.

The term "personal knowledge" as used in this section means the personal knowledge which is obtained from periodic visits to the

project site of reasonable frequency for the purpose of general observation of the work and also which is obtained from the reporting of others as to the progress of the work, testing of materials, inspection, and superintendence of the work that is performed between the above-mentioned periodic visits. The exercise of reasonable diligence to obtain the facts is required.

(3) Nothing in this section shall be construed as limiting in any manner the responsibility of the enforcement agency for reviewing the plans of proposed nonresidential buildings to confirm that they comply with these regulations.

(b) Enforcement Agency Requirements for Residential Buildings. An enforcement agency shall not issue a building permit or renew an existing permit which was applied for on or after the effective date of this article for any new residential building unless the enforcement agency determines, in writing, that the new building is designed to comply with the requirements of Title 24, Part 2, Chapter 2-53.

The enforcement agency shall require that every application for a building permit contain plans and specifications with adequate detail for determining compliance with the requirements of Title 24, Part 2, Chapter 2-53.

The enforcement agency shall inspect new buildings to ensure that they are constructed according to the agency's approved plans and that the buildings meet the applicable requirements of Title 24, Part 2, Chapter 2-53.

(c) Statement of Design Compliance for Residential Buildings. The person who designs the building or applies for the building permit shall state on the building plans or submit a written statement with the permit application that the building design meets the requirements of Title 24, Part 2, Chapter 2-53.

(d) Insulation Certificate (All Occupancies). After installing insulation, the installer shall post in a conspicuous location in the building a certificate signed by the installer and the builder stating that the installation conforms with the requirements of Title 24, Part 2, Chapter 2-53, and that the materials installed conform with the requirements of Title 20, Chapter 2, Subchapter 4, Article 3. The certificate shall 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 density for the desired "R" value.

(e) Occupant Information for Residential Buildings. The builder shall provide the original occupant a list of the heating, cooling, water heating, and lighting systems and conservation or solar devices installed

in the building and instructions on how to use them efficiently. The instructions shall be consistent with specifications set forth by the Executive Director.

- (f) Identification of Complying HVAC Equipment (All Occupancies). The efficiency of the equipment described in Title 24, Part 2, Chapter 2-53, Section 2-5306, shall be shown on the plans or in the documents submitted to the enforcement agency for approval.
- (g) Electric Resistance Comfort Heating Equipment (All Occupancies). The manufacturer of electric resistance comfort heating equipment shall make available to prospective purchasers, designers, or contractors, upon request, full-load energy input over the range of voltages at which the equipment is intended to operate.
- (h) Maintenance Information (All Occupancies). Equipment which requires preventive maintenance for efficient operation shall be furnished with complete necessary maintenance information. Required routine maintenance actions shall be clearly stated and incorporated on an accessible label, which may be limited to identifying, by title and/or publication number, the operation and maintenance manual for that particular model and type of product. At least one copy of this information shall be furnished by the manufacturer for the original owner upon request.
- (i) Responsibility of Equipment Suppliers (All Occupancies). Suppliers of HVAC equipment shall furnish, upon request by prospective purchasers, designers, or contractors, the full and partial capacity and standby input(s) and output(s) of all equipment and components of applied systems, based on equipment in new condition, to enable determination of their compliance with these standards. This includes performance data under modes of operation and ambient conditions necessary to make the analysis outlined in these standards.

Performance data furnished by the equipment supplier or certification under a nationally recognized certification program, when available, satisfies this requirement when all energy input(s), output(s), and operating modes are included.

- (j) Exceptional Designs, Materials, and Devices for Residential Buildings, Except Apartment Houses with Four or More Habitable Stories and Hotels. When designs, materials, or devices are proposed which cannot be adequately modeled by an approved calculation method, an applicant may be granted a building permit upon approval by the Executive Director, based on a determination of energy efficiency using an alternative evaluation technique which demonstrates compliance with the standards.

To obtain approval, the applicant must submit the following materials to the Executive Director:

- (1) A copy of the detailed plans required by Subsection 1403(b).
- (2) A statement explaining why meeting the energy budget requirements cannot be demonstrated using an approved calculation method.
- (3) A letter from the enforcement agency stating that the energy budget requirements cannot be determined using an approved calculation method.
- (4) A detailed evaluation of the energy efficiency of the building's design, materials, or devices using an alternative evaluation technique.
- (5) Any additional materials requested by the Executive Director to evaluate the energy efficiency.

When the materials described above have been properly submitted, the Executive Director shall notify the applicant in writing that his application is complete. The Executive Director shall notify the applicant in writing of his determination within 45 days of the date of notification. If a determination is not made within 45 days, the enforcement agency may issue a building permit. The Executive Director may charge a fee for the review and approval of the application. The Executive Director may delegate the approval of exceptional designs, materials, and devices to a local enforcement agency.

- (k) Other Documentation Requirements for Nonresidential Buildings. Other documentation requirements are contained in Title 24, Part 2, Chapter 53, Sections 2-5313 and 2-5315.

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

Section 1405. Enforcement by the Commission (All Occupancies).

- (a) Where There Is No Local Enforcement Agency. The Executive Director shall review plans and specifications for proposed buildings in areas where there is no local enforcement agency and for all proposed governmental agency buildings and certify in writing that the buildings conform to the requirements of Title 24, Part 2, Chapter 2-53.
- (b) Where the Local Enforcement Agency Fails to Enforce. If a local enforcement agency fails to enforce the requirements of this article or of Title 24, Part 2, Chapter 2-53, the Commission, after furnishing 10 days written notice, may condition building permit issuance on the Executive Director's review of all plans and his written certification that specifications for proposed new buildings conform to the requirements of Title 24, Part 2, Chapter 2-53.

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

Section 1406. Locally Adopted Energy Standards (All Occupancies).

- (a) Requirements. Local governmental agencies may adopt and enforce energy standards for new buildings, provided the Commission finds that the standards will require the diminution of energy consumption levels permitted by the provisions of Title 24, Part 2, Chapter 2-53, currently in effect. Such actions include adopting the requirements of Chapter 2-53 prior to its effective date, requiring additional energy conservation measures, or setting more stringent energy budgets.
- (b) Documentation. Local governmental agencies wishing to enforce locally adopted energy conservation standards shall submit four copies of the following documents to the Commission:
- (1) The proposed local energy standards.
 - (2) A study and supporting materials showing how the local agency determined energy savings.
 - (3) A statement that the local standards will result in the reduction of energy consumption to or below the levels permitted by the requirements of Title 24, Part 2, Chapter 2-53.
 - (4) The basis of the agency's determination that the standards are cost effective.

The Commission or its designee may request additional information if needed for a complete staff analysis of the proposed standard.

- (c) Staff Recommendations. The Executive Director shall distribute copies of the material to the Commissioners, the Public Adviser, and all persons who have requested in writing a copy of the materials.

The Executive Director shall analyze the submitted material. No later than 60 days after submission of the materials, the Executive Director shall submit a written report which contains a recommendation and the basis of such recommendation to the Commission which shall be considered at the next regularly scheduled Commission business meeting. At least 10 days notice shall be given to the local agency.

The Executive Director shall notify the local agency of the number assigned to the filing, the Executive Director's written recommendation, the date, time, and place at which the filing will be considered by the Commission, and the general procedures of the Commission concerning hearings. Notice shall also be sent to any person who requested notice in writing.

- (d) Hearing. All interested persons may present comments on the Executive Director's recommendation at the hearing, subject to the presiding member's discretion, to limit statements to relevant issues and assure an orderly proceeding. Notice of the Commission's decision shall be sent to the local agency and to any person who has requested such notice in writing.

NOTE: Authority cited: Public Resources Code, Section 25402.1

Reference: Public Resources Code, Section 25402.1

Section 1407. Interpretations (All Occupancies).

The Executive Director may make a determination as to the application or interpretation of any provision of this article or of Title 24, Part 2, Chapter 2-53, to any person requesting such a determination. The Executive Director's interpretation shall be placed on the consent calendar for Commission approval. Those interpretations which have wide application or interest shall be broadly publicized.

NOTE: Authority cited: Public Resources Code, Section 25402.1

Reference: Public Resources Code, Section 25402.1

Section 1408. Claims of Exemptions (All Occupancies).

- (a) Requirements. Any person may claim exemption from the provisions of any building standard provided he can show that:

- (1) Actual site preparation and construction had not begun before the date the claim for exemption was filed.
- (2) Substantial funds had been expended in good faith on planning, designing, architecture, or engineering before the adoption date of the building standard.
- (3) Compliance with the requirements of the building standard would be impossible without both substantial delays and substantial increase in cost of construction.

The claimant has the burden of proof in establishing the claim.

- (b) Documentation. The claim shall be submitted to the Executive Director and shall include:

- (1) The completed signed claim (on a form provided by the Executive Director);
- (2) Contracts entered into by the claimant pertaining to the project;
- (3) Internal financial reports relative to the project accounts;

- (4) Dated schedules of design activities;
- (5) A progress report on project completion; and
- (6) Any additional evidence to support the claim.

The Executive Director may require additional information if needed for a complete staff analysis of the claim.

- (c) Staff Recommendations. No later than 60 days after the receipt of a claim and all required documentation, the Executive Director shall submit a recommendation to the Commission which shall be considered at its next regularly scheduled business meeting. At least 10 days notice shall be given to the claimant and to any other person who requests such notice.

The Executive Director shall notify the claimant of the number assigned to the filing, the Executive Director's written recommendation, the date, time, and place at which the claim will be considered by the Commission, and the Commission's general procedures for hearings and actions on claims.

- (d) Hearing. Claims shall be placed on the consent calendar for consideration by the Commission. The business meeting agenda need specify only that claims for exemption from provisions of the building standard will be considered. Notice of specific claims need be sent only to the claimant, the Commissioners, the Public Adviser, and those persons who have requested in writing such notice.

Upon the request of any interested person, a claim may be removed from the consent calendar and considered as a separate item of business.

The Commission shall approve or disapprove the claim in whole or in part and shall provide a statement of reasons supporting the decision. Unless otherwise decided by the Commission, the Executive Director's report shall be deemed adopted as the statement of reasons supporting the decision. The Commission's decision shall be final. Notice of the decision shall be sent to the claimant and to any person who has requested such notice.

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

Section 1409. Approved Calculation Methods.

- (a) Public Domain Computer Program (All Occupancies). By the effective date of this article the Executive Director shall provide at least one public domain computer program which may be used to demonstrate that proposed building designs meet the energy budget requirements of Title 24, Part 2, Chapter 2-53.

For each public domain computer program, the Executive Director shall provide instructions for using the program to demonstrate that the energy budget requirements are met. These instructions shall include a statement of those input values that are set by the Executive Director and those input values which may be varied by the building designer to model energy saving options.

- (b) Simplified Calculation Method (Residential Occupancies). By the effective date of this article the Executive Director shall provide one or more simplified calculation methods, at least one of which shall be a point system, which may be used as an alternative to the public domain computer programs to demonstrate that proposed building designs meet the requirements of Title 24, Part 2, Chapter 2-53. The use of the simplified calculation method(s) shall result in energy-saving requirements which are consistent with those in Title 24, Part 2, Chapter 2-53.

- (c) Certification of Alternative Calculation Methods (All Occupancies). The Executive Director shall certify alternative calculation methods which may be used to demonstrate that proposed building designs meet the requirements of Title 24, Part 2, Chapter 2-53. Any person may apply for certification of an alternative calculation method. The applicant shall provide documentation to the Executive Director that demonstrates that the alternative calculation method:
 - (1) Differentiates the estimated energy-savings results among alternative options substantially similar to the public domain computer program;
 - (2) Shows that no changes are made in any of the variables fixed by the Executive Director;
 - (3) Provides input and output documentation in a format specified by the Executive Director which facilitates the enforcement agency's review;
 - (4) Is supported by clear and concise instructions for using the alternative to demonstrate that the requirements of Title 24, Part 2, Chapter 53, are met; and
 - (5) Establishes energy budgets for that alternative calculation method by modeling the buildings used to develop the energy budgets in Title 24, Part 2, Chapter 2-53.

The Executive Director shall provide instructions to the applicant upon request which specify the certification requirements. When the applicant properly submits all required documentation, the Executive Director shall notify the applicant in writing. The Executive Director shall notify the applicant of his or her determination within 90 days of the date of notification of proper documentation.

- (d) Certification of Alternative Component Packages (Residential Occupancies). The Executive Director may certify any alternative component package which he determines will meet the energy budgets specified in Title 24, Part 2, Chapter 2-53, Section 2-5342(a), and is likely to apply to a significant percentage of new residential buildings or to a significant segment of the building construction and design community.
- (e) Publication of Commission Determinations (All Occupancies). The Executive Director shall periodically publish a manual, newsletter, or other administrative guide containing determinations made by the Executive Director and Commission pursuant to this section.

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

Section 1410. Appeal to Commission (All Occupancies).

Any person aggrieved by any determination made by the Executive Director pursuant to this article or Title 24, Part 2, Chapter 2-53, may appeal such determination to the California Energy Commission.

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

CALIFORNIA ADMINISTRATIVE CODE

Title 24
(State Building Standards Code)

Part 2
(State Building Code)

Chapter 2-53
(Energy Conservation in New Building Construction)

Complete bound copies of the State Building Code, Title 24, Part 2, (1981 Edition) of which this is a part, may be obtained from:

State of California
Documents Section
P.O. Box 1015
North Highlands, CA 95660

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A, B, E, and H (NONRESIDENTIAL BUILDINGS)

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**CHAPTER 2-53.
ENERGY CONSERVATION IN NEW
BUILDING CONSTRUCTION**

NOTE: Chapter 53 of the U.B.C. is not adopted by reference. The provisions of this chapter represent an entire new Chapter 2-53.

Adoption Table No. 2-53A

Code Section	HCD		OSA		OSH		DHS	OSHA	CEC	SHB	DOT	AGR	YA	BOC	DOE	CA	
	BSC	1	2	SFM	SSS	HC											PD
Entire Chapter																	
2-53																	X ³

- NOTES:** 1. See Sections 2-105 and 2-106 for explanation of this Table.
 2. See State Building Code History Note Appendix.
 3. The building standards contained in this Chapter become effective upon publication.

- EXCEPTIONS:** 1. Until June 30, 1982,* Sections 2-5361 through 2-5365 apply to all new buildings of Occupancy R
 2. Effective July 1, 1982,* Sections 2-5351 and 2-5352 apply to new buildings of Occupancy R except apartment houses with four or more habitable stories and hotels and Sections 2-5361 through 2-5365 apply to new apartment houses with four or more stories and hotels.
 3. Effective March 25, 1982, Section 2-5305(a) applies to existing buildings of Occupancy R and Sections 2-5305(b), (c) and (d) apply to existing buildings of all occupancies.
 4. For effective dates applicable to appliance efficiency standards see Section 2-5306(c)2.

**ENERGY CONSERVATION STANDARDS—PROVISIONS
APPLICABLE TO ALL OCCUPANCIES ****

Scope

Sec. 2-5301.

NOTE: See Adoption Table No. 2-53A, Note 3, for the effective dates of building standards contained in this chapter.

(a) **GENERAL.** 1. **All Buildings.** The provisions of Section 2-5303 and 2-5304 apply to new and existing buildings of all occupancies.

2. **New Buildings.** The provisions of this chapter apply to new buildings of occupancies A, B, E, H, and/or R, which are heated or mechanically cooled and for which an application for a building permit or renewal of an existing permit is filed on or after the effective date of this chapter except as listed in 4. It also applies to heated or mechanically cooled new buildings of occupancies A, B, E, H, and/or R constructed by a governmental agency, whether or not a building permit is needed.

A. The provisions of Sections 2-5306 and 2-5307 apply to new buildings of occupancies A, B, E, H, and R.

* These dates are based on the auxiliary implementation documents being available to the public on or before January 1, 1982. If the auxiliary documents are not available to the public on January 1, 1982 these dates will change to be six months after such documents are available to the public.

** See Section 2-5301(a) 3. and 4. for details of application.

- B. The provisions of Sections 2-5311 through 2-5344 apply to new buildings of occupancies A, B, E, and H.
- C. The provisions of Sections 2-5351 and 2-5352 apply to all new buildings of occupancy R except apartment houses with four or more habitable stories and to hotels.
- D. The provisions of Section 2-5361 through 2-5365 apply to new buildings of occupancy R.

EXCEPTION: Effective July 1, 1982, the provisions of Sections 2-5361 through 2-5365 apply only to apartment houses with four or more habitable stories and to hotels.

3. **Existing Buildings.** The provisions of subsections 2-5305(b), (c) and (d) apply to existing buildings of all occupancies. The provisions of subsection 2-5305(a) apply only to existing buildings of occupancy R.

4. The following buildings are not subject to the provisions of this chapter.

A. Historical buildings; and

B. Building, in which no energy for space heating, space cooling, and water heating is obtained from depletable sources.

(b) **Mixed Occupancy.** When a new building contains both residential occupancy (R) and nonresidential occupancies (A, B, E, and/or H), the residential portion of the building shall comply with the provisions for residential buildings, and the nonresidential portion of the building shall comply with the provisions for nonresidential buildings with the following exceptions: 1. The entire new building may be treated, for the purpose of this chapter, as a nonresidential building if the residential portion of the building is both less than 1,000 square feet and less than 30 percent of the gross square feet of conditioned floor area of the building.

2. The entire new building may be treated, for the purpose of this chapter, as a residential building if the nonresidential portion of the building is both less than 1,000 square feet and less than 30 percent of the gross square feet of conditioned floor area of the building.

(c) **Additions, Alterations, and Repairs.** 1. Occupancies A, B, E and H (Nonresidential Buildings).

NOTE: See Section 2-5312 for the extent of compliance required.

2. Occupancy R (Residential Buildings).

NOTE: See Section 2-5361 for the extent of compliance required.

EXCEPTION: Effective July 1, 1982, additions to existing buildings of occupancy R other than apartment buildings with four or more stories or hotels which increase the conditioned space shall be subject to the ceiling insulation, wall insulation, floor insulation, glazing "U" value, and shading requirements of Package A for the appropriate climate zone in Tables 2-53U1 through 2-53U16 in Section 2-5351(c), and all the requirements for Sections 2-5351(b) Loose Fill Insulation, 2-5352(c) Wall Insulation, 2-5352(d) Infiltration Control, 2-5352(e) Vapor Barriers, 2-5352(f) Ducts, and 2-5352(m) Lighting, and shall have a maximum total glazing area of 16 percent of the conditioned floor area plus the glazing area that was removed from the existing building because of the addition. Alternatively, additions may meet the energy budgets in Section 2-5351(a) for the appropriate climate zone and building type. New space heating and cooling equipment installed in conjunction with an addition shall meet the requirement of 2-5352(g) Space Conditioning Equipment Sizing, 2-5352(h) Setback Thermostats, and 2-5306 Heating, Ventilation, and Air Conditioning Equipment. New water heating equipment installed in conjunction with an addition shall meet the requirements of 2-5352(i) Water Heating System Insulation and 2-5307 Water Heating Equipment.

(d) **Construction by Governmental Agencies.** No governmental agency shall begin construction of any new building unless the building is designed to comply with

the requirements of this chapter, and of Article 1, Subchapter 4, Chapter 2, Title 20, CAC.

(e) **Administrative Requirements.** Administrative requirements relating to permit requirements, enforcement by the California Energy Commission, locally adopted energy standards, interpretations, claims of exemption, approved calculation methods, and rights of appeal are specified in Article 1, Subchapter 4, Chapter 2, Title 20, CAC.

Definitions

Sec. 2-5302. For the purpose of this chapter the following definitions shall apply:
ACCESSIBLE is having access thereto, but which first may require the removal or opening of an access panel, door or similar obstruction.

ADDITION is an extension or increase in floor area or height of a building or structure.

AIR CONDITIONER is one or more factory made assemblies which include an evaporator or cooling coil and an electrically driven compressor and condenser combination, and may include a heating function.

ALTERATION is any change, addition or modification in construction or occupancy.

ANSI is the American National Standards Institute.

APPLIANCE EFFICIENCY REGULATIONS are the regulations adopted by the California Energy Commission regulating the minimum efficiency of certain appliances sold in California.

APPROVED CALCULATION METHOD is the California Energy Commission's Public Domain Computer Program, one of the California Energy Commission's Simplified Calculation Methods, or any other calculation method approved by the Executive Director of the California Energy Commission.

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

ASTM is the American Society for Testing and Materials.

AUTOMATIC is self-acting, operating by its own mechanism when actuated by some impersonal influence, as for example, a change in current strength, pressure, temperature, or mechanical configuration.

BASIC GLAZING AREA is an area of glazing equal to 16 percent of the gross floor area for buildings with less than four habitable stories and 40 percent of the exterior wall area for all other buildings.

BUILDING ENVELOPE is the elements of a building which enclose conditioned spaces and through which thermal energy may be transferred to or from the exterior.

CLIMATE CONTROL SYSTEM is a system that provides either collectively or individually the processes of comfort heating, ventilating, and/or cooling within or associated with a building.

COEFFICIENT OF PERFORMANCE (COP), Cooling is the ratio of the rate of net heat removal to the rate of total energy input, expressed in consistent units and under designated operating conditions. British thermal units shall be converted to kilowatt hours at the rate of 3413 British thermal units per kilowatt-hour.

CONDITIONED FLOOR AREA is the floor area of conditioned space on all floors, including basements, intermediate floor tiers, and penthouses, measured from the exterior faces of exterior walls and the exterior face of walls separating conditioned and unconditioned spaces. Conditioned floor area does not include covered walkways, open roofed-over areas, porches, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, parking garages, unheated basements, and closets for central gas forced air furnaces.

CONDITIONED SPACE is the space within a building which is provided with a heat supply or a method of cooling, either of which has a connected output capacity in excess of 10 Btu/hr per square foot.

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 shall be those listed in Table 2-53D. For those localities not listed in Table 2-53D the number of degree days shall be determined by the applicable enforcing agency.

DESIGN HEAT LOSS is the total calculated heat loss through the building envelope under design conditions.

EAST-FACING is oriented to within 67½ degrees of true east.

EFFICACY is the ratio of light from a lamp to the electrical power consumed, including ballast losses, expressed in lumens per watt.

ENERGY CONSERVATION DESIGN MANUAL is a manual developed by the California Energy Commission to aid designers, builders and contractors in meeting energy conservation standards.

ENERGY EFFICIENCY RATIO (EER) is the ratio of net cooling capacity in BTU/hr to total rate of electric input in watts under designated operating conditions.

ENERGY OBTAINED FROM DEPLETABLE SOURCES is electricity purchased from a public utility or energy obtained from burning coal, oil, natural gas, or liquefied petroleum gases.

ENERGY OBTAINED FROM NONDEPLETABLE SOURCES is energy which is not energy obtained from depletable sources.

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

EXTERIOR WALL AREA is the gross area of wall surface adjacent to heated or cooled spaces, including glazing and doors, exposed to ambient climatic temperatures, measured for a dwelling unit or group of units served by a climate control system.

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.

GLAZING is all transparent or translucent materials in exterior openings.

GLAZING AREA is the area of glazing in exterior openings, including the sash area.

GOVERNMENTAL AGENCY is any public agency or subdivision thereof, including any agency of the state, county, city, district, association of governments, and joint power agency.

GROSS FLOOR AREA is the floor area of space on all floors including basements, intermediate floor tiers, and penthouses, measured from the exterior faces of exterior walls. **GROSS FLOOR AREA** does not include covered walkways, open roofed over areas, porches, pipe trenches, exterior terraces or steps, chimneys, roof overhangs, parking garages and unheated basements.

HABITABLE STORY is a story which contains habitable space.

HEAT PUMP is an air conditioner which is capable of heating by refrigeration, and which may or may not include a capability for cooling.

HISTORICAL BUILDING is a building that has been designated by official government action as having historical or architectural significance.

HVAC SYSTEM is a system that provides either collectively or individually the processes of comfort heating, ventilating, and/or cooling within or associated with a building.

INFILTRATION is the uncontrolled inward air leakage through cracks and interstices in any building envelope and around windows and doors of a building.

LUMINAIRE is a complete lighting unit consisting of a lamp or lamps together with the parts designed to distribute the light, to position and protect the lamps, and to connect the lamps to the power supply.

MANUAL is capable of being operated by personal intervention.

NEW ENERGY is electrical or chemical energy converted to thermal or mechanical energy expressly for the purpose of comfort heating or cooling.

NONRESIDENTIAL BUILDING is any building which is of an occupancy type A, B, E, and/or H.

OUTSIDE AIR is air taken from outdoors and not previously circulated through the system.

PLENUM is an air compartment connected to one or more air inlets or outlets.

READILY ACCESSIBLE is capable of being reached quickly for operation, renewal, or inspection, without requiring those to whom ready access is requisite to climb over or remove obstacles or to resort to the use of portable access equipment.

RECOOL is the application of cooling as a secondary process to either preconditioned primary air or recirculated room air.

RECOVERED ENERGY is energy utilized which would otherwise be wasted from an energy system.

REHEAT is the application of heat as a secondary process to either preconditioned primary air or recirculated room air.

RESIDENTIAL BUILDING is a building which is of an occupancy type R.

SERVICE SYSTEMS is the HVAC, service water heating, electrical distribution, and illuminating systems provided in a building.

SERVICE WATER HEATING is heating of water for domestic or commercial purposes other than comfort heating.

SHADING is externally protected from direct solar radiation by use of devices permanently affixed to the structure or by an adjacent building.

NOTE: Effective July 1, 1981, "Shading", as applied to buildings of occupancy R, other than apartment houses with four or more stories and hotels, is protection from direct solar radiation by use of devices affixed to the structure.

SHADING COEFFICIENT is the ratio of the solar heat gain through a glazing system corrected for external and internal shading to the solar gain through an unshaded single light of double strength sheet glass under the same set of conditions.

SKYLIGHT is any opening in the roof surface which is glazed with a transparent or translucent material.

SOUTH-FACING is oriented to within 22-½ degrees of true south.

SPECIAL GLAZING is glazing which has a maximum U value of 0.65 for all glazed surfaces.

SYSTEM is a combination of equipment and/or controls, accessories, interconnecting means, and terminal elements, by which energy is transformed to perform a specific function, such as climate control, service water heating or illumination.

TASK-ORIENTED LIGHTING is lighting designed specifically to illuminate one or more task locations, and generally confined to those locations.

THERMAL RESISTANCE (R) is the measure of the resistance of a material or building component to the passage of heat in hr-ft²F/Btu.

TINTED GLAZING is glazing material which is permanently tinted or permanently surface coated by the manufacturer and provides a maximum shading coefficient as hereinafter specified.

UNCONDITIONED SPACE is space within a building which is not conditioned space.

U-VALUE (Overall Coefficient of Thermal Transmittance) is the heat flow rate through a given construction assembly, air-to-air, expressed in Btu/hr-ft²F.

VALUE, as used in Section 2-5312, is the estimated cost to replace the building in kind, based on current replacement costs.

VAPOR BARRIER is a material with a permeance of one perm or less which provides resistance to the transmission of water vapor.

VENTILATION AIR is that portion of supply air which comes from outside plus any recirculated air that has been treated to maintain the desired quality of air within a designated space.

WEST-FACING is oriented to within 67-½ degrees of true west.

ZONE is a space or group of spaces within a building combined for common control of heating or cooling.

Installation of Certified Insulating Material

Sec. 2-5303. Insulating material of the types listed in Table 2-53B shall not be installed in any building unless it has been certified by the manufacturer, to comply with the California Quality Standards for Insulating material. See Appendix 2-53A for availability of directories of certified insulating material.

TABLE 2-53B.
INSULATING MATERIALS SUBJECT TO REGULATION

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
Polystyrene	board form, molded, extruded
Polyurethane	board form and field applied
Polyisocyanurate	board form and field applied
Urea formaldehyde foam	field applied
Vermiculite	loose fill

NOTE: See the definition of "Exposed application" in Title 20, Section 1552(e) as it applies to the surface burning characteristics for mineral aggregate and mineral fiber.

Installation of Urea Formaldehyde Foam Field Applied

Sec. 2-5304. (a) Installation of urea formaldehyde foam insulation is prohibited unless, in addition to the requirements of Section 2-5303, the foam is installed in compliance with the following requirements.

(b) **Exterior Sidewalls, Vapor Barrier.** Application is restricted to exterior sidewalls in all buildings. A four mil thickness plastic polyethylene vapor barrier, or equivalent plastic sheeting vapor barrier, shall be installed between the urea formaldehyde foam insulation and the interior space in all applications.

Installation of Additional Insulation

Sec. 2-5305. Insulating material shall not be installed by a contractor unless the contractor certifies to the customer, in writing, that the insulation meets the requirements of subsections (a), (b), (c), and (d), as applicable. (a) This subsection applies only to residential buildings not subject to the requirements of Sections 2-5351, 2-5352, or 2-5361 through 2-5365 (new residential buildings). If insulating material is installed in an accessible attic, the total amount of insulation (after addition of insulation to the amount, if any, already in the attic) shall meet or exceed the higher of the thermal resistance (R-value) determined from Table 2-53C or the R-value recommended by a Residential Conservation Service audit, if one has been performed. Where adequate accessible space is not available, the contractor may install a lesser amount of insulation to fill the area being insulated.

(b) If external insulation is applied to water heaters and storage and backup tanks for solar water heating systems, it shall have a thermal resistance of at least R-6.

(c) If insulation is applied to piping in unconditioned space leading to and from water heaters, it shall have a thermal resistance of at least R-3 for the five feet of pipe closest to the water heater, or whatever shorter length is in accessible unconditioned space.

(d) If external insulation is applied to heating and cooling system ducts, it shall conform to the thermal resistance requirements of Section 1005 of the State Mechanical Code (Title 24, Part 4).

**TABLE 2-53C. MINIMUM REQUIREMENTS FOR ADDITIONAL
ATTIC INSULATION**

<i>Degree Days</i>	<i>R-value</i> ¹
Up to 3000	19
3001 to 4100	20
4101 to 4800	21
4801 to 5500	22
5501 to 6050	23
6051 to 6500	24
6501 to 7000	25
7001 to 7350	26
7351 to 7650	27
7651 to 7900	28
7901 to 8150	29
8151 and up	30

For listing of degree days by locality, see Table 2-53D

¹The R-values listed refer to the total of in-place insulation and insulation added.

TABLE 2-53D. ANNUAL HEATING DEGREE DAYS

<i>Location</i>	<i>Annual Heating Degree Days</i>
Alameda Naval Air Station	2,900
Alderpoint	3,290
Alpine	2,104
Alturas	6,785
Anaheim	1,490
Antioch	2,627
Arcata	4,800
Auburn	3,047
Bakersfield	2,122
Barrett Dam	2,363
Barstow	2,496
Beale Air Force Base	2,400
Beaumont	2,790
Benicia	2,600
Berkeley	2,850
Bishop	4,275
Blythe Airport	1,076
Bolinas	2,800
Bonita	1,897
Borrego Springs	1,262
Brawley	1,161
Brisbane	3,060
Burbank Airport	1,800
Burlingame	2,650
Burney	6,249
Buttonwillow	2,010
Cabrillo National Monument	1,653
Calaveras Big Trees	5,736
Calabasas	1,800
Campo	3,247
Capitola	2,900
Carmel	2,900
Carmichael	2,800
Carpinteria	2,290
Castle Air Force Base	2,550
Castroville	2,900
Central Valley	3,010
Ceres	2,750
Chico	2,795
China Lake	2,570

TABLE 2-53D. ANNUAL HEATING DEGREE DAYS—Continued

<i>Location</i>	<i>Annual Heating Degree Days</i>
Chowchilla	2,400
Chula Vista	2,229
Claremont	1,600
Cloverdale	2,666
Clovis	2,600
Colfax	3,441
Colusa	2,788
Concord	2,766
Corning	2,790
Corona	1,875
Corte Madera	2,600
Crescent City	4,545
Culver City	1,711
Cuyamaca	4,649
Daggett Airport	2,203
Daly City	3,100
Danville	2,700
Davis	2,819
Death Valley	1,205
Deep Springs College	4,300
Delano	2,220
Dixon	2,800
Dunsmuir	5,300
Edwards Air Force Base	3,123
El Cajon	1,920
El Capitan Dam	1,397
El Centro	1,216
Elk Valley	5,404
Elsinore	2,101
Encinitas	1,952
Escondido	2,052
Eureka	4,679
Fairfield	2,434
Fairmont	3,327
Fair Oaks	2,900
Fillmore	2,377
Folsom	2,899
Fort Bidwell	6,365
Fort Bragg	4,424
Fort Jones	5,614

TABLE 2—53D. ANNUAL HEATING DEGREE DAYS—Continued

<i>Location</i>	<i>Annual Heating Degree Days</i>
Fortuna	4,700
Fremont.....	2,906
Fresno	2,611
Calt.....	2,780
Garberville	3,510
Gardena.....	1,700
Gilroy.....	2,808
Grass Valley	4,400
Gridley.....	2,600
Gustine.....	2,360
Half Moon Bay.....	2,700
Hamilton Air Force Base	2,600
Hanford	2,642
Hawthorne	1,800
Hayward	2,850
Healdsburg	2,700
Henshaw Dam	3,652
Hetch Hetchy.....	4,797
Hillsdale.....	2,650
Hollister.....	2,725
Huntington Beach.....	2,361
Imperial Airport	1,060
Independence	2,995
Inyokern	2,570
Ione.....	2,728
Jackson	2,760
Julian Wynola.....	4,085
King City.....	2,655
Lafayette.....	2,700
Laguna Beach	2,262
La Jolla.....	1,750
Lake Arrowhead	5,200
Lakeport	3,716
Lakewood	1,800
La Mesa	1,492
Lancaster.....	3,100
Laytonville	4,160
Lemoore	2,960
Lincoln.....	2,890
Lindsay	2,619

TABLE2—53D. ANNUAL HEATING DEGREE DAYS—Continued

<i>Location</i>	<i>Annual Heating Degree Days</i>
Live Oak	2,370
Livermore	2,781
Lodi	2,785
Lompoc	2,900
Long Beach Airport	1,803
Los Angeles Airport	2,061
Los Banos	2,267
Los Gatos	2,794
McCloud	6,007
Madera	2,485
Manteca	2,600
Maricopa	2,165
Mariposa	3,116
Markleeville	7,884
Martinez	2,650
Marysville	2,377
Mecca	1,117
Mendota	2,555
Merced	2,697
Mineral	7,192
Mitchell Cavern	2,510
Modesto	2,767
Moffett Naval Air Station	2,800
Mojave	2,590
Monterey	2,985
Morro Bay	1,600
Mount Shasta	5,800
Napa	2,690
Needles Airport	1,072
Nellie	4,745
Nevada City	4,488
Newport Beach	2,350
Novato	2,815
Oakdale	2,832
Oak Grove	3,516
Oakland	2,906
Oceanside	2,092
Orland	2,830
Oroville	2,597
Oxnard	2,352

TABLE 2—53D. ANNUAL HEATING DEGREE DAYS—Continued

<i>Location</i>	<i>Annual Heating Degree Days</i>
Palmdale Airport	3,088
Palm Springs	1,232
Palo Alto	2,869
Palomar Mt. Observatory	3,868
Paradise	4,010
Pasadena	1,694
Paso Robles Airport	2,890
Patterson	2,368
Perris	2,100
Petaluma	2,966
Pismo Beach	2,800
Pittsburg	2,633
Placerville	4,161
Point Loma	1,860
Pomona	2,166
Porterville	2,563
Portola	7,055
Quincy	5,852
Ramona Spaulding	2,223
Red Bluff	2,688
Redding	2,610
Redlands	2,052
Redwood City	2,596
Richmond	2,644
Ripon	2,700
Riverside	2,089
Roseville	2,899
Sacramento Executive Airport	2,782
St. Helena	2,833
Salinas	2,959
San Bernardino	2,018
San Clemente	1,877
San Diego	1,439
San Fernando	1,800
San Francisco Airport	3,080
San Jacinto	2,376
San Jose	2,656
San Juan Capistrano	1,646
San Luis Obispo	2,582

TABLE 2—53D. ANNUAL HEATING DEGREE DAYS—Continued

<i>Location</i>	<i>Annual Heating Degree Days</i>
San Mateo	2,655
San Rafael	2,619
Santa Ana	1,496
Santa Barbara	2,290
Santa Clara	2,566
Santa Cruz	2,900
Santa Maria	2,985
Santa Paula	2,400
Santa Rosa	2,980
Scotia	3,954
Sierraville	6,953
Sonora	3,086
South San Francisco	3,061
South San Gabriel	1,600
Squaw Valley	200
Stockton	2,690
Stony Gorge Reservoir	3,124
Susanville	6,248
Tahoe City	8,162
Tahoe Valley	8,198
Thousand Oaks	2,425
Tracy	2,616
Truckee	8,208
Twentynine Palms	2,006
Ukiah	3,030
Vacaville	2,812
Vallejo	2,598
Vincent	3,510
Visalia	2,526
Vista	2,546
Warner Springs	3,470
Weaverville	4,935
Weed	5,870
Willits	4,160
Willows	2,807
Woodland	2,447
Yosemite	4,800
Yreka	5,393
Yuba City	2,386

Heating, Ventilating, and Air Conditioning Equipment

Sec. 2-5306. (a) Electrically Operated Cooling Equipment. 1. Air conditioners of the types described below shall not be installed unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of air conditioners. See Appendix 2-53A for availability of directories of certified air conditioners.

Room air conditioners (of any capacity), central air conditioning heat pumps (of any capacity) and other central air conditioners with a cooling capacity of less than 65,000 Btu per hour.

Requirements for central air conditioning heat pumps with cooling capacity of 65,000 Btu per hour or more apply to heating performance but not cooling performance.

2. The efficiency of all air conditioners whose energy input in the cooling mode is entirely electric, and whose standard rated capacity is equal to or greater than 65,000 Btu/hour shall be not less than the values shown in Tables 2-53E and 2-53F based on one of the test procedures specified in Table 2-53G.

Table 2-53E. MINIMUM EFFICIENCY OF ELECTRICALLY DRIVEN COOLING EQUIPMENT, 65,000 Btu/HOUR AND OVER

<i>Classification in Table 2-53G</i>	<i>Type</i>	<i>Condensing Means</i>	<i>EER COP</i>
A	Air Conditioners	Any	7.5
B	Refrigerant Condensing Units	Air	2.5
		Evaporator or Water	3.5

Table 2-53F. MINIMUM EFFICIENCY OF ELECTRICALLY DRIVEN WATER CHILLING PACKAGES

<i>Classification in Table 2-53G</i>	<i>Type</i>	<i>Condensing Means</i>	<i>COP</i>
C	Centrifugal	Air	2.3
		Water	4.0
C	Rotary or Reciprocating	Air	2.2
		Water	3.4

Table 2-53G. TEST PROCEDURES FOR ELECTRICALLY OPERATED AIR COOLING SYSTEMS

<i>Classification</i>	<i>Type</i>	<i>Test Procedure</i>
A	Unitary Air-Conditioning Equipment	ARI 210-81
	Commercial and Industrial Unitary Air-Conditioning Equipment	ARI 360-75
	Air-Source Unitary Heat Pump Equipment	ARI 240-81
	Water-Source Heat Pumps	ARI 320-81
	Commercial and Industrial Unitary Heat Pump Equipment	ARI 340-76
B	Positive Displacement Refrigerant Condensing Units	ARI 320-78
C	Centrifugal or Rotary Water-Chilling Packages	ARI 550-77
	Reciprocating Water-Chilling Packages	ANSI/ARI 590-1976

(b) **Heat Operated Cooling Equipment.** 1. The coefficient of performance of heat-operated cooling equipment shall be not less than the values shown in Table 53H when tested at standard rating conditions established in ANSI Standard Z21.40.1—1973, ARI Standard 560-75, ASHRAE Standard 22-71 or ASHRAE Standard 24-71 as applicable. These requirements apply to, but are not limited to, absorption equipment, engine-driven equipment, and turbine driven equipment.

2. The performance of heat operated (absorption) water chilling equipment shall be based not only on the components included in the unit, but shall include cooling tower fans, pumps, and other parts of the complete system which may be supplied separately. Absorption water chilling units, employing steam or hot water as the energy source, and water cooled absorbers and condensers shall comply with the requirements of ARI Standard 560-75. Direct-fired, absorption water chillers and air conditioners shall comply with ANSI Standard Z21.40.1-1973, with Addenda Z21.40.1a—1974 and the provisions of the Boiler and Fired Pressure Vessel Safety Orders, Title 8, Chapter 4, California Administrative Code.

**TABLE 2-53H. MINIMUM EFFICIENCY OF HEAT
OPERATED COOLING EQUIPMENT**

<i>Heat Source</i>	<i>COP</i>
Direct-Fired (Gas, Oil)	0.48
Indirect-Fired (Steam, Hot Water)	0.68
Performance at Sea Level	
COP = $\frac{\text{Net cooling output}}{\text{Total heat input (electrical auxiliary inputs excluded)}}$	

(c) **Combustion Type Heating Equipment.** 1. Gas-fired comfort heating equipment of the types described below shall not be installed unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of heating equipment. See Appendix 2-53A for availability of directories of certified gas-fired comfort heating equipment.

Gas space heaters excluding the following types:

- gravity type central furnaces
- fan type central furnaces with input rates of 4,000,000 Btu per hour or more
- infrared heaters

2. The appliance efficiency standards include more stringent standards for the following appliances which will become effective on the following dates:

<i>Effective Date</i>	<i>Appliance</i>	<i>Standard</i>
December 22, 1982	Gas fan type central furnaces with input rate less than 175,000 Btu per hour, except those combined with a single package central air conditioner with rated cooling capacity exceeding 65,000 Btu per hour.	71% seasonal efficiency
December 22, 1984	Gas fan type central furnaces with input rate of 175,000 Btu per hour or more and those combined with a single package central air conditioner with rated cooling capacity exceeding 65,000 Btu per hour.	71% seasonal efficiency
December 22, 1981	Fan type wall furnace	80% thermal efficiency 10 watts standby loss (natural gas) 147 watts standby loss (LPG)
December 22, 1983	Unit heaters and duct furnaces	80% thermal efficiency 10 watts standby loss (natural gas) 147 watts standby loss (LPG)

Gas-fired comfort heating equipment of the above types shall not be installed in a building for which the building permit was issued on or after the applicable effective date these standards unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of heating equipment.

Gas-fired comfort heating equipment of the above types regardless of the date of manufacture, shall not be installed in a building for which a building permit is issued more than one year after the applicable effective date unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of heating equipment.

3. Gas-fired fan type central furnaces or gas-fired fan type wall furnaces (except those designed to burn only liquefied petroleum gases) shall not be installed unless they comply with the intermittent ignition device requirements of the appliance efficiency regulations.

NOTE: Additional requirements related to the efficiency of gas and oil burning heating equipment in buildings of occupancy A, B, E, and H are specified in Section 2-5337.

(d) **Heat Pumps—Heating Mode.** 1. Heat pumps of the types described below shall not be installed unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of heat pump. See Appendix 2-53A for availability of directories of certified heat pumps.

- Room air conditioning and central air conditioning heat pumps

Requirements for central air conditioning heat pumps with cooling capacity of 65,000 Btu per hour or more apply to heating performance but not cooling performance.

2. Heat pumps shall be installed with controls to prevent supplementary heater operation when the heating load can be met by the heat pumps alone. Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat setpoint advance, and during defrost.

A two stage room thermostat, which controls the supplementary heat on its second stage, shall be accepted as meeting this requirement. The cut-on temperature for the compression heating shall be higher than the cut-on temperature for the supplementary heat, and the cut-off temperature for the compression heating shall be higher than the cut-off temperature for the supplementary heat. Supplementary heat may be derived from any source of electric resistance heating or combustion heating.

Water Heating Equipment

Sec. 2-5307. (a) Equipment Efficiency. 1. Water heaters of the type described below shall not be installed unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of water heater. See Appendix 2-53A for availability of directories of certified water heaters.

EXCEPTION: Water heaters of the following type are excluded:

1. Non-storage type electric water heaters.
2. Water heaters used exclusively for space heating.

2. Oil-fired automatic storage heaters shall have a recovery efficiency (E_r) of not less than 75 percent and a standby loss percentage (S) not exceeding

$$S = 2.3 + \frac{67}{CAP}$$

where: CAP = storage capacity in gallons

The method of test of E_r and S shall be as described in Section 2.8 of ANSI Standard Z21.10.3—1975. For oil-fired units, CF = 1.0; Q = total gallons of oil consumed; and H = total heating value of oil in Btu/gallon.

(b) **Showerheads and Faucets.** Showerheads, lavatory faucets, and sink faucets shall not be installed unless the manufacturer has lawfully certified to the California Energy Commission compliance with the appliance efficiency standards for that model of showerhead, lavatory faucet, or sink faucet. See Appendix 2-53A for availability of directories of certified showerheads, lavatory faucets and sink faucets.

(c) **Solar Water Heaters in State-Owned Buildings.** Construction shall not commence on any state-owned building which has more than 10,000 square feet of floor area and which has a heating, cooling, water heating, or lighting system expected to be used more than 1,000 hours per year, unless the building is equipped with a solar water heating system or has been exempted from this requirement by the State Architect for reasons of economic or physical infeasibility.

**ENERGY CONSERVATION STANDARDS FOR NEW
BUILDINGS OF OCCUPANCIES A, B, E, AND H
(NONRESIDENTIAL BUILDINGS)****DIVISION 1. GENERAL PROVISIONS****Design Requirements**

Sec. 2-5311. Buildings of occupancy A, B, E, or H comply with these regulations if they comply with the requirements of any one of Subsections (a), (b), or (c) as applicable. (a) A building of occupancy A, B, E, or H complies with these regulations if it is designed and constructed so that its service systems consume no more energy than is permitted by Section 2-5313 as determined by the analysis described in Section 2-5314 and to comply with the standards set forth in Section 2-5317.

(b) A building of occupancy A, B, E, or H that either derives over 40 percent of its annual thermal energy requirement (heating, cooling, and service water heating) or over 20 percent of its annual total energy requirement for all service systems from nondepletable energy sources complies with the requirements of these regulations. Documentation, as described in the Energy Conservation Design Manual, shall be provided to verify the percentage of annual energy use derived from such nondepletable sources.

(c) Any building of occupancy A, B, E, or H complies with these regulations if it is designed and constructed in accordance with each of the provisions of Divisions 4 through 9.

Modifications to Existing Buildings

Sec. 2-5312. (a) General. Existing buildings which are altered or repaired shall, at the designer's option, comply with the requirements of this chapter or the energy conservation requirements in effect when the permit authorizing the original construction of the building was issued, except as shown in subsections (b), (c), and (d).

(b) Additions to Existing Buildings. The building envelope of additions to existing buildings, and all complete new HVAC systems, HVAC equipment service water heating systems and lighting systems located within additions to existing buildings shall comply with the requirements of this chapter. When an addition to a building is heated or cooled by expanding an existing mechanical system, only new ductwork and piping or those portions of ducts and pipes which are altered need comply with this chapter.

(c) Repairs to Existing Buildings. 1. HVAC and water heating equipment to be installed shall comply with Divisions 6 and 7 and Sections 2-5306 and 2-5307. 2. Repairs need not comply with the other requirements of this chapter.

(d) Alterations to Existing Buildings Which are Not Additions or Repairs. 1. Alterations Which Lead to the Conditioning of Previously Unconditioned Space. HVAC systems, HVAC equipment, service water heating systems and lighting systems located or to be installed in portions of buildings which are not conditioned space, but which will become conditioned space as a result of the alteration, shall comply with the requirements of this chapter. The building envelope shall, at the designer's option, comply with the requirements of this chapter or the energy conservation requirements in effect when the permit authorizing the original construction of the building was issued.

2. Alterations To Previously Conditioned Space More Than 50 Percent. When alterations (which are not additions or repairs) within any 12 month period exceed 50 percent of the value of an existing building, the building envelope, HVAC systems, HVAC equipment, service water heating systems and lighting systems of conditioned space in the building which is to be altered shall fully comply with the requirements of this chapter.

3. Alterations To Previously Conditioned Space Less Than 50 Percent. When al-

terations (which are not additions or repairs) within any 12 month period do not exceed 50 percent of the value of an existing building, the building envelope, HVAC systems, HVAC equipment, service water heating systems and lighting systems of conditioned space in the building which is to be altered shall comply with the requirements of this chapter as described below.

A. **Building Envelope.** Alterations may be made to the building envelope if the overall U-value of the building envelope of heated buildings is not increased or remains less than the maximum overall U-value allowed in Division 4 and the OTTV of the building envelope of cooled buildings is not increased or remains less than the maximum OTTV allowed in Division 4.

B. **HVAC Systems.** Complete new HVAC systems to be installed shall meet all the requirements of Division 5. When existing systems are altered, only those portions of ducts and pipes which are altered shall comply with the insulation and construction requirements of Division 5. Unaltered portions need not be made to comply.

C. **HVAC Equipment.** HVAC equipment to be installed shall comply with the requirements of Division 6 and Section 2-5306.

D. **Water Heating Systems.** Complete new water heating systems to be installed shall meet all the requirements of Division 7 and Section 2-5307. When existing service water heating systems are altered, portions of service water heating pipes which are altered shall be insulated to comply with the requirements of Division 7 and Section 2-5307. Unaltered portions need not be made to comply. Water heaters to be installed shall comply with the requirements of Division 7 and Section 2-5307.

E. **Lighting.** Alterations to existing lighting systems may be made if the maximum connected load is not increased or if the maximum connected load does not exceed the amount allowed by Division 9. Alterations to lighting systems which involve re-circuiting of the lighting shall comply with the provisions of Section 2-5343(b). Alterations which do not involve re-circuiting, such as the addition or deletion of partitions, need not comply with 2-5343(b).

EXCEPTION: The requirements of this chapter shall not apply to any new construction on buildings built before July 1, 1978, for which it is shown by the designer that the requirement will not result in energy cost savings greater than the cost of compliance amortized over the economic life of the building.

DIVISION 2. ENERGY BUDGETS**Energy Requirements for Building Designs**

Sec. 2-5313. (a) A building of occupancy A, B, E, or H complies with these regulations if it is designed and constructed to comply with Section 2-5317 of this division and if the total calculated annual energy consumption of its service systems does not exceed the product of the square feet of conditioned floor area and the allowable energy budget (in Btu per year per square foot) set forth in Table 2-531.

(b) When a building of occupancy A, B, E or H is designed and constructed for more than one type of nonresidential occupancy, the total calculated annual energy consumption of its service systems shall not exceed the sum of the products of the square feet of conditioned floor area to be used for each type of occupancy and the energy budget (in Btu per year per square foot) for that occupancy as set forth in Table 2-531.

(c) When part of a building is designed and constructed for occupancy R and part of the building designed and constructed for occupancy A, B, E and/or H and the nonresidential occupancy exceeds 30 percent of the square feet of conditioned floor area of the building, the energy budget (in Btu per year per square foot) used for the areas with residential type occupancy shall be the weighted average of the applicable energy budgets for the areas used for the nonresidential types of occupancy as determined from Equation 2-1.

EQUATION 2-1

$$\begin{array}{l} \text{Residential} \\ \text{Energy} \\ \text{Budget} \end{array} \quad (\text{Btu}/\text{ft}^2/\text{yr}) = (A_1 \times B_1) + \frac{(A_2 \times B_2) \times \dots}{A_{\text{total}}}$$

Where A = area of conditioned space (ft²)
B = energy budget (Btu/ft²/yr)

(d) When part of a building is conditioned and part of the building is not conditioned, the total calculated annual energy consumption of its service systems shall be determined for the conditioned area only. The energy used in the unconditioned part of the building shall not be included in the calculation, but the service systems in the unconditioned part of the building shall be designed to comply with Divisions 4 through 9.

(e) The total calculated annual energy consumption of the service systems shall include energy used for comfort heating, comfort cooling, ventilation for the health and comfort of the occupants, service water heating and lighting. It shall also include energy used by appliances which are rated at no more than one half watt per square foot of the gross square feet of conditioned floor area of the room housing such appliance. It shall not include energy used for transportation systems or energy used by processing or manufacturing equipment, or for product storage. Nor shall the total calculated annual energy consumption include additional energy needed for comfort cooling, comfort heating, and ventilation for the health and comfort of the occupants which results directly from a process. Nor shall the total calculated annual energy consumption include the energy required by make-up air or water systems and may be required by the process or manufacturing systems, equipment or appliances mentioned above.

TABLE 2-53I
MAXIMUM ALLOWABLE ENERGY CONSUMPTION PER YEAR
(THOUSANDS OF BRITISH THERMAL UNITS PER SQUARE FEET OF CONDITIONED FLOOR AREA)

UBC Occupancy ⁽¹⁾	Occupant Load ⁽²⁾	Climatic Thermal ⁽³⁾ Zones 1-5			Climatic Thermal Zones 6, 8, 9, 10			Climatic Thermal Zone 7			Climatic Thermal Zones 11, 12, 13			Climatic Thermal Zones 14, 15		
		Heated ⁽⁴⁾ & Cooled Only	Heated Only	Cooled Only	Heated & Cooled Only	Heated Only	Cooled Only	Heated & Cooled Only	Heated Only	Cooled Only	Heated & Cooled Only	Heated Only	Cooled Only	Heated & Cooled Only	Heated Only	Cooled Only
A—drinking and dining establishments		131	126	82	108	102	82	104	103	80	132	119	96	148	109	126
all others		159	154	64	123	114	68	118	106	71	155	140	86	189	120	141
B-1		180	171	163	191	163	184	189	162	184	196	173	185	243	168	236
offices	under 300	141	135	134	145	133	142	145	132	143	148	139	140	165	137	160
	over 299	126	125	124	129	128	128	131	130	131	134	131	130	132	129	128
retail grocery stores		214	212	167	194	189	176	192	187	176	235	216	199	255	204	229
B-2 other retail stores	under 300	180	171	163	191	163	184	189	162	184	196	173	185	243	168	236
	over 299	200	195	190	207	195	202	209	196	204	213	199	205	231	205	225
drinking and dining establishments		131	126	82	108	102	82	104	103	80	132	119	96	148	109	126
classrooms		120	118	77	105	94	82	101	94	83	156	143	89	142	97	123
storage		104	104	104	65	65	65	63	63	63	92	92	92	80	80	80
B-3		104	104	104	65	65	65	63	63	63	92	92	92	80	80	80
B-4																
H																
E		120	118	77	105	94	82	101	94	83	156	143	89	142	97	123
I ⁽⁵⁾		—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Others ⁽⁶⁾		141	135	134	145	133	142	145	132	143	148	139	140	165	137	160

NOTES

- Occupancy, as defined in the Uniform Building Code, 1979 Edition. Occupancies A and B-2 have been further subdivided. For B-2 group occupancies not listed, use the subdivision which most closely describes the occupancy.
- Occupant load, calculated as described in Table 2-53J.
- Climatic thermal zone, as described in Figure 2-53A.
- Use appropriate columns for buildings that are heated and cooled, heated only or cooled only.
- Maximum allowable energy consumption values are under development for UBC occupancy I.
- Occupancies which are not included in any of the listed UBC occupancies.

TABLE 2-53J. OCCUPANT LOAD VALUES

<i>Use</i>	<i>Square Feet Per Occupant</i>
Aircraft Hangars	500
Auction Rooms	7
Assembly Areas	
Concentrated Use (without fixed seats)	
Auditoriums	7
Bowling Alleys (Assembly areas)	7
Churches and Chapels	7
Dance Floors	7
Lodge Rooms	7
Reviewing Stands	7
Stadiums	
Assembly Areas	
Less Concentrated Use	
Conference Rooms	15
Dining Rooms	15
Drinking Establishments	15
Exhibit Rooms	15
Gymnasiums	15
Lounges	15
Skating Rinks	15
Stages	15
Children's Homes and Homes for the Aged	80
Classrooms	20
Garage, Parking	200
Hospitals and Sanitariums, Nursing Homes	80
Kitchen, Commercial	200
Library Reading Room	50
Locker Rooms	50
Mechanical Equipment Room	300
Nurseries for Children (Day Care)	50
Offices	100
School Shops and Vocational Rooms	50
Stores, Retail	30
Warehouses	300
All Others	100

- NOTES: 1. The occupant load in any building or portion thereof shall be determined by dividing the square feet of conditioned floor area assigned to the specified use by the square feet per occupant set forth in this table.
2. When the square feet of conditioned floor area per occupant are not given for a particular occupancy, it shall be determined by the enforcing agency based on the area given for the occupancy which it most nearly resembles.
3. The occupant load of an area having fixed seats shall be determined by the number of fixed seats installed. Aisles serving the fixed seats and not used for any other purpose shall not be assumed as adding to the occupant load.

Energy Analysis Program

Sec. 2-5314. (a) The CALCON I Public Domain Computer Program for Building Energy Calculation or any other computer program certified pursuant to Title 20, Section 1409 shall be used to determine the calculated annual energy consumption for comparison with the maximum allowable energy consumption listed in Table 2-531.

(b) **Basis for Comparison.** The same design conditions regarding indoor temperature and humidity criteria, occupancy schedules, equipment operation schedules and outdoor weather conditions that were used in calculating the values in Table 2-531 shall be used to calculate the annual energy consumption of the proposed design. These schedules and conditions are detailed in the Energy Conservation Design Manual.

Comparison of Energy Forms

Sec. 2-5315. For the purposes of Section 2-5313, total calculated annual electricity consumption shall be converted to British thermal units at the rate of 10,239 British thermal units per kilowatt hour.

Documentation

Sec. 2-5316. Proposed nonresidential building designs, submitted in accordance with the requirements of this division, shall be accompanied by an energy analysis report. The report shall provide sufficient technical detail, as set forth in the Energy Conservation Design Manual, on the design and on the data used in and resulting from the analysis to demonstrate that the design meets the requirements of this division.

Mandatory Standards

Sec. 2-5317. Sections 2-53, 2-5328, 2-5332, 2-5334, 2-5335, 2-5336, 2-5338, 2-5339, 2-5340, 2-5341, and 2-5343(b) shall apply to all buildings of occupancy A, B, E, or H, including, but not limited to, those buildings seeking to comply with the energy budget requirements of this division.

DIVISION 3. NONDEPLETABLE ENERGY SOURCES**Requirements for Buildings Utilizing Nondepletable Energy Sources.**

Sec. 2-5318. (a) **General.** When a proposed nonresidential building design submitted and evaluated in accordance with division 2 utilizes nondepletable sources of energy for all or part of its energy sources, such energy used in the building shall be excluded from the total energy chargeable to the proposed building design.

(b) **Documentation.** The energy derived from nondepletable sources must be separately identified within the analysis as specified in the energy Conservation Design Manual and filed with the documentation required by Section 2-5316.

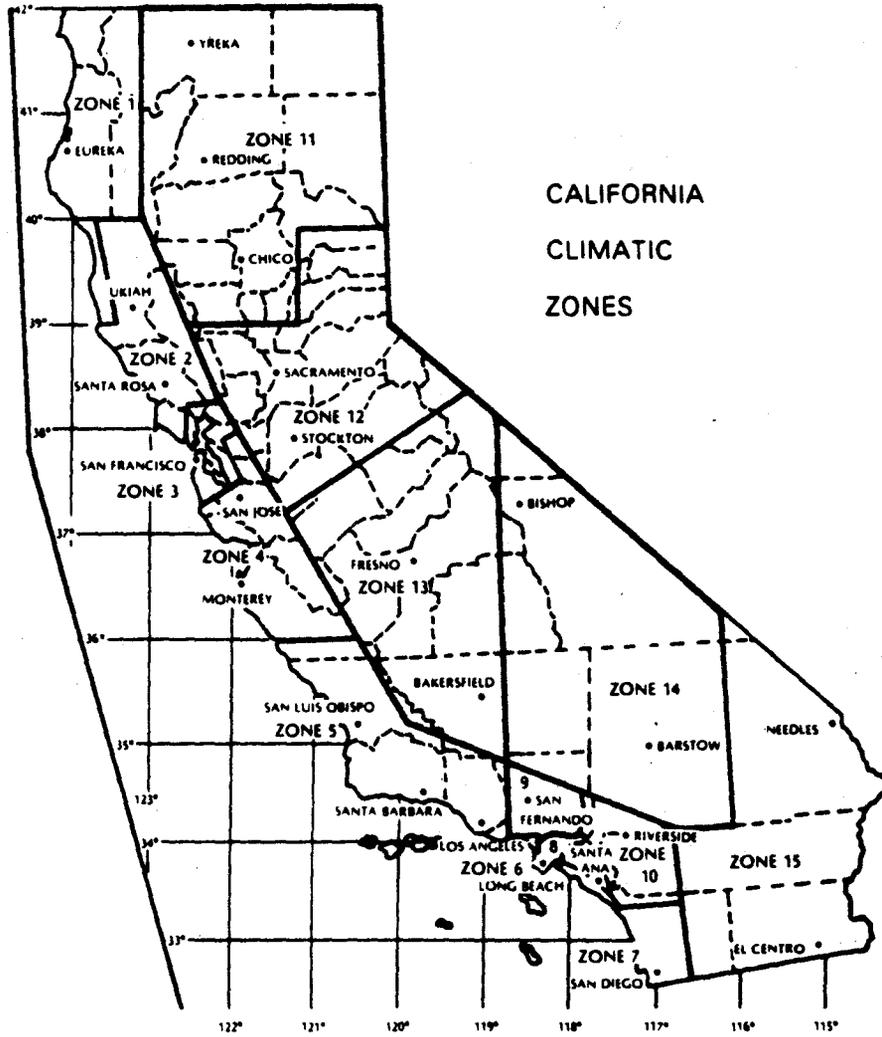


FIGURE 2-53A. CLIMATE ZONES FOR OCCUPANCIES A, B, E and H

DIVISION 4. BUILDING ENVELOPE**General**

Sec. 2-5319. This division establishes minimum requirements for thermal design of the building envelope of buildings of occupancy A, B, E, or H which include conditioned space. A building that will be both heated and cooled shall meet the more stringent of the heating or cooling design requirements for the building envelope as provided in this division. A building that is to be heated only shall meet the heating design requirements for the building envelope as provided in this division. A building that is to be cooled only shall meet the cooling design requirements for the building envelope as provided in this division.

Alternatives

Sec. 2-5320. The U value of any component such as roof/ceiling, wall, or floor may be increased and the U value for other components decreased until the overall heat gain/or heat loss for the entire building envelope does not exceed the total resulting from conformance to the stated U values.

Design Conditions

Sec. 2-5321. For the purposes of calculations called for in this division, indoor design temperature shall be 70°F for heating and 75°F for cooling.

Outdoor design temperatures for specific localities shall be those listed in the center columns of the summer dry bulb, summer wet bulb, and winter heating temperatures from Recommended Design Temperatures, published by ASHRAE Golden Gate and Southern California Chapters, as follows:

	<i>Edition Cooling Heating</i>		
Northern California	1977	2½%	1%
Southern California.....	1972	0.5%	0.2%

Heating Design Criteria

Sec. 2-5322. (a) **Walls.** The combined thermal transmittance value (U_{ow} value) for the gross area of exterior walls consisting of opaque wall areas, window areas, and door areas, that enclose interior heated space, and including areas of foundation walls above grade that enclose heated space, shall not exceed the values shown in Figure 2-53B for the degree days applicable.

Equation 4-1 shall be used to determine acceptable combinations of wall, window, and door areas, and thermal properties to meet the requirements of Figure 2-53A.

MAXIMUM U_{or} VALUE FOR FLOORS OVER UNHEATED SPACES

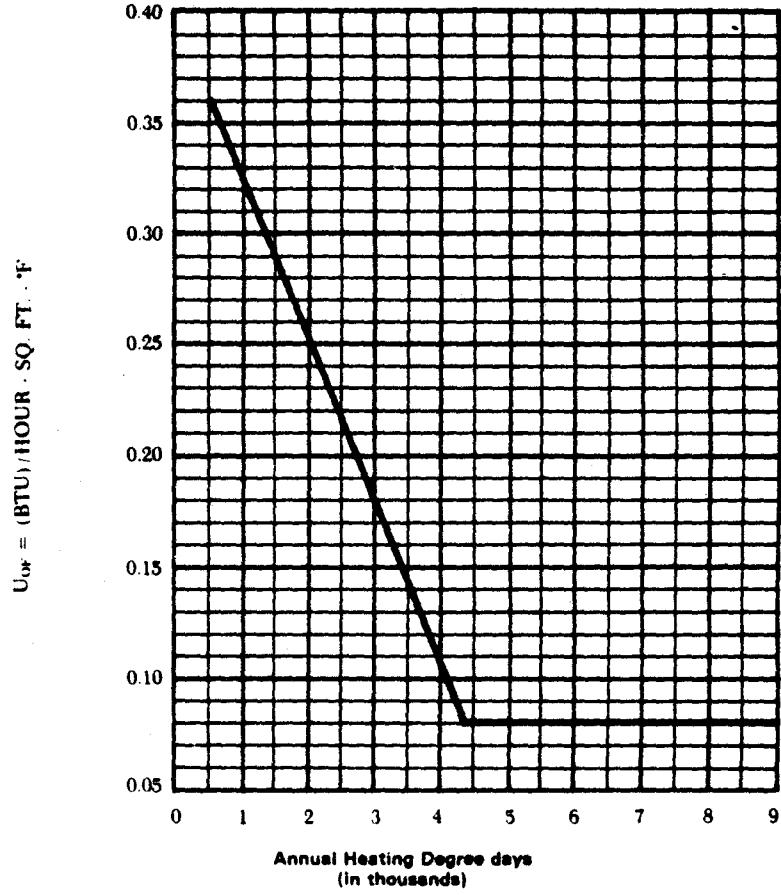
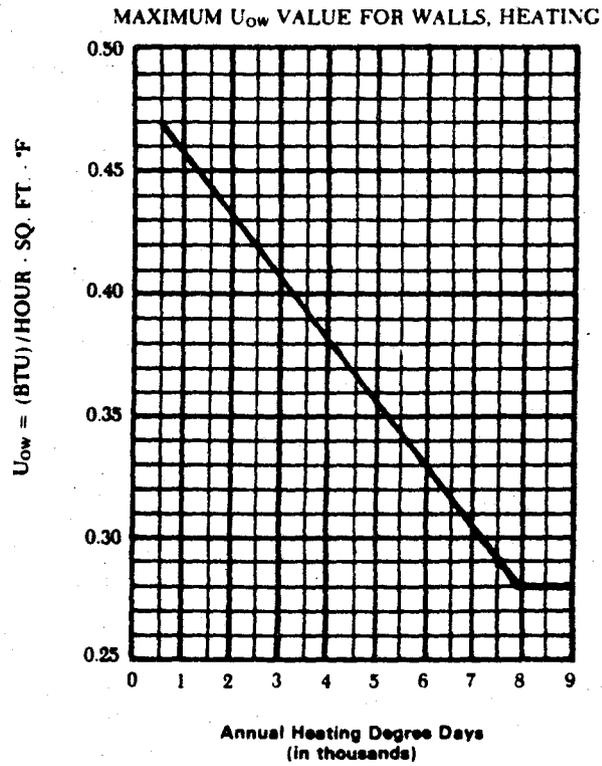


FIGURE 2-53B
MAXIMUM U_{ow} VALUES FOR WALLS, HEATING



EQUATION 4-1

$$U_{ow} = \frac{U_{wall} A_{wall} mcf + U_{window} A_{window} + U_{door} A_{door}}{A_{ow}}$$

- where U_{ow} = the average thermal transmittance of the gross wall area, Btu/hr ft²°F
- A_{ow} = the external exposed above grade gross wall area of building that faces heated spaces, ft²
- U_{wall} = the thermal transmittance of all elements of the opaque insulated building section, Btu/hr ft²°F
- A_{wall} = opaque wall area, ft²
- MFC = Mass Correction Factor, value given in Table 2-53K
- U_{window} = the thermal transmittance of the window area, Btu/hr ft²°F
- A_{window} = window area including sash, ft²
- U_{door} = the thermal transmittance of the door, considered as an assembly, including the frame, Btu/hr ft²°F
- A_{door} = door area including frame, ft²

NOTE: Where more than one type of wall, window, and/or door is used, the term or terms for the exposure shall be expanded into its subelements, as $U_{wall_1} A_{wall_1} MCF_1 + U_{wall_2} A_{wall_2} MCF_2$, etc.

TABLE 2-53K. MASS CORRECTION FACTOR VALUES

Weight of Wall Construction Pounds/ Feet	MCF	Note: The values in apply in areas with less than 3500 degree days. For areas having more than 3500 degree days MCF = 1.00.
0-25	1.00	
26-40	0.85	
41-60	0.75	
81 and above	0.65	

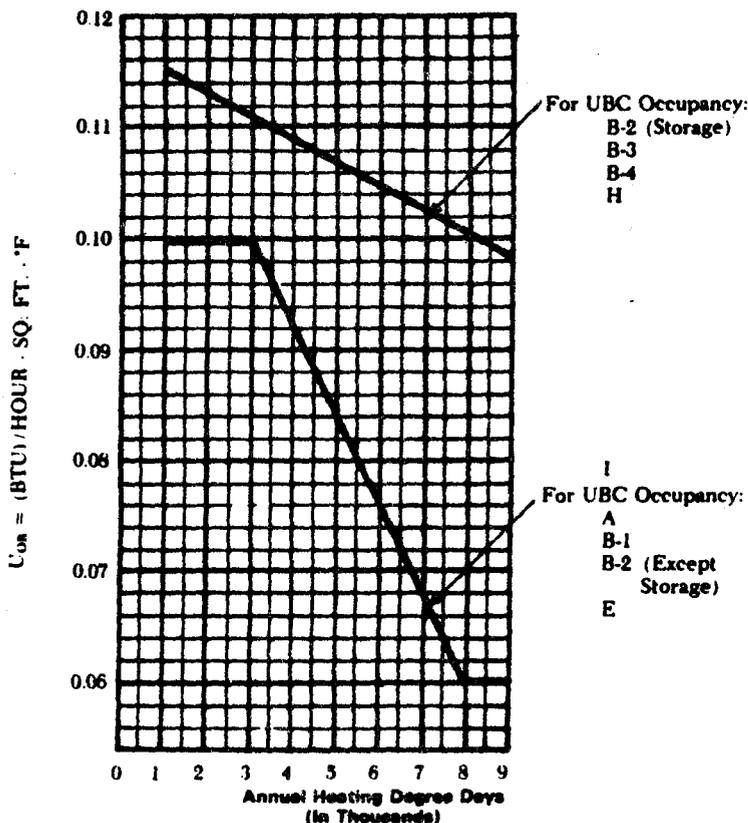
(b) **Roof/Ceiling.** The combined thermal transmittance value (U_{or}) for the gross roof area, including skylights, that enclose heated spaces shall not exceed the values shown in Figure 2-53C for degree days applicable. A roof assembly shall be considered as those components of the roof envelope through which heat flows, creating building transmission heat loss. If a ceiling is employed as an element of a plenum, the thermal performance of the assembly shall be the thermal performance of the roof portion only.

Equation 4-2 shall be used to determine acceptable combinations of roof and skylight areas and thermal properties to meet the requirements of Figure 2-53C.

1. For buildings that are heated only, skylight areas up to 5 percent of the gross ceiling or roof area are exempt from the U_{or} calculations of Equation 4-2. The daylighting and solar heat gain from skylights that are considered in the exempt area cannot be used to increase the U values of any portion of the building envelope.

2. When more than 5 percent of the gross roof area is in skylights, automatic light sensitive switching will be required and the skylight area in excess of 5 percent must be included in the U_{or} calculations in Equation 4-2.

**FIGURE 2-53C.
MAXIMUM U_c VALUES FOR ROOFS AND CEILINGS, HEATING**



EQUATION 4-2

$$U_{or} = \frac{U_{roof} A_{roof} + U_{skylight} A_{skylight}}{A_{or}}$$

- where U_{or} = the average thermal transmittance of the gross roof/ceiling area, Btu/hr ft²°F
 A_{or} = the external exposed gross roof/ceiling area of the building over heated spaces, ft²
 U_{roof} = the thermal transmittance of all elements of the opaque roof/ceiling area, adjusted for the effect of framing in the insulated building section, Btu/hr ft²°F
 A_{roof} = opaque roof/ceiling area, ft²
 $U_{skylight}$ = the thermal transmittance of the skylight area, Btu/hr ft²°F
 $A_{skylight}$ = skylight area, ft²

NOTE: Where more than one type of roof/ceiling and/or skylight is used, the $U \times A$ term for that exposure shall be expanded into its subelements, as

$$U_{roof1} A_{roof1} + U_{roof2} A_{roof2}, \text{ etc.}$$

(c) **Floors Over Unheated Spaces.** For floors of heated spaces over unheated spaces or outdoors, the U value of the floor section shall not exceed the value shown in Figure 2-53D for the degree days applicable.

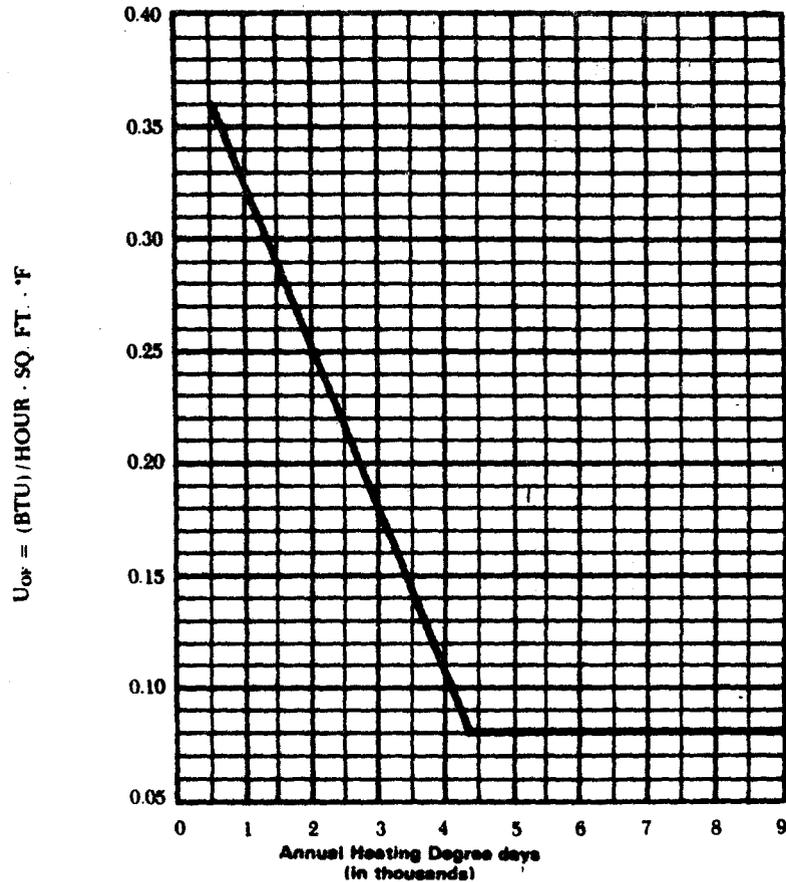


FIGURE 2-53D
MAXIMUM U_{max} VALUES FOR FLOORS OVER
UNHEATED SPACES

Cooling Design Criteria

Sec. 2-5323. (a) Walls. The overall thermal transfer value, Btu/hr ft², for the gross area of exterior walls consisting of opaque wall area and fenestration areas that enclose interior cooled spaces shall not exceed the values given in Figure 2-53E.

Equation 4-3 shall be used to determine the acceptable combination of opaque wall, fenestration areas, and thermal properties to meet the requirements of Figure 2-53E.

The solar factor for windows oriented within 22½° of true north shall be considered to be 30 Btu/hr/ft² for the purpose of inclusion in Equation 4-3.

The solar factor for windows or portions of windows which are not exposed to direct sunlight between the hours of 8:00 a.m. and 5:00 p.m. solar time on April 21 through October 21 because of orientation or fixed exterior shading devices (such as roof overhangs) shall be considered to be 30 Btu/hr/ft² for the purpose of inclusion in Equation 4-3.

The solar factor for other windows or portions of windows shall be determined from Figure 2-53F for the purpose of inclusion in Equation 4-3.

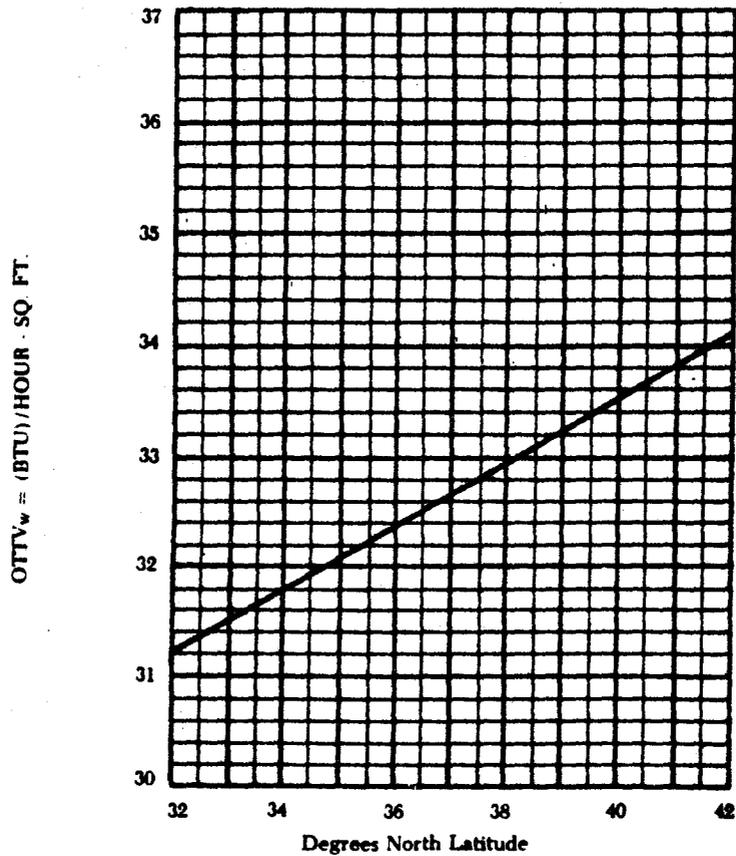


FIGURE 2-53E
OVERALL THERMAL TRANSFER VALUES FOR
WALLS, COOLING

EQUATION 4-3

$$OTTV_w = \frac{(U_w \times A_w \times TD_{eq}) + (A_f \times SF \times SC) + (U_f \times A_f \times \Delta T)}{A_{ow}}$$

- where $OTTV_w$ = overall thermal transfer value for walls, Btu/hr ft²
 U_w = the thermal transmittance of opaque walls, and doors, Btu/hr ft² °F
 A_w = area of opaque wall, ft²
 U_f = the thermal transmittance of fenestration, Btu/hr ft² °F
 A_f = area of fenestration, ft²
 TD_{eq} = equivalent temperature difference, °F from Table 2-53L
 SC = shading coefficient of fenestration
 ΔT = temperature difference between exterior and interior design conditions, °F

A_{ow} = total area of wall opposite cooled spaces, ft^2
 SF = solar factor value given in Figure 2-53F, $Btu/hr\ ft^2$

NOTE: Where more than one type of wall and/or fenestration is used, the respective term or terms shall be expanded into subelements, as

$$(U_{w1} \times A_{w1} \times TD_{EQ1}) + (U_{w2} \times A_{w2} \times TD_{EQ2}), \text{ etc.}$$

TABLE 2-53L
EQUIVALENT TEMPERATURE DIFFERENCE VALUES

Weight of Wall lb/ft^2	TD_{EQ}
0-25	44
26-40	37
41-70	30
71 and above	23

Weight of wall construction shall be determined from Chapter 26, of the 1981 ASHRAE Handbook of Fundamentals.

(b) **Roof/Ceiling.** The overall thermal transfer value in $Btu/hr/ft^2$ for the gross area of the exterior roof consisting of opaque roof areas and fenestration areas that enclose interior cooled spaces shall not exceed $41 \times U_w$ from Figure 2-53C. Equation 4-4 shall be used to determine the acceptable combinations of opaque roof and fenestration areas.

(c) **Fenestration Shading Coefficient.** The shading coefficient values to be used in Equations 4-3 and 4-4 shall be obtained from Chapter 27 of the 1981 edition of the ASHRAE Handbook of Fundamentals.

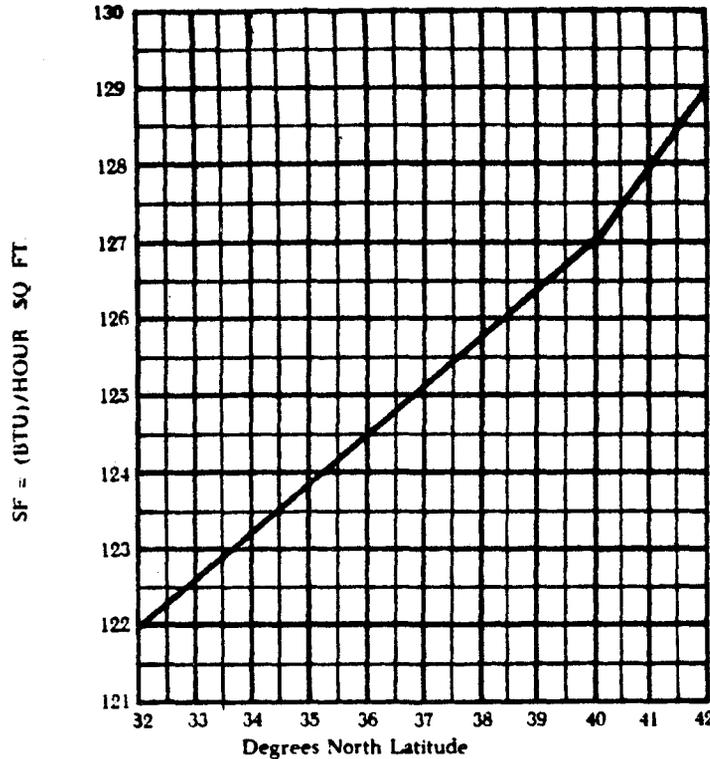


FIGURE 2-53F

SOLAR FACTOR

EQUATION 4-4

$$OTTV = (41 U_r A_r \times A_c M_c) + (118 SC_s A_s + \Delta T U_s A_{ex})$$

- where
- OTTV_r = overall thermal transfer value for roofs, Btu/hr/ft²
 - U_r = the thermal transmittance of opaque roof, Btu/hr/ft²/F
 - A_r = area of opaque roof, ft²
 - A_c = absorptance coefficient, from Table 2-53N
 - U_s = the thermal transmittance of skylight, Btu/hr²/F
 - A_s = area of skylight, ft²
 - SC = shading coefficient of skylights
 - ΔT = temperature difference between exterior and interior design conditions, °F
 - M_c = mass coefficient, from Table 2-53M
 - A_{ex} = the external exposed gross roof/ceiling area of the building over cooled spaces, ft²

**TABLE 2-53M
MASS COEFFICIENT VALUES (M_c)**

Wt, lb/ft. ²	Class	M _c
0-15	Light	1.00
16-40	Medium	0.92
41 and above	Heavy	0.84

**TABLE 2-53N
ABSORPTANCE COEFFICIENT VALUES (A_c)**

Surface	Absorptance	A _c
Asphalt, "dark roof"	0.90	1.00
Gravel	0.70	0.79
ASHRAE "light roof"	0.45	0.52
Intense white	0.35	0.42

Air Leakage

Sec. 2-5324. (a) General. The requirements for air leakage are limited to those locations separating exterior building ambient conditions from interior building conditioned space and are not applicable to the separation of interior conditioned spaces from each other.

(b) Windows. Air leakage requirements for windows shall be as follows: 1. The air infiltration rate and/or exfiltration rate for manufactured openable exterior windows shall not exceed 0.5 cfm per foot of operable sash crack. Manufactured windows shall be certified and labeled and shall comply with the following standards:

- Metal WindowsANSI/AAMA 302.9-1977
- Wood Windows ANSI/NWMA I.S.2-80

NOTE: Required steel fire-rated windows are exempted from these requirements.

2. Fixed windows constructed on site shall be sealed to limit air infiltration.

(c) Doors. Air leakage requirements for doors shall be as follows: 1. The air infiltration rate and/or exfiltration rate for manufactured exterior sliding glass doors shall

not exceed 0.75 cfm per linear foot of crack. Manufactured sliding glass doors shall be certified and labeled and shall comply with the following standards:

Metal Sliding Glass Doors.....ANSI/AAMA 402.9-1977
Wood Sliding Glass Doors ANSI/NWMA I.S.3.-70

NOTE: Required steel fire-rated doors are exempted from these requirements.

2. Exterior doors, other than fire-rated doors, shall be so designed to limit air leakage around their perimeter when in a closed position. A. Doors shall be provided with a seal, astragal, or baffle at the head and sill.

B. Doors mounted on either the inside or outside of an exterior wall shall have a minimum one-inch lap at each jamb.

C. Doors requiring vertical track or guides shall use a continuous mounting angle, sealed in accordance with Section 2-5324(e) at each jamb.

D. Doors mounted between the jambs shall have a continuous seal or baffle at each jamb.

E. Meeting rails of sectional doors and meeting stiles or rails of biparting doors shall be provided with a seal, astragal, or baffle.

F. Swinging and revolving doors shall be weatherstripped at the head, sill, and jambs.

G. Double doors shall be provided with a weathertight astragal or closure at the center crack.

(d) **Caulking and Sealants.** Open exterior joints around window and door frames, between wall and foundation, between wall and roof, between wall panels, at penetrations of utility services through walls, floors, and roofs, and all other openings in the exterior envelope shall be sealed, caulked, gasketed, or weatherstripped to limit air leakage.

(e) **Gravity Ventilators.** Gravity ventilators shall comply with the provisions of Section 2-5332.

(f) **Elevator Shaft Vents.** Elevator shaft vents, if installed, shall be fitted with approved normally closed smoke dampers which shall be automatically opened upon the action of a detector of products of combustion other than heat located at the top of the elevator shaft.

**DIVISION 5. HEATING, VENTILATING, AND
AIR CONDITIONING (HVAC) SYSTEMS****HVAC Systems**

Sec. 2-5325. (a) **Scope.** This division establishes HVAC system requirements for efficient utilization of energy. System criteria developed from the requirements of this division shall be the basis for equipment selection as described in Division 6. This division covers the determination of heating and cooling loads, design requirements, and control requirements. Criteria are established for insulating piping and air handling systems, and for duct construction.

(b) **Exceptions.** Sections 2-5326 through 2-5333 and Section 2-5336 shall not apply to buildings with an occupant load of 49 or fewer as determined from Table 2-53J and conditioned floor area not exceeding 1,000 square feet.

Calculation of Heating and Cooling Loads

Sec. 2-5326. (a) **Design Loads.** Heating and cooling design loads shall be determined in accordance with one of the procedures described in Chapters 25 and 26 of the 1981 ASHRAE Handbook of Fundamentals, Chapters 25 and 26, or an equivalent computing procedure.

(b) **Design Parameters.** The following design parameters, in conjunction with other provisions of this standard, shall be used for HVAC system design load determination for general comfort applications. 1. **Outdoor Design Conditions.** The design values for winter and summer outdoor conditions shall be as defined in Section 2-5321, consistent with project requirements.

2. **Indoor Design Conditions.** Indoor design conditions for general comfort applications shall be in accordance with ANSI/ASHRAE 55-1981, except that winter humidification and summer dehumidification are not required.

3. **Outdoor Air.** The heating and/or cooling design loads caused by the outdoor portion of the ventilation air supplied to the occupied spaces shall be based upon the air quantities tabulated in Section 6 of ASHRAE Standard 62-73. For those HVAC systems which are designed to utilize outside air for cooling, design loads shall be based upon outdoor air quantities not more than 33 percent of the tabulated Recommended Ventilation Rates. For those HVAC systems which are designed to use a fixed minimum amount of outside air, design loads shall be based upon outdoor air quantities of not more than the tabulated minimum ventilation rates. In both instances, the quality of the air shall conform with the requirements of ASHRAE Standard 62-73, and in no case shall there be less than 5 cfm per person. A. If values of outdoor air, other than those indicated above, are proposed because of special occupancy or process requirements or source control of air contaminants, these outdoor air quantities shall be utilized only after local enforcement agency approval and shall be used as the basis of calculating the heating and/or cooling design loads.

B. The use of recirculated air as set forth in ASHRAE Standard 62-73 will be acceptable when not in conflict with other sections of Division 5.

4. **Infiltration.** When infiltration calculations employ the air change method, heating and cooling design load determinations for the entire structure shall include infiltration at the rate of no more than 0.5 air changes per hour for all buildings that are not pressurized. In pressurized buildings, the infiltration shall be offset by the outdoor air portion of the ventilation air requirements of Section 5326(b)3.

Ventilation Requirements

Sec. 2-5327. The HVAC system shall be capable of supplying the following quantities of ventilation air: In areas of buildings, where smoking is permitted, the design quantity of ventilation air shall not be less than the recommended values for required ventilation air listed in Section 6 of ASHRAE Standard 62-73. In areas of buildings where smoking is prohibited, the design quantity of ventilation air shall not be less

than the minimum values for required ventilation air listed in Section 6 of ASHRAE Standard 62-73.

Controls

Sec. 2-5328. (a) **Temperature Control.** Each HVAC system shall be provided with at least one automatic temperature control device for the regulation of temperature as required in Section 2-5328(c). These automatic temperature control devices shall be capable of being set to maintain space temperature set points from 55°F to 85°F and shall be capable of operating the system heating and/or cooling in sequence, if both are provided. Except as allowed in Section 2-5329(g), these controls shall be adjustable to provide a temperature range of up to 10°F between full heating and full cooling being supplied. Further, the controls shall have the capability of terminating all heating at a temperature no more than 70°F and of terminating all cooling at a temperature not less than 78°F.

(b) **Zoning for Temperature Control.** At least one automatic space temperature control device shall be provided for: 1. Each zone. (Not more than one floor of a building shall be included in a zone.)

2. Each separate HVAC system.

3. Each zone as covered by Section 2-5329.

(c) **Control Setback and Shutoff.** Each HVAC system shall be equipped with a readily accessible manually adjustable automatic means of reducing the energy used for HVAC during periods of nonuse or alternate uses of the building spaces or zones served by the system.

Simultaneous Heating and Cooling

Sec. 2-5329. Simultaneous heating and cooling of a zone by reheat, recooling, or concurrent operation of independent heating and cooling systems shall be restricted as delineated below: (a) **Recovered Energy.** Recovered energy, including new energy expended in the recovery process (provided the amount expended is less than the amount recovered) may be used for control of temperature and humidity.

(b) **New Energy.** New energy may be used for control of temperature if minimized as delineated in Sections 2-5329(c) through 2-5329(g).

(c) **Reheat Systems.** Systems serving multiple zones, including those employing variable air volume for temperature control, shall be provided with controls that will automatically reset the system cold air supply to the highest temperature level that will satisfy the zone requiring the most cooling. Single zone reheat systems shall be controlled so as to sequence reheat and cooling.

Constant volume reheat systems which utilize new energy to simultaneously cool and heat air streams, shall only be used where a specific humidity level is required to satisfy the process needs.

Exterior and interior zones of constant volume reheat systems shall not be served by the same cooling coil if the total air quantity serving exterior spaces exceeds 20 percent of the total air quantity through the cooling coil.

(d) **Dual-Duct and Multizone Systems.** 1. Constant volume dual duct or multizone systems which utilize new energy to simultaneously heat and cool air streams which are subsequently mixed for temperature control are prohibited for buildings larger than 20,000 square feet of conditioned space.

2. The hot deck temperatures of these systems shall be automatically reset to the lowest temperatures necessary to satisfy the zone requiring the most heating.

3. The cold deck temperature shall be automatically reset to the highest temperatures necessary to satisfy the zone requiring the most cooling.

4. The air leakage for dampers utilized in these systems for the mixing of heating and cooling air shall be limited to a maximum 3 percent of the total air quantity handled by the dampers when operating at the maximum system pressure to which the dampers will be subjected. Manufacturer's label or name plate shall state leakage rates.

5. The amount of outside air used with these systems may be fixed. Economizer cycles need not be used.

(e) **Recooling Systems.** Recooling of heated air, directly or indirectly by refrigeration to control space temperature, shall be limited by automatically resetting the temperature to which the supply air is heated to the lowest temperature that will satisfy the zone requiring the most heating.

(f) **Temperature Reset.** For the purpose of resetting hot and cold deck temperatures or fan discharge air temperatures as required in Sections 2-5329(c) through 2-5329(e), one representative zone may be chosen to represent a number of zones with similar heating or cooling requirements. In no case, however, shall the representative zone be allowed to represent more than 10 similar zones.

The supply air temperature reset requirements of Sections 2-5329(c) and 2-5329(e) shall not be required for HVAC systems that employ reheating or recooling of less than 20 percent of the total air in the system.

(g) **Concurrent Operation.** Concurrent operation of independent heating and cooling systems serving common spaces, and requiring the use of new energy for heating, shall be minimized by one or both of the following: 1. By providing sequential temperature control of both heating and cooling capacity in each zone.

2. By limiting the heating energy input, through automatic resetting of the heating medium temperature (or energy input rate), to only that necessary to offset heat loss due to transmission and infiltration.

Cooling with Outdoor Air

Sec. 2-5330. (a) **General.** Each cooling fan system other than those covered under Section 2-5329(d), which serves a zone or aggregate of zones that have greater than 134,000 Btu/hr total cooling capacity or more than 5,000 cfm, shall be designed with an economizer cycle to use up to 100 percent of the fan system capacity for cooling with outdoor air whenever cooling, requiring new energy, is needed and:

1. The enthalpy of outdoor air is lower than that of the indoor air, or

2. The outdoor dry bulb temperature is lower than that of the return or indoor air.

(b) **Exceptions.** Cooling with outdoor air is not required under any of the following conditions: 1. The quality of the outdoor air, as defined in Table 1 of ASHRAE Standard 62-73, is so poor as to require extensive treatment of the air.

2. The need for humidification or dehumidification requires the use of more energy than is conserved by outdoor air cooling.

3. The use of outdoor air cooling may affect the operation of other systems (such as return air fans or supermarket refrigeration) so as to increase the overall energy consumption of the building.

Electric Resistance Heating Systems

Sec. 2-5331. Electric resistance heating systems shall not be used for space heating unless at least one of the following conditions is met: (a) The electric resistance system is used to supplement a heating and/or cooling system by which at least 60 percent of the annual energy requirement is supplied by a device using a nondepletable source of energy.

(b) The electric resistance heating equipment is the supplementary electric resistance equipment for a heat pump system.

(c) The capacity of the electric resistance heating system is less than 10 percent of the capacity of the total heating system.

(d) A cost comparison has been performed which demonstrates that the life cycle cost of the electric resistance heating system is lower than the cost of the alternatives considered. If the building is mechanically cooled, the costs associated with cooling shall be included in the cost comparison.

1. In areas where natural gas utility service is available, the two alternatives considered shall be: A. A system in which 100 percent of the annual heating energy is met by burning of natural gas, or oil in a boiler or furnace. The type of fuel, boiler and/or

furnace to be considered is at the option of the building designer.

B. The system proposed for installation by which more than 10 percent of the annual heating of the annual heating energy requirement is met by electric resistance heating.

2. In areas where natural gas utility service is not available, the two alternatives considered shall be: A. A system in which at least 90 percent of the annual heating energy requirement is met by a heat pump.

B. The system proposed for installation by which more than 10 percent of the annual heating energy requirement is met by electric resistance heating.

The method of calculating life cycle costs is defined in the Energy Conservation Design Manual.

Mechanical and Gravity Ventilation

Sec. 2-5332. Each mechanical or gravity system or unit (supply and/or exhaust) shall be equipped with a means of providing air volume reduction and/or shut-off when ventilation is not required. On mechanical ventilating systems, automatic dampers interlocked and closed on fan shutdown shall be provided. On gravity ventilating systems, either automatic or readily accessible manually operated dampers in all openings to the outside other than combustion air openings shall be provided.

Power Consumption of Fans

Sec. 2-5333. (a) General. Overall air capacity and air handling system components, such as ducts, filters, coils, etc., shall be selected so as to provide an average fan performance index (FPI) of less than 5.0 cfm-inches per gross square feet of the conditioned floor area of the heated or cooled space. The fan performance index shall be calculated in accordance with Equation 5-1.

EQUATION 5-1

$$FPI = \frac{CFM_t \times TP_t}{\text{Gross Floor Area}}$$

Where CFM_t = The total supply air quantity, cfm.

TP_t = The total pressure of the supply fan, inches of water.

(b) Process Loads. The factor CFM_t in Equation 5-1 may be adjusted in accordance with Equation 5-2 or 5-3 when systems serve process heating or cooling loads or make-up air. Where state or local jurisdictions require special air filtration, the pressure drop resulting from these special air filtration requirements may be subtracted from the TP_t values used above for the portion of air subject to these special requirements.

EQUATION 5-2

$$CFM_a = CFM_t - CFM_p$$

Where: CFM_a = Adjusted total CFM

CFM_p = CFM required for processing heating, cooling, or make-up.

EQUATION 5-3

$$CFM_p = CFM_t \times \frac{H_p}{H_a}$$

Where: H_p = Sensible heat of process load.

H_a = Total system room sensible heat, including process heat.

(c) Special Occupancies. Where the design square feet per occupant in a space is less than 50 square feet per person, the fan performance index may be increased as follows:

1. More than 15 square feet per person: FPI = 6.0
2. 15 square feet per person or less: FPI = 6.5

(d) Variable Volume Systems. The factor FPI may be modified to reflect the average power consumed by variable volume systems in accordance with Equations 5-4, 5-5, 5-6, and 5-7.

EQUATION 5-4

$$FPI_a = FPI_m \times C_{vv}$$

Where: FPI_a = Adjusted fan power index.
 FPI_m = Fan power index at maximum flow.
 C_{vv} = Variable volume constant.

The value of C_{vv} shall be determined as follows:

1. For systems having no static pressure control other than discharge side dampers.

EQUATION 5-5

$$C_{vv} = \frac{CFM_a}{CFM_m}$$

2. For systems having static pressure control operating vortex type inlet vanes on centrifugal fans.

EQUATION 5-6

$$C_{vv} = \frac{CFM_a \times TP_a}{CFM_m \times TP_m}$$

3. For systems having static pressure control operating fan speed or variable pitch axial fan blades.

EQUATION 5-7

$$C_{vv} = \frac{CFM_a \times TP_a}{CFM_m \times TP_m}$$

Where CFM_a = Average air flow, cfm.
 CFM_m = Maximum air flow, cfm.
 TP_a = Average system total pressure, inches of water.
 TP_m = Maximum system total pressure, inches of water.

In the absence of verifying calculations, CFM_a may be assumed to be $0.95 \times CFM_m$.

Piping Insulation

Sec. 2-5334. (a) Minimum Pipe Insulation. Piping shall be insulated in accordance with Table 2-530 except that piping insulation is not required when: 1. Piping is installed within HVAC equipment.

2. Piping is conveying fluids at temperatures between 55°F and 105°F.

3. The heat loss or heat gain of the piping, without insulation, does not increase the new energy requirements of the building.

(b) Other Insulation Thicknesses. Insulation thicknesses in Table 2-530 are based on insulation having thermal resistance in the range of $R = 4.0$ to 4.6 per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased proportionately for materials having R values less than 4.0 per inch of thickness or may be reduced for materials having R values greater than 4.6 per inch of thickness. 1. For materials with thermal resistance greater than $R = 4.6$, the minimum insulation thickness shall be reduced as follows:

$$\frac{4.6 \times \text{Table 2-530 Thickness}}{\text{Actual } R} = \text{New Minimum Thickness}$$

2. For materials with thermal resistance less than $R = 4.0$, the minimum insulation thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 2-530 Thickness}}{\text{Actual } R} = \text{New Minimum Thickness}$$

3. For domestic hot water systems, see Division 7.

TABLE 2-53 O
MINIMUM PIPE INSULATION

Piping System Types	Fluid Temperature Range, °F	Runouts Up to 2'	Insulation Thickness in Inches for Nominal Pipe Sizes (in inches)				
			1 and Less	1.25-2	2.50-4	5 & 6	8 and Larger
Heating Systems							
Steam & Hot Water							
High Pressure/Temp	306-460	1.5	1.5	2.0	2.5	3.5	3.5
Medium Pressure/Temp	251-305	1.5	1.5	2.0	2.5	3.0	3.0
Low Pressure/Temp	201-250	1.0	1.0	1.5	1.5	2.0	2.0
Low Temperature	106-200	0.5	0.75	1.0	1.0	1.0	1.5
Steam Condensate (for Feed Wa- ter)	Any	1.0	1.0	1.0	1.5	1.5	2.0
Cooling Systems							
Chilled Water	40-55	0.5	1.0	1.0	1.0	1.0	1.0
Refrigerant, or Brine	Below 40	1.0	1.0	1.5	1.5	1.5	1.5

* Runouts to individual terminal units (not exceeding 12 feet in length)

Air-Handling Duct System Installation

Sec. 2-5335. Insulation of air handling duct systems shall conform to the provisions of Section 1005 of the State Mechanical Code (Title 24, Part 4).

Duct Construction

Sec. 2-5336. Duct work shall be constructed, erected, and tested in accordance with the most restrictive of local regulations, procedures detailed in Chapter 33 of the 1981 ASHRAE Handbook of Fundamentals or the applicable standards adopted by the Sheet Metal and Air Conditioning Contractors National Association.

Transverse joints on all air supply ducts, installed in locations where air leakage through the joints would be nonbeneficial to the occupied area temperature requirements, shall be sealed with mastic or tape. Longitudinal joints on low pressure supply duct work with internal static pressures in excess of 0.75 inches of water pressure shall be sealed with mastic or tape.

**DIVISION 6. HEATING VENTILATING AND
AIR CONDITIONING (HVAC) EQUIPMENT****Combustion Type Heating Equipment**

Sec. 2-5337. In addition to the requirements in Section 2-5306, equipment of the types listed in Table 2-53P shall have a minimum thermal efficiency of 75 percent based on the applicable test procedures.

**TABLE 2-53P. TEST PROCEDURES FOR GAS-FIRED
HEATING EQUIPMENT**

<i>Type</i>	<i>Test Procedure</i>
Forced Air Central Furnaces	ANSI Z21.47-1978
Gravity Central Furnaces	ANSI Z21.47-1978
Gravity Direct Vent Wall Furnaces	ANSI Z21.44-1973
Gravity Vented Wall Furnaces	ANSI Z21.40-1975
Gravity and Fan Type Floor Furnaces	ANSI Z21.40-1976
Vented Room Heaters	ANSI Z21.11.1-1974

Oil-fired comfort heating equipment shall have a minimum combustion efficiency of 75 percent at maximum rated output. Combustion efficiency is defined as 100 percent minus stack losses in percent of heat input. Stack losses are:

- a. Loss due to sensible heat in dry flue gas
- b. Loss due to incomplete combustion
- c. Loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the fuel.

DIVISION 7. SERVICE WATER HEATING**Water Heaters, Storage Tanks, Boilers and Piping**

Sec. 2-5338. (a) **Combination Service Water-Heating/Space-Heating Boilers.** Service water-heating equipment shall not be dependent on year-round operation of boilers whose primary function is winter space-heating. Excepted from this provision are systems with service/space-heating boilers having a stand-by loss Btu/hr less than
$$\frac{13.3 \text{ pmd} + 400}{N}$$

Where pmd is the probable maximum demand in gallons per hour determined as per Chapter 37 of the 1980 ASHRAE Handbook and Product Directory, Systems Volume, and N is the fraction of the year when outdoor daily mean temperature is more than 65°F.

The stand-by loss is to be determined for a test period of 24-hour duration while maintaining a boiler water temperature of 90°F above ambient.

(b) **Insulation.** 1. Heat loss from unfired hot water storage tanks shall be limited to a maximum of 15 Btu/hr ft² of external tank surface area. The design ambient temperature shall be 65°F.

2. Service hot water supply and recirculation piping (except for runouts to fixture not longer than 12 feet in length) shall be insulated in accordance with Table 2-53 O.

Temperature Controls

Sec. 2-5339. 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 37 of the 1980 ASHRAE Handbook and Product Directory, Systems Volume.

Pump Operation

Sec. 2-5340. Circulating hot water systems shall be arranged so that the circulating pump(s) can be automatically turned off when the hot water system is not in operation.

DIVISION 8. ELECTRICAL DISTRIBUTION SYSTEMS

Scope

Sec. 2-5341. The electrical distribution system in a building should be designed for efficient distribution of energy.

DIVISION 9. LIGHTING**General**

Sec. 2-5342. This division establishes lighting power allotment standards for the efficient utilization of energy for illumination. Designs shall be based on good lighting practice.

Lighting Standards

Sec. 2-5343. Illumination systems and associated services for buildings shall be designed to make efficient use of energy, and to allow for flexibility in operation. These standards do not apply to lighting outside the building envelope.

(a) A maximum connected lighting load in watts for the entire building shall be determined in accordance with Section 2-5344. Where lighting is by the direct combustion of a fossil fuel, the maximum connected lighting load shall be calculated in British thermal units in the fuel based on the conversion factor of one kilowatt = 10,239 Btu/hour.

(b) The lighting loads as determined in accordance with Section 2-5344 shall be controlled as follows: 1. Each area enclosed by ceiling-height partitions shall have independent control of the lighting within that area.

2. All switching devices used to control lighting within an area shall be readily accessible to personnel occupying that area.

3. For all areas larger than 100 square feet, and for which a maximum connected lighting load of more than 1.0 watt per square foot is allowed by Table 2-53Q, the connected lighting load shall be so controlled that it may be reduced by at least one-half in a uniform pattern. The maximum area that may be controlled by any two switching devices shall be limited to that area which can be served by two 20 ampere single pole circuits, loaded to no more than 80 percent.

EXCEPTION: Any area whose actual installed connected lighting load is 1 watt per square foot or less, or in which a single light source (lamp) produces all of the illumination in the area, shall not be required to comply with this section.

4. Areas with maximum connected lighting loads from Table 2-53Q to which Note 2 of Table 2-53Q applies shall utilize local switching for task locations, with no more than four task locations controlled by one switch.

5. In all areas where effective use may be made of natural light, lighting circuiting shall be arranged so that units, in portions of the area where natural light is available, are switched independently of the remainder of the area.

Procedure for Determining Maximum Connected Lighting Load

Sec. 2-5344. (a) Calculate room cavity ratio for each area from Equation 9-1.

$$\text{EQUATION 9-1}$$

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

where RCR = room cavity ratio

L = length of room

W = width of room

h = vertical distance from the work plan to the lighting fixture

(b) Select from Table 2-53Q, the maximum allowable value in watts per square foot, based on the applicable task or area and the applicable room cavity ratio.

If the applicable task or area in Table 2-53Q is referenced to note 1, determine the allowable square feet per occupant of each area from Table 2-53J, calculate the number of occupants in the area by dividing the area by the allowable square feet per occupant; and calculate the watts allowed for task-oriented lighting and general area lighting as per reference note 1. Total the watts of task-oriented lighting and general lighting for the area.

If reference note 2 applies, calculate the additional wattage required to provide the allowable foot-candle level on the task.

(c) For entire building, total the wattages for each area to obtain maximum connected lighting load for the building. This total includes wattages required to provide the illumination levels called for by reference note 2.

TABLE 2-53 Q
MAXIMUM CONNECTED LIGHTING LOAD

The maximum connected lighting load (watts per square foot) for each task and/or area shall be obtained from this table. Where no listing of load is found for a task or area, the designer shall select a load based on a similar listed task, and submit information for approval on the task, the similar task, and the reasoning behind the selection.

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Aircraft manufacturing				
Stock parts				
Production		2.9	3.8	1
Inspection		(200)	(200)	2
Parts manufacturing				
Drilling, riveting, screws.....		2.4	3.4	1
Spray booths.....		2.9	3.8	1
Sheet layout and template work, shaping & smoothing of parts		2.9	3.8	1
Welding				
General illumination		2.0	2.7	
Precision manual arc welding		(1000)	(1000)	2
Subassembly				
Landing gear, fuselage, wing sections, etc.		2.9	3.8	1
Final assembly				
Placing of motors, wing sections, landing gear, etc.		2.9	3.8	1
Inspection of assembled craft		2.9	3.8	1
Machine tool repairs		2.9	3.8	1
Aircraft hangars				
Repair service		2.9	3.8	
Armories				
Drill		1.0	1.4	
Exhibitions		1.3	2.0	
Art Galleries				
General		1.1	1.6	
On paintings.....		(30)	(30)	2
On statuary & other displays.....		(100)	(100)	2
Assembly, manufacturing				
Rough easy seeing		1.4	2.0	
Rough difficult seeing		2.1	2.7	
Medium		2.9	3.8	1
Fine		(500)	(500)	2
Extra Fine.....		(1000)	(1000)	2
Auditoriums				
Assembly		0.7	1.0	
Exhibitions		1.1	1.6	
Social activities		0.3	0.4	
Automobile manufacturing				
Frame assembly.....		2.0	2.7	
Chassis assembly.....		1.4	3.4	1
Final assembly, inspection		(200)	(200)	2

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Body manufacturing				
Parts.....		2.4	3.4	1
Assembly.....		2.9	3.8	1
Finishing & inspecting.....		(200)	(200)	2
Bakeries				
Mixing room.....		2.0	2.7	
Fermentation room.....		1.3	2.0	
Makeup room.....		2.0	2.7	
Proofing room.....		1.3	2.0	
Oven room.....		1.3	2.0	
Fillings & other ingredients.....		2.0	2.7	
Decorating & icing				
Hand.....		2.9	3.8	1
Mechanical.....		2.0	2.7	
Scales & thermometers.....		2.0	2.7	
Wrapping.....		1.3	2.0	
Banks				
Lobby				
General.....		1.7	2.5	
Writing areas.....		3.6	4.4	1
Tellers stations.....		5.0	6.0	1
Posting & keypunch.....		5.0	6.0	1
Barber shops & beauty parlors.....		3.6	4.1	1
Bookbinding				
Folding, stitching, cutting, etc.....		2.4	3.4	1
Embossing & inspection.....		(200)	(200)	2
Breweries				
Brew house, boiling, keg washing.....		1.3	2.0	
Filling.....		2.0	2.7	
Candy making				
All except decorating, sorting.....		2.0	2.7	
Decorating, sorting.....		2.9	3.8	1
Canning & preserving				
Inspection, color grading.....		(200)	(200)	2
Labeling & cartoning.....		1.3	2.0	
All other.....		2.9	3.6	1
Central station				
Chemical laboratory.....		2.5	3.4	1
Turbine room.....		1.3	2.0	
Auxiliaries, battery rooms, boiler feed, tanks, burner platforms, hydrogen & CO, manifold, greenhouse, switch gear, telephone equip, gallery & water treat- ment area.....		1.0	1.4	
All other.....		0.6	0.8	
Chemical works.....		1.3	2.0	
Churches & synagogues				
Alter, ark, rerodos.....		(100)	(100)	2
Choir & chancel.....		1.0	1.6	
Pulpit, rostrum.....		3.8	5.0	1
Main worship area.....		0.7	1.0	
Clay products & cements				
Grinding, presses, kiln.....		1.3	2.0	
Molding, pressing, trimming.....		1.3	2.0	
Enameling, rough color & glazing.....		2.9	3.7	1
Fine color & glazing.....		(300)	(300)	2
Cleaning & pressing				
Checking, sorting, cleaning.....		2.0	2.7	
Inspection & spotting.....		(500)	(500)	2
Pressing.....		3.2	4.0	1
Repair & alteration.....		(200)	(200)	2
Cloth products				
Cloth inspection.....		(2000)	(2000)	2

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Cutting, pressing		(300)	(300)	2
Sewing		(300)	(300)	2
Clothing manufacture				
Receiving, storing, shipping, sponging, decating, wind- ing, measuring, fitting, bundling		1.3	2.0	
Pattern making, preparation of trimming, piping, can- vas & shoulder pads		2.0	2.7	
Shops, piling up & marketing		2.9	3.7	1
Cutting, pressing		(300)	(300)	2
Sewing, inspection		(300)	(300)	2
Examining (perching)		(300)	(300)	2
Club and lounge rooms		1.0	1.6	
Coal tipples & cleaning plants				
Breaking, screening, cleaning		0.6	0.8	
Picking		(300)	(300)	2
Control & dispatch rooms				
General illumination		1.7	2.5	
Vertical boards		(50)	(50)	2
Cotton gin industry				
Overhead equipment, bale press		1.3	2.0	
Gin stand, control console, lint cleaner		2.0	2.7	
Court rooms				
Seating area		1.0	1.6	
Court activity area		3.6	4.4	1
Dairy products				
Filling inspection, laboratory		3.1	4.1	1
Bottle sorting, gauges, scales		2.0	2.7	
All other areas		1.3	2.0	
Dance halls		0.3	0.4	
Depots, terminals, stations				
Ticket offices		4.1	4.7	1
Baggage check		1.7	2.5	
Waiting room, restrooms		1.0	1.6	
Concourse		0.5	0.75	
Electrical equipment manufacturing				
Impregnating		2.0	2.7	
Insulating, coil winding, testing		2.9	3.7	
Elevators		-	1.0	
Engraving (wax)		(300)	(300)	2
Explosives manufacturing		1.4	2.0	
Farms, dairy				
Milking operation		1.0	1.4	
Milk handling equipment				
General		1.0	1.4	
Washing area, bulk tank interior		2.9	3.6	1
Feed area		1.0	1.4	
Livestock housing area		0.4	0.6	
Flour mills				
Rolling, sifting, purifying		2.0	2.7	
Product control	2.9	3.6	1	
General		1.4	2.0	
Forge shops		2.1	2.7	
Foodservice facilities				
Dining Areas				
Cashier		(50)	(50)	2
General		1.0	1.4	
Food Displays		(50)	(50)	2
Commercial kitchen		2.4	3.4	
Foundries				
Annealing, cleaning, shakeout		1.4	2.0	
Pouring, sorting		2.1	2.7	
Core making, inspection, grinding and chipping, mold- ing		2.9	3.6	1

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Garages, auto and truck				
Service garages				
Repairs		3.4	4.4	1
Active traffic areas		1.2	1.7	
Parking garages				
Entrance		(50)	(50)	2
Traffic & parking areas		1.0	1.4	
Class works				
Mix & furnace rooms, pressing & lehr, glassblowing machines		1.4	2.0	
Grinding, cutting, silvering		2.0	2.7	
Fine grinding, bevel, polish		2.9	3.6	1
Inspection, etching, decorating		(200)	(200)	2
Glove manufacturing				
Knitting, sorting		2.9	3.6	1
Pressing, cutting		(300)	(300)	2
Sewing, inspection		(500)	(500)	2
Hat manufacturing				
Dyeing, stiffing, braiding, etc.		2.9	3.7	1
Forming, sizing, pouncing, etc.		(200)	(200)	2
Sewing		(500)	(500)	2
Hospitals				
General		1.3	1.9	
Autopsy room		3.6	4.8	1
Autopsy table		(1000)	(1000)	2
Museum		2.0	3.0	
Central sterile supply				
Work table, glove room, issuing		2.0	3.0	
Syringe room, needle sharpening		3.8	5.0	
Cystoscopic room				
General		3.1	4.1	
Cystoscopic table		(2500)	(2500)	2
Dental suite				
General, operator		2.7	4.0	
Recovery room		0.3	0.4	
EEG suite		1.2	1.9	
Emergency operating room				
General		3.6	4.8	
Local (operating table)		(2000)	(2000)	2
Examination & treatment rooms				
General		2.0	3.0	
Examining table		3.6	4.8	1
Eye, ear, nose, throat suite		2.0	3.0	
Formula room		2.0	3.0	
Fracture room				
General		2.0	3.0	
Fracture table		(200)	(200)	2
Laboratories				
General		2.0	3.0	
Close work areas		4.1	4.7	1
Linens, sewing room		3.1	4.1	1
Medical records room		4.1	4.7	1
Nurses desk		3.7	3.7	1
Nursery				
General		1.0	1.6	
Examining table		3.1	4.1	1
Obstetrical suite				
General		1.3	1.9	
Delivery table		(2500)	(2500)	2
Pharmacy				
Compounding & dispensing		3.6	4.8	1
Manufacturing, solution room		2.0	3.0	

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Surgical suite				
Cleanup room, instrument.....		3.6	4.8	1
Operating room and scrub-up area.....		(200)	(200)	2
Operating table.....		(2500)	(2500)	2
Therapy, physical				
General.....		1.3	1.9	
Lip reading.....		4.5	6.0	1
Therapy, occupational				
Work area, general.....		2.0	3.0	
Work tables, fine work.....		3.6	4.8	1
Hotels				
Guest rooms				
General.....		-	1.0	
Reading, writing areas.....		-	3.4	1
All other (See offices, kitchens).....		1.0	1.6	
Ice Making, engine & compressor room.....		1.0	1.4	
Inspection				
Ordinary.....		(50)	(50)	2
Difficult.....		(100)	(100)	2
Highly difficult.....		(200)	(200)	2
Very difficult.....		(500)	(500)	2
Most difficult.....		(1000)	(1000)	2
Iron and steel manufacturing				
Control platforms, hot top, mixer building.....		1.3	2.0	
Charging floor, slag pits stripping yard.....		1.0	1.4	
Rolling mills				
Pipe, rod, tube, wire drawing.....		2.0	2.7	
All other areas.....		1.3	2.0	
Tin plate mills.....		2.0	2.7	
Motor, machine room.....		1.3	2.0	
Inspection				
Black plate, bloom & billet chipping.....		2.7	4.0	1
Tin plate & other bright surfaces.....		(200)	(200)	2
All other areas.....		0.5	0.75	
Jewelry & watch manufacturing.....		(500)	(500)	2
Laundries				
Washing.....		1.3	2.0	
Flatwork ironing, listing, marking.....		2.0	2.7	
Machine & press finishing, sorting.....		2.4	3.4	1
Fine hand ironing.....		2.9	4.0	1
Leather manufacturing				
Cleaning, tanning, stretching, vat.....		1.3	2.0	
Cutting, fleshing, stuffing.....		2.0	2.7	
Finishing & scarfing.....		2.9	4.0	1
Leather working				
Pressing, winding, glazing.....		(200)	(200)	2
Grading, matching, cutting scarfing, sewing.....		(300)	(300)	2
Libraries				
Reading areas				
Reading printed material.....		2.0	2.5	
Study and note taking.....		3.8	4.0	1
Conference areas.....		2.0	2.5	
Seminar room.....		3.8	4.0	1
Book stacks.....		2.0	2.5	
Book repair & binding.....		2.3	3.4	1
Cataloging.....		3.8	4.0	1
Card Files.....		4.1	4.7	1
Carrels.....		3.8	4.0	1
Circulation desk.....		3.8	4.0	1

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Rare book rooms, archives				
Storage areas		1.0	1.6	
Reading areas		4.1	4.7	1
Map, picture & print rooms				
Storage areas		1.3	1.9	
Use areas		4.1	4.7	1
Audiovisual areas		2.3	3.4	1
Audio listening areas				
General		1.3	1.9	
Note taking		3.8	4.0	1
Record inspection		3.0	3.6	1
Locker rooms		0.9	1.3	
Machine shops				
Rough bench & machine work		2.0	2.7	
Medium bench & machine work, automatic machines, rough grinding, medium buffing & polishing		3.0	3.7	1
Fine bench and machine work, medium grinding, fine buffing & polishing		(500)	(500)	2
Extra-fine work		(1000)	(1000)	2
Materials handling				
Wrapping, packing labeling		2.3	3.2	
Picking stock, classifying		1.6	2.2	
Loading, trucking		1.2	1.7	
Meat packing				
Slaughtering		1.6	2.2	
Cleaning, cutting, cooking, grinding, canning, packing		2.9	3.7	1
Municipal buildings—fire, police				
Police				
Identification records		5.0	6.0	1
Jail cells & interrogation rooms		1.6	2.2	
Fire hall				
Dormitory		0.9	1.3	
Recreation room, wagon room		1.3	1.9	
Nursing homes				
Corridors, physical therapy, patient room, utility		0.9	1.3	
Stairways, occupational therapy, dining area, pharmacy area, toilet & bath facilities		1.3	1.9	
Administration, lobby, recreation, nurse station, barber & beautician		2.0	3.0	
Nurses desk		3.7	3.8	1
O.T. work table, pharmacy dispensing area		3.1	4.0	1
Offices				
Drafting rooms				
Detailed drafting, cartography		(200)	(200)	2
Rough layout drafting		5.0	6.0	1
Accounting offices				
Auditing, tabulating, bookkeeping, business machine operation		5.0	6.0	1
General offices				
Reading poor reproductions, business machine opera- tion, computer operation		5.0	6.0	1
Reading handwriting in hard pencil or on poor paper, reading fair reproductions, active filing, mail sort- ing		4.0	4.7	1
Reading handwriting in ink or medium pencil on good quality paper, intermittent filing		3.6	3.8	1
Private offices—same except:				
Reading high contrast or well printed materials		1.7	2.0	
Conferring and interviewing		1.0	1.6	
Paint manufacturing				
General		1.3	2.0	
Color matching		(200)	(200)	2

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Paint shops				
Dipping, spraying, firing		2.0	2.7	
Rubbing, hand painting & finishing, art, stencil, special spraying.....		2.0	2.7	
Fine hand painting and finishing.....		2.7	3.7	1
Extra-fine hand work		(300)	(300)	2
Paper box manufacturing.....		2.0	2.5	
Paper manufacturing				
Beaters, grinders, calendering		1.3	2.0	
Finishing, fitting, trimming, papermaking machines		2.0	3.0	
Hand counting, wet end of paper machine		2.4	3.4	1
Paper machine reel, paper inspection, laboratories		3.1	4.1	1
Rewinder		3.8	5.0	1
Plating.....		1.6	2.2	
Polishing and burnishing		2.7	3.7	1
Post offices				
Lobby, on tables.....		1.0	1.6	
Sorting, mailing, etc.		3.1	4.1	1
Poultry industry				
Brooding, production, laying rooms		1.0	1.5	
Hatcheries				
General		1.0	1.5	
Dubbing station		3.8	5.0	1
Sexing		(1000)	(1000)	2
Egg handling		2.0	2.7	
Egg processing		2.3	3.4	
Poultry processing				
Unloading and killing		1.0	1.4	
General		2.3	3.4	
Inspection & grading station.....		3.1	4.1	1
Feed storage		0.6	0.8	
Charts and records, gauges		1.3	2.0	
Printing industries				
Type foundries				
Matrix making, dressing type, casting		2.9	4.1	1
Font assembly, sorting		10	17	
Printing plants				
Color inspection		(200)	(200)	2
Machine composition		3.1	4.1	1
Composing room		3.1	4.1	1
Presses.....		2.4	3.4	1
Proofreading		3.8	5.0	1
Electrotyping				
Molding, routing, finishing, leveling molds, trimming		3.1	4.1	1
Blocking, tinning, electroplating, washing, backing		2.0	2.7	
Photoengraving				
Etching, staging, blocking		2.0	2.7	
Routing, finishing, proofing, tint laying, masking		2.9	3.7	1
Rubber goods, mechanical				
Stock preparation				
Plastering, milling, banbury		1.3	2.0	
Calendering.....		2.0	2.7	
Fabric preparation, stock cutting, hose looms, extruded & molded products, curing		2.0	2.7	
Inspection.....		(200)	(200)	2
Rubber tire manufacturing				
Banbury		1.3	2.0	
Tread stock				
General.....		2.0	2.7	
Booking and inspection, extruder, checking weighing, width measuring.....		2.9	3.7	1

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Calendering		2.0	2.6	
Stock cutting				
General		1.3	2.0	
Cutters & splicers		2.9	3.7	1
Bead building		2.0	2.7	
Tire building				
General		2.0	2.7	
At machines		3.2	3.9	
In-process stock		1.3	2.0	
Curing				
General		1.3	2.0	
At molds		2.4	3.4	1
Inspection				
General		2.9	3.7	1
At tires		(300)	(300)	2
Storage		1.0	1.4	
Sawmills				
Grading redwood lumber		(00)	(300)	2
Schools				
Classrooms				
Grade A		3.7	-	3
Grade B		3.2	-	3
Grade C		2.7	-	3
Grade D		2.2	-	3
Shops		3.1	4.1	1
Service space				
Stairways, corridors		-	1.0	
Toilets, wash rooms		-	1.6	
Service Stations				
Service bays		1.3	2.0	
Sales room		2.0	2.7	
Sheet metal works				
General		2.0	2.7	
Tin plate inspection, scribing		(200)	(200)	2
Shoe manufacturing, leather				
Cutting and stitching		(300)	(300)	2
Making and finishing		(200)	(200)	2
Shoe manufacturing, rubber				
Washing, coating, mill run compounding		1.3	2.0	
Varnishing, vulcanizing, calendering, upper and sole cutting		2.0	2.7	
Sole rolling, lining, finishing		2.9	3.7	1
Show windows—varies, see note 2		-	-	2
Soap manufacturing		1.7	2.3	
Stone crushing and screening				
Screens		1.0	1.4	
All other		0.6	0.8	
Storage battery manufacturing		2.0	2.7	
Storage rooms or warehouses				
Inactive		0.3	0.4	
Active				
Rough bulky		0.6	0.8	
Medium		1.0	1.4	
Fine		2.0	2.7	
Circulation areas		1.0	1.6	
Merchandising areas		3.1	4.1	1
Showcases, displays, see note 2		-	-	2
Alteration room				
General		1.7	2.5	
Pressing		3.8	5.0	1
Sewing		(200)	(200)	2

Table 2-53 Q—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Fitting room				
General		1.7	2.5	
Fitting areas		(200)	(200)	2
Structural steel fabrication		2.0	2.7	
Sugar refining				
Grading		2.0	2.7	
Color inspection		(200)	(200)	2
Testing laboratories				
General		2.0	3.0	
Meters, scales, etc.		(200)	(200)	2
Textile mills				
General		2.0	3.0	
Warping, weaving, spinning, dyeing, finishing		2.9	3.7	1
Inspection—varies, see note 2		-	-	2
Theatres and motion picture houses				
Auditorium & foyer		0.3	0.4	
Lobby		0.9	1.3	
Tobacco products				
Drying, stripping, general		1.3	2.0	
Grading & sorting		(200)	(200)	2
Toilets, wash rooms, lounges		1.0	1.6	
Upholstering		2.9	3.7	1
Welding				
General		2.0	3.0	
Precision welding		(1000)	(1000)	2
Woodworking				
Rough sawing & bench work		1.3	2.0	
Sizing, planning, rough sanding, medium machine and bench work, gluing, veneer, cooperage		2.0	3.0	
Stockrooms		1.3	2.0	
Fine bench & machine work		2.9	3.7	1

NOTES:

- Maximum connected lighting load for these tasks shall be based on a combination of general and task-oriented lighting. Values given in Table 2-53Q are for task-oriented lighting. Maximum connected load for general lighting shall not be more than one-third of the listed level for the task, and not more than two watts per square foot unless a specific load is listed for the general area involved. In this case the general and task areas are calculated separately. Where several types of tasks in the same area require differing loads, the load for general lighting shall not be more than one-third of the area-weighted loads for the tasks. Where task-oriented lighting is used, it should be designed for maximum effectiveness for the particular task and generally confined to the task area. Task area is defined as 50 square feet in area, centered at the major task location and of any shape appropriate to the task, for all areas with an occupant rating from Table 2-53J of 50 square feet per occupant or more. For occupant ratings of less than 50 square feet per occupant, task area shall equal occupant rating.
- Numbers in parentheses are recommended illumination levels in footcandles. Lighting for these tasks shall be obtained by local or localized general lighting, and must be confined to the specific task area, which must be described. No wattage limit applies, but the wattage required must be included in the maximum connected lighting load, and care shall be taken to follow the general provisions of Section 2-5342. Power allotment for general lighting in the same area shall not exceed two watts per square foot unless a specific value is given for the general area. Note that the wattage obtained under this note is the actual required design wattage and not a power allotment.

3. Grade letters apply to Performance Grade (ESI) only. For determination of grade of visual performance to be obtained, refer to "California School Lighting Design and Evaluation," 1977 revision, California State Department of Education, Bureau of School Facilities Planning, Sacramento, CA, and Los Angeles, CA.
4. Purely decorative or ornamental lighting must comply with the voltage limitations of the particular area.

EXCEPTION: Areas where lighting is an integral part of the process such as stage lighting in theaters, lighting for plant growth, photographic lighting and areas where control requirements dictate the use of specific systems such as those requiring incandescent dimming or frequent switching are exempt from those watts per square foot limitation only. The maximum connected lighting load for these areas must be reported. In general, this will be light which is present for reasons other than to perform a visual task.

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APPENDIX 2-53A

STANDARDS REFERENCED IN ENERGY CONSERVATION REGULATIONS

STATE OF CALIFORNIA

Appliance Efficiency Regulations
Standards for Insulating Material
Nonresidential Design Manual
Residential Design Manual
Various Directories for Certified Appliances
Directory of Certified Insulating Materials
Available from: California Energy Commission
Publications Office
1111 Howe Avenue
Sacramento, CA 95825
(916) 920-6216

INTERNATIONAL CONFERENCE ON BUILDING OFFICIALS

Uniform Building Code, 1979 Edition
Uniform Mechanical Code, 1976 Edition
Uniform Mechanical Code, 1979 Edition
Available from: International Conference of Building Officials
5360 South Workman Mill Road
Whittier, CA 90601

AIR-CONDITIONING AND REFRIGERATION INSTITUTE

ARI 210-81 Standard for Unitary Air-Conditioning Equipment
ARI 240-81 Standard for Air-Source Unitary Heat Pump Equipment
ARI 320-76 Standard for Water-Source Heat Pumps
ARI 340-76 Standard for Commercial and Industrial Unitary Heat Pump
Equipment
ARI 360-75 Standard for Commercial and Industrial Unitary Air-Condition-
ing Equipment
ARI 520-78 Standard for Positive Displacement Refrigerant Compressors,
Compressor Units, and Condensing Units
ARI 550-77 Standard for Centrifugal and Rotary Water-Chilling Packages
ARI 560-75 Standard for Absorption Water-Chilling Packages
ANSI/ARI 590-1976 Standard for Reciprocating Water-Chilling Packages
Available from: Air-Conditioning and Refrigeration Institute
1815 North Fort Myer Drive
Arlington, VA 22209
703-524-8000

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (NATIONAL PUBLICATIONS)

Handbook and Product Directory

Equipment Volume, 1979 Edition.
Systems Volume, 1980 Edition.
Fundamentals Volume, 1981 Edition.

Standards

ASHRAE 22-71 Methods of Testing for Rating Water Cooled Refrigerant Con-
densers

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1981 EDITION

ASHRAE 24-71 Methods of Testing for Rating Liquid Coolers
ANSI/ASHRAE
55-1981 Thermal Environment Conditions for Human Occupancy
ASHRAE 62-73 Standards for Natural and Mechanical Ventilation
Available from: American Society of Heating, Refrigerating, and
Air-Conditioning Engineers
1791 Toullie Circle N.E.
Atlanta, GA 30329
404-636-8400

**AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND
AIR CONDITIONING ENGINEERS (REGIONAL PUBLICATIONS)**

Recommended Outdoor Design Temperatures for Northern California, 1977

Available from: ASHRAE
Golden Gate Chapter
126 Post Street
San Francisco, CA
415-962-3042

Recommended Outdoor Design Temperatures for Southern California, Arizona, Ne-
vada, 1972

Available from: ASHRAE
Southern California Chapter

AMERICAN NATIONAL STANDARDS—Z21 SERIES

ANSI Z21.10.3—1975 Standard for Gas Water Heaters, Volume III Circulating
Tank, Instantaneous and Large Automatic Storage Type
Water Heaters

ANSI Z21.11.1—1977 Standard for Gas-Fired Room Heaters, Volume I, Vented
Room Heaters

ANSI Z21.40.1—1973 Standard for Gas-Fired Absorption Summer Air Conditioning
Appliance

ANSI Z21.44—1977 Standard for Gas-Fired Gravity and Fan Type Direct Vent
Wall Furnaces

ANSI Z21.47—1978 Standard for Gas-Fired Gravity and Fan Type Central
Furnaces

ANSI Z21.48—1979 Standard for Gas-Fired Gravity and Fan Type Floor Furnaces

ANSI Z21.49—1979 Standard for Gas-Fired Gravity and Fan Type Vented Wall
Furnaces

ANSI Z21.56—1979 Standard for Gas-Fired Swimming Pool Heaters

Available from: American Gas Association Laboratories
8510 East Pleasant Valley Road
Cleveland, OH 44131

ARCHITECTURAL ALUMINUM MANUFACTURERS ASSOCIATION

ANSI/AAMA
302.9—1977 Specifications for Aluminum Prime Windows

ANSI/AAMA
402.9—1977 Specifications for Aluminum Sliding Glass Doors

ANSI/AAMA
1002.10—1980 Specifications for Aluminum Combination Storm Windows
for External Application

ANSI/AAMA
1102.7—1977 Specification for Aluminum Storm Doors

Available from: Architectural Aluminum Manufacturers Association

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(Part 2, Title 24, C.A.C.)**

**35 East Wacker Drive
Chicago, IL 60601
(312) 782-8256**

NATIONAL WOODWORK MANUFACTURERS ASSOCIATION

ANSI/NWMA I.S. 1-80 Standard for Wood Flush Doors
ANSI/NWMA I.S. 2-80 Standard for Wood Window Units
ANSI/NWMA I.S. 3-70 Standard for Wood Sliding Patio Doors
ANSI/NWMA I.S. 5-73 Standard for Ponderosa Pine Doors
NWMA I.S. 610-79 Standard for Exterior Wood Swinging Doors

**Available from: National Woodwork Manufacturers Association
205 West Touhy Avenue
Park Ridge, IL 60068
312-823-6747**

**SHEET METAL AND AIR-CONDITIONING CONTRACTORS
NATIONAL ASSOCIATION**

"Applicable Standards"

FIR AND HEMLOCK DOOR ASSOCIATION

FHDA/7-79 Industry Standard for Douglas Fir, Western Hemlock, and Sitka
Spruce Doors.

**Available from: Fir and Hemlock Door Association
Yeon Building
Portland, OR 97204
503-224-3930**

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM E774-81 Specifications for Testing Seal Durability of Sealed Insulating Glass
Units.

**Available from: American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
215-299-5400**

CALIFORNIA ADMINISTRATIVE CODE

TITLE 24

(STATE BUILDING STANDARDS CODE)

Part 4

(State Mechanical Code)

Chapter 4-10 Ducts

CHAPTER 4-10

DUCTS

4-1000. Basic Provisions.

- (a) Except as provided herein, Chapter 10 of the UMC, as set forth in the table below, is hereby adopted by reference for the purpose of providing the basic mechanical regulations relating to ducts.
- (b) The following table identifies the sections of the UMC and this part which have been adopted by the listed agencies. See Section 4-104 for explanations of the abbreviations used in the table, the application of the regulations, and their intended use.

TABLE NO. 4-10A

Code Section	CEC
Entire Chapter	x ⁵
Entire Chapter, except as noted in this table	
1005	x ⁶

5 CEC Adopted by reference for new buildings of occupancy R (except apartment houses with four or more habitable stories and hotels). See Section 2-5352(f).

6 CEC Adopted by reference for Occupancies A, B, E, and H; See Section 2-5334. Adopted by reference for Occupancy R; see Section 2-5363. Adopted by reference for all occupancies under specified installation conditions; see Section 2-5305.

NOTE: Authority cited: Public Resources Code, Section 25402, 25922.
Reference: Public Resources Code, Section 25402, 25922.

