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California Energy Commission

Conservation Division

Regulations

Establishing

Energy Conservation Standards

for

New Residential and New Nonresidential Buildings

As Amended, July 26, 1978

FOREWARD

This document contains all sections of Title 24 of the California Administrative Code which have been adopted by the California Energy Commission. These regulations establish energy conservation standards for new residential and new nonresidential buildings. The vast majority of these regulations were adopted in 1977 and became effective July 1, 1978. In June and July of this year amendments were made to some parts of the regulations. In order to avoid confusion over what requirements are now in effect, and at the suggestion of the Office of Administrative Hearings, the Commission, on July 26th, re-adopted all the building regulations on an emergency basis. Thus, all the regulations in this document are now in effect, except as indicated below. They will remain in effect until further notice as they have also been adopted on a permanent basis.

On July 19, 1978, the California Energy Commission acted, pursuant to an order of the Marin County Superior Court, to set aside the following amendments made to sections 1402 and 1403 of the Residential Standards on March 11 and March 23 of 1977.

(a) Wall Regulation - The amendment to 20 Cal. Administrative Code Section 1403(a)(1) adopted March 11, 1977, which increased wall insulation requirements in low-rise buildings in areas over 4500 degree days.

(b) Ceiling Regulation - The amendment to 20 Cal. Administrative Code Section 1403(a)(2) adopted March 11, 1977, which increased ceiling insulation requirements in low-rise residential buildings above 3,000 degree days.

(c) Glazing Regulations

(1) The amendments to 20 Cal. Administrative Code Section 1403 (c)(1) adopted March 11, 1977, extending the requirement of double glazing from 4500 degree days to 3500 degree days effective July 1, 1978.

(2) The amendment to 20 Cal. Administrative Code Section 1403 (c)(1) extending the requirement of double glazing from 3500 degree days to 2600 degree days as of January 1, 1979.

(3) The amendment to 20 Cal. Administrative Code Section 1402 which reduces the basic glazing area of buildings with less than four stories (excluding basements, parking areas and nonhabital areas) from 20 percent to 16 percent of the gross floor area.

(4) The amendment to 20 Cal. Administrative Code Section 1402 changing the definition of special glazing from glazing with a maximum U value of .70 to glazing with a maximum U value of .65.

While this action was taken pursuant to an order of the Marin County Superior Court, the order is being appealed. If the appeal is successful, the standards set aside on July 19th will automatically go back into effect.

A number of builders' representatives have suggested a problem could occur if the standards set aside today are reinstated by action of the Court of Appeal. Specifically, the problem would be that a builder might submit plans which comply with the standards now in effect and then find that before his permit is issued, the new standards are reinstated. To alleviate this problem, the Commission has, by policy resolution, determined that it will not seek enforcement of the reinstated standards as to anyone who has submitted plans to a building department but has not yet had the plans approved before the standards are reinstated by the Court of Appeal. The Commission urges other parties to adopt a similar attitude to lessen the confusion caused by the Marin litigation. The Commission will continue to work with the building industry to attempt to make the transition to the new standards as smooth as possible.

California Energy Commission

Conservation Division

Regulations

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Energy Conservation Standards

for

New Residential Buildings

As Amended, July 26, 1978

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CALIFORNIA ADMINISTRATIVE CODE
TITLE 24, PART 6
ARTICLE 1

ENERGY CONSERVATION STANDARDS FOR NEW RESIDENTIAL BUILDINGS

T20-1401. General Provisions. (a) Scope. (1) This article applies to all new hotels, motels, apartment houses, lodging houses, dwellings, and other residential buildings which are heated or mechanically cooled. Notwithstanding the above, this article shall not apply to residential buildings in which 100 percent of the required energy for heating and cooling is derived from a nondepletable energy source. Section T20-1414 applies to residential buildings for which application for a building permit is made after December 23, 1976, but no building permit was issued before July 1, 1978.

Amended
July 26, 1978

(2) No building permit for any such residential building or renewal of an already issued building permit shall be issued by a city, county, city and county, or state agency on or after July 1, 1978, unless a review by the building department of the plans for the proposed building containing detailed energy system specifications confirms that the building satisfies the minimum requirements established in this article.

(3) On or after July 1, 1978, no governmental agency shall commence construction on any new residential building which has 10,000 gross square feet of conditioned floor area or less or which is designed to provide lighting for 1,000 hours per year or less or which is designed to provide space conditioning 1,000 hours per year or less unless it complies with the requirements of this article. On or after January 1, 1979, no governmental agency shall commence construction of any new residential building regardless of its size or hours of use unless it complies with the requirements of this article.

Added
July 26, 1978

(4) Notwithstanding any of the above, this article, except Section T20-1414, shall not apply to any building for which a building permit was issued prior to July 1, 1978, nor to any building excluded by reason of Section T20-1410 of this article.

(b) Mixed Occupancy. (1) When a building contains both residential and nonresidential occupancies, the residential occupancy portion of the building shall comply with these regulations and the nonresidential occupancy portion of the building shall comply with the Energy Conservation Standards for New Nonresidential Buildings as set forth in Title 24, Part 6, Division T20, Article 2, of the California Administrative Code.

Added
July 19, 1978

(2) Notwithstanding the provisions of subsection (b)(1), the entire building may, at the designers option, be treated for purposes of these regulations as a nonresidential building if the residential portion of the building is both less than 1000 square feet and less than 30 percent of the gross square feet of conditioned floor area.

(3) Notwithstanding the provisions of subsection (b)(1), the entire building may, at the designer's option, be treated for purposes of these regulations as a residential building if the nonresidential portion of the building is both less than 1000 square feet and less than 30 percent of the gross square feet of conditioned floor area.

Added
July 26, 1978

(c) Additions to Existing Buildings. All heated or cooled additions to existing residential buildings shall be constructed to comply with this Article.

The square footage of glazing which was physically eliminated from an existing structure by an addition may be added to that addition's basic glazing area.

The building official may approve alternate designs, including energy conservation measures in the existing structure, provided that the entire structure does not use more energy from depletable energy sources than would be required if the addition were constructed to conform to the provisions of this Article.

If the gross floor area of the addition is greater than 30 percent of the gross floor area of the existing structure, the accessible attic of the existing structure shall be insulated to conform to the provisions of this Article.

(d) Alternate Materials, Method of Construction, Design or Insulating System. The provisions of this Article are not intended to prevent the use of any material, method of construction, design or insulation system not specifically prescribed herein, provided that any such alternate has been approved by the building official as set forth below.

The U value of any component of roof deck, ceiling, wall or floor may be increased and the U value for other components decreased until the overall heat gain or heat loss of the building does not exceed the total resulting from conformance to the prescribed U values. Such alternate designs shall be based upon buildings of identical configuration.

The building official may approve any alternative design, including designs using nondepletable energy sources, provided he finds that the proposed design complies with the provisions of this Article in that the material, method of construction, design, or insulating system does not use more energy from depletable energy sources than the requirements of this Article.

The building official shall require that sufficient evidence be submitted to substantiate any claims made regarding the installation and use of any such alternate and may require testing of the final installation.

(e) Design Conditions. Inside winter design temperature shall be 70°F and inside summer design temperature shall be 78°F. Outdoor design temperatures for specific localities shall be those listed in Appendix T20-A. For localities not listed in Appendix T20-A, the outdoor design temperature shall be those listed in the columns of the Summer dry bulb, Summer wet bulb and Winter heating temperature from "Recommended Design Temperatures," published by ASHRAE Golden Gate and Southern California Chapters as follows:

	<u>Edition</u>	<u>Cooling</u>	<u>Heating</u>
Northern California	1965	1%	Median of Extremes
Southern California	1972	0.1%	Median of Extremes

For those localities not listed in these documents, the outdoor design temperatures shall be determined by the local enforcement agency having jurisdiction.

T20-1402. Definitions. For the purpose of this Article, the following definitions shall apply:

"Accessible" means having access thereto, but which first may require the removal of an access panel, door or similar obstruction.

"Actual Site Preparation and Construction" means any construction activity undertaken in reliance upon a foundation or building permit.

"Air Conditioner" means 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.

"ANSI" means the American National Standards Institute.

"Appliance Efficiency Regulations" means the California Administrative Code, Title 20, Chapter 2, Subchapter 4, Article 4.

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

"ASTM" means the American Society for Testing and Materials.

"Automatic" means 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" means an area of glazing equal to 16* percent of the gross floor area for buildings with less than four stories, excluding basements, parking areas and nonhabitable areas and 40 percent of the exterior wall area for all other buildings.

"Building Envelope" means the elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior.

"Building Official" means the designated city, county, or state official responsible for issuing the building permit.

"Central Air Conditioner" means an air conditioner which is not a room air conditioner.

"Claimant" means any person who files a claim of exemption under this Article.

"Climate Control System" means a system that provides either collectively or individually the processes of comfort heating, ventilating, and/or cooling within or associated with a building.

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*This value is the subject of litigation; for further information please consult the enclosed notice.

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"Coefficient of Performance (COP) - Heat Pump, Heating " means the ratio of the rate of useful heat output delivered by the complete heat pump unit (exclusive of supplementary heating) to the corresponding rate of energy input, in consistent units and under designated operating conditions. British thermal units shall be converted to kilowatt hours at the rate of 3413 British thermal units per kilowatt-hour.

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

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

"Degree Day, Heating" means 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 Appendix T20-A. For those localities not listed in Appendix T20-A the number of degree days shall be determined by the local enforcement agency having jurisdiction.

"Design Heat Loss" means the total calculated heat loss through the building envelope under design conditions.

"Energy Efficiency Ratio (EER)" means the ratio of net cooling capacity in Btu/hr to total rate of electric input in watts under designated operating conditions.

"Exterior Wall Area" means 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.

"Glazing" means all transparent or translucent materials in exterior openings.

"Glazing Area" means the area of glazing in exterior openings including the sash area.

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

"Gross Floor Area" means the sum of the areas of the several floors of the building, including basements, mezzanine and intermediate-floored tiers and penthouses of headroom height, measured from the exterior faces of exterior walls or from the centerline of walls separating buildings. Covered walkways, open roofed-over areas, porches and similar spaces shall be excluded. The gross floor area does not include such features as pipe trenches, exterior terraces or steps, chimneys, roof overhangs, parking garages, and unheated basements.

Added
July 19, 1978

Added
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"Gross Square Feet of Conditioned Floor Area" means the sum of the enclosed areas of conditioned space on all floors of the building, including basements, mezzanines, and intermediate floor tiers and penthouses, measured from the exterior faces of exterior walls and the centerline of walls separating conditioned and unconditioned spaces of the building.

Added
July 19, 1978

"Heat Pump" means an air conditioner which is capable of heating by refrigeration, and which may or may not include a capability for cooling.

"Infiltration" means the uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effect of wind and/or the effect of differences in the indoor and outdoor air density.

"Nondepletable Energy Source" means an energy source which cannot be exhausted by use, such as wind and solar energy. Energy sources which are renewable, such as wood can be considered to be nondepletable if, and only if, it can be shown that sufficient quantities of the resource are available at the site so that the rate at which the resource regenerates exceeds the anticipated rate of consumption.

Added
July 19, 1978

"Packaged Terminal Air Conditioner" means a room air conditioner consisting of a factory-selected combination of heating and cooling components, assemblies or sections, intended to serve an individual room or zone and constructed in a manner which complies with the definition contained in the Standard for packaged Terminal Air Conditioners approved by the Air-Conditioning and Refrigeration Institute in 1976, known as ARI-76.

"Residential Building" means a building which is heated or cooled and is of an occupancy type R-1 or R-3, as defined in the 1976 edition of the Uniform Building Code, as adopted by the International Conference of Building Officials.

"Residential Energy Conservation Manual" means the manual developed by the Commission to aid designers, builders, and contractors of buildings in meeting energy conservation standards.

Added
July 19, 1978

"Room Air Conditioner" means a factory encased air conditioner designed as a unit for mounting in a window or through a wall, or as a console. It is designed for delivery of conditioned air to an enclosed space without ducts. "Room air conditioner" includes packaged terminal air conditioners.

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

"Shading Coefficient" means 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.

"Special Glazing" means glazing which has a maximum U value of 0.65* for all glazed surfaces.

*This value is the subject of litigation; for further information please consult the enclosed notice.

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

"Thermal Resistance (R)" means the measure of the resistance of a material or building component to the passage of heat in $\frac{^{\circ}\text{F} - \text{sq ft.}}{\text{Btu/hr}}$. The resistance value (R) of mass type insulations shall not include any value for reflective facing.

"Tinted Glazing" means glazing material which is permanently tinted or permanently surface coated by the manufacturer and provides a maximum shading coefficient as hereinafter specified.

"U Value (Overall Coefficient of Heat Transfer)" means the heat flow rate through a given construction assembly, air to air, expressed in Btu/hr per sq ft $^{\circ}\text{F}$ temperature difference.

$$U = \frac{1}{R_t}$$

Where R_t equals the sum of the thermal resistances (R) for the individual components of the assembly. U values shall be calculated according to ASHRAE methods.

T20-1403.* Building Envelope. (a) Insulation.

(1) Walls. The U value of the opaque surfaces between conditioned and unconditioned spaces shall not exceed the values shown in Table A for the building types, wall densities and degree day ranges listed.

TABLE A

Degree Days	Building Type	Wall Density (pounds/square foot)	Maximum U Value	
			[1]	[2]
3500 or less	All	Over 40	0.16	Not Applicable
3500 or less	All	26 - 40	0.12	Not Applicable
3500 or less	All	25 or less	0.095	0.080
Over 3500, but not over 4500	All	All	0.095	0.080
Over 4500	(3)	All	0.065	0.055
Over 4500	(4)	All	0.095	0.080

[1] When the effects of all elements of the wall construction, including studs are considered or when all of the thermal insulation is installed so that it is not penetrated by framing members.

[2] When the effects of framing members such as studs are not considered.

(3) Buildings with less than four stories (excluding basements, parking areas and nonhabitable areas).

(4) Buildings with four or more stories (excluding basements parking areas and nonhabitable areas).

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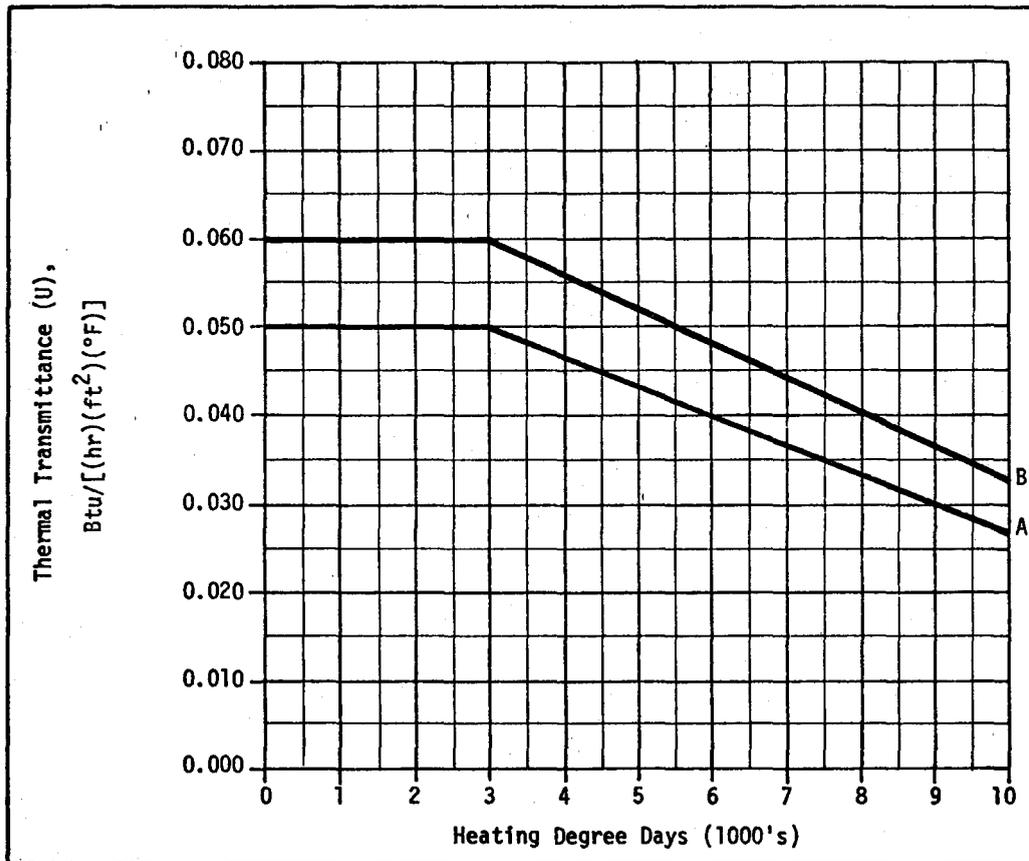
(2) Ceilings.

(A) The maximum allowable U value for ceilings in low rise buildings shall be as shown in Figure 1.

(B) The maximum allowable U value for ceilings on buildings with more than four stories shall be 0.050 when the effects of framing members such as joists are not considered. When the effects of all elements of the ceiling construction, are considered or when all of the thermal insulation is installed so that it is not penetrated by framing members, the U value shall not exceed 0.060.

*Portions of this section are the subject of litigation; for further information please consult the enclosed notice.

Figure 1



- NOTES: A. When the effects of framing members such as joists are not considered.
- B. When the effects of all elements of the ceiling construction, including framing members such as joists, are considered or when all of the thermal insulation is installed so that it is not penetrated by framing members.
- C. Blown or poured type insulating material may only be used in attic spaces where the slope of the roof is at least 2-1/2 feet in 12 feet and the distance from the top of the bottom chord of the truss or ceiling joists to the underside of the roof sheathing is at least 30 inches at the roof ridge. When eave vents are installed, adequate baffling of the vent opening shall be provided to deflect the incoming air above the surface of the material and shall be installed at the soffit on a 45-degree angle. Baffles shall be in place at the time of framing inspection. The thermal resistance (R) of the insulation required to comply with these regulations shall be shown on the building plans.

(3) Floor Section, Foundation Walls, Crawl Space Plenum Walls and Slab-on-Ground Floors.

(A) Floors over Unheated Spaces. For floors over unheated spaces, unheated basements, unheated garages, or ventilated crawl spaces, the U values of floor section shall not exceed the value shown in Table B.

TABLE B

Maximum U values of floor sections over unheated basements, unheated garages or crawl spaces.

Heating Degree Days	Maximum U Value
3000 or less	No requirement
over 3000	0.08

In lieu of the requirements of Table B, floor insulation may be omitted from buildings with less than four stories (excluding basement, parking areas and nonhabitable areas) with operable crawl space louvers if the foundation walls are insulated, a vapor barrier having a permeance of less than one perm is installed on the crawl-space ground surface, and the total building design heat loss with the louvers closed does not exceed the total resulting from conformance with the requirements of Table B.

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(B) Floors Over Heated Spaces. Foundation walls of heated basements or heated crawl spaces above grade shall be insulated to provide a U value not to exceed the values shown in Table C. Insulation may be omitted from floors over heated basement areas or crawl spaces if foundation walls are insulated.

TABLE C

Maximum U values of foundation wall sections of heated basement or heated crawl spaces

Heating Degree Days	Maximum U Values
2500 or less	No requirement
Over 2500	0.15

When a crawl space is used as a supply or return plenum, the crawl space perimeter wall shall be insulated to provide a maximum U value of 0.15.

(C) Slab-On-Ground Floors. For slab-on-ground floors, the edge heat loss around the perimeter of heated spaces shall not exceed the maximum value per linear foot of exposed edge of 21 Btuh for unheated slabs and 25 Btuh for heated slabs.

(4) Compliance. The building official shall be responsible for determining that the work required by these regulations has been properly completed. Upon completion of the installation of insulation, a card certifying that the insulation has been installed in conformance with the requirements of these regulations shall be completed and executed by the insulation applicator and by the builder. This insulation compliance card shall be posted at a conspicuous location within the dwelling.

(b) Vapor Barriers. In areas where the winter design temperature is 25°F or below, a vapor barrier having a permeance of less than one perm shall be installed on the heated side of the insulation in all exterior walls, unvented attics, or unvented crawl spaces.

(c) Glazing.

(1) Buildings with less than four stories (excluding basements, parking areas and nonhabitable areas).*

(A) For heated low-rise buildings located in areas of 3500 degree days or less, where the total glazing area exceeds the basic glazing area, treatment shall be required to limit the conducted design heat loss to that which would occur with the basic glazing area single glazed. On January 1, 1979, this standard shall apply only to heated low-rise buildings located in areas of 2600 degree days or less.

(B) Heated low-rise buildings located in areas over 3500 degree days shall be provided with special glazing for all exterior glazing. Where the total glazing area exceeds the basic glazing area, treatment, as specified in Section T20-1401(d) of these regulations, shall be required to limit the conducted design heat loss to that which would occur with the basic glazing area special glazed. On January 1, 1979, this standard shall apply to heated low-rise buildings in all areas over 2600 degree days.

(2) Buildings with four or more stories (excluding basements parking areas and nonhabitable areas).

*Subsection (c)(1) is the subject of litigation; for further information, please consult the enclosed notice.

treatment shall be required to limit the conducted design heat loss that that which would occur with the basic glazing area single glazed.

(B) Heated buildings located in areas over 4500 degree days shall be provided with special glazing for all exterior glazing. Where the total glazing area exceeds the basic glazing area, treatment shall be required to limit the conducted design heat loss to that which would occur with the basic glazing area in special glazing.

(3) Passive Solar.

In buildings with less than four stories, excluding basements, parking areas and nonhabitable areas, special glazing oriented within 22-1/2° of true South shall be exempt from the total glazing area if:

(A) The glazed area is shaded to protect it from direct solar exposure for the hours of 9:00 a.m., noon, and 3:00 p.m. solar time on August 21; and

(B) The glazed area receives direct solar exposure for the hours of 9:00 a.m., noon, and 3:00 p.m. solar time on December 21; and

(C) The thermal mass of the house exceeds the basic thermal mass by 30 Btu/°F for each square foot of exempt glazing.

The basic thermal mass in Btu/°F of a light-weight construction house with a slab floor is given by thermal mass = 2.25 x gross floor area (in square feet).

The thermal mass of slab floors or other massive elements inside the insulated envelope is given by thermal mass = (specific heat) x (weight). In the case of a concrete slab floor, the maximum allowable thermal mass shall be no more than 5 Btu/°F per square foot of slab.

(4) Cooled Buildings.

Cooled buildings shall utilize tinted glazing when the total glazing area exceeds the basic glazing area. The glazing area on walls oriented within 22-1/2 degrees of true North need not be included in the total glazing area. The required tinted glazing area shall not be less than the difference between the total glazing area and the basic glazing area. Permanent external shading to allow not more than 50 percent direct solar exposure on the glazing, taken on August 21 at 9:00 a.m., noon, and 3:00 p.m. solar time, may be utilized in lieu of tinted glass. Tinted glazing or permanent external shading on walls oriented within 22-1/2 degrees of true North shall not be considered as part of the required tinted glazing area. For purposes of this section, tinted glazing shall have a maximum shading coefficient of 0.55.

(d) Infiltration.

(1) Doors and Windows. All swinging doors and windows exposed to ambient conditions or to unconditioned areas such as garages shall be fully weatherstripped, gasketed or otherwise treated to limit infiltration. All manufactured windows and sliding glass doors shall meet the air infiltration standards of the 1972 American National Standards Institute (A134.1, A134.2, A134.3 and A134.4), when tested in accordance with ASTM E282-73 with a pressure differential of 1.57 lbs/ft² and shall be certified and labeled.

(2) Exhaust Fans. All fan systems exhausting air from the building envelope to the outside shall be provided with backdraft dampers or automatic dampers installed to prevent air leakage.

T20-1404. Climate Control Systems. (a) System Selection. Electric resistance heating systems shall not be used for space heating unless at least one of the following conditions is met:

(1) The electric resistance system is used to supplement a heating and/or cooling system by which at least 60% of the annual energy requirement is supplied by a device using a nondepletable source of energy.

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

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

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

The four alternatives considered shall be:

(A) A system in which 100% of the annual heating energy requirement is met by burning of natural gas in a central furnace.

(B) A system in which at least 90% of the annual heating energy requirement is met by a heat pump.

(C) A system in which at least 60% of the annual heating energy requirement is met by a solar collecting device or other device using a nondepletable source of energy.

(D) The system proposed for installation by which more than 10% of the annual heating energy requirement is met by electric resistance heating.

AMENDED JULY 19, 1978

(b) Life Cycle Cost Calculation. The procedure for determining life cycle costs shall take into account the initial cost of purchase and installation of the system, the expected life of the building, the expected life of the heating equipment, the replacement cost of the heating equipment and the operating and maintenance costs, year by year, for the expected life of the building. The procedure for determining life cycle costs shall be as shown in the Residential Energy Conservation Manual.

(c) Heating Equipment Sizing. The bonnet capacity of gas central furnaces in buildings for which the building permit is issued before January 1, 1979 shall not exceed the building design heat loss by more than 50 percent. If the building designer or contractor demonstrates that there is no equipment that has been tested by an accepted laboratory or that no equipment has been certified by the Commission pursuant to the Appliance Efficiency Regulations which meets this requirement, then installation of a gas central furnace whose bonnet capacity is not more than 30,000 British thermal units per hour greater than the building design heat loss shall be allowed.

The bonnet capacity of gas central furnaces in buildings for which the building permit is issued on or after January 1, 1979 shall not exceed the building design heat loss by more than 30 percent. Until June 30, 1979, if the building designer or contractor demonstrates that there is no equipment that has been tested by the Commission pursuant to the Appliance Efficiency Regulations which meets this requirement, then installation of a gas central furnace whose bonnet capacity is not more than 30,000 British thermal units per hour greater than the building design heat loss shall be allowed.

Notwithstanding the above requirements, central gas furnaces whose bonnet capacity does not exceed 48,000 British thermal units per hour may be installed in buildings for which the building permit is issued before July 1, 1979.

The building design heat loss shall be calculated using methods described in the Residential Energy Design Manual. The bonnet capacity shall be calculated using the method described in American National Standard ANSI Z21.47-1973.

(d) Ducts.

(1) Joints. All transverse duct, plenum and fitting joints shall be sealed with pressure sensitive tape or mastic to prevent air loss.

(2) Insulation. Insulation of ducts shall conform to the provisions of Section 1005 of the Uniform Mechanical Code, 1976 edition.

AMENDED JULY 19, 1978

T20-1405 Climate Control Equipment

(a) Electrically Operated Air Cooling Systems. No air conditioner of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in a building for which a building permit is issued on or after the applicable effective date shown in Section 1604 of the Appliance Efficiency Regulations unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the energy efficiency ratio, or seasonal energy efficiency ratio as applicable is not less than the values shown in Section 1604 of the Appliance Efficiency Regulations. This requirement only applies to buildings for which the building permit was issued on or after January 1, 1979.

The energy efficiency ratio 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, installed in buildings for which the building permit is issued on or after the effective date specified, shall be not less than the values shown in Tables 6-1, 6-2, 6-3 based on one of the test procedures specified in Table 6-4.

Table 6-1

Minimum EER for Air Conditioners
65,000 Btu Per Hour and Over
(Classification A in Table 6-4)

Effective Date	EER
October 1, 1978	6.8
January 1, 1980	7.5

Amended
July 19, 1978

ADDED JULY 19, 1978

Table 6-2

Minimum COP of Electrically
Driven Refrigerant and Condensing
Units 65,000 Btu/hour and Over
(Classification B in Table 6-4)

Effective Date	Condensing Means	
	Air	Evaporator or Water
October 1, 1978	2.3	3.3
January 1, 1980	2.5	3.5

Table 6-3

Minimum COP of Electrically
Driven Water Chilling Packages
(Classification C in Table 6-4)

Condensing Means	Air	Water
Effective October 1, 1978	C 2.2	3.8
	R 2.1	3.2
Effective January 1, 1980	C 2.3	4.0
	R 2.2	3.4

where C = Centrifugal,
R = Reciprocating or Rotary

ADDED JULY 19, 1978

Table 6-4

Test Procedures for Electrically Operated
Air Cooling Systems

<u>Classification</u>	<u>Type</u>	<u>Test Procedure</u>
A	Unitary Air Conditioning Equipment	ARI 210-75
	Commercial and Industrial Unitary Air Conditioning Equipment	ARI 360-75
	Air Source Unitary Heat Pump Equipment	ARI 240-77
	Water Source Unitary Heat Pump Equipment	ARI 320-76
	Commercial and Industrial Heat Pump Equipment	ARI 340-76
	<hr/>	
B	Positive Displacement Refrigerant Condensing Units	ARI 520-74
<hr/>		
C	Centrifugal or Rotary Water-Chilling Packages	ARI 550-77
	Reciprocating Water-Chilling Packages	ANSI/ARI 590-1976
<hr/>		

(b) Heat Operated Cooling Equipment. The coefficient of performance of heat-operated cooling equipment installed in buildings for which the building permit is issued on or after the effective date specified shall be not less than the values shown in Table 6-5 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.

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 for Absorption Water Chilling Packages, 560-75. Direct-Fired, absorption water chillers and air conditioners shall comply with ANSI Standard for Gas-Fired Absorption Summer Air Conditioning Appliances, Z21.40.1-73, 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.

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Table 6-5

Minimum COP of Heat-Operated Cooling Equipment

Effective Date	Heat Source	
	Direct Fired (Gas, Oil)	Indirect Fired (Steam, Hot Water)
July 1, 1978	0.40	0.65
January 1, 1980	0.48	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) No gas-fired comfort heating equipment of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in a building for which the building permit was issued on or after the applicable effective date shown in Section 1604 of the Appliance Efficiency Regulation unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the steady state efficiency, or seasonal efficiency is not less than the values shown in Section 1604 of the Appliance Efficiency Regulations and the energy consumption during standby does not exceed the values shown.

(2) No gas-fired fan type central furnace or gas-fired fan type wall furnace (except those designed to burn only liquefied petroleum gases) shall be installed in a building for which the building permit is issued on or after the applicable effective date shown in Section 1605 of the Appliance Efficiency Regulations unless it complies with the intermittent ignition device requirements of Section 1603 of the Appliance Efficiency Regulations.

(d) Heat Pumps - Heating Mode. (1) Heat pumps whose energy input is entirely electric, installed in buildings for which the building permit is issued before December 22, 1978, shall, have a Coefficient of Performance (COP) - heating of not less than the values shown in Table 6-7, based on one of the test procedures specified in Table 6-8.

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Table 6-7

Minimum COP - Heating
of Heat Pumps

Air Source		Water Source
47°F outdoor temperature	17°F outdoor temperature	
2.2	1.2	2.2

Test Procedures for
Heat Pumps - Heating Mode

<u>Type</u>	<u>Test Procedure</u>
Room Air Conditioners	ANSI/AHAM RAC-1
Packaged Terminal Heat Pumps	ARI 380-78
Air Source Unitary Heat Pump Equipment	ARI 240-77
Water Source Unitary Heat Pump Equipment	ARI 320-76
Commercial and Industrial Unitary Heat Pump Equipment	ARI 340-76

(2) No heat pumps of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in a building for which the building permit is issued on or after December 22, 1978 unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the adjusted coefficient of performance, is not less than the values shown in Section 1604 of the Appliance Efficiency Regulations.

(3) The heat pump shall be installed with a control to prevent supplementary heater operation when the heating load can be met by the heat pump alone. Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat set-point 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

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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.

(e) Identification of Complying Equipment. The energy efficiency ratio, coefficient of performance, adjusted coefficient of performance, thermal efficiency and/or combustion efficiency of equipment described in Subsections T20-1405(a) through T20-1405(d) shall be shown on the documents submitted to the building official for approval and on the equipment.

(f) Electric Resistance Comfort Heating Equipment. 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.

(g) Maintenance. Equipment which requires preventive maintenance to maintain 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.

(h) Responsibility of Equipment Suppliers. 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.

(i) Intermittent Ignition Devices on Gas Cooking Appliances

No gas-fired household cooking appliance, except those designed to burn only liquefied petroleum gases, or those which do not have an electrical line voltage supply connection and have three or less continuously burning pilot lights, shall be installed unless it has been certified by the Commission as complying with the intermittent ignition device requirements of Section 1604 of the Appliance Efficiency Regulations. No gas-fired, household cooking appliance, except those designed to burn only liquefied petroleum gases and those which do not have an electrical line voltage supply connection and have only one continuously burning pilot light consuming less than 150 Btus per hour, shall be installed in buildings for which a building permit is issued on or after January 1, 1979, unless it has been certified by the Commission.

ADDED JULY 19, 1978

T20-1406 Water Heating.

(a) Equipment Efficiency. (1) No water heaters of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in buildings for which the building permit is issued on or after December 22, 1978, unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations, and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the recovery efficiency, or thermal efficiency (as applicable), is not less than the values shown and the standby loss does not exceed the values shown in Section 1604 of the Appliance Efficiency Regulations.

(2) Gas- and 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 Z21.10.3 1975-Gas Water^r Heaters, Vol. III, Circulating Tank, Instantaneous and Large Automatic Storage-Type Water Heaters. For oil-fired units, CF = 1.0; Q = total gallons of oil consumed; and H = total heating value of oil in Btu/gallon.

If the building designer demonstrates that no storage type water heater, whose capacity is within 50 gallons of the required capacity, has been certified by any manufacturer pursuant to the Appliance Efficiency Regulations as meeting the requirement for standby loss, installation in buildings for which the building permit is issued before January 1, 1979, of a storage type water heater whose standby loss exceeds

$$2.3 + \frac{67}{CAP} \text{ percent}$$

shall be allowed.

(3) Automatic electric storage water heaters installed in buildings for which the building permit is issued before December 22, 1978 shall have a standby loss not exceeding 4 watts per square foot of tank surface area. The method of test of stand-by loss shall be as described in Section 4.3.1 of ANSI C72-1-1972 Household Automatic Electric Storage-Type Water Heaters.

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(b) Service Water Heating. Electric resistance water heating systems shall not be used unless the life cycle cost of equivalent natural gas and solar systems exceeds the life cycle cost of the electric resistance system. The procedure for determining life cycle costs is shown in the Residential Energy Conservation Manual.

(c) Swimming Pool Heating. Swimming pool heating systems for buildings for which a building permit is issued on or after December 15, 1978, shall be selected on the basis of the lowest life cycle cost of equivalent natural-gas and solar-energy systems. The procedure for determining life cycle costs is shown in the Residential Energy Conservation Manual.

(d) Pipe Insulation. Steam and steam-condensate return piping and recirculating hot-water piping in attics, garages, crawl spaces or unheated spaces other than between floors or in interior walls shall be insulated to provide maximum loss of not more than 50 Btu/hr. per linear foot for piping up to and including 2 inch nominal diameter and 100 Btu/hr. per linear foot for larger sizes.

(e) 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 1000 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.

(f) Showerheads and Faucets. Commencing January 1, 1979, showerheads, lavatory faucets and sink faucets, used for other than safety reasons, shall be equipped with flow control devices to limit total flow to maximum of three gallons per minute.

In addition, no showerhead, lavatory faucet or sink faucet, used for other than safety reasons, shall be installed unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations, and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations that the water flow rate does not exceed the values shown in Section 1604 of the Appliance Efficiency Regulations.

Amended
July 26, 1978

Added
July 26, 1978

1407. Enforcement by the Commission. (a) All plans and energy system specifications for proposed residential buildings in areas where there is no local building department and for proposed public buildings shall be reviewed by the executive director of the Commission or his designee to confirm by written certification that the building satisfies the requirements of this Article.

(b) If a local building department fails to enforce these regulations, the executive director or his designee may, after furnishing ten days written notice to the local building department, review all plans and energy system specifications for proposed residential buildings to confirm by written certification that the building satisfies the requirements of this Article.

(c) The executive director may promulgate such procedures for the submission of plans and specifications as are necessary and reasonable to carry out the purposes of these regulations.

1408. Interpretations by the Commission. The Commission or its designee may make a determination as to the application or interpretation of Sections 25402(a) and (b) of the Public Resources Code or these regulations if a dispute arises between an applicant for a building permit and the building department. Either party may request such a determination and shall submit the request in writing. The Commission or its designee shall make written replies to such requests which shall be binding on the parties except for replies made by a designee which may be appealed to the full Commission for final determination. Those interpretations which have wide application or interest shall be broadly published.

ADDED JULY 19, 1978

1409. Enforcement of State and Local Energy Conservation Standards.

(a) Nothing in this Article or Sections 25402(a), 25402(b), and 25402.1 of the Public Resources Code shall prohibit the enforcement of state or local energy conservation or energy insulation standards adopted prior to July 1, 1978, with regard to any residential buildings on which actual site preparation and construction have commenced prior to July 1, 1978.

(b) Nothing in this Article or Sections 25402(a), 25402(b) and 25402.1 of the Public Resources Code shall prohibit the enforcement of local energy conservation or energy insulation standards, whenever adopted, with regard to any residential building on which actual site preparation and construction have not commenced prior to July 1, 1978, provided the Commission finds that such local standards will require the diminution of energy consumption levels permitted by this Article for residential buildings.

(1) Any local agency requesting such a finding shall submit the following to the Commission: (A) a copy of its local energy conservation or energy insulation standards, (B) any supplementary materials needed for determination of energy savings and (C) a short statement describing how its local standards will require the diminution of energy consumption levels permitted by these regulations. Twelve copies of the above materials shall be submitted unless the executive director indicates otherwise. Any additional material that is needed for a complete staff analysis may be requested from the local agency by the executive director, general counsel or their designees.

(2) The executive director shall distribute copies of the material to each member and ex officio member, the general counsel, the public adviser, and all persons who have requested in writing that a copy of the materials be provided.

(3) As soon as practicable, the executive director or his designee shall analyze the submitted materials. No later than 45 days after submission of the materials, the executive director, or his designee, in consultation with the general counsel, shall issue a recommendation on whether the local agency's standards will require the diminution of energy consumption levels permitted by these regulations. Such recommendation shall be considered at the next regularly scheduled Commission business meeting, but in no event shall it be considered before ten days notice has been given to the local agency.

(4) The executive director shall notify each local agency whose request has been filed and for which a recommended decision has been prepared, of the receipt of the filing, the number assigned to the filing, the date, time, and place at which the filing will be considered by the Commission, the recommended decision, and the general procedure of the Commission concerning hearings. Notice shall also be sent to any person requesting notice in writing.

(5) At the hearing, the executive director shall enter into the record all evidence relating to the local agency's filing. Notice of the Commission's decision shall be sent to the local agency and to any person who has requested such notice.

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1410. Claims of Exemption. Any person who has not begun actual site preparation and construction and who wishes to claim an exemption for any proposed building from the requirements of Sections 25402 and 25402.1 of the Public Resources Code and the regulations adopted pursuant thereto must file a claim of exemption and obtain approval in accordance with the provisions of this Article. The claimant in all proceedings under this Article shall assume the burden of proof.

1411. Filing and Distribution of Claims of Exemption. (a) All claims of exemption shall be made on forms published by the executive director. The forms shall be revised as necessary to assist claimants in providing the information necessary to substantiate a claim. The claim shall be verified by the claimant under penalty of perjury.

(b) The claimant shall also furnish the following supporting documentation where relevant:

- (1) Contracts entered into by the claimant pertaining to the project.
- (2) Internal financial reports relative to the project accounts.
- (3) Dated schedules of design activities.
- (4) A progress report on project completion.
- (5) Any additional evidence in support of the claim.

(c) The claimant shall submit twelve copies of the claim of exemption to the executive director. Only one copy of supporting documentation need be included unless the executive director requests otherwise.

(d) At any time after submission of a claim, the executive director, general counsel or their designees may request from the claimant such information as is needed for a complete staff analysis of the claim.

(e) The executive director shall distribute copies of the claim to each member and ex officio member, the general counsel, the public adviser, and all persons who have requested in writing that a copy of the claim be provided.

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1412. Initial Review and Recommendation on Claims of Exemption.

(a) As soon as practicable after filing of a claim, the executive director shall review and prepare a summary of the claim. No later than 45 days after filing of a claim, the executive director, in consultation with the general counsel, shall submit a written recommendation for action on the claim and reasons therefor to the Commission. Such recommendation shall be considered at the next regularly scheduled Commission business meeting, but in no event shall it be considered before ten days notice has been given to the claimant.

(b) Notice. The executive director shall notify each claimant whose claim has been filed, and for which a recommended decision has been prepared, of the receipt of the filing, the number assigned to the claim, the date, time, and place at which the claim will be considered by the Commission, the recommended decision, and the general procedure of the Commission concerning hearings and action on claims. Notice shall also be sent to any person requesting notice in writing.

(c) The meeting agenda need only specify that claims for exemption pursuant to Sections 25402 and 25402.1 of the Public Resources Code will be considered. Notice of the specific claims that will be considered each week need be sent only to the claimant, the members and ex officio members, the general counsel, the public adviser, and those persons who have requested in writing such notice.

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1413. Hearing Procedure for Claims of Exemption. (a) All claims shall be placed on the consent calendar for public hearing and processed in the manner provided by Title 20, Section 1104(e). Upon the request of any interested person with the concurrence of a commissioner, a claim shall be removed from the consent calendar and shall be considered at the same meeting or continued to a later meeting as a separate item of business. Such requests may be made orally at the hearing or in writing prior to the hearing at which a claim is scheduled to be considered.

(b) At the hearing, the executive director shall enter into the record all evidence relating to the claim.

(c) No claim shall be approved unless the Commission finds that:

(1) substantial funds have been expended in good faith on planning, designing, architecture or engineering prior to March 23, 1977;

(2) compliance with Sections 25402 and 25402.1 of the Public Resources Code and regulations adopted pursuant thereto would be impossible without substantial delays in construction; and

(3) compliance with Sections 25402 and 25402.1 of the Public Resources Code and regulations adopted pursuant thereto would be impossible without substantial increases in cost of construction.

(d) A proposed building shall be presumed to be one for which compliance would be impossible without substantial delays and increases in cost of construction, and for which substantial funds have been expended in good faith on planning, designing, architecture, or engineering prior to the date of adoption of this Article if all of the following conditions are satisfied:

(1) The building has an occupant load greater than 299, as determined from Table 2-2 of Article 2 of this subchapter.

(2) By January 1, 1978, (i) a legally enforceable written lease had been executed; or binding financing commitment had been made, or an application submitted to a governmental agency for a permit or approval, and (ii) where such lease, financing commitment, permit, or approval would be lost if design changes to the building were necessary in order to comply with the energy conservation standards; and

(3) By January 1, 1978, all of the following documents had been completed and at least one of them submitted to a governmental entity in support of an application for a permit or approval: site plan, floor plan, building elevations, schematic drawings, outline specification, and tentative budget.

(e) The decision on the claim shall either approve or disapprove the claim in whole or in part, and shall include a statement of reasons supporting the decision. A certificate of exemption shall be issued for those claims which the Commission approves. Unless otherwise decided by the Commission, the executive director's report and recommended decision shall be deemed adopted as the statement of reasons supporting the decision. The Commission's decision shall be final.

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(f) Notice of the decision shall be sent to the claimant and to any person who has requested such notice.

1414. Energy Insulation Standards for Buildings For which a Building Permit is Issued before July 1, 1978. (a) Scope. The requirement of this section shall apply to all applications for building permits made subsequent to December 23, 1976 but shall not apply to any building for which a building permit is issued on or after July 1, 1978. Additions to existing hotels, motels, apartment houses, lodging houses, dwellings and other residential buildings shall be constructed to comply with this section if the existing building was required to be constructed in conformance with this section.

(b) Alternate Materials, Method of Construction, Design or Insulation System. The requirements of subsection T20-1401(d) shall apply to this section.

(c) Definitions. The definitions in subsection T20-1401(e) shall apply to this section.

(d) Thermal Design Standards For Ceiling and Walls. The design of the opaque surfaces of the structure, exposed to ambient conditions, shall provide a maximum U factor of 0.05 for ceilings and 0.08 for walls and spandrels, when the effects of occasional framing members such as studs and joists are not considered. In lieu of the above, when the effects of all elements of the wall or ceiling construction, including occasional framing members such as studs and joists, are considered or when all of the thermal insulation is installed so that it is not penetrated by framing members, the U factor shall not exceed 0.095 for walls and 0.06 for ceilings.

For buildings located in areas of 3500 degree days or less and the effects of all elements of the wall construction are considered, the U factor shall not exceed 0.12 for walls with a construction weight of 26 through 40 pounds per square foot or a U factor not exceeding 0.16 for walls with a construction weight greater than 40 pounds per square foot.

(e) Thermal Design Standards For Glazing.

(1) For heating buildings located in areas of 4500 degree days or less, where the total glazing area exceeds the basic glazing area, treatment shall be required to limit the conducted design heat loss to that which would occur with the basic glazing area single glazed.

(2) Heated buildings located in areas over 4500 degree days shall be provided with special glazing for all exterior glazing. Where the total glazing area exceeds the basic glazing area, treatment shall be required to limit the conducted design heat loss to that which would occur with the basic glazing area in special glazing.

(3) Cooled buildings shall utilize tinted glazing when the total glazing area exceed the basic glazing area. The glazing area on walls oriented within 22 1/2 degrees of true North need not be included in total glazing area. The required tinted glazing area shall not be less than the difference between the total glazing area and the basic glazing area. Permanent external shading to allow not more than 50 percent direct

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solar exposure on the glazing, taken on August 21, at 9:00 a.m., noon and 3:00 p.m. solar time, may be utilized in lieu of tinted glass. Tinted glazing or permanent external shading on walls oriented within 22 1/2 degrees of true North shall not be considered as part of the required tinted glazing area.

(4) Tinted glazing shall have a maximum shading coefficient of 0.55.

(f) Floor Section, Foundation Walls, Crawl Space Plenum Walls and Slabs-On-Grade. For floors over unheated spaces, unheated basements, unheated garages, or ventilated crawl spaced with operable louvers, the "U" values of floor section shall not exceed the value shown in Table D.

Table D

Maximum "U" Values of Floor Sections Over Unheated Basements, Unheated Garage or Crawl Spaces

Heating Degree Days	Maximum "U" Value
3000 or less	No requirement
3001 to 4500	0.10
Over 4500	0.08

Note: A basement or garage shall be considered unheated unless it is provided with a positive heat supply to maintain a minimum temperature of 50°F.

Foundation walls of heated basements or heated crawl spaces above grade shall be insulated to provide a "U" value not to exceed the values shown in Table C. Insulation may be omitted from floors over heated basement areas or heated crawl spaces if foundation walls are insulated. A crawl space is considered heated when it has a positive heat supply to maintain a minimum temperature of 50°F.

When a crawl space is used as a supply or return plenum, the crawl space perimeter wall shall be insulated to provide a maximum "U" value of 0.15.

For slab-on-ground floors, the edge heat loss around the perimeter of heated spaces shall not exceed a maximum value per linear foot of exposed edge of 42 Btuh for heated slabs. Calculations of heat loss around slab edges shall be made using the following formula:

$$H = F \times P$$

WHERE

H = Heat loss of the slab edge in Btuh

F = Heat loss coefficient from Table E in Btuh per linear foot of exposed edge.

P = Perimeter of exposed slab edge (linear feet)

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Table E

Slab Edge Heat Loss Coefficients (Btuh per Linear Foot)

Winter Design Temperature	Total Width of Insulation (Inches)	F for Unheated Slab			F for Heated Slab		
		R=5.00	R=3.75	R=2.50	R=5.00	R=3.75	R=2.50
-30 or colder	24	34			46		
-25 to -29	24	32			44		
-20 to -24	24	30			41		
-15 to -19	24	28			39		
-10 to -15	24	27	40		37		
- 5 to - 9	24	25	38		35		
Zero to -4	24	24	36		32	48	
+ 5 to + 1 ¹	24	22	33		30	45	
+10 to + 6 ¹	18	21	31	42	25	38	50
+15 to +11 ¹	12	21	31	42	25	38	50

¹Where winter design temperatures are warmer than +15F, perimeter insulation is not required. If installed in these areas (edge only) use values shown for +15F to +11F above. If not installed, use value of F = 45 for unheated and F = 60 for heated slabs.

(g) Doors and Windows. All swinging doors and windows opening to the exterior to unconditioned areas such as garages shall be fully weather-stripped, gasketed or otherwise treated to limit infiltration. All manufactured windows and sliding glass doors shall meet the air infiltration standards of the 1972 American National Standards Institute (A134.1, A134.2, A134.3 and A134.4), when tested in accordance with ASTM E283-73 with a pressure difference of 1.5 lbf/ft² and shall be certified and labeled.

(h) Loose Fill. Blown or poured type loose fill may be used in attic spaces where the slope of the roof is not less than 2 1/2 feet in 12 feet and there is at least 30 inches of clear headroom at the roof ridge. ("Clear Headroom" is defined as the distance from the top of the bottom chord of the truss or ceiling joists to the underside of the roof sheathing.) When eave vents are installed, adequate baffling of the vent opening shall be provided to deflect the incoming air above the surface of the material and shall be installed at the soffit on a 45-degree angle. Baffles shall be in place at the time of framing inspection. When loose fill insulation is proposed, the R value of the material required to meet these regulations shall be shown on the building plans.

(i) Design Temperature. Inside winter design temperature shall not be less than 70°F., and summer design temperature not greater than 78°F. Heat loss and heat gain calculations shall be made using the winter design dry bulb

at 99 percent and summer design dry bulb at 2 1/2 percent shown in the current ASHRAE. Handbook of Fundamentals.

(j) Pipe Insulation. All steam and steam condensate return piping and all continuously circulating domestic or heating hot water piping which is located in attics, garages, crawl spaces or unheated spaces other than between floors or in interior walls shall be insulated to provide a maximum heat loss of 50 Btu/hr, per linear foot for piping up to and including 2" and 100 Btu/hr, per linear foot for larger sizes.

(k) Compliance. Upon completion of the installation of insulation, a card certifying that the insulation has been installed in conformance with the requirements of these regulations shall be completed and executed by the insulation applicator and by the builder. This insulation compliance card shall be posted at a conspicuous location within the dwelling.

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APPENDIX T20-A

Climate Design Data

<u>City</u>	<u>Annual Heating Degree Days</u>	<u>Winter Design - 1%</u>	<u>Summer Design - 2 1/2%</u>
Alameda Naval Air Station	2,900	35 °F	78 °F
Alderpoint	3,290		
Alpine	2,104	32	98
Alturas	6,785	-1	90
Anaheim	1,490	35	91
Antioch	2,627	30	93
Arcata	4,800	32	65
Auburn	3,047	31	96
Bakersfield	2,122	30	101
Barrett Dam	2,363	26	97
Barstow	2,496	24	102
Beale AFB	2,400	28	100
Beaumont	2,790	28	96
Benicia	2,600	33	90
Berkeley	2,850	39	84
Bishop	4,275	16	98
Blythe AP	1,076	31	109
Bolinas	2,800	36	75
Bonita	1,897	32	91
Borrego Springs	1,262	28	106
Brawley	1,161	32	110
Brisbane	3,060	36	78
Burbank AP	1,800	36	96
Burlingame	2,650	34	79
Burney	6,249	5	90
Buttonwillow	2,010	23	102
Cabrillo NM	1,653	43	85
Calaveras Big Trees	5,736		
Calabasas	1,800	31	98
Campo	3,247	21	96
Capitola	2,900	34	82
Carmel	2,900	35	78
Carmichael	2,800	31	98
Carpinteria	2,290	34	85
Castle AFB	2,550	30	99
Castroville	2,900	32	82
Central Valley	3,010	29	99
Ceres	2,750	30	99
Chico	2,795	29	100
China Lake	2,570	22	106

<u>City</u>	<u>Annual Heating Degree Days</u>	<u>Winter Design - 1%</u>	<u>Summer Design - 2 1/2%</u>
Chowchilla	2,400	30	99
Chula Vista	2,229	36	80
Claremont	1,600	33	98
Cloverdale	2,666	31	96
Clovis	2,600	28	101
Colfax	3,441	25	89
Colusa	2,788	30	100
Concord	2,766	32	92
Corning	2,790	30	101
Corona	1,875	33	95
Corte Madera	2,600	33	88
Crescent City	4,545	33	69
Culver City	1,711	38	88
Cuyamaca	4,649	16	86
Daggett AP	2,203	24	103
Daly City	3,100	37	76
Danville	2,700	28	94
Davis	2,819	30	99
Death Valley	1,205	35	116
Deep Spr. Clg.	4,300	28	95
Delano	2,220	31	103
Dixon	2,800	30	98
Dunsmuir	5,300	16	94
Edwards AFB	3,123	21	102
El Cajon	1,920	30	96
El Capitan Dam	1,397	32	100
El Centro	1,216	31	110
Elk Valley	5,404		
Elsinore	2,101	28	102
Encinitas	1,952	39	83
Escondido	2,052	31	93
Eureka	4,679	35	65
Fairfield	2,434	30	95
Fairmont	3,327	28	94
Fair Oaks	2,900	29	99
Fillmore	2,377	33	90
Folsom	2,899	30	99
Fort Bidwell	6,365		
Fort Bragg	4,424	34	67
Fort Jones	5,614		

<u>City</u>	<u>Annual Heating Degree Days</u>	<u>Winter Design - 1%</u>	<u>Summer Design - 2 1/2%</u>
Fortuna	4,700	34	72
Fremont	2,906	30	89
Fresno	2,611	29	99
Galt	2,780	30	97
Garberville	3,510	30	85
Gardena	1,700	37	86
Gilroy	2,808	28	94
Grass Valley	4,400	26	93
Gridley	2,600	30	100
Gustine	2,360	30	100
Half Moon Bay	2,700	35	73
Hamilton Air Force Base	2,600	33	85
Hanford	2,642	28	100
Hawthorne	1,800	37	88
Hayward	2,850	30	85
Healdsburg	2,700	30	94
Henshaw Dam	3,652	20	96
Hetch Hetchy	4,797	18	90
Hillsdale	2,650	35	83
Hollister	2,725	30	91
Huntington Beach	2,361	40	81
Imperial Airport	1,060	33	109
Independence	2,995	19	96
Inyokern	2,570	23	102
Ione	2,728	28	96
Jackson	2,760	31	91
Julian Wynola	4,085	21	91
King City	2,655	25	93
Lafayette	2,700	29	92
Laguna Beach	2,262	37	80
La Jolla	1,750	40	84
Lake Arrowhead	5,200	20	86
Lakeport	3,716	25	89
Lakewood	1,800	38	90
La Mesa	1,492	37	91
Lancaster	3,100	17	102
Laytonville	4,160	25	90
Lemoore	2,960	29	100
Lincoln	2,890	30	100
Lindsay	2,619	30	100

<u>City</u>	<u>Annual Heating Degree Days</u>	<u>Winter Design - 1%</u>	<u>Summer Design - 2 1/2%</u>
Live Oak	2,370	30	100
Livermore	2,781	28	97
Lodi	2,785	30	97
Lompoc	2,900	30	78
Long Beach Airport	1,803	38	84
Los Angeles Airport	2,061	41	85
Los Banos	2,267	28	100
Los Gatos	2,794	32	89
McCloud	6,007	11	86
Madera	2,485	30	100
Manteca	2,600	30	98
Maricopa	2,165	32	101
Mariposa	3,116	27	96
Markleeville	7,884	8	83
Martinez	2,650	32	91
Marysville	2,377	32	100
Mecca	1,117	29	108
Mendota	2,555	29	100
Merced	2,697	29	99
Mineral	7,192		
Mitchell Cavern	2,510	26	99
Modesto	2,767	32	98
Moffett Naval Air Station	2,800	34	85
Mojave	2,590	25	100
Monterey	2,985	34	82
Morro Bay	1,600	36	83
Mount Shasta	5,800	14	87
Napa	2,690	31	92
Needles Airport	1,072	33	110
Nellie	4,745		
Nevada City	4,488	20	93
Newport Beach	2,350	37	80
Novato	2,815	30	89
Oakdale	2,832	28	99
Oak Grove	3,516	26	95
Oakland	2,906	35	85
Oceanside	2,092	37	82
Orland	2,830	30	101
Oroville	2,597	30	100
Oxnard	2,352	35	86

<u>City</u>	<u>Annual Heating Degree Days</u>	<u>Winter Design - 1%</u>	<u>Summer Design - 2 1/2%</u>
Palmdale Airport	3,088	24	101
Palm Springs	1,232	31	110
Palo Alto	2,869	34	88
Palomar, Mt. Observatory	3,868	21	84
Paradise	4,010	28	97
Pasadena	1,694	35	93
Paso Robles Airport	2,890	26	100
Patterson	2,368	30	100
Perris	2,100	27	101
Petaluma	2,966	29	91
Pismo Beach	2,800	34	85
Pittsburg	2,633	32	93
Placerville	4,161	25	96
Point Loma	1,860	44	83
Pomona	2,166	31	96
Porterville	2,563	30	100
Portola	7,055	-1	88
Quincy	5,852	10	93
Ramona Spaulding	2,223	26	99
Red Bluff	2,688	31	101
Redding	2,610	31	101
Redlands	2,052	34	96
Redwood City	2,596	32	86
Richmond	2,644	35	85
Ripon	2,700	30	99
Riverside	2,089	32	100
Roseville	2,899	30	100
Sacramento Executive Airport	2,782	29	97
St. Helena	2,833	28	95
Salinas	2,959	32	85
San Bernardino	2,018	31	101
San Clemente	1,877	38	81
San Diego	1,439	42	84
San Fernando	1,800	34	97
San Francisco Airport	3,080	42	80
San Jacinto	2,376	25	105
San Jose	2,656	34	88
San Juan Capistrano	1,646	39	82
San Luis Obispo	2,582	35	90

<u>City</u>	<u>Annual Heating Degree Days</u>	<u>Winter Design - 1%</u>	<u>Summer Design - 2 1/2%</u>
San Mateo	2,655	36	87
San Rafael	2,619	34	90
Santa Ana	1,496	33	91
Santa Barbara	2,290	34	84
Santa Clara	2,566	31	88
Santa Cruz	2,900	32	84
Santa Maria	2,985	32	82
Santa Paula	2,400	32	93
Santa Rosa	2,980	29	93
Scotia	3,954	34	78
Sierraville	6,953		
Sonora	3,086	29	96
South San Francisco	3,061	36	79
South San Gabriel	1,600	34	95
Squaw Valley	8,200	-2	84
Stockton	2,690	30	98
Stony Gorge Reservoir	3,124	29	99
Susanville	6,248	4	89
Tahoe City	8,162	7	77
Tahoe Valley	8,198	2	84
Thousand Oaks	2,425	32	93
Tracy	2,616	30	98
Truckee	8,208	-4	84
Twentynine Palms	2,006	28	104
Ukiah	3,030	27	96
Vacaville	2,812	29	98
Vallejo	2,598	33	88
Vincent	3,510	21	99
Visalia	2,526	32	100
Vista	2,546	35	87
Warner Springs	3,470	24	96
Weaverville	4,935	16	96
Weed	5,870	8	86
Willits	4,160	17	89
Willows	2,807	30	100
Woodland	2,447	30	100
Yosemite	4,800	18	90
Yreka	5,393	13	94
Yuba City	2,386	31	100

California Energy Commission

Conservation Division

Regulations

Establishing

Energy Conservation Standards

for

New Nonresidential Buildings

As Amended July 26, 1978

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CALIFORNIA ADMINISTRATIVE CODE

TITLE 24, PART 6

ARTICLE 2. ENERGY CONSERVATION STANDARDS FOR NEW

NONRESIDENTIAL BUILDINGS

DIVISION 1. GENERAL PROVISIONS

T20-1451. Application and Scope. (a) No building permit or renewal of an already issued building permit for any nonresidential building having conditioned space shall be issued by a local building department on or after July 1, 1978, unless a review by the building department of the plans for the proposed nonresidential building containing detailed energy system specifications confirms that the building satisfies the minimum requirements established in this Article.

(b) On or after July 1, 1978, no governmental agency shall commence construction on any new nonresidential building which has 10,000 gross square feet of conditioned floor area or less or which is designed to provide lighting for 1000 hours per year or less or which is designed to provide space conditioning 1000 hours per year or less unless it complies with the requirements of this Article. On or after January 1, 1979, no governmental agency shall commence construction on any new nonresidential building regardless of its size or hours of use unless it complies with the requirements of this Article.

(c) Notwithstanding any of the above, and except as provided in Section T20-1455 of these regulations, these regulations shall not apply to any building for which a permit was issued prior to July 1, 1978, nor to any building excluded by reason of Section T20-1456 or T20-1461 of these regulations.

(d) Notwithstanding any of the above, these regulations shall not apply to conditioned space intended for use with occupancy group I as defined in the Uniform Building Code, 1976 Edition.

T20-1452. Definitions. For the purpose of this Article, the following definitions shall apply:

"Accessible" means having access thereto, but which first may require the removal or opening of an access panel, door or similar obstruction.

"Actual Site Preparation and Construction" means any construction activity undertaken in reliance upon a foundation or building permit.

"Addition" means an extension or increase in floor area or height of a building or structure.

"Air Conditioner" means 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.

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Added July 19, 1978

July 19, 1978
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"Alteration" means any change, addition or modification in construction or occupancy.

"ANSI" means the American National Standards Institute.

"Appliance Efficiency Regulations" means the California Administrative Code, Title 20, Chapter 2, Subchapter 4, Article 4.

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

"ASTM" means the American Society for Testing and Materials.

"Automatic" means 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.

"Building Envelope" means the elements of a building which enclose conditioned spaces through which thermal energy may be transferred to or from the exterior.

"Central Air Conditioner" means an air conditioner which is not a room air conditioner.

"Claimant" means any person who files a claim of exemption pursuant to this Article.

"Coefficient of Performance (COP) - Cooling" means 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.

"Coefficient of Performance (COP) - Heat Pump, Heating" means the ratio of the rate of useful heat output delivered by the complete heat pump unit (exclusive of supplementary heating) to the corresponding rate of energy input, in consistent units and under designated operating conditions. British thermal units shall be converted to kilowatt hours at the rate of 3413 British thermal units per kilowatt-hour.

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

"Conditioned Space" means space, within a building, which is provided with a positive heat supply or a positive method of cooling.

"Degree Day, Heating" means 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 Appendix T20-B of these regulations. For those localities not listed in Appendix T20-B of these regulations, the number of degree days shall be determined by the applicable enforcement agency.

"Energy Conservation Design Manual" means the Energy Conservation Manual for Nonresidential Buildings, developed pursuant to the Health and Safety Code Section 19878.4, to aid designers, builders and contractors of nonresidential buildings in meeting energy conservation standards.

"Energy Efficiency Ratio (EER)" means the ratio of net cooling capacity in Btu/hr to total rate of electric input in watts under designated operating conditions.

"General Lighting" means lighting designed to uniformly illuminate an entire area.

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

"Gross Square Feet of Conditioned Floor Area" means the sum of the enclosed areas of conditioned space on all floors of the building, including basements, mezzanines, and intermediate floor tiers and penthouses, measured from the exterior faces of exterior walls and the centerline of walls separating conditioned and unconditioned spaces of the building.

"Heat Pump" means an air conditioner which is capable of heating by refrigeration, and which may or may not include a capability for cooling.

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

"Infiltration" means the uncontrolled inward air leakage through cracks and interstices in any building element and around windows and doors of a building, caused by the pressure effect of wind and/or the effect of differences in the indoor and outdoor air density.

"Manual" means capable of being operated by personal intervention.

"New Energy" means electrical or chemical energy converted to thermal or mechanical energy expressly for the purpose of comfort heating or cooling.

"Nondepletable Energy Source" means an energy source which cannot be exhausted by use, such as wind and solar energy.

"Nonresidential Building" means any building having conditioned space with an occupancy group other than Group H, I, or J as defined in the Uniform Building Code, 1973 edition, as adopted by the International Conference of Building Officials. These occupancies are equivalent to occupancy groups R1, R3, and M as defined in the Uniform Building Code, 1976 edition.

"Outside Air" means air taken from outdoors and not previously circulated through the system.

"Plenum" means an air compartment connected to one or more air inlets or outlets.

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"Packaged Terminal Air Conditioner" means a room air conditioner consisting of a factory-selected combination of heating and cooling components, assemblies or sections, intended to serve an individual room or zone and constructed in a manner which complies with the definition contained in the Standard for Packaged Terminal Air Conditioners approved by the Air-Conditioning and Refrigeration Institute in 1976, known as ARI 310-76.

"Readily Accessible" means 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" means the application of cooling as a secondary process to either preconditioned primary air or recirculated room air.

"Recovered Energy" means energy utilized which would otherwise be wasted from an energy utilization system.

"Reheat" means the application of heat as a secondary process to either preconditioned primary air or recirculated room air.

"Repair" means the reconstruction or renewal of any part of an existing building for the purpose of its maintenance.

"Replacement Value", as used in Section T20-1455 of these regulations, means the estimated cost to replace the building in kind, based on current replacement costs.

"Room Air Conditioner" means a factory encased air-conditioner designed as a unit for mounting in a window or through a wall, or as a console. It is designed for delivery of conditioned air to an enclosed space without ducts. "Room air conditioner" includes packaged terminal air conditioners.

"Service Systems" means the HVAC, service water heating, electrical distribution, and illuminating systems provided in a building.

"Service Water Heating" means heating of water for domestic or commercial purposes other than comfort heating.

"Shading Coefficient" means 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" means any opening in the roof surface which is glazed with a transparent or translucent material.

"Task-Oriented Lighting" means lighting designed specifically to illuminate one or more task locations, and generally confined to those locations.

"U Value (Overall Coefficient of Thermal Transmittance)" means the heat flow rate through a given construction assembly, air to air, expressed in Btu per hour per square foot of area, per °F temperature difference.

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"Ventilation Air" means 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.

"Zone" means a space or group of spaces within a building combined for common control of heating or cooling.

T20-1453. Design Requirements. Nonresidential buildings comply with these regulations if they comply with the requirements of any one of Subsections (a), (b), or (c) as applicable.

(a) A nonresidential building complies with these regulations if it is designed and constructed so that its service systems consume no more energy than is permitted by Section T20-1470 of these regulations as determined by the analysis described in Section T20-1471 of these regulations and to comply with the standards set forth in Section T20-1475 of these regulations.

(b) A nonresidential building 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 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 nonresidential building complies with these regulations if it is designed and constructed in accordance with each of the provisions of Divisions 4 through 9 of these regulations.

T20-1454. Mixed Occupancies. (a) When a building contains both residential and nonresidential occupancies, the nonresidential occupancy portion of the building shall comply with these regulations and the residential occupancy portion of the building shall comply with the Energy Conservation Standards for New Residential Buildings as set forth in Title 24, Part 6, Division T20, Article 1, of California Administrative Code.

(b) Notwithstanding the provisions of subsection (a), the entire building may, at the designers option, be treated for purposes of these regulations as a nonresidential building if the residential portion of the building is both less than 1000 square feet and less than 30 percent of the gross square feet of conditioned floor area.

(c) Notwithstanding the provisions of subsection (a), the entire building may, at the designer's option be treated for purposes of these regulations as a residential building if the nonresidential portion of the building is both less than 1000 square feet and less than 30 percent of the gross square feet of conditioned floor area.

T20-1455. Additions, Alterations, and Repairs. Additions, alterations, repairs to existing buildings shall comply with these requirements to the following extent and in the following manner:

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(a) When the cost of additions, alterations, or repairs exceeds 50 percent of the replacement value of the existing building, the entire building shall be made to comply with these regulations.

(b) When the cost of additions, alterations, or repairs does not exceed 50 percent of the replacement value of the existing building, and the building was previously heated or cooled, the new construction shall comply with these regulations, as they relate to the new construction only.

(c) When the cost of additions, alterations, or repairs does not exceed 50 percent of the replacement value of the existing building, and a portion of the building which was not previously heated or cooled is to become heated or cooled, the new construction shall comply with these regulations, as they relate to the new construction only, and the portion of the building to be heated or cooled shall comply with the energy conservation regulations applicable to heated or cooled buildings which were in effect when the building permit was issued for the original construction.

(d) Notwithstanding any of the above, no specific requirement set forth in Divisions 4 through 9 of these regulations shall apply to additions, alterations, or repairs of nonresidential buildings built before July 1, 1978, if 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.

T20-1456. Historic Buildings. These regulations shall not apply to the reconstruction or restoration of any building that has been designated by official government action as having historical or architectural significance.

T20-1457. Design and Compliance Requirements. (a) 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 floor area not exceeding 1,000 square feet and an occupant load not exceeding 49 persons.

(b) 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

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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 appears to have been 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.

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

T20-1458. Enforcement by the Commission. (a) All plans and energy system specifications for proposed nonresidential buildings in areas where there is no local building department and for proposed public nonresidential buildings shall be reviewed by the executive director of the Commission or his designee to confirm by written certification that the building satisfies the requirements of this Article.

(b) If a local building department fails to enforce these regulations, the executive director or his designee may, after furnishing ten days written notice to the local building department, review all plans and energy system specifications for proposed nonresidential buildings to confirm by written certification that the building satisfies the requirements of this Article.

(c) The executive director may promulgate such procedures for the submission of plans and specifications as are necessary and reasonable to carry out the purposes of these regulations.

T20-1459. Interpretations by the Commission. (a) The Commission or its designee shall make a determination as to the application or interpretation of any rule or regulation of these standards to any person, firm, corporation or governmental agency requesting such a determination. Any such request for determination shall be submitted in writing through the local enforcement agency. The Commission shall make written replies to such inquiries and shall broadly publish interpretations which have broad application or interest.

The Commission may promulgate rules and procedures necessary to carry out the purpose of this section.

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(b) The Commission or its designee may make a determination as to the application or interpretation of Section 25402 (a) and (b) of the Public Resources Code or these regulations if a dispute arises between an applicant for a building permit and the building department. Either party may request such a determination and shall submit the request in writing. The Commission or its designee shall make written replies to such requests which shall be binding on the parties except for replies made by a designee which may be appealed to the full Commission for final determination. Those interpretations which have wide application or interest shall be broadly published.

(c) Any person who believes that a building permit has been issued or denied in violation of these regulations shall have the right to file a complaint pursuant to Title 20, Chapter 2, Sections 1230-1238 of the California Administrative Code.

T20-1460. Enforcement of State and Local Energy Conservation Standards

(a) Nothing in this article or Sections 25402(a), 25402(b), and 25402.1 of the Public Resources Code shall prohibit the enforcement of state or local energy conservation or energy insulation standards adopted prior to July 1, 1978, with regard to any nonresidential buildings on which actual site preparation and construction have commenced prior to July 1, 1978.

(b) Nothing in this article or Sections 25402(a), 25402(b) and 25402.1 of the Public Resources Code shall prohibit the enforcement of local energy conservation or energy insulation standards, whenever adopted, with regard to any nonresidential building on which actual site preparation and construction have not commenced prior to July 1, 1978, provided the Commission finds that such local standards will require the diminution of energy consumption levels permitted by this article for nonresidential buildings.

(1) Any local agency requesting such a finding shall submit the following to the Commission: (a) a copy of its local energy conservation or energy insulation standards, (b) any supplementary materials needed for determination of energy savings and (c) a short statement describing how its local standards will require the diminution of energy consumption levels permitted by these regulations. Twelve copies of the above materials shall be submitted unless the executive director indicates otherwise. Any additional material that is needed for a complete staff analysis may be requested from the local agency by the executive director, general counsel or their designees.

(2) The executive director shall distribute copies of the material to each member and ex officio member, the general counsel, the public adviser, and all persons who have requested in writing that a copy of the materials be provided.

(3) As soon as practicable, the executive director or his designee shall analyze the submitted materials. No later than 45 days after submission of the materials, the executive director, or his designee, in consultation with the general counsel, shall issue a recommendation on whether the local agency's standards will require the diminution of energy consumption levels permitted by these regulations. Such recommendation

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shall be considered at the next regularly scheduled Commission business meeting, but in no event shall it be considered before ten days notice has been given to the local agency.

(4) The executive director shall notify each local agency whose request has been filed and for which a recommended decision has been prepared, of the receipt of the filing, the number assigned to the filing, the date, time, and place at which the filing will be considered by the Commission, the recommended decision, and the general procedure of the Commission concerning hearings. Notice shall also be sent to any person requesting notice in writing.

(5) At the hearing, the executive director shall enter into the record all evidence relating to the local agency's filing. Notice of the Commission's decision shall be sent to the local agency and to any person who has requested such notice.

T20-1461. Claims of Exemption. Any person who has not begun actual site preparation and construction and who wishes to claim an exemption for any proposed building from the requirements of Sections 25402 and 25402.1 of the Public Resources Code and the regulations adopted pursuant thereto must file a claim of exemption and obtain approval in accordance with the provisions of this Article. The claimant in all proceedings under this Article shall assume the burden of proof.

T20-1462. Filing and Distribution of Claims of Exemption. (a) All claims of exemption shall be made on forms published by the executive director. The forms shall be revised as necessary to assist claimants in providing the information necessary to substantiate a claim. The claim shall be verified by the claimant under penalty of perjury.

(b) The claimant shall also furnish the following supporting documentation where relevant:

- (1) Contracts entered into by the claimant pertaining to the project.
- (2) Internal financial reports relative to the project accounts.
- (3) Dated schedules of design activities.
- (4) A progress report on project completion.
- (5) Any additional evidence in support of the claim.

(c) The claimant shall submit twelve copies of the claim of exemption to the executive director. Only one copy of supporting documentation need be included unless the executive director requests otherwise.

(d) At any time after submission of a claim, the executive director, general counsel or their designees may request from the claimant such information as is needed for a complete staff analysis of the claim.

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(e) The executive director shall distribute copies of the claim to each member and ex officio member, the general counsel, the public adviser, and all persons who have requested in writing that a copy of the claim be provided.

T20-1463. Initial Review and Recommendation on Claims of Exemption.

(a) As soon as practicable after filing of a claim, the executive director shall review and prepare a summary of the claim. No later than 45 days after filing of a claim, the executive director, in consultation with the general counsel, shall submit a written recommendation for action on the claim and reasons therefor to the Commission. Such recommendation shall be considered at the next regularly scheduled commission business meeting, but in no event shall it be considered before ten days notice has been given to the claimant.

(b) Notice. The executive director shall notify each claimant whose claim has been filed, and for which a recommended decision has been prepared, of the receipt of the filing, the number assigned to the claim, the date, time, and place at which the claim will be considered by the Commission, the recommended decision, and the general procedure of the Commission concerning hearings and action on claims. Notice shall also be sent to any person requesting notice in writing.

(c) The meeting agenda need only specify that claims for exemption pursuant to Sections 25402 and 25402.1 of the Public Resources Code will be considered. Notice of the specific claims that will be considered each week need be sent only to the claimant, the members and ex officio members, the general counsel, the public adviser, and those persons who have requested in writing such notice.

T20-1464. Hearing Procedures for Claims of Exemption. (a) All claims shall be placed on the consent calendar for public hearing and processed in the manner provided by Title 20, Section 1104(e). Upon the request of any interested person with the concurrence of a commissioner, a claim shall be removed from the consent calendar and shall be considered at the same meeting or continued to a later meeting as a separate item of business. Such requests may be made orally at the hearing or in writing prior to the hearing at which a claim is scheduled to be considered.

(b) At the hearing, the executive director shall enter into the record all evidence relating to the claim.

(c) No claim shall be approved unless the Commission finds that:

(1) substantial funds have been expended in good faith on planning, designing, architecture or engineering prior to June 30, 1977;

(2) compliance with Sections 25402 and 25402.1 of the Public Resources Code and regulations adopted pursuant thereto would be impossible without substantial delays in construction; and

(3) compliance with Sections 25402 and 25402.1 of the Public Resources Code and regulations adopted pursuant thereto would be impossible without substantial increases in cost of construction.

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(d) A proposed building shall be presumed to be one for which compliance would be impossible without substantial delays and increases in cost of construction, and for which substantial funds have been expended in good faith on planning, designing, architecture, or engineering prior to the date of adoption of this Article if all of the following conditions are satisfied:

(1) The building has an occupant load greater than 299, as determined from table 2-2 of this Article;

(2) By January 1, 1978, (i) a legally enforceable written lease had been executed or binding financing commitment made or an application had been submitted to a governmental agency for a permit or approval, and (ii) where such lease, financing commitment, permit, or approval would be lost if design changes to the building were necessary in order to comply with the energy conservation standards; and

(3) By January 1, 1978, all of the following documents had been completed and at least one of them submitted to a governmental entity in support of an application for a permit or approval: site plan, floor plan, building elevations, schematic drawings, outline specification, and tentative budget.

(e) The decision on the claim shall either approve or disapprove the claim in whole or in part, and shall include a statement of reasons supporting the decision. A certificate of exemption shall be issued for those claims which the Commission approves. Unless otherwise decided by the Commission, the executive director's report and recommended decision shall be deemed adopted as the statement of reasons supporting the decision. The Commission's decision shall be final.

(f) Notice of the decision shall be sent to the claimant and to any person who has requested such notice.

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DIVISION 2. ENERGY BUDGETS

T20-1470. Energy Requirements for Building Designs. (a) A nonresidential building complies with these regulations if it is designed and constructed to comply with Section T20-1475 of this division and if the total calculated annual energy consumption of its service systems does not exceed the product of the gross floor area of conditioned space (in square feet) and the allowable energy budget (in Btu per year per square foot) as set forth in Table 2-1 of this division.

(b) When a nonresidential building 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 floor area of conditioned space (in square feet) 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 2-1 of this division.

(c) When part of a building is designed and constructed for residential occupancy and part of the building is designed and constructed for nonresidential occupancy, and the nonresidential occupancy exceeds 30 percent of the gross 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

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

Where A = area of conditioned space (ft^2)
 B = energy budget ($\text{Btu}/\text{ft}^2/\text{yr}$) (ft^2)

(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 of these regulations.

(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 gross 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 as may be required by the process or manufacturing systems, equipment or appliances mentioned pursuant to this section.

T20-1471. Energy Analysis Program. (a) The Cal/ERDA (CAL/CON) Public Domain Computer Program for Building Energy Calculation or any other computer program certified pursuant to Section T20-1472 of this division shall be used to determine the calculated annual energy consumption for comparison with the maximum allowable energy consumption listed in Table 2-1.

(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 2-1 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.

T20-1472. Energy Analysis Program Certification. The Executive Director shall certify programs which may be used in lieu of the Cal/ERDA (CAL/CON) program to demonstrate compliance with this article. Certification shall be given for any program that produces results substantially similar to results produced by the Cal/ERDA (CAL/CON) program. Any program widely accepted and used in industry but producing results not substantially similar to results produced by the Cal/ERDA (CAL/CON) program may be certified with appropriate correction factors to be used with such program to permit demonstration of compliance with this article. The Executive Director may revoke certification of any program not found to be consistent with the current state of the art. The Executive Director may establish procedures for the submission of information on any program proposed for certification that will ensure the comparability of results. The Executive Director shall publish a list of all approved programs.

T20-1473. Comparison of Energy Forms. For the purposes of Section T20-1470 of these regulations, total calculated annual electricity consumption shall be converted to British thermal units at the rate of 10,239 British thermal units per kilowatt hour.

T20-1474. Documentation. 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.

T20-1475. Mandatory Standards. Sections T20-1495, T20-1503, T20-1505, T20-1507, T20-1508, T20-1509, T20-1521, T20-1522, T20-1523, T20-1530, and T20-1541(b) of Divisions 4 through 9 of these regulations shall apply to all nonresidential buildings, including, but not limited to, those buildings seeking to comply with the energy budget requirements of this division.

Table 2-1
 Maximum Allowable Energy Consumption Per Year
 (Thousands of British Thermal Units Per Gross Square Foot of Conditioned Floor Area)

UBC Occupancy (1)	Occupant Load (2)	Climatic Thermal Zones 1-5 (3)			Climatic Thermal Zones 6,8,9,10			Climatic Thermal Zone 7			Climatic Thermal Zones 11, 12, 13			Climatic Thermal Zones 14,15			
		Heated & Cooled (4)	Heated Only	Cooled Only	Heated & Cooled	Heated Only	Cooled Only	Heated & Cooled	Heated Only	Cooled Only	Heated & Cooled	Heated Only	Cooled Only	Heated & Cooled	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	
B-2	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	
	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	
	class-rooms	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 B-4 H	104	104	104	65	65	65	63	63	63	92	92	92	80	80	80		
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

- (1) Occupancy, as defined in the Uniform Building Code, 1976 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.
- (2) Occupant load, calculated as described in Table 2-2.
- (3) Climatic thermal zone, as described in Figure 2-1.
- (4) Use appropriate columns for buildings that are heated and cooled, heated only or cooled only.
- (5) Maximum allowable energy consumption values are under development for UBC occupancy I.

Figure 2-1

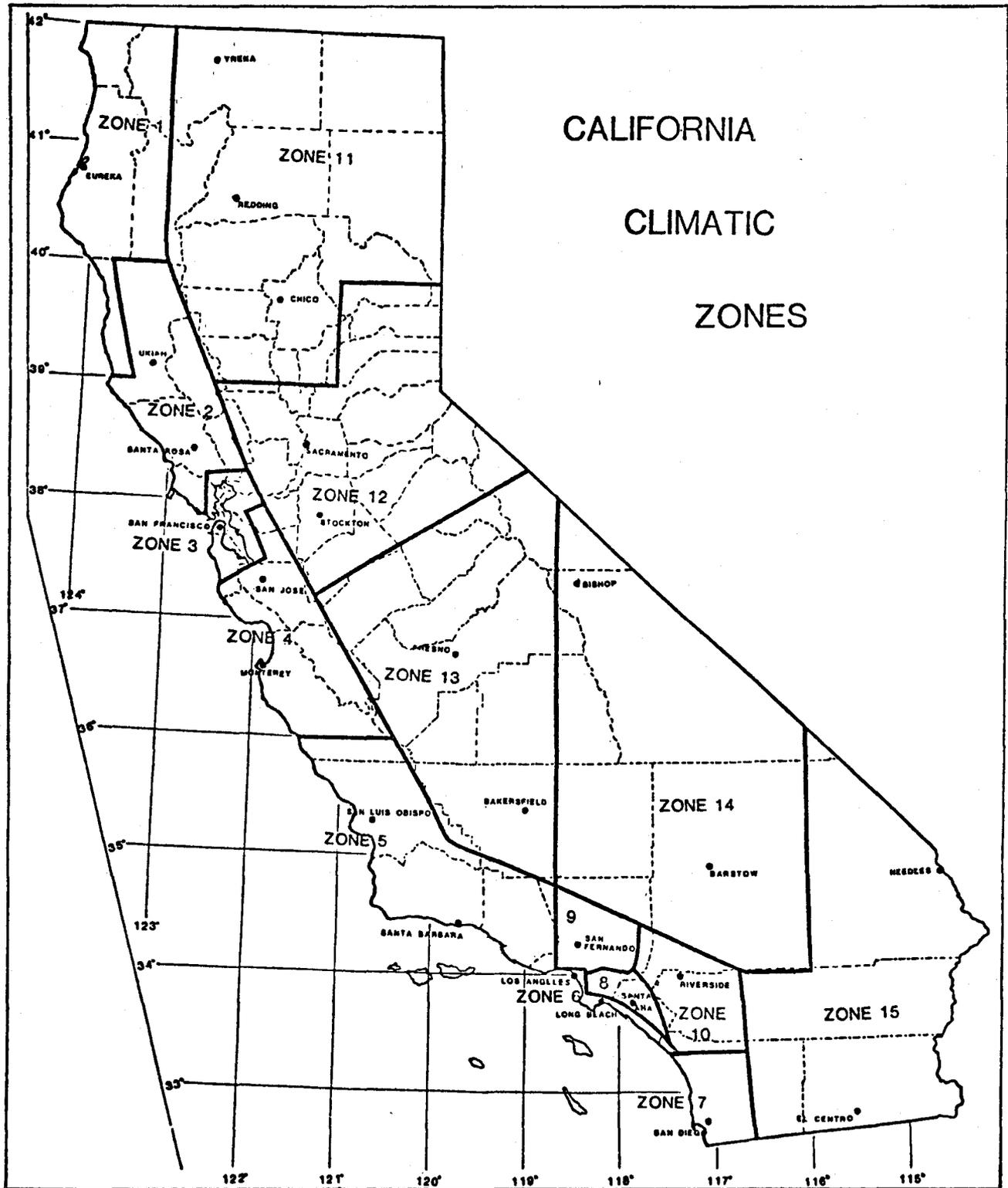


TABLE 2-2

<i>Use</i>	<i>Square Feet Per Occupant</i>
Aircraft Hangers.....	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.....	7
Assembly Areas	
Less Concentrated Use	
Conference Rooms.....	15
Dining Rooms.....	15
Drinking Establishments.....	15
Exhibit Rooms.....	15
Gymnasiums.....	15
Lunges.....	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

Note. The occupant load in any building or portion thereof shall be determined by dividing the gross square feet of conditioned floor area assigned to the specified use by the square feet per occupant set forth in this table.

When the gross square feet of conditioned floor area per occupant are not given for a particular occupancy, it shall be determined by the enforcement agency based on the area given for the occupancy which it most nearly resembles.

Exception: 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.

DIVISION 3. NONDEPLETABLE ENERGY SOURCES

T20-1480. Requirements for Buildings Utilizing Nondepletable Energy Sources. (a) General. When a proposed nonresidential building design submitted and evaluated in accordance with Division 2 of these regulations 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 Sections T20-1457 or T20-1474.

DIVISION 4. BUILDING ENVELOPE

T20-1490. General. (a) This division establishes minimum requirements for thermal design of the building envelope of nonresidential buildings. 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.

(b) Notwithstanding subsection (a), the provisions of this division shall only apply where the total connected output capacity of either the heating or cooling system exceeds 10 Btu per hour per square foot of gross floor area of the conditioned space.

T20-1491. Alternatives. 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 and/or heat loss for the entire building envelope does not exceed the total resulting from conformance to the stated U values.

T20-1492. Design Conditions. For the purposes of calculations called for in this division, indoor design temperature shall be 70°F for heating and 78°F for cooling.

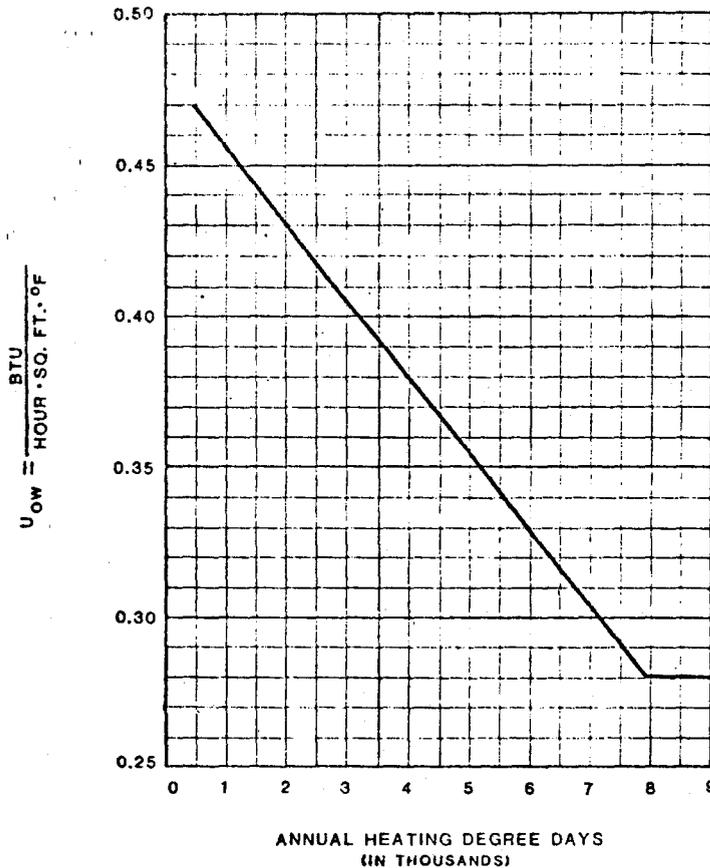
Outdoor design temperatures for specific localities shall be those listed in the center columns of the summer dry bulb, summer wet bulb, and winter heating temperatures from Recommended Design Temperatures, published by ASHRAE Golden Gate and Southern California Chapters, as follows:

	Edition	Cooling	Heating
Northern California	1965	2-1/2%	1%
Southern California	1972	0.5%	0.2%

T20-1493. Heating Design Criteria. (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 4-1 for the degree days shown in Appendix T20-B of these regulations.

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 4-1.

FIGURE 4-1
MAXIMUM U_{ow} VALUE 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 the building that faces heated spaces, ft²
- U_{wall} = the thermal transmittance of all elements of the opaque wall area, adjusted for the effect of framing in the insulated building section, Btu/hr ft²°F
- A_{wall} = opaque wall area, ft²
- MCF = Mass Correction Factor, value given in Table 4-1
- 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 sub-elements, as

$$U_{wall_1} A_{wall_1} MCF_1 + U_{wall_2} A_{wall_2} MCF_2, \text{ etc.}$$

TABLE 4-1

Weight of Wall Construction Pounds/Feet ²	MCF	Note: The values in Table 4-1 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	
41-80	0.75	
81 and above	0.65	

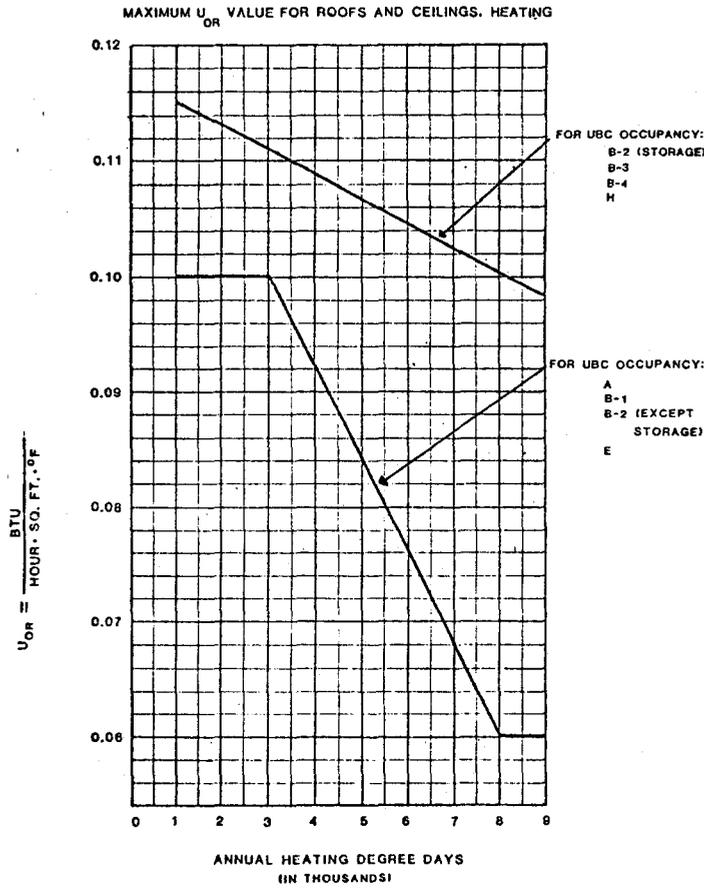
(b) Roof/Ceiling. The combined thermal transmittance value (U_{or}) for the gross roof area, including skylights, that enclose heated spaces shall not exceed the values shown in Figure 4-2 for degree days listed in Appendix T20-B. A roof assembly shall be considered as those components of the roof envelope 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 4-2.

(1) For buildings that are heated only, skylight areas up to 5% 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% of the gross roof area is in skylights, automatic light sensitive switching will be required and the skylight area in excess of 5% must be included in the U_{or} calculations in Equation 4-2.

FIGURE 4-2



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

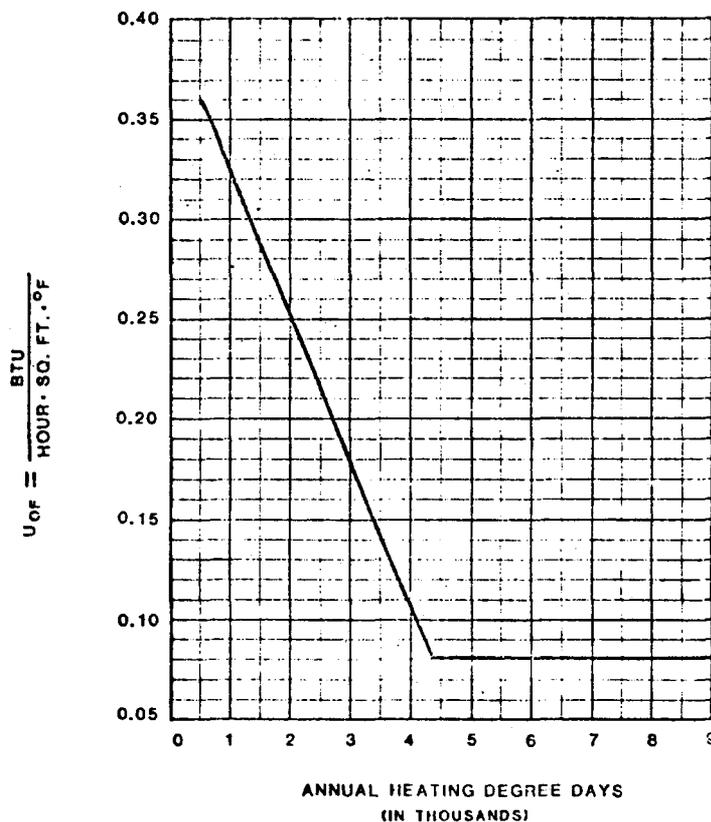
U_{skylight} = the thermal transmittance of the skylight area,
Btu/hr ft²°F

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 sub-elements, as: $U_{\text{roof}_1} A_{\text{roof}_1} + U_{\text{roof}_2} A_{\text{roof}_2}$ etc.

(c) Floors Over Unheated Spaces. For floors of heated spaces over unheated spaces or outdoors, the U_{of} value of the floor section shall not exceed the value shown in Figure 4-3 for the degree days shown in Appendix T20-B of these regulations.

FIGURE 4-3
MAXIMUM U_{of} VALUE FOR FLOORS OVER UNHEATED SPACES

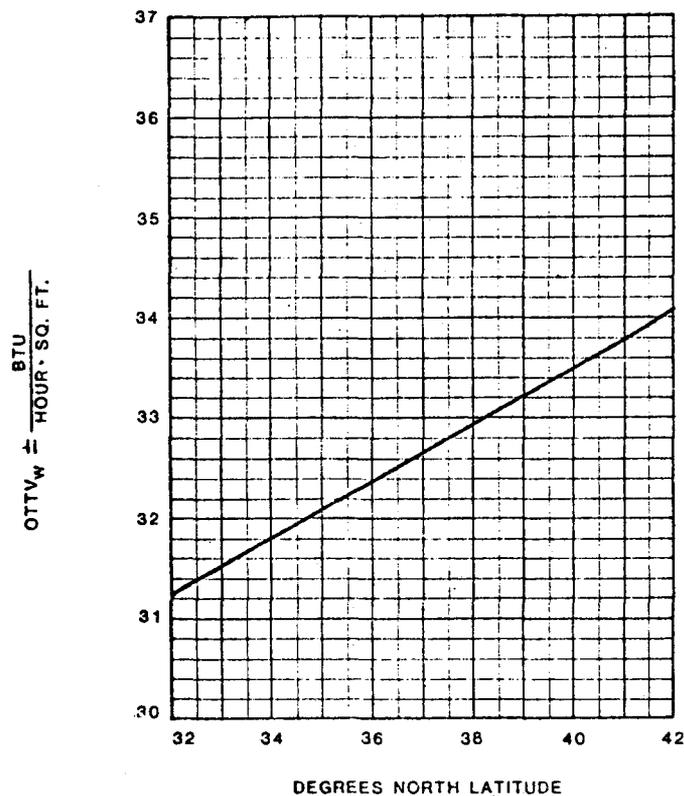


T20-1494. Cooling Design Criteria. (a) Walls. The overall thermal transfer value, Btu/hr ft^2 , for the gross area of exterior walls consisting of opaque wall area and fenestration areas that enclose interior cooled spaces shall not exceed the values given in Figure 4-4.

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

Windows or portions of windows that because of orientation or fixed exterior shading devices (including roof overhangs and horizontal projections) are never exposed to direct sunlight during the period of April 21 to October 21 shall be considered to have a solar heat gain factor (SF) of 30 Btu/hr ft^2 for the purposes of inclusion in Equation 4-3.

FIGURE 4-4
OVERALL THERMAL TRANSFER VALUE FOR WALLS, COOLING



EQUATION 4-3

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

- $OTTV_w$ = overall thermal transfer value for walls, Btu/hr ft²
 where U_w = the thermal transmittance of opaque wall, and doors, Btu/hr ft²°F
 A_w = area of opaque wall, ft²
 U_f = the thermal transmittance of fenestration, Btu/hr²°F
 A_f = area of fenestration, ft²
 TD_{EQ} = equivalent temperature difference, °F from Table 4-2
 SC = shading coefficient of fenestration
 ΔT = temperature difference between exterior and interior design conditions, °F
 A_{ow} = total area of wall opposite cooled spaces, ft²
 SF = solar factor value given in Figure 4-5, Btu/hr ft²

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

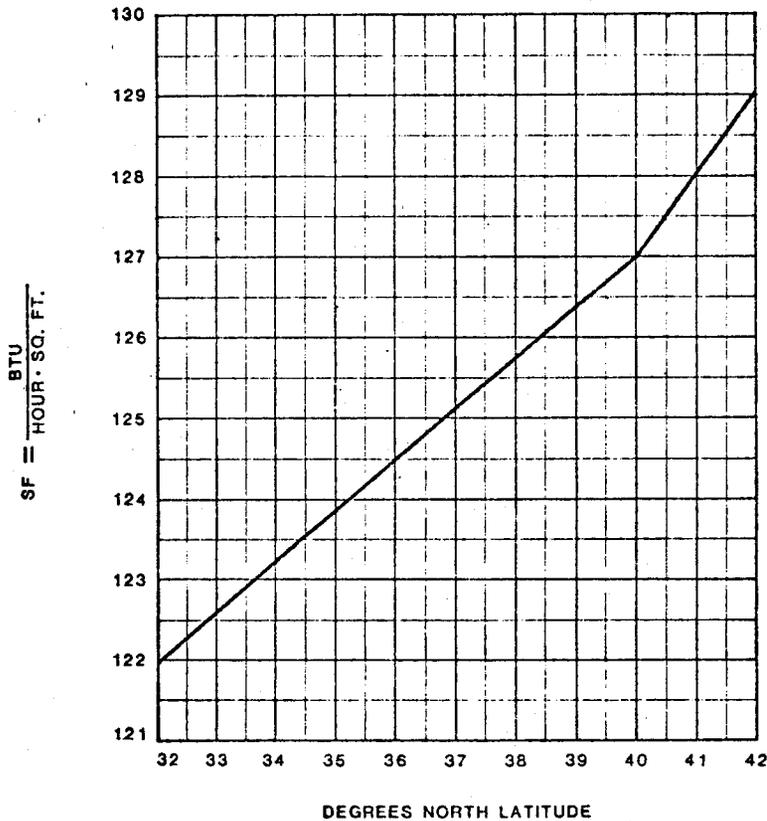
$$(U_{w_1} \times A_{w_1} \times TD_{EQ_1}) + (U_{w_2} \times A_{w_2} \times TD_{EQ_2}), \text{ etc.}$$

TABLE 4-2

Weight of Wall Construction pounds/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 the 1972 edition of the ASHRAE Handbook of Fundamentals, Chapter 22.

FIGURE 4-5
SOLAR FACTOR



(b) Roof/Ceiling. The overall thermal transfer value in Btu/hr ft² 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 x U_{or} from Figure 4-2. 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 22 of the 1972 edition of the ASHRAE Handbook of Fundamentals.

EQUATION 4-4

$$\text{OTTV}_r = \frac{(41 U_r A_r \times A_{c,c}) + (118 SC_s A_s + TU_s A_s)}{A_{or}}$$

OTTV_r = overall thermal transfer value for roofs, Btu/hr ft²

where U_r = the thermal transmittance of opaque roof, Btu/hr ft²°F
 A_r = area of opaque roof, ft²
 A_r^c = absorptance coefficient, from Table 4-4
 U_s = the thermal transmittance of skylight, Btu/hr ft²°F
 A_s = area of skylight, ft²
 SC^s = shading coefficient of skylights
 ΔT^s = temperature difference between exterior and interior design conditions, °F
 M_c = mass coefficient, from Table 4-3
 A_{or}^c = the external exposed gross roof/ceiling area of the building over cooled spaces, ft²

TABLE 4-3

Wt, lb/ft ²	Class	M_c
0-15	Light	1.00
16-40	Medium	0.92
41 and above	Heavy	0.84
TABLE 4-4		
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

T20-1495. Air Leakage. (a) General. The requirements for air leakage are limited to those locations separating exterior building ambient conditions from interior building conditioned air space and are not applicable to the separation of interior conditioned spaces from each other.

(b) Compliance. Compliance with the requirements for air leakage shall be determined by ASTM E 283-73, Standard Method of Test for Rate of Air Leakage through Exterior Windows, Curtain Walls and Doors, at a pressure differential of 1.567 lb/ft², which is equivalent to the effect of a 25 mph wind.

(c) Air Leakage Requirements, Window. Air leakage requirements for windows shall be as follows:

(1) The air infiltration rate for manufactured openable exterior windows shall not exceed 0.5 cfm per foot of operable sash crack. All manufactured windows shall be certified and labeled and shall comply

- Metal Windows.....ANSI A134.1-1972
- Wood Windows.....NWMA IS-2

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

(2) The air exfiltration rate for manufactured openable exterior windows shall meet the requirements of Section T20-1495(c)(1) by January 1, 1980.

(3) Fixed windows constructed on site shall be sealed to limit air infiltration.

(d) Air Leakage Requirements, Doors. Air leakage requirements for doors shall be as follows:

(1) The air infiltration rate for manufactured exterior sliding glass doors shall not exceed 0.75 cfm per linear foot of crack. All manufactured sliding glass doors shall be certified and labeled and shall comply with the following standards:

- Metal Sliding Glass Doors.....ANSI A134.2-1972
- Wood Sliding Glass Doors.....NWMA IS-3

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

(2) The air exfiltration rate for manufactured exterior sliding glass doors shall meet the requirements of Section T20-1495(d)(1) by January 1, 1980.

(3) All exterior doors, other than fire-rated doors, shall be so designed to limit air leakage around their perimeter when in a closed position.

(A) All 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 T20-1495(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 bi-parting 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.

(e) 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.

(f) Gravity Ventilators. Gravity ventilators shall comply with the provisions of Section T20-1505.

(g) 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

T20-1500. HVAC Systems. (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 T20-1501 through T20-1506 and T20-1509 shall not apply to buildings with an occupant load of 49 or fewer as determined from Table 2-2 and a gross floor area not exceeding 1000 square feet.

T20-1501. Calculation of Heating and Cooling Loads. (a) Design Loads. Heating and cooling design loads shall be determined in accordance with one of the procedures described in the latest edition of the ASHRAE Handbook of Fundamentals, Chapters 21 and 22, 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 T20-1492, consistent with project requirements.

(2) Indoor Design Conditions. Indoor design conditions for general comfort applications shall be in accordance with ASHRAE Standard 55-74, Thermal Environmental Conditions for Human Occupancy, 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, Natural and Mechanical Ventilation. 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 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 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 T20-1501(b) (3).

T20-1502. Ventilation Requirements. 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.

T20-1503. Controls. (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 T20-1503(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 1503.1(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 T20-1503.1.

(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 non-use or alternate uses of the building spaces or zones served by the system.

T20-1503.1. Simultaneous Heating and Cooling. 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 T20-1503.1(c) through T20-1503.1(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 leakage of 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 nameplate 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 T20-1503.1(c) through T20-1503.1(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 ten similar zones.

The supply air temperature reset requirements of Sections T20-1503.1(c) and T20-1503.1(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.

T20-1503.2. Cooling with Outdoor Air. (a) General. Each cooling fan system other than those covered under Section T20-1503.1(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.

T20-1504. Electric Resistance Heating Systems. 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% 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% 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 cost of the alternatives considered. If the building is mechanically cooled, the costs associated with cooling shall be included in the cost comparison.

In areas where natural gas utility service is available, the two alternatives considered shall be:

(1) 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.

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

In areas where natural gas utility service is not available, the two alternatives considered shall be:

(1) A system in which at least 90 percent of the annual heating energy requirement is met by a heat pump.

(2) 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.

AMENDED JULY 19, 1978

T20-1505. Mechanical and Gravity Ventilation. 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.

T20-1506. Power Consumption of Fans. (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 square foot of gross floor area of 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

$$CFM_{ta} = CFM_t - CFM_p$$

Where: CFM_{ta} = Adjusted total CFM

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

EQUATION 5-3

$$CFM_p = CFM_t \times \frac{H_{sp}}{H_{st}}$$

Where: H_{sp} = Sensible heat of process load.

H_{st} = 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

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

Where: FPI_a = Adjusted fan power index.

FPI_m = Fan power index at maximum flow

C_{va} = Variable volume constant.

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

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

EQUATION 5-5

$$C_{va} = \sqrt{\frac{CFM_a}{CFM_m}}$$

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

EQUATION 5-6

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

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

EQUATION 5-7

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

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 $0.85 \times CFM_m$.

T20-1507. Piping Insulation. (a) Minimum Pipe Insulation. All piping shall be insulated in accordance with Table 5-1, 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.

Amended
July 19, 1978

TABLE 5-1
Minimum Pipe Insulation

Piping System Types	Fluid Temperature Range, °F	Insulation Thickness in Inches for Nominal Pipe Sizes (in inches)					
		Runouts Up to 2*	1 and Less	1.25-2	2.50-4	5 & 6	8 and Larger
<u>Heating Systems</u>							
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	105-200	0.5	0.75	1.0	1.0	1.0	1.5
Steam Condensate (for Feed Water)	Any	1.0	1.0	1.0	1.5	1.5	2.0
<u>Cooling Systems</u>							
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

Amended
July 19, 1978

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

(b) Other Insulation Thicknesses. Insulation thicknesses in Table 5-1 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:

$$\frac{4.6 \times \text{Table 5-1 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

(2) For materials with thermal resistance less than R = 4.0, the minimum insulation Thickness shall be increased as follows:

$$\frac{4.0 \times \text{Table 5-1 Thickness}}{\text{Actual R}} = \text{New Minimum Thickness}$$

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

T20-1508. Air Handling Duct System Insulation.

Insulation of duct systems in buildings for which building permits are issued on July 1, 1978 through December 31, 1978 shall comply with the requirements of either Subsection T20-1508(a) or Subsection T20-1508(b) at the designer's option. Insulation of duct systems in buildings for which building permits are issued on or after January 1, 1979 shall comply with the requirements of Subsection T20-1508(a).

(a) Insulation of air handling duct systems shall conform to the provisions of Section 1005 of the Uniform Mechanical Code, 1976 Edition.

(b) All ducts, plenums, and enclosures installed in or on buildings shall be insulated as follows:

All duct systems, or portions thereof, shall be thermally insulated (externally or internally) in accordance with the minimum requirements in Table 5-2.

TABLE 5-2
MINIMUM DUCT INSULATION

Temp. Difference Between Design Air Duct Temp. and Temp. of Air Surrounding Ducts - °F	Minimum Insulation Thermal Resistance Exclusive of Film Resistance - R
0 - 14.9	No Requirement
15.0 - 29.9	4.0
30.0 - 55.0	6.0
Above 55	6.0 plus 1 for each 25 °F differential above 55 °F

EXCEPTION. Duct insulation is not required when the heat gain or loss of the ducts, without insulation, will not increase the energy requirements of the building.

T20-1509. Duct Construction. All duct work shall be constructed, erected, and tested in accordance with the most restrictive of local regulations, procedures detailed in the ASHRAE Handbook of Fundamentals or the applicable standards adopted by the Sheet Metal and Air Conditioning Contractors National Association.

Added
July 19, 1978

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

T20-1510. Scope. This division deals with equipment performance and manufacturers' documentation in accordance with the criteria for effective utilization of energy established in these regulations for HVAC equipment used in nonresidential buildings.

T20-1511. Electrically Operated Air Cooling Systems. No air conditioner of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in a building for which a building permit is issued on or after the applicable effective date shown in Section 1604 of the Appliance Efficiency Regulations unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the energy efficiency ratio, or seasonal energy efficiency ratio, as applicable, is not less than the values shown in Section 1604 of the Appliance Efficiency Regulations.

The energy efficiency ratio 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, installed in buildings for which the building permit is issued on or after the effective date specified, shall be not less than the values shown in Tables 6-1, 6-2, 6-3 based on one of the test procedures specified in Table 6-4.

Table 6-1

Minimum EER for Air Conditioners
65,000 Btu Per Hour and Over
(Classification A in Table 6-4)

Effective Date	EER
July 1, 1978	6.8
January 1, 1980	7.5

Added
July 19, 1978

AMENDED JULY 19, 1978

Table 6-4

Test Procedures for Electrically Operated
Air Cooling Systems

Classification	Type	Test Procedure
A	Unitary Air Conditioning Equipment	ARI 210-75
	Commercial and Industrial Unitary Air Conditioning Equipment	ARI 360-75
	Air Source Unitary Heat Pump Equipment	ARI 240-77
	Water Source Unitary Heat Pump Equipment	ARI 320-76
	Commercial and Industrial Heat Pump Equipment	ARI 340-76
B	Positive Displacement Refrigerant Condensing Units	ARI 520-74
C	Centrifugal or Rotary Water-Chilling Packages	ARI 550-77
	Reciprocating Water-Chilling Packages	ANSI/ARI 590-1976

Added
 July 19, 1978

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The energy efficiency ratio 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, installed in buildings for which the building permit is issued on or after the effective date specified, shall be not less than the values shown in Tables 6-1, 6-2, 6-3 based on one of the test procedures specified in Table 6-4.

Table 6-1

Minimum EER for Air Conditioners
65,000 Btu Per Hour and Over
(Classification A in Table 6-4)

Effective Date	EER
July 1, 1978	6.8
January 1, 1980	7.5

Added
July 19, 1978

AMENDED JULY 19, 1978

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Test Procedures for Electrically Operated
Air Cooling Systems

Classification	Type	Test Procedure
A	Unitary Air Conditioning Equipment	ARI 210-75
	Commercial and Industrial Unitary Air Conditioning Equipment	ARI 360-75
	Air Source Unitary Heat Pump Equipment	ARI 240-77
	Water Source Unitary Heat Pump Equipment	ARI 320-76
	Commercial and Industrial Heat Pump Equipment	ARI 340-76
B	Positive Displacement Refrigerant Condensing Units	ARI 520-74
C	Centrifugal or Rotary Water-Chilling Packages	ARI 550-77
	Reciprocating Water-Chilling Packages	ANSI/ARI 590-1976

Added
July 19, 1978

Table 6-2

Electrically Driven Minimum COP of Refrigerant Condensing Units
65,000 Btu/hour and Over
(Classification B in Table 6-4)

<u>Effective Date</u>	<u>Condensing Means</u>	
	Air	Evaporator or Water
July 1, 1978	2.3	3.3
January 1, 1980	2.5	3.5

Table 6-3

Minimum COP of Electrically
Driven Water Chilling Packages
(Classification C in Table 6-4)

<u>Condensing Means</u>		<u>Air</u>	<u>Water</u>
Effective July 1, 1978	C	2.2	3.8
	R	2.1	3.2
Effective January 1, 1980	C	2.3	4.0
	R	2.2	3.4

where C = Centrifugal,
R = Reciprocating or Rotary

AMENDED JULY 19, 1978

Added
July 19, 1978

T20-1512. Heat Operated Cooling Equipment. The coefficient of performance of heat-operated cooling equipment installed in buildings for which the building permit is issued on or after the effective date specified shall be not less than the values shown in Table 6-5 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.

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 for Absorption Water Chilling Packages, 560-75. Direct-Fired, absorption water chillers and air conditioners shall comply with ANSI Standard for Gas-Fired Absorption Summer Air Conditioning Appliances, Z21.40.1-73, 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 6-5

Minimum COP of Heat-Operated Cooling Equipment

Heat Source		
Effective Date	Direct Fired (Gas, Oil)	Indirect Fired (Steam, Hot Water)
July 1, 1978	0.40	0.65
January 1, 1980	0.48	0.68

Performance at sea level

$$COP = \frac{\text{Net Cooling Output}}{\text{Total Heat Input (Electrical Auxiliary Inputs Excluded)}}$$

T20-1513. Combustion Type Heating Equipment. (a) No gas-fired comfort heating equipment of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in a building for which the building permit was issued on or after the applicable effective date shown in Section 1604 of the Appliance Efficiency Regulations unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the steady state efficiency, or seasonal efficiency is not less than the values shown in Section 1604 of the Appliance Efficiency Regulations and the energy consumption during standby does not exceed the values shown.

(b) In addition to the above requirements, all gas comfort heating equipment shall have a minimum thermal efficiency of 75 percent based on one of the test procedures shown in Table 6-6.

Table 6-6

Test Procedures for Gas-fired Heating Equipment

<u>Classification</u>	<u>Type</u>	<u>Test Procedure</u>
A	Forced Air Central Furnaces	ANSI Z21.47-1973
	Direct Vent Wall Furnaces	ANSI Z21.44-1973
	Fan Type Vented Wall Furnaces	ANSI Z21.49-1975
	Unit Heaters	ANSI Z21.16-1971
	Duct Furnaces	ANSI Z21.34-1971
	Low-Pressure Steam and Hot Water Heating Boilers	ANSI Z21.13-1974
	B	Gravity Central Furnaces
Gravity Direct Vent Wall Furnaces		ANSI Z21.44-1973
Gravity Vented Wall Furnaces		ANSI Z21.49-1975
Gravity and Fan Type Floor Furnaces		ANSI Z21.48-1976
Vented Room Heaters		ANSI Z21.11.1-1974

All 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

(c) No gas-fired fan type central furnace or gas-fired fan type wall furnace (except those designed to burn only liquefied petroleum gases) shall be installed in a building for which the building permit is issued on or after the applicable effective date shown in Section 1605 of the Appliance Efficiency Regulations unless it complies with the intermittent ignition device requirements of Section 1603 of the Appliance Efficiency Regulations.

Added
July 19, 1978

T20-1514. Heat Pumps - Heating Mode. (a) Heat pumps whose energy input is entirely electric, installed in buildings for which the building permit is issued before November 22, 1978, shall have a Coefficient of Performance (COP) - heating of not less than the values shown in Table 6-7, based on one of the test procedures specified in Table 6-8.

Table 6-7

Minimum COP - Heating
of Heat Pumps

<u>Air Source</u>	<u>Water Source</u>	
47 °F Outdoor Temperature	17 °F Outdoor Temperature	
2.2	1.2	2.2

Table 6-8

Test Procedures for
Heat Pumps - Heating Mode

<u>Type</u>	<u>Test Procedure</u>
Room Air Conditioners	ANSI/AHAM RAC-1
Packaged Terminal Heat Pumps	ARI 380-78
Air Source Unitary Heat Pump Equipment	ARI 240-77
Water Source Unitary Heat Pump Equipment	ARI 320-76
Commercial and Industrial Unitary Heat Pump Equipment	ARI 340-76

(b) No heat pumps of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in a building for which the building permit is issued on or after December 22, 1978 unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the adjusted coefficient of performance, is not less than the values shown in Section 1604 of the Appliance Efficiency Regulations.

(c) The heat pump shall be installed with a control to prevent supplementary heater operation when the heating load can be met by the heat pump alone. Supplementary heater operation is permitted during transient periods, such as start-ups, following room thermostat set-point 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.

T20-1515. Identification of Complying Equipment. The energy efficiency ratio, coefficient of performance, adjusted coefficient of performance, thermal efficiency and/or combustion efficiency of equipment described in Sections T20-1511 through T20-1514 shall be shown on the documents submitted to the building official for approval and on the equipment, with the exception noted below.

Gas-fired heating equipment tested according to one of the test procedures under classification A in Table 6-6, and so certified by an accepted laboratory, are exempt from this requirement.

T20-1516. Electric Resistance Comfort Heating Equipment. 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.

T20-1517. Maintenance. 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.

T20-1518. Responsibility of Equipment Suppliers. 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.

DIVISION 7. SERVICE WATER HEATING

T20-1520. General. Service hot water shall be generated and delivered in a manner conducive to saving energy.

T20-1521. Water Heaters, Storage Tanks, Boilers and Piping. (a) Performance Efficiency.

(1) Gas- and 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 Z21.10.3 1975-Gas Water Heaters, Vol. III, Circulating Tank, Instantaneous and Large Automatic Storage-Type Water Heaters. For oil-fired units, CF = 1.0; Q = total gallons of oil consumed; and H = total heating value of oil in Btu/gallon.

If the building designer demonstrates that no storage type water heater, whose capacity is within 50 gallons of the required capacity, has been certified by any manufacturer pursuant to the Appliance Efficiency Regulations as meeting the requirements for standby loss, installation in buildings for which the building permit is issued before January 1, 1979, of a storage type water heater whose standby loss exceeds

$$2.3 + \frac{67}{CAP} \text{ percent}$$

shall be allowed.

(2) Automatic electric storage water heaters installed in buildings for which the building permit is issued before December 22, 1978 shall have a standby loss not exceeding 4 watts per square foot of tank surface area. The method of test of stand-by loss shall be as described in Section 4.3.1 of ANSI C72-1-1972 Household Automatic Electric Storage-Type Water Heaters.

(3) No water heaters of the types described in Section 1601 of the Appliance Efficiency Regulations shall be installed in buildings for which the building permit is issued on or after December 22, 1978, unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the recovery efficiency,

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or thermal efficiency (as applicable), is not less than the values shown and the standby loss does not exceed the values shown in Section 1604 of the Appliance Efficiency Regulations.

(b) 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 1973 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.

(c) 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 5-1.

T20-1522. Temperature Controls. 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 1 from ASHRAE 1973 Handbook and Product Directory, Systems Volume, Chapter 37.

T20-1523. Pump Operation. 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.

T20-1524. 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 1000 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.

ADDED JULY 19, 1978

T20-1525. Showerheads and Faucets. Commencing January 1, 1979, showers, lavatory faucets and sink faucets, used for other than safety reasons, shall be equipped with flow control devices to limit total flow to a maximum of three gallons per minute. In addition, no showerhead, lavatory faucet or sink faucet, used for other than safety reasons, shall be installed unless samples have been tested in accordance with the test procedures described in Section 1603 of the Appliance Efficiency Regulations, and the manufacturer has certified to the Commission, pursuant to the requirements of Section 1605 of the Appliance Efficiency Regulations, that the water flow rate does not exceed the values shown in Section 1604 of the Appliance Efficiency Regulations.

ADDED JULY 19, 1978

DIVISION 8. ELECTRICAL DISTRIBUTION SYSTEMS

T20-1530. Scope. The electrical distribution system in a building should be designed for efficient distribution of energy.

DIVISION 9. LIGHTING

T20-1540. General. This division establishes lighting power allotment standards for the efficient utilization of energy for illumination. Designs shall be based on good lighting practice.

T20-1541. Lighting Standards. 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 T20-1542. 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 T20-1542 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 9-1, 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.

Exceptions: 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 9-1 to which Note 2 of Table 9-1 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.

T20-1542. Procedure for Determining Maximum Connected Lighting Load.

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

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
 plane to the lighting fixture

- (b) Select from Table 9-1, 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 9-1 is referenced to note 1, determine the allowable square feet per occupant of each area from Table 2-2; 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 9-1

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.

<i>Task or Area</i>	<i>Room Cavity Ratio</i>	<i>Watts per Square Foot</i>		<i>Refer to Notes</i>
		<i>0-5</i>	<i>5+</i>	
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 ..				
Welding	2.9	3.8	1	
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		

**TITLE 24 SPECIAL BUILDING REGULATIONS—
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Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
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.....	2.4	3.4		1
Final assembly, inspection.....	(200)	(200)		2
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				
Filling.....	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

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BUILDING STANDARDS

TITLE 24
(Register 76, No. 33—8-14-76)

Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
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 ₂ manifold, screenhouse, switch gear, telephone equip, gallery & water treatment area.....				
All other.....		1.0	1.4	
All other.....		0.6	0.8	
Chemical works.....		1.3	2.0	
Churches & synagogues				
Alter, ark, reredos.....	(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				
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
Cutting, pressing.....	(300)	(300)		2
Sewing.....	(500)	(500)		2
Clothing manufacture				
Receiving, storing, shipping, sponging, decating, winding, measuring, fitting, bundling.....	1.3	2.0		
Pattern making, preparation of trimming, piping, canvas & shoulder pads.....				
Shops, piling up & marketing.....	2.0	2.7		
Cutting, pressing.....	2.9	3.7		1
Cutting, pressing.....	(300)	(300)		2
Sewing, inspection.....	(500)	(500)		2
Examining (perching).....	(2000)	(2000)		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		

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Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	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)	(200)	(200)		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		

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BUILDING STANDARDS

TITLE 24
(Register 76, No. 33—8-14-76)

Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Foundries				
Annealing, cleaning, shakeout	1.4	2.0		
Pouring, sorting	2.1	2.7		
Core making, inspection, grinding and chipping, molding	2.9	3.6		1
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		
Glass 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 r. 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

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Table 8-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Eye, ear, nose, throat suite		2.0	3.0	
Formula rooms		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	
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	

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BUILDING STANDARDS

TITLE 24
(Register 78, No. 33—8-14-78)

Table 8-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
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 chip-ping		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
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

Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
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

9-7

Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
General offices				
Reading poor reproductions, business machine operation, computer operation		5.0	6.0	1
Reading handwriting in hard pencil or on poor paper, reading fair reproductions, active filing, mail sorting		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
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, cutting, 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	

Table 8-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Fowl 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	2.0	2.7		
Printing plants				
Color inspection	(300)	(300)	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				
Plasticating, 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	(300)	(300)	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	
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	1	

8-6

Table 8-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
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 work				
General	2.0	2.7		
Tin plate inspection, scribing	(200)	(300)		2
Shoe manufacturing, leather				
Cutting and stitching	(300)	(300)		2
Making and finishing	(200)	(300)		2
Shoe manufacturing, rubber				
Washing, coating, mill run compounding	1.3	2.0		
Varnishing, vulcanizing, calendaring, 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		

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Table 9-1—Continued

Task or Area	Room Cavity Ratio	Watts per Square Foot		Refer to Notes
		0-5	5+	
Stores				
Circulation areas	1.0	1.6		
Merchandizing 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	(300)	(300)		2
Fitting room				
General.....	1.7	2.5		
Fitting areas	(300)	(300)		2
Structural steel fabrication	2.0	2.7		
Sugar refining				
Grading	2.0	2.7		
Color inspection.....	(300)	(300)		2
Testing laboratories				
General.....	2.0	3.0		
Meters, scales, etc.....	(300)	(300)		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	(300)	(300)		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	2.0	3.7		1

NOTES

1. Maximum connected lighting load for these tasks shall be based on a combination of general and task-oriented lighting. Values given in Table 9-1 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 2-2 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.

2. Numbers in parentheses are recommended illumination levels in foot-candles. 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 T20-1540. 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. Exempt Areas: Areas where lighting is an integral part of the process such as stage lighting in theaters, lighting for plant growth, photographic lighting, etc. In general, this will be light which is present for reasons other than to perform a visual task. Also, areas are exempt where control requirements dictate the use of specific systems, such as those requiring incandescent dimming or frequent switching. Such areas shall be exempt from the watts-per-square-foot limits. The wattage for such systems must be reported in the maximum connected lighting load, and the general provisions of Section T20-1540 followed. Purely decorative or ornamental lighting is specifically not exempted, and must comply with the wattage limitations of the particular area.

APPENDIX T20-B

Location	Annual Heating Degree Days	Location	Annual Heating Degree Days
Alameda Naval Air Station	2,900	Castroville	2,900
Alderpoint	3,290	Central Valley	3,010
Alpine	2,104	Ceres	2,750
Alturas	6,785	Chico	2,795
Anaheim	1,490	China Lake	2,570
Antioch	2,627	Chowchilla	2,400
Arcata	4,800	Chula Vista	2,229
Auburn	3,047	Claremont	1,600
Bakersfield	2,122	Cloverdale	2,666
Barrett Dam	2,363	Clovis	2,600
Barstow	2,496	Colfax	3,441
Beale Air Force Base	2,400	Colusa	2,788
Beaumont	2,790	Concord	2,766
Benicia	2,600	Corning	2,790
Berkeley	2,850	Corona	1,875
Bishop	4,275	Corte Madera	2,600
Blythe Airport	1,076	Crescent City	4,545
Bolinas	2,800	Culver City	1,711
Bonita	1,897	Cuyamaca	4,649
Borrego Springs	1,262	Daggett Airport	2,203
Brawley	1,161	Daly City	3,100
Brisbane	3,060	Danville	2,700
Burbank Airport	1,800	Davis	2,819
Burlingame	2,650	Death Valley	1,205
Burney	6,249	Deep Spr. Clg.	4,300
Buttonwillow	2,010	Delano	2,220
Cabrillo National Monument	1,653	Dixon	2,800
Calaveras Big Trees	5,736	Dunsmuir	5,300
Calabasas	1,800	Edwards Air Force Base	3,123
Campo	3,247	El Cajon	1,920
Capitola	2,900	El Capitan Dam	1,397
Carmel	2,900	El Centro	1,216
Carmichael	2,800	Elk Valley	5,404
Carpinteria	2,290	Elsinore	2,101
Castle Air Force Base	2,550	Encinitas	1,952

Location	Annual Heating Degree Days	Location	Annual Heating Degree Days
Escondido	2,052	La Jolla	1,750
Eureka	4,679	Lake Arrowhead	5,200
Fairfield	2,434	Lakeport	3,716
Fairmont	3,327	Lakewood	1,800
Fair Oaks	2,900	La Mesa	1,492
Fillmore	2,377	Lancaster	3,100
Folsom	2,899	Laytonville	4,160
Fort Bidwell	6,365	Lemoore	2,960
Fort Bragg	4,424	Lincoln	2,890
Fort Jones	5,614	Lindsay	2,619
Fortuna	4,700	Live Oak	2,370
Fremont	2,906	Livermore	2,781
Fresno	2,611	Lodi	2,785
Galt	2,780	Lompoc	2,900
Garberville	3,510	Long Beach Airport	1,803
Gardena	1,700	Los Angeles Airport	2,061
Gilroy	2,808	Los Banos	2,267
Grass Valley	4,400	Los Gatos	2,794
Gridley	2,600	McCloud	6,007
Gustine	2,360	Madera	2,485
Half Moon Bay	2,700	Manteca	2,600
Hamilton Air Force Base	2,600	Maricopa	2,165
Hanford	2,642	Mariposa	3,116
Hawthorne	1,800	Markleeville	7,884
Hayward	2,850	Martinez	2,650
Healdsburg	2,700	Marysville	2,377
Henshaw Dam	3,652	Mecca	1,117
Hetch Hetchy	4,797	Mendota	2,555
Hillsdale	2,650	Merced	2,697
Hollister	2,725	Mineral	7,192
Huntington Beach	2,361	Mitchell Cavern	2,510
Imperial Airport	1,060	Modesto	2,767
Independence	2,995	Moffett Naval Air Station	2,800
Inyokern	2,570	Mojave	2,590
Ione	2,728	Monterey	2,985
Jackson	2,760	Morro Bay	1,600
Julian Wynola	4,085	Mount Shasta	5,800
King City	2,655	Napa	2,690
Lafayette	2,700	Needles Airport	1,072
Laguna Beach	2,262	Nellie	4,745

Location	Annual Heating Degree Days	Location	Annual Heating Degree Days
Nevada City	4,488	San Bernardino	2,018
Newport Beach	2,350	San Clemente	1,877
Novato	2,815	San Diego	1,439
Oakdale	2,832	San Fernando	1,800
Oak Grove	3,516	San Francisco Airport	3,080
Oakland	2,906	San Jacinto	2,376
Oceanside	2,092	San Jose	2,656
Orland	2,830	San Juan Capistrano	1,646
Oroville	2,597	San Luis Obispo	2,582
Oxnard	2,352	San Mateo	2,655
Palmdale Airport	3,088	San Rafael	2,619
Palm Springs	1,232	Santa Ana	1,496
Palo Alto	2,869	Santa Barbara	2,290
Palomar, Mt. Observatory	3,868	Santa Clara	2,566
Paradise	4,010	Santa Cruz	2,900
Pasadena	1,694	Santa Maria	2,985
Paso Robles Airport	2,890	Santa Paula	2,400
Patterson	2,368	Santa Rosa	2,980
Perris	2,100	Scotia	3,954
Petaluma	2,966	Sierraville	6,953
Pismo Beach	2,800	Sonora	3,086
Pittsburg	2,633	South San Francisco	3,061
Placerville	4,161	South San Gabriel	1,600
Point Loma	1,860	Squaw Valley	8,200
Pomona	2,166	Stockton	2,690
Porterville	2,563	Stony Gorge Reservoir	3,124
Portola	7,055	Susanville	6,248
Quincy	5,852	Tahoe City	8,162
Ramona Spaulding	2,223	Tahoe Valley	8,198
Red Bluff	2,688	Thousand Oaks	2,425
Redding	2,610	Tracy	2,616
Redlands	2,052	Truckee	8,208
Redwood City	2,596	Twentynine Palms	2,006
Richmond	2,644	Ukiah	3,030
Ripon	2,700	Vacaville	2,812
Riverside	2,089	Vallejo	2,598
Roseville	2,899	Vincent	3,510
Sacramento Executive Airport	2,782	Visalia	2,546
St. Helena	2,833	Vista	1,760
Salinas	2,959	Warner Springs	3,470

Location	Annual Heating Degree Days
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