

## SUBCHAPTER 8

# LOW-RISE RESIDENTIAL BUILDINGS—PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

### SECTION 151 – PERFORMANCE AND PRESCRIPTIVE COMPLIANCE APPROACHES

(a) **Basic Requirements.** New low-rise residential buildings shall meet all of the following:

1. The requirements of Sections 111 through 119~~(d)~~ applicable to new residential buildings.
2. The requirements of Section 150 (mandatory features).
3. Either the performance standards (energy budgets) or the prescriptive standards (alternative component packages) set forth in this section for the climate zone in which the building will be located. Climate zones are shown in FIGURE 101-A.

**ALTERNATIVE to Section 151(a)3:** If a single contiguous subdivision or tract falls in more than one climate zone, all buildings in the subdivision or tract may be designed to meet the performance or prescriptive standards for the climate zone that contains 50 percent or more of the dwelling units.

**NOTE:** The California Energy Commission shall periodically updates, publishes, and makes available to interested persons and local building departments precise descriptions of the metes and bounds for climate zone boundaries depicted in FIGURE 101-A and a list of the communities in each zone.

4. For other provisions applicable to new low-rise residential buildings, refer to Section 100~~(e)~~.

(b) **Performance Standards.** A building complies with the performance standard if the combined depletable TDV energy use for water heating ~~§~~Section 151(b)1 and space conditioning ~~§~~Section 151(b)2 is less than or equal to the combined maximum allowable TDV energy use for both water heating and space conditioning, even if the building fails to meet either the water heating or space conditioning budget alone.

1. **Water heating budgets.** The water heating budgets for each climate zone shall be the calculated consumption of energy from depletable sources required for water heating in buildings in which the requirements of Section 151(a) and of Section 151(f)8A for systems serving individual dwelling units or of 151(f)8C for systems serving multiple dwelling units are met. To determine the water heating budget, use an approved calculation method.
2. **Space-conditioning budgets.** The space-conditioning budgets for each climate zone shall be the calculated consumption of energy from depletable sources required for space conditioning in buildings in which the basic requirements of Section 151(a) and the measures in Section 151(f) applicable to Alternative Component Package D are installed. To determine the space-conditioning budget, use an approved calculation method.
3. **Multiple heating systems.<sup>1</sup>** If a space or a zone is served by more than one heating system, compliance shall be demonstrated with the most TDV energy consuming system serving the space or the zone. For spaces or zones that are served by electric resistance heat in addition to other heating systems, the electric resistance heat shall be deemed to be the most TDV energy consuming system.

**EXCEPTION to Section 151(b)3:** A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed two kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 30 minutes.

(c) **Compliance Demonstration Requirements for Performance Standards.** The application for a building permit shall include documentation which demonstrates, using an approved calculation method, that the newly constructed building has been designed so that its TDV energy use from depletable energy sources does not exceed the combined water-heating and space-conditioning energy budgets for the appropriate climate zone.

1. To demonstrate compliance, the applicant's documentation shall:
  - A. Determine the combined energy budget for the proposed building by adding the following:
    - i. The annual water-heating budget (TDV kBtu/yr-ft<sup>2</sup>) as determined pursuant to Section 151(b)1; and

- ii. The annual space-conditioning budget (TDV kBtu/yr-ft<sup>2</sup>) as determined pursuant to Section 151(b)2.
- B. Calculate the TDV energy consumption total of the proposed building, using the proposed building's actual glazing area, orientation, and distribution, and its actual energy conservation and other features, including the actual water-heating, space-conditioning equipment and duct conditions and locations.  
 Include in the calculation the energy required for building cooling even if the building plans do not indicate that air conditioning will be installed.
- 2. The proposed building design complies if the energy consumption calculated pursuant to Section 151(c)1B is equal to or less than the combined energy budget established in Section 151(c)1A.

**MULTIPLE ORIENTATION ALTERNATIVE to Section 151(c):** A permit applicant may demonstrate compliance with the energy budget requirements of Section 151(a) and (b) for any orientation of the same building model if the documentation demonstrates that the building model with its proposed designs and features would comply in each of the four cardinal orientations.

- (d) **Compliance Methods for Performance Standards.** Compliance with the energy budget requirements of Section 151(b) must be demonstrated by using the compliance version of the Commission's Public Domain Computer Program or any alternative calculation method approved by the Commission for use in complying with Sections 151(a), 151(b), 151(c), and 151(e).
- (e) **Required Calculation Assumptions.** The Commission shall publish the assumptions and calculation methods it used to develop the standards for low-rise residential buildings, including those specified in Section 151. In determining the water-heating and space-conditioning budgets and calculating the energy use of the proposed building design, the applicant shall use only these assumptions and calculation methods, ~~or alternative assumptions and methods approved by the Commission~~ ~~or its executive director~~ (TM1).
  - 1. Such assumptions shall include, but not be limited to, the following:
    - A. The operating conditions regarding indoor temperature; occupancy loads and schedules; equipment loads and operation schedules, including lighting, HVAC, and miscellaneous electrical; and outdoor weather conditions.
    - B. The physical characteristics of building pressurization, interior heat transfer, film coefficients, solar heat gain coefficient and operation of installed shading devices, ground temperatures, and the method of determining slab heat loss.
    - C. The applicable modeling procedures for the assumptions, design conditions, and physical characteristics described in Section 151(e)1.
    - D. Water heating use schedules, cold water inlet temperatures, and average outdoor temperatures for calculating water heating loads and losses.

**EXCEPTION to Section 151(e)1:** The Commission may approve alternative schedules, assumptions, and performance modeling procedures that may be used in lieu of those described in Section 151(e)1, provided such alternatives do not alter the efficiency level required by these standards.

- 2. The total calculated annual energy consumption shall include all energy used for comfort heating, comfort cooling, ventilation for the health and comfort of occupants, and service water heating.
- 3. Heat transfers within the same building to adjacent spaces that are not covered by the permit and that are independently provided with space conditioning may be considered to be zero. Heat transfers to spaces not yet provided with space conditioning may be modeled as separate unconditioned zones, or as outdoor conditions.
- 4. The total calculated annual energy consumption need not include energy from any nondepletable sources, regardless of the purpose of the energy consumed.
- 5. Solar heat gain coefficients for interior shading devices used with fenestration products shall be 0.68 for vertical fenestration products and 1.0 for non-vertical fenestration products. No other solar heat gain coefficients shall be used for interior shading. The calculations for vertical fenestration products include the effects of draperies and insect screens without installation being verified at the time of final inspection.

(f) **Prescriptive Standards/Alternative Component Packages (Component Packages).** Buildings that comply with the prescriptive standards shall be designed, constructed, and equipped to meet all of the requirements of one of the packages of components shown in ~~TABLE 151-B~~ ~~TABLE 151-B<sub>2</sub>~~, ~~TABLE 151-C~~ ~~TABLE 151-C<sub>2</sub>~~ or TABLE 151-D<sup>2</sup> for the appropriate climate zone shown in FIGURE 101-A. In ~~TABLE 151-B~~ ~~TABLE 151-B<sub>2</sub>~~, TABLE 151-C and TABLE 151-D, a NA (not allowed) means that feature is not allowed in a particular climate zone and a NR (no requirement) means that there is no prescriptive requirement for that feature in a particular climate zone. Installed components shall meet the following requirements:

1. **Insulation.**

A. Ceiling, wall, slab floor perimeter, and raised-floor insulation which have an R-value equal to or higher than that shown in TABLE 151-B, TABLE 151-C, or TABLE 151-D shall be installed. The minimum opaque ceiling, wall (including heated basements and crawl spaces), and raised-floor R-values shown are for insulation installed between wood-framing members.

**ALTERNATIVE to Section 151(f)1A:** The insulation requirements of TABLE 151-B, TABLE 151-C, or TABLE 151-D may also be met by ceiling, wall, or floor assemblies that meet equivalent minimum R-values that consider the effects of all elements of the assembly, using a calculation method approved by the executive director.

**EXCEPTION to Section 151(f)1A:** Raised-floor insulation may be omitted if the foundation walls are insulated to meet the wall insulation minimums shown in TABLE 151-B, TABLE 151-C, or TABLE 151-D, a vapor barrier is placed over the entire floor of the crawl space, and the vents are fitted with automatically operated louvers.

B. The minimum depth of concrete-slab floor perimeter insulation shall be 16 inches or the depth of the footing of the building, whichever is less.

**EXCEPTION to Section 151(f)1B:** Perimeter insulation is not required along the slab edge between conditioned space and the concrete slab of an attached unconditioned enclosed space, covered porches, or covered patios.

2. **Radiant Barrier.** A radiant barrier required in TABLE 151-B, TABLE 151-C, or TABLE 151-D shall have an emittance of 0.05 or less, tested in accordance with ASTM C1371 or ASTM E408, shall be certified to the Department of Consumer Affairs as required by Title 24, Part 12, Chapter 12-13, Standards for Insulating Material, and shall meet the installation criteria specified in the Reference Residential Appendix RA4.

3. **Fenestration.**

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

**EXCEPTION to Section 151(f)3A:** For each building, up to three square feet of the glazing installed in doors and up to two square foot of tubular skylights with dual-pane diffusers.

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

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

4. **Shading.** Where TABLE 151-B, TABLE 151-C, or TABLE 151-D require a solar heat gain coefficient (SHGC), the requirements shall be met by either:

A. Installing fenestration products, except for skylights, that have an area weighted average SHGC equal to or lower than those shown in TABLE 151-B, TABLE 151-C, or TABLE 151-D. Skylights shall have an SHGC equal to or lower than those shown in TABLE 151-B, TABLE 151-C, or TABLE 151-D. The solar heat gain coefficient of installed fenestration products shall be determined in accordance with Section 116; or

B. An exterior operable louver or other exterior shading device that meets the required solar heat gain coefficient; or

- C. A combination of exterior shading device and fenestration product to achieve the same performance as achieved in Item A.
- D. For south-facing glazing by optimal overhangs installed so that the south-facing glazing is fully shaded at solar noon on August 21 and substantially exposed to direct sunlight at solar noon on December 21.

Except where the CBC requires emergency egress, exterior shading devices must be permanently attached to the outside of the structure with fasteners that require additional tools to remove (as opposed to clips, hooks, latches, snaps, or ties).

- 5. **Thermal mass.** Thermal mass required for Package C in TABLE 151-B shall meet or exceed the minimum interior mass capacity specified in TABLE 151-A.

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

*EQUATION 151-A — CALCULATION OF INTERIOR MASS CAPACITY*

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

**WHERE:**

$A_n$  = Area of mass material,  $n$ .

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

**NOTE:** The Commission's Residential Manual lists the unit interior mass capacity (UIMC) of various mass materials.

- 6. **Heating system type.** Heating system types shall be installed as required in ~~TABLE 151-B~~ ~~TABLE 151-B<sub>2</sub>~~ ~~TABLE 151-C~~ ~~TABLE 151-C<sub>2</sub>~~ or TABLE 151-D. A gas-heating system is a natural or liquefied petroleum gas-heating system.
- 7. **Space heating and space cooling.** All space heating and space cooling equipment shall comply with minimum Appliance Efficiency Regulations as specified in Sections 110 through 112 and meet the requirements of Subsections A and B:
  - A. When refrigerant charge measurement is shown as required by ~~TABLE 151-B~~ ~~TABLE 151-B<sub>2</sub>~~ ~~TABLE 151-C~~ ~~TABLE 151-C<sub>2</sub>~~ or TABLE 151-D, ducted split system central air conditioners and ducted split system heat pumps shall:
    - i. Have temperature measurement access holes and saturation temperature measurement sensors, and proper refrigerant charge confirmed through field verification and diagnostic testing in accordance with procedures set forth in the Reference Residential Appendix RA3.2<sub>2</sub> or
    - ii. Be equipped with a charge indicator display -clearly visible to the occupant. The display shall demand attention when the air conditioner fails to meet the requirements contained in Reference Joint Appendix JA6.2. The display shall be constantly visible and within one foot of the thermostat. The charge indicator display shall meet the requirements of Residential Field Verification and Diagnostic Test Procedures of Reference Residential Appendix RA3 and the specifications of Reference Joint Appendix JA6.
  - B. When airflow and fan watt draw is shown as required by ~~TABLE 151-B~~ ~~TABLE 151-B<sub>2</sub>~~ ~~TABLE 151-C~~ ~~TABLE 151-C<sub>2</sub>~~ or TABLE 151-D, ducted split system central air conditioners and ducted split system heat pumps shall:
    - i. Central forced air system fans shall simultaneously demonstrate, in every zonal control mode, a airflow greater than 350 CFM/ton of nominal cooling capacity and a fan watt draw less than 0.58 W/CFM. Meet the airflow and fan watt draw requirements as specified in Reference Residential Appendix RA3<sub>2</sub> and
    - ii. Have a hole for the placement of a static pressure probe or a permanently installed static pressure probe in the supply plenum downstream of the air conditioning evaporator coil. The size, location, and labeling shall meet the requirements specified in Reference Residential Appendix RA3.

8. **Domestic Water-heating systems.** Water heating systems shall meet the requirements of either A, B, or C and meet the requirements of D and E or shall meet the requirements of Section 151(b)1.
- A. For systems serving individual dwelling units, a single gas or propane storage type water heater with an input of 75,000 Btu per hour or less and no recirculation pumps, and that meets the tank insulation requirements of Section 150(j) and the requirements of Sections 111 and 113 shall be installed.
  - B. For systems serving individual dwelling units, a single gas or propane instantaneous water heater with an input of 200,000 Btu per hour or less and no recirculation pumps or storage tank, and that meets the requirements of Sections 111 and 113 shall be installed.
  - C. For systems serving multiple dwelling units, a central water heating system that has gas or propane water heaters, boilers or other water heating equipment that meet the minimum efficiency requirements of Sections 111 and 113 and a water heating recirculation loop that meets the requirements of Section 113(c)2 and Section 113(c)5 shall be installed.
  - D. All hot water pipes from the heating source to the kitchen fixtures shall be thermally insulated as specified by Section 150(j)2A or 150(j)2B.
  - E. All buried hot water piping shall be insulated to meet the requirements of Section 150(j)2 and be installed in a waterproof and non-crushable casing or sleeve that allows for installation, removal and replacement of the enclosed water piping. The internal cross-section or diameter of the casing or sleeve shall be large enough to allow for insulation of the hot water piping.

9. **Thermostats.** Heating systems shall be equipped with thermostats that meet the **Programmable Communicating setback thermostat-Thermostat (PCT)** requirements of Section 112(c). The exception 1 to Section 112 (c) shall not apply to any heating system installed in conjunction with [TABLE 151-B](#), [TABLE 151-B<sub>2</sub>](#), [TABLE 151-C](#), [TABLE 151-C<sub>2</sub>](#), or TABLE 151-D.

10. **Space conditioning ducts.** All ducts shall either be in conditioned space or be insulated to a minimum installed level as specified by [TABLE 151-B](#), [TABLE 151-B<sub>2</sub>](#), [TABLE 151-C](#), [TABLE 151-C<sub>2</sub>](#), or TABLE 151-D, and meet the minimum mandatory requirements of Section 150(m).

When duct sealing is shown as required by [TABLE 151-B](#), [TABLE 151-B<sub>2</sub>](#), [TABLE 151-C](#), [TABLE 151-C<sub>2</sub>](#), or TABLE 151-D, duct systems shall be sealed, as confirmed through field verification and diagnostic testing, in accordance with procedures specified in the Reference Residential Appendix RA3.

**NOTE:** Requirements for duct sealing and duct insulation in Tables 151-B, 151-C, and 151-D do not apply to buildings with space conditioning systems that have no ducts.

**11. Central Fan Integrated Ventilation Systems.** [Central forced air system fans used in central fan integrated ventilation systems shall demonstrate, in Air Distribution Mode, a watt draw less than 0.58 W/CFM.](#)

**12. Roofing Products.** All roofing products shall meet the requirements of Section 118 and the applicable requirements of Subsection A or B:<sup>3</sup>

- A. In low-rise residential buildings with steep-sloped roofs:
  - i. For roofing products with a density of less than five pounds per square foot, in climate zones 10 through 15 shall have a minimum aged [solar](#) reflectance of 0.20 and a minimum [thermal](#) emittance of 0.75, or a minimum SRI of 16.
  - ii. For roofing products with a density of five pounds per square foot or more, in climate zones 1 through 16 shall have a minimum aged [solar](#) reflectance of 0.15 and a minimum [thermal](#) emittance of 0.75, or a minimum SRI of 10
- B. Low-rise residential buildings with low-sloped roofs, in climate zones 13 and 15 shall have a minimum aged [solar](#) reflectance of 0.55 and a minimum [thermal](#) emittance of 0.75, or a minimum SRI of ~~0.65~~[64](#).

**EXCEPTIONS 1 to Section 151(f)12.:** Building integrated photovoltaic panels and building integrated solar thermal panels are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

**EXCEPTION 2 to Section 151(f)12:** Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft<sup>2</sup> are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI.

*TABLE 151-A INTERIOR MASS CAPACITY REQUIREMENTS FOR PACKAGE C*

<b>FLOOR TYPE</b>	<b>MINIMUM INTERIOR MASS CAPACITY</b>
slab floor	2.36 x ground floor area (ft <sup>2</sup> )
raised floor	0.18 x ground floor area (ft <sup>2</sup> )

TABLE 151-B COMPONENT PACKAGE C

Climate Zone	1, 16	3	4	5	6	7	8, 9	10	2, 11-13	14	15
<b>BUILDING ENVELOPE</b>											
Insulation minimums <sup>1</sup>											
Ceiling	R49	R38	R38	R38	R38	R38	R38	R49	R49	R49	R49
Wood-frame walls	R29	R25	R25	R25	R21	R21	R21	R25	R29	R29	R29
“Heavy mass” walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
“Light mass” walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Below-grade walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Slab floor perimeter	R7	R7	R7	R7	R7	R7	R7	R7	R7	R7	R7
Raised floors	R30	R30	R30	R30	R21	R21	R21	R30	R30	R30	R21
Concrete raised floors	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Radiant Barrier	NR	NR	REQ	NR	NR	NR	REQ	REQ	REQ	REQ	REQ
Roofing Products	See TABLE 151-C, COMPONENT PACKAGE D										
<b>FENESTRATION</b>											
Maximum U-factor <sup>2</sup>	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Maximum Solar Heat Gain Coefficient (SHGC) <sup>3</sup>	NR	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Maximum total area	14%	14%	14%	16%	14%	14%	14%	16%	16%	14%	16%
Maximum West facing area	NR	NR	5%	NR	NR	5%	5%	5%	5%	5%	5%
THERMAL MASS <sup>4</sup>	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
<b>SPACE-HEATING<sup>5</sup></b>											
Electric-resistant allowed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
If gas, AFUE =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
If heat pump, HSPF <sup>6</sup> =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
<b>SPACE-COOLING</b>											
SEER =	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN
If split system, Refrigerant charge measurement or charge indicator display	NR	NR	NR	NR	NR	NR	REQ	REQ	REQ	REQ	REQ
Central Forced Air Handler <sup>7</sup>	See TABLE 151-C, COMPONENT PACKAGE D										
<b>DUCTS</b>											
Duct sealing	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ
Duct Insulation	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8	R-8
WATER-HEATING	System shall meet Section 151(f)8 or Section 151(b)1 <sup>7</sup>										

TABLE 151-C COMPONENT PACKAGE D

			Climate Zone																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Insulation minimums <sup>1</sup>	Ceilings		R38	R30	R38	R38	R38	R38	R38	R38									
	Walls	Wood-frame walls	R21	R13	R19	R19	R19	R21	R21	R21									
		Heavy mass walls	(R4.76)	(R2.44)	(R4.76)	(R4.76)	(R4.76)	(R4.76)	(R4.76)	(R4.76)									
		Light mass walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Below-grade walls	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R13
	Floors	Slab floor perim.	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R7
		Raised floors	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19
Concrete raised floors		R8	R8	R0	R8	R4	R8	R8	R4	R8									
Radiant Barrier			NR	REQ	NR	REQ	NR	NR	NR	REQ	NR								
Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.55	NR	0.55	NR	
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR	
	Steep Sloped (less than 5 lb/ft <sup>2</sup> )	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
	Steep Sloped (5 lb/ft <sup>2</sup> or more)	Aged Solar Reflectance	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
		Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Fenestration	Maximum U-factor <sup>2</sup>		0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	
	Maximum Solar Heat Gain Coefficient (SHGC) <sup>3</sup>		NR	0.40	NR	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.35	NR	
	Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Maximum West Facing Area		NR	5%	NR	5%	NR	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
THERMAL MASS <sup>4</sup>			NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
SPACE-HEATING <sup>5, 10</sup>	Electric-resistant allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
	If gas, AFUE =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
	If heat pump, HSPF <sup>6</sup> =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
SPACE-COOLING	SEER =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
	If split system, Refrigerant charge measurement or charge indicator light		NR	REQ	NR	NR	NR	NR	NR	REQ	NR								
Central Forced Air Handlers	Cooling Airflow and Watt Draw		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	REQ <sup>11</sup>	NR					
	<del>Air Distribution System-Central Fan Integrated Ventilation System</del> Watt Draw		REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	
DUCTS	Duct sealing		REQ	REQ	REQ	REQ	R	REQ											
	Duct Insulation		R-6	R-6	R-6	R-6	R-6	R-4.2	R-4.2	R-4.2	R-6	R-6	R-6	R-6	R-6	R-8	R-8	R-8	
WATER-HEATING			System shall meet Section 151(f)8 or Section 151(b)1																



TABLE 151-D COMPONENT PACKAGE E

			Climate Zone																
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	
Insulation minimums <sup>1</sup>	Ceilings		R38	R30	R38	R30	R38	R38	R30	R30	R30	R30	R38	R38	R38	R38	R38	R49	
	Walls	Wood-frame walls	R21	R19	R21	R21	R21												
		Heavy mass walls	(R4.76)	(R2.44)	(R4.76)	(R4.76)	(R4.76)	(R4.76)	(R4.76)	(R4.76)									
		Light mass walls	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
		Below-grade walls	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R0	R13
	Floors	Slab floor perim.	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	R7
		Raised floors	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19	R19
Concrete raised floors		R8	R8	R0	R8	R4	R8	R8	R4	R8									
Radiant Barrier			NR	REQ	NR	REQ	NR	NR	NR	REQ	NR								
Roofing Products	Low-sloped	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.55	NR	0.55	NR	
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	NR	0.75	NR	
	Steep Sloped (less than 5 lb/ft <sup>2</sup> )	Aged Solar Reflectance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.20	0.20	0.20	0.20	0.20	0.20	NR
		Thermal Emittance	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.75	0.75	0.75	0.75	0.75	0.75	NR
	Steep Sloped (5 lb/ft <sup>2</sup> or more)	Aged Solar Reflectance	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
		Thermal Emittance	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Fenestration	Maximum U-factor <sup>2</sup>		0.50 <sup>8</sup>	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.57	0.45 <sup>9</sup>	
	Maximum Solar Heat Gain Coefficient (SHGC) <sup>3</sup>		NR	0.40	0.40	0.25	0.40	0.40	0.25	0.40	0.40	0.40	0.25	0.25	0.30	0.25	0.25	NR	
	Maximum Total Area		20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%
	Maximum West Facing Area		NR	5%	NR	5%	NR	NR	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	NR
THERMAL MASS <sup>4</sup>			NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	
SPACE-HEATING <sup>5, 10</sup>	Electric-resistant allowed		No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No	
	If gas, AFUE =		MIN <sup>8</sup>	MIN	MIN <sup>9</sup>														
	If heat pump, HSPF <sup>6</sup> =		MIN <sup>8</sup>	MIN	MIN <sup>9</sup>														
SPACE-COOLING	SEER =		MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	MIN	
	If split system, Refrigerant charge measurement or charge indicator light		NR	REQ	NR	NR	NR	NR	NR	REQ	NR								
Central Forced Air Handlers	Cooling Airflow and Watt Draw		NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	REQ <sup>11</sup>	NR					
	Central Fan Integrated Ventilation System Air Distribution System-Watt Draw		REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>	REQ <sup>12</sup>
DUCTS	Duct sealing		REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	REQ	
	Duct Insulation		R-8	R-6	R-8	R-6	R-6	R-4.2	R-4.2	R-4.2	R-6	R-6	R-8						
WATER-HEATING			System shall meet Section 151(f)8 or Section 151(b)1																



Footnote requirements to ~~TABLE 151-B~~ ~~TABLE 151-B~~, ~~TABLE 151-C~~ ~~TABLE 151-C~~, and TABLE 151-D.

- 1 The R-values shown for ceiling, wood frame wall and raised floor are for wood-frame construction with insulation installed between the framing members. For alternative construction assemblies, see Section 151(f)1A.

The heavy mass wall R-value in parentheses is the minimum R-value for the entire wall assembly if the wall weight exceeds 40 pounds per square foot. The light mass wall R-value in brackets is the minimum R-value for the entire assembly if the heat capacity of the wall meets or exceeds the result of multiplying the bracketed minimum R-value by 0.65. Any insulation installed on heavy or light mass walls must be integral with, or installed on the outside of, the exterior mass. The inside surface of the thermal mass, including plaster or gypsum board in direct contact with the masonry wall, shall be exposed to the room air. The exterior wall used to meet the R-value in parentheses cannot also be used to meet the thermal mass requirement.

- 2 The installed fenestration products shall meet the requirements of Section 151(f)3.
- 3 The installed fenestration products shall meet the requirements of Section 151(f)4.
- 4 If the package requires thermal mass, the thermal mass shall meet the requirements of Section 151(f)5.
- 5 Thermostats shall be installed in conjunction with all space-heating systems in accordance with Section 151(f)9.
- 6 HSPF means "heating seasonal performance factor."
- 7 Electric-resistance water heating may be installed as the main water heating source in Package C only if the water heater is located within the building envelope and a minimum of 25 percent of the energy for water heating is provided by a passive or active solar system.
- 8 As an alternative under Package E in climate zone 1, glazing with a maximum 0.57 U-factor and a 92% AFUE furnace or an 8.4 HSPF heat pump may be substituted for the Package E glazing U-factor requirement. All other requirements of Package E must be met.<sup>4</sup>
- 9 As an alternative under Package E in climate zone 16, glazing with a maximum 0.57 U-factor and a 90% AFUE furnace or an 8.4 HSPF heat pump may be substituted for may be substituted for the Package E glazing U-factor requirement. All other requirements of Package E must be met.
- 10 A supplemental heating unit may be installed in a space served directly or indirectly by a primary heating system, provided that the unit thermal capacity does not exceed two kilowatts or 7,000 Btu/hr and is controlled by a time-limiting device not exceeding 60 minutes.

~~11 Central forced air system fans shall simultaneously demonstrate, in every zonal control mode, a flow greater than 350 CFM/ton of nominal cooling capacity and a watt draw less than 0.58 W/CFM.<sup>5</sup>~~

~~12 Central forced air system fans used in Air Distribution Systems shall demonstrate, in Air Distribution Mode, a watt draw less than 0.58 W/CFM.<sup>6</sup>~~

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<sup>2</sup> Clarification in response received at a prior public workshop.

<sup>2</sup> All references to this table are from Mattison, CASE Study for Residential Windows, [http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-16\\_RES\\_WINDOWS.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-16_RES_WINDOWS.PDF)

<sup>3</sup> From LBNL, Wilcox and CEC staff, stakeholder workshop results.

<sup>4</sup> From Mattison, CASE Study for Residential Windows, [http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-16\\_RES\\_WINDOWS.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-16_RES_WINDOWS.PDF)

- <sup>5</sup> From Wilcox, Furnace Fan Watt Draw and Air Flow in Cooling and Air Distribution Modes, [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/FAN\\_WATT\\_DRAW\\_AND\\_AIR\\_FLOW.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/FAN_WATT_DRAW_AND_AIR_FLOW.PDF)
- <sup>6</sup> From Wilcox, Furnace Fan Watt Draw and Air Flow in Cooling and Air Distribution Modes, [http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12\\_workshop/FAN\\_WATT\\_DRAW\\_AND\\_AIR\\_FLOW.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-07-12_workshop/FAN_WATT_DRAW_AND_AIR_FLOW.PDF)
- <sup>7</sup> Edits in 8 – 14 are from Mattison, CASE Study for Residential Windows, [http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18\\_workshop/2006-05-16\\_RES\\_WINDOWS.PDF](http://www.energy.ca.gov/title24/2008standards/documents/2006-05-18_workshop/2006-05-16_RES_WINDOWS.PDF)