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SUBCHAPTER 9

LOW-RISE RESIDENTIAL BUILDINGS - ADDITIONS AND ALTERATIONS TO EXISTING LOW-RISE RESIDENTIAL BUILDINGS

SECTION 150.2 – ENERGY EFFICIENCY STANDARDS FOR ADDITIONS AND ALTERATIONS TO EXISTING LOW-RISE RESIDENTIAL BUILDINGS

- (a) **Additions.** Additions to existing low-rise residential buildings shall meet the requirements of Sections 110.0 through 110.9, Sections 150.0(a) through (q), and either Section 150.2(a)1 or 2.

EXCEPTION 1 to Section 150.2(a): Additions 1,000 square feet or less are exempt from the ASHRAE Standard 62.2 Section 4 requirements to provide whole-building ventilation airflow as referenced by Section 150.0(o), however all other applicable requirements of ASHRAE Standard 62.2 as referenced by Section 150.0(o) shall be met by the addition.

EXCEPTION 2 to Section 150.2(a): Additions of 300 square feet or less are exempt from the roofing requirements of Section 150.1(c)11.

EXCEPTION 3 to Section 150.2(a): Existing inaccessible piping shall not require insulation as defined under Section 150.0(j)2Aiii.

EXCEPTION 4 to Section 150.2(a): Space-Conditioning System. When heating or cooling will be extended to an addition from the existing system(s), the existing heating and cooling equipment need not comply with Part 6. The heating system capacity must be adequate to meet the minimum requirements of CBC Section 1204.1.

EXCEPTION 5 to Section 150.2(a): Space-Conditioning System Ducts. When ducts are extended from an existing duct system to serve the addition, the existing duct system and the extended ducts shall meet the applicable requirements specified in Section 150.2(b)1D.

EXCEPTION 6 to Section 150.2(a): Additions 1,000 square feet or less are exempt from the Ventilation Cooling requirements of Section 150.1(c)12.

NOTE: For alterations that change the occupancy classification of the building, the requirements specified in Section 150.2(b) apply to the occupancy after the alterations.

1. **Prescriptive approach.** Additions to existing buildings shall meet the following additional requirements:
 - A. Additions that are greater than 700 square feet shall meet the prescriptive requirements of Section 150.1(c), except:
 - i. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 framing and R-19 in a 2x6 framing.
 - ii. The maximum allowed fenestration area shall be the greater of 175 square feet or 20 percent of the addition floor area, and the maximum allowed west-facing fenestration area shall be the greater of 70 square feet or the requirements of Section 150.1(c).
 - B. Additions that are 700 square feet or less shall meet all the requirements of Section 150.1(c) except:
 - i. Roof and Ceiling insulation in an attic shall meet the requirement of Section 150.0; be insulated to R38 in climate zones 1, 11-16 or R-30 in climate zones 2-10; and
 - ii. Radiant barrier shall be installed in climate zones 2-15; and

- ~~ii-iii.~~ Extensions of existing wood-framed walls may retain the dimensions of the existing walls and shall install cavity insulation of R-15 in a 2x4 framing and R-~~19~~21 in a 2x6 framing; and
- iv. In Climate Zones 2, 4 and 6-15; the maximum allowed west-facing fenestration area shall not be greater than 60 square feet; and shall also comply with either a or b below:
 - a. For additions that are 700 square feet or less but greater than 400 square feet, the maximum allowed fenestration area limit is the greater of 120 square feet or 25 percent of the conditioned floor area of the addition; or
 - b. For additions that are 400 square feet or less, the maximum allowed fenestration area is the greater of 75 square feet or 30 percent of the conditioned floor area of the addition.
- v. Quality Insulation Installation (QII) requirements of Section 150.1(c)1E.

EXCEPTION 6 to Section 150.2(a)1B: Insulation in an enclosed rafter ceiling shall meet the requirements of Section 150.0.

- ~~iii.~~ In Climate Zones 2, 4 and 6-16; the maximum allowed west facing fenestration area shall not be greater than 60 square feet; and shall also comply with either a or b below:
 - a. For additions that are 700 square feet or less but greater than 400 square feet, the maximum allowed fenestration area limit is the greater of 120 square feet or 25 percent of the conditioned floor area of the addition; or
 - b. For additions that are 400 square feet or less, the maximum allowed fenestration area is the greater of 75 square feet or 30 percent of the conditioned floor area of the addition.
- C. Additions larger than 1,000 square feet shall meet the ASHRAE Standard 62.2 Section 4 requirement to provide whole-building ventilation airflow. The whole-building ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling conditioned floor area plus the addition conditioned floor area.
- D. **Water Heater.** When a second water heater is installed as part of the addition, one of the following types of water heaters shall be installed and assumed to comply:
- i. A natural gas or propane water-heating system that meets the requirements of Section 150.1(c)8; or
 - ii. If no natural gas is connected to the building/dwelling, an electric water heater that has an energy factor equal to or greater than required under the Appliance Efficiency Regulations. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or
 - iii. A water-heating system determined by the Executive Director to use no more energy than the one specified in Item ~~1-i~~ above; or if no natural gas is connected to the building, a water-heating system determined by the Executive Director to use no more energy than the one specified in Item ~~2-ii~~ above; ~~or.~~
 - iv. Using the existing building plus addition compliance or addition alone compliance as defined in Section 150.2(a)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.
2. **Performance approach.** Performance calculations shall meet the requirements of Section 150.1(a) through (c), pursuant to the applicable requirements in Items A, B, and C below.
- A. For additions alone. The addition complies if the addition alone meets the energy budgets as specified in Section 150.1(b).
 - B. Existing plus alteration plus addition. The standard design for existing plus alteration plus addition energy use is the combination of the existing building's unaltered components to remain; existing building altered components that are the more efficient, in TDV energy, of either the existing conditions or the requirements of Section 150.2(b)2; plus the proposed addition's energy use meeting the requirements of Section 150.2(a)1. The proposed design energy use is the combination of the existing building's unaltered components to remain and the altered components' energy features, plus the proposed energy features of the addition.

EXCEPTION to Section 150.2(a)2B: Existing structures with a minimum R-11 insulation in framed walls showing compliance with Section 150.2(a)2 are exempt from showing compliance with Section 150.0(c).

- C. Additions larger than 1,000 square feet shall meet the ASHRAE Standard 62.2 Section 4 requirement to provide whole-building ventilation airflow. The whole-building ventilation airflow rate shall be based on the conditioned floor area of the entire dwelling unit comprised of the existing dwelling conditioned floor area plus the addition conditioned floor area.
- (b) **Alterations.** Alterations to existing low-rise residential buildings or alterations in conjunction with a change in building occupancy to a low-rise residential occupancy shall meet either Item 1 or 2 below.
1. **Prescriptive approach.** The altered component and any newly installed equipment serving the alteration shall meet the applicable requirements of Sections 110.0 through 110.9 and all applicable requirements of Section 150.0(a) through (m), Section 150.0(o) through (q); and

- A. **Fenestration.** Alterations that add vertical fenestration and skylight area shall meet the total fenestration area and west facing fenestration area, U-factor, and Solar Heat Gain Coefficient requirements of Section 150.1(c) and TABLE 150.1-A or B.

EXCEPTION 1 to Section 150.2(b)1A: Alterations that add fenestration area of up to 75 square feet shall not be required to meet the total fenestration area and west-facing fenestration area requirements of Sections 150.1(c)3B and C.

EXCEPTION 2 to Section 150.2(b)1A: Alterations that add up to 16 square feet of new skylight area with a maximum U-factor of 0.55 and a maximum SHGC of 0.30 area shall not be required to meet the total fenestration area and west-facing fenestration area requirements of Sections 150.1(c)3B and C.

- B. **Replacement Fenestration.** ~~Replacement of fenestration, where existing fenestration area in an existing wall or roof is replaced with a new manufactured fenestration product and up to the total fenestration area removed in the existing wall or roof, the replaced~~ New manufactured fenestration products installed to replace existing fenestration products of the same total area shall meet the U-factor and Solar Heat Gain Coefficient requirements of Sections 150.1(c)3A, and 150.1(c)4.

EXCEPTION 1 to Section 150.2(b)1B: Replacement of vertical fenestration no greater than 75 square feet with a U-factor no greater than 0.40 in Climate Zones 1-16, and a SHGC value no greater than 0.35 in Climate Zones 2, 4, and 6-16 ~~65~~.

EXCEPTION 2 to Section 150.2(b)1B: Replaced skylights must meet a U-factor no greater than 0.55, and a SHGC value no greater than 0.30.

NOTE: Glass replaced in an existing sash and frame or ~~replacement of sashes~~ replaced in an existing frame are considered repairs, provided the replacement is at least equivalent to the original in performance.

- C. Entirely **New or Complete Replacement Space-Conditioning Systems** installed as part of an alteration, shall include all the system heating or cooling equipment, including but not limited to . condensing unit and cooling or heating coil for split systems; or complete replacement of a package unit; plus entirely new or replacement duct system (Section 150.2(b)1Diia); plus a new or replacement air handler.

Entirely New or complete replacement space-conditioning systems shall:

- i. Meet the requirements of Sections 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 through 150.0(m)13, 150.1(c)6, 150.1(c)7, 150.1(c)10 and ~~Table~~ TABLE 150.2-A; and
- ii. Be limited to natural gas, liquefied petroleum gas, or the existing fuel type, ~~unless it can be demonstrated that the TDV energy use of the new system is more efficient than the existing system.~~

EXCEPTION to Section 150.2(b)1Cii: When the fuel type of the replaced existing heating systems uses was natural gas or liquefied petroleum gas, the new or complete replacement space-conditioning system may be a heat pump.

D. **Altered Duct Systems - Duct Sealing:** In all Climate Zones, when more than 40 feet of new or replacement space-conditioning system ducts are installed, the ducts shall comply with the applicable requirements of subsections i and ii below:

- i. New ducts located in unconditioned space shall meet the applicable requirements of Sections 150.0(m)1 through 150.0(m)11, and the duct insulation requirements of TABLE 150.2-A, and

TABLE 150.2-A DUCT INSULATION R-VALUE

Climate Zone	1 through 10, 12&13	11, 14 through 16
Duct R-Value	R-6	R-8

- ii. The altered duct system, regardless of location, shall be sealed as confirmed through field verification and diagnostic testing in accordance with all applicable procedures for duct sealing of altered existing duct systems as specified in the Reference Residential Appendix RA3.1, utilizing the leakage compliance criteria specified in Reference Residential Appendix TABLE RA3.1-2, and conforming to either Subsection a or b below:

- a. **Entirely New or Complete Replacement Duct System.** If the new ducts form an entirely new or replacement duct system directly connected to the air handler, the measured duct leakage shall be equal to or less than 5 percent of the system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1.

Entirely new or complete replacement duct systems installed as part of an alteration shall be constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system, including but not limited to registers, grilles, boots, air handler, coil, plenums, duct material; if the reused parts are accessible and can be sealed to prevent leakage.

Entirely new or complete replacement duct systems shall also conform to the requirements of Section 150.0(m)12 and 150.0(m)13.

- b. **Extension of an Existing Duct System.** If the new ducts are an extension of an existing duct system, the combined new and existing duct system shall meet one of the following requirements:
 - ~~1.~~ The measured duct leakage shall be equal to or less than 15 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or
 - ~~2.~~ The measured duct leakage to outside shall be equal to or less than 10 percent of nominal system air handler airflow as confirmed by field verification and diagnostic testing utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or
 - ~~3.~~ If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Diib1, or 150.2(b)1Diib2, then all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION to Section 150.2(b)1Diib: Duct Sealing. Existing duct systems that are extended, which are constructed, insulated or sealed with asbestos.

E. **Altered Space-Conditioning System - Duct Sealing:** In all Climate Zones, when a space-conditioning system is altered by the installation or replacement of space-conditioning system equipment, including replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil; the duct system that is connected to the altered space-conditioning system equipment shall be sealed, as confirmed through field verification and diagnostic testing in accordance with the applicable procedures for duct sealing of altered existing duct systems as specified in Reference Residential Appendix RA3.1 and the leakage compliance criteria specified in Reference Residential Appendix Table RA3.1-2, conforming to one of the following requirements:

- i. The measured duct leakage shall be equal to or less than 15 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.1; or

- ii. The measured duct leakage to outside shall be equal to or less than 10 percent of system air handler airflow as determined utilizing the procedures in Reference Residential Appendix Section RA3.1.4.3.4; or
- iii. If it is not possible to meet the duct sealing requirements of either Section 150.2(b)1Ei or Section 150.2(b)1Eii, then, all accessible leaks shall be sealed and verified through a visual inspection and a smoke test by a certified HERS Rater utilizing the methods specified in Reference Residential Appendix RA3.1.4.3.5.

EXCEPTION 1 to Section 150.2(b)1E: Duct Sealing. Duct systems that are documented to have been previously sealed as confirmed through field verification and diagnostic testing in accordance with procedures in the Reference Residential Appendix RA3.1.

EXCEPTION 2 to Section 150.2(b)1E: Duct Sealing. Duct systems with less than 40 linear feet as determined by visual inspection.

EXCEPTION 3 to Section 150.2(b)1E: Duct Sealing. Existing duct systems constructed, insulated or sealed with asbestos.

- F. **Altered Space-Conditioning System - Mechanical Cooling:** When a space-conditioning system is an air conditioner or heat pump that is altered by the installation or replacement of refrigerant-containing system components such as the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping, the altered system shall comply with the following requirements:
- i. All thermostats associated with the system shall be replaced with setback thermostats meeting the requirements of Section 110.2(c).
 - ii. In Climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners and air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high velocity air systems, and minisplit systems, shall comply with subsections a and b, unless the system is of a type that cannot be verified using the specified procedures. Systems that cannot comply with the requirements of 150.2(b)1Fii shall comply with 150.2(b)1Fiii.
 - a. Minimum system airflow rate greater ~~than or equal to 300 cfm per ton~~ shall be demonstrated by the installer and be verified by the HERS Rater according to the procedures specified in Reference Residential Appendix Section RA3.3 or an approved alternative procedure as specified in Section RA1 in accordance with either I or II below;
 - I. Small duct high velocity systems shall demonstrate a minimum system airflow rate greater than or equal to 250 cfm per ton; or
 - II. All other air-cooled air conditioner or air-source heat pump systems shall demonstrate a minimum system airflow rate greater than or equal to 300 cfm per ton; and
 - b. The installer shall charge the system according to manufacturer's specifications. Refrigerant charge shall be verified according to one of the following options, as applicable.
 - I. The installer and rater shall perform the standard charge verification procedure as specified in Reference Residential Appendix Section RA3.2.2, or an approved alternative procedure as specified in Section RA1; or
 - II. The system shall be equipped with a fault indicator display (FID) device that meets the specifications of Reference Joint Appendix JA6. The installer shall verify the refrigerant charge and FID device in accordance with the procedures in Reference Residential Appendix Section RA3.4.2. The HERS Rater shall verify FID device in accordance with the procedures in Section RA3.4.2; or
 - III. The installer shall perform the weigh-in charging procedure as specified by Reference Residential Appendix Section RA3.2.3.1 provided the system is of a type that can be verified using the RA3.2.2 standard charge verification procedure and RA3.3 airflow rate verification procedure or approved alternatives in RA1. The HERS Rater shall verify the charge using RA3.2.2 and RA3.3 or approved alternatives in RA1.

EXCEPTION 1 to Section 150.2(b)1Fii: Systems unable to comply with the minimum 300 cfm per ton airflow rate requirement shall demonstrate compliance using the procedures in

Section RA3.3.3.1.5; and the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5.

~~**EXCEPTION 2 to Section 150.2(b)1Fiia:** The Executive Director may approve alternate airflow and fan efficacy requirements for small duct high velocity systems.~~

EXCEPTION 32 to Section 150.2(b)Fiia: Entirely new or complete replacement space conditioning systems, as specified by section 150.2(b)1C, without zoning dampers may comply with the minimum airflow rate by meeting the applicable requirements in TABLE-150.0-B or 150.0-C as confirmed by field verification and diagnostic testing in accordance with the procedures in Reference Residential Appendix Section RA3.1.4.4 and RA3.1.4.5. The design clean-filter pressure drop requirements of Section 150.0(m)12C for the system air filter device(s) shall conform to the requirements given in TABLES 150.0-B and 150.0-C.

EXCEPTION 1 to Section 150.2(b)1Fiib: When the outdoor temperature is less than 55 degrees F and the installer utilizes the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 to demonstrate compliance, the installer may elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2. If the HERS Rater verification procedure in Section RA3.2.3.2 is used for compliance, the system's thermostat shall conform to the specifications in Reference Joint Appendix JA5. Ducted systems shall comply with the minimum system airflow rate requirements in Section 150.2(b)1Fiia.

EXCEPTION to Section 150.2(b)1Fii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiia, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1.

- iii. In climate Zones 2, 8, 9, 10, 11, 12, 13, 14, and 15, air-cooled air conditioners or air-source heat pumps, including but not limited to ducted split systems, ducted package systems, small duct high velocity, and minisplit systems, which are of a type that cannot comply with the requirements of 150.2(b)1Fiib shall comply with subsections a and b, as applicable.
 - a. The installer shall confirm the refrigerant charge using the weigh-in charging procedure specified in Reference Residential Appendix Section RA3.2.3.1, as verified by a HERS Rater according to the procedures specified in Reference Residential Appendix RA3.2.3.2; and
 - b. Systems that utilize forced air ducts shall comply with the minimum system airflow rate requirement in Section 150.2(b)1Fiia provided the system is of a type that can be verified using the procedures in RA3.3 or an approved alternative procedure in RA1.

EXCEPTION to Section 150.2(b)1Fiii: Entirely new or complete replacement packaged systems for which the manufacturer has verified correct system refrigerant charge prior to shipment from the factory are not required to have refrigerant charge confirmed through field verification and diagnostic testing. The installer of these packaged systems shall certify on the Certificate of Installation that the packaged system was pre-charged at the factory and has not been altered in a way that would affect the charge. Ducted systems shall comply with minimum system airflow rate requirement in Section 150.2(b)1Fiiib, provided that the system is of a type that can be verified using the procedure specified in RA3.3 or an approved alternative in RA1.

G. Altered Space-Conditioning System. Replacement space-conditioning systems shall be limited to natural gas, liquefied petroleum gas, or the existing fuel type.

EXCEPTION to Section 150.2(b)1G: When the fuel type of the replaced existing heating systems uses was natural gas or liquefied petroleum gas, the replacement space-conditioning system may be a heat pump

HG. Water-Heating System. Altered or Rereplacement service water-heating systems or components shall:

- i. Pipe Insulation.** For newly installed piping, the insulation requirements of Section 150.0(j)2 shall be met. For existing accessible piping the applicable requirements of Section 150.0(j)2Ai, iii, and iv shall be met.
- ii. Distribution System.** For recirculation distribution system serving individual dwelling units, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used
- iii. Water heating system.** Altered or Thereplacement water heating system shall meet one of the following requirements:
 - a. A natural gas or propane water-heating system ~~that meets the requirements of Section 110.1 and 110.3. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used;~~ or
 - b. A single electric water heater with rated volume of more than 55 gallons and an additional photovoltaic system capacity of 1kW; or
 - ~~bc.~~ If no natural gas is connected to the building existing water heater location, an electric water heater ~~that meets the requirements of Section 110.1 and 110.3. For electric resistance~~ only storage type water heaters, the capacity shall not exceed 60 gallons. For recirculation distribution systems, only Demand Recirculation Systems with manual control pumps as specified in the Reference Appendix RA4.4 shall be used; or
 - ~~ed.~~ A water-heating system determined by the executive director to use no more energy than the one specified in Item ~~1-a.~~ above; or if no natural gas is connected to the building existing water heater location, a water-heating system determined by the executive director to use no more energy than the one specified in Item ~~2-b.~~ above; ~~or~~
 - ~~d.~~ Using the existing building plus addition compliance approach as defined in Section 150.2(b)2 demonstrate that the proposed water heating system uses no more energy than the system defined in Item 1 above regardless of the type or number of water heaters installed.

EXCEPTION TO 150.2(b)1Hii: For Climate Zones 1 through 15, a single heat pump water heater that meets the requirements of NEEA Advanced Water Heater Specification Tier 3 or higher.

HI. Roofs. Replacements of the exterior surface of existing roofs, including adding a new surface layer on top of the existing exterior surface, shall meet the requirements of Section 110.8 and the applicable requirements of Subsections i and ii where more than 50 percent of the roof is being replaced;

- i Low-rise residential buildings with steep-sloped roofs, 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.

EXCEPTION TO 150.2(b)1Hi: The following shall be considered equivalent to Subsection i:

- a. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or
- b. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product; or

- c. Existing ducts in the attic are insulated and sealed according to Section 150.1(c)9; or
 - d. Buildings with at least R-38 ceiling insulation; or
 - e. Buildings with a radiant barrier in the attic meeting the requirements of Section 150.1(c)2; or
 - f. Buildings that have no ducts in the attic; or
 - g. In Climate Zones 10-15, R-2or greater insulation above the roof deck.
- ii. Low-sloped roofs in Climate Zones 13 and 15 shall have a 3-year aged solar reflectance equal or greater than 0.63 and a thermal emittance equal or greater than 0.75, or a minimum SRI of 75.

EXCEPTION 1 to Section 150.2(b)1Hjii: Buildings with no ducts in the attic.

EXCEPTION 2 to Section 150.2(b)1Hjii: The aged solar reflectance can be met by using insulation at the roof deck specified in TABLE 150.2-B.

- I. **Lighting.** The altered lighting system shall meet the lighting requirements of Section 150.0(k). The altered luminaires shall meet the luminaire efficacy requirements of Section 150.0(k) and TABLE 150.0-A.
2. **Performance approach.** ~~This performance approach shall only be used for projects that include tradeoffs between two or more altered components that are listed in TABLE 150.2-C.~~

~~**NOTE:** The altered components may be components of the same type, such as a tradeoff between two windows, or components of differing types, such as a tradeoff between a window and an amount of attic insulation.~~

- A. The altered components shall meet the applicable requirements of Sections 110.0 through 110.9, ~~and~~ Section 150.0(a) through ~~(en)~~, ~~Section 150.0(o) through (q)~~; and
- B. The standard design for an altered component shall be the higher efficiency of existing conditions or the requirements stated in TABLE 150.2-C. For components not being altered, the standard design shall be based on the existing conditions. When the third party verification option is specified as a requirement, all components proposed for alteration for which the additional credit is taken, must be verified.

TABLE 150.2-B AGED SOLAR REFLECTANCE INSULATION TRADE OFF TABLE

Aged Solar Reflectance	Roof Deck Insulation R-value	Aged Solar Reflectance	Roof Deck Insulation R-value
0.62-0.60	2	0.44-0.40	12
0.59-0.55	4	0.39-0.35	16
0.54-0.50	6	0.34-0.30	20
0.49-0.45	8	0.29-0.25	24

TABLE 150.2-C STANDARD DESIGN FOR AN ALTERED COMPONENT

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall be Based On	Standard Design With Third Party Verification of Existing Conditions Shall be Based On
Ceiling Insulation, Wall Insulation, and Raised-floor Insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation R-value
Fenestration	The U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.	If the proposed U-factor is ≤ 0.40 and SHGC value is ≤ 0.35 , the standard design shall be based on the existing U-factor and SHGC values as verified. Otherwise, the standard design shall be based on the U-factor of 0.40 and SHGC value of 0.35. The glass area shall be the glass area of the existing building.
Window Film	The U-factor of 0.40 and SHGC value of 0.35.	The existing fenestration in the alteration shall be based on Table 110.6-A and Table 110.6-B.
Space-Heating and Space-Cooling Equipment	The requirements of TABLE 150.1-A.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Section 150.2(b)1D.	
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.1(b)1 150.2(b)1Gi without the solar water heating requirements.	The existing efficiency energy factor level.
Roofing Products	The requirements of Section 150.2(b)1H.	
All Other Measures	The proposed efficiency levels.	The existing efficiency levels.

C. The proposed design shall be based on the actual values of the altered components.

NOTES TO SECTION 150.2(b)2:

1. If an existing component must be replaced with a new component, that component is considered an altered component for the purpose of determining the standard design altered component energy budget and must meet the requirements of Section 150.2(b)2B.
2. The standard design shall assume the same geometry and orientation as the proposed design.
3. The “existing efficiency level” modeling rules, including situations where nameplate data is not available, are described in the Residential ACM Approval Manual

EXCEPTION 1 to Section 150.2(b): Any dual-glazed greenhouse or garden window installed as part of an alteration complies with the U-factor requirements in Section 150.1(c)3.

EXCEPTION 2 to Section 150.2(b): Where the space in the attic or rafter area is not large enough to accommodate the required R-value, the entire space shall be filled with insulation provided such installation does not violate Section 1203.2 of Title 24, Part 2.

~~**EXCEPTION 3 to Section 150.2(b): Space-Conditioning System Ducts.** The requirements of Section 150.0(m)12, 150.0(m)13, 150.0(m)14 and 150.0(m)15 are not applicable to Section 150.2(b).~~

- (c) **Whole Building.** Any addition or alteration may comply with the requirements of Title 24, Part 6 by meeting the requirements for the entire building.

2010 CALIFORNIA MECHANICAL CODE, CALIFORNIA CODE OF REGULATIONS, TITLE 24, PART 4 CHAPTER 6, DUCT SYSTEMS

TABLE P4-A ADOPTION TABLE

CODE SECTION	CEC
Entire 2010 CMC as noted in this table ¹	
601.0	X
602.0	X
604.0	X
605.0	X
¹ Adopted by reference for Occupancies A, B, E, F, H, M, R and S; see Sections 110.8(d)3, 120.4 and 150.0(m).	

APPENDIX 1-A STANDARDS AND DOCUMENTS REFERENCED IN THE ENERGY EFFICIENCY REGULATIONS

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE

AHRI 210/240-2008	Performance Rating of Unitary Air Conditioning and Air-Source Heat Pump Equipment (2008 with Addendum 1)
ANSI/AHRI/CSA 310/380-2004	Standard for Packaged Terminal Air-Conditioners and Heat Pumps (2004)
AHRI 320-98	Water-Source Heat Pumps
AHRI 325-98	Ground Water-Source Heat Pumps (1998)
ANSI/AHRI 340/360-2007	Performance Rating of Commercial and Industrial Unitary Air-Conditioning and Heat Pump Equipment (2007 with Addenda 1 and 2)
ANSI/AHRI 365-2009	Commercial and Industrial Unitary Air-Conditioning Condensing Units (2009)
ANSI/AHRI 460-2005	Performance Rating of Remote Mechanical-Draft Air-Cooled Refrigerant Condensers (2005)
AHRI 550/590-2011	Performance Rating of Water-Chilling Packages Using the Vapor Compression Cycle (2011)
ANSI/AHRI 560-2000	Absorption Water Chilling and Water Heating Packages (2000)
AHRI 680	Performance Rating of Residential Air Filter Equipment (2009)
Available from:	Air-Conditioning and Refrigeration Institute 4301 North Fairfax Drive, Suite 425 Arlington, Virginia 22203 (703) 524-8800

AIR CONDITIONING CONTRACTORS OF AMERICA

Manual J – Residential Load Calculation, Eighth Edition (2003)	
Available from:	Air Conditioning Contractors of America, Inc. 2800 Shirlington Road, Suite 300 Arlington, VA 22206 www.acca.org (703) 575-4477

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION
 CANADIAN STANDARDS ASSOCIATION
 WINDOW AND DOOR MANUFACTURERS ASSOCIATION

AAMA/WDMA/CSA 101/I.S.2/A440-11 NAFS 2011 – North American Fenestration Standard/Specification for windows, doors, and skylights

Available from:

AAMA
 1827 Walden Office Square, Suite 550
 Schaumburg, IL 60173-4268
 (847)303-5664
 www.aamanet.org

CSA
 5060 Spectrum Way, Suite 100
 Mississauga, ON, Canada L4W 5N6
 (800)463-6727
 www.csagroup.org

WDMA
 2025 M Street, NW, Suite 800
 Washington, DC 20036-3309
 (202)367-1157
 www.wdma.com

AMERICAN NATIONAL STANDARDS INSTITUTE

ANSI Z21.10.3-2001 Gas Water Heaters, Volume 1, Storage Water Heaters with Input Ratings above 75,000 Btu/h (2001)

ANSI Z21.13-2000 Gas-Fired Low Pressure Steam and Hot Water Boilers (2000)

ANSI Z21.40.4-1996 Performance Testing and Rating of Gas-Fired, Air-Conditioning and Heat Pump Appliances (1996)

ANSI Z21.47-2001 Gas-Fired Central Furnaces (2001)

ANSI Z83.8-2002 Gas Unit Heaters and Gas-Fired Duct Furnaces (2002)

Available from: American National Standards Institute

25 West 43rd Street, 4th Floor

New York, NY 10036

(212) 642-4900

ANSI/NSPI-5 2003 Residential Inground Swimming Pools (2003)ANSI C82.6-2005

Ballasts for High-Intensity Discharge Lamps - Methods of Measurement

Available from: Association of Pool & Spas Professionals

2111 Eisenhower Ave.

Alexandria, VA 22314

(703) 838-0083

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

ASHRAE Standard 52.2 -2012	Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size,
ASHRAE Standard 55-2010	Thermal Environment Conditions for Human Occupancy
ASHRAE Standard 62.2-2010	Ventilation and Acceptable Indoor Air Quality in Low-Rise Residential Buildings
ASHRAE Handbook	
Applications Volume,	Heating, Ventilating and Air-Conditioning Applications (2011)
Equipment Volume,	Heating, Ventilating and Air-Conditioning Systems and Equipment (2008)
Fundamentals Volume,	Fundamentals (2009)
Available from:	ASHRAE
	1791 Tullie Circle N.E.
	Atlanta, Georgia 30329-2305
	www.ashrae.org

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS (REGIONAL PUBLICATION)

ASHRAE Climatic Data for Region X Arizona, California, Hawaii, Nevada, Publication SPCDX, 1982, ISBN #20002196 and Supplement, 1994, ISBN #20002596

Available from: Order Desk
Building News
10801 National Boulevard
Los Angeles, CA 90064
(800) 873-6397 or (310) 474-7771
<http://www.bnibooks.com/>

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

ASME A112.18.1-2011/CSA B125.1-11 Plumbing Supply Fittings

Available from: ASME
Three Park Avenue
New York, NY 10016-5990
(800) 843-2763
<http://www.asme.org/>

AMERICAN SOCIETY FOR TESTING AND MATERIALS

ASTM C55-14	Standard Specification for Concrete Brick (2014)
ASTM C177-13	Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus (2013)
ASTM C272-12	Standard Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions (2012)
ASTM C335-10	Standard Test Method for Steady State Heat Transfer Properties of Horizontal Pipe Insulation (2010)
ASTM C518-10	Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus (2010)
ASTM C731-10	Standard Test Method for Extrudability, After Package Aging, of Latex Sealants (2010)
ASTM C732-12	Standard Test Method for Aging Effects of Artificial Weathering on Latex Sealants (2012)
ASTM C836-12	Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course (2012)
ASTM C1167-11	Standard Specification for Clay Roof Tiles(2011)
ASTM C1371-10	Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers (2010)
ASTM C1492-09	Standard Specification for Concrete Roof Tile (2009)

ASTM C1549-14	Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer (2014)
ASTM C1583-13	Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method) (2013)
ASTM D448-12	Standard Classification for Sizes of Aggrerate for Road and Bridge Construction (2012)
ASTM D522-13	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (2013)
ASTM D822-13	Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings (2013)
ASTM D1003-13	Standard Test Method for Haze and Luminous Transmittance of Transparent Plastics (2013)
ASTM D1653-13	Standard Test Methods for Water Vapor Transmission of Organic Coating Films (2013)
ASTM D1863-11	Standard Specification for Mineral Aggregate Used on Built-Up Roofs (2011)
ASTM D2370-10	Standard Test Method for Tensile Properties of Organic Coatings (2010)
ASTM D2824-13	Standard Specification for Aluminum-Pigmented Asphalt Roof Coatings, Nonfibered, Asbestos Fibered, and Fibered without Asbestos (2013)
ASTM D3468-13	Standard Specification for Liquid-Applied Neoprene and Chlorosulfonated Polyethylene Used in Roofing and Waterproofing (2013)
ASTM D3805-09	Standard Guide for Application of Aluminum-Pigmented Asphalt Roof Coatings (2009)
ASTM D4798-11	Standard Test Method Accelerated Weathering Test Conditions and Procedures for Bituminous Materials (Xenon-Arc Method) (2011)
ASTM D5870-11	Standard Practice for Calculating Property Retention Index of Plastics (2011)
ASTM D6694-13	Standard Specification for Liquid-Applied Silicone Coating Used in Spray Polyurethane Foam Roofing (2013)

ASTM E96-14	Standard Test Methods for Water Vapor Transmission of Materials (2014)
ASTM E283-12	Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen (2012)
ASTM E408-13	Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques (2013)
ASTM E972-13	Standard Test Method for Solar Photometric Transmittance of Sheet Materials Using Sunlight (2013)
ASTM E1918-15	Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field (2015)
ASTM E1980-11	Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces (2011)
ASTM E2178-13	Standard Test Method for Air Permeance of Building Materials (2013)
ASTM E2357-11	Standard Test Method for Determining Air Leakage of Air Barrier Assemblies (2011)
ASTM E779-10	Standard Test Method for Determining Air Leakage Rate by Fan Pressurization (2010)
ASTM E1677-11	Standard Specification for an Air Retarder (AR) Material or System for Low-Rise Framed Building Walls (2011)

Available from: American Society for Testing and Materials
100 Barr Harbor Drive
West Conshohocken, Pennsylvania 19428-2959
(800) 262-1373 or (610) 832-9585

CALIFORNIA BUILDING STANDARDS COMMISSION

2010 California Electrical Code
2010 California Plumbing Code
2010 California Mechanical Code
2010 California Building Code

Available from: California Building Standards Commission
2525 Natomas Park Drive, Suite 130
Sacramento, CA 95833-2936
(916) 263-0916
www.bsc.ca.gov

CALIFORNIA ENERGY COMMISSION

Appliance Efficiency Regulations

Building Energy Efficiency Standards for Residential and Nonresidential Buildings

Reference Appendices for the Building Energy Efficiency Standards for Residential and Nonresidential Buildings

Nonresidential Alternative Calculation Method (ACM) Approval Manual

Nonresidential Alternative Calculation Method (ACM) Reference Manual

Nonresidential Compliance Manual

Residential Alternative Calculation Method (ACM) Approval Manual

Residential Alternative Calculation Method (ACM) Reference Manual

Residential Compliance Manual

New Solar Homes Partnership Guidebook, currently adopted by the Energy Commission.

Available from: California Energy Commission/Publications
 1516 Ninth Street
 Sacramento, CA 95814
 (916) 654-5200
www.energy.ca.gov/title24.

CALIFORNIA DEPARTMENT OF CONSUMER AFFAIRS

Standards for Insulating Material

Available from: California Department of Consumer Affairs
 Bureau of Electronic and Appliance ,Home Furnishings and Thermal Insulation
 4244 South Market Court, Suite D
 Sacramento, California 95834-1243
 (916) 999-2041

COOLING TECHNOLOGY INSTITUTE

CTI ATC-105-00 Acceptance Test Code for Water Cooling Towers (2000)
 CTI STD-201-04 Standard for the Certification of Water-Cooling Tower Thermal Performance (2004)
 Available from: Cooling Technology Institute
 2611 FM 1960 West, Suite A-101
 Houston, Texas 77068-3730

 PO Box 73383
 Houston, Texas 77273-3383
 (281) 583-4087

COOL ROOF RATING COUNCIL

CRRC-1 Product Rating Program Manual (2014)
Available from: Cool Roof Rating Council
 449 15th Street, Suite 400
 Oakland, CA 94612
 (866) 465-2523
 www.coolroofs.org

HYDRONICS INSTITUTE

HI Heating Boiler Standard 86, 6th Edition, (1989)
Available from: Hydronics Institute
 35 Russo Place, P.O. Box 218
 Berkeley Heights, New Jersey 07922
 (908) 464-8200

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA

The IESNA Lighting Handbook, Ninth Edition (2000)
Available from: IESNA
 120 Wall Street, 17th Floor
 New York, New York 10005-4001
 (212) 248-5000
 Email: iesna@iesna.org

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS

2007 California Mechanical Code
Available from: International Association of Plumbing and Mechanical Officials
 2001 E. Walnut Drive South
 Walnut, California 91789-2825
 800 85-IAPMO (854-2766)
 www.iapmo.org

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS

2007 California Building Code
Available from: International Conference of Building Officials
 International Code Council Los Angeles District Office
 5360 South Workman Mill Road
 Whittier, California 90601-2298
 (800) 284-4406
 www.icbo.org

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO-13256-1 Water-Source Heat Pumps - Testing and Rating for Performance - Part 1: Water-to-Air and Brine-to-Air Heat Pumps (1998)

Available from: ISO
 1, rue de Varembe
 Case postale 56
 CH-1211
 Geneve 20, Switzerland

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

NEMA SSL 7A-2013 "Phase Cut Dimming for Solid State Lighting: Basic Compatibility"

Available from: 1300 North 17th Street, Suite 1752
 Rosslyn, VA 22209
 703-841-3200
www.nema.org

NATIONAL FENESTRATION RATING COUNCIL

NFRC 100 Procedures for Determining Fenestration Product U-factors (2014)

NFRC 200 Procedures for Determining Fenestration Product Solar Heat Gain Coefficients and Visible Transmittance at Normal Incidence (2014)

NFRC 202 Procedure for Determining Translucent Fenestration Product Visible Transmittance at Normal Incidence (2014)

Note: This Technical document has yet not been fully approved by NFRC. If this document is not approved before the Building Energy Standards effective date it will be removed.

NFRC 203 Procedure for Determining Visible Transmittance of Tubular Daylighting Devices (2014)

Note: This Technical document has yet not been fully approved by NFRC. If this document is not approved before the Building Energy Standards effective date it will be removed.

NFRC 400 Procedures for Determining Fenestration Product Air Leakage (2014)

Available from: National Fenestration Rating Council
 6035 Ivy Lane, Suite 140
 Greenbelt, MD 20770.

(301) 589-1776
WWW.NFRC.org and Email: info@nfr.org

NSF INTERNATIONAL (FORMERLY NATIONAL SANITATION FOUNDATION)

NSF/ANSI 50 2005 Circulation System Components and Related Materials for Swimming Pools, Spas/Hot Tubs (2005)

Available from: NSF International
 PO Box 130140
 Ann Arbor, MI 48113
 (734) 769-8010

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION

Residential Comfort System Installation Standards Manual (1998)

Available from: Sheet Metal And Air Conditioning Contractors National Association (SMACNA)
4201 Lafayette Center Drive
Chantilly, VA 20151-1209
(703) 803-2980
www.smacna.org

UNDERWRITERS LABORATORIES

UL 181 Standard for Safety for Factory-made Air Ducts and Connectors (1996)

UL 181A Standard for Safety for Closure Systems for Use with Rigid Air Ducts and Air Connectors (1994)

UL 181B Standard for Safety for Closure Systems for Use with Flexible Air Ducts and Air Connectors (1995)

UL 723 Standard for Test for Surface Burning Characteristics of Building Materials (1996)

UL 727 Standard for Oil-Fired Central Furnaces (1994)

UL 731 Standard for Oil-Fired Unit Heaters (1995)

[UL 1077](#) [Standard for Supplementary Protectors for Use in Electrical Equipment](#)

UL 1574 Track Lighting Systems (2000)

UL 1598 Standard for Luminaires (2000)

UL 2108 Low Voltage Lighting Systems (2008)

Available from: Underwriters Laboratories
333 Pfingsten Road
Northbrook, Illinois 60062-2096
(847) 272-8800