TABLE OF CONTENTS

LIST OF FIGURES

Page

LIST OF TABLES

Page

Additions, Alterations, and Repairs

Overview

This chapter covers key aspects of how the 2025 Building Energy Efficiency Standards (Energy Code) apply to the construction of additions and/or alterations to an existing residential building. As explained below, the Energy Code does not apply to building repairs.

The chapter is organized as follows:

- Section 9.1 – Introduction. Highlights the applicable standards definitions for additions, alterations, and repairs and provides several examples of each.
- Section 9.2 – What's New in the 2025 Energy Code. Highlights of the requirements and compliance options in the 2025 Energy Code.
- Section 9.3 – Compliance Approaches. An overview of prescriptive and performance compliance options.
- Section 9.4 – Prescriptive Approach and Mandatory Requirements. Detailed information on prescriptive compliance methods for additions and alterations, including how mandatory requirements apply.
- Section 9.5 – Performance Approach. An explanation of computer simulation of compliance for building additions, including existing + addition + alterations.

When additions and alterations include changes to the building envelope, mechanical systems, and/or water heating systems, a certificate of compliance form (CF1R) must be completed and submitted with the building permit application:

- If complying prescriptively, CF1R-ADD-01-E and/or CF1R-ALT-02-E, CF1R-ADD-02-E, or CF1R-ALT-05-E forms are used.
- For the performance approach, compliance software produces a CF1R-PRF-01-E. (See Appendix A for a list of forms.)

Changes to HVAC systems will likely include one or more features that require Energy Code Compliance (ECC) field verification and diagnostic testing. If ECC-Verification is required, the certificate of compliance must be completed and registered online with an approved ECC provider using the provider's website.

Refer to Chapter 2 for information about document registration and refer to Residential Appendix RA2 for more information about ECC-Verifications.

For a list of appropriate compliance documents refer to Appendix A of this manual.

Additions

An *addition* is any change to an existing building that increases both conditioned floor area and conditioned volume (including conditioning a previously unconditioned space). See Section 100.1.

Examples of an addition include:

- Adding a conditioned sunroom or other living space to an existing house.
- Converting a garage or other existing unheated space into living space.
- Enclosing and conditioning an existing patio area.
- Obtaining a permit to legalize an existing, conditioned space that was previously added to a residential building without a permit.
- Adding a bay window that extends from floor to ceiling, thereby increasing both floor area and volume.

Alterations

An *alteration* is any change to a water-heating system, space-conditioning system, lighting system, or envelope of a building that is not an addition. See Section 100.1.

Examples of alterations include:

- Adding insulation to an existing ceiling, exterior roof, exterior wall, or raised floor that is over a crawl space, garage, or unheated basement.
- Replacing or installing a new finish surface to an existing roof (reroofing) and replacing either portions of or the entire roof assembly.
- Replacing existing fenestration or adding fenestration area (for example, windows, glazed doors, dynamic glazing, or skylights) to an existing building.
- Replacing an existing skylight or increasing the skylight area of an existing roof over existing conditioned space.
- Constructing an entirely new roof over an existing conditioned space.
- Adding a loft within the conditioned volume of an existing home.

  Replacing an existing space heating system or adding a space heating system to existing conditioned space (furnace, wall heater, heat pump, or radiant floor).
- Adding heating to unconditioned space is considered an addition, not an alteration, when it increases both the conditioned floor area and conditioned volume of the building.
- Replacing an existing space cooling system or adding a space cooling system to existing conditioned space (for example, a central air conditioner or heat pump).
- Extending or replacing an existing duct system or adding an entirely new duct system.
- Replacing the existing water heater or adding water heaters and/or hot water piping.
- Replacing existing hardwired lighting or adding new hardwired lighting fixtures.
- Adding window film.

Repairs

Please refer to Chapter 9.1.3 of the *2022 Single-family Residential Compliance Manual*.

Example 9-1

Question:

A sunspace addition is designed with no mechanical heating or cooling and a glass sliding door separating it from all existing conditioned space. This design is approved by the enforcement agency as uninhabitable or unimproved space. Under what conditions will the Energy Code apply to this addition?

Figure 9-1: Unconditioned Sunspace

Source: California Energy Commission

Answer:

The mechanical and envelope requirements of the Energy Code do not apply if the space is not directly or indirectly conditioned, which is demonstrated by the air and thermal barrier between the added sunspace and the existing conditioned space. This space, therefore, is unconditioned as defined in Section 100.1; however, per Section 100.0(c)2, the sunspace must still comply with the applicable lighting requirements of Section 150.0(k). The sunspace is unconditioned if:

- The new space is not provided with heating or cooling
- All openings between the new space and the existing house can be closed off with weather-stripped doors and windows or
- The addition is not indirectly conditioned space (defined in Section 100.1 under CONDITIONED SPACE, INDIRECTLY).

A building official may require a sunspace to be conditioned if it appears to be habitable space, in which case the Energy Code applies.

Example 9-2

Question:

An existing duplex is remodeled, which includes only the installation of new faucets and bathroom lighting. Does the Energy Code apply?

Answer:

Yes, this remodel is considered an alteration. However, due to the limited scope of work and since no new conditioned space is being created, the remodel must comply only with the applicable mandatory requirements described in Section 110.1 for appliances and Section 150.0(k) for residential lighting.

Example 9-3

Question:

An existing house is remodeled by adding floor area but not increasing the volume of the house (adding a loft in an area in the house with a vaulted ceiling). As part of this remodel, some windows are replaced, and two windows are being added. Several exterior walls are being opened to install new wiring. What requirements will apply?

Answer:

Since floor area is added but not conditioned volume, this is an alteration and not an addition. It must comply with the Energy Code using either the prescriptive method or performance method and meet all the applicable mandatory requirements. To comply prescriptively, the new and replacement windows must meet the maximum U-factor and solar heat gain coefficient (SHGC) requirements of Section 150.2(b)1A and B. Newly installed and replacement windows must also comply with the mandatory requirements for caulking/sealing around windows per Section 110.7.Alternatively, the performance approach may be used to demonstrate compliance for the entire house, even if individual windows fail to meet the prescriptive requirements, if the building meets all applicable mandatory requirements. At this time, since the exterior walls are exposed or open, this allows the opportunity to insulate the walls and contribute the energy efficiency of the building. Such upgrades are unlikely to contribute to the compliance of the building without third party verification of existing conditions.

What's New for 2025

The 2025 Energy Code includes updates to the mandatory, prescriptive, and performance requirements for additions and alterations. This section highlights the key changes from the 2022 Energy Code. Note that prescriptive compliance requirements may be higher than mandatory requirements.

Building Envelope

- For additions and alterations, the prescriptive maximum U-factor requirements for windows reduced from 0.30 to 0.27 in climate zones 1 – 5, 11 – 14, and 16; climate zones 6 – 10 and 15 remain at 0.30 U-factor. For homes 500 square feet or less, the U-factor requirement remains at 0.30 in climate zone 5. In climate zone 15 an SHGC of 0.23 is allowed.
- Option C for roof insulation provides a prescriptive path for cathedral ceilings. The required cavity R-value for all climate zones is R-38. A radiant barrier is not prescriptively required for cathedral ceilings.

Space Conditioning System

- In addition to the requirements in 150.0(h)5, in additions and alterations where airflow is NOT field verified to be at least 350 cfm/ton, maximum capacity limits are provided in Tables 150.2-A and B that depend on the relative sizes of the calculated heating design load (HL) and cooling design load (CL), the type of space conditioning system, and the duct sizing (Section 150.2(a)1E).
- When doing load calculations for additions, the envelope leakage specified in the load calculation shall be no greater than the values shown in Table 150.2-C ("average" for many load calculation software tools). If leakage is established through field verification and

diagnostic testing, the tested envelope leakage value may be used in the load calculations (Section 150.2(a)1E).

- Block loads (the total load for all rooms combined that are served by the central equipment) may be used for the purpose of system sizing for additions (Section 150.0(h)5).
- The Energy Budget for additions is expressed in terms of Long-term System Cost (LSC) (Section 150.2(a)2).
- Refrigerant charge verification is required for heat pumps in all Climate Zones. Refrigerant charge verification is required for air conditioners in climate zones 2 and 8 – 15.

Water Heating

There are new mandatory requirements for air-source heat pump water heaters. These requirements are discussed in detail in Chapter 5 and summarized below.

- Heat pump water heaters installed so that inlet air is outdoor air must have backup heat if the compressor cutout temperature is above the local Heating Winter Median of Extremes (Section 110.3(c)7A).
- Ventilation is required when installing a heat pump water heater (Section 110.3(c)7B).

Compliance Approaches

Please refer to Chapter 9.3 of the *2022 Single-family Residential Compliance Manual*.

Additions

Regardless of the compliance approach selected, the following exceptions apply:

- Additions of ≤ 300 ft^2 do not require a cool roof product (if required by Section 150.1(c)11) to be installed.
- Whole-house fan (or ventilation cooling) does not apply to additions of 1,000 ft^2 or less (if otherwise required by Section 150.1(c)12).
- Existing space conditioning systems that are extended to provide conditioning to an addition are required (mandatory) to meet duct insulation and duct leakage requirements specified in Section 150.2(b)1Di and 150.2(b)1Dii (Section 150.2(a) Exception 4).
- Indoor air quality (IAQ) requirements (Section 150.0(o)1C, D, or F) do not apply to additions of 1,000 ft^2 or less that are not a new dwelling unit that is not a Junior Accessory Dwelling Unit.
- Photovoltaic (PV) requirements do not apply to additions or alterations.

Addition Alone

In this compliance scenario, the addition alone is modeled using compliance software, and the existing building is not modeled. This approach can work well when the existing building is not undergoing alterations, and the permitted work scope covers only the addition.

- Advantages: Little information about the existing building is needed (conditioned floor area, number of bedrooms) because it is not modeled.
- Disadvantages: Some prescriptive allowances for additions do not apply to the addition-alone compliance approach. For example, a 400 ft2 addition has a 30 percent fenestration area limit if complying using existing + addition, while only 20 percent is allowed when

complying as an addition alone. Also, with this approach, alterations to the existing building that improve its energy performance cannot be used to "trade-off" requirements for the addition

Existing + Addition + Alteration

In this compliance scenario, the entire building undergoes the compliance analysis, and unaltered building components are not required to be brought into compliance.

- Advantages: This approach offers the most flexibility by modeling improvements to the existing building. The energy budget provides more generous fenestration allowances for prescriptive compliance. Note: There is no requirement to make alterations to the existing building using this approach.
- Disadvantages: Plans and data for the existing building are needed, increasing the time and complexity of the calculations.

Existing + Addition as Newly Constructed Building

In this compliance scenario, modeling the existing building and the addition as if they were a newly constructed building. This approach is used when changes to the existing building are extensive. Demonstrating compliance can be difficult because all existing features must be brought up to current code.

Additions and Alterations Combined

Prescriptive Approach

When a single-family building project that includes an addition and alterations uses the prescriptive approach to compliance, all prescriptive requirements must be met. The addition complies with the CF1R-ADD-01-E prescriptive certificate of compliance.

Alterations to the existing building must also meet prescriptive requirements and be documented by a CF1R-ALT-02-E prescriptive certificate of compliance for alterations.

Performance Approach

Please refer to Chapter 9.3.2.2 of the *2022 Single-family Residential Compliance Manual*.

Alterations Only

Prescriptive

Alterations may comply prescriptively by meeting all applicable requirements in

Section 150.2(b), which are explained further in Prescriptive Approach and Mandatory Requirements. Several prescriptive alteration requirements or exceptions are specific to conditions such as building climate zone.

It is important to note that every applicable prescriptive requirement must be met; otherwise, the building must comply using the performance approach. However, if one or more proposed alterations do not comply prescriptively, other alterations must exceed prescriptive requirements for the project to comply based on the performance approach.

Under the prescriptive approach to alterations, the CF1R-ALT-02-E prescriptive certificate of compliance is completed and submitted with the permit application. If any mandatory or prescriptive features require ECC-Verification (see Chapter 2, ECC Field Verification and

Diagnostic Testing), the certificate of compliance must be completed and registered online with an ECC-Provider (see Chapter 2, Compliance Documentation) before being submitted to the enforcement agency.

Performance

Alterations may comply using the performance approach by meeting the requirements in Section 150.2(b)2. This is explained in Performance Approach. The main options are:

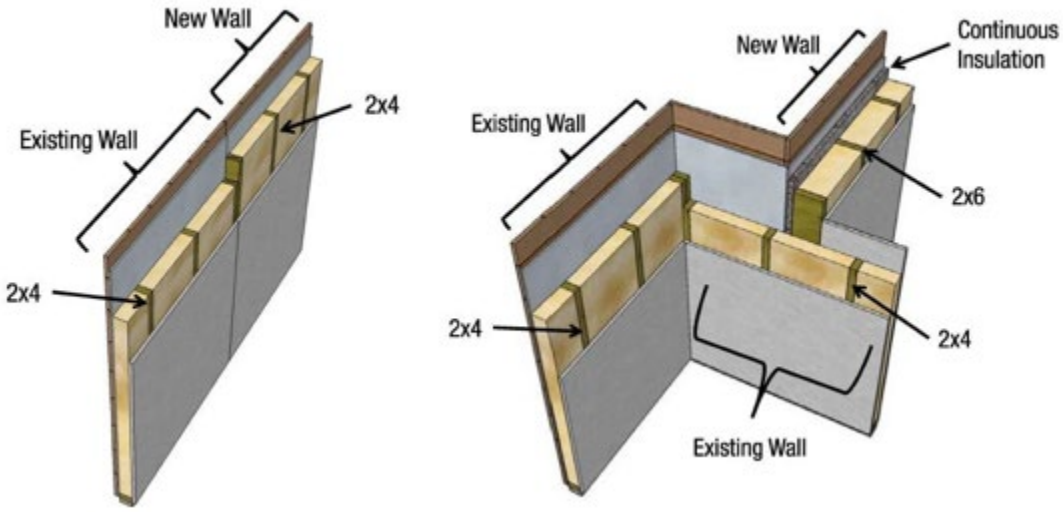
- Existing plus alterations: If multiple components or systems are being altered or if the proposed modification(s) exceed prescriptive requirements, then the existing + alterations performance approach can be used to make trade-offs.
- Compliance without third-party verification: This option allows alterations to comply without third-party inspection to verify existing conditions being altered.
- Compliance with third-party verification: This option allows for alterations to comply only with third-party inspection to verify existing conditions being altered.
- Existing plus alterations as a newly constructed building: This option is the most difficult.

Wall Exceptions to Continuous Insulation

Wall Extension

When an addition is built with a connection to an existing wood-framed wall, an extension to an existing wood-framed wall (Figure 9-2: Wall Extension to the Left and not a Wall Extension to the Right) is allowed to retain the existing dimensions (Section 150.2(a)1Ai or 150.2(a)1Biii).This exception will typically apply to only one or two walls of an addition. Prescriptive compliance for the walls that meet the criteria will require R-15 cavity insulation if the existing framing is 2x4 or R-21 cavity insulation if the existing framing is 2x6 for the extended wall(s). The energy budget for performance compliance will match the prescriptive requirements.

Figure 9-2: Wall Extension to the Left and not a Wall Extension to the Right



Source: California Energy Commission

Existing Wall with Siding

Please refer to Chapter 9.3.4.2 of the *2022 Single-family Residential Compliance Manual*.

Accessory Dwelling Units

California Government Code Section 65852.2 defines accessory dwelling units as an attached or detached residential dwelling unit which provides complete independent living facilities for one or more persons. An ADU shall include permanent provisions for living, sleeping, eating, cooking, and sanitation on the same parcel as the single-family dwelling is situated.

The Energy Code does not include a definition of Accessory Dwelling Unit. The Energy Code defines a junior accessory dwelling unit (JADU) which is a dwelling unit that is no more than 500 square feet in size and contained entirely within an existing or newly constructed single-family building A JADU includes a kitchen, a separate entrance from the main entrance to the building, and an interior entry to the main living area. A JADU may include separate sanitation facilities, or may share sanitation facilities with the existing single-family building.

State legislation effective since January 1, 2017 has given more flexibility to build ADUs, sometimes called "granny" or "in-law" units. For compliance, an ADU may be an addition, a newly constructed building, an alteration, or entirely within existing conditioned space. See Figure 9-3: ADU Type Newly Constructed Detached from Existing Home through Figure 9-10: ADU Type Alteration to Existing Detached Conditioned CFA to determine the compliance requirements.

Energy code compliance for Accessory Dwelling Units, with a few exceptions, only pertains to where and how conditioned space is altered or added. For the purposes of Energy code, a single-family residential building is an Occupancy Group (per CBC) R-3 building or a U-building on a residential site. According to Section 100.0 of the Energy Code, an ADU that is a newly constructed building triggers the mandatory and prescriptive/performance requirements of sections 150.0 and section 150.1, respectively. For all intents and purposes, it is considered a new single-family home and energy code does not confer any special category or requirements due to the fact that it is an ADU per Government Code. If an ADU is created as a part of an addition or alteration, then Section 150.2 requirements apply within the definitions and scope of additions or alterations.

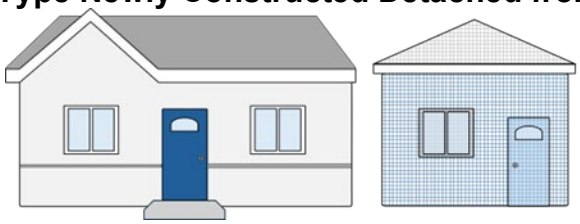
ADU compliance requirements are based on the associated Energy Code classification as either an addition or alteration to an existing residence or as a new building, as shown in Figure 9-3: ADU Type Newly Constructed Detached from Existing Home through Figure 9-10: ADU Type Alteration to Existing Detached Conditioned CFA. An ADU may comply using any of the prescriptive or performance method options available for other residential additions or new buildings plus meeting applicable mandatory requirements.

- If the ADU shares common walls with the existing dwelling unit and is newly constructed, some or all of the walls may be wall extensions (see Wall Exceptions to Continuous Insulation).
- If the ADU is converting an existing unconditioned structure into conditioned space, an exception to the prescriptive requirement for continuous insulation is available for walls where existing exterior siding (or cladding) is not removed.
- If the ADU shares common walls with an existing single-family residential building and is converting an attached unconditioned space into conditioned space, the existing walls of the

new ADU may meet an exception to the requirement for continuous insulation if exterior siding is not removed.

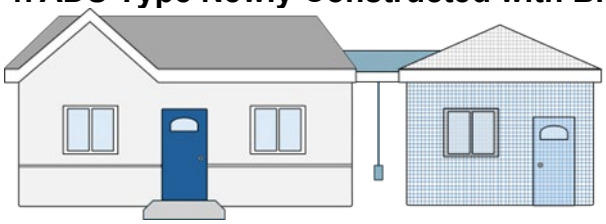
- If the ADU shares no common walls and is a new detached structure, this is a newly constructed residential building.
- If an ADU is created within existing conditioned space with a combination of existing, altered, and new components, then the project is an Alteration.
- If an ADU is created by adding off of an existing unconditioned space, such as building a second story over an existing detached garage building, the project is an Addition.

Figure 9-3: ADU Type Newly Constructed Detached from Existing Home



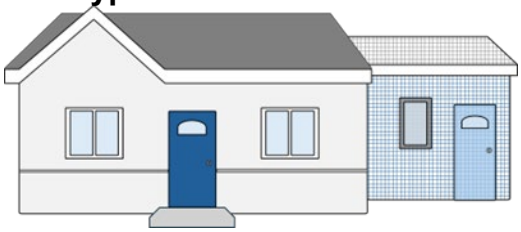
Source: California Energy Commission

Figure 9-4: ADU Type Newly Constructed with Breezeway



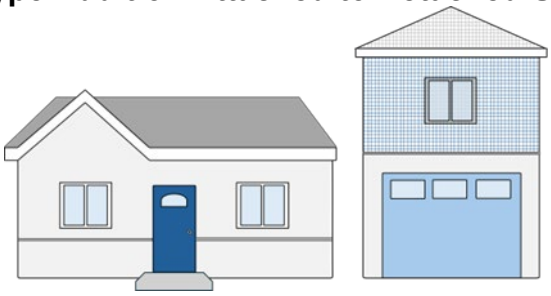
Source: California Energy Commission

Figure 9-5: ADU Type Addition Attached to Existing Home



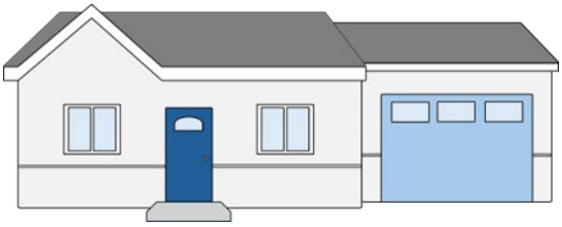
Source: California Energy Commission

Figure 9-6: ADU Type Addition Attached to Detached Unconditioned CFA



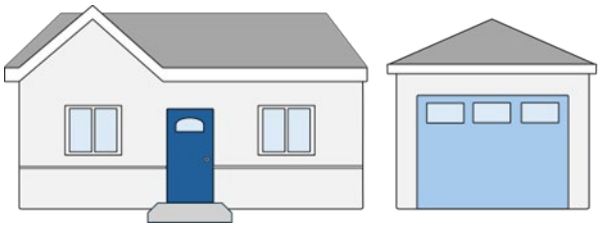
Source: California Energy Commission

Figure 9-7: ADU Type Addition Converting Attached Unconditioned CFA to Conditioned CFA



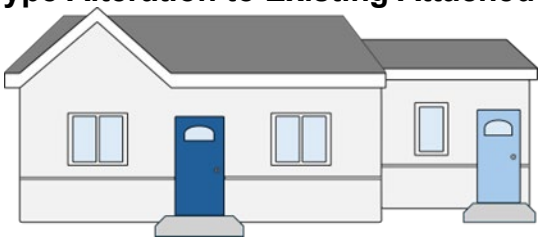
Source: California Energy Commission

Figure 9-8: ADU Type Addition Converting Detached Unconditioned CFA to Conditioned CFA



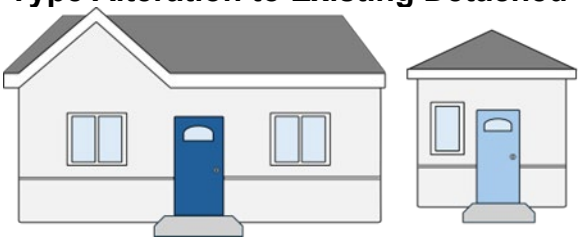
Source: California Energy Commission

Figure 9-9: ADU Type Alteration to Existing Attached Conditioned CFA



Source: California Energy Commission

Figure 9-10: ADU Type Alteration to Existing Detached Conditioned CFA



Source: California Energy Commission

HVAC

When adding an attached ADU to an existing home, the Mechanical Code does not allow return air from one dwelling unit to be discharged into another dwelling unit through a shared heating or cooling system (CMC 311.4). Systems without ducts are an option.

A system serving an ADU must have its own thermostat. Heating systems must be capable of maintaining 68 °F at a point three feet above the floor and two feet from the exterior walls in habitable rooms. Heating and cooling load calculations will need to be provided per Title 24, Part 6, Section 150.2(a)1E to verify that any existing and/or new system is properly sized. For additions, per section 150.2(a)1E, the envelope leakage specified in the load calculation shall be no greater than the values shown in Table 150.2-C. There is an exception to this requirement if leakage is established through field verification and diagnostic testing following procedures specified in Reference Residential Appendix RA3.8, the tested envelope leakage

value may be used in the load calculations and no disclosure is required. Any addition that adds a new dwelling unit must meet all applicable IAQ ventilation requirements of Sections 150.0(o)1C, except for additions that are JADUs (defined above). A detached ADU must meet all applicable IAQ ventilation requirements of Sections 150.0(o)1C. An attached ADU must also meet all requirements if the dwelling units do not share a floor or ceiling. The whole house ventilation airflow is to be based on the square footage of the new dwelling unit.

Local exhaust for bathrooms and kitchens is required for any addition. See Table 9-6: HVAC Requirements for Prescriptive Additions for a more detailed summary of prescriptive HVAC system requirements for additions.

Photovoltaics (PV)

Solar electricity generated by photovoltaics (PV) is not required if the ADU is an addition. PV is required for detached, newly constructed ADUs.

Example 9-4

An existing single-story residence has a 600 ft² attached unconditioned storage room that the owner plans to turn into an accessory dwelling unit. The existing uninsulated walls have 2x6 wood framing, and the owner plans to keep the existing exterior siding. For prescriptive compliance, what wall insulation is required in the proposed ADU?

Answer:

The proposed ADU is considered an addition for Title 24, Part 6. The existing 2x6 walls can be insulated with R-21 cavity insulation (Section 150.2(a)1Bvi) for prescriptive compliance. Continuous insulation is not required for these walls.

Example 9-5

Question:

Can the ADU in the previous example get energy compliance credit using ECC-Verification of existing conditions for performance method compliance?

Answer:

No. Existing walls in newly conditioned spaces are considered "new" for the purposes of the Energy Code since the walls enclose the building envelope around newly conditioned space. ECC-Verification of existing conditions is only applicable to "altered" components, which would not apply to parts of the building envelope that do not enclose existing conditioned space.

Example 9-6

Question:

In the ADU in the previous example, is solar electricity generated by PV required for prescriptive or performance method compliance?

Answer:

No, PV is not required for Title 24 energy compliance for additions using any compliance approach.

Example 9-7

Question:

The existing residence in the previous example has a ducted forced-air furnace with a central return and enough heating capacity to heat the existing residence and the new ADU. The proposed alteration is to extend the existing ductwork to serve the ADU. Is this allowed for code compliance?

Answer:

No. The California Mechanical Code does not allow return air from an existing forced-air system to be discharged into another dwelling unit through the heating or cooling system. Therefore, the existing ducted furnace may not serve the existing home and the proposed ADU.

Example 9-7a

Question:

When modeling a conversion of an existing garage to an accessory dwelling unit (ADU), and also making an addition to the existing house, can this be modeled together using the existing plus addition plus alteration approach?

Answer:

Yes. In this scenario, the existing home, addition, and ADU must be modeled as separate zones.

Example 9-7b

Question:

When converting existing conditioned space, like a conditioned basement, into an ADU or junior ADU, is this an addition?

Answer:

No. This is considered an alteration. Energy Code requirements may be triggered if altering a component which is covered by the Energy Code. Some examples of alterations that are covered by the Energy Code are newly installed water heaters or mini-split HVAC systems, lighting upgrades, changes to the building envelope, etc.

Example 9-8a

Question:

A new 1200 square feet (sq. ft.) detached garage is being proposed in climate zone 15. It is being proposed as conditioned space. There is not external shading to the roof. Do Prescriptive Solar PV requirements apply to this building?

Answer:

Yes. Per equation 150.1-C, the project is prescriptively assessed 1.87 kW of PV. [(1200 sq. ft. X 1.560)/1000 + (0 DU's x 1.47)= 1.87 kW. The project will require solar PV unless compliance can be achieved without PV using the Performance path. Exception 2 does not apply since this calculation exceeds 1.8 kW.

Example 9-8b

Question:

A newly constructed detached duplex of ADUs is being constructed in climate zone 1. The roof is fully exposed. The total conditioned floor area is 500 square feet (250 square feet for each ADU). Does this project prescriptively require PV?

Answer:

Yes. Per equation 150.1-C, the project is prescriptively assessed 2.86 kW of PV. [(500 sq. ft. X 0.793)/1000 + (2 DU's x 1.27)= 2.86 kW. The code specifies that this equation is assessed on the building, and not on the dwelling units in that building individually. The project will require solar PV unless compliance can be achieved without PV using the Performance path. Exception 2 does not apply since this calculation exceeds 1.8 kW.

Example 9-8c

Question:

A newly constructed detached duplex of ADUs is being constructed in climate zone 1. The total conditioned floor area is 500 sq. ft. (250 sq. ft. For each ADU). The low-sloped roof is shaded by nearby trees and combined with fire clearances, has a remaining Solar Access Roof Area of 125 sq. ft. Does this project prescriptively require PV?

Answer:

No. Per equation 150.1-C, the project is prescriptively assessed 2.94 kW of PV. [(500 sq. ft. X 0.793)/1000 + (2 DU's x 1.27)= 2.94 kW. The Solar Access Roof Area is assessed 1.75 kW (125 sq. ft. X 14 W/sq. ft.). The PV requirement assessed under section 150.1(c)14 is the smaller of the assessment using Equation 150.1-C and the SARA assessment, which is 1.75. Exception 2 applies since this calculation is less than 1.8 kW.

Example 9-9

Question:

An ADU is being created out of an existing detached 400 sq. ft. garage. What Prescriptive Indoor Air Quality fan requirements apply to the project?

Answer:

Only if the project qualifies as a Junior Accessory Dwelling unit., Section 150.2(a)1C indicates that IAQ fan requirements do not Prescriptively apply. Section 150.2(c) does require mechanical ventilation for "New dwelling units that are additions to an existing building," regardless of added floor area.

Prescriptive Approach and Mandatory Requirements

The prescriptive requirements apply to additions in the same way they apply to new buildings and must be documented on the certificate of compliance.

Except as noted, all applicable prescriptive requirements for additions must be met when using the prescriptive approach. Otherwise, the building must comply using the performance approach.

For prescriptive additions, a certificate of compliance (CF1R-ADD-01-E, CF1R-ADD-02-E, or CF1R-NCB-01-E) form must be completed and submitted for permit. If any mandatory or prescriptive features require ECC-Verification or testing or both, the certificate of compliance for the project must be completed and registered online using an ECC-Provider's residential data registry before submittal to the enforcement agency. Refer to Chapter 2 Design Phase and Chapter 2 ECC Field Verification and Diagnostic Testing.

Prescriptive Additions

There are three prescriptive paths available for additions based on the total conditioned floor area (CFA) of the addition. The total CFA of the addition may include floor areas representing several physically separate additions to the building under the same permit. Table 9-1: Envelope Roof/Ceiling Requirements for Prescriptive Additions through Table 9-6: QII Requirements for Prescriptive Additions summarize the key features of the prescriptive envelope requirements for the three prescriptive addition options in Section 150.2(a)1.

The prescriptive requirements for additions are listed in Section 150.2(a)1. Unless noted below, the newly constructed building prescriptive requirements contained in Section 150.1(c) also apply.

Additions (all sizes)

- Extensions of existing wood-framed walls (Figure 9-2: Wall Extension to the Left and not a Wall Extension to the Right) may retain the dimensions of the existing walls and require the following cavity insulation:
    - In 2x4 wood-framed walls, insulation shall be R-15.
    - In 2x6 or greater wood-framed walls, insulation shall be R-21.
- Existing wood-framed walls, where existing exterior siding (or cladding) will not be removed, do not need continuous insulation, and require only cavity insulation:
    - In 2x4 wood-framed walls, insulation shall be R-15.
    - In 2x6 or greater wood-framed walls, insulation shall be R-21.
- Ceiling insulation of R-38 in Climate Zones 1,2,4 and 8-16, or R-30 in climate zones 3 and 5 – 7. For cathedral ceilings, R-38 is required in all climate zones.
- Radiant barrier in climate zones 2 – 15.
- The prescriptive maximum U-factor requirement for windows is 0.27 in climate zones 1 – 5, 11 – 14, and 16. For climate zones 6 – 10 and 15 the U-factor requirement is 0.30. For homes 500 ft^2 or less, the U-factor requirement is 0.3 in climate zone 5.

Additions ≤ 400 square feet:

- Total glazing area up to 75 ft2 or 30 percent of the conditioned floor area, whichever is greater.
- QII does not apply.
- Rafter roof insulation of R-22.

Additions > 400 square feet and ≤ 700 square feetft2:

- Total glazing area up to 120 ft2 or 25 percent of the conditioned floor area.
- Total glazing area maximum for west-facing glazing is 60 ft2 or 5 percent in Climate Zones 2, 4, and 6-15.

- QII does not apply.
- Rafter roof insulation of R-22.

Additions > 700 square feet:

- Total glazing area up to 175 ft2 or 20 percent of the conditioned floor area, whichever is greater.
- Total glazing area maximum for west-facing glazing is 70 ft^2 or 5 percent in Climate Zones 2, 4, and 6-15.
- Alterations that add fenestration area of shall have a Maximum SHGC value of 0.23 in Climate Zone 15
- QII applies to the addition.
- When an addition is an existing unconditioned space converted to conditioned space, the QII requirements do not include:
    - Window and door header insulation.
    - Air sealing if the existing air barrier is not removed or replaced.

Example 9-8

Question:

I am retrofitting an existing home that includes an 800 square foot addition. Part of this addition includes converting a 400 square foot unconditioned garage to conditioned space and adding a 400 square foot bedroom above the garage. If complying prescriptively, is QII required for this addition?

Answer:

Yes. Because this addition, including the conversion of the garage, is greater than 700 ft2, QII is prescriptively required. If the existing walls of the garage are remaining and the exterior cladding is not being removed, the QII insulation requirements for window and door headers in the garage walls and QII air-sealing requirements are not required. For all new walls and walls that are being replaced, all aspects of QII must be met. If the performance method is used for compliance, the QII requirements can be traded off with other efficiency features to meet compliance. The prescriptive wall insulation requirements for existing wood framed walls in the garage are R-15 in 2x4 framing and R-21 in 2x6 framing.

Example 9-9:

Question

A small addition of 75 square feet is planned for a house in climate zone 7. An existing porch is being enclosed by extending the existing 2x4 wood-framed walls. The existing heating and air-conditioning system will serve the new conditioned space, including an extension of less than 25 linear feet of new ducts. The contractor wants to follow the prescriptive requirements. What requirements apply?

Answer:

Because the addition is smaller than 400 ft^2, the total fenestration area is limited to a maximum of 75 ft^2, and west-facing fenestration area is limited to 60 ft^2. The fenestration

must meet the prescriptive U-factor and SHGC requirements of Table 150.1- A, which are a maximum U-factor of 0.30 and a maximum SHGC of 0.23 in Climate Zone 7.

In climate zone 7, for an addition of this size, insulation requirements are R-30 ceiling insulation with radiant barrier in a ventilated attic, and R-19 floor insulation. The new 2x4 walls that are extensions of existing walls (Figure 9-1: Unconditioned Sunspace), require only R-15 cavity insulation. Any walls that are not extensions must have a maximum 0.065 U-factor. This can be achieved with a 2x4 wood-framed wall with R-15 cavity and R-4 continuous insulation. Since the addition is less than 300 ft2 there is no cool roof requirement.

Since existing heating and cooling equipment is used, that equipment does not have to meet the mandatory equipment efficiency requirements. Duct sealing requirements apply regardless of the length of ductwork extended to serve the addition. The existing duct system must be sealed and tested to have no more than 10 percent total leakage or 7 percent leakage to outside. Duct insulation requirements apply to any new ducts, which is R-6.0 minimum in unconditioned space, and the duct system must be sealed (Exception 4 to Section 150.2(a)). All other applicable mandatory requirements in Section 150.0(m) must be met.

Example 9-10

Question:

If I remove a window from the existing house and reuse this window in an addition to that house, does the relocated window have to meet the prescriptive requirements?

Answer:

Yes, if using prescriptive compliance, in which case the relocated window must be treated as a new window and must meet the U-factor and SHGC requirements of Section 150.1(c)3. If you use this existing window in the addition, you must use the actual or default U-factor and SHGC of the window in showing compliance. Therefore, meeting the prescriptive requirements may not be possible, and performance compliance may be the only option. Section

Relocated windows must also meet the maximum area-weighted average U-factor in

Section 150.0(q) with the Exception of up to 10 ft² or 0.5 percent of conditioned floor area, whichever is greater.

Example 9-11 Question:

For an addition alone, do the refrigerant charge requirements in Section 150.1(c)7A and fan airflow and watt draw measurements in Section 150.0(m)13 need to be met for existing air conditioners serving an addition?

Answer:

If existing equipment is used to serve the addition, the refrigerant charge, airflow, and watt draw requirements do not need to be met as specified by Exception 3 to Section 150.2(a). However, if the existing duct system is extended to serve the addition it must meet the duct insulation requirements and duct sealing requirements must be met (Exception 4 to

Section 150.2(a)). New ducts in unconditioned space also shall meet the prescriptive duct insulation requirements per Section 150.2(b)1Di.

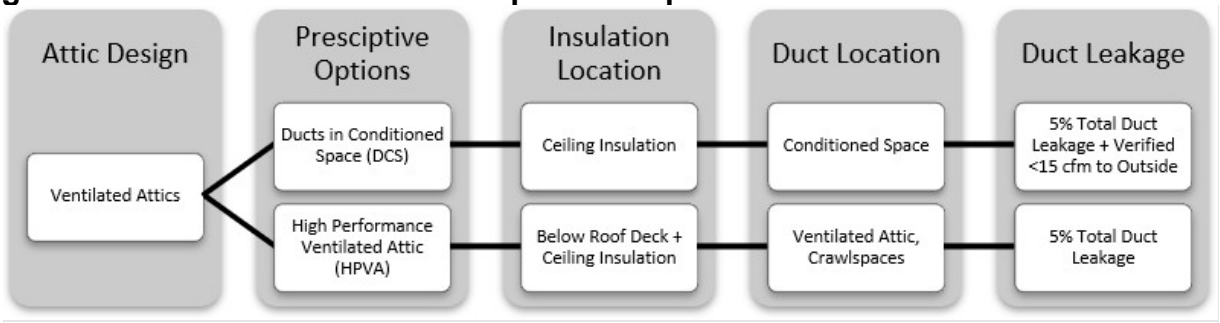
If a new system is installed to serve the addition, it must meet all the requirements for space conditioning in a new home which includes prescriptive refrigerant charge verification in all climate zones for heat pumps and in climate zones 2 and 8 – 15 for air conditioners. Additionally, mandatory fan airflow and watt draw testing in all climate zones.

Table 9-1: Envelope Roof/Ceiling Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤700 ft^2	Additions > 700 ft$_2$
Roof/Ceiling Insulation	Ventilated attics in CZ 1, 2, 4, 8-16: R-38 Ventilated attics CZ 3, 5-7: R-30 Cathedral Ceilings in all CZ R-38	Same as ≤ 400 ft^2	Option B or C [C = require ducts and air handler to be in conditioned space] (see Table 9-3 below).
Roof Products (Cool Roof)	Steep Slope (≥2:12): CZ10-15: Reflectance = 0.20 and Emittance = 0.75; or SRI = 16 Low-Sloped (<2:12): CZ`13&15: Reflectance = 0.63 and Emittance = 0.75; or SRI = 75 Exception: Additions ≤ 300 ft^2 exempt from cool roof requirements	Same as ≤ 400 ft^2	Steep-Sloped (≥2:12): CZ10-15: Reflectance = 0.20 and Emittance = 0.75; or SRI = 16 Low-Sloped (<2:12) CZ 13&15: Reflectance = 0.63 and Emittance = 0.75; or SRI = 75
Radiant barrier above attic	CZ 2-15: Radiant barrier above attic spaces. Does not apply to cathedral ceilings	Same as ≤ 400 ft^2	CZ 2-15: Radiant barrier above attic spaces except when complying with Option B (see Section 150.1(c)2)

Source: California Energy Commission

Figure 9-11: Ventilated Attic Prescriptive Compliance Choices for Additions > 700 ft^2



Source: California Energy Commission

Table 9-2: Roof and Ceiling Requirements for Prescriptive Additions

Component	Option B	Option C
Roof Deck Insulation	Below-deck insulation CZ 4, 8-16: R-19	No roof deck insulation required
Radiant Barrier	CZ 2-3, 5-7	CZ 2-15 vented attics
Roofing	Tile roof or other product with an air space	Tile roof or other product with an air space

Component	Option B	Option C
Ceiling Insulation	CZ 1, 2, 4, 8-16: R-38 CZ 3, 5-7: R-30	CZ 2-7,: R-30 CZ 1, 8-16: R-38 Cathedral Ceilings: R-38
Duct and Air Handler Location	Attic	Conditioned space

Source: California Energy Commission

Table 9-3: Envelope Door and Glazing Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤700 ft^2	Additions > 700 ft^2
Allowable total glazing area	Up to 75 ft^2 or 30% of conditioned floor area, whichever is greater	Up to 120 ft^2 or 25% of conditioned floor area, whichever is greater	Up to 175 ft^2 or 20% of conditioned floor area, whichever is greater
Allowable west-facing glazing area: CZ 2, 4, 6-15	Up to 60 ft^2	Up to 60 ft2	The greater of 70 ft^2 or 5% of conditioned floor area in CZ 2, 4, 6-15
Glazing U-factor & SHGC[1]	CZs 1-4, 11-14 & 16: U=0.27 CZs 5-10 & 15: U = 0.30 CZ 2, 4 & 6-15: SHGC = 0.23	CZs 1-4, 11-14 & 16: U = 0.27 CZs 6-10 & 15: U = 0.30 CZ 5: U = 0.30 (≤500ft^2) or 0.27 (>500ft^2) CZ 2, 4 & 6-15: SHGC = 0.23	CZs 1-5, 11-14 & 16: U = 0.27 CZs 6-10 & 15: U = 0.30 CZ 2, 4 & 6-15: SHGC = 0.23
Opaque door U-factor	U = 0.20	U = 0.20	U = 0.20

1. See Section 150.0(q) and 150.1(c)3 for new and replaced window and skylight exceptions.

Source: California Energy Commission

Table 9-4: Envelope Wall/Floor Insulation Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤700 ft2	Additions > 700 ft2
Exterior framed wall[1] insulation	CZ 1-5, 8-16: U = 0.048 CZ 6-7: U = 0.065	Same as ≤ 400 ft2	Same as ≤ 400 ft2
Extension of existing wood-framed wall Or Existing wood-framed wall with exterior siding (or cladding) to remain	R-15 in 2x4 wood framing R-21 in 2x6 wood framing	Same as ≤ 400 ft2	Same as ≤ 400 ft2
Raised floor[1] insulation	All CZs: R-19 or U = 0.037	Same as ≤ 400 ft2	Same as ≤ 400 ft2
Slab floor[1] perimeter insulation	CZ 1-15: No requirement CZ16: R-7 or F = 0.58	Same as ≤ 400 ft2	Same as ≤ 400 ft2

1. See Table 150.1-A and 150.1-B for requirements for non-framed walls including mass walls

2. R-values refer to wood framing, and U-factors refer to metal framing.

Source: California Energy Commission

Table 9-5: QII Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤700 ft^2	Additions > 700 ft^2
New structure	No requirement	Same as ≤ 400 ft^2	All CZs: Required (Does not apply to any altered spaces)
Converting unconditioned to conditioned space	No requirement	Same as ≤ 400 ft^2	Same as above except: Window and door header insulation Air sealing if the existing air barrier is not removed or replaced

Source: California Energy Commission

Table 9-6: HVAC Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤700 ft	Additions > 700 ft^2
Ventilation cooling[1] (whole-house fan)	No Requirement	Same requirements as ≤400 ft^2	Additions ≤ 1000 ft^2 – no requirement Additions > 1,000 ft2: CZ 8-14 - Required
Adding new space conditioning system(s)	All prescriptive requirements	Same requirements as ≤400 ft^2	All except requirement for ducts in conditioned space[2]
Replacing existing space conditioning system(s)	All prescriptive requirements	Same requirements as ≤400 ft^2	All except requirement for ducts in conditioned space[2]
Adding all new complete duct system(s)	All prescriptive requirements	Same requirements as ≤400 ft^2	All except requirement for ducts in conditioned space[2]
Extending existing duct system(s)	All duct insulation, duct system sealing, and ECC verification	Same requirements as ≤400 ft^2	All duct insulation, duct system sealing, and ECC verification, Except requirements for ducts in conditioned space[2]

1. (Note: also, mandatory mechanical ventilation per ASHRAE 62.2 with ECC-Verification for additions > 1,000 ft^2)

2. For more information about ducts in conditioned space, see Section 3.5.3.5.

Source: California Energy Commission

Water Heating System

If an addition increases the number of water heaters serving a dwelling unit, the addition can comply prescriptively if one of the conditions contained in Section 150.2(a)1Di-iv are met. If a heat pump water heater is being installed, there are mandatory requirements for venting the HPWH.

Alterations – Prescriptive/Mandatory Requirements

This section provides a road map and a few relevant summaries that identify the requirements unique to alterations. Envelope, mechanical, and water-heating system alterations must meet all applicable mandatory requirements and comply with either the prescriptive or performance approach. If a building does not meet all applicable prescriptive requirements, then the performance method using of approved compliance software is the alternative. This section describes the mandatory requirements for single-family residential buildings as they apply to additions and alterations. More information on the mandatory requirements can be found in Chapters 3, 4, 5, and 6. Note: Mandatory requirements are not incorporated explicitly as such but rather as requirements under both the Prescriptive and Performance pathways.

Residential lighting alterations need to meet applicable mandatory requirements. There are no prescriptive lighting requirements in residential buildings.

Although alterations must meet many of the same prescriptive requirements for newly constructed buildings and additions, there are several exceptions or special allowances for certain types of alterations.

Envelope Alterations

This section summarizes the requirements for many typical residential envelope alterations.

Table 9-7: Single-family Alterations Summary of Mandatory and Prescriptive Requirements

Envelope Alteration Type	Applicable Mandatory Requirements[1]	Summary of Relevant Prescriptive Requirements[2]	Exception(s) to the Prescriptive Requirements
Altered Ceiling	Ceiling w/ attic and roof rafters: R-19, U=0.054 Section 110.8/Exception to Section 150.0(a)2	R-49 (U=0.20) attic insulation: CZ 1-4, 6, 8-16 Recessed can lights covered with insulation to the same depth as the rest of the ceiling: CZ 1-4, 8-16 Air sealing: CZ 2,4,8-16 Min. attic ventilation: all CZs Section 150.2(b)1J	R-38 existing attic insulation. Asbestos or knob and tube wiring in the attic. Attic space is shared with another dwelling unit which does not have an altered ceiling. The above conditions exempt a project from all the prescriptive requirements. Other exceptions apply to individual requirements.

Altered rafter roof	R-19, U=0.054 Section 110.8/Exception to Section 150.0(a)2	N/A	N/A
Adding exterior framed wall insulation	In 2x4 framing: R-15, U=0.095 In 2x6 framing: R-21, U=0.069 Exception: 2x4 framing already insulated to R-11 (u-0.110) or greater per Section 150.0(c)1	N/A	N/A
Mass or Masonry walls above grade	Section See requirements under Table 150.1-A for Mass Walls	Meet 150.1(c) and Table 150.1-A CZ 1-15 Interior R-13 (U 0.077) Exterior R-8 (U0.125) CZ 16 Interior R-17 (U 0.059) Exterior R-13 (U 0.077	N/A
Mass or Masonry walls below grade	See requirements under Table 150.1-A for Mass Walls	Meet 150.1(c) and Table 150.1-A CZ 1-15 Interior R-13 (U 0.077) CZ 1-13 Exterior R-5 (U 0.20) CZ 14-15 R-10 (U 0.10) CZ 16 Interior R-15 (U 0.067) Exterior R-19 (U 0.053	N/A
Replacing > 50% of existing steep-sloped (≥2:12) roof surface, including adding a new surface	Section 110.8(i)	Cool Roof Requirements CZ 4, 8 - 15: Aged Solar Reflectance ≥0.20	(a) Building has ≥ R-38 ceiling insulation. (b) Building has a radiant barrier per

layer on top of existing exterior surface		and Thermal Emittance ≥0.75; or SRI ≥16 Section 150.2(b)1Ii	Section 150.1(c)2 (not over spaced sheathing). In CZ 2, 4, 9, 10, 12, & 14 no ducts in attic. >≥R-2.0 insulation above roof deck Roof area covered by building integrated PV or solar thermal panels. Roof constructions with a weight ≥25 lbs/ft^2.
Adding raised floor insulation	R-19 or equivalent U-factor Exception: Floors over controlled ventilation or unvented crawlspaces per Section 150.0(d)	N/A	N/A
Adding or replacing skylight[3]	Weighted average U-factor ≤0.40 Exception 1: Up to 20 ft^2 or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor requirement of Section 150.0(q) Exception 3 to Section 150.0(q): Fenestration installed in buildings meeting Part 7 of the CBC CA WUI Code, where the building is located in Fire Hazard Severity	Must not exceed 20% total (all CZs) and 5% west fenestration area (CZ 2, 4, 6-15) with a U-factor of ≤ 0.27 in CZs 1-5, 11-14, 16 and ≤ 0.30 in CZs 6-10, 15); in CZ2, 4 & 6-15: SHGC ≤ 0.23 Section 150.2(b)1A	Section Replacement fenestration and skylights up to 16 ft^2 need not meet total fenestration and west-facing area requirements per Section 150.2(b)1A Exception 2. Replacement skylights must meet U-factor max 0.40 and SHGC max 0.30

	Zones or WUI Fire Areas.		
Replacing vertical fenestration[3] (altered glazing)	Weighted average U-factor ≤0.40 Exception 1: Up to 10 ft^2 or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor Exception 3 to Section 150.0(q): Fenestration installed in buildings meeting Part 7 of the CBC CA WUI Code, where the building is located in Fire Hazard Severity Zones or WUI Fire Areas.	Must not exceed 20% total (all CZs) and 5% west fenestration area (CZ 2, 4, 6-15) with a U-factor of ≤ 0.27 in CZs 1-5, 11-14, 16 and ≤ 0.30 in CZs 6-10, 15: SHGC ≤ 0.23 Section 150.2(b)1A	Section Up to 75 sq. ft. with U factor of max 0.40 in CZ 1-16 and max SHGC of 0.35 in CZ 2, 4, and 6 through 15
Adding vertical fenestration[3] (new glazing) and greenhouse	Weighted average U-factor ≤0.40 Exception 1: Up to 10 ft^2 or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor requirement of Section 150.0(q) Exception 2 to Section 150.0(q): For dual-glazed greenhouse or garden windows, up to 30 square feet of fenestration ara is not required to comply with the maximum U-factor requirement Exception 3 to Section 150.0(q):	Must not exceed 20% total (all CZs) and 5% west fenestration area (CZ 2, 4, 6-15) with a U-factor of ≤ 0.27 in CZs 1-5, 11-14, 16 and ≤ 0.30 in CZs 6-10, 15; in CZs 2, 4 & 6-15: SHGC =≤ 0.23 Section 150.2(b)1A	Added fenestration and skylights up to 16 ft^2 need not meet total fenestration and west-facing area requirements per Section 150.2(b)1A Exception 2.

	Fenestration installed in buildings meeting Part 7 of the CBC CA WUI Code, where the building is located in Fire Hazard Severity Zones or WUI Fire Areas.		

Alterations must comply with all applicable mandatory measures in Section 110.0 and Section 150.0 of the Energy Standards as explained in Chapters 3, 4, 5 and 6 of this manual, except as

1. Noted in Section 150.2(b).
2. Several prescriptive measures are climate zone (CZ) specific.
3. Replacement fenestration may include fenestration that is located in the same existing wall or roof in which the same or larger area of existing fenestration is being removed. This is labeled as "altered." Any new fenestration area that increases the total net area of fenestration in any existing wall or roof is labeled as "new."

Source: California Energy Commission

Replacing the Roof Surface or Roof Sheathing (Partial or Entire Replacement)

Please refer to Chapter 9.4.4.1 of the *2022 Single-family Residential Compliance Manual*.

Example 9-12

Question:

There is a Victorian building that has been converted into an office building and needs to have a shake roof replacement. This building has a vented unconditioned attic with the insulation on the ceiling. Would I need to meet Section 150.2(b)Hi?

Answer:

No, this section does not apply. The occupancy type has been changed to nonresidential. Since the Victorian building has a shake roof and is considered a steep-sloped roof,

Section 141.0(b)2Bib for nonresidential buildings would apply.

Example 9-13

Question:

What happens if I have a low-slope roof on most of the house but a steep-sloped roof on another portion? Do I have to meet two criteria for the new roofing products if using the Prescriptive approach?

Answer:

Yes. For roof replacements in climate zone 4 and 6 – 15, will need to meet the low-slope criteria for the areas with low slope when using the Prescriptive approach. The areas with the steep-slope roof will need to meet the steep-slope cool roof criteria for climate zones 4 and 8 – 15. Alternatively, you may use the Performance approach to evaluate other options.

Example 9-14

Question:

I am replacing my existing wood shake roof with asphalt shingles. Would this be considered a repair?

Answer:

No. A repair is defined as a reconstruction or renewal for maintenance of any component, system, or equipment of an existing building. A replacement of any component (i.e., roof-top), system, or equipment for which there are requirements in the Energy Code is considered an alteration and not a repair.

Example 9-15

Question:

If a radiant barrier is required for my addition, where does it need to be installed?

Answer:

The radiant barrier needs to be installed only on the underside of an attic roof assembly and the gable wall ends associated with the addition. See Residential Appendix 4.2.1

Example 9-16

Question:

I am considering reroofing my house. Under what conditions will I be required to put on a cool roof?

Answer:

Cool roof requirements are triggered when 50 percent or more of the roof area is being replaced. Prescriptive requirements are waived if one of the exceptions to Section 150.2(b)1H below applies:

Prescriptive Exceptions for Steep-Sloped Roofs

- Section Buildings have at least R-38 ceiling insulation.
- Buildings have an attic radiant barrier meeting the requirements of Section 150.1(c)2.
- Buildings have no ducts in the attic in climate zones 2, 4, 9, 10, 12, and 14.
- Buildings with R-2 or greater insulation above or below the roof deck.

Prescriptive Exceptions for Low-Sloped Roofs

- Aged solar reflectance and roof deck insulation R-value in Table 150.2-E are met. Alternatively, the building may show compliance using the performance approach.

Example 9-17

Question:

I am building a 450 ft² addition on my house. Do I have to meet cool roof requirements in the prescriptive package?

Answer:

Yes. Once the addition exceeds 300 ft2, if using prescriptive compliance is in a climate zone with a cool roof requirement, the roof must meet the requirements for the type of roof slope. To avoid the cool roof requirements for this addition, you may use the performance approach and trade-off against other energy efficiency features of the addition alone or the existing building by using the Existing + Addition + Alterations approach.

Example 9-18

Question:

When doing a full roof replacement on a steep slope roof in climate zone 12 with a new integrated photovoltaic roofing product which includes active photovoltaic components and inactive filler pieces that are visually identical, does the roofing product need comply with the Energy Code requirements in Section 150.2(b)1 for Prescriptive compliance?

Answer:

Yes. The roofing product must comply with the Energy Code and be rated by the Cool Roof Rating Council. Only the active photovoltaic area of the roof is exempt from these requirements.

Insulating Existing Roof/Ceilings

Rafter Roofs and Unvented Attics

When a roof/ceiling surface is altered, if the space between framing members becomes accessible, the ceiling/roof is considered altered. Rafter roofs have a mandatory requirement of at least R-19 (U 0.054) per the Exception to Section 150.0(a)2 insulation is prescriptively required if indicated for that climate zone above and beyond the mandatory requirement described above.

Vented Attics

Attic insulation and air sealing prescriptive requirements in vented attics apply when the ceiling above a conditioned space is altered or when an entirely new duct system is installed in the vented attic. A ceiling may be considered altered under various conditions including when the existing attic insulation is replaced, new attic insulation is added, or the ceiling plane is replaced.

Most single-family homes in California contain vented attics. On hot days, a typical vented attic is hotter than outside and if poorly ventilated the temperature difference between the attic and outdoors can be substantial. In homes with little or no attic insulation, this temperature difference can result in significant total heat gain or loss through the ceiling. High levels of attic insulation and an air barrier at the ceiling is an important approach to minimize those gains and losses and result in considerable energy savings.

A common circumstance that results in the disruption of existing attic insulation occurs when a new duct system is installed in a vented attic. At minimum, existing insulation is moved to access certain areas and then replaced. Sometimes, insulation is disturbed and left unfixed. In cases where penetrations are added to the ceiling layer for new registers, air sealing is critical to limit gains or losses to and from the home. By requiring insulation improvements and proper air sealing at duct replacement, vented attics are addressed as a system saving energy and improving comfort for the occupant.

When an attic is altered or a new duct system is installed when the ductwork and air handler are located in that attic, there are four primary sets of requirements that must be met as listed below.

- Air seal the ceiling between conditioned spaces and the unconditioned attic.
- Insulate the attic floor over any conditioned spaces to R-49.
- Insulate over all recessed can lighting fixtures. Any recessed can lighting fixtures not rated for insulation contact (IC-rated) must be replaced with IC-rated fixtures or have a fire rated cover installed over the attic side of the fixture to allow for insulation to be installed over the fixtures.
- Ensure attic ventilation meets California Residential Code requirements in Section R806.

An ECC Rater is not required to verify any of these prescriptive requirements. All requirements will be verified by an official from the building department.

The first three options above may or may not be required depending on climate zone and the existing attic insulation level. For projects that are subject to all or a portion of these requirements, the first step is to identify which requirements apply. Table 9-8: Altered Attic Requirements by Climate Zone below summarizes when these prescriptive requirements apply.

Table 9-8: Altered Attic Requirements by Climate Zone

Climate Zones	Building with < R-19 existing attic insulation	Building with ≥ R-19 existing attic insulation
5, 7	Attic ventilation only1	Attic ventilation only
6	R-49, attic ventilation	Attic ventilation only
1, 3	R-49, recessed cans, attic ventilation	Attic ventilation only
2, 4, 8-10	R-49, recessed cans & air sealing, attic ventilation	R-49, attic ventilation
11-16	R-49, recessed cans & air sealing, attic ventilation	R-49 & recessed cans, attic ventilation

1. Mandatory minimum R-19 insulation requirements still apply if the ceiling is being altered.

Source: California Energy Commission

If any of the following four conditions are met, the project is exempt from all of the four requirements:

- Existing attic insulation of R-38 or better.
- Alteration directly causes the disturbance of asbestos located in the ceiling, attic, or ductwork and remediation of asbestos is not being done as part of the scope of work.
- Knob and tube wiring located in the attic, which is not being removed as part of the scope of work.
- Altered attic space is shared with other dwelling units whose attic space is not considered altered.

If any of the exceptions are being claimed the existing conditions must be documented on the Certificate of Compliance which can be completed and signed by the homeowner, contractor, energy consultant, or any other party taking responsibility for the documentation. The existing conditions will be verified by the building official.

Below is additional detail on each of the four prescriptive requirements.

Air Sealing

In Climate Zones 2, 4, and 8 through 16, where existing attic insulation is less than R-19, all accessible areas of the attic floor between the attic and the conditioned space must be air sealed (see Table 9-9: Attic Air Sealing Requirements by Climate Zone). Homes with atmospherically vented space heating or water heating combustion appliances located inside the building pressure boundary are exempt from this requirement. This exception does not cover combustion appliances located in a vented attic, garage, or crawlspace.

Table 9-9: Attic Air Sealing Requirements by Climate Zone

Climate Zones	< R-19 existing attic insulation	≥ R-19 existing attic insulation
1, 3, 5-7	No requirement	No requirement
2, 4, 8-10	Yes	No requirement
11-16	Yes	No requirement

Source: California Energy Commission

Most air sealing can be completed with caulking or foam. Areas where large holes exist, such as at soffits and dropped ceilings, may require an air barrier to be installed if not already in place. Areas that present sources of air leakage that should be inspected when sealing the attic include:

- Soffits, dropped ceilings, and chases connected to conditioned space
- Gaps around chimneys and combustion venting
- Along the top plate
- Electric and plumbing penetrations
- Ceiling mounted duct boots
- Ceiling mounted exhaust fans and exhaust ducts
- Attic hatches
- Knee walls
- Recessed lighting fixtures

Recessed Can Lighting

In climate zones 1 – 4 and 8 – 16 any recessed can fixtures in the ceiling shall be covered with insulation to the same depth as the rest of the attic floor. Fixtures not rated for insulation contact must be replaced or retrofitted with a fire-proof cover that allows for insulation to be installed directly over the cover. Homes in climate zones 1 – 4 and 8 – 10 with existing attic insulation of R-19 or greater are exempt from this requirement. Table 9-10: Recessed Can Lighting Requirements by Climate Zone summarizes the recessed can lighting requirements by climate zone and existing insulation value.

Table 9-10: Recessed Can Lighting Requirements by Climate Zone

Climate Zones	< R-19 existing attic insulation	≥ R-19 existing attic insulation
5-7	No requirement	No requirement
1-4, 8-10	Yes	No requirement
11-16	Yes	Yes

Source: California Energy Commission

For recessed can fixtures to be directly covered with insulation the fixtures must be rated for Insulation Contact (IC). Fixtures that are IC rated usually have an Underwriters Laboratory (UL) sticker or stamp on the inside of the housing that says "IC" in some form. The lamp will likely need to be removed to properly view the housing. If the housing has slits or holes in it, it is not IC rated. If it cannot be determined whether a fixture is IC rated or not, it should be assumed that it is not. Recessed cans that are not IC rated present a serious fire hazard if they are surrounded by any flammable material because of the heat generated by the fixture. In these cases, the fixtures must be dammed to maintain separation between them and the attic insulation. This results in areas of the attic floor with minimal or no insulation where heat gains and losses are high, contributing to degraded insulation performance across the entire attic.

When present, older recessed can lighting can be a significant contributor to air leakage through a ceiling plane. Existing recessed cans typically are not airtight, and their perimeter can present a path for conditioned air to flow into the attic or unconditioned attic air to enter the conditioned space below. In addition to an IC rating, recessed can fixtures can also be rated to be "Airtight". This prescriptive standard does not require that existing fixtures be airtight. However, if existing recessed fixtures are being entirely replaced with new luminaires, the requirements of Section 150.0(k)1C must be met which requires the fixtures be certified as airtight with air leakage tested in accordance with ASTM E283 to be less than 2 cfm at 75 Pascals. Existing fixtures that are IC rated but not airtight can be retrofit with a retrofit trim kit which provides an airtight enclosure. Recessed cans that are not IC or AT rated may be replaced with IC rated housing units designed for retrofit applications.

In some cases, a fire-rated attic recessed light cover, shaped as domes or boxes, can be installed over the fixture allowing for insulation to be installed directly up to and over the cover. The recessed can fixture must have a thermal switch, which disconnects the electricity to the light if the temperature exceeds unsafe levels. The covers are to be installed over existing fixtures and sealed around the perimeter to the ceiling floor.

Products that act as dams for the can lighting but do not allow insulation to cover the area over the fixture are not acceptable for meeting these prescriptive requirements. If it cannot be determined whether the fixture has a thermal switch, assume that it is does not, and a fire-rated recessed light cover cannot be used.

Projects using the Performance compliance must meet the requirements specified in the CF1R-PERF.

Attic Insulation

Please refer to Chapter 9.4.4.2 of the *2022 Single-family Residential Compliance Manual*.

Attic Ventilation

When any work is conducted in an existing attic, ventilation is required to be reviewed and altered as necessary to ensure compliance with current code requirements per the California Building Code. Ventilation allows the natural flow of air that removes accumulated warm air and moisture from the attic. The relevant requirements that usually need to be addressed from Title 24, Part 2.5 Section R806 are listed below.

- A minimum net free ventilating area of 1/150 of the area of the attic space. This can be reduced down to 1/300th of the area of the attic if ventilation openings are equally distributed within 3 ft of ridgeline (or highest point) and in the bottom 1/3rd of the attic space.
- Ventilation openings shall be no smaller than 1/16" and no greater than 1/4".
- Ridge baffles should be installed when ceiling insulation is next to eave or soffit vents. The baffles should be placed at the top plate to direct ventilation air up and over the ceiling insulation. It is important to ensure the baffle extends sufficiently beyond the height of the ceiling insulation so as not to disturb the insulation.

Example 9-19

Question

I want to improve the performance of my existing vented attic and add attic insulation. The existing insulation is only about 3 inches deep. Is there a minimum insulation level that I must meet? Are there other requirements that apply to my project?

Answer:

For Prescriptive compliance, in climate zones 1 – 4, 6, and 8 – 16, a minimum of R-49 insulation shall be installed at the ceiling level or a weighted U-factor of 0.020 shall be achieved. In climate zones 5 and 7 only the mandatory minimum R-19 ceiling insulation must be met. Additionally, air sealing of all accessible areas between the attic and conditioned space is required in climate zones 2, 4, and 8 – 16 . The air sealing should be performed in accordance with Section 110.7. In climate zones 1 – 4 and 8 – 16 any existing recessed lights must be rated for insulation contact or retrofitted with a fire-proof cover that allows for insulation to be installed directly over the cover. In all climate zones, if attic ventilation does not meet California Building Code requirements it must be increased to meet current code. There are exceptions for various existing conditions.

Example 9-20

Question:

What if I have an atmospherically vented water heater inside a closet in my house?

Answer:

If space heating or water heating combustion appliances that are atmospherically vented are located inside the pressure boundary of the home, the project is exempt from the air sealing requirement. The other requirements still apply based on climate zone.

Example 9-21

Question:

What if my existing ceiling insulation is R-19?

Answer:

With an existing minimum insulation level of R-19, in climate zones 1, 3, and 5 – 7 none of the attic insulation, air sealing, or insulation covering recessed can requirements apply. In climate zones 2, 4, and 8 – 16 projects are only required to meet the insulation and attic ventilation requirements and are exempt from the air sealing and insulation covering recessed can requirements.

Example 9-22

Question:

What if my existing ceiling insulation is R-38?

Answer:

The project is exempt from all the prescriptive requirements.

Example 9-23

Question:

I am installing two new recessed can fixtures in my kitchen, do I have to meet the prescriptive attic insulation and air sealing requirements for an altered ceiling?

Answer:

No, this is a lighting alteration and does not constitute a ceiling alteration. The new recessed can fixtures must meet the requirements of Section 150.0(k).

Example 9-24

Question:

I am installing a new duct system in my vented attic, but I have asbestos insulation and knob and tube wiring, am I required to insulate and air seal my attic?

Answer:

No, the project is exempt from all the prescriptive requirements if either asbestos or knob and tube wiring is in the vented attic where work is being conducted. If asbestos abatement is occurring to remove asbestos on existing ductwork, and no other exceptions exist, then the prescriptive requirements still apply.

Fenestration and Doors

Replacement Fenestration

Please refer to Chapter 9.4.4.3 of the *2022 Single-family Residential Compliance Manual*.

New Fenestration in Alterations

Please refer to Chapter 9.4.4.3 of the *2022 Single-family Residential Compliance Manual*.

Greenhouse Windows

Greenhouse or garden windows are special windows that project from the façade of the building and are typically five-sided structures. An NFRC-rated U-factor for greenhouse windows is typically high and may not meet the mandatory requirements in Section 150.0(q) for the fenestration U-factor of 0.40.

To meet this mandatory requirement, greenhouse windows:

- Must have a maximum U-factor of 0.40 or better; or
- Must use the area-weighted average for all new and replacement fenestration with a combined mandatory maximum of 0.40 U-factor as per Section 150.0(q); or
- Must meet the Exception 1 to Section 150.0(q) for up to 10 ft2 or 0.5 percent of CFA, whichever is greater.
- Must meet the Exception 2 to Section 150.0(q) for buildings meeting Part 7 of the CBC, California WUI Code.

Exterior Doors

Please refer to Chapter 9.4.4.3 of the *2022 Single-family Residential Compliance Manual*.

Labeling, Certification, and Other Mandatory Requirements

Please refer to Chapter 9.4.4.3 of the *2022 Single-family Residential Compliance Manual*.

Example 9-25

Question:

An alteration in climate zone 12 is to move an existing 25 ft2 window to another location within the same existing wall. What prescriptive requirements does the relocated window need to meet?

Answer:

Removing glazing from an existing wall and reinserting up to the same area of glazing in a different opening is an alteration, covered by Section 150.2(b)1B. Exception 1 to Section 150.2(b)1B states that up to 75 ft2 of vertical replacement fenestration is allowed to meet a prescriptive requirement of 0.40 U-factor in all climate zones and 0.35 SHGC in climate zones 2, 4, and 6 – 15.

Example 9-26

Question:

For additions and alterations that include a greenhouse window (also known as garden window), how do I measure the fenestration area? What U-factor and SHGC requirements apply to a greenhouse window?

Answer:

The area of a greenhouse windows is the rough opening in the wall.

The default U-factor for greenhouse windows does not meet the mandatory maximum fenestration U-factor of 0.40 (there is no mandatory SHGC requirement). A metal-framed greenhouse window from Table 110.6-A has a 1.40 U-factor and the default SHGC from Table 110.6-B is 0.73 (for fixed, clear glass). By comparison, fenestration in prescriptive additions has to meet the prescriptive U-factor of 0.30 for all climate zones and an SHGC of 0.23 in all climate zones except 1, 3, 5, and 16, which have no SHGC requirement.

There are two options to meet the mandatory U-factor requirement: (1) up to 30 ft2 is exempt (Section 150.0[q], Exception 2), and (2) a weighted-average U-factor with other fenestration products is allowed.

For alterations, Exception 1 to Section 150.2(b) allows any dual-pane greenhouse window to meet the prescriptive U-factor requirement . This makes it possible for greenhouse windows to comply as part of a prescriptive alteration if there is no SHGC requirement (Climate Zones 1, 3, 5, and 16).

For climate zones with an SHGC requirement, if other windows are being altered, a weight-average SHGC may be calculated, or performance compliance is an option for achieving compliance. Compliance will likely depend on higher-than-average energy efficiency for some other components of the project to offset the poor performance of the greenhouse windows.

For other alternatives, see Chapter 3.

Example 9-27

Question:

An existing house in climate zone 12 has all single-pane windows. Most of the windows (300 ft2 total) will be replaced within existing openings. One existing 30 ft2 window is being replaced with a pair of 40 ft2 French doors. What requirements apply to this project?

Answer:

For prescriptive compliance, replacement fenestration (equal to or less than the area of existing windows in each wall being altered) and added fenestration area must meet the U-factor (0.30 in climate zones 6 – 10, 15 or 0.27 in climate zones 1 – 5, 11 – 14, 16) and SHGC (0.23 in climate zones 2, 4, 6 – 15) in Table 150.1-A. There are only 10 ft^2 of added fenestration, so the project meets Exception 1 to Section 150.2(b)1A and is not required to meet the prescriptive total glazing area requirement. All installed fenestration also must meet applicable mandatory requirements in Section 110.6.

For performance compliance:

- Using the Existing + Alterations approach *without* third-party verification, replacement fenestration that achieves the fenestration values in Table 150.2-D of the Energy Code is compared to those same values in the standard design. Replacement fenestration that does not reach these values is penalized.
- Using the Existing + Alterations approach *with* third-party verification, replacement fenestration that achieves the fenestration values in Table 150.2-D of the Energy Code is compared to Section Tables 110.6-A and 110.6-B default values for the existing fenestration condition. Replacement fenestration that does not reach these values is penalized.

Example 9-28

Question:

An existing building has all single-pane, metal-frame windows. A proposed remodel will replace all the windows; no other work is being done as part of the remodel. What applies?

Answer:

All replacement windows must meet the prescriptive requirements of Section 150.2(b)1B, and new fenestration must meet applicable mandatory requirements of Section 110.6, and 150.0.

If the prescriptive requirements cannot be met, the Existing + Alteration performance method can be used.

Example 9-29

Question:

An existing building has all single-pane, wood-framed windows. In addition to replacing more than 75 ft2 of window area, two double-pane, metal-frame greenhouse windows will be added. How should the greenhouse windows be shown to comply using the prescriptive standards?

Answer:

Greenhouse windows add conditioned volume but do not add conditioned floor area. There are three unique requirements (1) prescriptive SHGC, (2) prescriptive U-factor, and

(3) mandatory U-factor. Any dual-glazed greenhouse windows installed as part of an alteration must meet any SHGC requirements (0.23 or lower in climate zones 2, 4, 6 – 15, no requirement in other climate zones). While the prescriptive U-factor requirements do not apply (Section 150.2(b) Exception 1), all applicable mandatory requirements must be met. This includes Section 150.0(q), which requires a maximum weighted average U-factor of 0.40 or less. Exception 2 exempts up to 30 ft^2 from this requirement.

Water Heating Alterations

Please refer to Chapter 9.4.5 of the *2022 Single-family Residential Compliance Manual*.

Ventilation Requirements for Heat Pump Water Heater

Please refer to Chapter 9.4.5.1 of the *2022 Single-family Residential Compliance Manual*.

Trouble-shooting Water Heater Problems

If installing a recirculation system to reduce the long wait time for hot water, the only system type allowed in an alteration is a demand recirculation system with manual on/off controls. Any other alteration to the hot water distribution system, such as timer or temperature control recirculation systems, must be analyzed using the performance compliance approach to show that the energy use of the building has not been increased.

Another alternative is to install a natural gas or propane instantaneous (tankless) water heater closer to the fixtures having problems. Any other type of water heater may be installed as long as compliance is demonstrated using the performance compliance approach. When an additional water heater is installed as part of an addition, it must be a heat pump water heater meeting requirements 2 or 3 above. Additions 500 square feet or less may choose to install an electric water heater with point-of-use distribution per 150.2(a)1Diii

For more information on any of these requirements, see Chapter 5.

Example 9-30

Question:

I want to install a second water heater for an addition to a single-family home with an existing natural gas water heater. Does this comply?

Answer:

Yes, but it must be a heat pump water heater that complies with Section 150.2(a)1D. For small additions 500 square feet or less an electric water heater meeting certain conditions is also allowed. Otherwise, performance compliance may be used to demonstrate compliance.

Example 9-31

Question:

An existing 1,500 ft² single-family home is getting a 500 ft² addition. A new 50-gallon gas water heater will replace the existing water heating system. How do the water heating requirements apply?

Answer:

Because this is an alteration or replacement (Section 150.2[b]1H) of an existing water heating system, this proposed replacement meets the requirement of Section 150.2(b)1Hiiia.

For newly installed piping and existing accessible piping, all the applicable insulation requirements of Section 150.0(j)1 shall be met. If building energy compliance is achieved with the existing + addition + alterations calculation, the UEF or EF and other energy features of the altered water heating system are modeled in the performance method.

Example 9-32

Question:

An existing 2,000 ft² single-family house has one 50-gallon gas water heater, and a 600 ft² addition with a new instantaneous gas water heater is proposed. How does this comply?

Answer:

When there is an increase in the number of water heaters with an addition, the Energy Code allows addition-alone compliance in certain circumstances. An instantaneous gas water heater of 200,000 Btu/h or less is NOT one of those circumstances. A heat pump water heater must be used, or the performance method can allow for an alternate type of water heater. Compliance with applicable mandatory requirements is also needed.

The alternative to show compliance is by using the existing-plus-addition or whole- building compliance.

Example 9-33

Question:

An existing single-family home with one electric water heater has a 500 ft² addition with a 30-gallon electric water heater proposed. Does this comply with prescriptive addition requirements?

Answer:

Yes. When there is an increase in the number of water heaters with an addition, . Per 150.2(a)1Div, any electric resistance water heater for additions up to 500 ft2 is allowed.

Performance compliance may also be possible. The compliance software will adjust the simulated energy usage based on the use of electric resistance water heating.

Example 9-34: Alterations

Question:

If my house has an electric-resistance water heater and I plan to upgrade my water heater, do I need to install a gas instantaneous, gas storage water heater, or HPWH?

Answer

No, if the existing water heater is electric, then a consumer electric water heater that meets the requirements of California's Appliance Efficiency Regulations can replace the existing water heater. If installing new piping to the water heater, then you will need to comply with the mandatory pipe insulation requirements. See Chapter 5 for more information on pipe insulation requirement.

HVAC System Alterations

Please refer to Chapter 9.4.6 of the *2022 Single-family Residential Compliance Manual*.

Entirely New or Complete Replacement Space Conditioning Systems

A system installed in an existing dwelling as part of an alteration shall be considered entirely new when:

- The air handler and all the system heating/cooling equipment (e.g., outdoor condensing unit and indoor cooling or heating coil for split systems; or complete replacement of a package unit), are new.
- The duct system is entirely new (including systems with less than 40 feet in length).

An entirely new or complete replacement must meet all applicable mandatory requirements and prescriptive requirements as described below (See Chapter 4 for details).

- Section 150.0(h)1-2: Cooling and heating load calculations.
- Section 150.0(h) 3: Outdoor condensing unit requirements.
- Section 150.0(h)4: Heating furnace temperature rise requirements.
- 150.0(h)5-9: System selection, defrost, supplemental heating, and third-party thermostat requirements
- Section 150.0(i): Setback thermostats or controlled by EMCS.
- Section 150.0(j)1-2: Pipe insulation.
- Section 150.0(m)1-10: Duct insulation, labeling, & damper requirements.
- Section 150.0(m)12: Air filtration requirements.
- Section 150.0(m)13: Static pressure probe, airflow, and fan efficacy requirements (or alternative return duct sizing as per Table 160.3-A and B).
- Section 150.1(c)7: Prescriptive refrigerant charge verification.
- Section 150.2(a)1E: Space-Conditioning Load Calculations and System Capacity.
- Section 150.2(b)1G: Electric resistance heating restrictions
- Table 150.2-A: Prescriptive duct insulation.

Altered Duct Systems

New ducts that are installed to replace or extend existing ducts must comply with the mandatory duct insulation, labeling and damper requirements of Section 150.0(m)1-10 (see Chapter 4 for details). When more than 25 feet of new ducts are installed, additional duct

insulation and duct sealing and leakage testing requirements must be met, as described below.

New ducts installed in an unconditioned space must be insulated to a minimum R- value as described in Table 9-11: Duct Minimum R-Value.

Table 9-11: Duct Minimum R-Value

Climate Zone	3, 5 through 7	1, 2, 4, 8 through 16
Duct R-value	R-6	R-8

Source: California Energy Commission

The duct system must also be sealed by the installer and verified by an ECC-Rater as specified in RA3.1 (duct leakage test), regardless of whether the ducts are located in unconditioned space. The only exception is if the existing duct system contains asbestos.

- If the new ducts form an entirely new duct system, the measured duct leakage must be equal or less than 5 percent of the system airflow. The duct system must also meet the air filtration requirements, and the static pressure probe, airflow, and fan efficacy requirements (Section 150.0[m]12 and Section 150.0[m]13). If the air handler and ducts are located in a vented attic, then attic and air sealing requirements (Section 150.2[b]1J) apply, as described in Section 9.4.4.2. An entirely new duct system is having at least 75 percent of new duct material, and up to 25 percent of reused parts that must be accessible.
- If the new ducts (more than 25 feet installed) do not form an entirely new duct system, the measured duct leakage must be equal to or less than 10 percent of the system airflow, or the measured duct leakage to outside must be equal to or less than 7 percent of the system airflow. If it is not possible to meet either of these duct leakage targets (which must be performed first), then all accessible leaks must be sealed and verified through a visual inspection and a smoke test by an ECC-Rater.

Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in a garage, the ducts must be the sealed by an ECC-Rater to a measured duct leakage of 6 percent or less of the system airflow. The alternative to this is having all accessible leaks located in the garage space sealed and verified through a visual inspection and a smoke test by an ECC-Rater. This requirement applies when any length of new ducts is installed (not limited to 25 feet of ducts).

When performing a visual inspection and smoke test, sampling is not allowed. The ECC-Rater must perform the inspection and test on every house. Some judgement is required in determining if ducts are accessible, where the local enforcement agency will have the final say when it is not immediately obvious.

Altered Space Conditioning Equipment

New space conditioning equipment that is installed, typically as equipment replacements, must comply with the applicable mandatory requirements for the new equipment (See Chapter 4 for details).

Load calculations are sensitive to the selection of the envelope infiltration rate. When doing load calculations for additions, the designer often has to estimate the envelope leakage. If this value is set too high, the system may end up oversized. Per the Energy Code, for additions, the infiltration rate used in load calculations cannot be greater than the values shown in Table 150.2-C ("average" for many load calculation software tools). However, if leakage is established through field verification and diagnostic testing (e.g., with a blower door test), the tested envelope leakage value may be used in the load calculations (Section 150.2(a)1E).

When used for the purpose of system sizing, for additions, block loads (the total load for all rooms combined that are served by the central equipment) may be used (Section 150.0(h)5).

In additions and alterations where airflow is field verified to be at least 350 cfm/ton, there is no limit on the maximum capacity of systems. Where airflow is NOT field verified to be at least 350 cfm/ton, maximum capacity limits are provided in Tables 150.2-A and B that depend on the relative sizes of the calculated heating design load (HL) and cooling design load (CL), the type of space conditioning system, and the duct sizing. These requirements are summarized in Table 9-12: Capacity Limits for Additions and Alterations below (which, for completeness, also shows the minimum capacity, as described in 150.0(h)5). In this table, "Heating Dominated" is defined as an application (building construction and local climate) where the heating load exceeds the cooling load by more than 12 kBtuh. "Cooling Dominated" is defined as an application where the cooling load exceeds the heating load by more than 12 kBtuh (Section 150.2(a)1E).

Table 9-12: Capacity Limits for Additions and Alterations

	Minimum Capacity	Maximum Capacity, when Airflow is NOT field verified to be at least 350 cfm/ton
Heat Pumps		
Heating Dominated	HC ≥ HL	No Limit on HC or CC
Cooling Dominated	HC ≥ HL	CC ≤ CL+6 and HC ≤ HL+12
Highly Cooling Dominated	HC ≥ HL	CC ≤ CL+6
Other:		
Cooling Only Sys	No Limit on CC	CC ≤ CL+6
Furnace / Heating Only Sys	HC defined in Man S	HC ≤ HL+6

(HC = Heating Capacity, HL = Heating Load, CC = Total Cooling Capacity, CL = Total Cooling Load)

Source: California Energy Commission

In addition to these limits, the capacity at lowest speed for variable or multi-speed systems must be no more than 80 percent of design load for:

- Heating only systems.
- Cooling only systems.
- Heat pump heating capacity when HL is greater than CL.

- Heat pump cooling capacity when CL is greater than HL.

In addition, altering space conditioning equipment triggers duct sealing and leakage testing, and other requirements as described below.

The duct system connected to the altered equipment must be sealed by the installer and verified by an ECC-Rater as specified in RA3.1 under any of the following conditions:

- An air handler is replaced.
- An outdoor condensing unit of a split system air conditioner or heat pump is installed or replaced.
- A packaged system is completely replaced.
- A cooling or heating coil is installed or replaced.

The measured duct leakage must be equal to or less than 10 percent of the system airflow, or the measured duct leakage to outside must be equal to or less than 7 percent of the system airflow. If it is not possible to meet either of these duct leakage targets (which must be performed first), then all accessible leaks must be sealed and verified through a visual inspection and a smoke test.

There are a few cases where duct sealing and duct leakage verification are not required. These exceptions include:

- Ducts that have already been sealed, tested, and certified by an ECC-Rater.
- Duct systems with a total less than 40 feet of duct; and
- Duct systems that contain asbestos. See Blueprint Issue 130, Q&A: Residential Duct Testing.

Additionally, when altered ducts, air-handling units, cooling or heating coils, or plenums are located in a garage, the ducts must be the sealed by an ECC-Rater to a measured duct leakage of 6 percent or less of the system airflow. The alternative to this is having all accessible leaks located in the garage space sealed and verified through a visual inspection and a smoke test by an ECC-Rater. This requirement applies when any length of new ducts is installed (not limited 25 feet of ducts).

When performing a visual inspection and smoke test, sampling is not allowed. The ECC-Rater must perform the inspection and test on every house. Some judgement is required in determining if ducts are accessible, where the local enforcement agency will have the final say when it is not immediately obvious.

When a refrigerant-containing component of an air conditioner in climate zones 2 and 8 – 15 or heat pump in all climate zones is replaced or installed in an existing house,

Section 150.2(b)1F requires a system to have refrigerant charge field verified (RCV) in accordance with all applicable procedures specified in RA3.2.2, or RA1. When RCV is required for compliance, the system must also comply with the minimum airflow of 250 cfm/ton for

small duct high velocity systems and 300 cfm/ton for all other systems, according to the procedures specified in RA3.3.

For all climate zones, when an existing system has a refrigerant containing component added or replaced the thermostat must be upgraded to a digital setback type that meets Section 110.2(c).

If the space heating system is being replaced, the replacement system must not use electric resistance as the primary heat source unless one of the following exceptions is met:

- The existing system is electric resistance, and the replacement system is not ducted.
- The existing system is electric resistance, and a ducted space cooling system is not being replaced or installed.
- The existing system is electric resistance and located in climate zone 7 or 15.

Example 9-35

Question:

Do I have to seal the ducts if I replace the outdoor units in my house without changing the indoor unit?

Answer:

Yes. Replacing the outdoor unit (or indoor unit) by itself will trigger the duct sealing and verification requirement. The alteration requirements differ from newly constructed building requirements. (See Section 150.2[b]1Ei through iii for the requirements and exceptions.)

Example 9-36

Question:

I have an existing electric furnace and I'm adding a new bedroom. Can I extend the

existing ducts to the new room and use the existing furnace?

Answer:

Yes. If ducts are extended (of any length) from an existing space-conditioning system, compliance requires meeting the mandatory duct requirements, and the additional prescriptive duct insulation and duct sealing and leakage testing requirements. The existing furnace must also have adequate heating capacity to meet California Building Code requirements for the additional space.

Example 9-37

Question:

I am adding a bedroom to a house that has a central forced-air natural gas furnace. I would like to heat the room with an electric resistance baseboard heater rather than extend the existing ductwork to reach the new space. Is this allowed?

Answer:

Not using prescriptive compliance. This is only possible if using performance compliance and the relatively high energy consumption of the electric resistance heater is made up by

reductions from other energy efficiency features in the addition or in an accompanying alteration.

Example 9-38

Question:

My central gas furnace stopped working. If I get a new efficient unit rather than repair the existing one, what are the requirements?

Answer:

The furnace must meet minimum efficiency requirements, but all systems sold in California should already meet the minimum efficiency requirements. If the new system includes mechanical cooling, and the existing thermostat is not a setback thermostat, it must be replaced with a setback thermostat (Section 110.2(c)).

All new ducts must meet insulation and construction requirements. All existing and new ducts must be sealed and ECC-Verified, as specified Section 150.2(b)1E.

Prescriptively, the new heating unit must be natural gas fueled or a heat pump

Example 9-39

Question:

As part of an upgrade in an existing house, one of the ducts is being replaced because of deterioration of the insulation. What requirements apply to the replacement duct?

Answer:

This is an alteration to the space-conditioning system. If more than 25 feet of the duct is altered, the requirements of Section 150.2(b)1D trigger diagnostic testing and ECC-Verification of the duct system, as well as the prescriptive duct insulation requirements.

Example 9-40

Question:

An upflow air-handling unit with a furnace and air conditioning coil is located on a platform in the garage of an existing house. The platform is used as a return air plenum. The air-handling unit is being replaced, and the platform is being repositioned to the corner of the garage (three feet away from the current location). What requirements apply to this alteration?

Answer:

The mandatory requirements apply to this alteration. In particular, Section 150.0(m) prohibits raised platforms or building cavities from being used to convey conditioned air (including return air and supply air). When the platform is relocated, it is being altered, and the mandatory requirement applies. Ducts made from sheet metal, duct board, or flexible ducts must be installed to carry the return air to the replaced air handler.

Since the air handler is being replaced the prescriptive duct sealing requirements of

Section 150.2(b)1D and E, which apply to ducts in garage spaces, would require either 6 percent duct leakage or a visual inspection and smoke test.

Example 9-41

Question:

What is meant by the term "air handler"?

Answer:

The term "air handler" is used to identify the system component that provides the central system forced-air movement for the ducted heating or cooling space-conditioning system. The term "air handler" may be properly used to identify various types of central system forced-air-moving components that must meet the functional requirements for different types of space-conditioning systems. For instance, a "gas furnace" air handler includes a gas combustion heat exchanger and the central system fan, but does not include a direct expansion (DX) cooling coil; an "electric furnace" air handler has electric heating coils and the central system fan, but does not include a DX cooling coil; a "fan-coil unit" air handler for a split system heat pump has a DX cooling/heating coil and a central system fan; a "hydronic heat pump" air handler includes the air-side DX coil, compressor, water-cooled condenser, and the central system fan. There are other air handler configuration variations as well.

Example 9-42

Question:

I have a residential building that was constructed in the 1920s. It has a freestanding gas furnace, and I want to change it to an electric wall heater. Is this permitted?

Answer:

No. Section 150.2(b)1Cii states that the new space-conditioning system be limited to natural gas, liquefied petroleum gas, or the existing fuel type. The only electric option is a heat pump.

Example 9-43

Question:

I am replacing only my heat pump equipment. What requirements apply for my duct system?

Answer:

When a space conditioning system is altered duct sealing requirements are triggered. If the ducts are not being replaced, the existing duct system needs to be tested by the installer and an ECC-Rater to have no greater than 10% total leakage or 7% leakage to outside. If this leakage criteria cannot be met, a smoke test and visual verification may be conducted by an ECC-Rater to verify that all accessible ducts have bene sealed.

Example 9-44

Question:

What are the duct sealing requirements if am I replacing or adding 20 feet or more of ducts located in my garage?

Answer:

When replacing or adding any length of ducts in garage spaces or altering any space conditioning equipment in a garage (including air-handling units, cooling or heating coils, or

plenums) duct sealing requirements apply. Ducts must be tested by the installer and an ECC-Rater to have leakage less than or equal to 6% of air handler airflow. If this leakage criteria cannot be met, a smoke test and visual verification may be conducted by an ECC-Rater to verify that all accessible ducts have bene sealed.

Example 9-45

Question:

I am replacing an existing ducted electric resistance furnace and am installing central A/C, can I install another electric resistance furnace?

Answer:

In climate zones 1 – 6, 8 – 14, and 16 no. When replacing an existing ducted electric resistance furnace in these climate zones, the only time another ducted electric resistance furnace can be installed is when ducted air conditioning is not being replaced or installed new. Otherwise, a heat pump or gas or propane heating system is required. In climate zones 7 and 15 an electric resistance furnace may be installed in this case.

Question:

What if I am replacing baseboard electric heating in addition to adding a central A/C system?

Answer:

When the replacement heating system is ductless, such as with baseboard heating, this is allowed whenever the existing system is electric resistance.

Mechanical Ventilation for Additions and Alterations

Please refer to Chapter 9.4.7 of the *2022 Single-family Residential Compliance Manual*.

Additions

Please refer to Chapter 9.4.7.1 of the *2022 Single-family Residential Compliance Manual*.

Alterations

Please refer to Chapter 9.4.7.2 of the *2022 Single-family Residential Compliance Manual*.

Lighting for Additions and Alterations

Highlights of the residential lighting requirements are listed below. All residential indoor and outdoor lighting requirements are mandatory. Details of the 2025 Energy Code residential lighting requirements can be found in Chapter 6.

- Luminaire (light fixture) requirements, see Section 150.0(k)1 and Chapter 6
- Recessed downlight luminaires in ceilings, see Section 150.0(k)1C and Chapter 6
- Indoor lighting control requirements, see Section 150.0(k)2 and Chapter 6
- Residential outdoor luminaires and lighting controls requirements, see Section 150.0(k)3 and Chapter 6
- Internally illuminated address sign requirements, see Section 150.0(k)4 and Chapter 6
- Residential garages , see Section 150.0(k)5 and Chapter 6

Altered lighting and any newly installed lighting equipment are required to comply with the residential lighting standards, which apply to permanently installed lighting and associated lighting controls.

Only the lighting equipment that is altered needs to comply with the Energy Code. Existing lighting equipment is not required to be replaced to comply.

Example 9-46

Question:

I am remodeling and renovating my whole home and putting in an entirely new indoor lighting system. How does the Energy Code apply to the new lighting system?

Answer:

When an entirely new lighting system is installed, it is treated like required for a newly constructed building. The new indoor lighting system must meet the lighting requirements in Section 150.0(k)1 and 150.0(k)2.

If the remodeling includes any lighting in garages with eight or more vehicles, there are also applicable requirements in Section 150.0(k)5.

Example 9-47

Question:

I am doing minor renovations to my kitchen that has six recessed incandescent cans, and I am adding a new luminaire over the sink. How does the Energy Code apply to the new luminaire and the altered luminaires in this case?

Answer:

The new luminaire and the altered luminaires must meet the luminaire efficacy requirements of Section 150.0(k)1. Where existing screw base sockets are present in ceiling-recessed luminaires, removal of these sockets is not required provided that new JA8 compliant trim kits or lamps designed for use with recessed downlights or luminaires are installed.

Example 9-48

Question:

In the kitchen above, I am replacing one of the recessed downlight luminaires. Must the new downlight luminaire be high luminous-efficacy?

Answer:

Yes, newly installed luminaires must be high luminous-efficacy and meet the requirements in Section 150.0(k)1. Screw-based sockets are not permitted for newly installed recessed downlight luminaires in ceilings.

Example 9-49

Question:

I am replacing my incandescent bath bar in the bathroom. Must the new luminaire meet the Energy Code requirements?

Answer:

The new luminaire is the altered component and must meet requirements in Section 150.0(k)1 including the high luminous-efficacy luminaires and the lighting controls requirements. The 2025 Energy Code now allows the installation of Joint Appendix JA8-compliant lamps in screw-based fixtures as a way to comply with the high luminous-efficacy lighting requirements as long as the luminaire is not a recessed downlight in ceiling. See Chapter 6.

Performance Approach

Performance: Addition Alone

Please refer to Chapter 9.5.1 of the *2022 Single-family Residential Compliance Manual*.

Performance Method: Additions and Existing + Addition + Alterations Approach

Please refer to Chapter 9.5.2 of the *2022 Single-family Residential Compliance Manual*.

Existing + Addition + Alterations Without Third-Party Verification

Please refer to Chapter 9.5.3 of the *2022 Single-family Residential Compliance Manual*.

Existing + Addition + Alterations with Third-Party Verification

Please refer to Chapter 9.5.4 of the *2022 Single-family Residential Compliance Manual*.

Existing + Addition + Alterations as Newly Constructed Buildings

Please refer to Chapter 9.5.5 of the *2022 Single-family Residential Compliance Manual*.

Summary of Modeling Rules

Please refer to Chapter 9.5.6 of the *2022 Single-family Residential Compliance Manual*.

Example 9-50

Question:

A 1,600 ft² house built in 1980 in Climate Zone 12 is being renovated as follows:

- A 500 ft² room will be added, including 120 ft² of new windows.
- A 200 ft² wall and 100 ft² of old window will be removed.
- Attic insulation in the existing house will be upgraded to R-38.
- The addition will be connected to the existing HVAC and duct system.

If the performance approach is used to demonstrate compliance, how does the compliance software establish the standard and proposed designs?

Answer:

Under the performance rules, the removed wall and window are not included in the energy model and have no effect. The standard design for the added conditioned floor area is set using the prescriptive requirements of Section 150.1(c). If the existing duct system is extended by 25 linear feet or more, the standard design assumes duct alterations with 10 percent duct leakage requirements.

The standard design assumptions for the existing house follow the rules summarized in

Section 150.2(b)2 and Table 150.2-D based on whether there is third-party verification of the existing conditions. Without third-party verification, upgraded energy components in the existing house are modeled as fixed assumptions that represent reasonably expected levels of efficiency for each altered component. If optional third-party verification is selected for the components in the existing house that are to be upgraded, the standard design assumes the existing conditions specified by the software user. These features must be verified before construction begins and before application of the permit.

The standard design assumptions for the 500 ft2 addition is based on the features of

Section 150.1(c), Table 150.1-A.

The existing space conditioning system, as defined by the software user, is modeled in both the standard and proposed design. The duct system is made up of new ducts as an extension of the existing ducts.

Example 9-51

Question:

For the 1980 house in the examples above, an operable single-pane metal window is replaced with a 0.55 U-factor window. Does this alteration result in a compliance credit? How about the case where the existing window is replaced with a window that has a U- factor of 0.35?

Answer:

Altered components that receive compliance credit must exceed the requirements of Table 150.2-D. Windows in the addition must have a U-factor of ≤ 0.30 and SHGC ≤ 0.23 to receive credit (climate zone 12). Replacement windows in the existing house must have a U-factor of ≤ 0.40 and SHGC ≤ 0.35 to receive credit.

Adjustments will be made to energy usage to reflect window replacement with a 0.55 U-factor. **Without** third-party verification of existing conditions, a 0.35 U-factor window replacement will receive a credit compared with a 0.40 U-factor standard design assumption for that window. **With** third-party verification of existing conditions, either window replacement will receive a credit as compared with a 1.28 U-factor standard design assumption for an operable single-pane metal existing window.

Although this example describes a window alteration, the same principles apply to other building systems, such as other building envelope components, as well as HVAC and water-heating equipment.

Example 9-52

Question:

An addition of 590 ft² is being added to a 2,389 ft² single-family house. How do you demonstrate compliance using the Existing + Addition + Alterations method?

Answer:

The steps are the following:

- Collect accurate envelope and mechanical information about the addition and existing building from scaled drawings (plans, sections, and elevations); determine what components, (HVAC, ducts, water heating, etc.) are being altered as part of the permitted scope of work.
- Enter the information about the addition and the existing building into the compliance software program, identifying each modeled feature as "existing," "altered," or "new." Proper identification of these inputs is critical to correctly and accurately determining compliance.
- Run the compliance software to determine if the proposed building TDV energy is equal or less than the standard design TDV energy.
- If the project does not comply, modify the energy features of the addition and/or the existing building until compliance is achieved.
- If features of the existing building are being modified, consider the option of verifying existing conditions. When using this option, this inspection by an ECC-Rater must be completed before construction begins and before the project registration (Step 6) can be completed.
- All projects that include energy features requiring ECC field verification and diagnostic testing, which represent almost all buildings under the 2022 Energy Code, must be registered online with an ECC-Provider as explained in Chapter 2 in order to obtain a valid CF1R to apply for a permit.
- Attach the registered CF1R to the permit application submittal.

Example 9-53

Question:

When using the existing-plus-addition performance approach, do the mandatory requirements, including airflow, watt draw measurement, etc. (Section 150.0[m]13) need to be met for space-conditioning equipment serving an addition? What about the prescriptive requirement for refrigerant charge verification (or one of the alternatives to Section 150.1[c]7)?

Answer:

If existing equipment is extended to serve the addition, these space conditioning requirements do not need to be met as specified by Exception 4 to Section 150.2(a). However, Exception 5 to Section 150.2(a) requires a duct system that is extended be sealed, tested, and ECC-verified according to Section 150.2(b)1D.

If an entirely new or complete replacement system is installed to serve the addition, it must meet the requirements of Section 150.2(b)1C. When the new equipment is designed to serve the existing house and the addition, it is an alteration and must meet the requirements of Section 150.2(b). The duct sealing, testing, and verification requirements of

Section 150.2(b)1E must also be met. Refrigerant charge verification is not a mandatory requirement. However, if the project is in Climate Zone 2 or 8-15 or if the HVAC system is a heat pump, the energy usage simulated in compliance software will be adjusted to if refrigerant charge verification is not modeled.

Example 9-54

Question:

When using the E+A+A performance method, can compliance credit be gained by sealing the existing ducts when it was not required for prescriptive compliance?

Answer:

No. Once the status of the ducts is "altered" the standard design assumes the duct

sealing is required.

Example 9-55

Question:

When using the existing-plus-addition performance compliance method, can credit be gained by installing a radiant barrier in the existing house attic?

Answer:

No. Once the attic/roof is "altered" the standard design becomes equivalent to Table

150.1-A or B

Example 9-56

Question:

I am adding a room to and altering an existing building in climate zone 12. I am upgrading an existing single-pane clear glass window with a U-factor of 1.2 and SHGC of

1.0 to a dual-pane window with a U-factor of 0.50 and SHGC of 0.45. Do I receive credit toward the addition compliance for installing this window?

Answer:

No. Without third-party verification of the existing building features, the energy usage simulated by compliance software will be adjusted since the window is not as efficient as defined by Section 150.1(c)3A, requiring a U-factor of 0.23 and maximum SHGC of 0.23 in Climate Zone 12. The penalty for the U-factor is based on the difference between 0.23 and 0.50 and for the SHGC is based on the difference between 0.23 and 0.45. If fenestration is installed that exceeds the performance of the values in Table 150.2-G, then credit is available.

Example 9-57

Question:

I am planning to install R-19 insulation in the attic of an existing house built in 1970. Can I use this added insulation as a credit for trading with the energy features of an addition?

Answer:

No. When insulation is added to an attic, it must comply with Section 150.0(a), which sets a mandatory minimum for attic insulation of R-38. Since R-38 is a mandatory minimum, a lower insulation cannot be installed.

Example 9-58

Question:

I am planning to install R-25 insulation in an uninsulated vaulted ceiling without an attic space in an existing house built in 1970. Can I use this added insulation as a credit for trading with the energy features of an addition?

Answer:

Only if you choose verified existing conditions. Once the roof is altered, the standard design becomes a cathedral ceiling meeting Option C of R-38. For Climate Zones 1 through 3 and 5 through 7, no below roof deck insulation is required under Option B and it's possible to get credit for insulating an uninsulated vaulted roof to R-25.