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9 Additions, Alterations, and Repairs

9.1 Introduction

This chapter covers key aspects of how the *2022 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:

1. **Section 9.1 – Introduction.** Highlights the applicable standards definitions for additions, alterations, and repairs and provides several examples of each.
2. **Section 9.2 – What's New in the 2022 Energy Code.** Highlights of the requirements and compliance options in the 2022 Energy Code.
3. **Section 9.3 – Compliance Approaches.** An overview of prescriptive and performance compliance options.
4. **Section 9.4 – Prescriptive Approach and Mandatory Requirements.** Detailed information on prescriptive compliance methods for additions and alterations, including how mandatory requirements apply.
5. **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 and/or CF1R-ALT-02 forms are used.
- For the performance approach, compliance software produces a CF1R-PRF-01. (See Appendix A for a list of forms.)

Changes to HVAC systems will likely include one or more features that require Home Energy Rating System (HERS) field verification and diagnostic testing. If HERS verification is required, the certificate of compliance must be completed and registered online with an approved HERS 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 HERS verifications.

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

9.1.1 Additions

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

Examples of an addition include:

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

9.1.2 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 §100.1.

Examples of alterations include:

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

   Note: Adding heating to unconditioned space is an addition, not an alteration.
8. Replacing an existing space cooling system or adding a space cooling system (for example, a central air conditioner or heat pump).
9. Extending or replacing an existing duct system or adding an entirely new duct system.

10. Replacing the existing water heater or adding water heaters and/or hot water piping.
11. Replacing existing hardwired lighting or adding new hardwired lighting fixtures.
12. Adding window film.

9.1.3 Repairs

A *repair* is "the reconstruction or renewal for the purpose of maintenance of any component, system, or equipment of an existing building. Repairs shall not increase the pre-existing energy consumption of the repaired component, system, or equipment. Replacement of any component, system, or equipment for which there are requirements in the Energy Code is considered an alteration and not a repair**."** (See §100.1).

Note*:* Repairs to residential buildings are not within the scope of the Energy Code.

For example, when a component, system, or equipment in an existing building breaks or is malfunctioning and maintenance fixes are needed for it to work properly again, it is considered a repair and not subject to the standards. However, if instead of fixing the break or malfunction, the component, system, or equipment is replaced with a new or different one, the scope of work is considered an alteration and not a repair and requirements of the Energy Code must be met.

Examples of work considered repairs include:

1. Replacing a broken pane of glass but not the entire window.
2. Removing fenestration and other envelope components for maintenance or repair, then reinstalling the same fenestration or other envelope components in the same location.
3. Replacing a failed fan motor or gas valve in a furnace but not replacing the entire furnace.
4. Replacing a heating element in a water heater but not replacing the entire water heater.

Note: When any existing envelope component is moved to a new location, even when that location partially overlaps the previous location of the item, the work is considered an alteration.

Note 2: Replacement of some HVAC components needing repair is defined by the Energy Code as an alteration, therefore triggering requirements that must be met. Section 150.2(b)1E of the Energy Code defines the following HVAC component replacements as an alteration that triggers the requirement for duct sealing: *"replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, or cooling or heating coil."* Similarly, if more than 25 linear feet of new or replacement space conditioning ducts are installed, then the

entire duct system must be sealed and leakage tested to be equal or less than 10 percent of system air handler airflow. (See §150.2[b]1D.)

Note 3: Some cooling system component replacements are defined by the Energy Code as alterations, which require meeting certain requirements. Section 150.2(b)1F of the Energy Code defines installing or replacing a compressor, condensing or evaporator coil, refrigerant meting device, or refrigerant piping as an alteration, which triggers several requirements, including thermostat, and, depending on the climate zone, airflow, and refrigerant charge requirements.

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?

Unconditioned Sunspace

Answer:

The mechanical and envelope requirements of the Energy Code do not apply if the space is not considered habitable or improved and, therefore, can be unconditioned as defined in §100.1; however, per §100.0(c)2, the sunspace must still comply with the applicable lighting requirements of §150.0(k). The sunspace is unconditioned if:

The new space is not provided with heating or cooling (or supply ducts).

All openings between the new space and the existing house can be closed off with weather-stripped doors and windows.

The addition is not indirectly conditioned space (defined in §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 §110.1 for appliances and §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 §150.2(b)1A and B. Newly installed and replacement windows must also comply with the mandatory requirements for caulking/sealing around windows per §110.7. In alterations, it is recommended to install insulation in the exposed walls if no insulation is found when walls are opened; for 2x4 wood framing install the mandatory minimum R-13 and for 2x6 wood framing install R-20.

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.

9.2 What's New in the 2022 Energy Code

The 2022 Energy Code includes updates to the mandatory, prescriptive, and performance requirements for additions and alterations. This section highlights the key changes from the 2019 Energy Code. Note that prescriptive compliance requirements may be higher than mandatory requirements.

Multifamily building standards have moved into new sections of the Energy Code. Most documentation and testing will be carried by the ATTCP program, but some requirements for residential buildings three stories and under will continue to require HERS verification. Any HERS-verified projects will be subject to registration with a HERS provider data registry. Refer to the Nonresidential and Multifamily Compliance Manual <*Publication Number*> for further guidance.

9.2.1 Building Envelope

Updated ceiling insulation requirements for alterations in vented attics.

- R-49 ceiling insulation in climate zones 1-3, 6, 8-16. Exception of verified R-19 in climate zones 1, 3, and 6. Section 150.2(b)1Ji.
- Seal all accessible areas of ceiling plane between attic and conditioned space in climate zones 2, 4, and 8-16. Exception 1 and Exception 2. Section 150.2(b)1Jii.
- Insulate over recessed lighting to match ceiling insulation in climate zones 1-4 and 8-16. Use a fire-proof cover if the fixtures are not I-C rated. Section 150.2(b)1Jiii.
- Attic ventilation complies with California Building Code requirements, with exceptions.

9.2.2 Mechanical Ventilation

1. An exception was added that exempts Junior Accessory Dwelling Units (JADUs) that are classified as additions to an existing building from whole-building mechanical ventilation requirements. JADUs are dwelling units that are no more than 500 square feet and contained entirely within an existing single-family building,
2. New language clarifying when whole-dwelling unit mechanical ventilation and local mechanical exhaust requirements must be met for additions and alterations.

9.2.3 Space Conditioning System

1. The trigger for duct insulation and duct sealing requirements has been revised from 40 feet to 25 feet of altered ducts. The duct requirements apply when any length of duct is extended to serve an addition.
2. Duct insulation levels have been revised. Climate zones 3 and 5-7 require R-6. All other climate zones require R-8.
3. Duct leakage targets have been revised. The duct leakage must now be equal to or less than 10 percent of the system airflow, or the duct leakage to outside must be equal to or less than 7 percent of system airflow.

4. Electric resistance space heating is prohibited as the primary heat source. Replacement space heating systems must be gas or heat pump unless one of the exceptions are met.

9.2.4 Prescriptive Alterations

1. Expand the cool roof requirements for steep-sloped roof replacements to Climate Zones 4 and 8-9. The allowable exceptions were also revised.
2. Expand the cool roof requirements for low-sloped roof replacements to Climate Zones 4, 6-12 and 14. The allowable exceptions were also revised.
3. Add a new requirement for roof deck insulation for low-sloped roof replacements in Climate Zones 1, 2, 4, and 8-16. R-14 continuous roof deck insulation or and equivalent assembly roof assembly U-factor of 0.039 is required. Various exceptions to this requirement are allowed.
4. Changes to when replacement electric resistance space heating equipment is allowed when the existing equipment is electric resistance.
5. Reduce the duct sealing target for altered duct and space conditioning systems from 15% to 10% of total duct leakage in all climate zones.
6. Increase the prescriptive duct insulation from R-6 to R-8 in Climate Zones 1-2, 4, 8-10, and 12-13.
7. Reduce the 40-foot trigger for prescriptive duct sealing and insulation to 25-feet for altered systems. Eliminate the minimum length requirement for additions and require duct sealing whenever an existing duct system is extended to serve an addition.
8. Add a prescriptive requirement for insulation and sealing in vented attics for altered ceilings or when an entirely new or complete replacement duct system is installed in a vented attic. The requirements apply in all climate zones except 5 and 7. Various exceptions to this requirement are allowed.
9. New doors that result in an increase in exterior door area must meet thenewly constructed buildings requirementof a maximum U-factor of 0.20.

9.2.5 Water Heating

New, more specific language specifying which water heating systems are allowed prescriptively

9.3 Compliance Approaches

Apart from meeting all applicable mandatory requirements (Section 9.4), additions and alterations must demonstrate compliance using the prescriptive or performance approach.

There are several compliance paths depending on the scope of work:

1. **Addition only:** No changes are made to the existing building except removal of roofs, exterior walls, fenestration, and floors required as a result of the addition.
2. **Alterations only**: There is no addition (no increase in conditioned floor area and volume or adding conditioning to a previously unconditioned space).
3. **Addition and alterations:** There are additions and alterations to the existing building.

For each of these permit scenarios, Table 9-1 summarizes the available compliance approaches for single family residential additions and alterations.

Table 9-1: Compliance Alternatives for Residential Additions and Alterations

Project Scope	Prescriptive Approach	Performance Approach[1]
1. Alteration only:	Meet all applicable requirements for prescriptive alterations	Existing + Alterations without third party verification of existing conditions; or Existing + Alterations with third party verification of existing conditions; or Existing + Alterations as all newly constructed buildings
2. Addition only:	Additions ≤400 ft²; or Additions >400 ft² and ≤700 ft²; or Additions >700 ft²	Addition Alone
3. Addition and existing combined (with or without alteration):	Meet all applicable requirements for prescriptive alterations (if any) and a prescriptive addition approach (see additions only above)	Existing + Addition + Alterations without third-party verification of existing conditions; or Existing + Addition + Alterations with third-party verification of existing conditions; or Existing + Addition + Alterations as allnewly constructed buildings

1) In the performance approach, the building must be modeled with Energy Commission-approved compliance software, as explained in Chapter 8 of this manual.

9.3.1 Additions

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

1. **Additions of ≤ 300 ft²** do not require a cool roof product (if required by §150.1[c]11) to be installed.

2. **Whole-house fan (or ventilation cooling)** does not apply to additions of 1,000 ft^2 or less (if otherwise required by §150.1[c]12).
3. **Existing space conditioning systems** that are extended to provide conditioning to an addition are not required to meet the Energy Code (§150.2[a] Exception 4).
4. **Indoor air quality (IAQ)** requirements (§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.
5. **Photovoltaic (PV)** requirements do not apply to additions or alterations.
6. **Heat pump space conditioning** requirements do not apply to additions or alterations.

A. 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.

1. **Advantages**: Little information about the existing building is needed (conditioned floor area, number of bedrooms) because it is not modeled.
2. **Disadvantages**: Some prescriptive allowances for additions do not apply to the addition-alone compliance approach. For example, a 400 ft^2 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.

B. 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.

1. **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.
2. **Disadvantages**: Plans and data for the existing building are needed, increasing the time and complexity of the calculations.

C. Existing + Addition as a 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.

9.3.2 Additions and Alterations Combined

9.3.2.1 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 prescriptive certificate of compliance.

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

9.3.2.2 Performance Approach

The performance approach to projects that include both an addition and alterations to an existing residential building is called "**Existing + Addition + Alterations.**" (See Section 9.5.2.) Projects can comply with or without the benefit of pre-construction third-party inspection and verification of existing conditions that are to be altered.

9.3.3 Alterations Only

9.3.3.1 Prescriptive

Alterations may comply prescriptively by meeting all applicable requirements in §150.2(b), which are explained further in Section 9.4. Several prescriptive alteration requirements or exceptions are specific to conditions such as building climate zone.

It is important to note that the energy budget is based on prescriptive requirements and 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 prescriptive certificate of compliance is completed and submitted with the permit application. If any mandatory or prescriptive features require HERS verification (see Section 2.5, HERS Field Verification and Diagnostic Testing, of this manual), the certificate of compliance must be completed and registered online with a HERS provider (see Section 2.3 of this manual) before being submitted to the enforcement agency.

9.3.3.2 Performance

Alterations may comply using the performance approach by meeting the requirements in §150.2(b)2. This is explained in Section 9.5. The main options are:

1. **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.
2. **Compliance without third-party verification**: This option allows alterations to comply without third-party inspection to verify existing conditions being altered.
3. **Compliance with third-party verification**: This option allows for alterations to comply only with third-party inspection to verify existing conditions being altered.
4. **Existing plus alterations as a newly constructed building**: This option is the most difficult.

9.3.4 Wall Exceptions to Continuous Insulation

9.3.4.1 Wall Extension

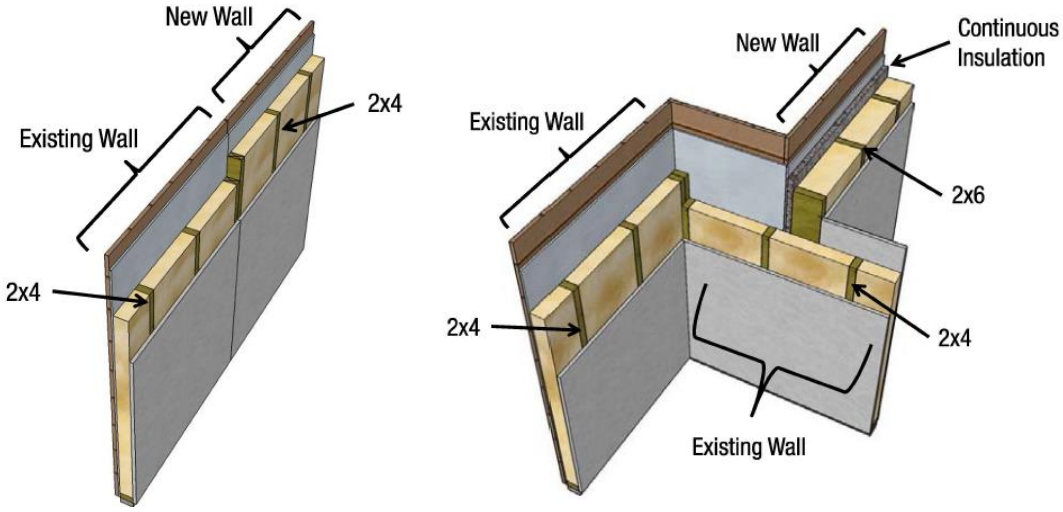
When an addition is built with a connection to an existing wood-framed wall, an extension to an existing wood-framed wall (Figure 9-1) is allowed to retain the existing dimensions (§150.2(a)1Ai or 150.2(a)1Biii). Retain the dimensions means two things: (1) if the existing wood-framed wall has no continuous insulation, the extended wall also does not require continuous insulation; and (2) the existing framing size may be kept.

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.

9.3.4.2 Existing Wall With Siding

Similar to a wall extension is a provision that applies to existing wood-framed walls of a previously unconditioned space. If the existing exterior siding (or cladding) of the structure is not being removed, and the space is converted to conditioned space, §150.2(a)1Aiii or 150.2(a)1Bvi requires only cavity insulation of R-15 in a 2x4 wall or R-21 in a 2x6 wall.

Figure 9-1: Wall Extension



New wall is an extension New wall is not an extension

9.3.5 Accessory Dwelling Units (ADUs)

The California Department of Housing and Community Development 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 2022 Energy Code adds a new definition for junior accessory dwelling unit (JADU). A JADU is a dwelling unit that is no more than 500 square feet in size and contained entirely within an existing 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 that took effect on January 1, 2017, gave more flexibility to build ADUs, sometimes called "granny" or "in-law" units. For compliance, an ADU may be either an addition or a newly constructed building. SeeFigure 9-2 to determine the compliance requirements. Although the Energy Code that applies to the ADU may be the same as an addition, this may not be the same for other Parts of Title 24. Check with your local building department to confirm applicable requirements.

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 inFigure 9-2. 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.

1. If the ADU shares common walls with the existing dwelling unit and is newly constructed, some of the walls may be wall extensions (Section 9.3.4).
2. If the ADU shares no common walls with the existing dwelling unit (detached) and is converting an existing unconditioned structured into conditioned space, an exception to the requirement for continuous insulation is available for walls where existing exterior siding (or cladding) is not removed.
3. If the ADU shares common walls with the existing dwelling unit 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.
4. If the ADU shares no common walls with the existing dwelling unit (detached) and is a new structure, this is a newly constructed residential building.

Figure 9-2: ADU Types

<table>
<tr>
<td> 
Addition: Converting existing unconditioned space, attached to existing home. Walls may qualify as "existing wall with siding." (See Section 9.3.4 for wall exceptions.)</td>
<td> 
Addition: Converting existing unconditioned space, detached from existing home. Walls may qualify as "existing wall with siding." (See Section 9.3.4 for wall exceptions.)</td>
</tr>
<tr>
<td> 
Addition: Newly constructed, attached to existing home. One or more walls may qualify as wall extensions. (See Section 9.3.4 for wall exceptions.)</td>
<td> 
Newly Constructed Building: Newly constructed and detached from existing home.</td>
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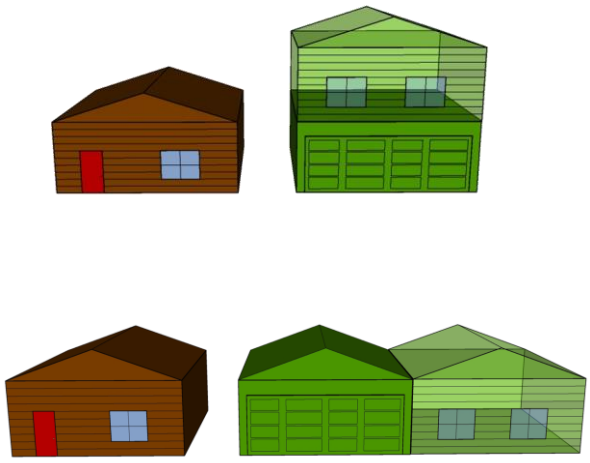
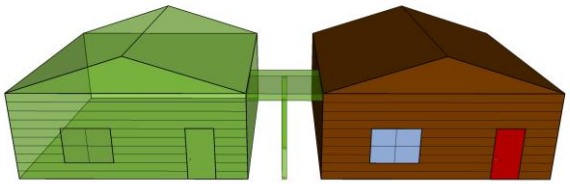
</table>



Addtion: Newly constructed ADU on top of existing detached garage or side-by-side with existing detached garage



Newly Constructed Building: Newly constructed ADU attached to existing home by breezeway, or covered walkway

1. 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. 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 150.0(h) to verify that any existing and/or new system is properly sized,

   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 9-7 in Section 9.4.2 for a more detailed summary of prescriptive HVAC system requirements for additions.

2. 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:

Question:

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 (§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 HERS verification of existing conditions for performance method compliance?

Answer:

No. Existing walls in newly conditioned spaces are not eligible for the HERS verification of existing conditions.

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 enough heating capacity to heat the existing residence and the new 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. Also, if the existing home has natural gas connected to it, the project must be modeled with natural gas being available.

Example 9-7b:

Question: When converting an existing garage into an ADU in a high-rise residential building, do the high-rise residential Energy Code requirements apply to the ADU?

Answer: Yes. The building occupancy type determines the compliance approach. If there are four or more habitable stories in the building, the ADU must comply with high-rise residential Energy Code requirements.

Example 9-7c:

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

Answer: No. This is 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.

9.4 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 CF1R-ADD-01 or CF1R-NCB-01 Form.

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 or CF1R-NCB-01) form must be completed and submitted for permit. If any mandatory or prescriptive features require HERS verification or testing or both, the certificate of compliance for the project must be completed and registered online with a HERS Provider before submittal to the enforcement agency. Refer to Section 2.2.2 and Section 2.5.

9.4.1 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 9-2 through Table 9-6 summarize the key features of

the prescriptive envelope requirements for the three prescriptive addition options in §150.2(a)1.

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

1. **Additions ≤ 400 ft^2**:
    1. Total glazing area up to 75 ft^2 or 30 percent of the conditioned floor area, whichever is greater.
    2. Total glazing area maximum for west-facing glazing is 60 ft^2 or 5 percent in Climate Zones 2, 4, and 6-15.
    3. QII does not apply.
    4. Rafter roof insulation of R-22.
    5. Ceiling insulation of R-38 in Climate Zones 1,2,4 and 8-16, or R-30 in Climate Zones 3 and 5-7.
    6. Radiant barrier in Climate Zones 2-15.
    7. Extensions of existing wood-framed walls (Figure 9-1) may retain the dimensions of the existing walls and require the following cavity insulation:
        a. In 2x4 wood-frame walls, insulation shall be R-15.
        b. In 2x6 or greater wood-frame walls, insulation shall be R-21.
    8. Existing wood-framed walls where existing exterior siding (or cladding) will not be removed, do not need continuous insulation, and require only cavity insulation:
        a. In 2x4 wood-framed walls, insulation shall be R-15.
        b. In 2x6 or greater wood-framed walls, insulation shall be R-21.

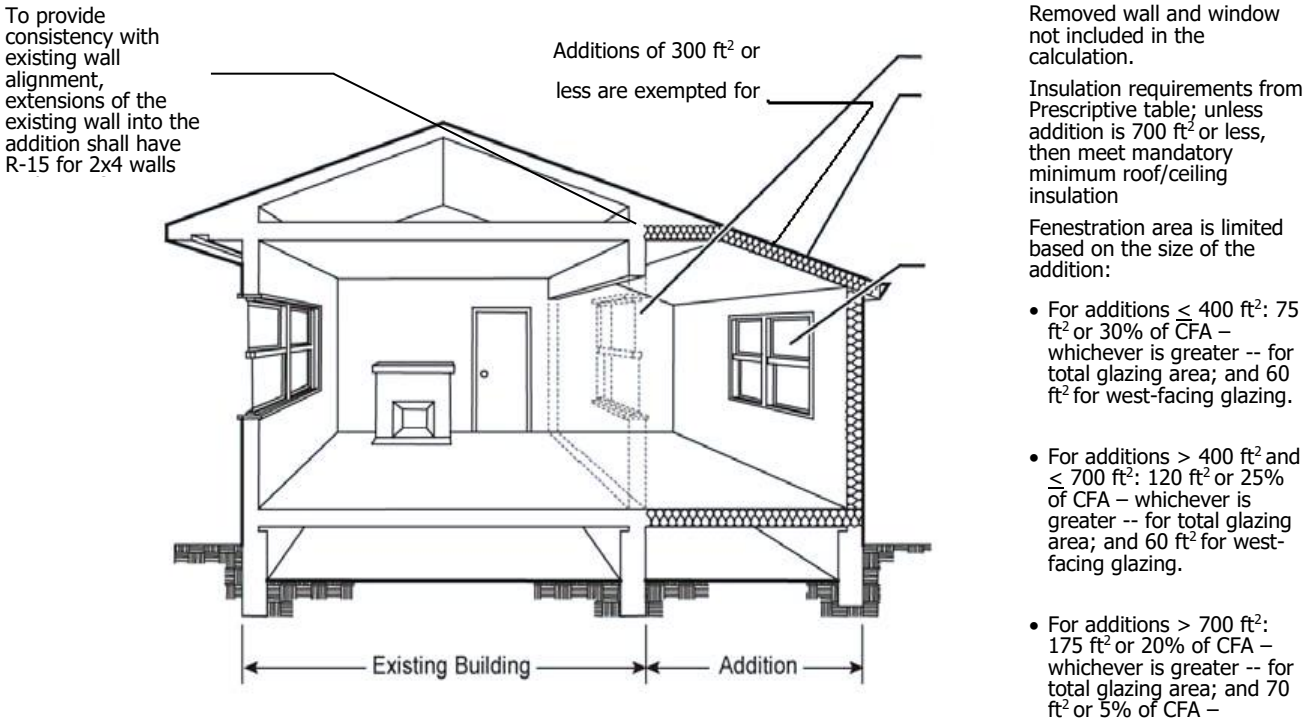
B. **Additions > 400 ft^2 and ≤ 700 ft^2**:
    1. Total glazing area up to 120 ft^2 or 25 percent of the conditioned floor area.
    2. Total glazing area maximum for west-facing glazing is 60 ft^2 or 5 percent in Climate Zones 2, 4, and 6-15.
    3. QII does not apply.
    4. Rafter roof insulation of R-22.
    5. Ceiling insulation of R-38 in Climate Zones 1,2,4, and 8-16 or R-30 in Climate Zones 3 and 5-7.
    6. Radiant barrier in Climate Zones 2-15.

7. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and require the following cavity insulation:
    a. In 2x4 wood-framed walls, insulation shall be R-15.
    b. In 2x6 or greater wood-framed walls, insulation shall be R-21.
8. Existing wood-framed walls, where existing exterior siding (or cladding) will not be removed, do not need continuous insulation, and require only cavity insulation:
    a. In 2x4 wood-framed walls, insulation shall be R-15.
    b. In 2x6 or greater wood-framed walls, insulation shall be R-21.

C. **Additions > 700 ft^2**:

1. Total glazing area up to 175 ft^2 or 20 percent of the conditioned floor area, whichever is greater.
2. Total glazing area maximum for west-facing glazing is 70 ft^2 or 5 percent in Climate Zones 2, 4, and 6-15.
3. Extensions of existing wood-framed walls may retain the dimensions of the existing walls and require the following cavity insulation:
    a. In 2x4 wood-framed walls, insulation shall be R-15.
    b. In 2x6 or greater wood-framed walls, insulation shall be R-21.
4. Existing wood-framed walls, where existing exterior siding (or cladding) will not be removed, do not need continuous insulation, and require only cavity insulation:
    a. In 2x4 wood-framed walls, insulation shall be R-15.
    b. In 2x6 or greater wood-framed walls, insulation shall be R-21.
5. QII applies to the addition.
6. When an addition greater than 700 ft^2 is an existing unconditioned space converted to conditioned space, the QII requirements do not include:
    a. Window and door header insulation.
    b. Air sealing if the existing air barrier is not removed or replaced.

Figure 9-3: Prescriptive Addition Envelope Requirements



Example 9-8

Question:

I am retrofitting an existing home that includes an 800 ft^2 addition. Part of this addition includes converting a 400 ft^2 unconditioned garage to conditioned space and adding a 400 ft^2 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 ft^2, 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 ft² 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 ft², the total fenestration area is limited to a maximum of 75 ft², and west-facing fenestration area is limited to 60 ft². 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), 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 §150.2(a)). All other applicable mandatory requirements in §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 §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. Window certification and labeling requirements of §110.6(a) do not apply to existing used windows.

Relocated windows must also meet the maximum area-weighted average U-factor in §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 §150.1(c)7A and fan airflow and watt draw measurements in §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 §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 §150.2(a)). . New ducts in unconditioned space also shall meet the prescriptive duct insulation requirements per §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 Climate Zones 2 and 8-15 and mandatory fan airflow and watt draw testing in all climate zones. The one exception is that prescriptively the new systems may be either a heat pump or gas heating system.

Table 9-2: 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	CZ 1, 2, 4, 8-16: R-38 CZ 3, 5-7: R-30	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	Same as ≤ 400 ft^2	CZ 2-15: Radiant barrier above attic spaces except when complying with Option B (see §150.1(c)2)

Figure 9-4: Ventilated Attic Prescriptive Compliance Choices for Additions >700 ft^2

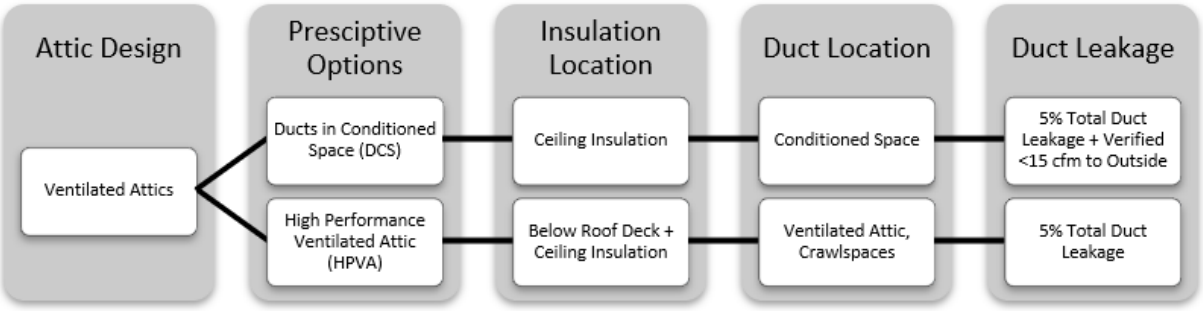


Table 9-3: Roof and Ceiling Requirements for Prescriptive Additions

Component	Option B	Option C (CZ 4, 8-16)
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
Roofing	Tile roof or other product with an air space	Tile roof or other product with an air space
Ceiling Insulation	CZ 1, 2, 4, 8-16: R-38 CZ 3, 5-7: R-30	CZ 2-10: R-30 CZ 1, 11-16: R-38
Duct and Air Handler Location	Attic	Conditioned space

Table 9-4: Envelope Door and Glazing Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft²	Additions > 400 and ≤700 ft²	Additions > 700 ft²
Allowable total glazing area	Up to 75 ft² or 30% of conditioned floor area, whichever is greater	Up to 120 ft² or 25% of conditioned floor area, whichever is greater	Up to 175 ft² or 20% of conditioned floor area, whichever is greater
Allowable west-facing glazing area: CZ 2, 4, 6-15	Up to 60 ft²	Up to 60 ft2	The greater of 70 ft² or 5% of conditioned floor area in CZ 2, 4, 6-15
Glazing U-factor & SHGC[1]	All CZs: U = 0.30 CZ 2, 4 & 6-15: SHGC = 0.23	All CZs: U = 0.30 CZ 2, 4 & 6-15: SHGC = 0.23	All CZs: 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 §§150.0(q) and 150.1(c)3 for new and replaced window and skylight exceptions.

Table 9-5: Envelope Wall/Floor Insulation Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft²	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 CZ1: R-7 or U = 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.

Table 9-6: QII Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft²	Additions > 400 and ≤700 ft²	Additions > 700 ft²
New structure	No requirement	Same as ≤ 400 ft²	All CZs: Required (Does not apply to any altered spaces)
Converting unconditioned to conditioned space	No requirement	Same as ≤ 400 ft²	Same as above except: Window and door header insulation Air sealing if the existing air barrier is not removed or replaced

Table 9-7: HVAC Requirements for Prescriptive Additions

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

Source: California Energy Commission

1. (Note: also, mandatory mechanical ventilation per ASHRAE 62.2 with HERS verification for additions > 1,000 ft²)

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

9.4.2 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 §150.2(a)1Di-iv are met.

For a complete list of options, see Chapter 5.

9.4.3 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.

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.

9.4.4 Envelope Alterations

This section summarizes requirements for many typical residential envelope alterations.

Table 9-8: 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 §150.0(a)	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	1. R-38 existing attic insulation. 2. Asbestos or knob and tube wiring in the attic. 3. Attic space is shared with another dwelling unit which does not have an altered ceiling. The above conditions exempt a project from all the

Envelope Alteration Type	Applicable Mandatory Requirements[1]	Summary of Relevant Prescriptive Requirements[2]	Exception(s) to the Prescriptive Requirements
		Min. attic ventilation: all CZs §150.2(b)1J	prescriptive requirements. Other exceptions apply to individual requirements, see Section 9.4.3.2 for further details.
Altered rafter roof	R-19, U=0.054 §150.0(a)	N/A	N/A
Adding exterior framed wall insulation	In 2x4 framing: R-13, U=0.102 In 2x6 framing: R-20, U=0.071 Exception: 2x4 framing already insulated to R-11 or greater per §150.0(c)1	N/A	N/A
Mass/concrete walls	See §150.1(c) for applicable climate zone	N/A	N/A
Replacing > 50% of existing steep-sloped (≥2:12) roof surface, including adding a new surface layer on top of existing exterior surface	§110.8(i)	Cool Roof Requirements CZ 4, 8 - 15: Reflect.≥0.20 and Emittance≥0.75; or SRI≥16 §150.2(b)1Ii	(a) Air space 1.0" between roof deck and bottom of roofing product (b) Profile ratio of rise to width of 1:5 for >50% width of roofing product. (c) Existing ducts in attic insulated and sealed per §150.1(c)9.

Envelope Alteration Type	**Applicable Mandatory Requirements[1]**	**Summary of Relevant Prescriptive Requirements[2]**	**Exception(s) to the Prescriptive Requirements**
			(ad) Roof has ≥ R-38 ceiling insulation. (be) Roof has a radiant barrier per §150.1(c)2 (not over spaced sheathing). (c) In CZ 2, 4, 9, 10, 12, & 14 no ducts in attic. (d) >≥R-2.0 insulation above roof deck (e) Roof area covered by building integrated PV or solar thermal panels. (f) Roof constructions with a weight ≥25 lbs/ft^2.
Replacing > 50% of existing low-sloped (<2:12) roof surface, including adding a new surface layer on top of existing exterior surface	§110.8(i)	Cool Roof Requirements CZ 4,6 - 15: Reflectance ≥ 0.63; Emittance ≥ 0.75 §150.2(b)1Iiia	(a) There are no ducts in the attic. (b) Reflectance and Roof Deck Insulation R-value in Table 150.2-A are met (c) Roof area covered by building integrated PV or solar thermal panels.

Envelope Alteration Type	Applicable Mandatory Requirements[1]	Summary of Relevant Prescriptive Requirements[2]	Exception(s) to the Prescriptive Requirements
			(d) Roof constructions with a weight ≥25 lbs/ft^2.
Adding or replacing skylight[3]	Weighted average U-factor ≤0.58 Exemption: Up to 20 ft^2 or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor requirement of §150.0(q)	Must not exceed 20% total (all CZs) and 5% west fenestration area (CZ 2, 4, 6-15) with a U-factor ≤ 0.30 (all CZs); in CZ2, 4 & 6-15: SHGC ≤ 0.23 §150.2(b)1A	Up to 75 ft^2 need not meet total or west-facing fenestration area per §150.2(b)1A Exception 1 Replacement skylights up to 16 ft^2 with a U≤0.55 and SHGC ≤0.30 and not meet total fenestration and west-facing area requirements per §150.2(b)1A Exception 2
Adding raised floor insulation	R-19 or equivalent U-factor Exception: Floors over controlled ventilation or unvented crawlspaces per §150.0(d)	N/A	N/A
Replacing vertical fenestration[3] (altered glazing)	Weighted average U-factor ≤0.58 Exemption: Up to 10 ft^2 or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor	Must not exceed 20% total (all CZs) and 5% west fenestration area (CZ 2, 4, 6-15) with a U-factor ≤ 0.30 (all CZs); in CZ2, 4 & 6-15: SHGC ≤ 0.23 §150.2(b)1A	Up to 75 ft^2 need not meet total or west-facing fenestration area per §150.2(b)1A Exception 1 Replacement skylights up to 16 ft^2 with a U≤0.55

Envelope Alteration Type	**Applicable Mandatory Requirements[1]**	**Summary of Relevant Prescriptive Requirements[2]**	**Exception(s) to the Prescriptive Requirements**
	requirement of §150.0(q)		and SHGC ≤0.30 and not meet total fenestration and west-facing area requirements per §150.2(b)1A Exception 2
Adding vertical fenestration[3] (new glazing) and greenhouse	Weighted average U-factor ≤0.58 Exemption: Up to 10 ft^2 or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor requirement of §150.0(q)	Must not exceed 20% total (all CZs) and 5% west fenestration area (CZ 2, 4, 6-15) with a U-factor ≤ 0.30 (all CZs); in CZ2, 4 & 6-15: SHGC =≤ 0.23 §150.2(b)1A	Up to 75 ft^2 need not meet total or west-facing fenestration area per §150.2(b)1A Exception 1 Added greenhouse must either meet the maximum or weighted average U-factor of 0.58 or up to 10ft^2 or 0.5% of CFA whichever is greater as per Exception 1 to §150.0(q)1

Source: California Energy Commission

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

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

If 50 percent or more of the roof surface of an existing building is being altered, either by replacing the existing roof or adding a new surface lay on top of the existing surface, the following requirement must be met.

1. Steep-Sloped Roofs (≥ 2:12) [150.2(b)1Ii]

Steep-sloped roofs will need to meet a cool roof product requirement when 50 percent or more of the roof surface of an existing building is being replaced. In climate zones 4, and 8 through 15, the new roof products for the replaced steep-sloped roofing area shall have a minimum aged solar reflectance of 0.20 and minimum thermal emittance of 0.75, or a minimum SRI of 16. These requirements apply unless one of the following is present per Exception 1 to §150.2(b)1Ii:

1. Building has at least R-38 insulation or ceiling assemblies with maximum U-factor of 0.025.
2. Roof of attic spaces has a radiant barrier (not installed directly above spaced sheathing) according to §150.1(c)2.
3. There are no ducts in the attic space in climate zones 2, 4, 9, 10, 12 and 14.
4. Buildings with R-2.0 or greater continuous insulation above or below the roof deck.

Exception 2 to Section 150.2(b)1Ii exempts roof areas covered by building integrated photovoltaic panels or building integrated solar thermal panels from meeting the roofing product requirements.

Exception 3 to Section 150.2(b)1Ii exempts roof constructions with a weight of at least 25 pounds per square foot from meeting the roofing product requirements.

2. Low-Sloped Roofs (< 2:12) [150.2(b)1Iiia]

Low-sloped roofs will need to meet a cool roof product requirement as well as a roof insulation requirement when 50 percent or more of the roof surface of an existing building is being replaced.

In climate zones 4, and 6 through 15, the new roof products for the replaced low-sloped roofing area shall have a minimum aged solar reflectance of 0.63 and minimum thermal emittance of 0.75, or a minimum SRI of 75 per §150.2(b)1Iiia.

Exception 1 to §150.2(b)1Iiia allows the aged solar reflectance to be traded off by adding insulation at the roof deck as specified in Table 150.2-B of the Energy Code.

Table 9-9: Aged Solar Reflectance Insulation Trade Off

Minimum Aged Solar Reflectance	Roof Deck Continuous Insulation R-value Climate Zones 6-7	Roof Deck Continuous Insulation R-value Climate Zones 2, 4, 8-15
0.60	R-2	R-16
0.55	R-4	R-18
0.50	R-6	R-20
0.45	R-8	R-22
No requirement	R-10	R-24

Source: California Energy Commission

Exception 2 to Section 150.2(b)1Iiia exempts roof areas covered by building integrated photovoltaic panels or building integrated solar thermal panels from meeting the roofing product requirements

Exception 3 to Section 150.2(b)1Iiia exempts roof constructions with a weight of at least 25 pounds per square foot from meeting the roofing product requirements.

In addition to the roofing product requirements, low-sloped roofs in climate zones 1, 2, 4, and 8 through 16, shall be insulated to meet either continuous insulation of R-14 or a roof assembly U-factor of 0.039 per §150.2(b)1Iiib. There are some exceptions to the insulation requirements.

Exception 1 to Section 150.2(b)1Iiib exempts existing roofs with R-10 or greater continuous insulation above or below the roof deck.

Exception 2 to Section 150.2(b)1Iiib exempts existing roofs in climate zones 1, 2, 4, and 8 through 10 with an assembly U-factor of 0.056 or less or that are insulated with at least R-19 insulation between the roof rafters and in contact with the roof deck.

Exception 3 to Section 150.2(b)1Iiib allows the continuous insulation requirements to be reduced to R-4 when meeting either of the following conditions:

1. Mechanical equipment located on the roof will not be temporarily disconnected and lifted as part of the roof replacement. And the addition of insulation required would reduce the height from the roof surface to the top of the base flashing to less than what is required by the manufacturer's installation instructions as per the California Residential Code Section R900

2. Replaced roofing abuts sidewall or parapet walls and the addition of insulation required would reduce the height from the roof surface to the top of the base flashing to less than what is required by the manufacturer's

installation instructions as per California Residential Code Section R900, when all the following conditions apply:

a. The sidewall or parapet walls are finished with an exterior cladding material other than the roof covering membrane material.

c. The sidewall or parapet walls have exterior cladding material that must be removed to install the new roof covering membrane to maintain the minimum base flashing height.

c. The ratio of the replaced roof area to the linear dimension of affected sidewall or parapet walls is less than 25 square feet per linear foot.

Exception 4 to Section 150.2(b)1Iiib allows the continuous insulation requirements to be reduced where increasing the thickness of above deck insulation would reduce the flashing around an existing exterior wall opening below what is permitted by the fenestration or door manufacturer's installation instructions, or registered design professionals approved flashing design, as per the California Residential Code Section R703.4, or by California Residential Code Section R905.2.8.3.

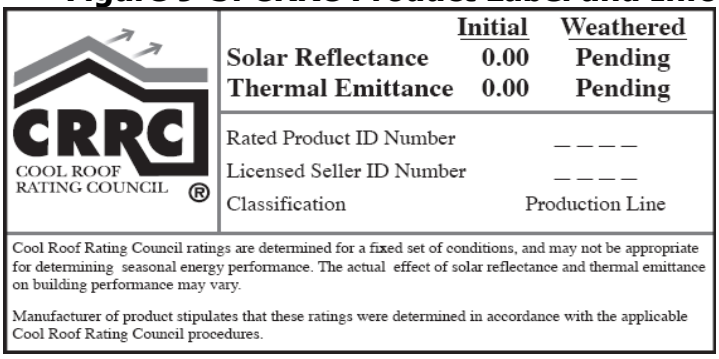
Exception 5 to Section 150.2(b)1Biib allows tapered insulation with lower thermal resistance at the drains and other low points to be used, provided that the thickness of insulation is increased at the high points of the roof so that the average thermal resistance equals or exceeds the required value.

3. Roofing Products: Cool Roof

Cool roofs are not just white roofs but are products (tile, asphalt shingles, etc.) designed to reflect much of the sun's radiant energy back into space instead of transferring it as heat into the building below. The two basic characteristics that determine the performance of a cool roof are solar reflectance and thermal emittance. These roofing products must be certified by the Cool Roof Rating Council (**www.coolroofs.org**) per §§10-113 and 110.8(i).

A cool roof requires the roofing product manufacturer to test for solar reflectance and thermal emittance and be listed in the Cool Roof Rating Councils (CRRC) Rated Product Directory. Figure 9-5 an example of an approved CRRC product label.

Figure 9-5: CRRC Product Label and Information



If the aged value for the reflectance is not available in the CRRC Rated Product Directory, the equation below is used.

***Equation 9-1**: Aged Reflectance*

$$Aged\ Reflectance_{calculated} = (0.2 + \beta * [\rho_{initial} - 0.2])$$

Where:
$\rho_{initial}$ = Initial Reflectance listed in the CRRC Rated Product Directory
β = soiling resistance value listed in Table 9-10

Table 9-10: Soiling Resistance Value β, by Product Type

PRODUCT TYPE	β
Field-applied coating	0.65
Other	0.70

Since this is not a mandatory requirement, prescriptive compliance for a given roof slope and climate zone require a minimum reflectance and emittance, can be met using one of the exceptions above or by using the performance compliance approach.

Example 9-14

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

Example 9-13

Question:

On an existing building, 50 ft^2 of 85 ft^2 of vertical glazing is being removed from an existing south-facing wall and new glazing will be replaced as part of the alteration in the same opening. What requirements apply?

Answer:

Since 50 ft^2 is "replacement" fenestration and 35 ft^2 is existing, the replaced fenestration must comply with the §150.2(b)1B. For this example, Exception 1 to §150.2(b)1B can used. This allows vertical fenestration no greater than 75 ft^2 to meet have a U-factor no greater than 0.40 in Climate Zones 1-16 and an SHGC of 0.35 or less in Climate Zones 2, 4, and 6 through 15.

Example 9-14

Question:

Why is the low-sloped roofing products requirement listed for only Climate Zones 13 and 15?

Answer:

These two climate zones are the only climate zones that show energy cost-effectiveness for having a low-slope roofing product (cool roof) requirement.

Example 9-15

Question:

Why are there so many exceptions to the addition and alterations section that can be considered equivalents to roofing products?

Answer:

There are several energy features that are equivalent or having a greater impact on energy savings than the roofing products. For example, older homes often have ducts under the house, and newer homes may have materials slightly below current requirements or equal to one of the items considered to be equivalent. If the ducts are insulated and air leakage controlled to meet current requirements, energy savings are expected to be at least equal the benefit of reflective roof coverings.

Example 9-16

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 roofing products?

Answer:

Yes. If your house is in Climate Zone 13 or 15, you will need to meet the low-slope criteria for the areas with low slope. The areas with the steep-slope roof will need to meet the other cool roof criteria.

Example 9-17

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 9-18

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.

Example 9-19

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 §150.2(b)1H below applies:

Prescriptive Exceptions for Steep-Sloped Roofs

1. Air-space of 1.0 inch (25 mm) is provided between the top of the roof deck and the bottom of the roofing product.

2. The installed roofing product has a profile ratio of rise to width of 1 to 5 for 50 percent or greater of the width of the roofing product.

3. If existing ducts in the attic are insulated and sealed according to §150.1(c)9.

4. Buildings have at least R-38 ceiling insulation.

5. Buildings have an attic radiant barrier meeting the requirements of §150.1(c)2.

6. Buildings have no ducts in the attic.

7. Buildings are in Climate Zones 10-15, R-2 or greater insulation above the roof deck.

Prescriptive Exceptions for Low-Sloped Roofs

1. Buildings have no ducts in the attic.

2. Aged solar reflectance and roof deck insulation R-value in Table 150.2-A are met.

Alternatively, the building may show compliance using the performance approach.

Example 9-20

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 ft^2, 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 9-21

Question:

When doing a full roof replacement on a steep slope roof in climate zone 12 with new integrated photovoltaic roofing product, does the roofing product need comply with the Energy Code requirements in Section 150.2(b)1?

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.

9.4.4.2 Insulating Existing Roof/Ceilings

A. Rafter Roofs and Unvented Attics

When insulating a rafter roof, at least R-19 (maximum U-factor of 0.054) is required.

When a roof surface is altered, if the space between framing members becomes accessible, the ceiling/roof is considered altered, and insulation is required.

The prescriptive requirement for alterations to walls and floors is to add the equivalent of the specified level of insulation that fits within the cavity of wood-framed assemblies:

1. R-13 in 2x4 exterior walls, and R-20 in 2x6 or greater exterior walls (no exterior continuous insulation is required); or

2. Existing 2x4 exterior walls that already have R-11 insulation installed in framed walls are exempt from the mandatory minimum R-13 wall insulation required

by §150.0(c)6; or

3. R-19 in raised floors over crawl spaces, over open outdoor areas, unheated basements, and garages.

B. 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, there are four primary sets of requirements that must be met as listed below.

1. Air seal the ceiling between conditioned spaces and the unconditioned attic.
2. Insulate the attic floor over any conditioned spaces to R-49.
3. 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.
4. Ensure attic ventilation meets California Building Code requirements.

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

These components combine to form a package that addresses many issues in existing attics. Combined they provide a much greater benefit than any of these

measures do on their own. If an attic is insulated without first air sealing the ceiling assembly, the opportunity to seal any penetrations between the attic and conditioned space below is lost, and sealing can only be performed in the future if the insulation is removed. Once installed, R-49 insulation is 16-20" deep and it becomes a challenge to maneuver around the attic space. Air infiltration through the ceiling plane between the attic and conditioned space also reduces the effectiveness of attic insulation.

Items #1 through #3 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. Air sealing, recessed cans, and attic ventilation must be addressed prior to adding attic insulation. Table 9-11 below summarizes when these prescriptive requirements apply.

Table 9-11: 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:

(a) Existing attic insulation of R-38 or better.

(b) 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.

(c) Knob and tube wiring located in the attic, which is not being removed as part of the scope of work.

(d) 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.

To qualify for the exceptions based on a minimum of R-19 or R-38 attic insulation, existing insulation must be documented to meet the minimum levels on the Certificate of Compliance. To verify the existing insulation R-value, the depth of insulation must be measured. To obtain an accurate measurement it's recommended to measure in at least two places and take the average. If the depths across various sections of the attic differ by more than two of inches, measurements at the lower sections should be used. For example, if half of the attic has 6 inches of insulation and the other half has only 3-1/2" of insulation, a depth of 3-1/2" should be used for purposes of determining the existing insulation level. Next, multiply the depth of insulation by the R-value per inch based on the insulation product type. See Table 9-12 below for typical insulation densities for various product types. For the example above, if the insulation was high density cellulose at R-3.2 per inch, then the R-19 minimum condition is not met because half of the attic has insulation with an R-value of approximately R-13.

Table 9-12: Typical Insulation R-Values per Inch

Typical Insulation R-values

Insulation Type	R-value per inch	Typical Applications
Cellulose, loose fill	3.7	Attic Floor
Cellulose, high density	3.2	Walls, Enclosed Cavities, Framing Transitions
Fiberglass, batts	3.0*	Basement Ceiling, Open Stud Walls, Attic Floor*
Fiberglass, loose fill	2.8	Attic Floor, Walls (existing)
Fiberglass, loose fill, fluffed below manufacturer's standards	uncertain	Do not install, or correct by blowing over with higher density
Rockwool	3.0	Attic Floor, Walls, Basement Ceiling (may be loose or batts)
Vermiculite	2.7	Attic Floor
Poly-isocyanurate, rigid board	7.0	Foundation Walls, Attic Access Doors
Polystyrene, expanded rigid board	4.0	Foundation Walls, Sill Plate
Polystyrene, extruded rigid board	5.0	Foundation Walls, Sub-Slab, Sill Plate
Low Density Urethane, sprayed foam	3.7	Attics, Walls (new construction); Sill Plate, Band Joist, Framing Transitions
Urethane, sprayed foam	6.0	Attics, Walls (new construction); Sill Plate, Band Joist, Framing Transitions
Urea Formaldehyde Foam	4.0	Attics, Walls (existing)

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

1. 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 9-13). 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 9-13: 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

Addressing air leakage requires removing or temporarily moving any existing insulation around the attic to access the attic floor. Most air sealing can be completed with caulking or foam. Areas where large holes might exist, such as at soffits and dropped ceilings, will require an air barrier to be installed if not already in place and the perimeter will need to be secured and fully sealed. 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
- Kneewalls
- Recessed lighting fixtures

2. 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 9-14 summarizes the recessed can lighting requirements by climate zone and existing insulation value.

Table 9-14: 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

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 disconnect 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. Example covers include the TENMAT and Insullite covers (see Figure 9-6). 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 meet 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.

Figure 9-6: Example fire rated cover products. Left is Tenmat, and right is Insullite.

(1) https://www.recessedlightcover.com/product-selection/tenmat-ff130e-recessed-light-draft-stop-cover/

(2) https://insulation4us.com/products/recessed-light-cover-solid-insullite-all-sizes?variant=32508051849265&gclid=CjwKCAjwqcKFBhAhEiwAfEr7zfAPOJY7SqKTCmwahDo05n7klkNhzihRNF6K_VJccWpRpaDuLdEyXhoCVgUQAvD_BwE

3. Attic Insulation

In all climate zones, except 5 and 7, attic insulation shall be installed at the attic floor to a level of R-49 or to achieve a weighted U-factor of 0.020. Table 9-15 summarizes the insulation requirements by climate zone, based on whether the existing attic insulation meets a minimum R-19 or not.

Table 9-15: Attic Insulation Requirements by Climate Zone

Climate Zones	< R-19 existing attic insulation	≥ R-19 existing attic insulation
5, 7	No requirement	No requirement
1, 3, 6	R-49	No requirement
2, 4, 8-16	R-49	R-49

In cases where there is limited vertical height in an attic (preventing the installation of the required insulation R-value), an exception allows for the installation of a lower R-value. Insulation must still be installed to maximize the depth of insulation while still meeting code requirements for roof ventilation as specified in Section 806.3 of the California Residential Code (Title 24, Part 2.5). A minimum of 1 inch air gap must be provided between the insulation and roof deck as well as at all vent locations. The use of blocking, bridging and insulation must not block the free flow of air.

Attic insulation is either batt, loose fill (blown-in), rigid, or spray foam and can be made of various materials. Most new and retrofit attics use blown-in fiberglass or cellulose insulation. Blown-in insulation is a loose fill product

installed using a blowing machine with a large, attached hose. While both blown-in and batt insulation have similar properties, it is much easier to achieve a consistent installation with loose fill since the particles more easily fill in small gaps and hard to reach areas. R-value ratings per inch vary somewhat by product type and across manufacturers. Manufacturers provide coverage charts which specify how many bags of insulation are needed to cover a certain square footage based on the ceiling framing spacing and depth. The charts account for settling of the insulation due to compression under its own weight.

Insulation must be installed evenly throughout the attic space and insulation levels must be documented on the certificate of installation (CF2R). The insulation level can be verified by checking that the depth of insulation conforms to the manufacturer's coverage chart for achieving the required R-value. The insulation also must meet the manufacturer's specified minimum weight per ft² for the corresponding R-value. When using loose fill insulation at the ceiling, baffles should be installed at eaves or soffit vents to keep the insulation from blocking ventilation and prevent air movement under the insulation. Attic access doors shall have permanently attached insulation using adhesive or mechanical fasteners.

4. 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.
- 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 9-22

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:

In Climate Zones 1 through 4, 6, and 8 through 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 through 16. The air sealing should be performed in accordance with Section 110.7. In Climate Zones 1 through 4 and 8 through 16 any existing recessed can 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, see Section 9.4.4.2 for further detail.

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.

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.

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.

9.4.4.3 Fenestration and Doors

1. Replacement Fenestration

Any fenestration (i.e., windows, skylights, clerestories, and glazed doors) that is being removed and replaced in an exterior wall or roof is considered "replacement fenestration."

Replacement fenestration is an area of new fenestration that replaces an equal or lesser area of glazing removed in the same existing wall or roof area. It is labeled as "altered" fenestration, and it need not occur in the same openings as the glazing being removed as long as it is being installed in the same existing wall or roof surface that remains a part of the existing building. Any added fenestration area that is larger than the total altered glazing area is labeled as "new."

2. New Fenestration in Alterations

The Energy Code has relaxed some of the prescriptive restrictions on new vertical fenestration for alterations in existing homes. When new vertical fenestration is added in existing dwellings, up to 75 ft² are not required to meet the overall total fenestrations limit (20 percent of the CFA) and the west facing area limit (5 percent of the CFA). This provides for additional flexibility to meet the Energy Code

requirements using the prescriptive approach, without having to comply using the performance approach. However, this additional fenestration must meet the prescriptive U-factor and SHGC requirements or meet the U-factor and SHGC requirements of Exceptions 1 and 2 to §150.2(b)1B.

3. 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 for the fenestration U-factor of 0.58.

To meet this mandatory requirement, greenhouse windows:

1. Must have a maximum U-factor of 0.58 or better; or
2. Must use the area-weighted average for all new and replacement fenestration with a combined mandatory maximum of 0.58 U-factor as per §150.0(q)2; or
3. Must meet the Exception 1 to §150.0(q)1 for up to 10 ft^2 or 0.5 percent of CFA, whichever is greater.

4. Exterior Doors

Alterations that add exterior door area must meet the same requirements as newly constructed buildings (Section 150.1(c)5) which requires a maximum U-factor of 0.20 for swinging doors. Swinging doors between the garage and conditioned space that are required to have fire protection are exempt from the U-factor requirement.

5. Labeling, Certification, and Other Mandatory Requirements

See Chapter 3 for a full list of mandatory requirements for certification and labeling for fenestration products and exterior doors (§110.6), and air leakage requirements (§110.7).

Example 9-25

Question:

An alteration in Climate Zone 12 is to move an existing 25 ft^2 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 §150.2(b)1B. Exception 1 to §150.2(b)1B states that up to 75 ft^2 of vertical replacement fenestration is allowed to meet a prescriptive requirement of 0.40 U-factor and 0.35 SHGC.

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 0.58 (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 ft^2 is exempt (§150.0[q], Exception 2), and (2) a weighted-average U-factor with other fenestration products is allowed.

For additions and alterations, Exception 1 to §150.2(b) allows any dual-pane greenhouse window to meet the prescriptive U-factor requirement (separate from the mandatory 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 ft^2 total) will be replaced within existing openings. One existing 30 ft^2 window is being replaced with a pair of 40 ft^2 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) and SHGC (0.23) in Table 150.1-A or B. There are only 10 ft^2 of added fenestration, so the project meets Exception 1 to §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.

For performance compliance:

(a) 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.

(b) 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 §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 (§150.2[b]1B), and new fenestration must meet applicable mandatory requirements of C1V10.6, 110.7, 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 ft^2 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 (§150.2[b] Exception 1), all applicable mandatory requirements must be met. This includes §150.0(q), which requires a maximum weighted average U-factor of 0.58 or less. Exception 2 exempts up to 30 ft^2 from this requirement.

9.4.5 Water Heating Alterations

For a replacement water heater, there are separate requirements for the distribution system and the water heater. The requirements for pipe insulation are mandatory

and cannot be traded off. For the distribution system and the water heater, if the prescriptive requirements cannot be met, then the performance compliance method can be used to comply.

The mandatory pipe insulation requirement includes the following:

1. Any newly installed and existing accessible piping must meet mandatory insulation requirements in §150.0(j)1.

To meet the prescriptive requirements, the replacement water heater must be one of the following:

1. Any natural gas or propane water heater
2. A single heat pump water heater meeting NEEA Tier 3 or higher specifications.
3. A single heat pump water heater, (1) located in an unconditioned space like the garage or in conditioned space, (2) placed on an incompressible (rigid) surface that is insulated to a minimum R-10, and (3) installed with a communication interface (demand control device) meeting §110.12(a), or has an ANSI/CTA-20450B communication port.
4. If the existing water heater is an electric resistance water heater, a replacement electric resistance water heater may be installed.
5. A water-heating system determined by the California Energy Commission's Executive Director to use no more energy than those specified above.

If a recirculation system is installed, then it must be a demand recirculation system with a manual on/off control to meet the prescriptive requirements.

9.4.5.1 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. (See Section 9.5.)

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

Example 9-26

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:

It depends on the type of water heater. A heat pump water heater or instantaneous gas or propane water heater meeting certain conditions of 200,000 Btu/h or less complies with §150.2(a)1D. For small additions 500 square feet or less an instantaneous electric water heater meeting certain conditions is also allowed. Otherwise, performance compliance may be used to demonstrate compliance.

Example 9-27

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 (§150.2[b]1H) of an existing water heating system, this proposed replacement meets the requirement of §150.2(b)1Hiiia.

Any applicable mandatory requirements must also be met. For newly installed piping and existing accessible piping, all the applicable insulation requirements of §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 9-28

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 one of those circumstances. 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 9-29

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:

No. When there is an increase in the number of water heaters with an addition, . Per 150.2(a)1Div, the only prescriptive electric resistance option for additions up to 500 ft2 is an instantaneous water heater.

Performance compliance may be possible. There is a significant penalty for this type of electric resistance water heating.

Example 9-30 – 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 natural gas is not already connected to the existing water heater location, 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 Section 5.3.5.1 for more information on pipe insulation requirement.

9.4.6 HVAC System Alterations

If the heating and cooling system is unchanged as part of an addition or alteration, compliance for the HVAC system is not necessary. However, altering or replacing any component of a system typically triggers requirements for that component, as well as a requirement for duct sealing and leakage testing. Residential Appendices RA3 contains the applicable field verification and diagnostic test protocols that must be followed.

Energy Code requirements are determined by the type of the work performed on the existing space conditioning system. In practice, this work is commonly referred to as an "HVAC changeout". The two types of HVAC changeouts are:

1. Entirely new or complete replacement space conditioning systems
2. Altered space conditioning systems (equipment and/or ducts)

9.4.6.1 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:

1. 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.
2. 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).

1. §150.0(h)1-2: Cooling and heating load calculations.
2. §150.0(h) 3: Outdoor condensing unit requirements.
3. §150.0(h)4: Heating furnace temperature rise requirements.
4. §150.0(i): Setback thermostats or controlled by EMCS.
5. §150.0(j)1-2: Pipe insulation.
6. §150.0(m)1-10: Duct insulation, labeling, & damper requirements.
7. §150.0(m)12: Air filtration requirements.
8. §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).
9. §150.1(c)7: Prescriptive refrigerant charge verification.
10. §150.2(b)1G: Electric resistance heating restrictions
11. Table 150.2-A: Prescriptive duct insulation.

9.4.6.2.1 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 §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 9-16.

Table 9-16: Duct Minimum R-Value (*from Energy Code Table 150.2-A*)

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 a HERS 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 (§150.0[m]12 and §150.0[m]13). If the air handler and ducts are located in a vented attic, then attic and air sealing requirements (§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 a HERS 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 a HERS 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 a HERS 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 HERS 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.

9.4.6.2.2 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). In addition, this altering of 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 a HERS Rater as specified in RA3.1 under any of the following conditions:

1. An air handler is replaced.
2. An outdoor condensing unit of a split system air conditioner or heat pump is installed or replaced.

3. A packaged system is completely replaced.
4. 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 by a HERS rater.

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

1. Ducts that have already been sealed, tested, and certified by a HERS Rater.
2. Duct systems with a total less than 40 feet of duct; and
3. 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 a HERS 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 a HERS 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 HERS 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.

In Climate Zones 2 and 8 through 15, when a refrigerant-containing component of an air conditioner or heat pump is replaced or installed in an existing house, §150.2(b)1F requires a system that does not have a fault indicator display (FID) installed 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 §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:

1. The existing system is electric resistance, and the replacement system is nonducted.

2. The existing system is electric resistance, and a ducted space cooling system is not being replaced or installed.

3. The existing system is electric resistance and located in Climate Zone 7 or 15.

Example 9-31

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 §150.2[b]1Ei through iii for the requirements and exceptions.)

Example 9-32

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 9-33

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 9-34

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:

Mandatory requirements apply to the components being replaced. 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 (§150.2[b]1Fi).

All new ducts must meet insulation and construction requirements. All existing and new ducts must be sealed and HERS-verified, as specified §150.2(b)1E.

Prescriptively, the new heating unit must be natural gas fueled or a heat pump. A CF1R-ALT-02 can be completed by you or your mechanical contractor and registered on a HERS Provider's website.

Example 9-35

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; therefore, the mandatory requirements for ducts apply. If more than 25 feet of the duct is altered, the requirements of §150.2(b)1D trigger diagnostic testing and HERS verification of the duct system, as well as the prescriptive duct insulation requirements.

Example 9-36

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, §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 §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. (See Section **Error! R eference source not found.**.)

Example 9-37

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 9-38

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 9-39

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 a HERS 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 a HERS Rater to verify that all accessible ducts have bene sealed.

Example 9-40

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 a HERS 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 a HERS Rater to verify that all accessible ducts have bene sealed.

Example 9-41

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.

9.4.7 Mechanical Ventilation for Additions and Alterations

The whole-dwelling unit ventilation and local mechanical exhaust requirements apply to additions and alterations based on specific conditions as described in this section. See Chapter 4 for details on mechanical ventilation requirements.

9.4.7.1 Additions

The whole-dwelling unit ventilation requirements in §150.0(o)1C apply to additions greater than 1,000 square feet and additions that add a new dwelling unit.

- An addition to an existing dwelling unit that increase the conditioned floor area by more than 1,000 square feet must have the required whole-dwelling unit

ventilation airflow calculated by using the entire dwelling unit conditioned floor area. This is the existing conditioned floor area plus the added conditioned floor area.

- An addition that adds a new dwelling unit to an existing building must have the required whole-dwelling unit ventilation airflow calculated by using the conditioned floor area of the new dwelling unit.

Additions less than 1,000 square feet of conditioned floor area and additions that add a junior accessory dwelling unit (JADUs) do not need to meet the whole-dwelling unit ventilation requirements.

When whole-building ventilation airflow is required for compliance, field verification and diagnostic testing of airflow performance are required in accordance with the procedures in Residential Appendix RA3.7. In that case, a Certificate of Compliance CF1R form must be registered online with a HERS Provider. (See Section 2.5 and Appendix A.)

The local mechanical exhaust requirements of §150.0(o)1G and §150.0(o)2 must also be met, as applicable, when a kitchen or bathroom is added as part of an addition.

9.4.7.2 Alterations

Alterations that install a new or completely replaces an existing ventilation system must comply with all the applicable requirements in §150.0(o). An entirely new or complete replacement ventilation systems is a new ventilation fan component and an entirely new duct system. An entirely new duct system is constructed of at least 75 percent new duct material, and up to 25 percent may consist of reused parts from the dwelling unit's existing duct system if the reused parts are accessible and can be sealed to prevent leakage.

When a whole-dwelling ventilation fan is altered or replaced:

- Dwellings that were previously required by a building permit to comply with whole-dwelling ventilation requirements, are required to comply with the current whole-dwelling ventilation airflow specified in §150.0(o)1C. Field verification and diagnostic testing of airflow performance are required in accordance with the procedures in Residential Appendix RA3.7. In that case, a Certificate of Compliance CF1R form must be registered online with a HERS Provider. (See Section 2.5 and Appendix A.)
- All replacement whole-dwelling unit ventilation fans must be rated for airflow and sound in accordance with ASHRAE 62.2 Section 7.1. When meeting whole-dwelling unit ventilation airflow is required (as described above), the replacement ventilation fan must be rated to deliver an airflow rate that is equal to or greater than the required airflow.

- If the air filtration device is altered or replaced it must comply with the ventilation system air filtration requirements in §150.0(m)12 for dwellings that were previously required by a building permit to comply with the air filtration requirements.

When a local mechanical exhaust system is altered or replaced:

- All altered bathroom local exhaust systems must comply with the applicable requirements of §150.0(o)1G.
- Altered kitchen exhaust systems for dwellings that were previously required by a building permit to comply with the kitchen local exhaust requirements in §150.0(o)1G are required to meet or exceed the applicable airflow or capture efficiency requirements specified in §150.0(o)1G.
- Altered kitchen exhaust systems for dwellings that were previously required by a building permit to install a vented kitchen range hood or other kitchen exhaust fan are required to install a replacement fan that meets or exceeds the airflow required by the previous building permit, or 100 cfm, whichever is greater.
- All replacement local mechanical exhaust fans must be rated for airflow and sound in accordance with ASHRAE 62.2 Section 7.1 and Title 24, Part 6 Section 150.0(o)1Gvi. When meeting an exhaust airflow is required (as described above), the replacement exhaust fan must be rated to deliver an airflow rate that is equal to or greater than the required airflow.

9.4.8 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 2022 Energy Code residential lighting requirements can be found in Chapter 6.

1. Luminaire (light fixture) requirements, see §150.0(k)1 and Table 150.0-A, and Residential Compliance Manual Section 6.2
2. Screw based luminaire requirements, see §150.0(k)1B and Residential Compliance Manual Section 6.2.5
3. Recessed downlight luminaires in ceilings, see §150.0(k)1C and Residential Compliance Manual Section 6.2.3
4. Indoor lighting control requirements, see §150.0(k)2 and Residential Compliance Manual Section 6.3
5. Outdoor luminaires and lighting controls requirements, see §150.0(k)3 and Residential Compliance Manual Section 6.4.1 and 6.4.2
6. Internally illuminated address sign requirements, see §150.0(k)4 and Residential Compliance Manual Section 6.4.3

7. Residential garages , see §150.0(k)5, Section 6.5

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 9-42

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 §150.0(k)1, Table 150.0-A and 150.0(k)2.

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

Example 9-43

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 and TABLE 150.0-A. 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 9-44

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 §150.0(k)1 and Table 150.0-A. Screw-based sockets are not permitted for newly installed recessed downlight luminaires in ceilings.

Example 9-45

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 §150.0(k)1 and Table 150.0-A, including the high luminous-efficacy luminaires and the lighting controls requirements. The 2022 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 Sections 6.2 and 6.3 of this manual for details.

9.5 Performance Approach

9.5.1 Performance: Addition Alone

With very few exceptions, modeling an addition alone requires meeting the same requirements as newly constructed buildings. Any exceptions for additions are explained in Sections 9.3.1 and 9.3.2.

9.5.2 Performance Method: Additions and Existing + Addition + Alterations Approach

The computer programs used for compliance include requirements from §150.2(a)2B as well as §150.2(b)2A and B to set the standard design budget. Table 9-17 contains the efficiencies used to establish the standard design for a building using existing + addition + alteration (which includes existing + alteration) compliance.

Table 9-17: Standard Design for Altered Components

Altered Component	Standard Design Without Third Party Verification of Existing Conditions Shall Be Based On	Standard Design With Third Party Verification of Existing Conditions Shall Be Based On
Ceiling Insulation, Wall Insulation, and Raised-Floor Insulation	The requirements of Sections 150.0(a), (c), and (d)	The existing insulation R-value
Fenestration	U-factor of 0.40 and SHGC value of 0.35. Glass area is existing glass area.	If proposed U-factor is £ 0.40 and SHGC value is £ 0.35, standard design is existing U-factor and SHGC values, as verified. Otherwise, standard design is 0.40 U-factor and 0.35 SHGC. Glass area is existing glass area.
Window Film	U-factor of 0.40 and SHGC value of 0.35.	Existing fenestration based on Table 110.6-A and Table 110.6-B.
Doors	U-factor of 0.20. Door area is existing door area.	If proposed U-factor is < 0.20, standard design is existing U-factor, as verified. Otherwise, standard design U-factor is 0.20. Door area is existing door area.
Space-Heating and Space-Cooling Equipment	TABLE 150.1-A or B for equipment efficiency requirements. Section 150.2(b)1C for entirely new or complete replacement systems. Section 150.2(b)1F for refrigerant charge verification requirements.	The existing efficiency levels.
Air Distribution System – Duct Sealing	The requirements of Sections 150.2(b)1D and 150.2(b)1E	The requirements of Sections 150.2(b)1D and 150.2(b)1E
Air Distribution System – Duct Insulation	The proposed efficiency levels.	The existing efficiency levels.
Water Heating Systems	The requirements of Section 150.2(b)1H	The existing efficiency levels.
Roofing Products	The requirements of Section 150.2(b)1H.	The requirements of Section 150.2(b)1H.
All Other Requirements	Proposed efficiency levels.	Existing efficiency levels, as verified.

Source: Table 150.2-D, Energy Code.

The table below summarizes the basic rules for modeling a single-family residential building using the existing + addition + alterations performance approach. For more detailed information, see Section 9.4 or the software user manual.

Table 9-18: Modeling Rules for Existing + Addition + Alterations

Type of Component or System Modeled	Standard Design Without Third-Party Verification of Existing Conditions	Standard Design With Third-Party Verification of Existing Conditions
EXISTING – Components or systems to remain unchanged	**Model each component or system as "Existing"**	**Model each component or system as "Existing"**
ALTERED—Components or systems being changed or replaced	**Model each altered component as "Altered" (prealtered conditions are not modeled)**	**Model each altered component as "Altered" with prealtered conditions also modeled**
NEW—Components or systems being added (did not previously exist)	**Model each component or system as "New"**	**Model each component or system as "New"**
REMOVED—Components or systems being removed and not replaced	**These components omitted from the model**	**These components omitted from the model**

Source: California Energy Commission

1. **Without** third-party verification of the existing (prealteration) conditions of the building, the E+A+A approach provides credits only once a fairly high threshold is met. See §150.2(b)2B and Table 150.2-D of the Energy Code.
2. **With** third-party verification of the pre-alteration conditions of the building, the E+A+A approach provides full credit for the effect of the altered component. See §150.2(b)2B and Table 150.2-D of the Energy Code.

Energy Commission-approved compliance software is used to model the building as explained in Chapter 8 or the software user manual. Whichever compliance path is selected, the Certificate of Compliance (CF1R) generated by the software must be submitted for permit. If the CF1R includes energy requirements that require HERS testing or verification, the CF1R must also be registered online with a HERS Provider before it is submitted for permit. See Chapter 2 of this manual.

9.5.3 Existing + Addition + Alterations Without Third-Party Verification

The existing building with all alterations is modeled together with the addition and **existing** conditions are not verified by a third-party HERS Rater. Under this performance path, the building is modeled as follows:

1. Addition: All new components of the addition and all new systems serving the addition are modeled, including roof/ceilings, skylights, exterior walls, glazing (fenestration), raised floors and slab floors, HVAC equipment, ducts, and water heating. Only HVAC equipment and water heating may be existing. All other components are "new."
2. Existing Components to Remain Unchanged: Existing components and systems to remain are modeled and tagged within the compliance software as "existing."
3. Existing Components to Be Altered or Replaced: Each altered component (i.e., a new component that replaces an existing component) is modeled as "altered." For example, a new water heater that replaces an existing water heater is

labeled "altered," while a water heater that supplements an existing water heater is labeled "new." Since verification of existing conditions is not being used, no "existing" conditions are specified.

4. Existing to Be Removed: These features are not modeled.

   Note: Portions of new fenestration including skylights that will occur in the existing opening of fenestration to be replaced are tagged "altered." Portions of new fenestration that will occur where there is no existing fenestration opening are labeled "new."

9.5.4 Existing + Addition + Alterations With Third-Party Verification

The existing building with alterations is modeled together with the addition(s) in the same manner as above. Any altered components that are tagged to be verified by a third-party HERS Rater must be verified before permit application is made or construction begins. The standard design that sets the energy budget may, depending on the energy efficiency of the altered component or system, be based on the prealtered existing conditions.

9.5.5 Existing + Addition + Alterations as Newly Constructed Buildings

A rarely used option is to model Existing + Addition + Alterations as all "new" components. The compliance software sets the energy budget as if the project were an entirely new building.

9.5.6 Summary of Modeling Rules

Table 9-18 summarizes the basic rules for compliance software users analyzing a residential addition or alteration using the Existing + Addition + Alterations approach. For further information, see the specific compliance software user's manual for details on how to input data correctly.

Example 9-46

Question:

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

1. A 500 ft² room will be added, including 120 ft² of new windows.

2. A 200 ft² wall and 100 ft² of old window will be removed.

3. Attic insulation in the existing house will be upgraded to R-38.

4. 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:

Table 9-18 summarizes the Modeling Rules for Existing + Addition + Alterations, which must be followed to have the compliance software accurately set the standard design and model the proposed design. 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 §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 §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 ft^2 addition is based on the features of §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 9-47

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:

As explained in Example 9-42, 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.

A window replacement with a 0.55 U-factor will receive a penalty compared with a 0.40 U-factor standard design assumption for that window. **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 9-48

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:

1. 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.

2. Enter the information about the addition and the existing building into the compliance software program, identifying each modeled feature as "existing," "altered," or "new," as summarized in Table 9-18. Proper identification of these inputs is critical to correctly and accurately determining compliance.

3. Run the compliance software to determine if the proposed building TDV energy is equal or less than the standard design TDV energy.

4. If the project does not comply, modify the energy features of the addition and/or the existing building until compliance is achieved.

5. If features of the existing building are being modified, consider the option of verifying existing conditions. When using this option, this inspection by a HERS Rater must be completed before construction begins and before the project registration (Step 6) can be completed.

6. All projects that include energy features requiring HERS field verification and diagnostic testing, which represent almost all buildings under the 2022 Energy Code, must be registered online with a HERS Provider as explained in Section 2.3 in order to obtain a valid CF1R to apply for a permit.

7. Print the registered CF1R for permit application submittal.

Example 9-49

Question:

When using the existing-plus-addition performance approach, do the mandatory requirements, including airflow, watt draw measurement, etc. (§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 §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 §150.2(a). However, Exception 5 to §150.2(a) requires a duct system that is extended be sealed, tested, and HERS verified according to §150.2(b)1D.

If an entirely new or complete replacement system is installed to serve the addition, it must meet the requirements of §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 §150.2(b). The duct sealing, testing, and verification requirements of §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, there is a compliance penalty if refrigerant charge verification is not modeled.

Example 9-50

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 9-51

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 9-52

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, there will be a penalty toward achieving compliance since the window is not as efficient as required by Table 150.2-D for Climate Zone 12, which requires a U-factor of 0.40 and an SHGC of 0.35. The penalty for the U-factor is based on the difference between 0.40 and 0.50 and for the SHGC is based on the difference between 0.35 and 0.45. If fenestration is installed that exceeds the performance of the values in Table 150.2-D, then credit is available.

Example 9-53

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 §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 9-54

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 (see Example 9-44), and even then, it will depend on the climate zone. Because the prescriptive approach has no provision for vaulted roofs, once the roof is altered, the standard design becomes an attic/roof meeting Option B. If Option B has no below roof deck insulation, it is possible to get credit for insulating an uninsulated vaulted roof to R-25.