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9 Additions, Alterations, and Repairs

9.1 Introduction

This chapter covers key aspects of how the *2019 Building Energy Efficiency Standards* (Energy Standards) apply to construction of residential additions, alterations to an existing residential building, or both. As explained below, the Energy Standards do not apply to 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 2019 Energy Standards.** Highlights of the requirements and compliance options in the 2019 Energy Standards.
3. **Section 9.3 – Compliance Approaches.** An overview of prescriptive and performance compliance options.
4. **Section 9.4 – Prescriptive Approach and Mandatory Measures.** Detailed information on prescriptive compliance methods for additions and alterations, including how mandatory measures apply.
5. **Section 9.5 – Performance Approach.** An explanation of computer compliance approaches for additions, including existing + addition + alterations.

When additions and alterations include changes to the envelope, mechanical systems, and/or water heating systems, a certificate of compliance must be completed prescriptively or be generated by compliance software with the performance approach. The prescriptive certificate of compliance is the CF1R-ADD-01 or CF1R-ALT-02 form. (See Appendix A for a full list of forms.)

Changes to the HVAC systems will likely include one or more measures that require Home Energy Rating System (HERS) diagnostic testing and field verification. If a HERS measure is required, the certificate of compliance must be completed and registered online with an approved HERS provider using the provider's web-site. Refer to Chapter 2 for information about document registration and to Residential Appendix RA2 for more information about HERS measures.

For copies of the appropriate compliance documentation, 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 rooms to an existing house.

2. Converting a garage or other existing unheated space into conditioned living space.
3. Enclosing and conditioning an existing patio area.
4. Obtaining a permit to legalize an existing, habitable, and conditioned space that was added to a residential dwelling without a permit.
5. Adding a bay window that extends to the floor, 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 any existing exterior roof or ceiling, exterior wall, or raised floor over a crawl space, garage, or unheated basement.
2. Replacing or installing a new top surface to an existing roof (reroofing) and replacing portions of or the entire roof assembly.
3. Replacing existing fenestration or adding fenestration area (for example, windows, bay windows, greenhouse/garden windows, dynamic glazing, clerestories, or glass doors) to existing walls.
4. Replacing an existing skylight or increasing the area of skylight to an existing roof.
5. Constructing an entirely new roof over an existing conditioned space.
6. Adding a loft within the existing conditioned volume of a home.
7. Replacing an existing heating system or adding a heating system (for example, a furnace, wall heater, heat pump, or radiant floor). (NOTE: Adding heating to a previously unconditioned space is an addition, not an alteration.)
8. Replacing an existing cooling system or adding a cooling system (for example, an 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 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 Standards is considered an alteration and not a repair**."** (See §100.1).

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

For example, when a component, system, or equipment of 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 Standards 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 and 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 for repair are defined by the Energy Standards as alterations, therefore triggering requirements that must be met. Section 150.2(b)1E of the Energy Standards 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 40 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 15 percent. (See §150.2 [b]1D.)

Note 3: Some cooling system component replacements are defined by the Energy Standards as alterations, which require meeting certain requirements. Section 150.2(b)1F of the Energy Standards 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. (See §150.2 [b]1F.)

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 nonhabitable or unimproved space. Under what conditions will the Energy Standards apply to this addition?


Unconditioned Sunspace

Answer:

The mechanical and envelope requirements of the Energy Standards 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 Standards apply.

Example 9-2

Question:

An existing duplex is remodeled, which includes only the installation of new faucets and bathroom lighting. Do the Energy Standards 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 measures 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 up 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 needs to comply with the Energy Standards using either the prescriptive or performance method, as well as meet all the applicable mandatory measures. 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. (If needed, area-weighted averaging may be used to meet these requirements.) Newly installed and replacement windows must also comply with the mandatory measures 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, as long as 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 2019 Energy Standards

The 2019 Energy Standards include new mandatory measures and different compliance requirements for additions and alterations. This section highlights the key changes from the 2016 Energy Standards. Prescriptive compliance requirements may be higher than mandatory requirements.

9.2.1 Mandatory Envelope

Walls with 2x6 insulation have a mandatory insulation requirement of R-20 or U-0.071 (§150.1[c]2).

New masonry walls are required to be insulated to levels required in Table 150.1-A or 150.1-B (see Chapter 3) (§150.0[c]5).

9.2.2 Mandatory Mechanical Ventilation

When an addition to an existing building adds a new dwelling unit, indoor air quality requirements of §150.0(o) apply to the new dwelling unit. This includes accessory dwelling units (§150.2[a]1Cii).

9.2.3 Prescriptive Additions

1. Additions greater than 700 square feet must meet quality insulation installation (QII) requirements (§150.1[c]1E).
2. Additions 700 square feet or less:
   a. Ceiling insulation in an attic shall meets R-38 in Climate Zones 1 and 11-16 and R-30 in Climate Zones 2-10.
   b. Radiant barrier must be installed in Climate Zones 2-15.
3. Existing wood-framed walls with siding (or cladding) that will not be removed require only cavity insulation of R-15 in a 2x4 wall or R-21 in a 2x6 wall. (Continuous insulation is not required.)

See Section 9.3.4 for more information about wall extensions and exceptions to continuous insulation requirements.

9.3 Compliance Approaches

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

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

1. **Addition only,** where 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,** where there is no addition (that is, no increase in conditioned floor area and volume or adding conditioning to a previously unconditioned space).
3. **Addition and alterations,** where there are both additions and alterations to the existing building.

For each of these permit scenarios, Table 9-1 summarizes the available compliance approaches for low-rise 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 new construction
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 all new construction

1) In the performance method, 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 compliance approach selected, the following exceptions apply:

1. **Additions of ≤ 300 ft^2** 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 Standards (§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/alterations.

A. Addition Alone

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

1. **Advantages**: Very little information about the existing building is needed (existing conditioned floor area and number of bedrooms). The existing building is not modeled.
2. **Disadvantages**: Many prescriptive allowances for additions do not apply to the addition alone performance approach. For example, a 400 ft^2 addition is allowed a 30 percent fenestration area limit if complying using existing + addition, while only 20 percent is allowed when complying as an addition alone. Alterations to the existing conditions that improve the energy performance of the existing building cannot be used in this approach as "trade-offs" with the addition.

B. Existing + Addition + Alteration

In this compliance scenario, the entire building is included in the analysis. This approach does not require unaltered components to be brought into compliance.

1. **Advantages**: This approach offers the most flexibility by modeling improvements to the existing building. The energy budgets include the more generous glazing allowances given to 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 New Construction

Demonstrating compliance as a whole new building, which entails combining existing plus the addition as all new construction, is another approach. This approach is used when the changes are extensive. Compliance can be difficult because all existing features must be brought up to the current code.

9.3.2 Additions and Alterations Combined

9.3.2.1 Prescriptive

When a low-rise residential project includes an addition and alterations, the prescriptive requirements for each condition must be met. The addition may comply with the appropriate prescriptive addition approach and documented with the applicable form (for example, CF1R-ADD-01).

The alterations must also meet all prescriptive requirements and be documented with the specific compliance documentation for alterations (for example, CF1R-ALT-02).

9.3.2.2 Performance

The performance approach that includes both additions and may include alterations is called "**Existing + Addition + Alterations.**" (See Section 9.5.2.) There are two ways to analyze the building using this method: compliance with third-party

verification of all existing conditions altered or compliance without third-party verification.

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 are specific to the building site climate zone. There are also several exceptions based on either climate zone or other conditions.

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

Under the prescriptive alteration approach, the appropriate certificate of compliance (for example, CF1R-ALT-02) form is completed and submitted for a permit. If any mandatory or prescriptive measures require HERS verification or testing (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 submittal 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 + Alterations:** If multiple components or systems are being altered or if the proposed modification(s) exceed the prescriptive requirements, then the existing + alterations performance approach may be used to make trade-offs.
2. **Compliance Without Third-Party Verification**: This option allows for compliance of the alterations without the need for third-party inspection to verify existing conditions being altered.
3. **Compliance With Third-Party Verification**: This option allows for compliance of the alterations only with third-party inspection to verify existing conditions being altered.
4. **Existing + Alterations as new construction**: 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

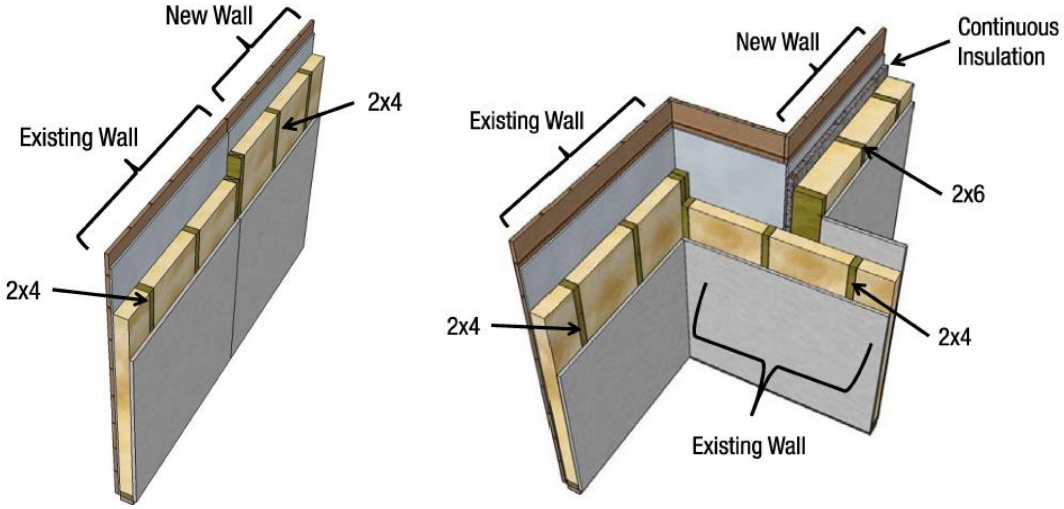
extended wall also does not require continuous insulation; and (2) the existing framing size may be kept.

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.

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 treated as an addition or may be a new dwelling unit. See Figure 9-2 to determine the compliance requirements. Although the Energy Standards that apply 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 to an existing residence or as a new building, as shown in Figure 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 measures.

A. 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).

B. 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.

C. 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.

D. 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> 
New Construction: Newly constructed and detached from existing home.</td>
</tr>
</table>

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. 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.

9.4 Prescriptive Approach and Mandatory Measures

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 measures 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.

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 summarizes the key features of the prescriptive envelope requirements for the three prescriptive addition options in §150.2(a)1. Envelope requirements unique to that type of prescriptive addition are shown in bold.

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

A. **Additions ≤ 400 ft^2**: All prescriptive requirements must be met **except**:

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 and 11-16, or R-30 in Climate Zones 2-10.
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:
    c. In 2x4 wood-framed walls, insulation shall be R-15.
    d. In 2x6 or greater wood-framed walls, insulation shall be R-21.

B. **Additions > 400 ft^2 and ≤ 700 ft^2**: All prescriptive requirements must be met **except**:

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 and 11-16 or R-30 in Climate Zones 2-10.
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.

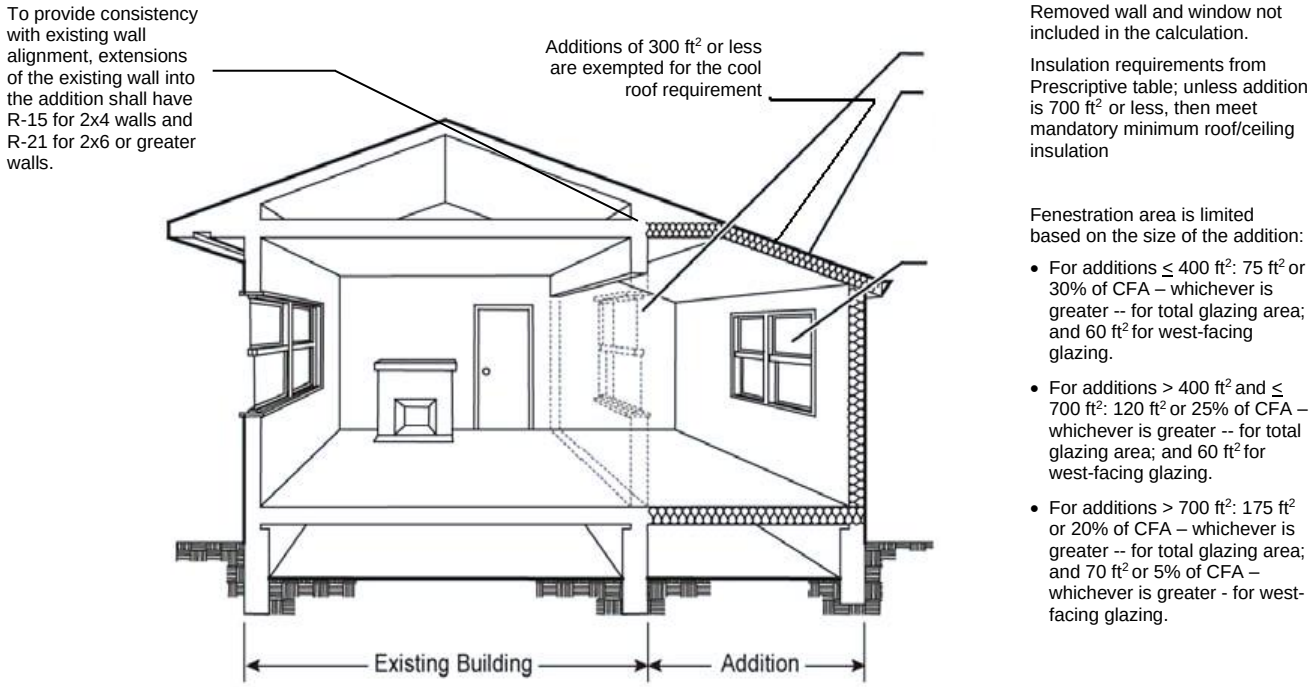
5. QII applies to the addition.
6. When an addition greater than 700 ft^2 is an existing unconditioned space converted to conditioned space, the QII requirements do not include:

a. Window and door header insulation.

b. Air sealing if the existing air barrier is not removed or replaced.

9.4.1 Prescriptive Additions

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 measures 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 40 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, 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, 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 ft^2 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. Mandatory duct insulation requirements of §150.0(m) apply to any new ducts, including R-6.0 minimum in unconditioned space. All other mandatory requirements in §150.0 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.

Prescriptive Mechanical Measures

For a summary and discussion of prescriptive mechanical requirements when installing new or replacement space-conditioning equipment and/or ducts, see Section 9.6.2.

Example 9-11

Question:

When using the performance approach for the 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 5 to §150.2(a). However, if added ducts to serve the addition are more than 40 linear feet and they are in unconditioned space, then the ducts must be tested and verified by a HERS Rater as described in §150.2(b)1D. All installed ducts regardless of length and location shall be sealed and meet insulation levels as described in §150.0(m) Items 1 through 6.

If a new system is installed to serve the addition, it must meet all of the requirements for space conditioning in a new home.

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, 11-16: R-38 CZ 2-10: 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): CZ 10-15: 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): CZ 10-15: 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

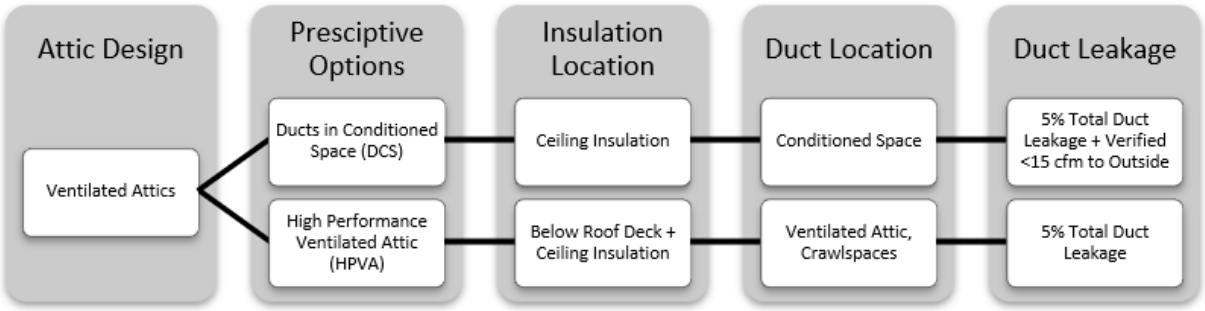


Table 9-3: Roof and Ceiling Requirements for Prescriptive Additions

Component	Option B – Single Family	Option B - Multifamily	Option C (CZ 4, 8-16)
Roof Deck Insulation	Below-deck insulation CZ 4, 8-16: R-19	Below-deck insulation CZ 4, 8, 9, 11-15: R-19 CZ 10, 16: R-13	No roof deck insulation required
Radiant Barrier	CZ 2-3, 5-7	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	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 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	Attic	Conditioned space

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

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤ 700 ft^2	Additions > 700 ft^2
Allowable total glazing area	Up to 75 ft^2 or 30% of conditioned floor area, whichever is greater	Up to 120 ft^2 or 25% of conditioned floor area, whichever is greater	Up to 175 ft^2 or 20% of conditioned floor area, whichever is greater
Allowable west-facing glazing area: CZ 2, 4, 6-15	Up to 60 ft^2	Up to 60 ft2	The greater of 70 ft^2 or 5% of conditioned floor area in CZ 2, 4, 6-15
Glazing U-factor & SHGC[1]	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 ft^2	Additions > 400 and ≤ 700 ft^2	Additions > 700 ft^2
Exterior framed wall[1] insulation – single-family	CZ 1-5, 8-16: U = 0.048 CZ 6-7: U = 0.065	Same as ≤ 400 ft^2	Same as ≤ 400 ft^2
Exterior framed wall[1] insulation - multifamily	CZ 1-5, 8-16: U = 0.051 CZ 6-7: U = 0.065	Same as ≤ 400 ft^2	Same as ≤ 400 ft^2
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 ft^2	Same as ≤ 400 ft^2
Raised floor[1] insulation	All CZs: R-19 or U = 0.037	Same as ≤ 400 ft^2	Same as ≤ 400 ft^2
Slab floor[1] perimeter insulation	CZ 1-15: No requirement CZ 16: R-7 or U = 0.58	Same as ≤ 400 ft^2	Same as ≤ 400 ft^2

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

Table 9-6: QII Requirements for Prescriptive Additions

Component	Additions ≤ 400 ft^2	Additions > 400 and ≤700 ft^2	Additions > 700 ft^2
Single-family additions – new structure	No requirement	No requirement	All CZs: Required (Does not apply to any altered spaces)
Multifamily additions – new structure	No requirement	No requirement	CZ 1-6, 8-16: Required CZ 7: No requirement (Does not apply to any altered spaces)
Converting unconditioned to conditioned space	No requirement	No requirement	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 ft^2	Additions > 400 and ≤ 700 ft^2	Additions > 700 ft^2
Ventilation cooling[1] (whole-house fan)	No Requirement	Same requirements as ≤ 400 ft^2	Additions ≤ 1000 ft^2 – no requirement Additions > 1,000 ft2: CZ 8-14 - required
Adding new space conditioning system(s)	All prescriptive requirements	Same requirements as ≤ 400 ft^2	All except requirement for ducts in conditioned space[2]
Replacing existing space conditioning system(s)	All prescriptive requirements	Same requirements as ≤ 400 ft^2	All except requirement for ducts in conditioned space[2]
Adding all new complete duct system(s)	All prescriptive requirements	Same requirements as ≤ 400 ft^2	All except requirement for ducts in conditioned space[2]
Extending existing duct system(s) by > 40 feet	All duct insulation, duct system sealing, and HERS verification	Same requirements as ≤ 400 ft^2	All duct insulation, duct system sealing, and HERS verification, Except requirements for ducts in conditioned space[2]

1. (Note: also, mandatory mechanical ventilation per ASHRAE 62.2 with HERS verification for additions > 1,000 ft^2)
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 or ii are met. The most common option is a natural gas or propane tankless water heater.

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 measures, then the performance method using of approved compliance software is the alternative. This section describes the mandatory requirements for low-rise residential buildings as they apply to additions and alterations. More information on the mandatory measures can be found in Chapters 3, 4, 5, and 6.

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

Although alterations must meet many of the same prescriptive requirements for new construction 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: For Residential Alterations, Summary of Mandatory and Prescriptive Measures

Envelope Alteration Type	Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures
Adding ceiling insulation to an existing roof; or a new roof on an existing building	Ceiling w/ attic and roof rafters: 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*	Same as mandatory	N/A
Mass/concrete walls	See §150.1(c) for applicable climate zone	Same as mandatory	N/A
Replacing > 50% of existing roof surface, including adding a new surface layer on top of existing exterior surface	§110.8(i)	Steep-Sloped (≥ 2:12): CZ 10-15: Reflectance ≥ 0.20 and Emittance ≥ 0.75; or SRI ≥ 16	(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. (d) Roof has ≥ R-38 ceiling insulation. (e) Roof has a radiant barrier per §150.1(c)2. (f) No ducts in attic. (g) In CZ10-15, >R-2.0 insulation above roof deck
Replacing > 50% of existing roof surface, including adding a new surface layer on top of existing exterior surface	§110.8(i)	Low-Sloped (< 2:12): CZ13 & 15: Reflectance ≥ 0.63; Emittance ≥ 0.75; or SRI ≥ 75	(a) There are no ducts in the attic. (b) Reflectance and roof deck insulation R-value in Table 150.2-B are met.

Table 9-8: For Residential Alterations, Summary of Mandatory and Prescriptive Measures (continued)

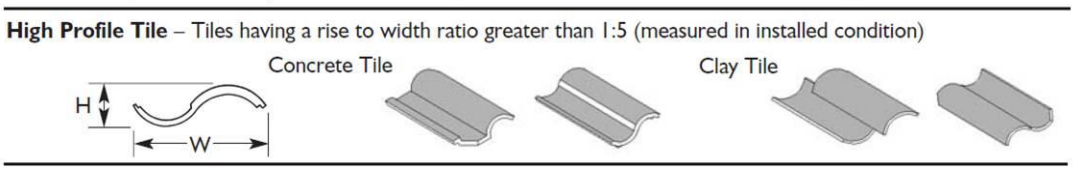
Envelope Alteration Type	Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures
Adding vertical fenestration[3] (new glazing) and greenhouse or garden windows	Must have a maximum U-factor ≤ 0.58 OR Weighted average of all fenestration including skylight products U-factor ≤ 0.58 per §150.0(q) Exception 1: Up to 10 ft² or 0.5% of conditioned floor area, whichever is greater, is exempt from the U-factor requirement of §150.0(q)1 Exception 2: Added greenhouse or garden windows up to 30 ft² are exempt from the U-factor requirement of §150.0(q)1	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 CZ 2, 4 & 6-15: SHGC =≤ 0.23 per §150.2(b)1A	*Up to 75 ft² need not meet total or west-facing fenestration area per §150.2(b)1A Exception 1*
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)

A. Steep-Sloped Roofs (≥ 2:12)

In Climate Zones 10 through 15, if 50 percent or more of the roof surface of an existing building is being replaced, the minimum cool roof requirement for the replaced steep-sloped roofing area shall have an aged solar reflectance of 0.20, thermal emittance equal to 0.75, or a minimum SRI of 16. The requirements above apply unless one of the following is present (considered equivalent to the cool roof requirements in §150.2[b]1Ii):

1. Air space of 1.0" (25mm) between the roof deck and the bottom of the roofing product.
2. Roofing product profile ratio of rise to width is at least 1:5 for >50 percent width of roofing product.



3. Existing ducts in attic are insulated and sealed according to §150.1(c)9.
4. Building has at least R-38 roof/ceiling insulation.
5. Roof of attic spaces has a radiant barrier according to §150.1(c)2.
6. There are no ducts in the attic space.
7. In Climate Zones 10 through 15, there is greater than R-2.0 insulation above the roof deck.

B. Low-Sloped Roofs (< 2:12)

In Climate Zones 13 and 15, if 50 percent or more of the roof surface of an existing building is being replaced, the minimum cool roof requirements for low-sloped roofs shall have an aged solar reflectance of 0.63, thermal emittance of 0.75, or a minimum SRI of 75 per §150.2(b)1Iii. These apply unless one of the following is present, which is considered equivalent to the cool roof requirements in §150.2(b)1Iii:

1. There are no ducts in any attic space.
2. The aged solar reflectance can be traded off with additional insulation added at the roof deck as specified in Table 150.2-B of the Energy Standards.

Table 9-9: Aged Solar Reflectance Insulation Trade Off

Aged Solar Reflectance	Roof Deck Insulation R-value	Aged Solar Reflectance	Roof Deck Insulation R-value
0.62 - 0.60	2	0.44 – 0.40	12
0.59 - 0.55	4	0.39 – 0.35	16
0.54 - 0.50	6	0.34 – 0.30	20

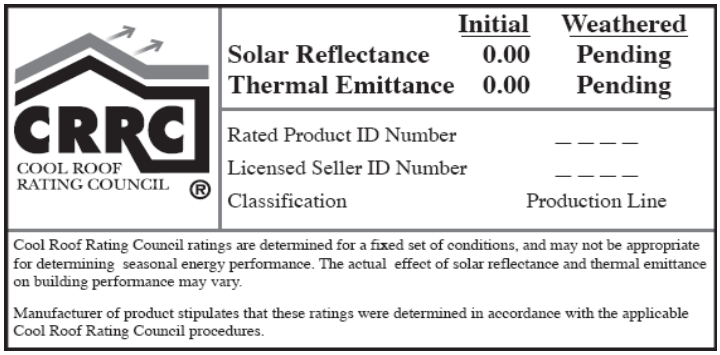
0.49 - 0.45	8	0.29 – 0.25	24

C. 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 9-4**Error! Reference source not found.** provides an example of an approved CRRC product label.

Figure 9-4: 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, if prescriptive compliance for a given roof slope and climate zone require a minimum reflectance and emittance, you can either meet one of the exceptions above or use the performance compliance approach to use some other building feature to trade off the requirement.

Example 9-12

Question:

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

9.4.4.2 Insulating Existing Roof/Ceilings, Walls, and Raised Floors

When insulation is added to an existing ceiling of an existing conditioned space, at least R-19 (or a maximum U-factor of 0.054) is required in all climate zones. 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.

9.4.4.3 Fenestration

A. 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.”

B. New Fenestration in Alterations

The Energy Standards have 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 Standards 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.

C. 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 measure, 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.

D. 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 9-14

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 9-15

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 9-16

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 measures.

For performance compliance:

(a) Using the Existing + Alterations approach *without* third-party verification, replacement fenestration that achieves the fenestration values in Table 150.2-C of the Energy Standards 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-C of the Energy Standards 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 9-17

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 measures of §110.6, §110.7, and §150.0.

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

Example 9-18

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 measures 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.

Example 9-19

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 9-20

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 9-21

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 9-22

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 Standards is considered an alteration and not a repair.

Example 9-23

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 9-24

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 9-25

Question:

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

Answer:

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

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 piping must meet mandatory insulation requirements in §150.0(j)2.
2. Any accessible existing piping must be insulated on (1) the first 5 feet of cold water pipes from the storage tank, and (2) all hot water piping less than ¾-inch that is:
   (a) Associated hot water recirculation system.
   (b) Piping from the heating source to the kitchen.
   (c) Piping from the heating source to a storage tank.
   (d) Or piping that is buried below grade.

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

1. Any natural gas or propane water heater
2. If there is no natural gas connected to the existing water heater location, a consumer electric water heater
3. In Climate Zones 1-15, a single heat pump water heater meeting NEEA Tier 3 or higher specifications with the tank located in an unconditioned space like the garage or in conditioned space

4. In Climate Zones 1-15, 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).

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 an additional water heater to a single-family home with an existing natural gas water heater. Does this comply?

Answer:

It depends on the type of water heater. An instantaneous gas or propane water heater complies with §150.2(a)1D. For prescriptive compliance, the same options allowed for new construction are allowed for an addition (See Chapter 5). 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 measures must also be met. For newly installed piping, all the applicable insulation requirements of §150.0(j)2 shall be met. For existing piping that is accessible, the insulation requirements §150.0(j)2 shall be met, which includes the first five feet of cold water lines from the storage tank and all hot water piping. 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 Standards allow addition-alone compliance in certain circumstances. An instantaneous gas water heater 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, the prescriptive compliance option is to meet the same requirements as for new construction. The only electric option is a heat pump water heater. (See §150.1[c]8iv or v for a full list of requirements, or Chapter 5 of this manual.)

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

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. Changing, altering, or replacing any component of a system often triggers a requirement to seal the ducts. A HERS Rater verifies the duct leakage is less than 15 percent. However, since the ducts are existing, if 15 percent leakage is not feasible, there are alternatives, including all

accessible leaks being sealed and confirmed by a visual inspection (Section 150.2[b]1E).

Extending ducts to condition an addition is not an alteration, however if more than 40 feet of new ductwork is installed in unconditioned space, Section 150.2(b)1D contains duct leakage requirements.

When the duct system is entirely new or a complete replacement, then mandatory and prescriptive requirements apply. (See below.)

9.4.6.1 HVAC "Changeouts"

The Energy Standards make a distinction between two HVAC "changeout" situations**:**

1. Entirely new or complete replacement space conditioning systems
2. Altered space conditioning systems

A. Entirely New or Complete Replacement Space Conditioning Systems

An *e*ntirely new or complete replacement must meet all applicable mandatory measures. (See Chapter 4.)

Completely new or replacement duct systems in *multifamily* dwelling units must meet the 12 percent (total leakage protocol) or 6 percent (leakage to outside protocol) criteria used for newly constructed systems (may also use the smoke test protocol if the system does not meet these criteria) (§150.2[b]1DiiaII). Otherwise, altered duct systems in multifamily dwelling units shall meet the 15 percent (total leakage protocol), 10 percent (leakage to outside protocol), or smoke test criteria given in §150.2(b)1DiiaIIB.

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).

B. Duct Systems – Altered or New

Whether a duct system is altered or new affects which mandatory requirements apply and duct leakage requirements. An altered duct system installed in an existing home is entirely new when:

1. At least 75 percent of the duct material is new.
2. All remaining components from the previous system are accessible and can be sealed.

Entirely new or complete replacement systems must meet mandatory requirements including:

1. Section 150.0(m)12 – air filtration requirements.

2. Section 150.0(m)13 – HSPP/PSPP, airflow and fan efficacy requirements (or alternative return duct sizing as per Table 150.0-B and C).

These requirements are detailed in Chapter 4.

Altered duct systems that are not entirely new or complete replacements are treated as an extension of an existing system.

C. New and Altered Duct System – Insulation

When any new ducts are installed in an unconditioned space, the duct must be insulated to a minimum R-value as described in Table 9-11.

Table 9-11: Duct Minimum R-Value

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

When more than 40 linear feet of ducts are installed in conditioned space, the ducts must be insulated to the minimum mandatory insulation level of R-4.2 and be verified to be in conditioned space by both visual verification and diagnostic testing in accordance to RA3.1.4.3.8.

D. Duct Sealing

Duct systems meet duct sealing requirements found in Table RA3.1-2.

A new duct system may include an existing air handler, which leaks substantially more than new equipment. If the 5 percent leakage rate criteria cannot be met, a smoke test should be performed to verify that the excess leakage is non-accessible and not from other *accessible* portions of the duct system. The protocol for the smoke test for accessible-duct sealing is given in RA3.1.4.3.7.

If 40 feet of duct are being added or replaced, this work alone can trigger the requirement for duct sealing and field verification. The system would have to meet one of the leakage criteria for “altered existing systems” cases in Table RA3.1-2.

All climate zones require that existing duct systems must be sealed by the installer and verified by a HERS Rater when portions of the heating and cooling system are altered.

When an air handler is installed or replaced, ducts must be sealed (as described below) under any of the following conditions:

1. An outdoor condensing unit of a split system air conditioner or heat pump is installed or replaced.
2. A packaged system is completely replaced.
3. A cooling or heating coil is installed or replaced.
4. More than 40 feet of new or replacement ducts are installed.

If a residence has more than one duct system, only the ducts connected to the altered equipment need to be sealed and verified.

There are three options for showing compliance for existing duct systems listed below. The HERS Rater or installing contractor must at least attempt compliance with the first option (15 percent leakage); then any of the other options can be used:

1. Total leakage is less than 15 percent of nominal system fan airflow (RA3.1.4.3.1).
2. Leakage to the outside is less than 10 percent of system fan airflow (RA3.1.4.3.4).
3. If the first option (15 percent) leakage target cannot be met, then compliance can be achieved by sealing all accessible leaks verified by a HERS Rater inspection. When using this option, sampling is not allowed (RA3.1.4.3.5-7).

- HERS field verification is required for all options listed above. For Options 1, and 2, verification can be accomplished through sampling as described in *Sampling for Additions or Alterations* below. For Option 3, sampling is not allowed; a certified HERS Rater must do the visual inspection and the smoke test on every house.
- Since test equipment must be set up for Option 1, it may be most efficient to test and record the results and then attempt to meet each option sequentially until compliance is achieved.
- There are a few cases where duct sealing and duct leakage verification are not required. These exceptions include:
    - Ducts that have already been sealed, tested, and certified by a HERS Rater.
    - Duct systems with less than 40 feet of duct.
    - Duct systems that are insulated or sealed with asbestos.

If altered ducts, heating or cooling equipment, or plenums are in a garage, the duct sealing requirements (not limited to 40 feet of new duct) are one of the following:

1. Leakage is less than or equal to 6 percent or air handler airflow (RA3.1.4.3.1).
2. All accessible leaks in the garage space are sealed, and both a visual verification and smoke test are performed by a HERS Rater using methods from RA3.1.4.3.5.

E. Accessible Ducts

Some judgment is required in determining if ducts are accessible. The local code enforcement agency will have the final say when it is not immediately obvious.

F. Refrigerant Charge Verification

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 building,

§150.2(b)1F requires a system that does not have a fault indicator display (FID) installed to have refrigerant charge field verified in accordance with all applicable procedures specified in RA3.2.2, or RA1.

1. **Minimum Airflow**. When RCV is required for compliance, the system must also comply with the minimum airflow of 300 cfm/ton according to the procedures specified in RA3.3.

   Entirely new or complete replacement space-conditioning systems, as specified in §150.2(b)1C, must meet the minimum 350 cfm/ton airflow rate compliance criterion or the duct design alternative specified in §150.0(m)13.

2. **Thermostats**. 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)

G. System Replacements

See Chapter 4 for HVAC system replacement details for entirely new or complete replacements.

Prescriptive compliance requires new heating systems be limited to gas, propane, or the existing fuel type. The exception to this is a heat pump (§150.2[b]1G).

Example 9-30

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

Example 9-31

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 from an existing space-conditioning system, §150.2(b)1Diib includes three options for showing prescriptive compliance when more than 40 feet of new duct work is installed. The existing furnace must have adequate heating capacity to meet California Building Code requirements for the additional space.

Example 9-32

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 measures in the addition or in an accompanying alteration.

Note: If there are more than 40 linear feet of added ducts, the ducts must be sealed, tested, and verified as sealed by a HERS Rater.

Example 9-33

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 or a heat pump. A CF1R-ALT-02 or 03 form can be completed by you or your mechanical contractor. If HERS requirements apply this is done at the HERS Provider's web-site.

Example 9-34

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 measures for ducts apply. If more than 40 feet of the duct is altered, the requirements of §150.2(b)1D trigger diagnostic testing and HERS verification of the duct system.

Example 9-35

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 9.4.6.1.)

Example 9-36

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 9-37

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.

9.4.7 Mechanical Ventilation

The whole-building ventilation airflow requirement in ASHRAE 62.2 is required only in new buildings, new dwelling units, and buildings with additions greater than 1,000 ft^2. However, all other mechanical ventilation requirements in §150(o), including local exhaust, must be met, as applicable, in all additions and alterations.

If an addition to an existing building adds a new dwelling unit, indoor air quality requirements of §150.0(o) apply to the new dwelling unit (§150.2[a]1Cii).

When an addition is greater than 1,000 ft^2, the mechanical ventilation airflow rate is based on the conditioned floor area of the entire existing and new floor area of the dwelling unit (§150.2[a]1Ci).

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.)

9.4.8 Lighting Measures

Highlights of the residential lighting measures are listed below. All residential indoor and outdoor lighting measures are mandatory. Details of the 2019 Energy Standards residential lighting requirements can be found in Chapter 6.

1. Luminaire (light fixture) requirements, see §150.0(k)1, Section 6.2
2. Indoor lighting controls, see §150.0(k)2, Section 6.3
3. Lighting in bathrooms, garages, laundry rooms, and utility rooms, see §150.0(k)2J, Section 6.3.3
4. Recessed downlight fixtures, see §150.0(k)1C, Section 6.2.3
5. Outdoor lighting, see §150.0(k)3, Section 6.5
6. Internally illuminated address signs, see §150.0(k)4, Section 6.5.4
7. Residential garages for eight or more vehicles, see §150.0(k)5, Section 6.6
8. Interior common areas of low-rise multifamily buildings, see §150.0(k)6, Section 6.4

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 Standards. Existing lighting equipment is not required to be replaced to comply with the Energy Standards.

Example 9-38

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. Does this luminaire have to be a high-efficacy luminaire?

Answer:

Yes, in kitchens, all new luminaires must be high-efficacy.

Example 9-39

Question:

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

Answer:

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

Example 9-40

Question:

I am completely remodeling my kitchen and putting in an entirely new lighting system. How do the Energy Standards apply to this case?

Answer:

When an entirely new lighting system is installed, it is treated like new construction. The new lighting system must comply with all the mandatory lighting requirements in §150.0(k)1 and (k)2.

Example 9-41

Question:

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

Answer:

The new luminaire is the altered component and must meet requirements in §150.0(k), including the high-efficacy luminaire and lighting control requirements. The 2019 Energy Standards now allow the installation of Joint Appendix JA8-compliant lamps in screw-based fixtures as a way to comply with the high-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 new construction. 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 9-12 contains the efficiencies used to establish the standard design for a building using existing + addition + alteration (which includes existing + alteration) compliance.

Table 9-12: 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 level.
Roofing Products	The requirements of Section 150.2(b)1H.	The requirements of Section 150.2(b)1H.
All Other Measures	Proposed efficiency levels.	Existing efficiency levels, as verified.

Source: Table 150.2-C, Energy Efficiency Standards.

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

Table 9-13: 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

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-C of the Energy Standards.
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-C of the Energy Standards.

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 measures 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 New Construction

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 9-13 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 9-42

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 9-13 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 2019 standards 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 40 linear feet or more, the standard design assumes duct alterations with 15 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-C 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 9-43

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-C. Windows in the addition must have a U-factor of $\leq$ 0.30 and SHGC $\leq$ 0.23 to receive credit (Climate Zone 12). Replacement windows in the existing house must have a U-factor of $\leq$ 0.40 and SHGC $\leq$ 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 9-44

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 9-13. 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 measures requiring HERS field verification and diagnostic testing--which represent almost all buildings under the 2019 Energy Standards--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 9-45

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 9-46

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 9-47

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 9-48

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-C 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-C, then credit is available.

Example 9-49

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-22. Since R-22 is a mandatory minimum a lower insulation cannot be installed.

Example 9-50

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.