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9. Additions, Alterations and Repairs

9.1 Introduction

This chapter covers key aspects of how the Standards apply to construction of residential additions, alterations to an existing residential building, or both. As explained further below, the 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 2013 Standards.** Highlights of the requirements and compliance options which have changed or are entirely new in the 2013 Standards as compared with the 2008 Standards.
3. **Section 9.3, Compliance Approaches.** An overview of all prescriptive and performance compliance options available to meet the Standards for additions only, for alterations only and for projects which include both additions and alterations.
4. **Section 9.4, Mandatory Requirements.** Mandatory requirements for additions and alterations as they apply to the envelope, fenestration, mechanical system, water heating system, indoor lighting, and outdoor lighting.
5. **Section 9.5, Additions.** Detailed information on prescriptive and performance compliance methods and related information for additions, with or without alterations.
6. **Section 9.6, Alterations.** Detailed information on prescriptive and performance compliance methods and related information for alterations, with or without an addition.
7. **Section 9.7 Performance Method.** An explanation of the Existing + Addition + Alteration Approach with examples.
8. **Section 9.8 Online Registration.** Compliance Forms and Online Registration with a HERS Provider.

Whenever additions and alterations trigger mandatory measures - whether envelope, mechanical, water heating, indoor lighting or outdoor lighting - the Certificate of Compliance and the Mandatory Measures Summary must be submitted with the permit documentation and included in the building plans.

When additions and alterations include changes to the envelope, mechanical and/or water heating systems, a Certificate of Compliance must be completed prescriptively or generated by compliance software with the performance approach. The prescriptive Certificate of Compliance that should be used for additions and alterations in all climate zones is the CF1R-ADD or CF1R-ALT form. For HVAC-only change-outs and other mechanical system alterations, a climate zone specific CF1R-ALT-HVAC form for prescriptive compliance may be used. Almost all additions and alterations under the 2013 Standards that include changes in HVAC systems also include

one or more measures that require HERS Diagnostic Testing and Field Verification. When a HERS measure is specified, the Certificate of Compliance must be registered online with an approved HERS provider web site. Refer to Section 2.2.2 and to Residential Appendix RA2 for more information about document registration.

For copies of the appropriate compliance forms, refer to Appendix A.

9.1.1 Additions

An addition is any change to an existing building that increases conditioned floor area and conditioned volume. See §100.1.

Examples of projects considered as additions 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 residence without a permit;
5. Adding a bay window that extends to the floor increasing both floor area and volume.

9.1.2 Alterations

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

Examples of projects considered 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 roofing assembly (re-roofing); replacing portions of or replacing the entire roof assembly;
3. Replacing existing fenestration or adding fenestration area (e.g., windows, bay windows, greenhouse/garden windows, dynamic glazing, clerestories or glass glazed 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 residence;
7. Replacing an existing heating system or adding a heating system (e.g., furnace, wall heater, heat pump or radiant floor);
8. Replacing an existing cooling system or adding a cooling system (e,g., 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, when complying under the Performance approach only.

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 Standards is considered an alteration and not a repair**."** See §100.1.

Note: Repairs to residential buildings are not within the scope of the 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, it is decided to replace the component, system or equipment with a new or different one, the scope of work is considered an alteration and not a repair and requirements of the Standards pertaining the that measure must be met.

Examples of work considered repairs include:

1. Replacing a broken pane of glass but not replacing the entire window;
2. When fenestration and other envelope components are uninstalled for maintenance or repair purposes and the same fenestration or other envelope components are re-installed in the same location, this is considered a repair;
3. When any existing envelope component is moved to a new location (even when that location partially overlaps the item's previous location), the work is considered an alteration;
4. Replacing a failed fan motor or gas valve in a furnace but not replacing the entire furnace;
5. Replacing a heating element in a water heater but not replacing the entire water heater.

Note, replacement of some HVAC components for repairs purposes are defined by the Standards as alterations, therefore triggering requirements that must be met. Section 150.2(b)1E 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 lineal feet of new or replacement space conditioning ducts are installed the entire duct system must be sealed, tested and verified for low duct leakage §150.2(b)1D.

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 non habitable or unimproved space. Under what conditions will the Standards apply to this addition?

Unconditioned Sunspace

Answer

The mechanical and envelope requirements of the 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 Standards apply.

Example 9-2

Question

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

Answer

This is an alteration since no new conditioned space is being created, the remodel must comply with applicable mandatory measures described in §110.1 for appliances and §150.0(k) for lighting.

Example 9-3

Question

An existing house is remodeled by adding additional floor area but not increasing the volume of the house. This was accomplished by adding a loft through an area in the house with a vaulted ceiling. As part of this remodel new fenestration are replacing existing ones, and two new windows are being added. Several exterior walls are being opened up to install new wiring. What requirements will apply?

Answer

Since floor area is being added but not conditioned volume, this is an alteration and not an addition. New and replacement fenestration must meet the maximum U-factor and SHGC prescriptive requirements of §150.2(b)1. Newly installed fenestration must also comply with the mandatory measures for caulking/sealing around windows of §110.7. In alterations, the Energy Commission recommends installing insulation to walls being exposed if no insulation was found when the walls were opened; for a 2x4 wood framing use R-13 and for 2x6 wood framing use R-19.

Alternatively, the performance approach may be used to demonstrate compliance for overall building (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 expose or open, this allows the opportunity to insulate the walls and contribute the ability to meet energy compliance; otherwise it would be difficult to comply with overall building compliance.

9.2 What's New in the 2013 Standards

The 2013 Standards includes new mandatory measures and different compliance requirements for additions and alterations. This section highlights the key changes from the 2008 Standards.

Mandatory Measures in Additions and Alterations

Envelope

9.2.1 Wall Insulation:

1. Walls: exterior walls built with 2x6 or greater framing must have a minimum of R-19 cavity insulation or achieve a U-factor = 0.074. See §150.0(c);
2. Raised-floor insulation: raised floors must have a minimum of R-19 insulation between framing members or achieve the equivalent U-factor as specified in §150.0(d);
3. Fenestration: the area-weighted average U-factor of all new and replacement fenestration must have a maximum value of 0.58; §150.0(q); Exception: up to 10 square feet or 0.5% of the conditioned floor area, whichever is greater, is exempt from the maximum fenestration U-factor requirement.

9.2.2 HVAC and Water Heating

New piping insulation requirements per Table 120.3A include:

1. All piping with a ¾ inch (19 mm) or larger diameter must be insulated as specified in §150.0(j);
2. All hot water pipes from the heating source to the kitchen fixtures must be insulated as specified in §150.0(j); Exceptions: piping in walls which meet Quality Insulation Installation (QII) criteria; and inaccessible existing piping.

9.2.3 Ducts and Air Distribution Systems

Installation of all new (or full replacement) duct systems:

1. Duct system sealing and leakage testing and field verified per RA3.1.4.3; online registration of the CF1R form with a HERS provider as specified in§150.0(m);
2. Zonally controlled central forced air systems must deliver greater than 350 CFM/ton of nominal cooling and have a fan efficacy less than 0.58 W/CFM; accordance to the procedures as specified in Residential Reference Appendix RA3.3 with online registration of the CF1R form with a HERS provider as specified in §150.0(m);
3. Additions must meet the mechanical ventilation requirements in ASHRAE Standard 62.2 (*not a new requirement*); <u>and</u> the whole building ventilation airflow must be in accordance to the procedures as specified in Residential Reference Appendix RA3.7 with online registration of the Certificate of Compliance with a HERS provider as specified in §150.0(o).

9.2.4 Lighting

1. Simplified requirements for classifying "high efficacy" luminaires (lighting fixtures) per Tables 150.0-A and 150.0-B as specified in §150.0(k);
2. An Energy Management Control System (EMCS) or multi-scene programmable controller may be used to comply with dimmer requirements if specific listed requirements are met. See §150.0(k);
3. An Energy Management Control System (EMCS) may be used to comply with vacancy sensor requirements if specific listed conditions are met See §150.0(k);
4. A minimum of one high efficacy luminaire shall be installed in each bathroom, and all other bathroom lighting shall be high efficacy or controlled by vacancy sensors. See §150.0(k).

9.2.5 Prescriptive Additions

All new size (conditioned floor area) categories and new special requirements for prescriptive additions as outlined in this section and Table 9--3A through 9-3D.

1. Additions ≤ 400 ft2 are allowed a Total Glazing Area up to 75 ft2 or 30% of Conditioned Floor Area, whichever is greater; and have up to 60 ft2 West-Facing Glazing Area. See §150.2(a)1B;
2. Additions > 400 ft2 and ≤ 700 ft2 are allowed a Total Glazing Area up to 120 ft2 or 25% of Conditioned Floor Area, whichever is greater; and have up to 60 ft2 West-Facing Glazing Area, see §150.2(a)1B;
3. Additions > 700 ft2 are allowed a Total Glazing Area up to 175 ft2 or 20% of Conditioned Floor Area, whichever is greater; and have West-facing Glazing Area up to 70 ft2 or 0.5% of Conditioned Floor Area, whichever is greater. See §150.2(a)1.A;

4. Additions > 1,000 ft^2 must meet Package A whole house fan requirements, while Additions ≤ 1,000 ft^2 are exempt. See §150.2(a), EXCEPTION 6 to §150.1(c)12.

   Note: None of the above options allows credit for glazing when removed to make way for the addition.

9.2.6 Prescriptive Alterations

1. The total fenestration area and west-facing area limitations include vertical glazing and skylights;
2. Up to 75 square feet of vertical fenestration is exempt from the total area and west-facing area limitations.

9.2.7 Performance Approach - Existing + Addition + Alterations (E+A+A)

1. Performance compliance may not be used for tradeoffs unless there are at least two or more altered components listed in TABLE 150.2-B;
2. Existing roofs/ceilings removed as part of an addition or alteration -- and all existing skylights being removed as part of the removed roofs/ceilings - <u>are excluded</u> (not modeled) in the Existing + Addition + Alterations performance calculations;
3. Existing exterior walls removed as part of an addition or alterations -- and all existing vertical fenestration (windows, clerestories, glazed doors) being removed as part of the removed walls -- <u>are excluded</u> (not modeled) in the Existing + Addition + Alterations performance calculations;
4. Only "Existing", "Altered" and "New" building components and/or systems are included and modeled in the Existing + Addition + Alterations performance calculations;
5. Existing fenestration not being removed as part of an alteration can now be improved with Window Films and can be modeled in the Existing + Addition + Alterations performance calculations;
6. <u>Without</u> Third Party Verification of the building's existing (i.e., pre-alteration) conditions, the E+A+A approach no longer provides energy credits based on altered components which upgrade (improve) the existing conditions. See §150.2(b)2B and Table 150.2-B;
7. <u>With</u> Third Party Verification of the building's existing (i.e., pre-alteration) conditions, the E+A+A approach still provides energy credits based on altered components which upgrade (improve) the existing conditions. See §150.2(b)2B and Table 150.2-B.

   See Table 9-4 in this chapter for a summary of how the compliance software sets the Standard Design (energy budget) for alterations.

   For further discussion on how Energy Commission-approved 2013 compliance software programs have changed from the 2008 compliance software, see Chapter 8.

9.3 Compliance Approaches

Apart from meeting all applicable mandatory requirements as outlined in Section 9.4, an addition or alteration must also demonstrate energy compliance using a prescriptive or performance method.

There are number of different compliance alternatives or compliance paths to demonstrate that an addition or alteration meets the Standards. Compliance alternatives depend on whether the scope of permitted work is:

1. **Addition Only** where no changes are being made to the existing building except removal of roofs, exterior walls and floors required as a result of the addition; and removal of any fenestration in those same removed roofs and exterior walls to make way for the addition; or
2. **Alterations Only** where there is no addition (i.e., no increase in conditioned floor area and volume); or
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, 2]
1. Addition Only:	Additions ≤400 ft2; or	Addition Alone
	Additions >400 ft2 and ≤700 ft2	
	Additions >700 ft2; or	
2. 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
3. Addition and Alteration Combined:	Meet All Applicable Requirements for Prescriptive Alterations 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.

2) The Existing + Alterations performance approach with or without third party verification may be used only if there are at least two types of altered components in the existing building. This requirement does not apply to the Existing + Addition + Alterations compliance method.

9.3.1 ADDITIONS ONLY

A. Prescriptive

The prescriptive standard requirements for new addition construction are listed in §150.2(a); however, prescriptive additions have some alternative requirements as summarized:

1. **Additions of < 300 ft^2** or less do not require a cool roof to be installed;
2. **Additions ≤ 400 ft^2**: Total glazing area up to 75 ft^2 or 30% of the conditioned floor area, whichever is greater; and up to 60 ft^2 of West-facing glazing area; wall insulation of R-13 is acceptable;
3. **Additions > 400 ft^2 and ≤ 700 ft^2**: Total glazing area up to 120 ft^2 or 25% of the conditioned floor area, whichever is greater; up to 60 ft^2 of West-facing glazing area; and need not exceed R-13 insulation in exterior walls;
4. **Additions > 700 ft^2**: Total glazing area up to 175 ft^2 or 20% of the conditioned floor area, whichever is greater; and up to 70 ft^2 of West-facing Glazing area.

Note that every applicable prescriptive requirement for additions must be met when using the prescriptive approach. Otherwise, the building as a whole must comply using a performance approach.

For prescriptive additions, a Certificate of Compliance (CF1R-ADD) form must be completed and submitted for permit. If any mandatory or prescriptive measures require HERS verification and/or testing, the Certificate of Compliance for the project must be registered online with a HERS provider before submittal to the enforcement agency. Refer to Section 2.5, HERS Field Verification and Diagnostic Testing and Section 2.2.2, Permit Application.

B. Performance

Additions may comply using the performance approach by meeting the requirements in §150.2(a)2 of the Standards and explained further in Section 9.5.2. The performance options are:

- **Addition Alone**: Only the addition is modeled for compliance, and not the existing building;
- **Existing + Addition as New Construction**. Demonstrating compliance as a whole new building, combining existing plus the addition as all new construction, this approach is usually difficult to achieve, but still an option. Typically this approach is when the addition cannot comply on its own; it would require the existing building to help the addition to comply. Depending on the age of the existing building, the older the building the more revisions or alterations will be required to bring-in the existing and addition into compliance as a whole.

9.3.2 ALTERATIONS ONLY

C. Prescriptive

Alterations may comply prescriptively by meeting all applicable requirements in §150.2(b) of the Standards as explained further in Section 9.5.1 of this manual and summarized in Tables 9-5A and 9-5B. Several prescriptive alteration requirements are specific to the building site

climate zone. There are also a number of exceptions to the prescriptive requirements based on either climate zone or other conditions listed in the Standards.

Note: Every applicable prescriptive alteration requirement must be met to use the prescriptive approach; otherwise, the building must comply using a performance approach.

Under the prescriptive alteration approach, the appropriate Certificate of Compliance (e.g., CF1R-ALT or CF1R-ALT-HVAC) form must be completed and submitted for 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 for the project must be registered online with a HERS provider (see Section 2.3, Energy Standards Compliance Documentation of this manual) before submittal to the enforcement agency.
ALTERATIONS ONLY

D. Performance

Alterations may comply using the performance approach by meeting the requirements in §150.2(b)2 of the Standards explained in Section 9.6.2, and summarized in Table 9-1. The main options are:

1. **Existing + Alterations:** When two or more types of components or systems are being altered in the existing building, then the Existing + Alterations performance approach may be used.
2. **Compliance Without Third Party Verification** 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** allows for compliance of the alterations only with third party inspection to verify existing conditions being altered;
4. **Existing + Alterations** as new construction: Demonstrating alterations compliance as a whole new building is usually difficult to achieve, but still an option. Typically this approach is used is when prescriptive alterations cannot meet the prescriptive requirements in Table 150.1-A.

Note: Every applicable prescriptive alteration requirement must be met to use the prescriptive approach; otherwise, the building must comply using a performance approach.

9.3.3 ADDITIONS and ALTERATIONS COMBINED

E. Prescriptive

When a low-rise residential project includes both an addition and any alterations, the prescriptive requirements for each separate condition must be met for the prescriptive approach to be used. The addition may comply with any of the prescriptive addition options explained above and documented by the appropriate compliance forms (e.g, CF1R-ADD). However, the alterations must also meet all prescriptive requirements, and be documented with the specific compliance forms for alterations (e.g., CF1R-ALT, CF1R-ALT-HVAC).

Performance

The performance path that includes both additions and alterations is the "**Existing + Addition + Alterations**" approach. As explained above (under Alterations Only – Performance), there

are two ways to analyze the building using this method: with third party verification of all existing conditions to be altered; and without third party verification. See Section 9.5.2.

9.4 Mandatory Requirements

The mandatory measures apply to all added or altered envelope components as they do to new construction, regardless of whether the prescriptive or performance compliance method is used. This section describes the mandatory requirements for low-rise residential buildings as they apply to additions and alterations. More information on the mandatory measures is in Chapters 3, 4, 5 and 6.

9.4.1 Envelope Measures

Envelope mandatory measures are listed below, including the relevant reference in the Standards and the section number in this manual. The following measures include products and exterior doors, insulation, roofing products and radiant barriers. See Sections 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, and 3.8 for more information.

a. Manufactured fenestration products and exterior doors air leakage infiltration rates, see §110.6(a)1, Section 3.5.2;

b. Fenestration U-factor, SHGC, VT ratings, see §10-111, §110.6(a)2, 3 & 4, Section 3.5;

Fenestration temporary and permanent labels, see §110.6(a)5, Section 3.5;

Fenestration maximum weighted average U-factor = 0.58, see §150.0(q), Section 3.5;

Installation of field-fabricated fenestration and exterior doors, see §110.6(b), Section 3.5;

Sealing joints and other openings, see §110.7, Section 3.6;

Certification of insulating materials, see §110.8(a), Section 3.6;

Restrictions on use of urea formaldehyde foam insulation, see §110.8(b), Section 3.6;

Flame spread insulation ratings, see §110.8(c), Section 3.6;

Insulation placement on roof/ceilings, see §110.8(e), Section 3.6;

Minimum roof/ceiling insulation, see §150.0(a), Section 3.6;

Minimum roof/ceiling insulation in an existing attic, see §110.8(d)1 and §150.0(a), Section 3.6;

Roofing products (cool roofs) solar reflectance and thermal emittance rating and labeling, see §10-113 and §110.8(i);

Loose-fill insulation, see §150.0(b), see Section 3.6;

Minimum wall insulation, see §150.0(c), see Section 3.6;

Minimum floor insulation, see §150.0(d), see Section 3.6;

Slab edge insulation moisture resistance and physical protection, see §150.0(l), Section 3.6;

Insulation requirement for heated slab floors, see §110.8(g), Section 3.6;

Vapor retarder §150.0(g), see Section 3.6.

9.4.2 Ceiling/Roof and Wall Insulation

When insulation is installed in the attics of existing buildings, at least R-30 shall be installed in all climate zones. When ceilings without attics are altered, at least R-19 shall be installed between wood-framing members; or enough insulation shall be installed to achieve the equivalent of R-19 insulation between wood framing members. When the space between framing members becomes accessible as a part of a ceiling/roof modification, the ceiling/roof is considered altered and the insulation measure applies. However, if the roofing surface material is replaced but the roof sheathing is not being removed, there is no insulation requirement.

Existing buildings that already have R-11 insulation installed in framed walls are exempt from the mandatory minimum R-13 or R-19 wall insulation required by §150.0(c) if the building can demonstrate performance method compliance with the walls modeled as R-11.

9.4.3 Roofing Products: (Cool Roof)

Roofing products installed either to meet prescriptive requirements or to take performance compliance credit for reflectance and emittance are referred to as "cool roof". These roofing products must be certified by the Cool Roof Rating Council (www.coolroofs.org) per §10-113 and §110.8(i).

To be considered a cool roof the roofing products manufacturer must have its roofing product tested for solar reflectance and thermal emittance, and be listed in the Cool Roof Rating Councils (CRRC) Rated Product Directory. Figure 9-1 provides an example of an approved CRRC product label.

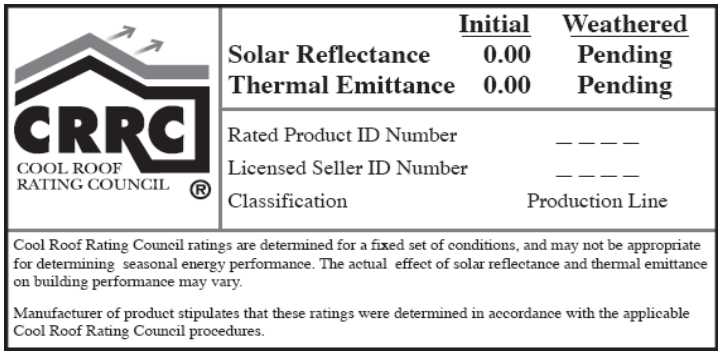


Figure 9-1 CRRC Product label and information

If the aged value for the reflectance is not available in the CRRC's Rated Product Directory then the equation below can be used until the aged rated value for the reflectance is posted in the directory.

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 which is listed in Table 9-2

Table 9-2 –Soiling Resistance Value β, By Product Type

PRODUCT TYPE	β
Field-applied coating	0.65
Other	0.70

9.4.4 Fenestration

Fenestration which is new or replacement (altered) glazing – including skylights -- must meet the maximum U-factor requirement in one of three ways:

1. Every fenestration product (glazed opening) meets the mandatory maximum U-factor of 0.58; or
2. All new or replacement fenestration combined meet the mandatory maximum of 0.58 U-factor using an area weighted average calculation; or
3. the area of new and replacement fenestration up to 10 ft^2 or 0.5% of the conditioned floor area (CFA), whichever is greater, is exempt from the U-factor requirement per Exception to §150.0(q).

Example: an existing 2,500 ft^2 house undergoes an alteration with all the existing windows being replaced. The owner may install up to 12.5 ft^2 of new glazing (i.e., up to 0.5% of 2,500 ft^2) without meeting the maximum U-factor of 0.58. If the overall alterations meet the Standards with the prescriptive or performance approach (see Sections 9.6).

Consistent with Exception 1 to §150.1(c)3A: For each dwelling unit, up to 3 square feet of new glazing area installed in doors and up to 3 square feet of new tubular skylight area with dual-pane diffusers shall not be required to meet or be included in the area-weighted average fenestration calculation to meet the mandatory requirement of §150.0(q).

9.4.5 Greenhouse Windows

Greenhouse or garden windows are special windows that project from the façade of the building and are typically five sided structure. An NFRC-rated U-factor for greenhouse windows is typically quite high and may not meet the mandatory requirements for the fenestration U-factor of 0.58.

The three ways to meet this mandatory measure for greenhouse windows are:

Must have a maximum U-factor of 0.58 or better; or

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

The Exception to §150.0(q)1 for up to 10 ft^2 or 0.5% of CFA, whichever is greater; or

When using the performance approach, Exception 1 to s. 150.2(b) states that any dual-glazed greenhouse or garden window installed as part of an alteration complies automatically with the U-factor requirements of s. 150.1(c)3. However, these windows are not exempt from the SHGC requirements of s. 150.1(c)3.

9.4.6 Mechanical (HVAC) and Water Heating Measures

Mechanical (HVAC) system and water heating mandatory measures are listed below for additions and alterations. They include measures applicable to space conditioning equipment, controls and systems; water heaters, controls and systems, pool and spa equipment, controls and systems; outdoor air ventilation; pipe insulation; air ducts and plenums; and fireplaces. See Sections reference below:

1. Appliance efficiencies and verification, see §110.1, Section 4.1.6;
2. Space conditioning equipment efficiencies, see §110.2(a), Sections 4.2.1 & 4.3.1;
3. Heat pump controls, see §110.2(b), Sections 4.2.1;
4. Setback thermostats (in most cases), see §110.2(c), Section 4.5.1;
5. No continuously burning gas pilot lights, see §110.5, Sections 4.2.1 & 5.2;
6. Heating and cooling load calculations, see §150.0(h), Sections 4.2.1 & 4.3.1;
7. Pipe insulation and refrigerant line insulation, see §150.0(j), Section 5.2;
8. Duct insulation and protection of insulation, see §150.0(m), Section 4.4.1;
9. Dampers to prevent air leakage, see §150.0(m), Section 4.4.1;
10. Flexible duct labeling, see §150.0(m), Section 4.4.1;
11. Duct connections and closures, see §150.0(m), Section 4.4.1;
12. Duct system sealing and leakage testing, see §150.0(m)11, Section 4.4.1;
13. Zonally controlled central forced air systems, see §150.0(m)15, Section 4.4.1;
14. Mechanical ventilation for indoor air quality, see §150.0(o), Section 4.6;
15. Fireplaces, decorative gas appliances, gas logs, see §150.0(e), Section 4.2.1;
16. Water Heating Systems, see §150.0(n), Chapter 5;
17. Solar water heating, see §150.0(n)3, Section 5.5;
18. Pool systems and equipment installation, see §150.0(p), Section 5.6.

9.4.7 Mechanical Ventilation

The whole building ventilation airflow requirement in ASHRAE 62.2 is required only in new buildings and in 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.

When whole-building ventilation airflow is required for compliance, field verification and diagnostic testing of airflow performance is 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

1. Indoor and outdoor lighting mandatory measures are listed below. See Chapter 6 for more information.
2. Lighting fixture (luminaire) requirements, see §150.0(k)1, Section 6.3;
3. Switching devices and controls, see §150.0(k)2, Section 6.5;
4. Lighting in kitchens, see §150.0(k)3, Section 6.6.1;
5. Lighting internal to cabinets, see §150.0(k)4, Section 6.6.1;
6. Lighting in bathrooms, see §150.0(k)5, Section 6.6.2;
7. Lighting in garages, laundry and utility rooms, see §150.0(k)6, Section 6.6.3;
8. Lighting in other rooms such as living rooms, dining rooms, bedrooms, family rooms and closets), see §150.0(k)7, Section 6.6.4;
9. Recessed ceiling fixtures, see §150.0(k)8, Section 6.3.12;
10. Outdoor lighting, see §150.0(k)9, Section 6.7;
11. Internally illuminated address signs, see §150.0(k)10, Section 6.7.4;
12. Garages for eight (8) or more vehicles, see §150.0(k)11, Section 6.7.7;
13. Interior common areas of low-rise multi-family buildings, see §150.0(k)12, Section 6.8.

Altered lighting and any newly installed lighting equipment is required to comply with the residential lighting Standards, which apply to permanently installed lighting (Section 6.3.1) and associated lighting controls.

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

If a residential kitchen has eight existing luminaires, and only two of them are altered, then only the two altered luminaires need to comply with the Standards. This means, however, that low efficacy lighting cannot be added to an altered kitchen until at least 50% of the lighting in the finished kitchen becomes high efficacy. The newly installed lighting is also required to comply with the switching requirement.

Example 9-4

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 until at least 50 percent of the total lighting wattage in the finished kitchen comes from high efficacy luminaires, see §150.0(k)3. The high efficacy luminaires also have to be controlled by a separate switch from the low efficacy luminaire, see §150.0(k)2.

An alternative approach to adding an extra switch and wiring is to retrofit all the pre-existing incandescent cans to high efficacy. This can be done with a California Energy Commission certified LED retrofit kit that does not have a screw base. The database of Energy Commission certified LED sources http://www.appliances.energy.ca.gov/QuickSearch.aspx. These kits require the removal of the screw (Edison) base from the luminaire and replacement with another form of electrical connection (such as GU-24 socket and base or quick-connect connectors) Exception to §150.2(b)1I. See sections 6.2.3; 6.3.5; 6.4.6; and 6.9 of the 2013 Residential Compliance Manual for additional information.

Example 9-5

Question

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

Answer

Yes, the new luminaire is the altered component and must be high efficacy. In fact, all luminaire replacements must be high efficacy until at least 50 percent of the total lighting wattage in the finished kitchen comes from high efficacy luminaires.

Example 9-6

Question

I am completely remodeling my kitchen and putting in an entirely new lighting system. How do the 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 of the mandatory kitchen lighting requirements in §150.0(k)3. This includes the following:

At least half the lighting watts must be high efficacy luminaires (lighting internal to cabinets is not included in this calculation);

If all the lighting in the kitchen is controlled by vacancy sensors or dimmers in addition to high efficacy and low efficacy lighting being separately switched, an added 50 W of low efficacy lighting is allowed for dwelling units ≤ 2,500 sf and an added 100 W of low efficacy lighting allowed for dwelling units > 2,500 sf;

High efficacy and low efficacy lighting have to be controlled by separate switches as specified in §150.0(k)2.

Permanently installed lighting internal to cabinets is limited to no more than 20 watts of power per linear foot of illuminated cabinet as specified in §150.0(k)4. The linear foot of cabinet is defined as follows:

A. The horizontal length of the illuminated cabinet; or

B. One vertical length, per illuminated cabinet section, or

C. No more than one vertical length per every 40 horizontal inches of illuminated cabinet.

See section 6.6.1 of the 2013 Residential Compliance Manual for additional information.

Example 9-7

Question

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

Answer

It depends if there is already another luminaire in the bathroom that qualifies as high efficacy. If there are no high efficacy luminaires in the bathroom, the bath bar is the altered component and must meet the Standards requirements of §150.0(k)5, which requires at least one high efficacy luminaire in each bathroom. The alternative would be to use a low efficacy bath bar in conjunction with a vacancy sensor and have at least one other luminaire in the bathroom which is high efficacy.

Note that a luminaire with a screw-in lamp, is not considered high efficacy, even if the lamp is LED (light emitting diode) or CFL (compact fluorescent lamp).

Example 9-8

Question

Are there ever situations with a kitchen lighting alteration where I can end up with more than 50 percent low efficacy wattage after the alteration?

Answer

Yes, there is a tradeoff option which allows an additional 50W of low efficacy lighting for houses ≤ 2,500 sf and 100 W for houses > 2,500 sf if vacancy sensors or dimmers are installed to control all of the lighting in the kitchen as specified in Exception to §150.0(k)3. These controls are required in addition to low efficacy lighting being switched separately for high efficacy lighting. See Section 6.6.1 of the 2013 Residential Compliance Manual for more information about the kitchen low efficacy tradeoff option.

9.5 Additions

For a definition of an addition in the Standards, and several useful examples of additions, see the Introduction, Section 9.1 of this chapter.

For a summary of compliance alternatives for additions, see Compliance Approaches, Section 9.2 of this chapter.

Beyond the outline provided in Section 9.2, this section provides more specific information, descriptions and guidelines on how to meet the Standards using each of the available compliance paths. Copies of compliance forms referenced here are included in the Compliance Forms Summary, Appendix A of this manual.

9.5.1 Prescriptive Requirements

In general, the prescriptive requirements apply to additions in the same way they apply to entirely new buildings and must be documented on the CF1R-ADD Form. However, there are a few exceptions as noted below and summarized in Table 9-3A.

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 9-3A summarizes the key features of the prescriptive envelope requirements for the three prescriptive addition options in §150.2(a)1 of the Standards. Envelope requirements unique to that type of prescriptive addition are shown in bold face on white background. Table 9-3B shows that all prescriptive additions have the same mechanical system and water heating system requirements as the Package A prescriptive measures for new construction listed in §150.1(c) and explained in Chapters 4 and 5.

F. Additions ≤ 400 ft^2

All prescriptive Package A requirements must be met <u>except</u>:

1. Total glazing area may be up to 75 ft^2 or 30% of conditioned floor area, whichever is greater;
2. West-facing glazing area may be up to 60 ft^2;
3. Required exterior wall insulation:
    a. In 2x4 wood frame walls, insulation shall be R-13 or an overall construction assembly U-factor ≤ 0.102, for wood or metal frame walls;
    b. In 2x6 or greater wood frame walls, insulation shall be R-19 or an overall construction assembly U-factor ≤ 0.074, for wood or metal frame walls;
4. No requirement for a whole house fan (WHF) to provide ventilation cooling;
5. For additions ≤ 300 ft^2 cool roof compliance is not required.

G. Additions > 400 ft2 and ≤ 700 ft2 :

All prescriptive Package A requirements must be met <u>except</u>:

1. Total glazing area may be up to 120 ft^2 or 25% of conditioned floor area, whichever is greater;
2. West-facing glazing area may be up to 60 ft^2;
3. Required exterior wall insulation:
    a. In 2x4 wood frame walls, insulation shall be R-13 or an overall construction assembly U-factor ≤ 0.102, for wood or metal frame walls;
    b. In 2x6 or greater wood frame walls, insulation shall be R-19 or an overall construction assembly U-factor ≤ 0.074, for wood or metal frame walls;
4. No requirement for a whole house fan (WHF) to provide ventilation cooling.

H. Additions > 700 ft2

All prescriptive Package A requirements must be met <u>except</u>:

1. Total glazing area may be up to 175 ft^2 or 20% of conditioned floor area, whichever is greater;
2. West-facing glazing area may be up to 70 ft^2 or 5% of conditioned floor area, whichever is greater;
3. If the addition is $\leq$ 1,000 ft^2, there is no requirement for a whole house fan (WHF) to provide ventilation cooling;
4. Additions > 1,000 ft^2 must include provide ventilation cooling with a WHF as indicated in §150.1(c)12;
5. If the Total Proposed fenestration area exceeds the Standard Maximum Glazing Area of 20% then the performance compliance approach must be used. Likewise, if the Proposed West-Facing fenestration area in climate zones 2, 4, and 6-16 exceeds 5% of the conditioned floor area, then the performance compliance approach must be used;
6. If the addition has a floor area >700 ft^2 and < 1,000 ft^2, all requirements of Package A apply except the West-Facing Glazing Area may be allow up to 70 ft^2 for additions up to 1,400 ft^2 (since 70 ft^2 is 5% of 1,400 ft^2). See §150.2(a)1A.

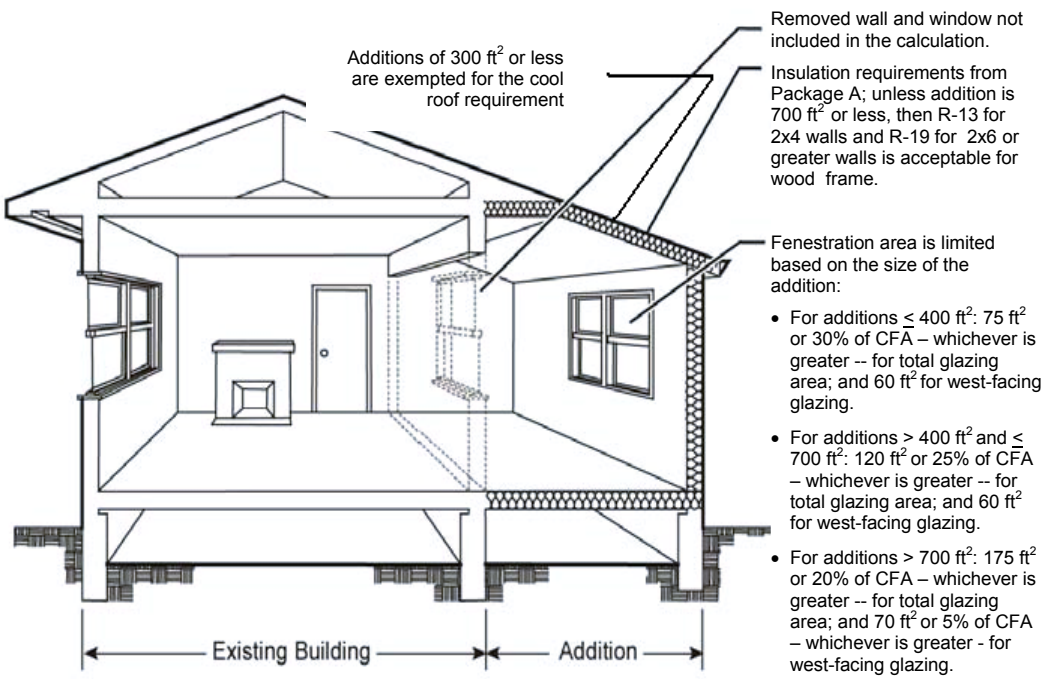


Figure 9-2 – Prescriptive Addition Envelope Requirements

Compliance Forms for Prescriptive Additions

The permit applicant must submit a completed version of the Certificate of Compliance, CF1R-ADD form, for prescriptive additions when less than 100 ft^2 .

Important note: All projects which require third party diagnostic testing and/or field verification by a HERS rater *must also have the CF1R-ADD form uploaded and registered online with a HERS provider (*see Chapter 2).

Use the CF1R-ADD form to document fenestration by orientation. The total percentage of fenestration should be no greater than the amount summarized above and in Table 9-3A. West facing area includes skylights tilted to the west or tilted in any direction when the pitch is less than 1:12 (9.5 degrees from the horizontal), and must not exceed 5 percent of the conditioned floor area (CFA) in climate zones 2, 4, and 6-16.

Note: Plan checkers will verify on the CF1R-ADD form that the Total Proposed Glazing Area is less than or equal to the Standard Maximum Glazing Area; and that the Proposed West-Facing Glazing Area is less than or equal to the Standard West-Facing Glazing Area.

9.5.2 Fenestration Exceptions

New fenestration in prescriptive additions must meet the area-weighted average U-factor and SHGC requirements in §150.1(c)3A with the following exceptions particularly relevant to additions:

1. EXCEPTION 1: For each dwelling unit, up to 3 ft^2 of new glazing in doors and up to 3 ft^2 of tubular skylights with dual pane diffusers are exempt;

2. EXCEPTION 2: For each dwelling unit, up to 16 ft^2 of skylights with a maximum U-factor of 0.55 and a maximum SHGC of 0.30 is exempt.

See Section 3.5 for further information on fenestration which meets or is exempt from §150.1(c)3A in new construction.

Other Prescriptive Addition Envelope Measures

For further information on prescriptive envelope measures which are not specific to additions and not highlighted above, see Chapter 3.

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 9.6.1.

Example 9-9

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 central split system 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 their length and location shall be sealed and meet insulation levels as described in §150.0(m) items 1 through 6.

If a new central split system is installed to serve the addition, it must meet all of the requirements for air conditioners in a new residence.

Table 9-3A: Envelope Roof/Ceiling Requirements for Prescriptive Additions

Component	Requirements of Additions ≤ 400 ft^2	Requirements of Additions > 400 ft^2 and ≤ 700 ft^2	Requirements of Additions > 700 ft^2
Roof/Ceiling Insulation:	Package A: CZ1, 11-16: R-38 / U=0.025; CZ2-10: R-30 / U=0.031	Package A: CZ1, 11-16: R-38 / U=0.025; CZ2-10: R-30 / U=0.031	Package A: CZ1, 11-16: R-38 / U=0.025; CZ2-10: R-30 / U=0.031
Roof Products (Cool Roof):	Package A: Steep-Sloped (> 2:12): CZ10-15: Reflect.=0.20 and Emittance=0.75; or SRI=16	Package A: Steep-Sloped (> 2:12): CZ10-15: Reflect.=0.20 and Emittance=0.75; or SRI=16	Package A: Steep-Sloped (> 2:12): CZ10-15: Reflect.=0.20 and Emittance=0.75; or SRI=16
	Package A: Low-Sloped (< 2:12): CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75 Exception: Additions < 300 ft^2 exempt from all cool roof requirements.	Package A: Low-Sloped (< 2:12): CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75	Package A: Low-Sloped (< 2:12): CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75
Radiant Barrier Above Attic:	Package A: CZ2-15: Radiant Barrier above Attic Spaces	Package A: CZ2-15: Radiant Barrier above Attic Spaces	Package A: CZ2-15: Radiant Barrier above Attic Spaces

Table 9-3B: Envelope Glazing Requirements for Prescriptive Additions

Component	Requirements of Additions ≤ 400 ft^2	Requirements of Additions > 400 ft^2 and ≤ 700 ft^2	Requirements of Additions > 700 ft^2
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
West-Facing Glazing Area: In Climate Zone 2, 4, 6-16	Up to 60 ft^2	Up to 60 ft^2	Up to 70 ft^2 or 5% of Conditioned Floor Area, whichever is greater
Glazing U-Factor & SHGC[1]:	Package A: All CZs: U = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25	Package A: All CZs: U = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25	Package A: All CZs: U = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25
1. See §150.0(q) and §150.1(c)3 for new and replaced window and skylight exceptions .			

Table 9-3C: Envelope Insulation Requirements for Prescriptive Additions

Component	Requirements of Additions ≤ 400 ft^2	Requirements of Additions > 400 ft^2 and ≤ 700 ft^2	Requirements of Additions > 700 ft^2
Exterior Wall[1] Insulation:	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074	Package A: All CZs: U=0.065
Raised Floor[1] Insulation:	Package A: All CZs: R-19 or equivalent U-factor	Package A: All CZs: R-19 or equivalent U-factor	Package A: All CZs: R-19 or equivalent U-factor
Slab Floor[1] Insulation:	Package A: CZ1-15: No Requirement; CZ 16: R-7.0 or U=0.58	Package A: CZ1-15: No Requirement; CZ 16: R-7.0 or U=0.58	Package A: CZ1-15: No Requirement; CZ 16: R-7.0 or U=0.58
1. R-values refer to wood framing and U-factors refer to metal framing.			

Table 9-3D HVAC and Water Heating Requirements for Prescriptive *Additions*

Component	Requirements of Additions < 400 ft2	Requirements of Additions > 400 ft2 and < 700 ft2	Requirements of Additions > 700 ft2
Ventilation Cooling1 (Whole House Fan)	No Requirement.	No Requirement.	Additions < 1,000 ft2: No requirement Additions > 1,000 ft2: Package A Whole House Fan, §150.1(c)12
Adding New Space Conditioning System(s)	All Package A requirements.	All Package A requirements.	All Package A requirements.
Replacing Existing Space Conditioning System(s)	All Package A requirements.	All Package A requirements.	All Package A requirements.
Adding All New Complete Duct System(s)	All Package A requirements.	All Package A requirements.	All Package A requirements.
Extending Existing Duct System(s) by > 40 Feet	All Package A duct insulation requirements; duct system sealing and HERS Verified	All Package A duct insulation requirements; duct system sealing and HERS Verified	All Package A duct insulation requirements; duct system sealing and HERS Verified
1. (Note: also mandatory mechanical ventilation per ASHRAE 62.2 with HERS verification for additions > 1,000 ft^2)			

9.5.3 Prescriptive Water Heating System

If an addition increases the number of water heaters serving a dwelling unit, then the addition can comply prescriptively if any one of the following conditions contained in §150.2(a)1D.i, ii and iii:

The additional water heater is a 50 gallon or less, gas storage or gas instantaneous, non-recirculating water heater with an EF (Energy Factor) equal to or greater than the federal minimum standards as defined in Section 5.4; or

The building does not have natural gas or propane available; and the additional water heater is a 50 gallon or less electric storage tank water heater, or electric instantaneous with an EF equal to or greater than the federal minimum standards; or

A water-heating system determined by the Executive Director of the Energy Commission to use no more energy than the one specified in item 1 above; or if no natural gas is connected to the building, a water-heating system determined by the Executive Director to use no more energy than the one specified in item 2 above.

If none of these conditions can be met when adding a water heater to an existing dwelling unit, then the prescriptive addition compliance path cannot be used. In that case, the Existing + Addition + Alterations compliance approach must be used to demonstrate overall compliance with whatever combination of existing and new water heaters serve the dwelling unit. This is summarized in §150.2(a)1D.iv and discussed as part of the overall performance method in Section 9.5.2.

For other alterations to the water heating system that occur as part of an addition, see Section 9.6.

Example 9-10

Question

A small addition of 75 ft² is being planned for a house located in climate zone 7. An existing porch off the master bedroom is being enclosed. 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

Since 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 U-factor and SHGC requirements of Package A. For climate zone 7, these fenestration requirements are a maximum U-factor of 0.32 and a maximum SHGC of 0.25. For an addition of this size, insulation only must meet the mandatory requirements of R-30 ceiling insulation; R-13 wall insulation and R-19 floor insulation. Since the addition is also less than 300 ft^2, there is no cool roof requirement.

Since the existing heating and cooling equipment is being used for the addition, that equipment does not have to meet the mandatory equipment efficiency requirements. Mandatory duct insulation requirements of §150.0(m) apply (including R-6.0 minimum in unconditioned space). All other mandatory requirements in §150.0 must be met.

Example 9-11

Question

If I remove a window from the existing house and re-use this window in an addition to that house, does the relocated window have to meet the prescriptive requirements of Package A?

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 Package A, §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 square feet or 0.5% of conditioned floor area, whichever is greater.

Example 9-12

Question

I am doing an alteration in Climate Zone 12 in which I am moving an existing 25 ft^2 window to another location within the same existing wall; and am not increasing total glazing area. Does the re-located window need to meet any prescriptive requirements?

Answer

Removing an area of glazing in an existing wall, and re-inserting up to the same area of glazing in a different opening, is considered replacement fenestration as defined in §150.2(b)1B. Exception 1 to §150.2(b)1B states that up to 75 ft^2 of vertical replacement fenestration in Climate Zone 12 must meet a prescriptive U-factor = 0.40 and an SHGC = 0.35.

Example 9-13

Question

For additions and alterations that include a greenhouse window (also known as garden window), what are the U factor and SHGC requirements? What is the area used for calculations for greenhouse windows?

Answer

For greenhouse windows in alterations, they must also meet the prescriptive U-factor and SHGC requirements of Package A; however, not many greenhouses can meet the new efficiency prescriptive requirements. In the performance approach, any dual-glazed greenhouse or garden window installed as part of an alteration complies with the U-factor requirements, §150.1(b)1B.

Alternatively, Greenhouse windows can also meet the prescriptive maximum area-weighted average U-factor in §150.0(q) with the Exception of up to 10 square feet or 0.5% of conditioned floor area, whichever is greater is allowed. Note For greenhouse windows, the window area is the rough opening.

However, the SHGC for greenhouse windows must meet the requirements shown in the prescriptive Package A, or must meet the SHGC used to show compliance in the performance approach. To meet the SHGC for greenhouse windows, the proposed fenestration may use the NFRC rated SHGC or the default SHGC from Standards Table 110.6-B, if the area weighted average SHGC of the greenhouse window plus other fenestration in the proposed design meets the values used for compliance is also allowed.

For skylights, Exception to §150.1(c)3A, exempts up to two square foot of tubular skylights from the U-factor requirements, provided that the ceiling diffusers are dual-paned; and any additional skylights must meet the U-factor requirements. Skylights may use one of three methods for determining the proposed SHGC:

1) NFRC rated SHGC; or

2) Default SHGC from Standards Table 110.6-B; or

3) If site-built greenhouses then $SHGC_{fen}$ can be calculated from the manufacturer's center of glass SHGC (SHGCc) and using the following equation: $SHGC_{fen} = 0.08 + 0.86 \times SHGCc$.

9.5.4 Performance Method: Addition Alone and Existing + Addition + Alterations Approach

Additions may comply using the performance approach with one of the following compliance paths summarized in Section 9.2, Table 9-1:

1. Addition Alone;
2. E + A + A Without Third Party Verification;
3. E + A + A With Third Party Verification;
4. E + A + A as New Construction.

Energy Commission-approved compliance software is used to model the building as explained in Chapter 8. Whichever compliance path is selected, the Certificate of Compliance (CF1R) generated by the compliance 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. See Section 2.2.2.

To learn more about what kinds of alterations are assigned energy credit using the Existing + Addition + Alterations performance approach, see Section 9.5.2.

I. Addition Alone

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

1. **Advantages**: Data for the existing building is not needed except for the total existing conditioned floor area which is used to calculate the fractional "number of dwelling units" for the addition. The existing building is not modeled and not analyzed for altered components or systems. This typically saves a large amount of time performing the analysis.
2. **Disadvantages**: If the addition includes a large area of glazing or is otherwise deficient in comparison with the prescriptive requirements, it may be difficult to demonstrate compliance under this approach. Alterations to the existing conditions

which improve the energy performance of the existing building cannot be used in this approach as “trade-offs” with the addition.

J. 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. The Standard Design that sets the energy budget for this approach is automatically based only on the type of each altered component and not on the existing conditions. Under this performance path the building is modeled as follows:

1. Addition: All new components at the addition and all new systems serving the addition are modeled including roof/ceilings and skylights, exterior walls and glazing (fenestration), raised floors and slab floors, HVAC equipment, ducts and water heating. All these elements are tagged within the compliance software as “New”; or

2. Existing Components to Remain Unchanged: Existing components and systems to remain as is (untouched) are modeled and tagged within the compliance software as “Existing”; or

3. Existing Components to be Altered or Replaced, "Altered”: Each altered component (i.e. a new component which replaces an existing component) is modeled and tagged within the performance compliance program as "altered". Each component or system which remains is modeled and tagged within the compliance software as “Altered” such as, a new water heater that replaces an existing water heater would be labeled "altered”; a new water heater that is added to supplement an existing water heater would be labeled "new". Also, new mechanical equipment that does not replace existing mechanical equipment would be tagged as "new". No verification of existing conditions is required in this compliance path; therefore, no “Existing” (pre-alteration) conditions are specified.

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 as "new".

K. Existing to be Removed:

Existing roof/ceilings to be removed as part of the permitted work, plus any skylights within those removed roof/ceilings, are excluded from the model (i.e., they are completely omitted from the calculations); exterior walls to be removed, and all fenestration areas in those removed walls, are not modeled; and raised floors and slab-on-grade floors to be removed are also omitted.

Note: This is an important change in the E+A+A modeling rules from the 2008 Standards as discussed in Section 9.6.

Advantages: Energy improvements to the existing building that go beyond the Standard Design levels are an energy credit that can be effectively “traded” against features of the addition that are less energy efficient than required by the prescriptive levels that set the Standard Design for the addition alone. For example, an addition with a large glazing area may comply by replacing the existing HVAC system with high-efficiency equipment.

Disadvantages: Detailed plans and other information on the existing building may be difficult to document and obtain. The E+A+A analysis may be relatively complex and time-consuming.

Refer to Table 9-4 for a summary of E+A+A modeling rules.

L. Existing + Addition + Alterations With Third Party Verification

The existing building with alterations is modeled together with the addition(s); and existing conditions of the components being altered must be verified by a third party HERS Rater before any construction work 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 pre-altered existing conditions. In those instances, energy credit is calculated as a function of the difference between pre-altered existing conditions and post-alteration energy measures. Under this approach the building is modeled as follows:

1. **Addition**: All new components for the addition and all new systems serving the addition are modeled including roof/ceilings and skylights, exterior walls and glazing (fenestration), raised floors and slab floors, HVAC equipment, ducts and water heating. All these elements are tagged within the compliance software as “New”; or
2. **Existing Components to Remain Unchanged:** Existing components and systems to remain as is (untouched) are modeled and tagged within the compliance software as “Existing”; or
3. **Existing Components to be Altered or Replaced:** "Existing to be Altered: Each altered component (i.e. a new component which replaces an existing component) is modeled and tagged within the performance compliance program as "altered". Each component or system which remains is modeled and tagged within the compliance software as “Altered” such as, a new water heater that replaces an existing water heater would be labeled "altered”; a new water heater that is added to supplement an existing water heater would be labeled "new". Also, new mechanical equipment that does not replace existing mechanical equipment would be tagged as "new". No verification of existing conditions is required in this compliance path; therefore, the “Existing” (pre-alteration) conditions must be specified.

Note: Removing an area of fenestration in an existing wall or roof, and re-inserting up to the same total area of glazing in different openings, is considered replacement or “altered” fenestration as defined in §150.2(b)1B. Any net glazing area added to the total existing fenestration in an existing wall or existing roof is considered “new” fenestration.

4. **Removed Surfaces:** Existing roof/ceilings to be removed as part of the permitted work, plus any skylights within those removed roof/ceilings, are excluded from the model (i.e., they are completely omitted from the calculations). Exterior walls to be removed, and all fenestration areas to be removed in those walls, are not modeled; and raised floors and slab-on-grade floors to be removed are also omitted.

Note: This is an important change in the E+A+A modeling rules from the 2008 Standards summarized in Section 9.6.

5. **Advantages**: Energy improvements meeting certain threshold values are credited based on the difference between existing conditions and the altered component or system. These energy credits can be effectively “traded” against features of the addition that are less energy efficient than required by the prescriptive levels that set the Standard Design for the addition alone. For example, an addition with a large glazing area may comply by upgrading insulation levels in the existing house.
6. **Disadvantages**: Detailed plans and other information on the existing building may be difficult to document and obtain. The E+A+A analysis may be relatively complex and

time-consuming. And a third party verification must be conducted of all existing conditions prior to construction, and that verification must be registered online with a HERS provider prior to permit submittal.

Refer to Table 9-4 for a summary of E+A+A modeling rules.

M. Existing + Addition + Alterations as New Construction

A compliance approach rarely used, but available within the Standards, is to model Existing + Addition + Alterations as all "New" components and systems and the compliance software sets the energy budget as if the project were an entirely new building.

1. **Advantages:** Modeling the existing building with alterations and additions as all new makes the performance analysis relatively simple and less time-consuming. This method will provide the owner and designer with an energy efficiency compliance relative to requirements for new construction. Any owner who wants to bring their building up to new construction energy efficiency levels should have their project modeled as "new".
2. **Disadvantages:** The energy budget with this approach is very stringent. Unless a building is going through a complete retrofit of all its envelope components, as well as replacing all mechanical and water heating systems, it is unlikely that the building will meet the Standards with this approach.

N. Summary of Modeling Rules

Table 9-4 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.

Table 9-4: Modeling Rules for Existing + Addition + Alterations

Table summarizes basic rules for a low-rise residential building using the Existing + Addition + Alterations performance approach. Note for further details reference the Residential ACM Reference Manual.		
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 That Remain Unchanged	Model each component or system as "Existing"	Model each component or system as "Existing"
"ALTERED" -- Components or Systems Being Changed/Replaced	Model each altered component or system as "Altered" but do not model the "Pre-Altered Existing" conditions	Model each component or system as "Altered" and also model the "Pre-Altered Existing" conditions
"NEW" -- Components or Systems Being Added	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 and systems are omitted entirely from the model (Note: this is a change from 2008 Standards rules)	These components and systems are omitted entirely from the model (Note: this is a change from 2008 Standards rules)

9.6 Alterations

This section provides a road map and a few relevant summaries that identify the Standards requirements which are unique to alterations. Envelope, mechanical and water heating system alterations must meet all applicable mandatory measures as discussed in Section 9.3; and also must comply with the Standards using the prescriptive or performance approach. If a building does not meet all applicable prescriptive measures, see Section 9.5.1), then the performance method using of approved compliance software is the alternative, see Section 9.5.2.

Residential lighting alterations need to meet applicable mandatory measures discussed in Section 9.3.3 since there are no prescriptive lighting requirements in residential buildings.

9.6.1 Prescriptive Requirements

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. Table 9-5A provides a detailed outline of envelope requirements for alterations; and Table 9-5B provides a similar outline for HVAC and water heating alterations. For each type of alteration, the tables list:

1. The highlights of the mandatory measures applicable to that kind of alteration; and
2. A summary of the relevant prescriptive measures; and
3. Key exceptions, exemptions or special allowances to the prescriptive measures; and

4. The list of prescriptive compliance forms that must be submitted for permit.

9.6.2 Prescriptive Envelope Alterations

Table 9-5A summarizes requirements for the following types of residential envelope alterations:

1. Adding ceiling or roof insulation to an existing roof; or constructing a new roof on an existing building;
2. Replacing the roof sheathing of an existing roof;
3. Replacing part or all of roof surface of the existing building;
4. Replacing or adding skylights;
5. Adding exterior wall insulation; or constructing new walls in an existing building;
6. Adding raised floor insulation over unconditioned space;
7. Replacing vertical fenestration: windows, clerestories and glazed doors;
8. Adding vertical fenestration: windows, clerestories and glazed doors.

Table 9-5A: For Residential Alterations, Summary of Mandatory and Prescriptive Measures

Type of Envelope Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Adding Ceiling or Roof Insulation to an Existing Roof; or a New Roof on an Existing Building	Ceiling w/ Attic: R-30, U=0.031	CZ 1, 11-16: R-38, U=0.025	N/A	CF1R-ALT
	Roof Rafters: R-19, U=0.056 §150.0(a)	CZ 2 -10: R-30, U=0.0.031		
Replacing Roof Sheathing	§110.8(j)	CZ 2 - 15: Radiant Barrier above Attic Spaces	No requirement in CZ1 and CZ16	CF1R-ALT
Replacing > 50% of the Existing Roof Surface	§110.8(i)	Steep Sloped (≥ 2:12): CZ 10 - 15: Reflect.=0.20 and Emittance=0.75; or SRI=16	(a) Air space of 1.0" between roof deck and bottom of roofing product; or, (b) Profile ratio of rise to width of 1:5 for >50% width of roofing product; or, (c) Existing ducts in attic insulated and sealed per §150.1(c)9; or, (d) Roof has ≥ R-38 ceiling insulation; or, (e) Roof has a radiant barrier per §150.1(c)2; or, (f) There are no ducts in the attic; or, (g) In CZ10-15, ≥R-4.0 insulation above the roof deck.	CF1R-ALT

		Low Sloped< 2:12: CZ13 & 15: Reflect.=0.63 and Emittance=0.75; or SRI=75	(a) There are no ducts in the attic; or, (b) Reflectance and Roof Deck Insulation R-value in Table 150.2-A are met.	CF1R-ALT
Adding or Replacing Skylight[3]	Weighted average U-factor = or < 0.58 Exemption: Up to 10 ft^2 or 0.5% of Conditioned Floor Area, whichever is greater, is exempt from the U-factor requirement §150.1(q)	Must not exceed the 20% Total or 5% West Fenestration Area with a U-factor = 0.32 (all CZs); in CZ2, 4 & 6-16: SHGC = 0.25 §150.2(b)1.A.	Added fenestration up to 75 ft^2 need not meet Total or West-facing fenestration area as per §150.2(b)1A Exception 1. Replacement skylights up to 16 ft^2 with a U=0.55 and SHGC=0.30 and not meet the total fenestration and West-facing area requirements as per §150.2(b)1 A Exception 2.	CF1R-ALT
Adding Exterior Framed Wall Insulation[3] or a New Wall in an Existing Building	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074 Exception: Walls already insulated to R-11 §150.1(c)	In 2x4 Framing: R-13, U=0.102 In 2x6 Framing: R-19, U=0.074 (same as Mandatory)	N/A	CF1R-ALT

Table 9-5A: Residential Alterations, Summary of Mandatory and Prescriptive Measures (continued)

Type of Envelope Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)[2]	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Adding Raised Floor Insulation	R-19 or equivalent U-factor Exception: Floors over controlled ventilation or unvented crawlspaces per §150.1(d)	R-19 or equivalent U-factor (same as Mandatory)	N/A	CF1R-ALT
Replacing Vertical Fenestration[4] (Altered Glazing)	Weighted average U-factor = or < 0.58 Exemption: Up to 10 ft^2 or 0.5% of Conditioned Floor Area, whichever is greater, is exempt from the U-factor requirement §150.0(q)	All CZs: U-factor = 0.32 CZ 2, 4 & 6-16: SHGC = 0.25 §150.2(b)1.B.	Replacement of vertical fenestration up to 75 ft^2: U=0.40 (in all CZs) and SHGC=0.35 in CZs 2, 4 & 6-16 as per §150.2(b)1B Exception 1 .	CF1R-ALT

Adding Vertical Fenestration[4] (New Glazing) and Greenhouse	Weighted average U-factor = or < 0.58 Exemption: Up to 10 ft^2 or 0.5% of Conditioned Floor Area, whichever is greater, is exempt from the U-factor requirement §150.0(q)	Must not exceed the 20% Total or 5% West Fenestration Area U-factor = 0.32 (in all CZs); In CZ2, 4 & 6-16: SHGC = 0.25 §150.2(b)1.A.	Added fenestration up to 75 ft^2 need not meet total or west-facing fenestration area requirements as per §150.2(b)1A Exception 1 . Added Greenhouse must either meet the maximum U-factor of 0.58 or weighted average U-factor of 0.58 or up to 10ft^2 or 0.5% of CFA whichever is greater as per §150.0(q)1.	CF1R-AL
1: Alterations must comply with all applicable mandatory measures in §110.0 and §150.0 of the Standards as explained in Chapters 3, 4, 5 and 6 of this Manual.				
2: Several prescriptive measures are Climate Zone (CZ) specific.				
3: There are no mandatory measures or prescriptive requirements when altering below-grade or exterior mass walls.				
4: Replacement fenestration is new fenestration that is located in the same existing wall or roof in which the same or larger area of existing fenestration is being removed. It 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".				

Greenhouse Windows

Greenhouse or garden windows are special windows that project from the façade of the building and are typically five sided structure. An NFRC-rated U-factor for greenhouse windows is typically quite high and may not meet the mandatory requirements for the fenestration U-factor of 0.58.

The ways to meet this mandatory measure for greenhouse windows are:

Must have a maximum U-factor of 0.58 or better; or

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

The Exception to §150.0(q)1 for up to 10 ft^2 or 0.5% of CFA, whichever is greater; or

When using the performance approach Exception 1 as per §150.2(b) - Any dual-glazed greenhouse or garden window installed as part of an alteration complies automatically with the U-factor and meets the requirements as per §150.1(c)3.

9.6.3 Adding Insulation to Existing Roof/Ceilings, Walls and Raised Floors

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

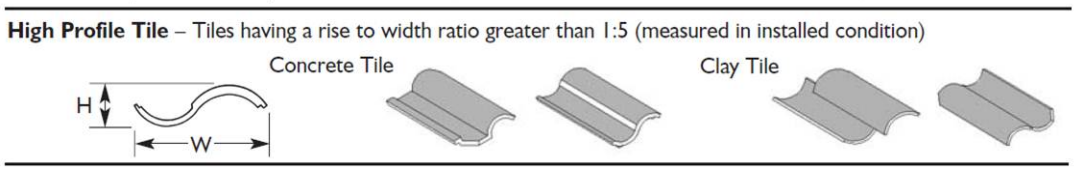
1. R-38 in attic spaces in climate zones 1 and 11 through 16; and R-30 in attics in climate zones 2 through 10; or
2. R-13 in 2x4 exterior walls, and R-19 in 2x6 or greater exterior walls; or
3. R-19 in raised floors over crawl spaces, over open outdoor areas and over unheated basements and garages.

9.6.4 Replacing the Roof Surface or Roof Sheathing

STEEP-SLOPED ROOFS (≥ 2:12)

In climate zones 10 through 15: if 50% or more of the existing building's roof surface is being replaced, the minimum cool roof requirement for the replaced steep-sloped roofing area is aged solar reflectance = 0.20, thermal emittance = 0.75 or a minimum SRI = 16. These apply unless any of the following is present which are considered equivalent to the cool roof requirements in §150.2(b)1Hi:

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



3. Existing ducts in attic insulated and sealed according to §150.1(c)9; or
4. Building has at least R-38 roof/ceiling insulation; or
5. Roof of attic spaces has a radiant barrier according to §150.1(c)2; or
6. There are no ducts in any attic space; or
7. In CZ10 through 15 only: greater than R-4.0 insulation above the roof deck.

LOW-SLOPED ROOFS (< 2:12)

In climate zones 13 and 15: if 50% or more of the existing building's roof surface is being replaced, the minimum cool roof requirements for low-sloped roofs are aged solar reflectance = 0.63, thermal emittance = 0.75 or a minimum SRI = 75 per §150.2(b)1Hii. These apply unless any of the following is present which are considered equivalent to the cool roof requirements in §150.2(b)1Hii:

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

Table 9-6Aged Solar Reflectance Insulation Trade Off Table

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

ROOF SHEATHING

In climate zones 2 through 15: if roof sheathing over an attic space with a continuous radiant barrier is being replaced, a continuous radiant barrier must be re-installed.

9.6.5 Replacement Fenestration

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

Example 9-14

Question

An existing building, 50 ft^2 of total 85 ft^2 vertical glazing is being removed from an existing south 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 treated as "replacement" fenestration and 35 ft^2 is considered existing then the replacement of fenestration must comply with the measures in §150.2(b)1B; or for this example Exception 1 can used. Vertical fenestration not greater than 75 ft^2 can meet the measures by installing fenestration no greater than a U-factor of 0.40 and SHGC of 0.35.

Replacement fenestration is an area of new fenestration which replaces an equal or greater 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 exact openings as the glazing being removed as long as it is being installed in the same existing wall or roof surface which remains a part of the existing building. Any added fenestration area that is larger than the total altered glazing area) is labeled as "new".

9.6.6 New Fenestration in Alterations

The 2013 Standards have relaxed some of the prescriptive restrictions on new vertical fenestration for alterations in existing dwellings. When new vertical fenestration is added in existing dwellings, up to 75 square feet 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 Standards requirements using the prescriptive approach, without having to resort to the performance approach. However, this additional fenestration must meet the prescriptive U-factor and SHGC requirements of Package A or meet the U-factor and SHGC requirements of Exceptions 1 and 2 to Section 150.2(b)1B.

Example 9-14

Question

An existing house in climate zone 12 has all single-pane windows. All of the windows will be replaced within existing openings, except a pair of 40 ft^2 French doors to replace an existing 30 ft^2 window. What requirements apply?

Answer

For prescriptive compliance, replacement fenestration (equal to or less than the area of existing windows in each wall being altered) and new additional fenestration area must both meet the U-factor (0.32) and SHGC (0.25) in Package A. The post-alteration total glazing area must be no greater than 20% of conditioned floor area, and all installed fenestration also must meet applicable mandatory measures.

In order to use the performance approach, at two or more energy measure must be used as a trade-off within the house per §150.2(b)2. For example, if the homeowner is replacing the 1) water heater along with 2) window replacements, then the Existing + Alterations calculation is available as a compliance alternative. In that case:

(a) In the Existing + Alterations approach *without* third party verification, replacement fenestration that achieves the fenestration values in Table 150.2-B is compared to those same values in the Standard Design. Replacement fenestration that does not reach these values is penalized; or,

(b) In the Existing + Alterations approach *with* third party verification, replacement fenestration that achieves the fenestration values in Table 150.2-B 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:

(c) New for the 2013 is the use of window films in lieu of fenestration replacement. Window films are considered as an alteration option to existing fenestration for energy compliance. Similar to fenestration replacement the window film must also meet the Standard Design for altered component *with* or *without* third party verification as indicated in Table 150.2-B. Also see window film installation protocols in Reference Appendices RA4.2.3.

Example 9-15

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

Because two or more altered components are required to use the performance method per §150.2(b)2, only the prescriptive path is available to meet the Standards. As a result, the area-weighted average of all replacement windows must meet the requirements of Package A, and new fenestration must also meet applicable mandatory measures of §110.6, §117.0 and §150.0.

Example 9-16

Question

An existing building has all single-pane, wood-frame windows. Two double-pane, metal-frame greenhouse windows will be added as part of a remodel. How should the greenhouse windows be treated?

Answer

Since greenhouse windows add conditioned volume, but do not add conditioned floor area, this remodel is considered an alteration rather than an addition. For the purposes of alterations, any dual-glazed greenhouse windows installed as part of an alteration may use §150.0(q) to meet the U-factor and Package A to meet SHGC requirement.

If two or more types of altered energy measures are in the existing building, the Existing + Alterations performance method may be used as explained above in the answer to Example 9-15. All applicable mandatory measures must be met.

Example 9-17

Question

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

Answer

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

Example 9-18

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 have a roughly equivalent or greater impact on energy savings than the cool roof requirements. There are older vintage structures that often have ducts under the house rather than in the attics; and newer homes may have materials just slightly below current requirements or equal to one of the items considered to be equivalent.

Often changing one performance measure in a system can have an impact, sometimes reducing or negating the positive benefit of another. In warm months the main concern is heat gain in the attic negatively impacting ducts, or, by conduction, heating the occupied area ceilings. For example,

If the ducts are insulated and air leakage controlled to meet current requirements, energy savings are expected to at least equal the benefit of reflective roof coverings.

Example 9-19

Question

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

Answer

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

Example 9-19

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 the purpose of 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 Standards is considered an alteration and not a repair.

Example 9-21

Question

Where do radiant barriers need to be installed when using the prescriptive Package A or meeting the performance standards where credit is taken for retrofitting a radiant barrier in the existing house?

Answer

The radiant barrier only needs to be installed on the underside of an attic roof assembly and the gable wall ends associated with an addition. The prescriptive requirement is the same for entirely new buildings.

Example 9-22

Question

I am considering doing a reroofing on 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:

<u>Prescriptive Exceptions for Steep-Sloped Roofs</u>

1. Air-Space of 1.0 inch (25 mm) is provided between the top of the roof deck to the bottom of the roofing product; or

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; or

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

4. Buildings with at least R-38 ceiling insulation; or

5. If the building has an attic radiant barrier meeting the requirements of §150.1(c)2 ; or

6. Buildings with no ducts in the attic; or

7. If in climate Zones 10-15, R-4 or greater insulation above the roof deck.

<u>Prescriptive Exceptions for Low-Sloped Roofs</u>

1. Buildings with no ducts in the attic; or

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 9-23

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. If using prescriptive compliance the roof must meet the cool roof requirements of Package A for the type of roof slope and density. To avoid the cool roof requirements, you may use the performance approach and tradeoff against other energy efficiency features of the addition alone or the existing building by using the Existing + Addition + Alterations approach.

9.6.7 Prescriptive HVAC System and Water Heating Alterations

The Standards apply to alterations of the heating and cooling system whether or not the alterations correspond to an addition to the building. This section describes the conditions where compliance is necessary and describes the corresponding prescriptive requirements.

If the heating and cooling system is left unchanged as part of an addition or alteration, then compliance with the requirements for altered HVAC systems is not necessary. Extension of an existing heating and cooling system, such as extension of a duct is not considered a change to the existing heating and cooling equipment therefore the existing heating and cooling system components are unchanged (except the ducts) and do not need to meet the Standards requirements. However, the extensions of the duct systems must meet mandatory requirements described in Section 9.4.2; and prescriptive requirements described below.

Example 9-24

Question

An existing 1,500 ft² single family residence 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

Since this is an alteration to an existing water heating system, no water heating calculations are required for compliance of the addition alone. However, applicable mandatory measures apply. The water heater must have an Energy Factor equal to or greater than the federal minimum standards, or R-12 insulation wrap. The first 5 ft. of hot and cold pipes must be insulated. If building energy compliance is achieved with the Existing + Addition + Alterations calculation, the EF and other energy features of the water heating system are modeled in the performance method.

Example 9-25

Question

An existing 2,000 ft² single family residence 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 standards allow addition alone compliance in certain circumstances. Since this is an instantaneous gas water heater, it may be installed if it can be demonstrated that it uses no more energy than a 50 gallon gas non-recirculating storage tank (see Prescriptive Water Heating Alterations above). Since §150.1(c)8B declares a single instantaneous gas water heater to be equivalent to a standard 50 gallon storage water heater, then no water heating calculations are required. Mandatory measures apply.

Other alternatives are to show compliance with existing-plus-addition or whole building compliance.

Example 9-26

Question

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

Answer

When there is an increase in the number of water heaters with an addition, the Standards allow addition alone compliance in certain circumstances.

If this residence does not have natural gas connected to the building and the new water heater has an EF equal to or greater than the federal minimum standards, the system automatically complies. No water heating calculations are submitted.

If it does have natural gas connected, then the new water heater must be natural gas, or calculations are required to show the proposed water heater would use no more TDV energy than a 50 gallon natural gas water heater with an EF equal to the federal minimum standards.

9.6.8 HVAC "Changeouts"

The Standards make a distinction between two types of HVAC "changeout" situations:

1. Entirely New or Complete Replacement Space Conditioning Systems;
2. Altered Space Conditioning Systems.

The differences in the requirements for these two types of HVAC changeout situations are discussed in the following sections.

9.6.9 *Entirely New or Complete Replacement Space Conditioning Systems*

When an Entirely New or Complete Replacement Space Conditioning Systems *is installed, the system must meet all applicable mandatory measures, including:*

§150.0(h) – Space conditioning equipment loads, design, installation, etc.;

§150.0(i) – Thermostat requirements;

§150.0(j)2 – Refrigerant line insulation thickness;

§150.0(j)3 – Refrigerant line insulation protection;

§150.0(m)1 – California Mechanical Code(CMC) compliance;

§150.0(m)2 – Factory fabricated duct system UL requirements;

§150.0(m)3 – Field fabricated duct system UL requirements;

§150.0(m)4 – Duct R-value minimum ratings;

§150.0(m)5 – Duct insulation thickness and R-value;

§150.0(m)6 – Duct labeling requirements;

§150.0(m)7 – Backdraft damper requirements on vent systems;

§150.0(m)8 – Gravity ventilation system dampers;

§150.0(m)9 – Protection of insulation;

§150.0(m)10 – Prohibition of using porous inner core;

§150.0(m)11 – Duct system sealing and leakage testing for new systems;

§150.0(m)12 – Air filtration requirements;

§150.0(m)13 – HSPP/PSPP, mandatory return duct sizing (or diagnostically tested airflow and fan efficacy);

§150.0(m)15 – Requirements for zonally controlled systems;

These systems must also meet the prescriptive requirements found in:

§150.1(c)6 – Allowed heating system types;

§150.1(c)7 – Space heating and cooling system minimum efficiencies and refrigerant charge verification in climate zones 2, 8 through 15.

§150.1(c)9 - Duct insulation requirements;

§150.1(c)10 – Central fan integrate systems added or required as part of an addition or alteration must meet the 0.58 watts per cfm requirement.

These requirements are discussed in detail in Chapter 4, HVAC Requirements.

Note: Completely New or Replacement Duct Systems in *multifamily* dwelling units shall meet the 12% (total leakage protocol), or 6% (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). Otherwise, altered duct systems in multifamily dwelling units shall meet the 15% (total leakage protocol), or 10% (leakage to outside protocol), or smoke test criteria given in 150.2(b)1Dii(b).

A system *installed in an existing dwelling shall be considered an* Entirely New or Complete Replacement Space Conditioning System *when:*

1. the air handler and all of 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, and
2. the duct system meets the definition of an *Entirely New or Complete Replacement Duct System (including systems less than 40 feet in length).*

An altered duct system installed in an existing home shall be considered an Entirely New or Complete Replacement Duct System when:

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

Altered duct systems that do not meet the definition of Entirely New or Complete Replacement Duct Systems shall be considered an Extension of an Existing System.

Space conditioning systems that do not meet the definition of Entirely New or Complete Replacement Space Conditioning Systems shall be considered Altered Space Conditioning Systems.

9.6.10 Altered Duct Systems – Duct Sealing Requirements

Entirely New or Complete Replacement Duct Systems must meet the mandatory requirements of:

§150.0(m)12 – Air filtration requirements, and

§150.0(m)13 – HSPP/PSPP, mandatory return duct sizing (or diagnostically tested airflow and fan efficacy).

These requirements are discussed in detail in Chapter 4.

Entirely New or Complete Replacement Duct Systems must also be sealed to the criteria for "new duct systems" found in Table RA3.1-2, discussed below.

Because *Entirely New or Complete Replacement Duct Systems* can also include the original air handler, which may leak substantially more than new equipment. An attempt should be made to seal the duct system to meet the 6 percent (of nominal system central fan airflow) leakage rate criteria. If the 6 percent leakage rate criteria cannot be met, a smoke test should be performed to verify that the excess leakage is coming only from the furnace cabinet (air handler cabinet), and not from other *accessible* portions of the duct system. Note that the protocol for Smoke Test of Accessible-duct Sealing given in Reference Residential Appendix RA3.1.4.3.7 makes an exception for the furnace cabinet (air handler cabinet).

Note that this will satisfy the sealing requirement and does not cause the system to no longer meet the definition of an *Entirely New or Complete Replacement Duct Systems.*

Altered duct systems that do not meet the definition of *Entirely New or Complete Replacement Duct Systems* shall be considered an *Extension of an Existing System.* These duct systems are required to meet one of the leakage criteria for "altered existing systems" cases in Table RA3.1-2.

Because duct sealing is a mandatory measure, alterations to an existing duct system, such as adding or replacing sections of duct, will trigger duct sealing. However, cost-effectiveness must also be taken into account. Having to seal an entire system because one foot of duct is being removed may not be cost effective all by itself. The standards set the length of 40 feet of duct as a criterion to trigger this requirement.

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.

In addition to the duct sealing requirements, the added or replaced ducts must also meet the air distribution requirements of §150.0(m) and the duct insulation requirements of §150.1(c)9. Note that the air distribution and duct insulation requirements must be complied with in all climate zones; however, these requirements apply to only new or replaced ducts, the existing and unaltered ducts do no need to comply with these requirements.

Installing 40 feet or less of new or replacement ducts alone will not trigger the sealing requirements described above; however, the new ducts and connections must still meet the air distribution and duct insulation requirements of §150.0(m) and §150.1(c)9.

9.6.11 Altered Space-Conditioning Systems - Duct Sealing and Insulation

Existing duct systems must be sealed and verified by a HERS rater when portions of the heating and cooling system are altered. The requirement applies in all climate zones.

9.6.12 An air handler is installed or replaced.

Ducts must be sealed (as described below) under any of the following circumstances:

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

The requirements apply to the duct system that is affected by any one of the alterations listed above. 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 rater or installing contractor must at least attempt compliance with the first option (15 percent leakage); then any of the other options can be utilized:

a. *Total leakage is less than 15 percent of nominal system fan airflow (RA3.1.4.3.1);*
b. *Leakage to the outside is less than 10 percent of system fan airflow (RA3.1.4.3.4);*
c. *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).*
d. 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 that chooses option 3.
e. Since test equipment must be set up for the first three options, it may be most efficient to test and record the results for the existing system and then attempt to meet each option sequentially until compliance is achieved.
f. There are a few cases where duct sealing and duct leakage verification are not required. These exceptions include the following:
g. *Ducts that have already been sealed, tested, and certified by a HERS rater;*
h. *Duct systems with less than 40 ft of duct in unconditioned spaces;*

Duct systems that are insulated or sealed with asbestos.

9.6.13 Accessible Ducts

Several code sections and protocols require a smoke test to demonstrate that all accessible leaks have been sealed.

Accessible is defined Joint Appendix JA1 as "having access thereto, but which first may require removal or opening of access panels, doors, or similar obstructions."

Ducts located in an attic or crawlspaces are generally considered accessible because code requires access to those spaces. Access is usually gained by opening a door, hatch, or other moveable panel. If this can be done without causing damage that would need to be repaired, this is considered accessible. It is not expected that drywall sections have to be cut or damaged to gain access,

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

For example:

If the ducts are buried under insulation, and gaining access to the leaks in these ducts would require substantially disturbing the insulation this is probably not considered accessible;

If a leak in the duct system is in too small a space between framing members for an average size person to be able to reach the joint to seal it, then this is probably not considered accessible;

If ducts are suspended far above the ground and reaching them would require scaffolding or special equipment other than normal ladders, then these are probably not considered accessible;

If sheet metal ducts are wrapped with insulation and a smoke test indicates multiple small leaks along the lengthwise seams in the ducts in many locations, it is probably not cost effective to remove the insulation to find and seal these leaks. However, if one or more location shows a very obvious and substantial leak, it should be sealed.

All other portions of the duct system for which a smoke test identifies the presence of leakage must be sealed in order to comply. The exemption for inaccessible portions of the duct system is applicable only if the other criteria for duct leakage compliance cannot be met.

The installing contractor may perform a smoke test to locate and seal accessible leaks, or assess whether or not the duct leaks are accessible. However, compliance by smoke test and sealing all accessible leaks must be determined by a smoke test that has been conducted by a HERS rater.

9.6.14 Refrigerant Charge Verification

In climate zones 2, and 8-15, 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 systems that do not have a CID installed to have refrigerant charge field verified in accordance with all applicable procedures specified in Reference Residential Appendix Sections RA3.2.2, or Reference Residential Appendix RA1.

The RCV procedures in RA3.2 are not intended to replace the equipment manufacturer's charging procedures and specifications. The installer must first charge the system according to the manufacturer's instructions and specifications. It is important to know that the procedures in RA3.2 are not procedures for charging a system; rather, they are procedures for verifying proper charge. HERS Raters are not allowed to adjust the refrigerant charge in systems that they are verifying. Raters are also prohibited from performing the weigh-in charge verification procedures. However, when specified by the Standards, a Rater may observe the installer while the installer performs the weigh-in procedure to verify compliance as specified in Section RA3.2.3.2 (described below).

A. ***Charge Indicator Display***. As an alternative to RCV the installer may install a special device called a charge indicator display (CID). This device provides real-time monitoring of the air conditioning system and will show a warning visible to the home's occupants when the system is either over or undercharged, or if the system airflow rate does not meet the minimum requirement. The display unit must be located within one foot of the thermostat. §150.1(c)7Aib states:

   (When applicable, systems shall) be equipped with a charge indicator display (CID)

device that provides a clearly visible indication to the occupant when the air conditioner fails to meet the required system operating parameters specified in the applicable section of Reference Joint Appendix JA6 for the installed CID technology. The CID indication display shall be constantly visible and within one foot of the air conditioners thermostat. CID installations shall be confirmed by field verification and diagnostic testing utilizing the procedures specified in Reference Residential Appendix RA3.4.2.

Minimum Airflow. When refrigerant charge verification is required for compliance, the system must also comply with the minimum airflow requirement specified in RA3.2.2.7 if the airflow verification protocol in RA3.3 can be applied to the system.

Altered HVAC systems must meet the minimum 300 cfm/ton airflow rate compliance criterion; example include but not limited to replacing the outdoor condensing unit, replacing the furnace or air handler, and entire replacement of the duct system.

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.

Alternative to Refrigerant Charge and Verification requiring at least 300 cfm per ton of airflow. If the altered HVAC that requires RC&V is not able to comply with the 300 cfm per ton of airflow required under subsection Reference Residential Appendix RA3.2.2.7.2, the HVAC installer may choose the alternative procedure outlined in Reference Residential Appendix RA3.2.2.7.3, *Alternative to Compliance with Minimum System Airflow Requirements for Altered Systems*, provided that the system thermostat is an Occupant Controlled Smart Thermostat (OCST) which conforms to the requirements of Reference Joint Appendix JA5.

Under RA3.2.2.7.3, installer must take a series of remedial steps, including but not limited to cleaning filters, removing obstructions from registers and dampers, replacing crushed or blocked ducts, cleaning the evaporator coil, making sure that the air handler is set to high speed and conforms to manufacturer specifications, and enlarging/adding the return duct and the return grill. These steps must be HERS verified by a HERS rater. Again, as mentioned above, when the installer chooses this option, the system thermostat must be an OCST.

B. ***Applicability of the protocols.*** The refrigerant charge verification (RCV) protocols in RA3.2 and RA1 are applicable only to air-cooled air conditioners and air-source heat pumps. Equipment types such as ground source, water source, and absorption air conditioners and heat pumps cannot be verified using the protocols in RA3.2 and RA1. When a system other than an air-cooled air conditioner or air-source heat pump is installed, the requirements in Standards §110.1 may provide further direction for compliance.

If an aspect of the RA3.2.2 or RA1 verification protocol is not applicable to the system, alternative requirements may be specified by applicable subsections of §150.2(b)1F, however the procedures in RA3.2.2 or RA1 that *are applicable to the system* shall be performed.

For example, if a system does not have both a high side and low side refrigerant access port, thus cannot conform to the subcooling or superheat refrigerant charge verification procedure, but is a ducted system that can conform to the airflow measurement protocol; the system must comply with the minimum airflow requirement specified in RA3.2.2.7. Similarly, if the outdoor temperature is below 55°F which

precludes use of the RA3.2.2 protocol for verification of the charge, and if the RA1 protocol cannot be used, then the weigh-in charging procedure in Reference Residential Appendix Section RA3.2.3.1 shall be used, and the minimum system airflow rate shall be verified as required by RA3.2.2.7.

The installer must determine which procedures are applicable to a system and verify compliance accordingly.

C. ***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)

Package Units. Package units are typically pre-charged at the factory prior to shipment. When a new package unit is being installed or is replacing an older unit it may not require RCV if the installer can document that the manufacturer certified correct refrigerant charge at the factory. The installer must submit a certificate of installation documenting this and third party verification of refrigerant charge by a HERS rater is not required. This only applies to new equipment shipped from the manufacturer. Any modification to existing equipment that adds or replaces refrigerant containing components voids the manufacturer's certification. It is also important to note that this does not relieve the contractor from the requirement to verify that the system meets the minimum 300 cfm per ton airflow rate requirement.

D. **Mini-Splits and Other System Types.** Some air-cooled air conditioning systems and air-source heat pumps cannot use the standard charge verification procedure, as specified in RA3.2.2, due to the design or construction of the system components. These include certain types of "mini-split" systems and variable speed condenser systems. In these cases, the installer must use the weigh-in charge procedures, as specified in RA3.2.3.1, and these systems must be HERS verified using the, as specified in RA3.2.3.2 procedure for HERS Rater observation of the weigh in charge procedure. These systems must also be equipped with an Occupant Controlled Smart Thermostat (OCST) which conforms to the requirements of Reference Joint Appendix JA5.

It is therefore important that the installation of these types of systems be coordinated with the third party verification. When these systems are ducted, they are still subject to the minimum system airflow requirements.

1. **Winter Refrigerant Charge Verification**. Most systems will normally be verified using the RA3.2.2 standard charge verification procedure to demonstrate compliance. However, when the outdoor temperature is less than 55°F, and the Standard Charge verification procedure cannot be used, the installer may elect to use the weigh-in charge method to demonstrate compliance. Compliance with HERS verification when the outdoor temperatures are less than 55°F can be demonstrated using one of two alternatives:

   A. The installer may use the weigh-in charging procedure, but elect to have the system verified by a HERS rater using the RA3.2.2 Standard Charge Verification procedure at a later time when the temperature is warmer; however, this option can delay the project; or

   B. The EXCEPTION to Section 150.2(b)1Fi provides for an alternative HERS verification procedure if the weigh-in method is used. This exception allows the installer to elect to utilize the HERS Rater verification procedure in Reference Residential Appendix Section RA3.2.3.2 in which the Rater observes the installer while the installer performs the weigh-in charging procedure. However,

when the HVAC installer elects this procedure for verification, as specified in RA3.2.3.2, the system thermostat must be an Occupant Controlled Smart Thermostat (OCST) which conforms to the requirements of Reference Joint Appendix JA5.

C. **Weigh-in Procedure During Warm Weather**. The installer may also opt to use the weigh-in procedure when the outdoor temperature is at or above 55°F, but in this case the rater must use the standard charge verification procedure.

D. **Weigh-in Procedure Description**. The weigh-in procedure involves charging the system by determining the appropriate weight of refrigerant based on the size of the equipment and refrigerant lines rather than by actual performance of the system. Systems utilizing the weigh-in procedure by the installer for any reason may not be third party verified by using sample groups.

There are two basic variations of the weigh-in procedures. One involves the adjustment to the amount of refrigerant in a system by adding or removing a fraction of the refrigerant as specified by the manufacturer (weigh-in charge adjustment). The other involves evacuating the entire system and recharging it with the correct total amount of refrigerant, by weight (weigh-in total charge).

The weigh-in charge adjustment procedure may only be used when a new factory-charged condenser is being installed and the manufacturer provides adjustment specifications based on evaporator coil size and refrigerant line size and length.

The weigh-in total charge may be used for any weigh-in procedure but still requires manufacturer's adjustment specifications.

E. **Standard Charge Procedure Description**. The standard charge verification procedure also has two basic variations. One is for systems that have a fixed orifice and the other is for systems that have a variable metering device such as a thermostatic expansion valve (TXV) or electronic expansion valve (EXV).

Both procedures, whether performed by the installer or the rater require that adequate airflow be confirmed prior to verifying charge. If the airflow is less than the minimum requirement of 300 cfm per ton, the system is not operating near its designed capacity or efficiency and the standard charge verification procedure is not valid.

The standard charge verification procedures involve taking refrigerant line temperatures and pressures, calculating equipment performance parameters and comparing those to targets either provided by the manufacturer or obtained from standard tables. All temperature and pressure measurements must be taken using calibrated digital meters. Analog gauges are no longer allowed for refrigerant charge verification procedures due to a lack of accuracy and precision.

In systems that have metering devices, the proper installation and performance can be verified by similar measurements and is an important part of the standard charge verification procedure for systems that have metering devices.

F. **Verifying Minimum System Airflow**. The procedures for measuring total system airflow are found in RA3.3. They include plenum pressure matching using a fan flow meter, a flow grid, a powered flow hood and the traditional (non-powered flow hood). The airflow verification procedures for refrigerant charge verification no longer include the temperature split method.

If a system does not meet the minimum airflow requirements, remedial steps may be required to bring the airflow up. More airflow is generally better for systems with air conditioning. Not only does this allow proper refrigerant charge to be verified, but it also

improves the overall performance of the system. When able to be performed on a system, regardless of the refrigerant charge verification procedure, minimum system airflow must always be verified. Note that §150.2(b)1F states that systems must be installed with "all applicable procedures". This includes the minimum system airflow requirements.

In some cases, improving airflow may be cost prohibitive and there is a process for documenting this in RA3.2.2.7.3. When this option is used, verification by sample groups is not allowed.

G. **Temperature Measurements**. To properly perform the standard refrigerant charge verification procedure, a means of taking an accurate return air dry-bulb temperature must be provided by the installer. In most systems, this is accomplished by drilling a 5/16" measurement access hole (MAH) in the return side of the air handler or return plenum as shown in Figure RA3.2-1. In some cases the correct location for these holes may not be accessible and an alternative location may be provided as long as an accurate return air temperature measurement of the air as it enters the return side of the equipment can be made.

In other cases, taking the return air dry-bulb temperature at the return grill may be appropriate. This is true when the return is located entirely within conditioned space and not subject to leakage or conduction that may change the temperature of the air after it passes through the return grill and before it enters the evaporator coil. This may also apply to equipment where the return grill is an integral part of the air handler, such as enclosed soffit-mounted air handlers (aka, "pancake units").

E. Maintaining 70°F Return Air Temperature. During the data collection portion of the standard charge verification procedures, the return air dry bulb temperature, as measured at the MAH, must remain at or above 70oF. This is to ensure proper refrigerant charge conditions, including but not limited to preventing the moisture on the coil from freezing. This requirement may be problematic during cooler outdoor conditions (above 55oF but below 70oF). The return air temperature can be maintained above 70°F by utilizing the home's heating system or supplemental heaters is permissible. <refer to Blueprint language on this topic>. Note that the weigh-in method is always an option for the installer in these cases.

F. Airflow and Fan Efficacy

In all climate zones when an *entirely new or replacement duct system* (refer to section 9.6.9, above) is installed, the central forced air fan of all ducted air conditioners and heat pumps must simultaneously, in every zonal control mode, demonstrate an airflow of greater than 350 CFM/ton of nominal cooling, and a fan watt draw of less than 0.58 W/CFM in accordance with the procedures in Reference Residential Appendix RA3.3.

As an alternative to the field verified air flow and fan efficacy requirements, the system's return ducts can be sized according to Tables 150.0-C or 150.0-D.

In addition to either the airflow/fan efficacy or return duct sizing alternative, the system installer must provide in the supply plenum, a hole for the placement of a static pressure probe (HSPP) or a permanently installed static pressure probe (PSPP), downstream of the evaporator coil that meets the specifications of Residential Reference Appendix RA3.3.1.

<Insert Diagram>

These requirements are mandatory measures and cannot be traded off by using the performance approach.

These requirements are discussed in more detail in Chapter 4 of this manual.

Heating-only space-conditioning systems are not required to meet the prescriptive cooling coil airflow and fan watt draw requirements.

G. Sampling for Alterations

When compliance for an alteration requires field verification and diagnostic testing, the building owners or their agents may choose to have testing and field verification completed for the dwelling unit alone, or as part of a closed sample group of dwelling units for which the same installing company has completed work that requires testing and field verification for compliance.

Registration of the compliance documentation is required and the procedures for registration of compliance documentation must be followed as described in Chapter 2 of this Residential Compliance Manual, and in Residential Reference Appendix RA2.

Notes regarding sampling for alterations:

1. The sample group shall be no larger than seven;
2. The installing company may request a smaller group for sampling;
3. Homes in a sample group must all have the same set of features to be verified (duct testing, airflow/fan efficacy, refrigerant charge, etc.);
4. Homes with systems utilizing the weigh in method for refrigerant charge verification by the installer cannot be sampled;
5. Whenever the HERS rater for the group is changed, a new group will be established;
6. Field verification and diagnostic testing shall be completed by the HERS rater for at least one randomly selected dwelling unit in each group;
7. Re-sampling, full testing and corrective action shall be completed if necessary, as specified by the Residential Reference Appendix RA2.6.3;
8. The installing contractor must self test and register certificates of installation for all features to be tested prior to the rater choosing a home for verification by sampling.

H. Third Party Quality Control Program

An approved Third Party Quality Control Program may serve some of the functions of HERS raters for field verification and diagnostic testing purposes but does not have authority to sign the Certificate of Field Verification and Diagnostic Testing (CF-4R) as a HERS rater, as specified in Residential Reference Appendix RA2.7.

When a Third Party Quality Control Program is used, the HERS rater must still submit completed, signed, registered copies of the CF-4R to the enforcement agency, the installing contractor, and the builder or building owner for all dwellings that must demonstrate compliance.

I. Setback Thermostat

When a split system air conditioner or heat pump is altered by the installation or replacement of any refrigerant containing component and the existing thermostat is not a setback thermostat, then a new setback thermostat must be installed as described in Chapter 4 of this manual and as specified in §150.2(b)1F.

J. Fuel Switching

For prescriptive compliance, new electric resistance heating systems are prohibited in alterations unless the system being replaced is an electric resistance heating system. If the existing system is gas, propane, or LPG, then new electric resistance systems are not permitted. However, changing from a gas, propane, or LPG space heating system to an electric heat pump is allowed as long as the heat pump efficiency meets minimum efficiency standards, and the heat pump installed size is shown to result in no more TDV energy use than the standard design heat pump using the performance method as specified in §150.2(b)1C.

Table 9-7 – Acceptable Replacement Heating System Fuel Source(s)

Existing Heating System Fuel Source	**Acceptable Replacement Heating System Fuel Source(s)**
Electric	Electric, natural gas, or equipment with efficiency equal to or better than existing system*
Natural gas	Natural gas, or equipment with efficiency equal to or better than existing system* or a heat pump with equal or lower TDV energy use than a standard design system.
LPG	Liquefied petroleum gas, natural gas, or equipment/ system with efficiency equal to or better than existing system* or a heat pump with equal or lower TDV energy use than a standard design system.
* Proof that equipment has an efficiency that is equal to or better than the existing system can be demonstrated by an approved compliance program or other approved alternative calculation method to compare the TDV energy use of the existing system to the proposed system.	

Table 9-5B summarizes requirements for the following types of residential mechanical and water heating system alterations:

1. New or complete replacement space conditioning system: all new equipment and all new ducts with more than 40 linear feet of ducts in unconditioned or indirectly conditioned space;
2. Altered space conditioning system with forced air ducts;
3. Altered mechanical cooling system;
4. Altered duct systems: when more than 40 linear feet of new or replacement ducts are installed in unconditioned or indirectly conditioned space;
5. Installed a zonally controlled central forced air system;
6. Replacing water heaters and altering hot water pipes.

Since there are some overlaps in Table 9-5B between a few mandatory and prescriptive measures depending on the kind of alteration, it is important to accurately identify the type(s) of alteration within the permitted scope of work. For example, duct sealing and HERS testing is a mandatory measure when there is a new or complete replacement space conditioning system and greater than 40 linear feet of ducts in unconditioned space. However, when only new or replacement ducts are being installed, and there is no new space conditioning equipment involved, duct sealing and HERS testing is a prescriptive measure. A key to using Table 9-5B effectively is to have a good understanding of the scope of the proposed alterations.

Example 9-27

Question

Do I have to seal my ducts if I replace my outdoor units in my existing 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 (§150.2(b)1E). However, there are two exceptions that might apply:

1. If the ducts have been previously sealed and verified as sealed, the ducts do not have to be sealed again and re-verified.

2. Less than 40 linear feet of the duct system is located in unconditioned spaces such as attics or crawl spaces.

Example 9-28

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)1D allows the existing system but requires duct sealing if more than 40 linear feet of the new duct system is located in unconditioned or indirectly conditioned space such as in an attic or crawl space. . The existing furnace must have adequate heating capacity to meet California Building Code requirements for the additional space.

Example 9-29

Question

I am adding a bedroom to an existing house which uses 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

No. If using prescriptive compliance and since the existing system is gas, the addition cannot use an electric heating system. Options for heating the space include:

Extending the existing natural gas furnace system as long as there is adequate capacity to meet the California Building Code requirement;

Heating the added bedroom with an electric resistance heater is allowed if the performance approach is taken and the relatively high TDV energy consumption of the electric resistance heater is made up by TDV energy reductions from energy efficiency measures in the addition or in an accompanying alteration.

Note: If there are more than 40 linear feet of added ducts being located in unconditioned or indirectly conditioned space, then the ducts must be sealed, tested and the ducts must be verified as sealed by a HERS rater.

Example 9-30

Question

My central gas furnace stopped working. Since it is about 30 years old I decided to get a new more efficient unit rather than repair the existing one. What are the requirements?

Answer

Mandatory requirements apply to the components being replaced. The furnace, of course, must meet minimum efficiency requirements, but all systems sold in California should already meet the minimum efficiency requirements. If the existing thermostat is not a setback thermostat, it must be replaced with a setback thermostat, as specified in §150.2(b)1F that meets the requirements described earlier in this chapter.

All new ducts must meet insulation and construction requirements. In climate zones 2, 9-16, all existing and new ducts must be sealed and HERS verified, as specified §150.2(b)1E.

Prescriptively, the new heating unit must also be a natural gas unit.

The performance approach could be applied but only if the alteration includes *"tradeoffs between two or more altered components that are listed in TABLE 150.2-B"* (insulation, fenestration, space conditioning equipment, air distribution systems, water heating system, roofing and other measures). Thus if other alterations are also being done one could specify other heating equipment such as heat pumps, electric resistance etc as long as the overall project has a lower TDV energy consumption than the "standard design" efficiency. When using the performance approach one can decide to either use the default standard design efficiencies that the alteration is compared against. Alternately one can hire a HERS rater to document the existing efficiencies and these existing efficiencies can be used in the standard design of performance calculation.

Example 9-31

Question

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

Answer

This is an alteration since no new conditioned space is being added. The mandatory measures for ducts apply. If more than 40 ft of altered duct is in unconditioned or indirectly conditioned space, then the requirements of §150.2(b)1D require diagnostic testing and HERS verification of the whole duct system.

Example 9-32

Question

An up-flow 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 (3 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. This requirement would not apply if the platform were not being altered.

In addition since the air handler is being replaced the prescriptive duct sealing requirements apply per §150.2(b)1E , unless the ducts have been previously sealed and confirmed through verification or there is less than 40 linear feet of ducts in unconditioned spaces.

Example 9-33

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 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 the 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 9-34

Question

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

Answer

No. §150.2(b)1Cii states that the new space-conditioning system be limited to natural gas, liquefied petroleum gas, or the existing fuel type unless it can be demonstrated that the TDV energy use of the new system is more efficient than the existing system. For your situation you would have to use gas or a heat pump for compliance.

Example 9-35

Reserved

Table 9-8 Summary of Prescriptive HVAC & Water Heating Alterations

Type of Mechanical System Alteration	Highlight(s) of Applicable Mandatory Measures [1]	Summary of Relevant Prescriptive Measure(s)	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
New or Complete Replacement Space Conditioning System (New Equipment and All New Ducts > 40 ft. in Unconditioned or Indirectly Conditioned Space)	New equipment must meet all minimum efficiency and other requirements in Sections 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 thru 11: duct sealing & HERS testing with forced air duct systems	All requirements of Section 150.1(c)6,7,9 & 10; and heating system limited to natural gas, LPG or existing fuel type	Exemption from fuel type requirement if new system can be shown to use less TDV energy than the existing system.	CF-1R-ALT or CF-1R-ALT-HVAC; MF-1R *(CF-1R must be registered w/ a HERS Provider)*
Altered Space Conditioning System with Forced Air Ducts	New equipment must meet all the minimum efficiency and other requirements in Sections 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 thru 11	Duct sealing & HERS testing per Section 150.2(b)1.E	(1) Duct systems documented as previously sealed and HERS tested; or, (2) Duct systems with < 40 lineal feet in unconditioned spaces; or, (3) Existing duct system constructed, insulated or sealed with asbestos	CF-1R-ALT or CF-1R-ALT-HVAC; MF-1R *(CF-1R must be registered w/ a HERS Provider)*
Altered[5] Mechanical Cooling (Refrigerant-Containing) System	New equipment must meet all the minimum efficiency and other requirements in Sections 110.2(c), 150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 thru 11	In CZ2, 8-15: refrigerant charge per RA3.2.2 and & HERS testing per Section 150.2(b)1.F.i.a.; or refrigerant weigh-in charging per RA3.2.3.1 & HERS testing	(1) Packaged systems w/ correct, verified and documented refrigerant charge by manufacturer do not require HERS testing (2) When outdoor temperature < 55° F. and refrigerant weigh-in charging used and HERS test RA3.2.3.2 used, system thermostat must be Demand Response.	CF-1R-ALT or CF-1R-ALT-HVAC; MF-1R *(CF-1R must be registered w/ a HERS Provider)*
Altered Duct Systems: When > 40 ft. of New or Replacement Ducts are Installed in Unconditioned or Indirectly Conditioned Space	New ducts must meet applicable portions of Sections 150.0(m)1 thru 11 including duct insulation in Table 150.1-A. Entirely new and complete replacement duct systems must meet additional requirements in Sections 150.0(m)12 & 13.	*New or Replacement Duct System*: duct sealing & HERS testing per Section 150.2(b)1.D.ii.a. *Extension of Existing Ducts By > 40 ft*: HERS testing of existing duct system per Section 150.2(b)D.ii.b.	*Exception to 150.2(b)D.ii.b. Duct Sealing:* when existing duct system is constructed, insulated or sealed with asbestos.	CF-1R-ALT or CF-1R-ALT-HVAC; MF-1R *(CF-1R must be registered w/ a HERS Provider)*

Note 1: Alterations must comply with all applicable mandatory measures in Sections 110 and 150 of the Standards as explained in Chapters 3, 4, 5 and 6 of this Manual.
Note 5: Non-setback thermostats must be replaced with setback thermostats per Section 110.2(c) when alterations include intallation or replacement of the compressor, condensing coil, evaporator coil, refrigerant metering device or refrigerant piping.

Table 9-8 Summary of Prescriptive HVAC & Water Heating Alterations (cont.)

Type of Mechanical System or Water Heating Alteration	Highlight(s) of Applicable Mandatory Measures [1]	Summary of Relevant Prescriptive Measure(s)	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
Installing Zonally Controlled Central Forced Air System	Airflow > 350 CFM/Ton cooling, Fan < 0.58 W/CFM: HERS testing *Section 150.1(m)15*	Bypass ducts that deliver conditioned supply air directly to the return duct airflow may not be used. *Section 150.1(c)13*	N/A	CF-1R-ALT or CZ-Specific CF-1R-ALT-HVAC; MF-1R *(CF-1R must be registered w/ a HERS Provider)*
Replacement Water Heaters and Altered Piping	New equipment must meet minimum efficiency and other requirements in Sections 110.1, 110.3 and 150.0(j)2 Exception to 150.0(j)2: Inaccessible piping requires no insulation	(1) A natural gas or propane water heater that meets the requirements of Section 150.1(c)8 with no recirculation system; or, (2) If no natural gas is connected to the building: an electric water heater with an Energy Factor = or > that required by the Appliance Efficiency Regulations and a storage tank < or = 60 gal and no recirculation system	According to a calculation method approved by the CEC: Any water heating system that uses no more TDV energy than the prescriptive natural gas/propane water heater; or. when no natural gas is connected to the building, any water heating system that uses no more TDV energy than the prescriptive electric water heater.	CF-1R-ALT; or CF-1R-ALT-HVAC; MF-1R

Note 1: Alterations must comply with all applicable mandatory measures in Sections 110 and 150 of the Standards as explained in Chapters 3, 4, 5 and 6 of this Manual.

Table 9-9: Residential Alteration, Summary of Mandatory and Prescriptive Measures

Type of Mechanical System Alteration	Highlight(s) of Applicable Mandatory Measures[1]	Summary of Relevant Prescriptive Measure(s)	Exception(s) to the Prescriptive Measures	Prescriptive Compliance Form(s)
New or Complete Replacement Space Conditioning System **(New Equipment and All New Ducts > 40 ft. in Unconditioned or Indirectly Conditioned Space)**	New equipment must meet all minimum efficiency and other requirements in §150.0(h), 150.0(i), 150.0(j)2, 150.0(j)3, 150.0(m)1 thru 11: duct sealing & HERS testing with forced air duct systems	All requirements of §150.1(c)6,7,9 & 10; and heating system limited to natural gas, LPG or existing fuel type	Exemption from fuel type requirement if new system can be shown to use less TDV energy than the existing system.	CF1R-ALT or CF1R-ALT-HVAC; (CF1R must be registered w/ a HERS Provider)
Altered Space Conditioning System with Forced Air Ducts	New equipment must meet all the minimum efficiency and other requirements in §150.0(h), §150.0(i), §150.0(j)2, §150.0(j)3, §150.0(m)1 thru 11	Duct sealing & HERS testing per §150.2(b)1.E	(1) Duct systems documented as previously sealed and HERS tested; or, (2) Duct systems with < 40 lineal feet in unconditioned spaces; or, (3) Existing duct system constructed, insulated or sealed with asbestos	CF1R-ALT or CF1R-ALT-HVAC; (CF1R must be registered w/ a HERS Provider)
Altered[(5)] Mechanical Cooling (Refrigerant-Containing) System	New equipment must meet all the minimum efficiency and other requirements in §110.2(c), §150.0(h), §150.0(i), §150.0(j)2, §150.0(j)3, §150.0(m)1 thru 11	In CZ2, 8-15: refrigerant charge per RA3.2.2 and & HERS testing per §150.2(b)1.F.i.a.; or refrigerant weigh-in charging per RA3.2.3.1 & HERS testing	(1) Packaged systems w/ correct, verified and documented refrigerant charge by manufacturer do not require HERS testing (2) When outdoor temperature < 55o F. and refrigerant weigh-in charging used and HERS test RA3.2.3.2 used, system thermostat must be Demand Response.	CF1R-ALT or CF1R-ALT-HVAC; (CF1R must be registered w/ a HERS Provider)
Altered Duct Systems: When > 40 ft. of New or Replacement Ducts are Installed in Unconditioned or Indirectly Conditioned Space	New ducts must meet applicable portions of §150.0(m)1 thru 11 including duct insulation in Table 150.1-A. Entirely new and complete replacement duct systems must meet additional requirements in §150.0(m)12 & 13.	New or Replacement Duct System: duct sealing & HERS testing per §150.2(b)1.D.ii.a. Extension of Existing Ducts By > 40 ft: HERS testing of existing duct system per §150.2(b)D.ii.b.	Exception to 150.2(b)D.ii.b. Duct Sealing: when existing duct system is constructed, insulated or sealed with asbestos.	CF1R-ALT or CF1R-ALT-HVAC; (CF1R must be registered w/ a HERS Provider)

9.7 Performance Method:

9.7.1 Existing + Additions + Alterations

Alterations may meet the Standards using the performance approach with any one of the following compliance paths summarized in Section 9.2, Table 9-1:

- *Existing + Addition + Alterations Without Third Party Verification*
- *Existing + Addition + Alterations With Third Party Verification*
- *Existing + Addition + Alterations as New Construction*

For a detailed explanation of each of these compliance alternatives, refer to Section 9.5.2. When there is no addition, the performance calculations model the existing building, all altered components to remain and any new components (see Section 9.5.2 and Table 9-4).

When there is no addition and only alterations to an existing building, this compliance path is allowed only when there are two or more types of altered components as stated in §150.2(b)2.

Energy Commission-approved compliance software is used to model the building as explained in Chapter 8 of this manual. Whichever compliance path is selected, the Certificate of Compliance (CF1R) generated by the compliance 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 (see Section 2.2.2).

Example 9-36

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; and
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 9-4 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 2013 Standards performance rules, the 200ft² wall removed and the 100 ft² of old window within it are not included in the energy model and will have no impact on the standard design. The standard design for the addition portion 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 the duct alterations requirements summarized in Table 9-5B.

The standard design assumptions for the existing house follow the rules summarized in §150.2(b)2 and Table 150.2-B based on whether there is a third party verification of the existing conditions. Without third party verification, upgraded energy components in the existing house are modeled as fixed assumptions in the standard design that represent levels of efficiency reasonably expected for each altered component. If the energy analyst using the compliance software selects third party verification of energy components in the existing house to be upgraded (see Section 9.5.2), the standard design assumes the existing conditions for those components to be as part of the alterations.

If the proposed design including Existing + Addition + Alterations does not pass, other energy components of the existing building and/or the addition may have to achieve compliance. For example, the water heater or the HVAC equipment in the existing portion of the house may be upgraded to achieve additional credits towards compliance. In the addition, higher performing windows and higher levels of roof and wall insulation may also be used to achieve compliance.

Example 9-37

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 9-36, altered components that receive compliance credit must exceed the requirements of Table 150.2-B. Windows in the addition must have a U-factor of < 0.32 and SHGC < 0.25 to receive credit. Replacement windows in the existing house must have a U-factor of < 0.40 and SHGC < 0.35 to receive credit.

A window replacement with a 0.55 U-factor will receive a penalty as 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 as compared with a 0.40 U-factor standard design assumption for that window. With third party verification of existing conditions, a 0.35 U-factor 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 9-38

Question

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

Answer

The first step is to determine whether alterations to the existing building include at least two different types of energy components (e.g. upgrading attic insulation and replacing the water heater.) If so, use the E+A+A approach. If not, you're not allowed to use the performance approach.

Assuming the E+A+A calculation is permissible, the process requires the following next steps:

1. Collect accurate envelope and mechanical information about the existing building from scaled drawings (plans, sections and elevations); and what components, including HVAC, ducts and water heating, 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 program, identifying each modeled feature as "Existing", "Altered" or "New" as summarized in Table 9-4. Proper tagging of each 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 not, modify the energy features of the addition and/or the existing building until compliance is achieved; and print out the appropriate compliance report for permit submittal.

5. All projects that include energy measures requiring HERS field verification and diagnostic testing – which represent almost all buildings under the 2013 Standards – must be registered online with a HERS provider as explained in Section 2.3.

Example 9-39

Question

When using the existing-plus-addition performance approach, do the refrigerant charge, access holes (MAH and STMS) or CID, see §150.1(c)7, airflow, watt draw measurement, and static pressure probe (HSPP), or a permanently installed static pressure probe (PSPP) as specified in §150.0(m)13 and need to be met for central split system air conditioners serving an addition?

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) indicates that the duct system that is going to be extended must be sealed tested and HERS verified according to §150.2(b)1D.

For performance compliance in climate zones that require a refrigerant charge and airflow measurement in Package A, a hypothetical standard design SEER split system with this credit would be modeled in both the standard and the proposed designs (for example, values from the vintage table, or minimally complying equipment), resulting in neither credit nor penalty related to this feature.

If a new central split system is installed to serve the addition, it must meet the requirements of §150.2(b)1C where installation of a new air conditioner to serve both the existing house and the addition is considered an alteration, and must meet the requirements for diagnostically tested refrigerant charge measurement fan airflow, watt draw and other requirements described. The duct sealing, testing and verification requirements of §150.2(b)1E must also be met.

Example 9-40

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

Yes. Credit can be obtained from sealing, testing and HERS verification of duct sealing.

However as shown in Table 150.2-B "Standard Design for an Altered Component," the base case duct leakage will be the requirements in Section 150.2(b)1D (i.e. with 15% duct leakage or 10% leakage to the outside). Sealing below 15% can be difficult if the ducts are not readily accessible and large holes are present in the ducts. An alternative approach is to replace the ducted system with a ductless system such as a mini-split.

Example 9-41

Question

When using the existing plus addition performance compliance method, can credit be gained by installing a radiant barrier in the existing house attic? If so, where does the radiant barrier need to be installed?

Answer

Yes, installing a radiant barrier in the existing building will result in a credit relative to the standard design for existing buildings permitted (or constructed) prior to June 1, 2001. The radiant barrier must be installed over the entire attic/roof area including gable walls. If there are roof/ceiling assemblies where it is not possible to reach the underside of the roof, such as roof/ceiling assemblies using enclosed rafters which are not proposed to be exposed as part of the project, the radiant barrier cannot be properly installed and compliance credit is not possible.

Example 9-42

Question

I am adding a room to and altering an existing building in climate zone 12. I am upgrading a 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. There will be a penalty toward achieving compliance since the window is not as efficient as required by Table 150.2-B 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 which exceeds the performance of the values in Table 150.2-B, then credit is available.

Example 9-43

Question

I am planning on installing R-25 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-30. No credit is allowed until the mandatory minimum R-30 is reached. However, if you install R-30 or greater in the existing attic, you are allowed to take credit for the difference between the proposed attic insulation R-value and the standard design assumption:

1. Without third party verification of existing conditions, the energy credit is the difference between the default construction assembly U-factor for R-30 and the lower U-factor for attic insulation greater than R-30.
2. With third party verification of existing conditions, the energy credit is the difference between the default construction assembly U-factor for R-30 and U-factor of the site-verified existing attic conditions.

Example 9-44

Question

I am planning on installing R-25 insulation in an un-insulated 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

Yes. Since there is no attic space, the requirements of §150.0(a) require only R-19 or the equivalent between roof rafters. When you install R-25 you are allowed to take credit for the difference between R-25 and R-19 without third party verification of existing conditions. With third party site verification of the existing un-insulated vaulted ceiling prior to construction, you may take credit for the difference between the R-25 and R-0 (no insulation) in the vaulted ceiling.