

8 Additions, Alterations, and Repairs

8.1 Introduction

Additions, alterations, and repairs are common construction projects for California homeowners. The Standards apply to both additions and alterations, but not to repairs.

Additions

§152(a)

This section is also shown in Appendix B of this manual.

An addition is a change to an existing building that increases conditioned floor area and volume. Converting a garage or unheated basement into a conditioned living space, enclosing and conditioning a patio, or building onto a home are all examples of an addition, as is a bay window that extends all the way to the floor and therefore increases both floor area and volume.

Alterations

§152(b)

This section is also shown in Appendix B of this manual.

Alterations are changes to a building's envelope, space-conditioning system, water-heating system or lighting system, that are not additions. An alteration does not increase both conditioned volume and floor area. Examples include the following:

1. Adding a new skylight (or window including a bay window that does not extend to the floor) to an existing building. If the skylight has a light well that cuts through an existing attic, the alteration adds conditioned volume but is not an addition because it does not add conditioned floor area.
2. Adding a new greenhouse window to an existing building. This is an alteration rather than an addition because it adds conditioned volume to the building, but not conditioned floor area.
3. Adding a loft within the existing conditioned volume of a residence. This is an alteration rather than an addition because it adds conditioned floor area, but not conditioned volume.
4. Installing a new central air conditioning and heating system.
5. Replacing an air conditioner or the exterior unit or indoor coil of a split system air conditioner.
6. Replacing of a furnace or water heater.
7. Replacing windows where all the glazing in an existing fenestration opening is replaced with a new manufactured fenestration product.

8. Enlarging an existing window.
9. Adding a new window or door to an exterior wall.
10. Adding new hardwired lighting.
11. Reroofing in specific climate zones for low-sloped and steep-sloped roofing.

Repairs

§101(b), §151(b)1B Note

Repairs to low-rise residential buildings are not within the scope of these Standards. A repair is the reconstruction or renewal of any part of an existing building for the purpose of its maintenance. In this case, “part of a building” means a component, system or equipment, for which there are requirements in the Standards. In simple terms, when such a component, system, or equipment of an existing building breaks or is malfunctioning, and a maintenance person fixes it so it works properly again, that is a repair. If instead of fixing the break or malfunction, the component, system or equipment is replaced with a new or different one – it is considered an alteration and not a repair. Some examples of repairs are the following:

1. Replacing a broken pane of glass but not replacing the entire window.
2. Replacing a failed compressor in an air conditioner but not replacing the entire air conditioner.
3. Replacing a failed fan motor or gas valve in a furnace but not replacing the entire furnace.
4. Replacing a heating element in a water heater but not replacing the entire water heater.

Example 8-1

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; however, per §100(c)2, the sunspace must still comply with the applicable lighting requirements of §150(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 Reference Joint Appendix JA1)

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

Example 8-2

Question

An existing duplex is remodeled, which includes 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 measures described in §152(b).

Example 8-3

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 new windows 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 areas is being added but not conditioned volume, this is an alteration and not an addition. New and replacement windows must meet the maximum U-factor and SHGC requirements of Package D or E. The house must also comply with the mandatory measures for caulking/sealing around windows. Also, insulation must be installed in the exterior walls that are being altered (See Chapter 3). Alternatively, the performance approach may be used to demonstrate compliance for overall building, even if individual windows fail to meet the prescriptive requirements.

8.2 Compliance Approaches

§152

There are three general approaches for showing that residential additions comply with the Standards. The entire structure may be treated as new construction (“whole building”), but this is usually the most stringent approach. The second method is to treat the addition as its own structure (“addition alone”). The third method is to consider the addition along with the existing house (“existing + addition + alteration”). This third method provides the most flexibility but requires using the performance approach.

Table 8-1 compares these three approaches, and details are documented in the vendor’s Compliance Software User Manual.

For alterations there are two compliance options. The first option is the prescriptive method, which requires that all components being altered meet the Package D requirements (with a few exceptions as described later). The second compliance option for alterations is the performance method using the “existing + alteration” approach which follows the same rules as the existing + addition + alteration method described in Section 8.7.3.

Table 8-1 – Comparison of Compliance Methods for Additions

Approach	Prescriptive Method	Performance Method
<p>Whole Building All building systems and components shall comply as if the entire structure is new construction.</p>	<p>This approach may be the easiest compliance method for major renovations and gut rehabilitation projects where the distinction between the existing house and the addition is muddled.</p>	<p>Provides most of the advantages of the performance approach for the addition alone and the existing-plus-addition-plus-alteration approach, but is likely to be more stringent.</p>
<p>Addition Alone The addition is treated as a separate structure.</p>	<p>All new components shall comply with the Package D prescriptive requirements. Glass area limits depend on the size of the addition and/or the amount of glass removed in order to install the addition for square footages up to 1000 ft². Area if glass is limited solely by the size of the addition if the square foot is equal to or greater than 1000 ft².</p>	<p>Some flexibility. Allows tradeoffs in efficiency measures within the addition, but not with existing house. Fenestration area can exceed prescriptive limits if the project complies with the energy budget. Internal gains are prorated by floor area. This method is not allowed when modifications are proposed to the existing water heating system, except if only one additional water heater is installed, and it meets the criteria described in §152(a)2A Exception 3. Otherwise, the Existing + Addition + Alteration approach is required.</p>
<p>Existing + Addition + Alteration The existing house is modeled in its present condition. Then the existing house is modeled with all proposed alterations, as well as the proposed addition.</p>	<p>Not applicable</p>	<p>Improvements in the existing house may be used to offset features in the addition that do not meet the prescriptive requirements. Altered features must meet or exceed the prescriptive requirements in order to obtain credit. This method is also used whenever an alteration is made to existing buildings, whether or not there is an addition to the building at the same time. Fenestration area can exceed prescriptive limits if the project complies with the energy budget.</p>

8.3 Building Envelope

This section describes the mandatory and prescriptive requirements for the building envelope as they apply to additions and alterations. The performance method is discussed in a later section.

8.3.1 Mandatory Requirements

The mandatory measures apply to all added or altered envelope components just as they do to new construction, regardless of whether the prescriptive or performance compliance method is used. The following requirements may apply. See Chapter 3 for more details.

- Fenestration air leakage
- Fenestration U-factor and SHGC ratings
- Fenestration temporary and permanent labels
- Certification of insulating materials
- Restrictions on use of urea formaldehyde foam insulation
- Flame spread ratings
- Ceiling insulation mandatory measures
- Minimum wall insulation
- Minimum floor insulation
- Slab insulation moisture resistance and physical protection (when required by the prescriptive requirements)
- Mandatory slab insulation for heated slabs
- Sealing of joints and other openings
- Vapor barrier in climate zones 14 and 16
- Roofing Products (cool roofs)

Insulation

When insulation is installed in the attics of existing buildings, at least R-38 shall be installed in climate zones 1 and 16 and at least R-30 in the other climate zones. When ceilings without attics are altered, at least R-19 shall be installed between wood-framing members, or sufficient insulation to achieve the equivalent of R-19 insulation between wood framing members and the ceiling, See §150(a). To be considered “altered”, the space between framing members must become accessible as a part of a ceiling/roof modification. For example, if roofing material is being replaced, but the roof sheathing to which the roofing is nailed is not removed, then the insulation would not be required.

Existing structures that already have R-11 insulation installed in framed walls are exempt from the mandatory minimum R-13 wall insulation required by §150(c) if the building can show compliance using performance compliance and modeling R-11.

Roofing Products

All roofing products must meet the mandatory requirements of §10-113 and §118(i), and the prescriptive requirements of §152(b)1H. Roofing products with high solar reflectance and thermal emittance are referred to as “cool roof”, which refers to an outer layer or exterior surface of a roof. As the term implies, the

temperature of a cool roof is lower on hot sunny days than for a conventional roof, reducing cooling loads and the energy required to provide air conditioning.

The benefit of a high reflectance is obvious: while dark surfaces absorb the sun’s energy (visible light, invisible infrared, and ultraviolet radiation) and become hot, light-colored surfaces reflect solar energy and stay cooler. However, high emittance is also important. Emittance refers to the ability of heat to escape from a surface once it is absorbed. Surfaces with low emittance (usually shiny metallic surfaces) contribute to the transmission of heat into the roof components under the roof surface. The heat can increase the building’s air conditioning load resulting in increased air conditioning load and less comfort for the occupants. High-emitting roof surfaces give off absorbed heat relatively quickly through the path of least resistance - upward (and out of the building).

Rating and Labeling

Roofing products that are used for compliance with the standards (prescriptive and performance approaches) are required to be tested and labeled by the Cool Roof Rating Council (CRRC) per §10-113 and that liquid applied products meet minimum standards for performance and durability per §118(i)4. The CRRC is the supervisory entity responsible for certifying cool roof products. The CRRC test procedure is documented in CRRC-1, the CRRC Product Rating Program Manual. This test procedure includes tests for both solar reflectance and thermal emittance.

The roofing products manufacturer must have its roofing product tested for solar reflectance and thermal emittance, and be labeled according to CRRC procedures. Figure 8-1 provides an example of an approved CRRC product label.

	Initial	Weathered	
	Solar Reflectance	0.00	Pending
	Thermal Emittance	0.00	Pending
	Rated Product ID Number	-----	
Licensed Seller ID Number	-----		
Classification	Production Line		
<p>Cool Roof Rating Council ratings are determined for a fixed set of conditions, and may not be appropriate for determining seasonal energy performance. The actual effect of solar reflectance and thermal emittance on building performance may vary.</p> <p>Manufacturer of product stipulates that these ratings were determined in accordance with the applicable Cool Roof Rating Council procedures.</p>			

Figure 8-1-CRRC Product Label and Information

8.3.2 Prescriptive Requirements for Additions Alone

§152(a)

In general, the prescriptive requirements apply to additions in the same way they apply to entirely new buildings and must be documented on the new CF-1R Form. However, there are a few exceptions as noted below and summarized in Table 8-2. Mechanical ventilation requirements do not apply to additions that are less than 1,000 ft².

Use the CF-1R-ADD form to document existing, removed and proposed fenestration by orientation. The total net percentage of fenestration should be 20 percent or less including West facing fenestration. 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 7-15.

Plan checkers will verify the CF-1R-ADD form, total Percentage of Fenestration calculation against the Total Net Fenestration and the CFA to make sure that they do not exceed the allowable limits for total fenestration area as well as west-facing fenestration area.

1. If the Total of Fenestration exceeds 20 percent of the conditioned floor area (CFA), the performance compliance approach must be used. Likewise, if the total west-facing fenestration area in climate zones 2, 4, and 7-15, exceeds 5 percent of the CFA, then the performance compliance approach must be used.
2. If the addition has a floor area of 100 ft² or less, then up to 50 ft² of fenestration area is allowed. Additions that add up to 50 ft² of fenestration area need to meet the Package D requirements for fenestration U-factor and SHGC, but are exempt from the fenestration maximum total area limits (this includes both 20 percent of conditioned floor limit and the 5 percent west-facing limit). There is no credit for glazing removed when using this option. For additions with floor areas of 100 ft² or less that have greater than 50 ft² of added fenestration area, the performance compliance is optional, or choose the less than 1,000 ft² Column.
3. If the addition has a floor area equal to or less than 1,000 ft², then only R-13 wall insulation is required in all climate zones. All other requirements of Package D apply, as indicated in Table 8-2.

The Standard allows the area of fenestration removed during the remodel to be added to the Package D fenestration area allowance (20 percent of floor area). However, the total allowed for west-facing fenestration is 5 percent of the CFA of the addition plus the amount of west-facing glazing removed from the existing building as a result to make way for the addition. The CF-1R-ADD Form is used to determine credit for glazing removed.

4. If the addition has a floor area greater than 1,000 ft² the new fenestration must meet the Package D requirements for fenestration U-factor and SHGC. The 20 percent CFA limitation on added fenestration area and 5 percent limitation on west-facing fenestration (in climate zones 2, 4, and 7-15) applies.

Table 8-2 – Prescriptive Envelope Requirements for Additions

Component	Size of Addition		
	100 ft ² or less	1,000 ft ² or less	More than 1,000 ft ²
Ceiling Insulation	R-19	Package D	Package D
Wall Insulation ¹	R-13	R-13	Package D
Floor Insulation	R-13	Package D	Package D
Fenestration U- factor	Package D	Package D	Package D
Glazing Area	≤ 50 ft ²	Package D (20%) + Glass Removed to make way for the addition ³	Package D
		For west orientation: CFA x 5% of the addition + glass removed to make way for the addition ⁴	
Solar Heat Gain Coefficient (SHGC)	Package D	Package D	Package D
Radiant Barrier ²	N/A	Package D	Package D
Roofing Products	N/A	Package D	Package D

1. Heavy mass and light mass walls may meet the Package D requirements for mass wall insulation instead of R-13.
2. Radiant barrier requirements are not applicable for additions less than 100 ft². For additions greater than 100 ft² in climate zones 2, 4, and 8-15 it is applicable to the roof area of the addition. It is not necessary to retrofit a radiant barrier in the existing attic. N/A (not allowed) means that feature is not allowed in a particular climate zone.
3. The removed glass area can be added to the maximum allowed 20% of the CFA of the addition.
4. For west orientations in climate zones 2, 4, 7-15, no more than 5% of the CFA is allowed for west facing glass plus west-facing glass area removed to make way for the addition.

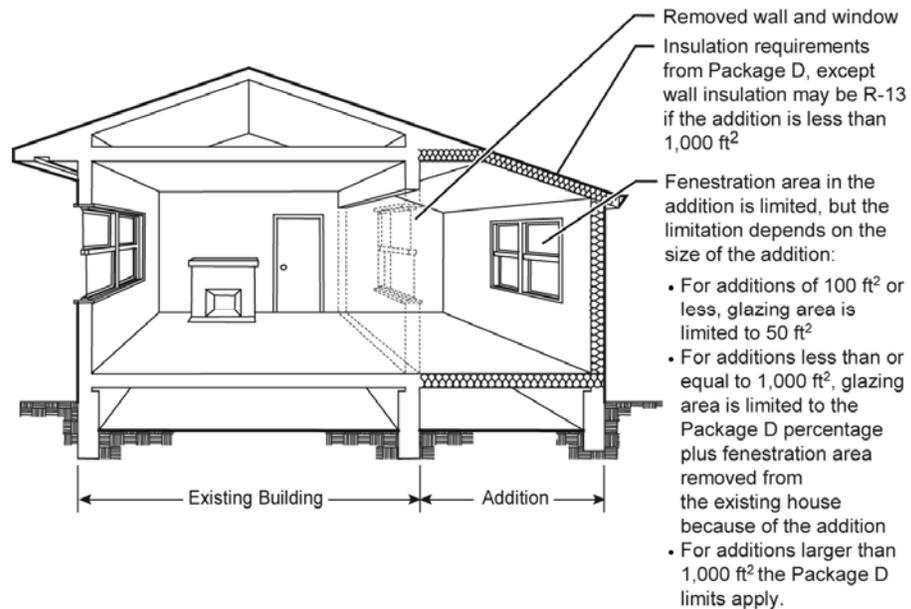


Figure 8-2 – Addition Alone Prescriptive Compliance Approach

Greenhouse Windows

Greenhouse windows are special windows that project from the façade of the building. In addition to the projected area, greenhouse windows typically have two sides, a top and a bottom surface from which heat is exchanged. The NFRC-rated U-factor for greenhouse windows is typically quite high and does not meet the prescriptive requirements for fenestration products.

When greenhouse windows are used in additions or alterations, they are deemed to comply with the prescriptive U-factor requirement when they are dual-glazed, though the prescriptive SHGC limit still applies. This applies only for greenhouse windows used in additions or alterations, not in newly constructed buildings. Greenhouse windows must either meet the SHGC requirements with an NFRC rating, or, if they are being installed with other fenestration products, they may use the default SHGC values from Standards Table 116-B and weight average the SHGC values as described in §151(f)4A.

Greenhouse windows add volume, but not floor area to the building and are therefore alterations, not additions, if this is the only change.

Skylights

Skylights must still comply with the prescriptive U-factor and SHGC maximum values limit in Package D. The SHGC for skylights may be determined either by using an NFRC rating, a default value from Standards Table 116-B, or by calculating the SHGC using a manufacturer's center of glass SHGC_c to determine SHGC_{fen} with the following equation:

$$SHGC_t = 0.08 + 0.86 \times SHGC_c$$

8.3.3 Prescriptive Requirements for Alterations

§152(b)1A and §152(b)1B

Fenestration

When over 50 ft² of fenestration area is added to an existing building, then the fenestration must meet the requirements of Package D for U-factor, fenestration area, and SHGC. The area requirement means that the total fenestration area for the whole building, including the added fenestration, must not exceed 20 percent of the conditioned floor area, and in climate zones 2, 4, and 7-15, the 5 percent west-facing area limit must be complied with. Use the worksheet form CF-1R ALT to document existing, removed and proposed fenestration by orientation. Plan checkers will verify the CF-1R ALT Total Percentage of Fenestration calculation against the Total Net Fenestration and the CFA to make sure that they do not exceed the allowable limits for total fenestration.

If the Total Percentage of Fenestration exceeds 20 percent, the performance compliance approach must be used. Alterations add up to 50 ft² of fenestration area (Exception to §152(b)1A) need to meet the Package D requirements for fenestration U-factor and SHGC, but are exempt from the fenestration maximum 20 percent total area and the 5 percent west-facing areas' limits.

If in an existing building the west-facing fenestration area already exceeds the 5 percent limit and during the alteration more glass is added to non-west facing orientations, so long as the total fenestration area does not exceed the 20 percent of the CFA limit, the building is in compliance with the total and west-facing areas limits. However, if the addition of new glass results in total fenestration exceeding the 20 percent of the CFA limit, then the performance approach must be used to demonstrate compliance with the Standards. Also, if in this scenario, new glass is added to the west-facing orientation, the performance approach must also be used to demonstrate compliance.

An important requirement is that when a fenestration product is replaced with a new manufactured fenestration product in the same orientation and tilt, the new unit must also meet the U-factor and SHGC requirements of Package D, even if the fenestration area does not increase. This requirement applies when all the glazing in an existing fenestration opening is replaced with a new manufactured fenestration product. The requirement applies even if only a single window is being replaced. It does not apply to repairs when only a portion of the glazing within a single opening is replaced. It also does not apply if the existing window is replaced with a field-fabricated window (defined in Chapter 3).

As noted earlier, greenhouse windows added during an alteration are deemed to comply with the prescriptive U-factor requirements as long as they are dual-glazed. The Package D SHGC requirement must still be met. See example 8-7 below for details.

If the added window area (the rough opening area for greenhouse windows) is no greater than 50 ft² then no fenestration area limits apply. However, if more than 50ft² of fenestration is added, then the Package D limit of 20 percent of floor area and the 5 percent West-facing area limits must not be exceeded for the whole building. Otherwise, the performance method must be used.

Example 8-4

Question

A small addition of 75 ft² is being planned – an existing porch is being covered off a master bedroom. The existing heating and air conditioning system will serve the new conditioned space. The contractor wants to follow the prescriptive requirements. What requirements apply? The house is located in climate zone 7.

Answer

Since the addition is smaller than 100 ft², the fenestration area is limited to a maximum of 50 ft². The fenestration must meet the U-factor and SHGC requirements of Package D. For climate zone 7, these fenestration requirements are a maximum U-factor of 0.40 and a maximum SHGC of 0.40. For an addition of this size, insulation only must meet the mandatory requirements of R-19 ceiling insulation; R-13 wall insulation and R-13 floor insulation.

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(m) apply (R-4.2 minimum in unconditioned space). All other mandatory requirements in §150 must be met. Note that this addition could comply with the requirements of §152(a)1B, instead. For some additions this could allow more glazing area, but additional Package D measures would apply.

Example 8-5**Question**

A kitchen is being expanded by 150 ft². As part of the addition a sliding glass door (42 ft²) is being removed. If using prescriptive compliance how much fenestration area is allowed for this addition? If the sliding glass door is west-facing, how much west-facing glazing will be allowed in the addition?

Answer

Since this addition is no larger than 1,000 ft², the Standard permits the area of fenestration removed during the remodel to be added to the Package D fenestration area allowance (20 percent of floor area). In this case, the Package D allowance is 30 ft². Therefore, the total allowance for this addition is 72 ft² of fenestration area. If the addition were larger than 1,000 ft², the area of the fenestration removed could not be added to the 20 percent Package D fenestration area allowance.

Also, in climate zones 2, 4, 7-15, the total allowed west-facing fenestration is 5 percent of the CFA of the addition plus the amount of west-facing glazing removed from the existing building as a result of the construction of the addition. So, the amount of west-facing glazing is 5 percent of 150 ft² (7.5 ft²), plus 42ft² or 49.5 ft².

Example 8-6**Question**

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

Answer

Yes, if using prescriptive compliance, the relocated window must meet the U-factor and SHGC requirements of Package D. If you use this existing window in the addition, you must use the actual or default U-factor and SHGC of this 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 §116(a) do not apply to used windows.

Example 8-7**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 additions and alterations, you can assume that double-glazed greenhouse windows have the U-factor required to comply with the prescriptive standards and that this U-factor can also be used to determine compliance with performance approaches. Alternatively, the NFRC rated U-factor may be used, if available, to meet the U-factor required

in the prescriptive package. However, for greenhouse windows the SHGC must meet the requirements shown in the prescriptive Package D, or 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 116-B if the area weight averaged SHGC of the greenhouse window plus other fenestration in the proposed design meets the values used for compliance.

For skylights, actual U-factors from NFRC rated labels or defaults from Standards Table 116-A may be used for compliance. Exception to §151(f)3A, exempts up to two square foot of tubular skylights from the U-factor requirements, provided that the ceiling diffusers are dual-paned; additional skylights must meet the U-factor requirements. Skylights may use one of three methods for determining the proposed SHGC; NFRC rated SHGC, default SHGC from Standards Table 116-B or a $SHGC_{fen}$ calculated from the manufacturer's center of glass SHGC ($SHGC_c$) using the following equation:

$$SHGC_{fen} = 0.08 + 0.86 \times SHGC_c$$

Note that for greenhouse windows in new construction that are not associated with an existing building, the actual U-factor of fenestration products must be used for compliance documentation/calculations. For greenhouse windows, the window area is the rough opening.

Example 8-8

Question

If I am doing an alteration to move an existing window to another location, does it need to meet the prescriptive requirements?

Answer

Once you move the window to a location where a window did not previously exist, it must meet the prescriptive requirements, because it is considered an altered component rather than a window repair.

Example 8-9

Question

An existing building has all single-pane windows. All of the windows will be replaced, and one wall will be altered to have French doors in place of an existing window. What requirements apply?

Answer

For prescriptive compliance, the Package D prescriptive requirements apply to all new windows. All of the installed fenestration must also meet applicable mandatory measures.

Note that in performance approach, to receive a compliance credit, all fenestration products must also meet or exceed the Package D requirements. There will be a penalty if the new windows fall short of Package D U-factors and SHGC levels.

Example 8-10

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

The Package D prescriptive requirements apply to all new windows. All of the installed fenestration must also meet applicable mandatory measures.

Note that in performance approach, to receive a compliance credit, all fenestration products must also meet or exceed the Package D requirements. There will be a penalty if the new windows fall short of Package D U-factors and SHGC levels.

Example 8-11

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 be treated as though they comply with the U-factor requirements applicable to prescriptive alterations. However, the Package D SHGC requirement applies to these greenhouse windows. All applicable mandatory measures must be met.

Roofing Products

Alterations to existing roofs need to meet §152(b)1H, which requires that when more than 50 percent of the roof or more than 1,000 ft² of exterior existing roof, whichever is less, is replaced, the criteria set forth below must be met.

It should be noted that the requirements for the solar reflectance of roofing products are no longer based on initial values, but rather on 3-year aged values. If the 3-year 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.

$$\text{Aged Reflectance}_{\text{calculated}} = (0.2 + 0.7 [\rho_{\text{initial}} - 0.2])$$

Where ρ_{initial} = Initial Reflectance listed in the CRRC Rated Product Directory.

Refer to Section 3.7 under the building envelope requirements in the residential manual for a full description and a better understanding of roofing products, solar reflectance, thermal emittance and SRI.

Steep-Sloped Roofs – In existing buildings, steep-sloped roofs must meet the following requirements:

1. For steep-sloped roofs, roofing products with a density of less than 5 lb/ft² in climate zones 10 through 15 shall have a minimum aged solar reflectance of 0.20 and a minimum thermal emittance of 0.75, or a minimum SRI of 16.
2. For steep-sloped roofs, roofing products with a density of 5 lb/ft² or more in climate zones 1 through 16 shall have a minimum aged solar reflectance of 0.15 and a minimum thermal emittance of 0.75, or a minimum SRI of 10.

Roofing products with less than 5 lb/ft² generally include asphalt shingles and metal roofs. Products with a density more than 5 lb/ft² generally include concrete, clay tiles, slate and possibly some synthetic roof coverings.

When any of the options in items a through h below are used, they are considered equivalent to the reflectance, emittance, and the SRI requirements described in items 1 and 2 above:

1. Insulation with a thermal resistance of at least 0.85 hr•ft²•°F/Btu or at least a 3/4 inch air-space is added to the roof deck over an attic; or
2. Existing ducts in the attic are insulated and sealed according to §151(f)10; or
3. In climate zones 10, 12 and 13, with 1 ft² of free ventilation area of attic ventilation for every 150 ft² of attic floor area, and where at least 30 percent of the free ventilation area is within two feet vertical distance of the roof ridge; or
4. Buildings with at least R-30 ceiling insulation; or
5. Buildings with a radiant barrier in the attic meeting the requirements of §151(f)2; or
6. Buildings that have no ducts in the attic; or
7. In climate zones 10, 11, 13 and 14, R-3 or greater roof deck insulation above vented attic.
8. Roof areas covered by building integrated photovoltaic panels and building integrated solar thermal panels and existing roof areas that have thermal mass over the roof membrane with a weight of at least 25 lb/ft² are exempted for this requirement as per Exceptions 1 and 2 to §151(f)12.

Example 8-12

Question

Why is there a different requirement in the different climate zones for the aged solar reflectance and SRI requirements between roofing products with density less than 5 lb/ft² versus roofing products and density of 5 lb/ft² or more?

Answer

Roofing products with less density perform differently compared to the higher density materials which have a tendency to retain some gained heat. For this reason the performance characteristics of the two different densities were evaluated separately for each climate zone.

Low-Sloped Roofs – In existing buildings, low-sloped roofs must meet the following requirements:

Low-sloped roofs in climate zones 13 and 15 shall have a 3-year aged solar reflectance equal to or greater than 0.55 and a thermal emittance equal to or greater than 0.75, or a minimum SRI of 64.

There are three exceptions:

1. Buildings that have no ducts in the attic are exempt from this requirement;
2. Roof areas covered by building integrated photovoltaic panels and building integrated solar thermal panels are exempted for this requirement as per Exception 1 to §151(f)12.
3. Roof constructions that have thermal mass over the roof membrane with a weight of at least 25 lb/ft² are exempt from the minimum requirements for solar reflectance and thermal emittance or SRI under Exception 2 to §151(f)12.

Example 8-13

Question

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

Answer

Essentially these two climate zones are the only climate zones which showed cost savings for having a low-slope roofing product requirement.

Example 8-14

Question

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

Answer

There are many things that can have differing impacts on the requirements. There are older vintage structures that often had ducts under the houses rather than in the attics and newer houses may have materials just slight below current requirements or equal to one of the "considered equivalent" items.

Often changing one performance item in a system can have an impact, thereby negating the positive benefit of another. Ultimately, in the warm months the main concern is heat gain in the attic affecting either ducts or by conduction heating the occupied area ceilings. For example, if the ducts are insulated to current requirements and air leakage controlled to meet current requirements, the energy savings would be expected to at least equal the benefit of the reflective roof coverings.

Example 8-15

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 the two different criteria for the roofing products?

Answer

Yes, however, 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 roofing product criteria.

Example 8-16**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 8-17**Question**

Where do radiant barriers need to be installed when using the prescriptive Package D or meeting the performance standards where no 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 the roof assembly and gable ends associated with the addition. This is the same as entirely new buildings.

Example 8-18**Question**

I am considering doing a reroof on my home. When will I be required to put on a cool roof?

Answer

Cool roof requirements are triggered when either more than 50 percent of the roof area or more than 1,000 ft², whichever is less is replaced. If one of the exceptions below applies, then cool roof requirements are not triggered:

1. Buildings with no ducts in the attic; or
2. If the building with a radiant barrier in the attic meeting the requirements of §151(f)2 ; or
3. Buildings with at least R-30 ceiling insulation; or
4. If in climate Zones 10, 11, 13, and 14, R-3 or greater roof deck insulation above vented attic; or
5. If existing ducts in the attic are insulated and sealed according to § 151(f)10 ; or
6. Insulation with a thermal resistance of at least 0.85hr.ft².°F/Btu or at least ¾ inch air-space is added to the rook deck over an attic; or
7. In climate zones, 10, 12, and 13, with 1ft² of free ventilation area of attic ventilation for every 150 ft² of attic floor area, and where at least 30 percent of the free ventilation area is within 2 feet vertical distance of the roof ridge; or
8. If the building can show compliance using performance approach.

Example 8-19

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 D for the type of roof slope and density. To avoid the cool roof requirements, you can use the performance approach and tradeoff against other energy efficiency features of the addition alone, or the existing building by using the existing + addition + alteration approach.

8.4 HVAC

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 requirements.

If the heating and cooling system is left unchanged as part of an addition or alteration, then compliance with the Standards 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 system therefore the existing heating and cooling system components are unchanged and do not need to meet the Standards requirements. However, the extensions of the duct systems must meet mandatory and prescriptive requirements that are described in the following Sections.

8.4.1 Mandatory Requirements

§152(b)1

§152(b)2

Any altered components of the heating and cooling system must meet the same mandatory requirements that apply to new construction. These mandatory requirements include the following as appropriate:

- Equipment efficiency (enforced at time of sale)
- Heat pump controls
- Heating and cooling load calculations
- Standby losses and pilot lights
- Pipe insulation and refrigerant line insulation
- Minimum duct insulation
- Duct connections and closures
- Product markings for flexible ducts
- Dampers to prevent air leakage

- Protection of insulation
- Setback thermostat (in most cases)
- Fireplaces, decorative gas appliances, and gas logs (infiltration and pilot light related requirements). See Chapter 4 for more details.

8.4.2 Prescriptive Requirements

The prescriptive requirements for HVAC alterations are described in this section. The performance method, as described later in this chapter, is an alternative to these prescriptive requirements.

The Standards make a distinction between two types of HVAC "changeout" situations: *new or replacement space conditioning systems*, and *altered space conditioning systems*. The differences in the requirements for these two types of HVAC changeout situations are discussed in the paragraphs below.

New or Replacement Space-Conditioning Systems

§152(b)1C

When a *new or replacement space-conditioning system* is installed, the system must meet all applicable mandatory measures as well as the prescriptive requirements found in §151(f)6, §151(f)7, §151(f)9, and §151(f)11. These prescriptive sections describe the heating system type, airflow and fan watt draw, refrigerant charge measurement and thermostat requirements. When a dwelling is altered to install a *new or replacement space-conditioning system*, §151(f)7 requires that split system air conditioners and heat pumps must meet the refrigerant charge verification requirements, and also the prescriptive cooling coil airflow and fan watt draw requirements. For additional information refer to the Airflow and Fan Watt Draw, and Refrigerant Charge measurement topics below in this section.

A *new or replacement space conditioning system* installed in an existing dwelling includes:

- 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), and
- entirely new or replacement duct system, and
- entirely new or replacement air handler.

A discussion of the characteristics of an *entirely new or replacement duct system* can be found below under the topic Duct Sealing and Insulation. For systems that are altered to repair or replace smaller portions, or separate components of existing space conditioning systems, refer to the topic *Altered Space conditioning Systems* that follows.

Altered Space-Conditioning Systems

§152(b)1E §152(b)1F

When a space-conditioning system is altered by the installation of or replacement of the air handler, outdoor condensing unit of a split system air conditioner or heat pump, cooling or heating coil, or the furnace heat exchanger, §152(b)1E requires the ducts to be sealed, and §152(b)1F requires that the system must have a setback thermostat and the system must also meet the refrigerant charge verification requirements specified in Reference Residential Appendix RA3 that requires installation of Temperature Measurement Access Holes (TMAH), and requires a minimum cooling coil airflow of 300 cfm/ton of nominal cooling capacity. This airflow requirement is less stringent than the prescriptive 350 cfm/ton of nominal cooling capacity required for split system air conditioners and heat pumps in the *new or replacement space conditioning systems* category described above. Refer to the sections on duct sealing, and refrigerant charge measurement below for additional information about these requirements.

Duct Sealing and Insulation

§152(b)1D, §152(b)1E, and §152(b)1F

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 climate zones 2, 9, 10, 11, 12, 13, 14, 15, and 16.

The ducts must be sealed (as described below) under *any* of the following circumstances:

1. An air handler is installed or replaced.
2. An outdoor condensing unit of a split system air conditioner or heat pump is installed or replaced.
3. A cooling or heating coil is installed or replaced.
4. A furnace heat exchanger is installed or replaced.

When more than 40 feet of new or replacement ducts are installed in unconditioned space, in addition to the duct sealing requirements in applicable climate zones described above, the added or replaced ducts must also meet the air distribution requirements of §150(m) and the duct insulation requirements of Package D, §151(f)10. 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 not need to comply with these requirements.

If 40 feet or less of new or replacement ducts are installed, the duct sealing requirements described above do not apply; however, the ducts must still meet the air distribution and duct insulation requirements of §150(m) and §151(f)10.

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.

In climate zones 2, and 9 through 16, for *entirely new or replacement duct systems* in existing residences, the leakage requirement is the same as described in Chapter 4 for new air distribution systems.

An **entirely new or replacement duct system** can also include existing parts of the original duct system (e.g., register boots, air handler, coil, plenums, etc.) if those parts are *accessible* and they can be sealed (refer to the following section on *Accessibility*). Thus, if the system includes the furnace cabinet (air handler) and other existing parts of the original system that are all *accessible*, 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).

In climate zones 2, and 9 through 16, for existing duct systems or when new ducts are being added as an extension of an existing duct system, the sealing requirements are different.

There are four 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:

1. Total leakage is less than 15 percent of nominal system fan airflow.
2. Leakage to the outside is less than 10 percent of system fan airflow.
3. Leakage is reduced by more than 60 percent compared to before the alteration and a smoke test shows that all *accessible* leaks have been sealed.
4. 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. Sampling is not allowed.

When existing duct systems are constructed, insulated, or sealed with asbestos, any new extended ducts are exempt from the duct leakage and sealing requirements.

HERS field verification is required for all options listed above. For options 1, 2, and 3, verification can be accomplished through sampling as described in *Sampling for Additions or Alterations* below. For option 4, sampling is not allowed; a certified HERS rater must do the visual inspection and the smoke test on every house that chooses option 4.

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.

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

1. Ducts that have already been sealed, tested, and certified by a HERS rater.
2. Duct systems with less than 40 ft of duct in unconditioned spaces.
3. Duct systems that are insulated or sealed with asbestos.

Accessibility

§152(b)1Diic, §152(b)1Diid, §152(b)1Eiii, and §152(b)1Eiv require a smoke test to demonstrate that all *accessible* leaks have been sealed.

Accessible is defined as having access thereto, but which first may require removal or opening of access panels, doors, or similar obstructions. For example, if walls or drywall sections have to be moved or removed, or if the ducts are buried under insulation, or if a joint in the duct system is in too small a space between framing members for someone to be able to access the joint to seal it, then that portion of the duct system is not *accessible* and is not required to be sealed even if smoke testing determines that the duct leaks in that inaccessible location. 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, thus only if the standards require a smoke test for compliance.

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.

Refrigerant Charge Measurement

§152(b)1C, §152(b)1F, and §151(f)7

In climate zones 2, and 8-15, when new or replacement or altered split system air conditioners or heat pumps are installed in existing buildings, correct refrigerant charge must be measured by the installer and verified by a HERS rater. The refrigerant charge verification requirement applies when a *completely new or replacement* split system *space-conditioning system* is installed, and also when components of an existing split system space-conditioning system, such as the air handler, outdoor condensing unit, indoor cooling or heating coil, or the furnace heat exchanger are replaced (*altered space conditioning systems*). The cooling coil airflow requirement for *altered space conditioning systems* is 300 cfm/nominal ton of cooling capacity, which is the minimum airflow required for a valid refrigerant charge verification. This airflow requirement is less stringent than the prescriptive 350 cfm/ton required for split system air conditioners and heat pumps in the *new or replacement space conditioning systems* category for which the prescriptive airflow and fan watt draw requirements apply.

Compliance with the refrigerant charge verification requirement by the HERS rater can be accomplished through use of group sampling as described in *Sampling for Additions or Alterations* below.

New or replacement space-conditioning systems must meet §151(f)7A which specifies that when refrigerant charge is required by Standards Tables 151-B, 151-C, or 151-D, ducted split system central air conditioners and heat pumps must also be equipped with either:

1. Temperature measurement access holes (TMAH) and saturation temperature measurement sensors (STMS) that must be HERS verified; or

2. Be equipped with a Charge Indicator Display (CID) that will notify the occupant in case of improper refrigerant charge. The CID display must be constantly visible to the building occupant. The installed CID must also be HERS verified. Installation of STMS is a prescriptive requirement only.

Note: For performance compliance, installation of the STMS is (optional) an alternative to use of refrigerant pressure gauges for determining the saturation temperature in the coil(s).

Temperature Measurement Access Holes (TMAH), Saturation Temperature Measurement Sensors (STMS), and the Charge Indicator Display (CID) provide a non-intrusive means for HERS raters and field technicians to verify the refrigerant charge by eliminating the need to install refrigerant pressure gauges on the suction and the discharge lines, and providing pre-drilled holes in the supply and return plenum where the airflow temperature sensors must be inserted by the technician/rater during the verification procedure. The TMAH feature consists of two 5/16 inch (8 mm) drilled holes; one hole upstream from the cooling coil in the return plenum, and one hole downstream from the cooling coil in the supply plenum. The STMS feature consists of two permanently installed sensors, one mounted on the (indoor) cooling coil and one mounted on the (outdoor) condensing coil. These sensors must be equipped with industry standard mini plugs to allow field technicians and HERS raters to determine the saturation temperature of the refrigerant in the coils by attaching a digital thermometer device to the permanently installed STMS mini plug and reading the saturation temperature using the digital thermometer. The test procedures that utilize the STMS, and the installation specifications for TMAH are described in Reference Residential Appendix RA3.2.

The purpose of the CID is to provide real-time information about the status of the air conditioning system refrigerant charge to the building occupant. The CID must meet the specifications of Reference Joint Appendix JA6 and must be installed by the air conditioning equipment manufacturer, or field installed in accordance with manufacturer specifications.

TMAH, STMS and CID may be factory installed by the equipment manufacturers or field installed by the installers.

The requirements for refrigerant charge measurement, TMAH, STMS and CID are described in more detail in Chapter 4. The affected climate zones are 2 and 8 through 15.

Note that the TXV alternative to meeting the refrigerant charge verification requirement is no longer available under the 2008 Standards.

Airflow and Fan Watt Draw

In climate zones 10-15 when a *new or replacement space-conditioning system* is installed, the central forced air fan of split system 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. In addition, 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 Reference Residential Appendix RA3.3.1. (HSPP) or (PSPP) in the supply plenum provides an accurate and non-intrusive means for measuring airflow. Accurate airflow measurements are necessary in order to verify the prescriptive requirement has been met for cooling coil airflow compliance, to verify cooling coil airflow that exceeds the prescriptive requirement, and for refrigerant charge verification procedures. Note that the temperature split method for determining cooling coil airflow is allowed to be used only for verification of the minimum airflow requirement for refrigerant charge verification procedure, and is not allowed for use in determining compliance with the prescriptive or performance cooling coil airflow and fan watt draw measures.

There are three acceptable methods allowed for use in determining compliance with the cooling coil airflow and fan watt draw measures as described in Reference Residential Appendix RA3.3:

- use of a flow capture hood to measure the total airflow through the return grill(s), or
- a flow grid device at the return grill(s) or other location where all the central fan airflow passes through the flow grid, or
- using a fan flow meter device to perform the plenum pressure matching procedure.

The flow grid measurement device, and the fan flow meter measurement device both require access to static pressure measurements of the airflow exiting the cooling coil (supply plenum), which utilizes the HSPP or PSPP mentioned above.

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

Sampling for Alterations

When compliance for an alteration requires field verification and diagnostic testing, the building owners or their agents may choose for the testing and field verification to be 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. The building owner or agent of the building owner (which may be the contractor) must complete the applicable portions of a Certificate of Compliance (CF-1R). The building owner or agent of the building owner must make arrangements for submittal of the CF-1R information to a HERS provider, identifying the building features and measures that require HERS verification. Also, arrangements must be made for the submittal of a completed, signed copy of the CF-1R to the HERS rater.

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

The sample group shall be no larger than seven. The installing company may request a smaller group for sampling. Whenever the HERS rater for the group is changed, a new group will be established. Field verification and diagnostic testing shall be completed by the HERS rater for one randomly selected dwelling unit in

each group. Re-sampling, full testing and corrective action shall be completed if necessary, as specified by the Reference Residential Appendix RA2.6.3.

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 Reference Residential Appendix RA2.7. The group for sampling purposes shall be a closed sample group no larger than thirty when a Third Party Quality Control Program (TPQCP) is used. The HERS provider shall arrange for the services of a HERS rater to conduct independent field verification of the installation work performed by the participating installing contractor and Third Party Quality Control Program. The HERS rater shall complete all of the responsibilities of a HERS rater as specified in Reference Residential Appendix RA2, with the exception that sampling procedures utilized shall be limited to sampling of a “closed” group as described in RA2.6.2. However, the sample tested shall be selected and field verified from within a group of up to thirty dwelling units (or thirty HVAC systems). The HERS rater shall be an independent entity from the Third Party Quality Control Program. Re-sampling, full testing and corrective action shall be completed as specified in RA2.6.3 with the exception that re-sampling shall be completed for a minimum of one out of every thirty dwelling units (or thirty HVAC systems) from the group. The Third Party Quality Control Program shall not impose restrictions on the HERS rater or the HERS provider that limit their independence, or the ability of the HERS rater or the HERS provider to properly perform their functions. For example, the Third Party Quality Control Program shall not impose restrictions on the HERS rater’s use of equipment beyond those required by the Commission.

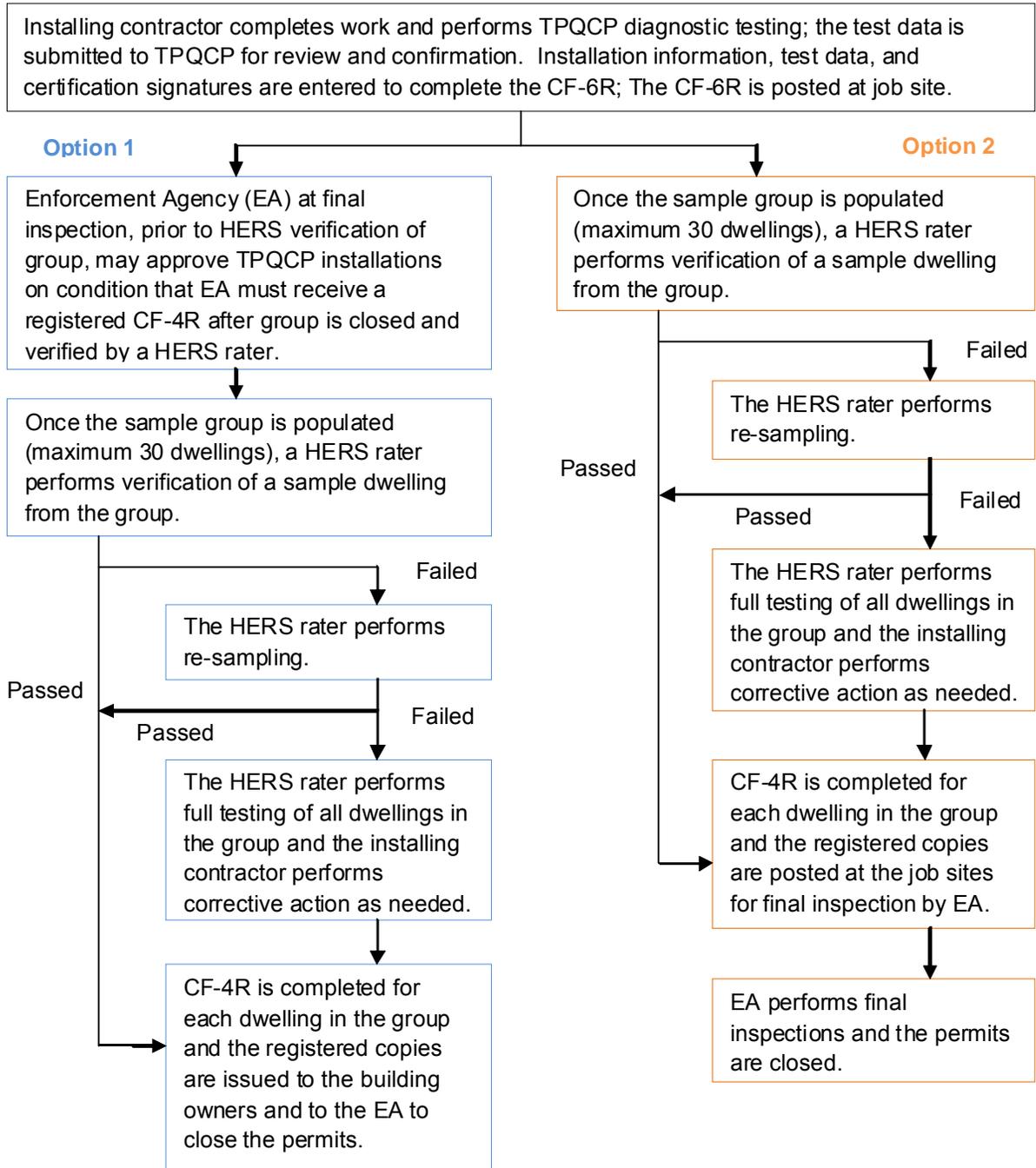
When a Third Party Quality Control Program is used, the CF-6R (submitted by the contractor) shall document that data checking by a TPQCP has indicated that the dwelling unit complies. When a Third Party Quality Control Program is used, the building official may approve compliance based on the CF-6R on the condition that if HERS compliance verification procedures determine that re-sampling, full testing, or corrective action is necessary, such work shall be completed.

If field verification and diagnostic testing determines that the requirements for compliance are met, the HERS rater shall transmit the test results to the HERS provider data registry, whereupon the provider shall make available a registered copy of the Certificate of Field Verification and Diagnostic Testing, to the HERS rater, the builder, the enforcement agency, and other authorized users of the HERS provider data registry.

Printed copies, electronic or scanned copies, and photocopies of the completed, signed registered Certificate of Field Verification and Diagnostic Testing shall be allowed for document submittals, subject to verification that the information contained on the copy conforms to the registered document information currently on file in the provider data registry for the dwelling.

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 (or HVAC systems) that must demonstrate compliance.

Approval of HVAC Installations utilizing Third Party Quality Control Programs (TPQCP) with group sampling for HERS verification



Setback Thermostat

§152(b)1F

When a split system air conditioner or heat pump is altered by the installation or replacement of the air handler, outdoor condensing unit, cooling or heating coil, or the furnace heat exchanger, and the existing thermostat is not a setback thermostat, then a new setback thermostat must be installed as described in Chapter 4.

Fuel Switching

§152(b)1C

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.

Table 8-3 – 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.	

Example 8-20

Question

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

Answer

Yes, just replacing the outdoor unit (or indoor unit) by itself will trigger the duct sealing and verification requirement (§152(b)1E).

Example 8-21

Question

I have an existing electric furnace and am adding a new bedroom. Can I extend the existing ducts to the new room and use the existing furnace?

Answer

Yes. §152(b)1C generally requires that gas heating be used but allows the existing fuel type, in this case electric resistance to be extended. The existing furnace must have adequate heating capacity to meet CBC requirements for the additional space. Duct requirements apply if more than 40 ft of ducts are added.

Example 8-22

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. If the existing system is electric resistance, then the room may be heated with an electric resistance baseboard heater (§152(a) Exception 4). Alternatively, performance compliance can be used, modeling the electric heat, or, the existing natural gas furnace system may be extended to serve the addition, if there is adequate capacity to meet the CBC requirement.

Example 8-23

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 (§152(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 (§152(b)1E).

The new heating unit must also be a natural gas unit (or a heat pump that provides equal or better TDV energy performance). An electric resistance furnace is not an option.

Example 8-24

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 duct is replaced, Package D duct insulation and sealing requirements also apply which require diagnostic testing of the whole duct system.

Example 8-25**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 (3ft away from the current location). What requirements apply to this alteration?

Answer

The mandatory requirements apply to this alteration. In particular, §150(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. A sheet metal or other suitable duct 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, the prescriptive duct sealing requirements apply per §152(b) because the air handler is being replaced, unless one of a few exceptions applies.

Example 8-26**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 8-27**Question**

I have a residential building that was made 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. §152(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 8-28

Question

What are the Standards requirements for Duct Sealing, Duct Insulation, Refrigerant Charge (RC), Cooling Coil Airflow (CCA), Fan Watt Draw (FWD), Saturation Temperature Measurement Sensors (STMS) and Temperature Measurement Access Holes (TMAH), Hole for the placement of a Static Pressure Probe (HSPP) or Permanently installed Static Pressure Probe (PSPP) for the following changeout scenarios in an existing home?

1. New or replacement outdoor condensing unit and/or indoor cooling or heating coil only (no duct alteration).
2. New or replacement furnace heat exchanger only (no duct alteration).
3. New or replacement air handler unit only (no duct alteration).
4. New or replacement entire duct system only (no air handler alteration).
5. New or replacement entire duct system and air handler only.
6. New or replacement entire duct system and outdoor condensing unit, and/or indoor cooling and/or heating coil (no air handler alteration).
7. New or replacement entire duct system, outdoor condensing unit, indoor cooling or heating coil, and air handler (i.e. entire space conditioning system).
8. New or replacement entire duct system and packaged air conditioner or heat pump (i.e. entire space conditioning system).
9. New or replacement packaged air conditioner or heat pump (no duct alteration).
10. More than 40 ft of new or replacement ducts installed (but not replacing the entire duct system as in #4 above) in unconditioned space (no other alteration).

Answer

1. Duct sealing (§152(b)1E), RC, CCA \geq 300 CFM/ton, TMAH.
2. Duct sealing (§152(b)1E), RC, CCA \geq 300 CFM/ton, TMAH.
3. Duct sealing (§152(b)1E), RC, CCA \geq 300 CFM/ton, TMAH.
4. Duct sealing < 6 percent (§152(b)1Di), Duct Insulation, CCA \geq 300 CFM/ton.
5. Duct sealing < 6 percent (§152(b)1Di), Duct Insulation, RC, CCA \geq 300 CFM/ton, TMAH.
6. Duct sealing < 6 percent (§152(b)1Di), Duct Insulation, RC, CCA \geq 300 CFM/ton, TMAH.
7. Duct sealing < 6 percent (§152(b)1Di), Duct Insulation, RC, CCA \geq 350 CFM/ton, FWD \leq 0.58 watt/CFM, TMAH, STMS, and either HSPP or PSPP.
8. Duct sealing < 6 percent (§152(b)1Di), Duct Insulation.
9. Duct sealing (§152(b)1E).
10. Duct sealing (§152(b)1Dii), Duct Insulation.

Notes: RC with CCA \geq 300 CFM/ton is required in climate zones 2, 8-15. CCA \geq 350 CFM/ton and FWD with HSPP or PSPP are required in climate zones 10-15 only for a completely new or replacement entire space conditioning system. Duct sealing is required in climate zones 2, 9-16. New or replacement ducts must meet the mandatory requirements of §150(m) for collars, joints, and plenum connections, and the Duct Insulation requirements of Package D in §151(f)10. Duct sealing, RC, CCA, FWD, STMS, TMAH, HSPP and PSPP must be verified by a HERS rater. An entirely new duct system can include existing parts of the original duct system (e.g., register boots, air handler, coil, plenums, etc.) if those parts are accessible and they can be sealed, as described in the Duct Sealing and Insulation section above. All Non-setback thermostats must be replaced with setback thermostats meeting the requirements of Standards Section 112(c).

8.5 Water Heating

8.5.1 Replacement Water Heaters

152(b)1G

Replacement water heaters must be either gas, LPG or the existing fuel type. The only exceptions are when it can be demonstrated that the TDV energy use of the new system is less than the existing system or when the water heater is being replaced as part of an alteration that is complying via the performance method. In other words, additional calculations are required if the replacement water heater is not either gas, LPG or the existing fuel type. The main intent of this requirement is to restrict the switch from gas to electric resistance water heaters.

When a water heater is replaced, then the mandatory requirements also apply to the water heater itself as well as any other components that are replaced. The water heater must be certified by the Energy Commission for minimum efficiency. New pipes must be insulated wherever insulation is required by the mandatory requirements.

8.5.2 Additions

§ 152(a), Exception No. 2

If an addition increases the number of water heaters serving a dwelling unit, then compliance for the addition may be determined using any of the compliance approaches under certain conditions. The “addition alone” compliance may be used for one additional water heater if either:

1. The additional unit is a 50 gallon or less, gas storage or gas instantaneous, nonrecirculating water heater with an EF equal to or greater than the federal minimum standards as defined in the Prescriptive Requirements section of Chapter 5,
2. The home does not have natural gas or propane available and the additional water heater is a 50gallon or less electric water heater, or electric instantaneous with an EF equal to or greater than the federal minimum standards, or
3. A water-heating system determined by the Executive Director of the Energy Commission to use no more energy than the one

specified in the first bullet 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 the second bullet above.

If either of the first two conditions is met, water heating calculations are not required with any of the compliance approaches, and no credit is allowed or penalty taken. Computer compliance calculations are used to determine the alternative described in the third bullet.

In order to receive credit for a water heating alteration that exceeds minimum efficiency requirements, or to use a water heater that does not meet either of the two conditions listed above, two options are available. The existing-plus-addition performance compliance method or the whole building compliance approach may be used. See the Vendor's Compliance Software User Manual.

8.5.3 Alterations to Systems

If it takes an extended period of time for hot water to get to a point of use or if a cold water surge comes along after warm water is turned the best remedy is usually altering the distribution system. Turning up the temperature setting on the water heater will only waste more energy. Most of these alternatives will save water and some will save energy, but before any alteration to the distribution is done, the energy performance of that medication must be confirmed.

With one exception, any alteration to the hot water distribution system must be analyzed using the performance approach to assure that the energy use of the system has not been increased. The exception to this rule is the installation of a manually controlled demand recirculation system. All other alterations, including automated controlled demand recirculation, must use the performance approach to verify energy equivalency.

Example 8-27

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, but the mandatory measures apply. The water heater must have an EF 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. Building energy compliance for the addition may be demonstrated for either the addition alone or for the existing-plus-addition.

Example 8-28

Question

An existing 2,000ft² 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, if it can be demonstrated that it uses no more energy than a 50 gallon gas non-recirculating storage tank (see the Prescriptive Requirements section above), then it may be installed. Since §151(f)8B declares a single instantaneous gas water heater to be equivalent to the 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 8-29

Question

Existing single family residence with one electric water heater; a 500 ft² addition with a 30 gallon electric water heater is 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.

8.6 Lighting

All of the lighting requirements apply to both additions and alterations as appropriate. These are all mandatory requirements; therefore they apply regardless of whether the prescriptive or performance approach is followed for the other building components. See Chapter 6 for information about the lighting requirements.

The requirements for new additions and new lighting systems are the same as those for new construction described in Chapter 6 of this compliance manual.

Alteration requirements apply to all altered lighting components in all areas of the house that are covered under §150(k). Luminaires or components that are not altered do not need to meet the requirements of the Standards.

Example 8-30

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, all new luminaires must be high efficacy until at least 50 percent of the total lighting wattage comes from high efficacy luminaires.

Example 8-31

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 comes from high efficacy luminaires.

Example 8-32

Question

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

Answer

At least half the lighting watts must be high efficacy luminaires. This is treated like new construction.

Example 8-33

Question

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

Answer

Yes, in this case, the bath bar is the altered component and must meet the Standards requirements of §150(k), which requires high efficacy luminaires in the bathrooms. The alternative would be to use the bath bar in conjunction with a “manual-on” occupant sensor.

Example 8-34

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 or 100W of low efficacy lighting to be installed in a residential kitchen, depending on the size of the house. The Standards allow this additional low efficacy wattage if all permanently installed luminaires in garages, laundry rooms, closets greater than 70 ft², and utility rooms are high efficacy and are controlled by a vacancy sensor, and special lighting controls are installed in the kitchen, You may need to alter the lighting and lighting controls in these other rooms before you can gain this additional low efficacy lighting for the kitchen alteration. Please see Section 6.4.2 for more information about the kitchen low efficacy tradeoff option.

8.7 Performance Method: Additions & Alterations

§152(a)2

The performance compliance method is an alternative to the prescriptive requirements described in the previous sections. If the performance compliance approach is used, then the mandatory requirements still apply but the prescriptive requirements such as fenestration area limits, duct sealing, and refrigerant charge measurement may or may not be necessary depending on the overall performance of the addition or alteration.

For additions, there is a choice of three performance approaches: the whole building, the addition alone and the addition in combination with the existing house.

8.7.1 Whole Building Approach

The whole building method is usually the most stringent and is used only for major rehabilitations of existing houses that also involve an addition. Under this approach the existing building and addition are modeled together as if they were a new building. This approach may also be used for alterations. When whole building compliance is used, all components that are in the existing structure must comply with mandatory minimums or the allowed exceptions.

8.7.2 Addition Alone Approach

The “addition alone” option is similar to showing compliance for a new building.¹ Analyzing additions alone works well for relatively large additions with moderate window and skylight area. If an addition alone does not comply with the Standards, improvements to the existing building may be necessary, and the Existing + Addition + Alteration method must be used.

The Addition Alone method cannot be used when alterations to the existing building are required to compensate for failure of an addition to comply alone or when alterations to the water heating system are proposed. In these events, either the Whole Building or the Existing + Addition + Alteration approaches can be used.

¹ When modeling additions alone, the number of dwelling units is input as the ratio of the addition conditioned floor area to the entire existing house plus addition conditioned floor area. This is needed in order for the internal gains, occupant density and other modeling assumptions to be properly prorated.

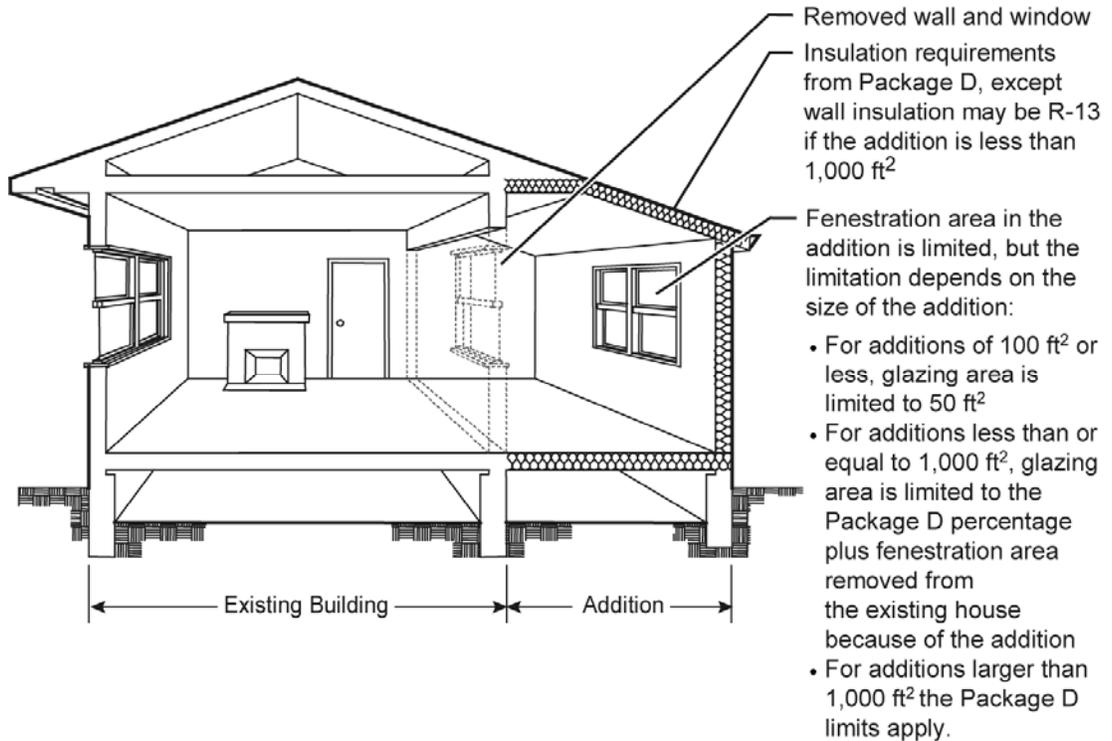


Figure 8-3 – Addition Alone Performance Compliance Approach

Example 8-35

Question

When using the performance approach for the addition alone, do the refrigerant charge, and fan airflow and watt draw measurements in §151(f)7 need to be met for central split system air conditioners serving an addition?

Answer

If existing equipment is used to serve the addition, this requirement does not need to be met as specified by Exception 3 to §152(a). For performance compliance in climate zones that require a refrigerant charge, and fan airflow and watt draw measurements, in Package D (including compliance with charge indicator light, access hole (TMAH), saturation temperature measurement sensors (STMS), and static pressure probe (HPSD or PSPP) requirements of §151(f)7), a hypothetical standard design SEER split system with this credit would be modeled in both the standard and the proposed designs, resulting in neither credit nor penalty related to this feature.

If a new central split system is installed to serve the addition, it must either:

- Meet the refrigerant charge, and fan airflow and watt draw measurements in order to comply with Package D, including compliance with charge indicator light, access hole, saturation temperature measurement sensors (TMAH and STMA), and static pressure probe (HPSD or PSPP) requirements of §151(f)7. See Section 8.4 for details.
- Meet or exceed the efficiency levels in Table 4-4 in Section 4.3.1 of this manual (to avoid the diagnostic testing and field verification)
- Meet the criteria modeled for the proposed design in the performance approach.

8.7.3 Existing + Addition + Alteration Approach (also applies to Existing + Alteration when there is no Addition)

For additions, the most flexible compliance method is to consider the entire existing building along with the addition (Existing + Addition + Alteration)². The rules for this method are documented in the program vendor's compliance program supplement. Compliance is shown using an approved computer program. Through this method, credit may be taken for energy efficiency features added to the existing building. When prescriptive approach is used, compliance can be demonstrated if the altered component meets or exceeds the requirements of §152(b)1 for that component. When the performance approach is used, the altered component must meet or exceed the requirements in §152(b)2, or another alteration(s) must be made to the existing building, which exceeds the requirements of §152(b)2 that saves the additional energy necessary to at least make up for the alteration(s) that fail to meet §152(b)2. Alternatively, when there is an addition, the addition could be designed to exceed prescriptive requirements to offset proposed existing house alterations that do not meet prescriptive requirements. The rest of this section assumes that the performance approach is used to demonstrate compliance.

In general, the following rules apply to Existing + Addition + Alteration:

1. Altered fenestration components must meet or exceed the U-factor and SHGC requirements of Table 151-C, Package D, in order to result in an energy "credit" in the performance calculation. Altered fenestration components not meeting the requirements of §152(b)2 will result in an energy "penalty" in the compliance calculation. The allowed fenestration area will be the fenestration area of the existing building.
2. For envelope alterations, insulation must be upgraded to meet the mandatory minimums of §150(c) for wall insulation, §150(d) for floor insulation, and §150(a), and §118(d) for ceiling/roof insulation. Note that the requirements of §118(d) are always more stringent than §150(a).
3. Space conditioning equipment must meet or exceed the requirements of Table 151-C, the Package D (see Section 8.4, HVAC, of this chapter). The mandatory measures must also be met. The failure to meet non-mandatory requirements of Package D, which includes refrigerant charge, fan watt drawn, access holes (TMAH and STMS), and pressure probes (HPSD or PSPP) will result in an energy "penalty" in the compliance calculations. If a charge indicator display (CID) is installed, compliance with TMAH and STMS is not required.
4. Duct alterations must meet the requirements of §152(b)1D, §152(b)1E, and §152(b)1F (see Section 8.4, HVAC, of this chapter). The mandatory measures must be met. The failure to meet non-mandatory requirements of §152(b)1D, §152(b)1E, and §152(b)1F will result in an energy "penalty" in the compliance calculations.

² This method may also be used whenever an alteration is made to existing buildings, whether or not there is an addition to the building at the same time.

5. Alterations to service water heating systems must meet the mandatory requirements of §150(j) and prescriptive requirements of §151(b)1 (see Section 8.5, Water Heating, of this chapter). The failure to meet non-mandatory requirements of §151(b)1 will result in an energy “penalty” in the compliance calculations.
6. Alterations to the roofing products must meet or exceed the requirements of §152(b)1H. The failure to meet non-mandatory requirements of §152(b)1H will result in an energy “penalty” in the compliance calculations.

The proposed design budget is based on the actual value of the altered component(s). If the altered component values (proposed design) meet or exceed the requirements of §152(b)2B (items 1 through 6 above), then there will be an energy credit for the difference between the proposed design and the standard design, where the standard design is based on the existing condition of that component (the existing condition may be based on documentation at the time of application for the alteration permit or on the vintage table in Appendix B). If the altered component does not meet the requirements of §152(b)2B (items 1 through 6 above), there will be an energy penalty for the difference between the proposed design and the standard design, where the standard design is based on having that component meet the requirements in §152(b)2B.

Therefore, it is important to note that the standards budget is calculated in two different ways depending upon whether the altered component meets or fails to meet the requirements (mandatory or prescriptive) that are described in §152(b)2B (items 1 through 6 above): 1) if the altered component meets or exceeds these requirements (§152(b)2B), the standards budget is based on the actual value for the component; or 2) if the altered component fails to meet the requirements (mandatory or prescriptive), then the standards budget will be based on prescriptive requirements for that component (§152(b)2B).

Alterations may include previous improvements that were made to the building after original permit (when the existing building was first constructed). The upgraded efficiency value of that component will be the proposed design and the standard design will be based on the vintage of the original building (subject to the same limitations as described in the previous paragraph). The permit applicant must provide evidence that the previous improvements were made subsequent to the original construction of the building. Such evidence may involve receipt, signed statement from previous owners or in the case where previous owners are not available, signed statement of the current owner or other record.

Note that previous improvements that have been used to achieve compliance for previous additions and alterations should not be considered for compliance for subsequent additions and alterations. In this case the efficiency value of the previously altered component should be shown as the existing condition. In this case, existing insulation and glazing that are to be considered as unchanged for the purposes of achieving compliance are modeled in both the standard and proposed designs as they presently exist when this can be ascertained and modeled in both the standard and proposed design as vintage table values when existing conditions are not readily discernible. The compliance software performance program will use the modeled existing component values or the vintage table values to develop the Standard budget based on the information described above. For example, if a 1975 building in climate zone 12 was built with R-11 ceiling insulation and was subsequently upgraded to R-38, then the

compliance software performance program would model the existing condition as R-13 consistent with the Vintage Table and model the proposed condition as R-38 consistent with the previously made improvement. Consequently, the credit would be relative to the difference between R-13 and R-38.

Note that if in this example, had the ceiling insulation been upgraded to any value less than R-30 (for example R-19), which is the mandatory requirement in §118(d)1 for ceiling insulation in climate zone 12, the alteration would be subject to a penalty for the difference between R-30 and R-19. Also, note that according to §151(b), Opaque envelope insulation must meet the most stringent of the mandatory requirements of §118(d)1 and §150(a).

Example 8-36

Question

A 1,600 ft² 1980 house that is in climate zone 12 is being renovated as follows: A 500 ft² room will be added including 120 ft² of new glazing, a 200 ft² wall and 100 ft² of old glazing will be removed, and the attic insulation in the existing portion will be upgraded to R-38. The new 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

You must refer to the compliance software documentation for the details of modeling using the existing plus addition plus alteration approach. In general, the standard design is established by the software based on vintage table values (or on actual existing conditions if those can be determined) for roof insulation, wall insulation, floor insulation, water heating energy factor, HVAC equipment efficiencies, and fenestration U-factors and SHGC values. This includes all features of the “existing” portion of the house before any renovations begin, including the wall and window areas that are to be removed. The standard design is modeled with sealed and tested ducts for any new duct that is extended to the new addition. This establishes the standard design, which determines the energy budget that is the basis for comparison with the proposed design to determine whether or not the project complies.

The proposed design for this project is based on the entire building after the addition and all alterations are completed. For example, in the “final building,” 200 ft² of old wall and 100 ft² of old windows no longer exist, and therefore are not modeled. The final building has 500 ft² of new floor space and 120 ft² of new windows. The proposed design also includes the R-38 attic insulation alteration that was made to the existing portion of the house. The area of the final building is now 2,100 ft² (1,600 + 500, existing building plus addition). The remainder of the existing house that did not go through any alterations is modeled with the same vintage table values (or actual existing conditions) that are modeled for the standard design, including the HVAC system. All components of the addition portion of the building are modeled using the proposed design values (just like for any newly constructed building). Note that any new ductwork that is extended to the new addition must either be sealed and tested or modeled as untested, which would require the higher energy use to be made up through additional efficiency measures elsewhere in the existing building or the addition.

If the building does not pass, other components of the existing building and/or the addition may have to be improved 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. Note: Sealing the ducts in the existing portion of the house results in a relatively large compliance credit. If other components of the existing building are improved (altered), then they must meet the requirements for those components in §152(b)2 to earn compliance credit. In the addition, higher performing windows and higher levels of roof and wall insulation may also be used to achieve compliance.

Example 8-37

Question

For the building in the question above, how does the compliance software establish the proposed design if the addition is served by a new SEER 13 packaged gas/electric unit with a 0.82 percent AFUE?

Answer

There will be a credit for the difference between the Package D value of 78 percent and the proposed equipment efficiency of 82 percent AFUE.

Example 8-38

Question

For the 1980 building 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

§152(b)2B states that to get compliance credit for any alterations in the existing building, the altered components must meet all applicable mandatory and prescriptive requirements specified in items 1 through six of that section for that component. From the vintage tables, the operable single pane window has a U-factor of 1.28. The prescriptive requirement specified in Package D for window U-factor in climate zone 12 is 0.40.

When the existing window is replaced with a window with a U-factor of 0.55, which does not meet the prescriptive requirements for that climate zone (Package D), there is a compliance penalty. The standard design for the window in this case is the 0.40 U-factor specified in Package D, while the proposed design is the 0.55 U-factor. So the penalty would be the difference between 0.40 and 0.55.

If on the other hand, the existing window is replaced with a window that has a U-factor of 0.35 (which meets the requirements of Package D), then the alteration will be eligible for a large compliance credit. The standard design for the window is based on the 1.28 U-factor from the default fenestration tables, while the proposed design is the 0.40 U-factor. So the credit would be the difference between 1.28 and 0.35.

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 8-39

Question

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

Answer

This process requires the following steps:

1. Collect information about the existing building.
2. Enter the information about the addition and the existing building into the compliance program, identifying those features that are existing and unchanged, those that are existing and altered, and those that are new. Proper identification of each of these features is critical to determining compliance. Analyze this set of input data with the compliance program to determine if compliance is achieved.
3. Consult the vendor's compliance supplement to determine how to model existing plus addition plus alteration. Note that alterations to the existing building must meet the efficiency levels described in §152 before a credit is available for showing compliance of the addition.

Example 8-40

Question

When using the existing-plus-addition performance approach, do the refrigerant charge, access holes (TMAH and STMS) or CID, airflow, watt draw measurement, and static pressure (HPSP or PSPP) requirements in §151(f) need to be met for central split system air conditioners serving an addition?

Answer

If existing equipment is extended to serve the addition, this requirement does not need to be met as specified by Exception 3 to §152(a). For performance compliance in climate zones that require a refrigerant charge and airflow measurement in Package D, 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 §152(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 of §151(f)7. The duct sealing requirements of §152(b)1E must also be met for any newly extended ducts in the addition.

Example 8-41

Question

When using the existing-plus-addition performance compliance method, can credit be gained by doing refrigerant charge and airflow measurement on the existing central split system air conditioner in the existing house?

Answer

Yes, the same requirements for refrigerant charge and airflow and watt draw measurement for a new central split system air conditioner must be met, including HERS rater verification. The credit is offered through the performance method, which adjusts the efficiency of equipment, depending on whether or not the refrigerant charge and airflow have been diagnostically tested.

Example 8-42

Question

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

Answer

Yes. The standard design must be selected as either “untested duct systems in homes built after June 1, 2001” or “untested duct systems in homes built prior to June 1, 2001.” If the entire duct system is designed and tested to have a leakage of less than 6 percent and is diagnostically verified by a HERS rater, then significant compliance credit may be available. See the discussion of the performance approach in the text above.

Example 8-43

Question

Where do radiant barriers need to be installed when using the performance approach where no 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 the roof assembly associated with the addition.

Example 8-44

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 8-45

Question

I am adding a room to an existing building. As part of an alteration to the 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 the prescriptive package for climate zone 12 which requires a U-factor of 0.40 and an SHGC of 0.40. 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 0.40 and 0.45. If fenestration meeting Package D requirements is installed, then the credit is available.

Example 8-46

Question

I am planning on installing R-25 insulation in the attic of an existing building in climate zone 13 that was built in 1970. Can I use this added insulation as a credit for trading with features in an addition?

Answer

No. When insulation is added to an attic, it must comply with the §118, which sets a mandatory minimum for attic insulation of R-30 for climate zone 13. No credit is allowed until the mandatory minimum R-30 is achieved. However, if you install R-30 you are allowed to take credit for the difference between the R-30 and the vintage table U-factor for a 1970 building if the vintage is documented to the enforcement agency. For a 1970 building, the vintage ceiling insulation is equivalent to R-11.

Example 8-47

Question

I am planning on installing R-25 insulation in a vaulted ceiling without an attic space that was built in 1970. Can I use this added insulation as a credit for trading with features in an addition?

Answer

Yes. Since there is no attic space, the requirements of §118 do not apply. Therefore, to receive credit, the ceiling must meet the requirements of §150(a), the equivalent of R-19 ceiling insulation between wood-framing members. When you install R-25 you are allowed to take credit for the difference between the R-25 and the vintage table U-factor for a 1970 building if the vintage is documented to the enforcement agency.
