
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 document.

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 document.

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:

- 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.
- 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.
- 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.
- Installation of a new central air conditioning and heating system.
- Replacement of an air conditioner or the exterior unit or indoor coil of a split system air conditioner.

- Replacement of a furnace or water heater.
- Window replacement where all the glazing in an existing fenestration opening is replaced with a new manufactured fenestration product.
- Enlarging an existing window.
- Adding a new window or door to an exterior wall.
- Adding new hardwired lighting.

Repairs

§101(b)

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:

- Replacing a broken pane of glass but not replacing the entire window.
- Replacing a failed compressor in an air conditioner but not replacing the entire air conditioner.
- Replacing a failed fan motor or gas valve in a furnace but not replacing the entire furnace.
- 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. Under what conditions will the Standards apply to this addition?



Unconditioned Sunspace

Answer

The Standards do not apply if the space is unconditioned. 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 Joint Appendix IV)

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 without increasing the amount of conditioned space. Do the Standards apply?

Answer

This is an alteration. Even though no new conditioned space is being created, the remodel must comply with applicable measures described in §152 (b) of the Building Energy Efficiency Standards.

Example 8-3

Question

An existing house is remodeled without increasing conditioned space. New windows are replacing old ones, and a new window is being added. Several exterior walls are being opened up to install new wiring. What requirements will apply?

Answer

New windows must meet the maximum U-factor and SHGC requirements of Package D. The house must also comply with the mandatory measures for caulking/sealing around windows and insulation in the exterior walls being altered (See Chapter 3).

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 performance approach compliance supplement.

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.</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

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 (See §150 (c)). 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.

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 CF-1R Form. However, there are a few exceptions as noted below and summarized in Table 8-2.

Use the worksheet form WS-4R to document existing, removed and proposed fenestration by orientation. The total net percentage of fenestration should be 20% 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, and must not exceed 5% of the conditioned floor area (CFA).

Plan checkers will verify the WS-4R 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.

facing fenestration area in climate zones 2, 4, and 7-15, exceeds 5% of the CFA, the performance compliance approach must be used.

- 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 less than 50ft² 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% of conditioned floor limit and the 5% 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 fenestration area, the performance compliance is optional or use the less than 1,000 ft² column.
- 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 and shall meet all the requirements of Package D as indicated in Table 8-2. The allowed 20% CFA limit and of which a maximum 5% CFA is allowed as west facing glazing (in climate zones 2, 4, and 7-15) non-west orientations may be increased by the amount of glazing removed in the wall that separates the addition from the existing house. Note Performance approach is an alternative when not able to comply prescriptively.
- If the addition has a floor area greater than 1,000 ft² the fenestration need to meet the Package D requirements for fenestration U-factor and SHGC. The allowed 20% CFA limit and of which a maximum 5% CFA is allowed as west facing glazing (in climate zones 2, 4, and 7-15).

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 ³	Package D	Package D	Package D
Glazing Area	≤ 50 ft ²	Package D (20%) + Glass Removed ⁴	Package D
Solar Heat Gain Coefficient (SHGC)	Package D	Package D	Package D
Radiant Barrier ²	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 The radiant barrier requirement applies only to the roof area of the addition. It is not necessary to retrofit a radiant barrier in the existing attic.

³ Dual-glazed greenhouse windows and dual-glazed skylights are assumed to meet the applicable U-factor requirement.

⁴ No more than 5% of the CFA is allowed for west facing regardless of glass area removed to make way for the addition. The balance of removed glass area can be added to the rest of the orientations plus the maximum allowed 20% of the CFA.

The Package D Alternative, which requires more energy efficient windows and space conditioning equipment in lieu of measures that require field verification and diagnostic testing, may also be used with addition alone, provided that if space conditioning equipment is installed, it will have the specified efficiency,

and its distribution system will serve only the addition. The Package D Alternative cannot be used for alterations including additions that involve alterations to the existing building features within the scope of Title 24, Part 6. The specific requirements of Package D Alternative vary by climate zone and are described in Table 151-C of the Standards (in Appendix B of this document).

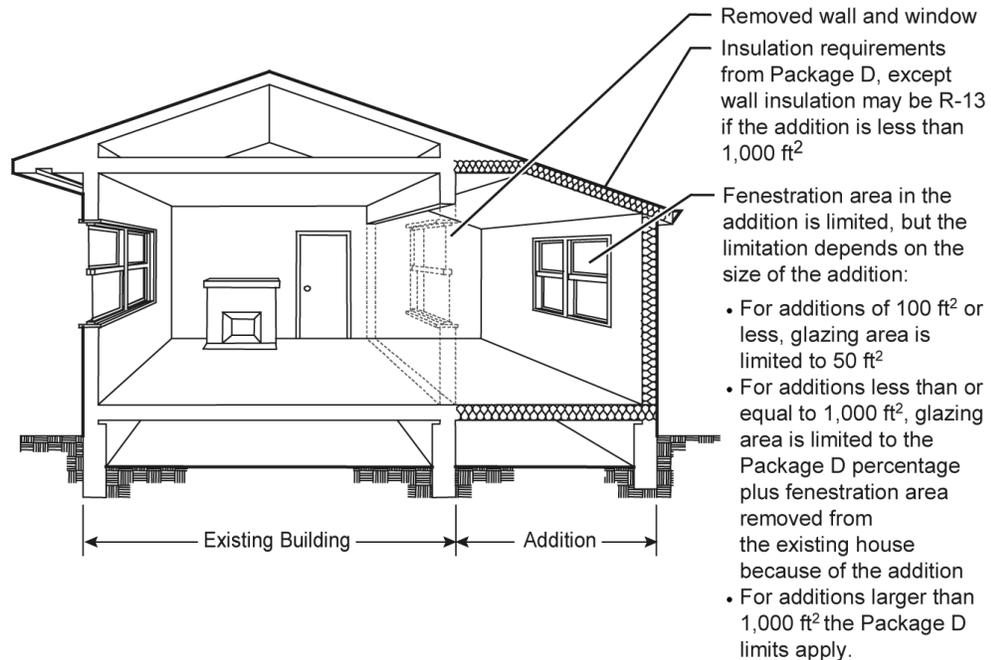


Figure 8-1 – Addition Alone Prescriptive Compliance Approach

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, and 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 Table 116-B and weight average the SHGC values as described in §151 (f) 4 A.

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 are treated the same as greenhouse windows for additions or alterations. Dual-glazed skylights are deemed to comply with the U-factor

requirements, but must still comply with the prescriptive SHGC limit. The SHGC for skylights may be determined either by using an NFRC rating, a default value from 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.

$$\text{SHGC}_{\text{fen}} = 0.08 + 0.86 \times \text{SHGC}_c$$

8.3.3 Prescriptive Requirements for Alterations

§152(b)1

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% of the conditioned floor area. Note that the 5% west-facing limit is not applicable to alterations. Use the worksheet form WS-4R to document existing, removed and proposed fenestration by orientation. Plan checkers will verify the WS-4R 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%, performance compliance approach must be used. Note that the Package D West fenestration area restriction does not apply to fenestration alterations.

Alterations that add not more than 50ft² 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.

An important new requirement for 2005 is that replacement windows 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 and skylights 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.

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 0.67 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) 1 B, 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. How much fenestration area is allowed for this addition?

Answer

Since this addition is no larger than 1000 ft², the Standard permits the area of fenestration removed during the remodel to be added to the Package D fenestration area allowance (20% 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 1000 ft², the area of the fenestration removed could not be added to the 20% Package D fenestration area allowance.

Example 8-6

Question

If I remove a window from the existing house while doing an addition, can I re-use this window in the addition, or does it need to meet a certain U-factor criterion?

Answer

You can use this existing window in the addition; however, 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 or a skylight, what are the U-factor and SHGC requirements? What is the area used for calculations for greenhouse windows?

Answer

In additions and alterations, you can assume that double-glazed greenhouse windows or skylights 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 it meets the U-factor required in the prescriptive package. However, for greenhouse windows or skylights the SHGC must meet the

requirements shown in the prescriptive packages 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 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. Skylights may use one of three methods for determining the proposed SHGC; NFRC rated SHGC, default SHGC from Table 116-B, or an SHGC_{fen} calculated from the manufacturer's center of glass SHGC (SHGC_c) using the following equation.

$$\text{SHGC}_{\text{fen}} = 0.08 + 0.86 \times \text{SHGC}_c$$

Note, in new construction that is 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

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 associated with the addition. This is the same as entirely new buildings.

Example 8-9

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 added fenestration rather than a window repair.

Example 8-10

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

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

Example 8-11

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.

Example 8-12**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 (and some skylights) 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 or skylights 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 windows. All applicable mandatory measures must be met.

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 50 ft² of fenestration is added, then the Package D limit of 20% of floor area must not be exceeded for the whole building. Otherwise, the performance method must be used.

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.

Duct Sealing and Insulation

§152(b) 1 D and §152(b) 1 E

A significant new requirement in the 2005 Standards is that an existing duct system 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 later below) under *any* of the following circumstances:

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

When more than 40 ft of new or replacement ducts are installed in unconditioned space, in addition to the duct sealing requirements described above, the ducts must also meet the duct insulation requirements of Package D, §151 (f) 10.

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

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

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.

For completely new duct systems in existing residences, the leakage requirement is the same as described in Chapter 4 for new air distribution systems. 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 to showing compliance for existing duct systems:

- Total leakage is less than 15% of fan airflow.
- Leakage to the outside is less than 10% of fan airflow.
- Leakage is reduced by more than 60% compared to before the alteration and a smoke test shows that all accessible leaks have been sealed.
- If the three leakage targets cannot be met, then compliance can be achieved by sealing all accessible leaks verified by a HERS rater inspection.

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.

Instead of meeting the duct sealing requirements, a high efficiency air conditioner meeting the SEER and EER efficiencies shown in Table 8-3 may be installed.

Accessibility

§152(b)1D(ii)(c) and §152(B)1D(ii)(d) require a demonstration that all accessible duct 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 and drywalls 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 member for someone to be able to get to the joint to seal it, then the duct system is not accessible. All other duct systems must meet the duct sealing requirements of the Standards. Note that

only the inaccessible portions of the duct systems do not have to be sealed; all other parts of the duct system that are accessible must still be sealed.

A smoke test may be employed to locate the leaks and to assess whether or not they are accessible.

Refrigerant Charge Measurement

§152(b) 1 C

When new or replacement split system air conditioners or heat pumps are installed in existing buildings, a refrigerant charge measurement or a TXV is required in certain climate zones. This requirement applies not only when a completely new air conditioning system is installed but also when components of an existing air conditioning system, such as the outdoor condensing unit or the indoor cooling coil are replaced. The refrigerant charge measurement and TXV require verification by a HERS rater (verification can be accomplished through sampling as described in **Sampling for Additions or Alterations** below). The refrigerant charge measurement/TXV requirements are described in more detail in Chapter 4. The affected climate zones are 2 and 8 through 15.

Sampling for Additions or Alterations

When compliance for an addition or alteration requires diagnostic testing and field verification, the building owner may choose for the testing and field verification to be completed for the dwelling unit alone or as part of a sample 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) shall complete the applicable portions of a Certificate of Compliance (CF-1R). The HERS provider shall define the group for sampling purposes as all dwelling units where the building permit applicant has chosen to have testing and field verification completed as part of a sample for the same installing company. The 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. Initial Field Verification and Testing shall be completed for the first dwelling unit in each group. Re-sampling, Full Testing and Corrective Action shall be completed if necessary as specified by Residential ACM Manual Section 7.5.3.

Field verification may be completed by an approved Third Party Quality Control Program as specified in Residential ACM Manual section 7.7. The group for sampling purposes shall be no larger than thirty when a Third Party Quality Control Program is used. The Third Party Quality Control Program may define the group instead of the Provider. When a Third Party Quality Control Program is used, the CF-6R (submitted by the contractor) shall document that data checking has indicated that the dwelling unit complies. The building official may approve compliance based on the CF-6R on the condition that if sampling indicates that re-sampling, full testing and corrective action is necessary, such work shall be completed.

requirements described in Chapter 4 (Building HVAC Requirements) of this manual.

Compliance with these measures requires verification by a HERS rater. However, there are three alternative compliance options as shown in Table 8-3 that take the place of duct sealing and possibly refrigerant charge measurement.

The table provides three options as alternatives to duct sealing in the indicated climate zones as described below:

The first option requires an efficiency upgrade of the furnace only. It requires installation of a furnace with an AFUE of 0.92.

The second option is an efficiency upgrade on the cooling side only. It requires the installation of high SEER & EER equipment, plus TXV (or refrigerant charge measurement instead of TXV), and Increased Duct Insulation.

The third option requires an efficiency upgrade in both heating and cooling equipment. It requires installation of a high SEER & EER unit with TXV (or refrigerant charge measurement instead of TXV), plus 0.92 AFUE (or 0.82 AFUE plus Increased duct Insulation instead of 0.92 AFUE).

In climate zone 8, to avoid TXV or refrigerant charge measurement requirements, a SEER 14 air conditioner or a 0.82 AFUE furnace may be used.

Table 8-3 – Alternatives to Duct Sealing



	Option 1	Option 2	Option 3
Climate Zone	0.92 AFUE	SEER-14 & EER-12, with either TXV or refrigerant charge measurement, plus Increased Duct Insulation	SEER-14 & EER-12 with either TXV or refrigerant charge measurement, plus either 0.92 AFUE or 0.82 AFUE with Increased Duct Insulation
CZ2	Yes	No	Yes
CZ9	No	No	Yes
CZ10	No	Yes	Yes
CZ11	No	No	Yes
CZ12	Yes	No	Yes
CZ13	No	Yes	Yes
CZ14	No	No	Yes
CZ15	No	Yes	Yes
CZ16	Yes	No	Yes

1. Increased duct insulation refers to an additional R-4 insulation wrap on existing ducts and R-8 duct insulation for all new ducts. 2. Package systems may use Option 2 or 3 without meeting the requirement for a TXV (or refrigerant charge measurement)

Note - There are no duct sealing requirements in climate zones 1 and 3-8.

Setback Thermostat

§152(b) 1 C

If the thermostat is to be replaced as part of the alteration, then a setback thermostat is required as described in Chapter 4.

Setback Thermostat

§152(b) 1 C

If the thermostat is to be replaced as part of the alteration, then a setback thermostat is required as described in Chapter 4.

Fuel Switching

§152(b) 1 C

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 8-4 – 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 8-13

Question

I would like to replace my outdoor units in my existing house in climate zone 12 without changing the indoor unit. Can I use Table 8-3 to avoid duct sealing?

Answer

No, without changing the outdoor unit along with a matching indoor unit, it is not possible to achieve EER of 12 that is required by Table 8-3. Without changing the indoor unit as well as the outdoor units, duct sealing is the only prescriptive alternative.

Example 8-14

Question

Is HERS verification required if I choose an alternative listed in Table 8-3 to avoid duct sealing in an alteration?

Answer

Yes, HERS verification is required to verify EER of 12 and existence of TXV. However, this should be simpler verification than duct sealing.

**Example 8-15****Question**

How could I use Table 8-3 to avoid duct sealing if I am replacing my air conditioning unit in climate zone 11?

Answer

Based on Table 8-3, the only option available to avoid duct sealing is Option 3, the combination heating and cooling option. You must install a SEER 14 & EER 12 (note that your unit must meet both SEER of 14 AND EER of 12) equipped with a TXV (or refrigerant charge), plus a 0.92 AFUE furnace. Instead of a 0.92 AFUE furnace, you may install a 0.82 AFUE furnace and add R-4 insulation to your existing ducts and install R-8 insulated new ducts. A HERS rater must verify the TXV and the EER of 12. Note that to achieve the EER of 12 the outdoor unit must be matched with a proper indoor unit.

Example 8-16**Question**

If the house in the example above is located in climate zone 13, what options do I have to avoid sealing ducts?

Answer

In climate zone 13, you have two options; Option 2, the cooling option and Option 3, the combination heating and cooling option. You can choose either option to avoid duct sealing.

Option 3 is similar to the answer in the example above.

Under Option 2, you must install a SEER 14 & EER 12 (note that your unit must meet both SEER of 14 AND EER of 12) equipped with a TXV (or airflow measurement), add R-4 insulation to your existing ducts and install R-8 insulated new ducts. A HERS rater must verify the TXV and the EER of 12. Note that to achieve the EER of 12 the outdoor unit must be matched with a proper indoor unit.

Example 8-17**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 8-18**Question**

I am adding a bedroom to an existing house. 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

If the existing system is electric resistance, then the room may be heated with an electric resistance baseboard heater. (§152(a) Exception 4). If the system serving the existing house is gas or LPG, then one of those system types is required. Alternatively, the existing system may be extended to serve the addition, if there is adequate capacity to meet the CBC requirement.

Example 8-19**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. If the thermostat is being replaced then the new thermostat must be a setback type that meets the requirements described earlier in this chapter. Any new ducts must meet insulation and construction requirements.

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.

If the home is located in climate zones 2, 9, 10, 11, 12, 13, 14, 15, or 16, then the most significant requirement is that either duct sealing and testing is required or other specific measures described in Table 4-10 are required.

Example 8-20**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 8-21**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 (three ft 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 8-22**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. The Building Energy Efficiency Standards §152 (b) B (ii) 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 source 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.

8.5 Water Heating

8.5.1 Replacement Water Heaters

152(b) 1 F

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. 3

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:

- The additional unit is a 50 gallon or less, gas storage or gas instantaneous, nonrecirculating water heater with an EF of 0.58 or higher as defined in the Prescriptive Requirements section of Chapter 5,
- The home does not have natural gas available and the additional water heater is a 50-gallon or less electric water heater with an EF of 0.90 or greater, or
- 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 computer program vendor’s compliance program supplement.

Example 8-23

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 of 0.58 or higher, 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 8-24**Question**

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

Answer

When there is an increase in the number of water heaters with an addition, the standards allow addition alone compliance in certain circumstances. Since this is an instantaneous gas water heater, 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)(8)(B) 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 8-25**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 of 0.90 or greater, 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 of 0.58.

Example 8-26**Question**

A single family residence with one gas water heater is replacing the water heater with a new gas water heater. How does this comply?

Answer

This system must comply with the mandatory requirements for alterations. This includes a certified water heater and pipe insulation on the first five ft of hot and cold water pipes. Since compliance with the annual water heating budget is not required, no water heating calculations are required.

Example 8-27**Question**

The owner of a residential building is replacing a gas water heating system with an electric water heating system. Does this comply?

Answer

In addition to complying with mandatory requirements, changing from gas to electric is prohibited unless it “can be demonstrated that the TDV energy use of the new system is more efficient than the existing system.” This is unlikely to be the case, therefore one of the performance compliance options is required. Either the whole building approach or the existing + addition + alteration approach may be used. These approaches could be used to take credit for improvements to the building being made to offset the water heating changes.

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 new construction that is 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 8-28**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% of the total lighting wattage comes from high efficacy luminaires.

Example 8-29**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% of the total lighting wattage comes from high efficacy luminaires.

Example 8-30

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 8-31

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.

8.7 Performance Method for Additions and 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.⁸ 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.

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.

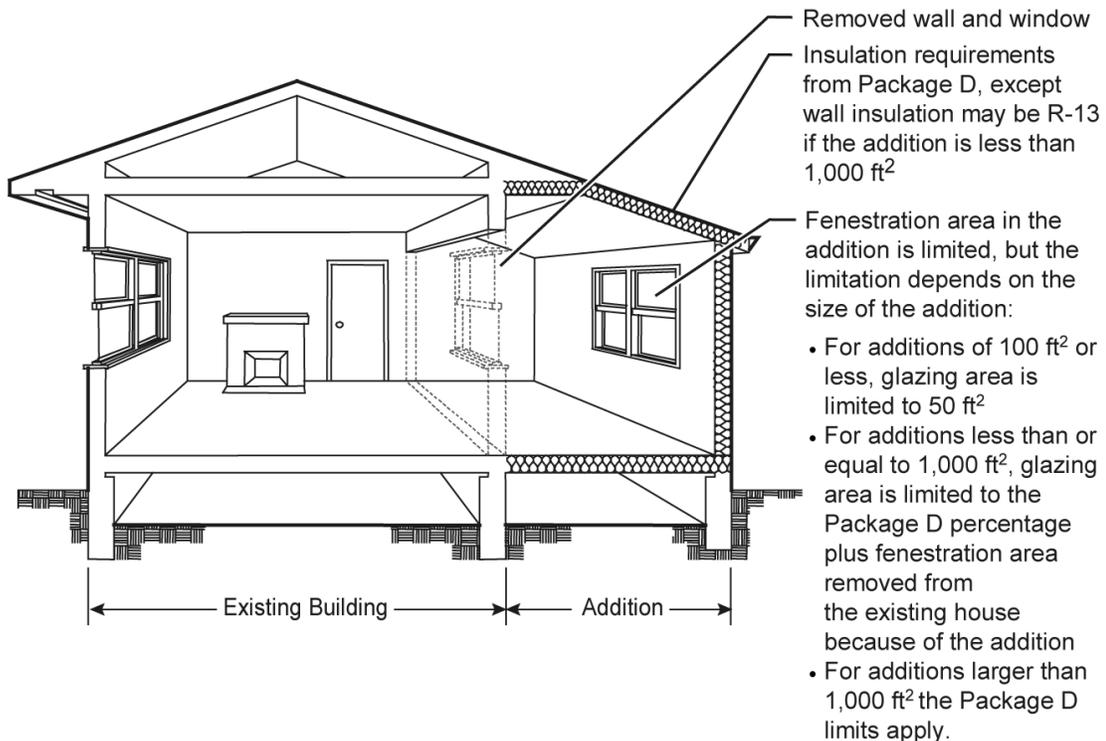


Figure 8-2 – Addition Alone Performance Compliance Approach

Example 8-32

Question

When using the performance approach for the addition alone, do the TXV or refrigerant charge and airflow measurement in §151(f) 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 4 to §152(a). For performance compliance in climate zones that require

⁸ 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.

a TXV or 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, 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 TXV or refrigerant charge and airflow measurement in order to comply with Package D
- Meet or exceed the efficiency levels in Table 4-10 (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)⁹. 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. However, when credit is taken for a proposed improvement to the existing building, the improvement must either meet or exceed the requirements of §152(b)1 for that component or another alteration(s) must be made to the existing building, which exceeds the requirements of § 152(b)1 that saves the additional energy necessary to at least make up for the alteration(s) that fail to meet § 152(b)1. 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.

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

- Altered fenestration components must meet or exceed the requirements of § 152 (b) 1 A and B in order to result in an energy "credit" in the performance calculation. Altered fenestration components not meeting the requirements of §§ 152 (b) 1 A and B will result in an energy "penalty" in the compliance calculation.
- 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).
- Space conditioning equipment must meet the requirements of §152(b)1C (see Section 8.4, HVAC, of this chapter). The

⁹ 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.

mandatory measures must be met. The failure to meet non-mandatory requirements of §152(b)1C, which includes refrigerant charge or TXV, will result in an energy “penalty” in the compliance calculations.

- Duct alterations must meet the requirements of §152(b)1D and §152(b)1E (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 and §152(b)1E, will result in an energy “penalty” in the compliance calculations.
- Alterations to service water heating systems must meet the requirements of §152(b)1F (see Section 8.5, Water Heating, of this chapter). The mandatory measures must be met. The failure to meet non-mandatory requirements of §152(b)1F will result in an energy “penalty” in the compliance calculations.

If the altered component meets or exceeds the requirements of § 152(b)1, 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)1, 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)1.

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. 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 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 standard design. 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 3 was built with R-11 ceiling insulation and was subsequently upgraded to R-30, 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-30 consistent with the previously made improvement. Consequently, the credit would be relative to the difference between R-13 and R-30.

Note that if in this example, had the ceiling insulation been upgraded to any value less than R-30, which is the mandatory requirement in §118(d) 1 for ceiling insulation in climate zone 3, the alteration would not have been eligible for any credits. Note that according to §151 (b), Opaque envelope insulation must meet the most stringent of the mandatory requirements of §118 (d)1 and 150.

Example 8-33

Question

A 1,600-square-foot 1980 house that is in climate zone 12 is being renovated as follows: A 500-square-foot room will be added including 120 square feet of new glazing, a 200-square-foot wall and 100 square feet 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 square feet of old wall and 100 square feet of old windows no longer exist, and therefore are not modeled. The final building has 500 square feet of new floor space and 120 square feet 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 square feet (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 building.

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. 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) 1 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 8-34

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 AFUE?

Answer

This is similar to the example above, except the addition is now served by a SEER 13/AFUE 0.82-packaged unit instead of simply extending the ductwork that serves the existing part of the house to the addition. In this case, similar to the standard design, the existing portion of the house must be modeled with the efficiencies of the existing HVAC equipment; these may be obtained either from the vintage tables or the actual existing conditions if those can be determined. The addition must be modeled with SEER 13 and 0.82 AFUE. You must refer to the compliance software documentation for modeling details.

Example 8-35

Question

For the 1980 building in the examples above, an operable single pane metal window is replaced with a 0.65 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 0.40?

Answer

§ 152 (b) 2 B 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 § 152 (b) 1 for that component. From the vintage tables, the operable single pane window has a U-factor of 1.28. The prescriptive requirement specified in § 152 (b) 1 for window U-factor in climate zone 12 is 0.57.

When the existing window is replaced with a window with a U-factor of 0.65, which does not meet the mandatory and prescriptive requirements for that climate zone (§ 152 (b) 1), there is a compliance penalty. The standard design for the window in this case is the 0.57 U-factor specified in § 152 (b) 1, while the proposed design is the 0.65 U-factor. So the penalty would be the difference between 0.57 and 0.65.

If on the other hand, the existing window is replaced with a window that has a U-factor of 0.40 (which meets the requirements of § 152 (b) 1), then the alteration will be eligible for a large compliance credit. The standard design for the window in this case is the 1.28 U-factor from the vintage table, while the proposed design is the 0.40 U-factor. So the credit would be the difference between 1.28 and 0.40.

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 8-36

Question

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

Answer

This process requires the following steps:

Collect information about the existing building.

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.

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 there will be credit available from the changes to the existing building that can be used for changes to efficiency measures in the addition.

Example 8-37

Question

When using the existing-plus-addition performance approach, do the TXV or refrigerant charge and airflow measurement in §151(f) 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 4 to §152(a). For performance compliance in climate zones that require a TXV or 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, 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) 1 C 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 or install a field verified TXV. The requirements of §152 (b) 1 E must also be met.

Example 8-38

Question

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

Answer

Yes, the same requirements for the TXV or refrigerant charge and airflow 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 8-39

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 less than 6% 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 8-40

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 8-41

Question

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

Answer

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

Example 8-42

Question

I am adding a room to an existing building. I am upgrading a single-pane clear glass window as part of an alteration to an existing building in climate zone 12. Do I receive credit toward the addition compliance for installing a window with a U-factor of 0.65 and an SHGC of 0.50?”

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 0.57 and

an SHGC of 0.40. If fenestration meeting these requirements is installed, then the credit is available.

Example 8-43

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 more stringent of §118 and §150. §150 requires a minimum R-19 ceiling insulation; however, §118 (d) 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 building department so the building department knows which vintage values are correct. For a 1970 building, the vintage ceiling insulation is equivalent to R-11.

Example 8-44

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. However, 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 building department.