

## What Does This Fact Sheet Cover?

This Fact Sheet addresses building envelope components, such as framing material, masonry or concrete, insulation, vapor retarders, sheathing, etc. which make up opaque envelope assemblies for roof/ceilings, walls and floors under the 2013 Building Energy Efficiency Standards (Energy Standards).

Additional Energy Code Ace Resources available include:

- ✦ **Fenestration:** See the [Nonresidential Fenestration Fact Sheet](#) and the [Nonresidential Fenestration Trigger Sheet](#) for direction on requirements related to windows, doors and skylights. Energy Code Ace also has a [Nonresidential Daylighting and Daylighting Controls Fact Sheet](#), which discusses daylighting requirements.
- ✦ **Roof Reflectance & Emittance:** Options to meet roof reflectance and emittance requirements are shown in the [Nonresidential Cool Roofs Fact Sheet](#).

## Determining Envelope U-factor

[Joint Appendix 4](#) (JA4) provides data tables which contain effective U-factors for common roof/ceilings, walls, and floor assemblies. U-factors found in these tables can be used only for the prescriptive approach. CBECC-Com (the performance compliance engine) calculates assembly U-factors for the performance approach.

U-factors can be determined using the JA4 tables by finding the row for the framing size, spacing, and cavity insulation R-value, then identify the continuous insulation R-value (columns A through G) to find the U-factor at the intersection between the row and column. If the proposed assembly cannot be found, choose the assembly which is most thermally similar to the proposed design.

## Mandatory Insulation Requirements

All newly constructed nonresidential, high-rise residential, and hotel/motel buildings must meet the minimum insulation requirements in [Section 120.7](#) of the Energy Standards, summarized in the table below:

	Assembly	Max U-factor*
Roof/Ceiling	Metal Building	0.098
	Wood Frame and others	0.075
Walls	Metal Building	0.113
	Metal Framed	0.105
	Light Mass Walls (6" or greater)	0.440
	Heavy Mass Walls (8" or greater)	0.690
	Wood Frame and others	0.110
	Spandrel panels and glass curtain wall	0.280
	Demising walls	<a href="#">Section 110.8(f)</a>
Floors	Raised Mass Floors	0.269
	Other floors	0.071
	Heated Slab floors	<a href="#">Section 110.8(g)</a>

Table 1: Mandatory U-factor requirements per §120.7

\*The maximum U-factor applies to the weighted average of the assembly.

In addition to the requirements shown here in Table 1, [Section 110.8](#) of the Energy Standards includes many other mandatory manufacture and installation requirements for insulation, roofing products, and radiant barriers.

## Mandatory Air Sealing Requirements

[Section 110.7](#) of the Energy Standards is a requirement that all joints, penetrations and other openings in the building envelope that could be potential sources of air leakage be caulked, gasketed, weather stripped, or otherwise sealed.

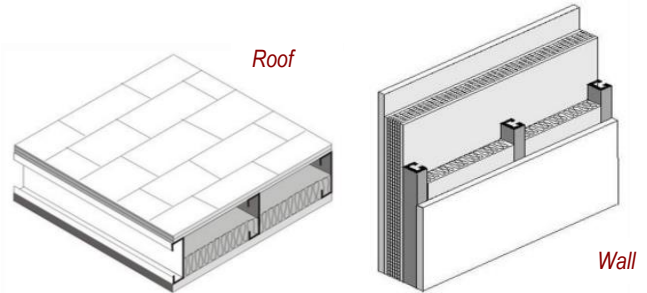


Figure 1: Example Roof & Wall Assemblies-per Joint Appendix 4

## Prescriptive Requirements

Building envelopes complying with the Standards prescriptively must meet requirements for various applicable envelope components included in [Section 140.3](#) of the Energy Standards. Subjects addressed in this section include:

- ✦ **Air Barriers:** Continuous air barriers are required for climate zones 10-16, for conditioned spaces. To meet the prescriptive requirement, the air barrier must be constructed of an approved material (see [Table 140.3-A](#)) and have sealed joints for their entire length of edges.
- ✦ **Air Leakage Rates:** There are three options to meet the air barrier requirements:
  - ✦ Air barrier material must have an air permeance not exceeding 0.004 cfm/ft<sup>2</sup> (at a pressure differential of 0.3 w.g.)
  - ✦ Assemblies of material and components have an average air leakage not exceeding 0.04 cfm/ft<sup>2</sup> (at a pressure differential of 0.3 w.g.)
  - ✦ The entire building will have an air leakage rate not exceeding 0.40 cfm/ft<sup>2</sup> (at a pressure differential of 0.3 w.g.)
- ✦ **Exterior Doors:** All non-swinging doors separating conditioned space from unconditioned space or from ambient shall have a maximum U-factor of 1.45 for climate zones 2-15 or 0.50 in climate zones 1 and 16. All swinging exterior doors shall have a maximum U-factor of 0.70 in all climate zones.
- ✦ **Insulation at Roof and ceilings, Exterior Walls and Exterior Floors and Soffits:** Prescriptive requirements stipulate that these envelope components must have an overall assembly U-factor equal to or less than the values shown in [Tables 140.3-B, C, or D](#).

## Performance Compliance Path

Compliance can be achieved using the performance approach for envelope only, whole building, or in conjunction with indoor lighting or mechanical, as long as these scopes are permitted at the same time. The performance approach provides the most flexible path to compliance by allowing trade-offs between measures.

If the **envelope only** performance approach is used, only trade-offs between envelope measures are allowed. Where the **whole building** performance approach is used, trade-offs can be made amongst the envelope, space conditioning, service water heating, and indoor lighting systems that are included in the permit application.

## Insulation Requirements for Alterations

Any altered components of the building envelope must meet the following mandatory requirements for insulation per [Section 141.0\(b\)1](#) of the Energy Standards. Designers or builders may choose between meeting the insulation requirements (R-value) or assembly U-factors for compliance.

	Assembly	Insulation Requirements	Max U-factor*
Roof	Low Sloped	<a href="#">Table 141.0-C**</a>	<a href="#">Table 141.0-C**</a>
	Steep Sloped	<a href="#">Table 141.0-C**</a>	<a href="#">Table 141.0-C**</a>
Walls	Metal Building	R-13	0.113
	Metal Framed	R-13	0.217
	Light Mass Walls	Exempt	Exempt
	Heavy Mass Walls	Exempt	Exempt
	Wood Frame and others	R-11	0.110
	Spandrel panels and glass curtain wall	R-4	0.280
Floors	Raised Framed Floors	R-11	0.071
	Raised Mass (hi-rise res, hotel/motel)	R-6	0.111
	Raised Mass (all other)	None	None

Table 2: Mandatory U-factor requirements for alterations per Section 141.0

\*The maximum U-factor applies to the weighted average of the assembly.

\*\*Exceptions apply. See Section 141.0(b)2Biii. Table 141.0-C applies when roofing is removed to the roof deck, otherwise the insulation requirement is based on Table 140.3-B, C, or D. Table 141.0-B applies to tradeoffs for aged solar reflectance and U-Factor

## Compliance Documentation

The following compliance forms are related to nonresidential envelope requirements, and facilitate needed compliance documentation:

- ✦ **NRCC-PRF-01-E:** The PRF-01 form is the only form needed to show building components compliance through the performance path. This form is generated through approved compliance software.
- ✦ **NRCC-ENV-01-E:** For prescriptive compliance, this is the primary form used for compliance with the requirements for opaque envelopes.
- ✦ **NRCC-ENV-06-E:** This form is used to calculate the area-weighted average for envelope assemblies in support of the NRCC-ENV-01-E. The U-factor maximum requirements in the code are based on weighted average of the assembly.
- ✦ **NRCC-CXR-02-E:** [Section 120.8](#) of the Energy Standards requires a design review to be performed as part of the commissioning process for newly constructed buildings. This form is a checklist used for that design review, and includes two checks related to mandatory air sealing requirements from [Section 110.7](#) and mandatory insulation requirements from [Section 120.7](#) of the Energy Standards.
- ✦ **NRCI-ENV-01-E:** This certification of installation is used to document the compliant installation of envelope components for inspectors. This form is used for both prescriptive and performance compliance methods.

## Definitions

**U Factor:** The overall coefficient of thermal transmittance of a fenestration, wall, floor, or roof/ceiling component, including air film resistance at both surfaces. This is the inverse of R-value. "Weighted" is a term applied to U factor to average out the effects of framing.

**R Value:** The measure of the [thermal resistance](#) of insulation or any material or building component.

**Vapor Retarder:** A material that limits the amount of moisture that passes through the material or assembly. Industry synonyms: air barrier or moisture membrane.

## What's New for the 2016 Standards?

The 2016 Standards are scheduled to go into effect on January 1, 2017. Any permit application submitted to an enforcement agency on or after that date will need to apply for permit under the 2016 Standards.

The following requirements are updates to the 2013 nonresidential opaque envelope requirements presented in this fact sheet. More detail on these requirements can be found on the [California Energy Commissions Standards Rulemaking page](#).

### Nonresidential buildings (Table 140.3-B, Table 140.3-D)

- ✦ The prescriptive metal building roof requirements have been updated to specify a maximum U-factor of 0.041, which corresponds to two layers of insulation, R-19 and R-10, in a filled cavity.
- ✦ The performance levels of standing seam metal building roofs have been revised to align U-factors with ASHRAE 90.1-2013, Appendix A.
- ✦ The prescriptive wood-framed roof requirements have been made more stringent in the southern coastal zones 6 through 8, with a maximum U-factor of 0.049, or R-19. Minor updates have been made to other zones.
- ✦ The prescriptive metal-framed wall requirements have been revised to require at least two inches of continuous insulation or equivalent, or U-0.069, for climate zones 1, 6 and 7.
- ✦ Minor updates have been made to prescriptive wood-framed wall requirements to the north coast (climate zone 1) with a U-factor of 0.095 and to the northern inland areas (climate zone 11) with a maximum U-factor of 0.45.
- ✦ Requirements for relocatable classrooms now align with the most stringent requirement in any climate zone, if the capability is desired to relocate the building during its life to any of the zones.

### High-Rise Residential (HRR) Buildings (Table 140.3-C)

- ✦ The prescriptive metal building roof requirements have also been updated to specify a maximum U-factor of 0.041.
- ✦ Minor updates have been made to prescriptive wood-framed wall requirements, with a maximum U-factor requirement of 0.028 (R-38) for climate zone 1 and a requirement of 0.034 (R-30) for coastal climate zones 3, 5 and 6.
- ✦ Prescriptive metal-framed wall requirements have been updated to require two inches of rigid continuous insulation for all climates zones except San Diego (climate zone 7), and the climate zone corresponding to the Palm Springs areas has been made more stringent, with a maximum allowed U-factor of 0.048.

### Other changes (120.7, 140.3(c))

- ✦ The mandatory minimum insulation for metal-framed walls has been revised to U-0.151 to correspond to R-13 batt insulation and R-2 continuous insulation or equivalent on the exterior.
- ✦ An exception has been added so that data center buildings with a design process load greater than 750 kW do not need to comply with mandatory minimum envelope insulation requirements.
- ✦ For large spaces above 5000 sf with high ceilings of 15 ft or greater, a requirement has been added for a minimum skylight area of 3% of the skylit daylight area, to ensure adequate daylight for dimming.

