

# Sealing and Insulating Existing Vented Attics - Code Compliance Brief

## Overview:

*The intent of this brief is to provide code-related information about sealing and insulating existing vented attics to help ensure that the measure will be accepted as being in compliance with the code. Providing the same information to all interested parties (e.g., code officials, builders, contractors, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.*

Because most heat loss in a home occurs through the attic, increasing attic insulation is one of the most cost-effective steps home builders can take to improve home energy efficiency. High-efficiency insulation meets or exceeds the insulation levels required by the 2015 International Energy Conservation Code (IECC) (see the excerpt from the 2015 IECC Insulation and Fenestration Requirements by Component Table under the Plan Review Section below). The efficiency level required in the latest IECC code is ~15% greater than levels required in the 2009 IECC. High-efficiency and ultra-efficient attic insulation systems include vented attics that are insulated over the ceiling deck with blown fiberglass or blown cellulose, unvented attics that are insulated on the underside of the roof deck with blown spray foam, and vented or unvented attics that are insulated above the roof deck with rigid foam.

Before upgrading a ventilated attic, the roof and attic must be inspected, leaks must be repaired, active knob and tube wiring must be removed, and hazardous materials, if any, must be remediated. If existing bath fans vent into the attic, they must be modified to vent to the outside. Any existing insulation must be removed to provide access to the ceiling plane for air sealing. The ceiling plane or attic floor should be thoroughly air sealed prior to installing insulation. It also may be recommended for worst-case testing of atmospheric venting systems in the 2015 IECC under Section R402.4 or R405 conditions at  $\leq 5$  ACH (see Appendix RA in the 2015 IECC for further information).

A decision needs to be made on the type of insulation—batt or blown-in—to be installed, and then the height at the attic eaves for required amounts of insulation needs to be determined. These factors are important because they will define how the insulation is installed, especially if existing mechanical and/or electrical equipment is located in the attic (e.g., duct work, air handler, recessed cans, etc.).

Baffles should be installed at each soffit vent to provide a pathway for ventilation air to move up past the insulation along the underside of the roof deck to ridge vents or mushroom cap vents located near the ridge. The lower edge of the baffle can be sealed to the attic floor at the outside edge of the top plate with spray foam, which also air seals seams for the top plate and dry wall. The baffles also serve to prevent insulation from covering soffit vents, and they can prevent “wind washing,” which occurs when wind blows through the soffit vents and moves the insulation back from the eaves. If the attic does not have soffit vents, attic ventilation can be provided by installing other types of vents such as gable or eyebrow vents near the attic floor, along with ridge vents or mushroom cap vents located near the roof ridge.

The following section (i.e., Plan Review) provides code sections for alterations, followed by the Field Inspection section that provides details of inspecting the sealing and insulating of existing vented attics. Refer to the last section of this brief for resources on technical validation, best practices, and measure guidelines.

## Plan Review:

Per the **2015 IECC/IRC, Section R103.3/R106.3 Examination of Documents**, the code official/building official must examine or cause to be examined construction documents for code compliance.

**Construction Documentation.** Review the construction documents for details describing attic insulation, installation, air sealing, and construction techniques.

- **2015 IECC/IRC, Section R103.2/N1101.5 Information on construction documents.** Construction documents should include:
  - Insulation materials and their R-values
  - Details indicating how the insulation is to be applied to the existing ceiling
  - Details indicating that existing or new vents meet the minimum net free ventilation area of the vented space
  - Details of eave baffles and attic access hatch or door
  - Air sealing details.

**2015 IECC/IRC, Section R501.1.1/N1107.1.1 Alterations - General.** Alterations to an existing building or portion thereof should comply with Section R502/N1108, R503/N1109 or R504/N1110. Unaltered portions of the existing building are not required to comply.

- **R503.1/N1109.1 General.** Alterations to any building or structure should comply with the requirements of the code for new construction. Alterations should be such that the existing building or structure is no less conforming to the provisions of this code than the existing building or structure was prior to the alteration. Alterations should not create an unsafe or hazardous condition or overload existing building systems. Alterations should be such that the existing building or structure uses no more energy than the existing building or structure prior to the alteration.
- **R503.2/N1103.2 Change in space conditioning.** Any non-conditioned or low-energy space that is altered to become conditioned space should be required to be in full compliance with this code. (This means not only the altered assembly is brought into compliance but the entire space or building would need to be brought into compliance.)
- **R503.1.1/N1109.1.1 Building Envelope.** Building envelope assemblies that are part of the alteration must comply with Sections R402.1.2/N1102.1.2 (Insulation and Fenestration Table) or R402.1.4/N1102.1.4 (U-factor Alternative), and Sections R402.2.1/N1102.2.1 through R402.2.12/N1102.2.12, R402.3/1/N1102.3.1, R402.3.2/N1102.3.2, R402.4.3/N1102.4.3 and R402.4.4/N1102.4.4

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

- Existing ceiling cavities exposed during construction, provided that the cavities are filled with insulation
- Construction where existing roof cavity is not exposed
- Roof recover
- Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing should be insulated either above or below the sheathing. (Insulating the attic floor per the applicable requirements under the Plan Review section below would apply.)

**2012 IECC/IRC, Section R101.4.3/N1101.3 and 2009 IECC/IRC, Section 101.4.3/N1101.4.3 Alterations – General.**

Alterations to an existing building or portion thereof should comply to the provisions of the code as they relate to new construction without requiring unaltered portion(s) of the existing building to comply with this code.

Exception: The following alterations need not comply with the requirements for new construction provided the energy use of the building is not increased:

- Existing ceiling cavities exposed during construction, provided that the cavities are filled with insulation
- Construction where existing roof cavity is not exposed
- Roofs without insulation in the cavity and where the sheathing or insulation is exposed during reroofing should be insulated either above or below the sheathing.

**2015 IECC/IRC, Section R402.1.2/N1102.1.2 Insulation Criteria.** The *building thermal envelope*<sup>[1]</sup> must meet the requirements of Table R402.1.2/N1102.1.2, based on the climate zone specified in Chapter 3 and the building assemblies associated with the vented attic (ceilings) that are considered part of the *building thermal envelope*.

**2015 IECC/IRC, Section R402.1.3/N1102.1.3 or 2012 IECC/IRC, Section R402.1.2/N1102.1.2 R-Value Computation.**

Insulation material used in layers, such as framing cavity insulation, or continuous insulation should be summed to compute the corresponding component R-value. Computed R-values should not include an R-value for other building materials or air films.

Excerpt from the *Insulation and Fenestration Requirements by Component Tables*

**2015 IECC/IRC, Table R402.1.2/N1101.1.2 or 2012 IECC/IRC, Table R402.1.1/N1102.1.1**

(R-values are the same for both versions of IECC/IRC)

Climate Zone	1	2	3	4 Except Marine	5 and Marine 4	6	7-8
Ceiling R-value	30	38	38	49	49	49	49

**2015 IECC/IRC, Section R402.1.4/N1102.1.4 or 2012 IECC/IRC Section R402.1.3/N1102.1.3 U-Factor Alternative.** An assembly with a U-factor equal to or less than that specified in Tables should be permitted as an alternative to the R-value value in Insulation and Fenestration Requirements by Component Tables of the IECC/IRC.

Excerpt from the *Equivalent U-factor Tables*

**2015 IECC/IRC, Table R402.1.4/N1102.1.4 or 2012 IECC/IRC, Table R402.1.3/N1102.1.3.** (U-factors are the same for both versions of the codes)

Climate Zone	1	2	3	4	5	6	7-8
Ceiling U-Factor	0.035	0.030	0.030	0.026	0.026	0.026	0.026

**2015 IECC/IRC, Section R402.2.1/N1102.2.1 Ceilings with attic spaces.** Where Section R402.1.2/N1102.1.2 would require R-

38 insulation in the ceiling, installing R-30 over 100% of the ceiling area requiring insulation should be deemed to satisfy the requirement for R-38 wherever the full height of uncompressed R-30 insulation extends over the wall top plate at the eaves. Similarly, where Section R402.1.2/N1102.1.2 would require R-49 insulation in the ceiling, installing R-38 over 100% of the ceiling should be deemed to satisfy the requirement for R-49 insulation wherever the full height of uncompressed R-38 insulation extends over the wall top plate at the eaves. This reduction should not apply to the U-factor alternative approach in Section R402.1.4/N1102.1.4.

**2015 IECC/IRC, Section R402.2.2/N1102.2.2 Ceilings without attic spaces.** Where Section R402.1.2/N1102.1.2 would require insulation levels above R-30 and the design of the roof/ceiling assembly does not allow sufficient space for the required insulation, the minimum required insulation for such roof/ceiling assemblies should be R-30. This reduction of insulation from the requirements of Section R402.1.2/N1102.1.2 should be limited to 500 square feet or 20% of the total insulated ceiling area, whichever is less. This reduction should not apply to the U-factor alternative approach in Section R402.1.4/N1102.1.4.

**2015 IECC/IRC, Section R402.2.3/N1102.2.3 Eave baffle.** For air-permeable insulation in vented attics, a baffle should be installed adjacent to soffit and eave vents. Baffles should maintain an opening equal or greater than the size of the vent. The baffle should extend over the top of the attic insulation. The baffle should be permitted to be any solid material.

**2015 IECC/IRC, Section R402.2.4/N1102.2.4 Access Hatches and Doors.** Any access hatches or doors from conditioned spaces to unconditioned spaces such as attics must also be insulated to a level equivalent to the insulation on the surrounding surfaces. In addition, the access hatch or door must also be provided with weather stripping and gaskets to minimize air leakage. Access should be provided to all equipment that prevents damaging or compressing the insulation. A wood-framed or equivalent baffle or retainer is required to be provided when loose-fill insulation is installed, the purpose of which is to prevent the loose-fill insulation from spilling into the living space when the attic access is opened, and to provide a permanent means of maintaining the installed R-value of the loose-fill insulation.

Exception: Vertical doors that provide access from conditioned to unconditioned spaces can be permitted to meet the fenestration requirements of Table R402.1.2/N1102.1.2 based upon the applicable climate zone specified in Chapter 3.

**2012 and 2009 IECC/IRC, Section R402.2.1/N1102.2.1 Ceilings with attic spaces.** Similar language as the 2015 IECC/IRC.

**2012 and 2009 IECC/IRC, Section R402.2.2/N1102.2.2 Ceilings without attic spaces.** Similar language as the 2015 IECC/IRC except the 2009 IECC/IRC limited the reduction to 500 square feet of ceiling area whereas the 2012 and 2015 allow either up to 500 square feet or 20% of the total insulated ceiling area, whichever is less.

**2012 IECC/IRC, Section R402.2.3/N1102.2.3 Eave baffle.** Similar language as the 2015 IECC/IRC. The 2009 IECC/IRC did not have this provision.

**2012 IECC/IRC, Section R402.2.4/N1102.2.4 and 2009 IECC/IRC, Section 402.2.3/N1102.2.3 Access Hatches and Doors.** Similar language as the 2015 IECC/IRC.

## **Air Sealing/Air Leakage Control**

**2015 IECC/IRC, R402.4./N1102.4 Air Leakage.** The *building thermal envelope* should be constructed to limit air leakage.

- **R402.4.1/N1102.4.1 Building Thermal Envelope.** The sealing methods between dissimilar materials should allow for differential expansion and contraction.
- **R402.4.1.1/N1102.4.1.1 Installation.** The components listed in the Air Barrier and Insulation Installation Table<sup>[2]</sup> should be installed in accordance with the manufacturer's instructions and the criteria listed as the applicable method of construction. Below are the General Requirements and components from the table that are applicable to sealing and insulating ceilings (vented attics).

### **2015 IRC/IECC, Air Barrier and Insulation Installation Table R402.4.1.1/N1102.4.1.1**

- **Continuous air barrier<sup>[3]</sup>** – Confirm that construction documents specify a continuous air barrier for the building components associated with the insulation of the ceiling (vented attic).
- **Ceiling/attic** – The air barrier in any dropped ceiling/soffit should be aligned with the insulation and any gaps in the air barrier sealed. Access openings, drop-down stairs, or knee wall doors to unconditioned attic spaces should be sealed.
- **Shafts/penetrations** – Duct shafts, utility penetrations, and flue shaft openings to the exterior or unconditioned space are sealed.
- **Recessed lighting** – Recessed lighting fixtures installed in the ceiling (vented attic) are sealed to the drywall, and the fixtures installed are air tight and IC rated.
- **HVAC register boots** – HVAC register boots that penetrate the ceiling (vented attic) are sealed to the subfloor or drywall.
- **Concealed sprinklers** – Concealed fire sprinklers should only be sealed in a manner that is recommended by the manufacturer. Caulking or other adhesive sealants should not be used to fill voids between fire sprinkler cover plates and ceiling.

**2012 IECC/IRC, R402.4/N1102.4 Air Leakage.** The *building thermal envelope* should be constructed to limit air leakage.

- **R402.4.1/N1102.4.1 Building Thermal Envelope.** The sealing methods used between dissimilar materials should allow for differential expansion and contraction.
- **R402.4.1.1/N1102.4.1.1 Installation.** The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer's instructions and the criteria listed as the applicable method of construction. The sub-bullets below are the components from the table that are applicable to sealing and insulating ceilings (vented attics).
- **R402.4.1.1/N1102.4.1.1 Air Barrier and Insulation Installation Table**
  - **Air barrier and thermal barrier** – A continuous air barrier should be installed in the building envelope (ceiling). Breaks or joints in the air barrier should be sealed. Air-permeable insulation should not be used as a sealing method.
  - **Ceiling/attic** – The air barrier in any dropped ceiling/soffit should be aligned with the insulation and any gaps in the air barrier should be sealed. Access openings, drop-down stair or knee wall doors to unconditioned attic spaces should be sealed.
  - **Shafts/penetrations, recessed lighting, and HVAC register boots** – Similar language as the 2015 IECC/IRC.

**2009 IECC/IRC, 402.4.1/N1102.4.1 Air leakage, Building Thermal Envelope**

- The *building thermal envelope* should be constructed to limit air leakage. Sealing methods used between dissimilar materials should allow for differential expansion and contraction. Sources of infiltration (see list below) should be caulked, gasketed, weather-stripped, or otherwise sealed with an air-barrier material, suitable film, or solid material:
  - All joints, seams, and penetrations
  - Utility penetrations
  - Dropped ceilings or chases adjacent to the thermal envelope
  - Attic access openings
  - Other sources of infiltration.

[1] The term "*building thermal envelope*" in the 2015 IECC/IRC is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

[2] Table R402.4.1.1 of the 2015 IECC and Table N1102.4.1.1 of the 2015 IRC.

[3] The term "continuous air barrier" in the 2015 IECC/IRC is defined as a combination of materials and assemblies that restrict or prevent the passage of air through the building thermal envelope.

#### **Field Inspection:**

Per the **2015 IECC, Section R104 Inspections**, construction or work for which a permit is required is subject to inspection. Construction or work is to remain accessible and exposed for inspection purposes until approved. Required inspections include footings and the foundation, framing and rough-in work, plumbing rough-in, mechanical rough-in, and final inspection.

Per the **2015 IRC, Section R109 Inspections**, for onsite construction, from time to time the building official, upon notification from the permit holder or his agent, can make or cause to be made any necessary inspections. Further details are provided for inspections regarding foundation, plumbing, mechanical, gas and electrical, floodplain, frame and masonry, and final inspection. Any additional inspections are at the discretion of the building official.

This section of the 2015 IRC provides details for inspecting to the specific provisions for sealing and insulation installation of the ceiling (vented attic) where one or more specific types of inspection called for by the IECC or IRC may be necessary to confirm compliance. To confirm code compliance, framing and rough-in would be the typical type of inspection performed. Because this document addresses existing residential vented attics where framing already exists, the framing inspection would involve ensuring that sources of air leakage from the ceiling have been sealed and the framing is acceptable (e.g., no water damage or deterioration is present).

- Verify that joints, seams, holes, and penetrations are caulked, gasketed, weather-stripped, or otherwise sealed.
- Ensure that the appearance of ceiling insulation, as appropriate, in the field matches what is on the approved construction documents.
- If the R-value or U-factor approach for compliance was used in the documentation, ensure that the insulation installed meets the minimum R-value or maximum U-factor required for the type of assembly and climate zone per the approved construction documents.

- Confirm that the continuous air barrier is properly installed and that the air barrier is aligned with the insulation in any dropped ceiling/soffit and sealed.

#### Technical Validation(s):

This section provides additional related information and references to materials that are applicable to the provision.

- [2015 IECC—International Energy Conservation Code](#) [1]  
 Author(s): ICC  
 Organization(s): ICC  
 Publication Date: May 2014  
 This code establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.
- [2015 IRC—International Residential Code for One- and Two-Family Dwellings](#) [2]  
 Author(s): ICC  
 Organization(s): ICC  
 Publication Date: May 2014  
 This code for residential buildings creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy, and electrical provisions for one- and two-family residences.
- [2012 IECC—International Energy Conservation Code](#) [3]  
 Author(s): ICC  
 Organization(s): ICC  
 Publication Date: January 2012  
 This code establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems, and service water heating systems in homes and commercial businesses.
- [2012 IRC—International Residential Code for One and Two Family Dwellings](#) [4]  
 Author(s): ICC  
 Organization(s): ICC  
 Publication Date: January 2012  
 This code for residential buildings creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy, and electrical provisions for one- and two-family residences.
- [2009 IECC—International Energy Conservation Code](#) [5]  
 Author(s): ICC  
 Organization(s): ICC  
 Publication Date: January 2009  
 This code establishes a baseline for energy efficiency by setting performance standards for the building envelope (defined as the boundary that separates heated/cooled air from unconditioned, outside air), mechanical systems, lighting systems and service water heating systems in homes and commercial businesses.
- [2009 IRC—International Residential Code for One- and Two-Family Dwellings](#) [6]  
 Author(s): ICC  
 Organization(s): ICC  
 Publication Date: January 2009  
 This code for residential buildings creates minimum regulations for one- and two-family dwellings of three stories or less. It brings together all building, plumbing, mechanical, fuel gas, energy and electrical provisions for one- and two-family residences.
- [Understanding Attic Ventilation](#) [7]  
 Author(s): J. Lstiburek  
 Organization(s): Building Science Corporation (BSC)  
 Publication Date: October 2006  
 This report provides guidance about whether to construct a vented or unvented attic based on hygro-thermal zone.

#### Related BASC Guides:

- Ceilings, <https://basc.pnnl.gov/resource-guides/ceilings#quicktabs-guides=6> [8]
- Batt Insulation for Existing Vented Attics, <https://basc.pnnl.gov/resource-guides/batt-insulation-existing-vented-attics> [9]
- Spray Foam Applied to Existing Ceilings, <https://basc.pnnl.gov/resource-guides/spray-foam-insulation-applied-exis...> [10]

- Dropped Ceiling/Soffit Below Unconditioned Attic, <https://basc.pnnl.gov/resource-guides/dropped-ceilingsoffit-below-unconditioned-attic> [11]
- [2009 IECC Code Level Insulation – ENERGY STAR Requirements](#) [12]
- [2012 IECC Code Level Insulation – DOE Zero Energy Ready Home Requirements](#) [13]
- [Above Deck Rigid Foam Insulation for Existing Roofs](#) [14]
- [Below Deck Spray Foam Insulation for Existing Roofs](#) [15]
- [Blown Insulation for Existing Vented Attic](#) [16]
- [Ducts Buried in Attic Insulation](#) [17]
- [Roof/Attic to Exterior Wall Air Control Upgrade](#) [18]