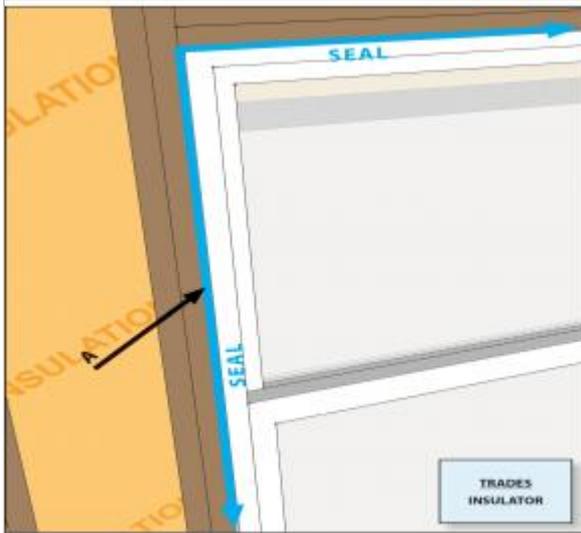


# Air Sealing Window and Door Rough Openings

Last Updated: 03/14/2016

## Scope



Air seal the rough opening around doors and windows to minimize air leakage.

Air seal the rough opening around doors and windows prior to installing trim to minimize air leakage.

- Fill the rough opening around windows and exterior doors with caulk, canned spray foam, or foam backer rod. If spray foam, use a low-expansion foam designated for doors and windows.
- Do not rely on fibrous insulation alone to block airflow; it will not air seal.

See the [Compliance Tab](#) for related codes and standards requirements, and criteria to meet national programs such as DOE's Zero Energy Ready Home program, ENERGY STAR Certified Homes, and Indoor airPLUS.

## Description

Window and door rough openings are essentially big holes in the building envelope, and while these holes get filled with window and door units, the gaps between the units and the framing rough openings can be major sites for uncontrolled air leakage in a home ([DOE 2000](#)). However, by sealing these rough opening gaps, this air leakage can be significantly reduced. A study conducted at Oak Ridge National Laboratory's Buildings Technology Center on window air sealing showed that windows with 3/4-inch rough-in gaps had an equivalent leakage area of 28.2 cm<sup>2</sup>/m<sup>2</sup>. When the gap was sealed from the interior side of the wall, the equivalent leakage area was cut to 0.5 cm<sup>2</sup>/m<sup>2</sup> ([Baechler et al. 2010](#)).

Sealing the gaps between window and door units and the framing rough openings requires care and precision. Unlike other parts of the air barrier on exterior walls, which have layers of redundancy, the seal around a window and door unit stands on its own: usually only a single closure separates the indoor air from the outdoors ([BSC 2009](#)).

## Window and Door Sealing Materials

Too often, an attempt to seal around a window or door unit is made by stuffing the gap with fiberglass insulation. However, fiberglass is not an air barrier; air can readily seep through the insulation fibers. Instead, the gap should be filled with one or more of the following materials ([DOE 2000](#)):

- Backer rod comes in both open- and closed-cell varieties. Only closed-cell products (usually made of polyethylene foam) should be used for sealing window and door rough openings, as open-cell foams can absorb and hold moisture. Closed-cell backer rod is typically stocked at hardware stores in 1/4 to 1-1/2-inch-diameters, and sold by the foot from a reel. Larger diameter backer rod (up to 4 inches) is also available in 6- or 7-foot lengths. Always use backer rod that is wider than the gap, so it can be pressed firmly into the gap and create a tight seal.

**Figure 1** - Closed-Cell Backer Rod for Air Sealing Window and Door Rough Openings 

- Caulk can be used to seal smaller gaps less than 1/2 inch wide. Caulk has the advantage of providing a more positive seal in irregular gaps, and when applied carefully, can create a tight seal around the shims used to install window and door units. For best results, use a silicone or polyurethane sealant that will shrink less than acrylic products when fully cured ([Jackson 1997](#)).
- Nonexpanding foam can be used to quickly and effectively seal the gap between the wall framing and window or door unit. It is important to use a nonexpanding product specially formulated for use as a window or door sealant. Ordinary expanding foam can swell with enough force to distort the jambs, and cause problems with operating the windows and doors. Use of ordinary expanding foam will often void window and door warranties.

**Figure 2** - Application of Window and Door Nonexpanding Foam Sealant. Although nonexpanding foam can quickly and effectively seal gaps between the jamb and the wall framing, only use nonexpanding foam sealants that are designed specifically for windows and doors. 

## Air Sealing Window and Door Rough Openings

Air sealing window and door rough openings is typically done by the insulation contractor, but in some cases it may be done by the window and door installer or by the finish carpenter prior to installing window and door trim.

With the window or door unit permanently installed in the rough opening, air seal the opening as follows:

1. Trim back the shims securing the window or door unit to the wall framing. If possible, try to cut these back behind the interior face of the wall and jambs, so that sealant can be applied over the shims for a tighter seal.
2. Apply the sealant toward the interior edge of the window or door unit. Using this approach, the gap to the exterior can drain freely and will be pressure equalized with the exterior, which limits the potential for an air pressure difference to force water into the joint ([BSC 2009](#)).

- With backer rod: Press the backer rod into the gap between the wall framing and the window or door unit. Use a flat bar to push it in. Apply even pressure; don't force it in, or the tool will tear the backer rod. Push the backer rod to an even depth. If caulk will be applied over it, take care to create an even surface that will provide a uniform substrate for the caulk.
- With caulk: If the gap is less than 1/2 inch wide, apply caulk over the backer rod for a tighter seal. Caulk should always be applied against backer rod, not just squeezed into the gap. Tool the bead against the backer rod. This will create an hour-glass shape (see Figure 3 below), which allows the sealant to expand and contract over time without cracking. Without the backer rod, the bead of caulk would be too thick and would be prone to cracking when it cures, and it would be resistant to flexing with movements in the building materials of the wall system as they change dimension with seasonal changes in temperature and humidity.

**Figure 3** - Caulk Applied Against the Backer Rod to Seal a Window Rough Opening. When tooled, a bead of caulk (light blue) should have an hour-glass shape when applied against backer rod (dark blue). This profile allows the caulk to expand and contract over time without cracking. 

- With nonexpanding foam, wear gloves when applying spray foam; the foam has an especially aggressive bond that will adhere to skin. Insert the spray nozzle about half an inch into the gap between the wall framing and the window or door unit. Keep the spray nozzle moving at a steady speed while applying the foam: Too slow and the foam will fill too much of the cavity; too fast will result in gaps in the bead.
3. With all types of sealant materials, pay close attention near the shims that hold the unit in the rough opening. It is important that the sealant fit tightly around these obstacles in the sealant path.

# Ensuring Success

## Visual Inspection

Visually inspect the seals between the window rough openings and the window and door units prior to installing interior finish materials. The seal from caulk or nonexpanding foam should be uniform without any visible gaps.

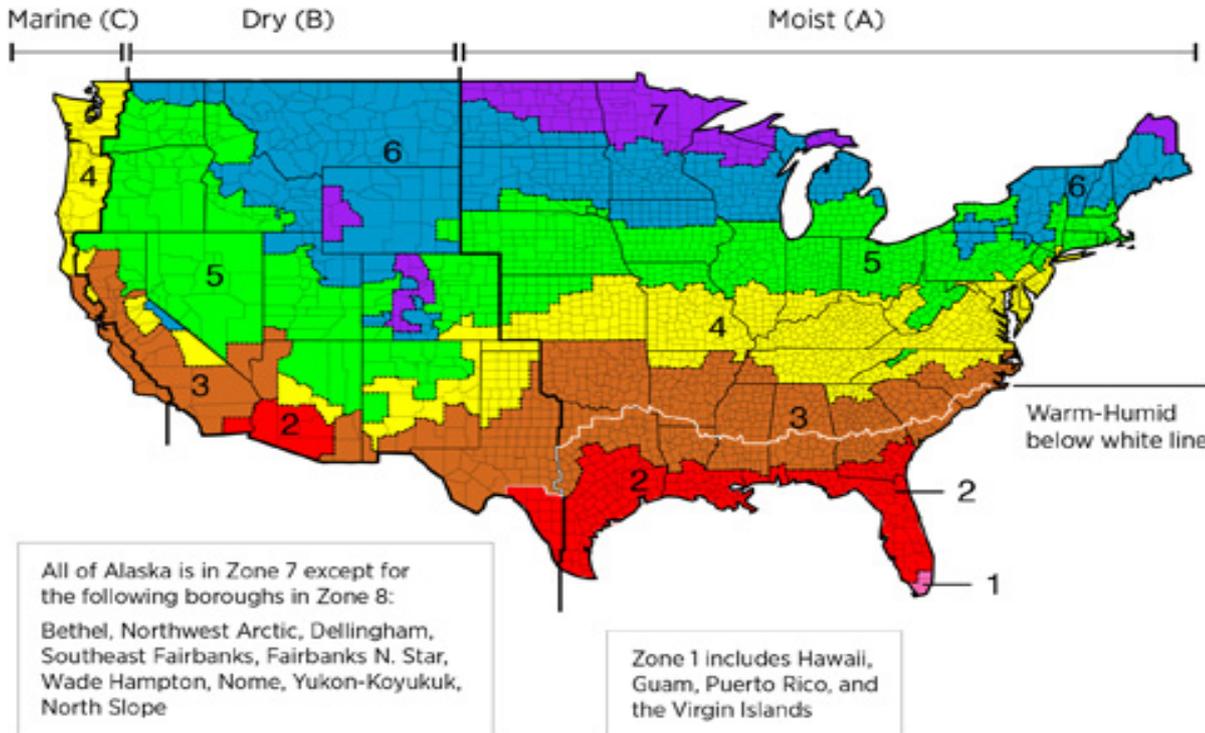
## Blower Door Testing with Smoke Pencil Diagnostics

Blower door testing, conducted as part of whole-house energy performance testing, may help indicate whether windows have been successfully sealed. With the blower door pressurizing the house, use a smoke pencil to check for air around windows. A smoke trail moving away from the smoke pencil into the wall around the window or door unit indicates a leak that should be sealed.

# Climate

## ENERGY STAR Version 3, (Rev. 07)

Thermal Enclosure Checklist, Air Sealing. Cracks in the building envelope fully sealed. Rough opening around windows & exterior doors sealed with caulk or foam. In Climate Zones 1 through 3, a continuous stucco cladding system sealed to windows and doors is permitted to be used in lieu of sealing rough openings with caulk or foam.



International Energy Conservation Code (IECC) Climate Regions

# Training

## Right and Wrong Images



Display Image: [ES\\_TESRC\\_5.2.4\\_PG146\\_308b\\_102811\\_0.jpg](#)

Reference: [Thermal Enclosure System Rater Checklist Guidebook](#)

Author(s): EPA

Organization(s): EPA

*Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.*



Display Image: [ES\\_TESRC\\_5.2.4\\_PG146\\_308b\\_102811\\_0.jpg](#)

Reference: [Thermal Enclosure System Rater Checklist Guidebook](#)

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Reference: [Thermal Enclosure System Rater Checklist Guidebook](#)

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Organization(s): EPA

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# CAD

None Available

# Compliance

The Compliance tab contains both program and code information. Exact code language is copyrighted and may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

## [ENERGY STAR Certified Homes](#)

ENERGY STAR Certified Homes (Version 3/3.1, Revision 08), Rater Field Checklist

Thermal Enclosure System

4. Air Sealing (Unless otherwise noted below, "sealed" indicates the use of caulk, foam, or equivalent material):

4.6 Rough opening around windows & exterior doors sealed.<sup>27</sup>

Footnotes:

(27) In Climate Zones 1 through 3, a continuous stucco cladding system sealed to windows and doors is permitted to be used in lieu of sealing rough openings with caulk or foam.

ENERGY STAR Revision 08 requirements are required for homes permitted starting 07/01/2016.

## [DOE Zero Energy Ready Home](#)

Exhibit 1: Mandatory Requirements. Certified under ENERGY STAR Qualified Homes Version 3

## [AAMA/WDMA/CSA 101/I.S.2/A440-08 NAFS](#)

North American Fenestration Standard/Specification for Windows, Doors, and Skylights. Available from AAMA. This is a voluntary standard/specification that covers requirements for the following components for new construction and retrofits: single and dual windows, single and dual side-hinged door systems, sliding doors, tubular daylighting devices, and unit skylights

## [ANSI/BHMA A\\*\\*\\*\\*\\*](#)

Door Gasketing and Edge Seal Systems. Available from ANSI. This standard sets performance and installation of gasketing systems applied to doors and/or frames. It includes definitions, general information, and tests

## [ASTM E-2112-07](#)

Standard Practice for Installation of Exterior Windows, Doors and Skylights. Available from ASTM. The standard covers fenestration product installation from pre-installation through post-installation procedures in new and existing construction

## [2009 IECC](#)

Table 402.4.2 Air Barrier and Insulation Inspection Component Criteria, Windows and doors: Seal space between window/door jambs and framing.\*

## [2009 IRC](#)

Table N1102.4.2 Air Barrier and Insulation Inspection, Windows and doors: Seal space between window/door jambs and framing.\*

## [2012 IECC](#)

Table R402.4.1.1 Air Barrier and Insulation Installation, Windows, skylights and doors: Seal space between window/door jambs and framing and skylights and framing.\*

## [2012 IRC](#)

Table N11402.4.1.1 Air Barrier and Insulation Installation, Windows, skylights and doors: Seal space between window/door jambs and framing and skylights and framing.\*

\*Due to copyright restrictions, exact code text is not provided. For specific code text, refer to the applicable code.

## [2015 IECC](#)

## [2015 IRC](#)

## More Info.

Access to some references may require purchase from the publisher. While we continually update our database, links may have changed since posting. Please contact our webmaster if you find broken links.

### Case Studies

None Available

### References and Resources\*

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**Author(s):** BSC  
**Organization(s):** BSC  
**Publication Date:** May, 2009  
*Brochure about air sealing windows.*
2. [Choosing High-Performance Caulks: A Guide to the Endless Array of Products on the Caulk Aisle](#)  
**Author(s):** Jackson  
**Organization(s):** Journal of Light Construction  
**Publication Date:** October, 1997  
*Document providing guidance about choosing the correct caulk for a project.*
3. [DOE Zero Energy Ready Home National Program Requirements](#)  
**Author(s):** DOE  
**Organization(s):** DOE  
**Publication Date:** August, 2015  
*Standard requirements for DOE's Zero Energy Ready Home national program certification.*
4. [Door Gasketing and Edge Seal Systems \(ANSI/BHMA A156.22-2012\)](#)  
**Author(s):** American National Standards Institute  
**Organization(s):** American National Standards Institute  
**Publication Date:** January, 2012  
*Standard establishing requirements for the performance and installation of gasketing systems including intumescent applied to, or mortised to doors, frames or both.*
5. [ENERGY STAR Certified Homes, Version 3 \(Rev. 08\) National Program Requirements](#)  
**Author(s):** EPA  
**Organization(s):** EPA  
**Publication Date:** September, 2015  
*Document outlining the program requirements for ENERGY STAR Certified Homes, Version 3 (Rev. 08).*
6. [North American Fenestration Standard/Specification for Windows, Doors, and Skylights](#)  
**Author(s):** American Architectural Manufacturers Association  
**Organization(s):** American Architectural Manufacturers Association  
**Publication Date:** May, 2008  
*Standard covering requirements for single and dual windows, single and dual side-hinged door systems, sliding doors, tubular daylighting devices, and unit skylights for new construction and replacement applications.*
7. [Retrofit Techniques & Technologies: Air Sealing, A Guide for Contractors to Share with Homeowners](#)  
**Author(s):** Baechler, Gilbride, Cole, Williamson, Love, Hefty  
**Organization(s):** PNNL, ORNL  
**Publication Date:** April, 2010  
*Report identifying steps to seal unwanted air leaks while ensuring healthy levels of ventilation and avoiding sources of indoor air pollution.*
8. [Standard Practice for Installation of Exterior Windows, Doors and Skylights](#)  
**Author(s):** American Society for Testing and Materials  
**Organization(s):** American Society for Testing and Materials  
**Publication Date:** January, 2007  
*Standard covering the installation of fenestration products in new and existing construction.*
- 9.

**Technology Fact Sheet - Air Sealing**

**Author(s):** Southface Energy Institute, ORNL

**Organization(s):** DOE

**Publication Date:** November, 1999

*Brochure with information for homeowners about the benefits of air sealing.*

10. **Thermal Enclosure System Rater Checklist Guidebook**

**Author(s):** EPA

**Organization(s):** EPA

**Publication Date:** October, 2011

*Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.*

\*Publication dates are shown for formal documents. Dates are not shown for non-dated media. Access dates for referenced, non-dated media, such as web sites, are shown in the measure guide text.

### Contributors to this Guide

The following Building America Teams contributed to the content in this Guide.

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