

Fully Flashed Window and Door Openings

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Scope



Install insulating foam sheathing and tape all seams to serve as a continuous drainage plane behind the home's cladding.

Install properly lapped flashing around window and door openings to direct water out, not into the wall cavity.

- Install rigid, flexible, or fluid-applied pan flashing at sills.
- Install window or door.
- Install side flashing that extends over the pan flashing.
- Install top flashing that extends over the side flashing.
- Properly integrate all flashing with the drainage plane layer (which could be house wrap, taped weather-resistant sheathing, a liquid-applied coating, or another approved material).

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

Windows and doors are an interruption in the wall's house wrap or insulated sheathing drainage plane and thus are a vulnerable spot for water leakage. Many a homeowner has suffered from water intrusion around doors and windows, often not discovered until considerable damage has been done within the wall. The wall framing around windows and doors must be protected from any water that finds its way behind the siding at these locations and the water must be directed out to prevent damage to the rest of the wall. Properly installed flashing that is integrated with the other elements of the wall can help prevent water damage.

Flashing materials may be installed by insulators, framers, or subcontractors or vendors hired specifically to install the windows and doors. This task should be included in the contract for the appropriate trade depending on the workflow at the specific job site.

Other Considerations: When designing the home, walls and doors should be located under overhangs or porch roofs whenever possible; these features protect against rain and snow and also minimize unwanted solar heat gain by blocking out high summer sun.

How to flash windows and doors

1. Cut the housewrap covering the rough opening in the shape of a modified "I." See Figure 1.
 - o Fold the side and bottom flaps into the window opening and secure.
 - o Above the window opening, cut a head flap. Fold it up to expose the sheathing and loosely tape it in place out of the way.



Figure 1 - Cut an I in the house wrap over the window rough opening. 

2. Install back dam and self-adhesive flashing at sill. Tape the corners. See Figure 2.

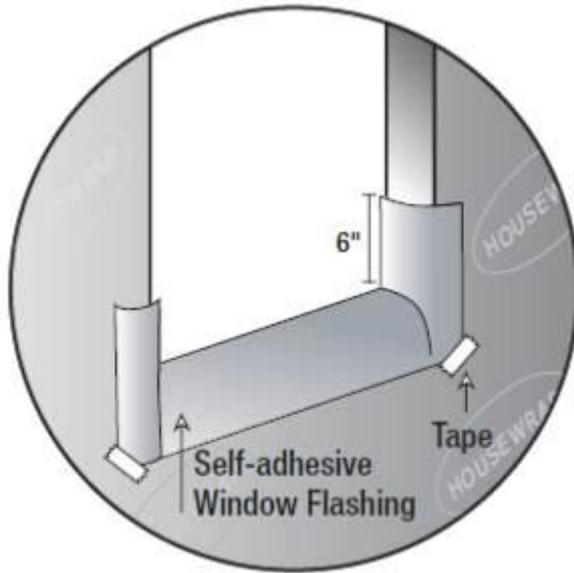


Figure 2 - Install self-adhesive sill flashing in the window rough opening. i

For pan or sill flashing, use formable flashing, a stretchable self-adhered membrane that bends at corners so one continuous piece can be used to cover the bottom and sides of the sill.

- First install a back dam consisting of a strip of wood or beveled siding nailed along the back (inside) edge of the rough opening (over the flap of housewrap). Sloped pans are required if the sill depth is greater than 6 inches according to ASTM E212207.
- Cover this with the membrane. Begin pressing in the middle of the sill and work toward the sides, removing adhesive covering strips as you go. Make sure to press the membrane tightly into the corners to avoid tears later when the window is installed.

Other options for pan flashing include self-adhered non-elastic membrane (see Figure 3), which must be cut and patched at corners, two-piece rigid manufactured pan flashing, which comes with a built-in back dam that must be protected from breakage during window installation, or asphalt-based liquid flashing that is applied with a paint brush or roller.

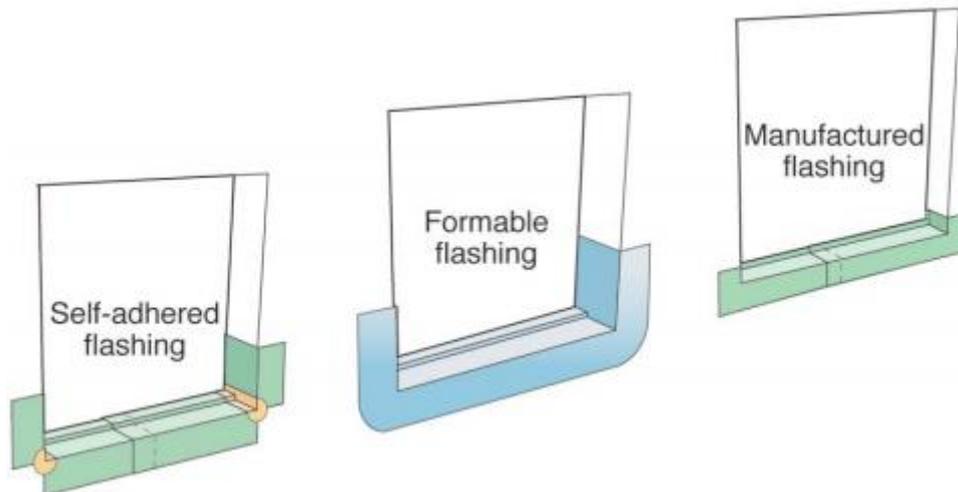


Figure 3 - Three types of window pan flashing with back dams. i

3. Caulk the outside edges of the head and side jambs and install the window. See Figure 4.

- Do not caulk across the sill.
- Install the window plumb, level, and square following manufacturer's specifications.

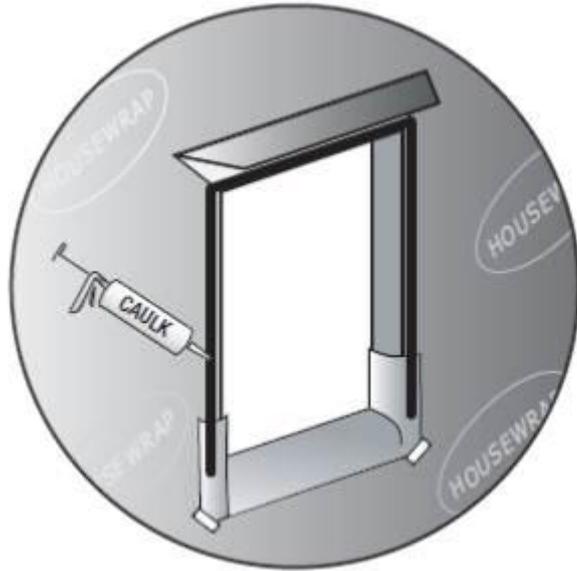


Figure 4 - Caulk the top and sides of the window rough opening, but not the bottom. ⓘ

4. Install jamb and head flashing. See Figure 5.

- Install self-adhesive jamb flashing extending 4 inches above the top of the head flange and even with the bottom of the sill flashing.
- Install self-adhesive head flashing extending 1 inch beyond the jamb flashing.
- Unfold the housewrap and lay over the head flashing. Tape bottom edge of housewrap across the top window flange and tape down corner seams of housewrap. See Figure 6.

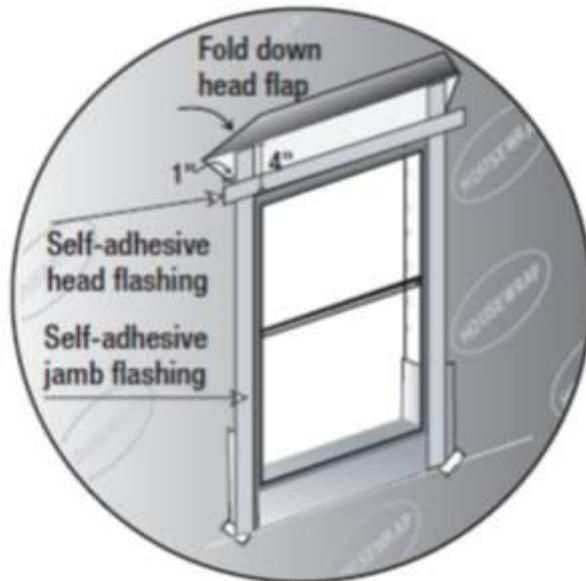


Figure 5 - Flash the sides and top of the window. 

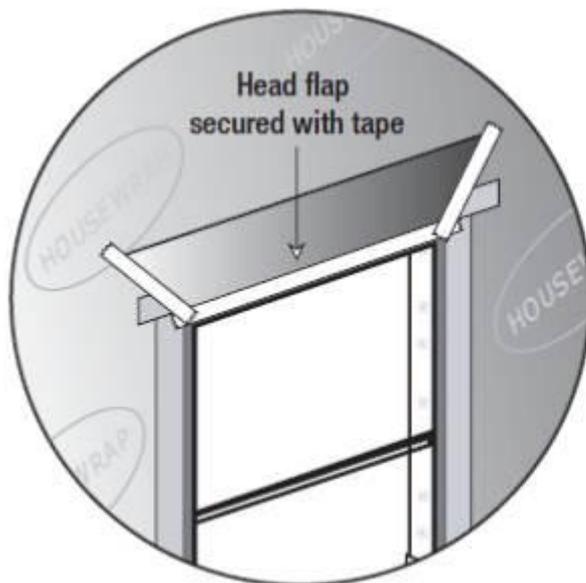


Figure 6 - Tape down the housewrap head flap. 

5. On the interior side of the window, seal the gap between the window and the rough opening with backer rod or non-expanding foam and caulk. See Figure 7.



Figure 7 - Air seal the rough opening around the window from the inside. 

6. Install trim that has been painted or primed on all sides. Above top trim, install cap flashing that extends past trim. Cover top edge of cap flashing with adhesive membrane strip. Cover top edge of membrane with sheathing tape. See Figure 8.

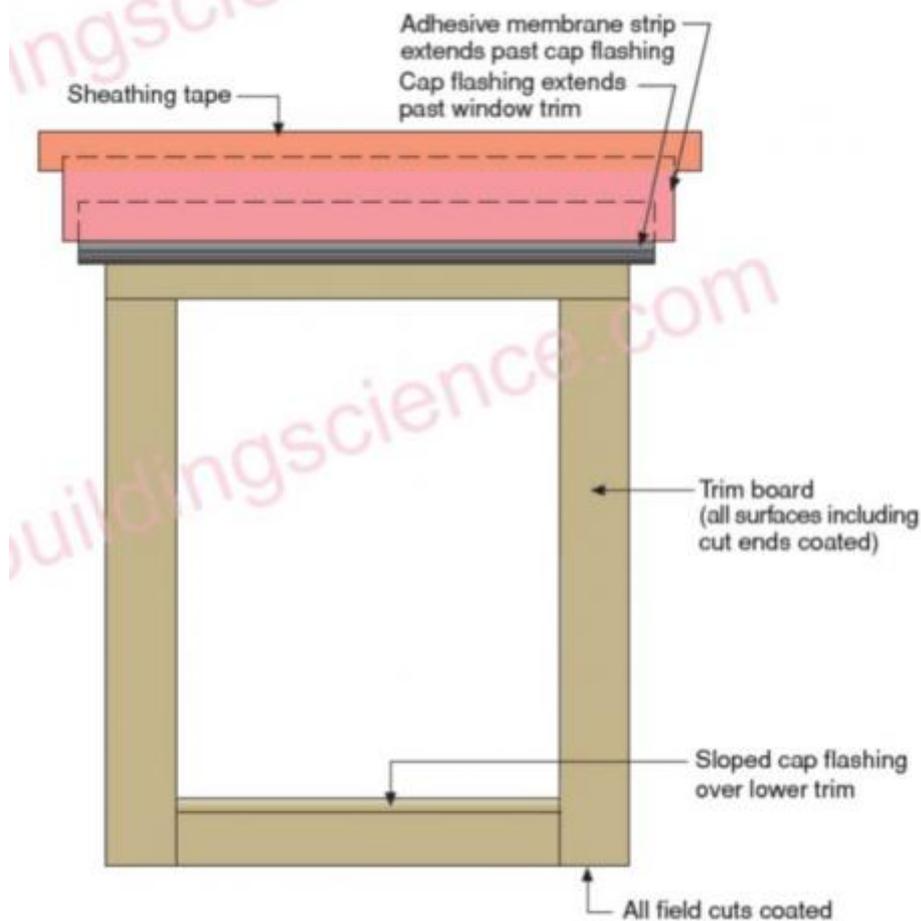


Figure 8 - Install trim and cap flashing above the window. 

How to Flash a Door

1. Flash the door head and jambs as described above for windows or in accordance with the door manufacturer's instructions.
2. For sill flashing, see the door manufacturer's instructions.

3. For houses with concrete slab floors, form a seat in the concrete slab to act as a "pan flashing." See Figure 9.

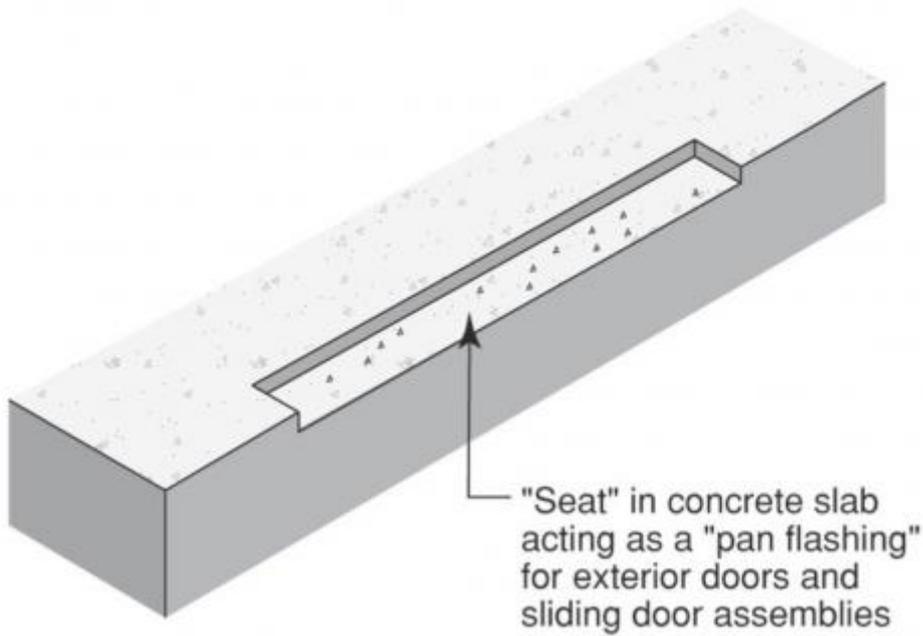


Figure 9 - A seat is formed in the concrete slab to act as pan flashing for a door. 

4. Install pan flashing that is integrated with the housewrap. ASTM E2112-07 recognizes several flashing materials and methods, including single-piece sill pans formed from rigid sheet metal (see Figure 10) , multi-piece sill pans formed from rigid sheet metal or plastic, flexible membrane, or combinations of rigid corners connected by flexible membrane.

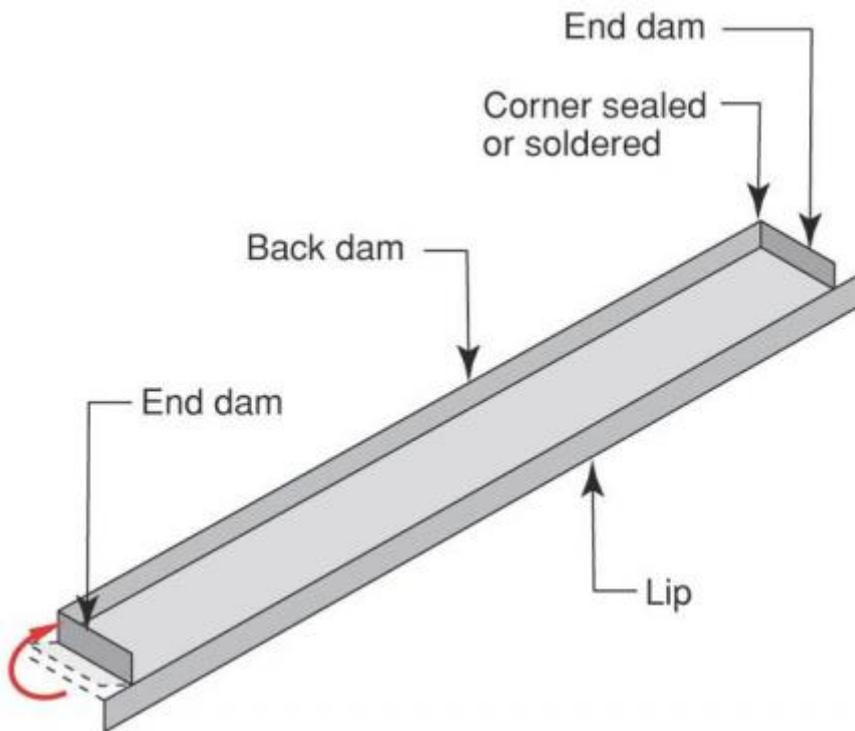


Figure 10 - Sheet metal pan flashing for doors. 

Ensuring Success

Visually inspect the window and door flashing before siding is installed to ensure that flashing is correctly installed and correctly integrated with sheathing and housewrap to direct water out and away from wall cavities.

Climate

No climate-specific information applies.

Training

Right and Wrong Images



Display Image: [ES_WMSBC_2.3_PG40_84b_32311_0.jpg](#)

Reference: [Water Management System Builder Checklist Guide](#)

Author(s): EPA

Organization(s): EPA

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder Checklist.



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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), Water Management System Builder Requirements

2. Water-Managed Wall Assembly:

2.3 Window and door openings fully flashed.¹¹

Footnotes:

(11) Apply pan flashing over the rough sill framing, inclusive of the corners of the sill framing; side flashing that extends over pan flashing; and top flashing that extends over side flashing or equivalent details for structural masonry walls.

Builders Responsibilities: It is the exclusive responsibility of builders to ensure that each certified home is constructed to meet these requirements. While builders are not required to maintain documentation demonstrating compliance for each individual certified home, builders are required to develop a process to ensure compliance for each certified home (e.g., incorporate these requirements into the Scope of Work for relevant sub-contractors, require the site supervisor to inspect each home for these requirements, and / or sub-contract the verification of these requirements to a Rater). In the event that the EPA determines that a certified home was constructed without meeting these requirements, the home may be decertified.

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.

[FMA/AAMA 100-07](#)

FMA/AAMA 100-07. Standard Practice for the Installation of Windows with Flanges or Mounting Fins in Wood Frame Construction. Available from AAMA's online store from the link above. The standard covers the installation of windows in new construction using a membrane/drainage system and the installation process for windows from pre- to post-installation and windows that use a mounting flange or fin attached and sealed to the window perimeter frame and designed as an installation fastening appendage. Minimum requirements for window installation based on current best practices are also provided.

[ASTM E-2112-07](#)

ASTM E-2112-07. Standard Practice for Installation of Exterior Windows, Doors and Skylights. The standard covers fenestration product installation from pre-installation through post-installation procedures in new and existing construction.

[2009 IRC](#)

Section R703.8 Flashing. Approved corrosion-resistant flashing to be applied shingle-fashion to prevent water from entering into wall cavities or from penetrating into building structural framing components. Self-adhered flashing must comply with AAMA 711. Flashing at exterior window and door openings must extend to the surface of the exterior wall finish or to the water-resistive barrier.

[2012 IRC](#)

Section R703.8 Flashing. Approved corrosion-resistant flashing to be applied shingle-fashion to prevent water from entering into wall cavities or from penetrating into building structural framing components. Self-adhered flashing must comply with AAMA 711. Flashing at exterior window and door openings must extend to the surface of the exterior wall finish or to the water-resistive barrier. Flashing must be installed in accordance with one or more of the following:

- In accordance with fenestration manufacturer's installation and flashing instructions or in accordance with the flashing manufacturer's instructions. Where instructions or details aren't provided, pan flashing is to be installed at the sill of exterior window and door openings and must be sealed or sloped to direct water to the surface of the exterior wall finish or water-resistive barrier. Openings using pan flashing must also incorporate flashing or protection at the head and sides.
- Per the flashing design or method of a registered design professional.
- Under other approved methods.*

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

[IRC 2015](#)

Section R703.4 Flashing. Approved corrosion-resistant flashing to be applied shingle-fashion to prevent water from entering into wall cavities or from penetrating into building structural framing components. Self-adhered flashing must comply with AAMA 711.

Fluid-applied membrane flashing must comply with AAMA 714. Flashing must be installed in accordance with manufacturer's instructions or as follows: Pan flashing at exterior window and door openings must direct water to the surface of the exterior wall finish or to the water-resistive barrier. Openings with pan flashing should also have flashing at the head and sides.

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

1. [Building America Top Innovations 2013 Profile: Window Replacement, Rehabilitation, & Repair Guide](#)
Author(s): PNNL
Organization(s): BSC, PNNL
Publication Date: September, 2013
Case study about a DOE Building America 2013 Top Innovation on upgrading or replacing windows in existing homes, based on research by Building America research partner Building Science Corporation..
2. [New Whole-House Solutions Case Study: Insight Homes: Deep Creek, Seaford, Delaware](#)
(867 KB)
Author(s): PNNL
Organization(s): PNNL
Publication Date: April, 2012
Case study about a home builder that has refined its home designs to achieve HERS scores of 49 to 56 on 40 to 70 homes per year.

References and Resources*

1. [Building America Best Practices Series Volume 12: 40% Whole-House Energy Savings in the Cold and Very Cold Climates](#)
Author(s): Baechler, Gilbride, Hefty, Cole, Love
Organization(s): PNNL, ORNL
Publication Date: February, 2011
Guide describing measures that builders in the cold and very cold climates can take to build homes that have whole-house energy savings of 40% over the Building America benchmark with no added overall costs for consumers.
2. [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.
3. [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).
4. [Guidance on Taped Insulating Sheathing Drainage Planes](#)
Author(s): Grin, Lstiburek
Organization(s): BSC
Publication Date: September, 2014
Measure Guideline research report providing simple, long term, and durable solutions when using tapes and flashing membranes in conjunction with the exterior face of rigid polymeric foam sheathing to create the drainage plane of a wall system.
5. [Pan Flashing for Exterior Wall Openings](#)
Author(s): BSC
Organization(s): BSC
Publication Date: May, 2009
Information sheet with details on pan flashing for exterior walls.
- 6.

[Technology Solutions Case Study: Guidance on Taped Insulating Sheathing Drainage Planes](#)

Author(s): Building Science Corporation

Organization(s): BSC

Publication Date: January, 2014

7. [Water Management System Builder Checklist Guide](#)

Author(s): EPA

Organization(s): EPA

Publication Date: February, 2011

Guide describing details that serve as a visual reference for each of the line items in the Water Management System Builder 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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