Air Sealing Electrical Wiring

Last Updated: 12/18/2017

Scope

Air seal around all wiring installed through walls, ceilings, and flooring to keep conditioned air from leaking into unconditioned space.

Air seal around all electrical wiring and electrical boxes installed through walls, ceilings, and flooring to prevent air leakage and moisture movement between unconditioned and conditioned space. Sealants (e.g., caulk, fire-retardant caulk, fire-rated spray foam, etc.) should be compatible with all adjoining surfaces and meet the fire and air barrier specifications according to code.

- Using a drill, cleanly cut holes for electrical wiring no more than 1 inch larger in diameter than the wiring diameter.
- Seal around installed wiring using caulk or canned spray foam.
- For ceiling-mounted electrical boxes, install the electrical box in the ceiling drywall, then caulk around the base and caulk all holes in the box with fire-retardant caulk.
- For wall-mounted electrical boxes, install gasketed, airtight electrical boxes or install standard electrical boxes, then caulk all openings and seal the box to the drywall with caulk.

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**

Air can pass through tiny gaps around electrical wiring and holes in electrical boxes, carrying conditioned air into wall cavities and up into unconditioned attics or allowing air from unconditioned garages and crawlspaces into living spaces. Pressure and temperature differences between conditioned and unconditioned spaces encourage this air flow. These air leaks represent energy losses, and they could also potentially allow warm, moisture-laden air into unconditioned spaces where it can condense on cold surfaces creating moisture problems. Conversely, air leaking into the house from the garage or crawlspace can affect indoor air quality and cause drafts. Air barriers need to be continuous to be effective; this means sealing all penetrations in exterior walls and in walls, ceilings, or floors adjoining unconditioned spaces. Holes drilled through studs and top and bottom plates should be caulked or foam sealed to prevent air from following the wiring through wall cavities.

Be sure to schedule caulking of electrical penetrations after the wiring has been installed and before the drywall is completed. Responsibility for sealing air leaks around electrical wiring and electrical boxes should be included in the contract for the appropriate trade, depending on the workflow at specific job sites.

**How to Air Seal Electrical Boxes and Wiring**

- For ceiling-mounted electrical boxes, install the electrical box in the ceiling drywall, then caulk around the base and caulk all holes in the box with fire-retardant caulk.

![Figure 1 - Air seal electrical box with fire-retardant material.](image1)

- For wall-mounted electrical boxes, specify that the electrician install prefabricated, airtight electric boxes that have flexible boot seals at wire penetrations and a gasketed flange at the face.

![Figure 2 - Air sealing an electrical box.](image2)

- Or, as another option, install standard electrical boxes and caulk all of the openings in the box (including around wire penetrations), then seal the face of the box to the drywall with caulk.
Seal all wiring holes through the exterior walls of the house, such as holes for electrical wiring, security system wiring, television and telephone cables, porch light fixtures, and exterior electrical outlets. Use caulk, gaskets, or spray foam (note that spray foam degrades in sunlight).

Use caulk or canned spray foam to seal wiring holes through all top plates and bottom plates.
Figure 5 - Air sealing wiring holes with foam.
Ensuring Success

Holes around wiring should be visually checked to see if caulk and canned spray foam have been applied before insulation and drywall are installed. Blower door testing, which is conducted as part of the whole-house energy performance test-out, may help indicate whether holes for electrical wiring in exterior walls have been successfully sealed. An experienced technician can also check for air leaks with a smoke pencil or by feeling with the back of the hand.
Climate

No climate-specific information applies.
Training

Right and Wrong Images

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The Compliance tab contains both program and code information. Code language is excerpted and summarized below. For exact code language, refer to the applicable code, which 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, Version 3/3.1 (Rev. 09)**

National Rater Field Checklist

Thermal Enclosure System.

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

4.1 Ducts, flues, shafts, plumbing, piping, wiring, exhaust fans, & other penetrations to unconditioned space sealed, with blocking / flashing as needed.

Please see the [ENERGY STAR Certified Homes Implementation Timeline](#) for the program version and revision currently applicable in your state.

**DOE Zero Energy Ready Home (Revision 07)**

Exhibit 1 Mandatory Requirements.

Exhibit 1, Item 1) Certified under the ENERGY STAR Qualified Homes Program or the ENERGY STAR Multifamily New Construction Program.

### 2009 IECC

Section 402.4.1. The building thermal envelope shall be durably sealed to limit infiltration...including utility penetrations.

### 2012, 2015, and 2018 IECC

Table R402.4.1.1 Air Barrier and Insulation Installation, Shafts/penetrations: Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space are air sealed. Table R402.4.1.1 Air Barrier and Insulation Installation, Plumbing and wiring: Insulation is placed between the exterior of the wall assembly and pipes. Batt insulation is cut and fitted around wiring and plumbing, or for insulation that on installation readily conforms to available space such insulation shall fill all space between wall and piping/wiring.

**Retrofit:** 2009, 2012, 2015, and 2018 IECC

Section R101.4.3 (Section R501.1.1 in 2015 and 2018 IECC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

### 2009 IRC

Section N1102.4.1. The building thermal envelope shall be durably sealed to limit infiltration...including utility penetrations.

### 2012, 2015, and 2018 IRC

Table N1102.4.1.1 Air Barrier and Insulation Installation, Shafts/penetrations: Duct shafts, utility penetrations, and flue shafts opening to exterior or unconditioned space are air sealed. Table N1102.4.1.1 Air Barrier and Insulation Installation, Plumbing and wiring: Insulation is placed between the exterior of the wall assembly and pipes. Batt insulation is cut and fitted around wiring and plumbing, or for insulation that on installation readily conforms to available space such insulation shall fill all space between wall and piping/wiring.

**Retrofit:** 2009, 2012, 2015, and 2018 IRC

Section N1101.3 (Section N1107.1.1 in 2015 and 2018 IRC). Additions, alterations, renovations, or repairs shall conform to the provisions of this code, without requiring the unaltered portions of the existing building to comply with this code. (See code for additional requirements and exceptions.)

Appendix J regulates the repair, renovation, alteration, and reconstruction of existing buildings and is intended to encourage their continued safe use.
Case Studies

1. New Whole-House Solutions Case Study: Attention to Detail in High-Performance Homes 2012, Heritage Buildings, Leland NC
   Author(s): PNNL
   Organization(s): PNNL
   Publication Date: October, 2012
   Case study about one builder's conversion to high-performance building in the hot-humid regions of the Atlantic seaboard.

2. Technology Solutions Case Study: Preventing Thermal Bypass
   Author(s): PNNL
   Organization(s): PNNL
   Publication Date: October, 2012
   Case study detailing techniques used to prevent thermal bypass in new homes.

References and Resources*

   Author(s): International Code Council
   Organization(s): ICC
   Publication Date: January, 2009
   Code establishing 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.

2. 2009 IRC - International Residential Code for One and Two Family Dwellings
   Author(s): International Code Council
   Organization(s): ICC
   Publication Date: January, 2009
   Code for residential buildings that 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.

   Author(s): International Code Council
   Organization(s): ICC
   Publication Date: January, 2012
   Code establishing 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.

4. 2012 IRC - International Residential Code for One and Two Family Dwellings
   Author(s): International Code Council
   Organization(s): ICC
   Publication Date: January, 2012
   Code for residential buildings that 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.
2015 IECC - International Energy Conservation Code
Author(s): International Code Council
Organization(s): ICC
Publication Date: May, 2014
Code establishing 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.

6. 2015 IRC - International Residential Code for One and Two Family Dwellings
Author(s): International Code Council
Organization(s): ICC
Publication Date: May, 2014
Code for residential buildings that 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.

Author(s): International Code Council
Organization(s): ICC
Publication Date: November, 2017
Code establishing 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.

8. 2018 IRC - International Residential Code for One and Two Family Dwellings
Author(s): International Code Council
Organization(s): ICC
Publication Date: August, 2017
Code for residential buildings that 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.

9. Air Barriers - Airtight Drywall Approach
Author(s): Lstiburek
Organization(s): Building Science Corporation
Publication Date: May, 2009
Brochure about creating an air barrier by sealing drywall assemblies.

Author(s): Baechler, Gilbride, Hefty, Cole, Love
Organization(s): Pacific Northwest National Laboratory, Oak Ridge National Laboratory
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.

11. DOE Zero Energy Ready Home National Program Requirements (Rev. 07)
Author(s): U.S. Department of Energy
Organization(s): DOE
Publication Date: May, 2019
Standard requirements for DOE's Zero Energy Ready Home national program certification.

12. ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09) National Program Requirements
Author(s): U.S. Environmental Protection Agency
Organization(s): EPA
Publication Date: September, 2018
Webpage with links to documents providing the program requirements and checklists for ENERGY STAR Certified Homes (Ver. 3/3.1, Rev. 09).

13. Guide to Attic Air Sealing
Author(s): Lstiburek
Organization(s): Building Science Corporation
Publication Date: January, 2010
Fact sheet providing detailed information about air sealing attics.

14.
Guide describing details that serve as a visual reference for each of the line items in the Thermal Enclosure System Rater Checklist.

Contributors to this Guide

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