Scope

Air seal the floor above an unconditioned basement or crawlspace and make sure floor insulation is in full contact with the underside of the subfloor.

- Seal all seams, gaps, and holes in the subfloor air barrier with caulk or foam.
- Air seal rim joists.
- Install insulation in floor joist bays without misalignments, compressions, gaps, or voids.
- Install supports to keep insulation in permanent contact with the air barrier above, for example, metal staves for batt insulation or netting for blown insulation.
- If spray foam insulation is used for the floor cavity insulation, the spray foam can serve as the air barrier if it is at least 5.5 inches thick if open-cell or at least 1.5 inches thick if closed-cell spray foam insulation.

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.
Floors can account for one-fourth to one-third of the building enclosure’s surface area. When defects in the air barrier and insulation system exist, heat loss through floors over unconditioned basements or vented crawlspaces can cause uncomfortably cold floors and increases in space conditioning costs as well. Heat loss in floors can be caused by:

- Conduction losses, also known as thermal bridging, when heat transfers through framing members due to a lack of insulation
- Air leakage, due to the lack of an effective air barrier or unsealed holes in the air barrier
- Misalignment of the air barrier and thermal barrier, which allows gaps to exist, for example between batt insulation and the drywall, which allow air to flow in wall cavities due to convective currents or holes in the air barrier, which rob the insulation of its effectiveness (EPA 2011).

To prevent these heat losses, the insulation layer in the floor should be continuous and consistent and should be completely aligned with (in continual contact with) the air barrier separating the house from the unconditioned space below. When basements or crawlspaces are uninsulated the air barrier is typically the subfloor, which consists of plywood or OSB. Any holes around plumbing wiring, etc., in the subfloor must be sealed.

Note, if HVAC equipment and plumbing pipes will be located in the crawlspace (especially in cold climates) or if the basement may be used for living space, the crawlspace or basement should be insulated along the walls rather than in the ceiling to include these areas within the thermal envelope of the home. The thermal envelope consists of the continuous air barrier and thermal barrier/insulation which surround the home’s walls, ceilings, and foundation. (See the guide Continuous Air Barrier in Exterior Walls for more information.) However, if HVAC equipment is not located in the basement and plumbing lines can be protected, it might be reasonable to establish the thermal and pressure boundary in the floor above the basement, rather than along the foundation walls.

**How to Insulate and Airseal the Floor above an Unconditioned Basement or Crawlspace**

1. Install a subfloor that can serve as a continuous air barrier between the crawlspace or basement and the house above. In most cases, this air barrier will be plywood or OSB floor sheathing. Install the subfloor sheathing panels according to APA Sturd-I-Floor recommendations, which includes the following (APA 2011):
   - Install subfloor in panel widths that align with the framing (typically 16-, 20-, or 24-inches on-center).
   - Stagger subfloor panel end joints.
   - Use tongue-and-groove subfloor panels or install blocking beneath panel joints.
   - Apply construction adhesive or caulk at panel seams and between subfloor panel and framing members.

   ![Subfloor diagram](image)

   **Figure 1** - Seams in the subfloor are sealed with construction adhesive so that the subfloor can serve as an air barrier separating the garage from the living space above.

2. Air seal the band and rim joists and any penetrations.
Floors: At exterior vertical surface of floor insulation in all climate zones and, if over unconditioned space, also at interior horizontal surface including supports to ensure alignment. Alternatives in Footnotes 11 & 12.

2012 2009 - 2018 IECC and IRC Minimum Insulation Requirements

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

Refer to code citations on insulation and air barrier placement: reference 2015 IECC/IRC, Section R402.2.8/N1102.2.8, Table 402.4.1.1 (N1102.4.1.1). An excerpt from the Table R402.4.1.1 is below.


Thermal Enclosure System.

Display Image:

Figure 5: Attached dwellings: ? 3 ACH50.

2. Fully-Aligned Air Barriers.

Technical Validation(s):

Display Image:

Footnote 10) EPA highly recommends, but does not require, an air barrier at the interior vertical surface of floor insulation in Climate Zones 4-8.

EPA

Thermal Enclosure System Rater Checklist Guidebook

Footnote 6) For purposes of this Checklist, an air barrier is defined as any durable solid material that blocks air flow ... paper-based products, or other materials that are easily torn. If polyethylene is used, its thickness shall be ? 6 mil.

If you find broken links.

Exhibit 2, Insulation and Infiltration) Insulation levels shall meet the 2015 IECC and achieve Grade 1 installation, per RESNET standards. Whole house leakage must be tested and meet the following infiltration limits:

322_CAD_3-2_cantilever_floor_1_in_rigid_foam_5-01019_GBA_1-31-12.pdf
table

2015, conducted as part of whole-house energy performance testing, may help indicate whether air leakage at through the floor has been successfully sealed.

Spray foam insulation can be used to insulate the floor above a crawlspace or basement as well as the band joist. Spray ... in one labor-saving application. To qualify as an air barrier, open-cell spray foam must have a finished thickness

Crawlspace Insulation

ENERGY STAR Certified Homes, Version 3/3.1 (Rev. 09)

5.5 inches and closed-cell spray foam must have a finished thickness

CAD FILE:

. With the blower door pressurizing, the garage door closed, and the door to the house open, check for air leaks in the ... a smoke pencil. A smoke trail moving away from the smoke pencil indicates a leak to the outdoors that should be sealed.

Table R402.1.1 (Table R402.1.2 in 2015 and 2018 IECC) Insulation and Fenestration Requirements – meet or exceed the insulation levels listed in this table.

Exhibit 2 DOE Zero Energy Ready Home Target Home.

Zone 8: ? 1.5 ACH50;

CAD FILE:

The following authors and organizations contributed to the content in this Guide.

Footnote 11) Examples of supports necessary for permanent contact include staves for batt insulation or netting for ... the insulation from achieving the required installation grade is the compression caused by the excess insulation.

Plan Review:

DOE Zero Energy Ready Home (Revision 07)

Document outlining building science principles about air flow, heat flow and moisture flow in homes.

webmaster

The U.S. Department of Energy's Zero Energy Ready Home program allows builders to choose a prescriptive or performance ... home that meets the requirements of Exhibit 2 as well as the mandatory requirements of Zero Energy Ready Home Exhibit 1.

ES_TESRC_3.2.3_PG78_127e_102811_0.jpg

Figure 2 - All mechanical and plumbing penetrations through the subfloor need to be air sealed.

Figure 3 - Seal and insulate rim joists with rigid foam board cut to fit and sealed with foam or caulk.