

## Air Sealing Attached Garage



Ensure that the garage is separated from the conditioned space by a continuous rigid air barrier. Seal all seams, gaps, and holes in the air barrier with caulk or foam before installing the insulation.

### **DOE Zero Energy Ready Home Notes**

The U.S. Department of Energy (DOE) [Zero Energy Ready Home](#) program requires that builders comply with the U.S. Environmental Protection Agency (EPA) [Indoor airPLUS program criteria](#). The Indoor airPLUS checklist (Item 4.3) requires that builders not locate air handling equipment or ductwork in garages but notes that ducts and equipment may be located in building cavities adjacent to garage walls or ceilings if the cavities are separated from the garage space with a continuous air barrier. The Indoor airPLUS Construction Specifications (Item 5.4) requires that homes with exhaust-only whole-house ventilation either are equipped with an exhaust fan or that the builder verify that the garage-to-house air barrier can maintain a pressure difference of greater than 45 Pascals while the home maintains a 50 Pascal pressure difference with respect to the outdoors, with all doors and windows closed during the blower door test.

### **ENERGY STAR Certified Homes Notes**

The [ENERGY STAR Certified Homes Thermal Enclosure Checklist](#) requires (in Item 3 Fully Aligned Air Barriers) that a complete air barrier that is fully aligned with insulation be installed at each insulated location of the home including at the interior or exterior surface of ceilings in Climate Zones 1 through 3 and at the interior surface of ceilings in Climate Zones 4 through 8; at the exterior surface of walls in all climate zones and at the interior surface of walls in Climate Zones 4 through 8; and at the interior surface of floors in all climates zones. It specifically indicates several areas requiring a complete air barrier including (item 3.1.8) the garage rim/band joist adjoining conditioned space. The air barrier must be located at the exterior surface of the walls in all climate zones. EPA highly recommends, but does not require, inclusion of an interior air barrier at rim and band joists in Climate Zones 4 through 8

(Footnote 7). The ENERGY STAR Certified Homes Thermal Enclosure Checklist requires (in Item 5 Air Sealing) that (5.1) all penetrations to unconditioned space be fully sealed with blocking, flashing, caulk, or foam; and that (5.2) cracks in the building envelope be fully sealed. See the Compliance tab for additional ENERGY STAR notes.

## Description

Isolating attached garages from the living space is critical for preventing the potential infiltration of carbon monoxide and other contaminants into the dwelling. Open joist bays above the garage that extend into living spaces are an unwanted air pathway. Cracks between and around the boards of the rim joist, the top plate, and the sill plate-foundation wall intersections are other areas where air can flow through if seams aren't adequately sealed. In addition, certain conditions in the home can cause the home to become depressurized, making it even more likely for garage air to be drawn into the home through leaks in and around the rim joists. Depressurization can occur when the house is airtight and an exhaust fan, range hood, clothes dryer, or combustion appliance is operated, if adequate makeup air is not provided to the house through a fresh air intake (a duct that brings outside air to the return side of the air handler).



**Figure 1.** Walls and ceilings shared by the garage and living space must be air sealed and insulated. (Image courtesy of CARB)

Walls and floors adjoining garage spaces need to be sheetrocked (typically with 1/2-inch-thick Type X gypsum board) in accordance with local fire codes, but this is not the same as air sealing. All ceiling and wall penetrations (wiring, piping, ductwork, etc.) need to be sealed with appropriate materials, such as caulk or spray foam. All joist cavities between the garage and adjoining living spaces should be blocked with rigid material or the framing should be designed so that rim joists or floor joists will serve as a naturally occurring air block at the shared wall. These same air-sealing concepts apply to overhangs and porch roofs.

To provide an air barrier between the garage and the adjoining conditioned space, solid blocking is often used to air seal joist bay openings spanning over the garage and conditioned space. A rigid material like rigid foam board, drywall, OSB, or plywood can be cut to fit each joist bay opening. Each piece must be cut to fit then nailed and caulked or spray foamed into place, which is a labor-intensive process.

The best option would be to design the home to isolate the attached garage through the use of framing members. Ideally the framing would be designed so that ceiling joists above the garage run parallel to the shared wall so that a ceiling joist can serve as a solid air barrier above the shared wall. Where open bays would span the shared walls, the floor joists can be cut so that they terminate on either side of a rim joist installed over the shared wall. The joints between the mud sill and rim joist at the foundation line of the garage-to-house wall should be sealed. The drywall separating the garage from the house should be sealed to the framing members at the top plate, bottom plate, corners, and seams.

### **How to Air Seal between the Garage and Living Space**

In all instances discussed below, additional air sealing of seams and cracks in framing with an appropriate material is still required.

1. Air seal the rim joist of the wall shared by the garage and the house. (See the guide [Garage Rim Band Joist for more details.](#))

a. Design walls adjoining garages so that the rim joist board runs parallel to the common wall, providing a continuous natural air barrier.

b. Where ceiling joists run perpendicular to the adjoining wall (see Figure 2), one option is to install a continuous rim joist to separate the two areas with separate but aligned ceiling joists on each side of the rim joist (see Figure 3 and Figure 4).

c. Another option is to install solid blocking material in the joist bays over the common wall. Cut rectangles of rigid blocking material (plywood, polyisocyanurate, extruded polystyrene, etc.) to fit each floor joist bay cavity. Install a backstop for the blocking material by tacking furring strips to the joists in line with the foundation or house wall. Insert rigid pieces into each joist bay and fasten with caulk or nails (Figure 5). When using I-joists, make sure to cut the blocking to fill the irregular shape of the opening (Figure 6). Also seal holes in open-web floor trusses at the shared wall, if needed (Figure 7). Use caulk or spray foam to air seal all four edges in each bay (Figure 8). Make sure to completely air seal around the rigid air barrier to prevent moist air from reaching and condensing on the rim joist.

d. Insulate the rim joist with additional rigid foam that is caulked or foamed into place or with spray foam. Use urethane spray foam insulation to cover the rim joist, and seams with the top plate below and subfloor above (see Figure 9). Medium-density (closed-cell, 2 pounds/cubic foot) or low-density (open-cell, 0.5 pounds/cubic foot) foams provide acceptable results. Open-cell foams might require additional vapor and condensation control measures in IECC Climate Zone 6 and higher. Foam can be applied by a spray foam subcontractor or use two-part spray foam kits.

Spray foam in band joists is typically concealed between floors so no other thermal barrier is required; however, the International Residential Code (IRC) allows the spray foam at rim joists to be exposed in basement and crawlspace applications (i.e., without a 15-minute thermal barrier such as drywall) as long as the thickness is less than 3.25 inches (see 2009 IRC R314.5.11). Closed-cell, 2-PCF spray foams were approved in the 2003 IRC and open-cell 0.5-PCF foams were approved in the 2009 IRC, along with any intermediate densities ([BSC](#)

2009).

**Climate Note:** Although open-cell spray foam is acceptable in this application per code, closed-cell spray foam is preferred in hot-humid or extreme cold climates (IECC Climate Zones 1A, 2A, 7, and 8) ([CARB 2009](#)).

2. Caulk or spray foam the garage slab-foundation wall junction. (See the guide [Reduce Pest Intrusion](#) for more on foundation sealing.)

3. Seal all penetrations through the common wall and ceiling. Use gaskets, airtight drywall technique, etc., to make the common wall and ceiling airtight. Consider a “flash” seal approach - spray foam the entire ceiling and/or inter-zonal walls of the garage to air seal any cracks, holes, or seams. Then add batt or blown insulation to meet the insulation R-value requirement (Figure 10), at a cost savings compared to using spray foam alone to meet the insulation requirement. Cover the ceiling insulation with taped and mudded drywall.

4. Other Important Considerations:

a. Install a self-closing, insulated, metal, fire-rated door with a good weather seal between the living space and the garage.

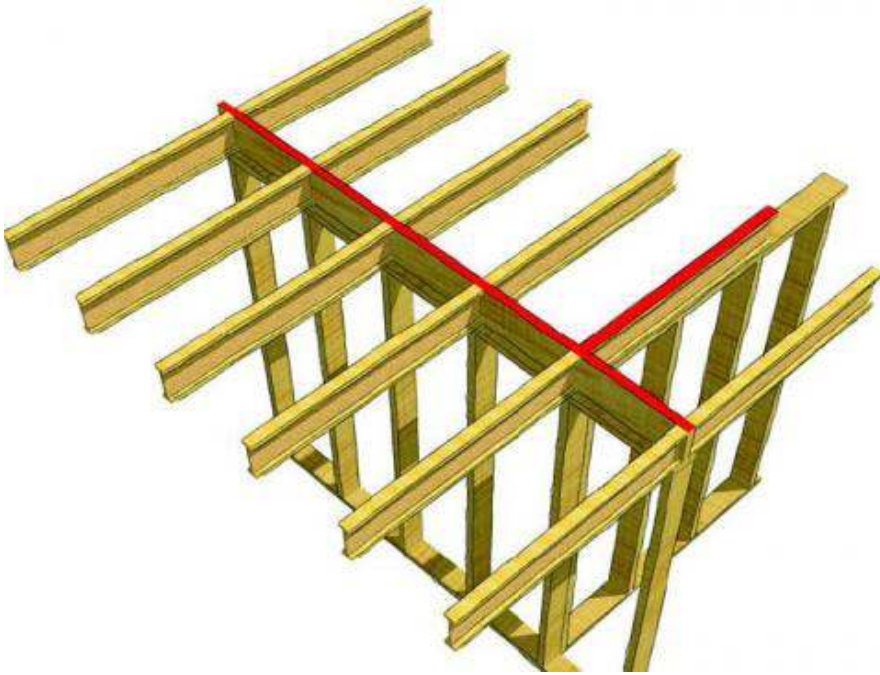
b. If the air handler for a central furnace must be located in the garage, it needs to be in an air-sealed closet. (See the report [Air Sealing Mechanical Closets in Slab-On-Grade Homes](#).)

Do not have supply or return registers in the garage. If ductwork is located in the garage ceiling to service rooms above, make sure it is encapsulated with closed-cell spray polyurethane foam to ensure a complete air barrier. (See the report [Buried and/or Encapsulated Ducts](#).)

c. Install a passive vent to keep the garage at a neutral pressure in relationship to the house or consider installing a timer-operated exhaust fan that vents to the outside.



**Figure 2.** When ceiling joists over a garage run perpendicular to the adjoining wall, the joist bays must be blocked and sealed to prevent garage fumes from entering the living space. (Image courtesy of CARB)



**Figure 3.** A continuous rim joist separates the garage from the living space.

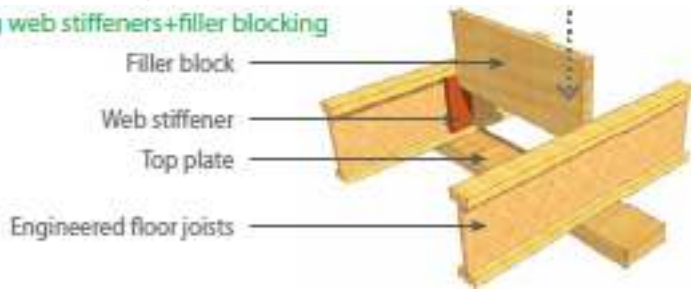


**Figure 4.** The I-joist is continuous along the shared wall and serves as a natural air barrier between the garage and the house. (Image courtesy of CARB)



**Figure 5.** Insert rigid blocking pieces into each joist bay and fasten with caulk or nails. (Image courtesy of CARB)

Detail showing web stiffeners+filler blocking



**Figure 6.** When using I-joists, make sure to fill in the gaps on each side of the blocking material to air seal the joist bay. (Image courtesy of CARB)



**Figure 7.** Foam holes in open-web floor trusses to completely seal the rim joist. (Image courtesy of CARB)



**Figure 8.** Use caulk or spray foam to air seal all four edges of the blocking material in each joist bay. (Image courtesy of CARB)



**Figure 9.** Spray foam insulates the rim joist and air seals the subfloor-rim joist and rim joist-top plate connections.



**Figure 10.** Use a flash and batt approach to insulate and air seal the garage ceiling.