Installing a garage exhaust fan is one important step in keeping auto exhaust and other pollutants out of the home.

Install an exhaust fan in an attached garage to pull fumes out of the garage and to depressurize the garage with reference to the home.

- Select an energy-efficient garage fan. Look for ENERGY STAR-certified models.
- Select an installation location on an exterior wall that is located away from the home’s doors, windows, and any ventilation air intakes.
- Integrate the fan with the water and air barrier layers in the exterior wall and properly flash around the opening for the fan.
- Install a motion sensor and timer with the fan.

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.
Garages can contain several airborne pollutants. Car exhaust contains combustion pollutants such as carbon monoxide and benzene; even if the garage door is open, some of these fumes can accumulate in the garage when starting or parking the car. An added concern are the keyless fobs that now come with many cars as they offer the potential to accidentally remotely start the car while it is parked in a closed garage. Garages are often used as storage areas for household cleaning products, fertilizers, pesticides, and gasoline for mowers and snow blowers. They are also used as workshop areas for projects involving hazardous chemicals, such as paints, solvents, and glues, which may continuously off-gas into the garage space. Water from rain or snow melt dripping off cars can encourage the growth of mold, another source of potential pollution in the garage. Without proper isolation and ventilation, these pollutants can accumulate in the garage space and may leak into the living areas of the home. See Figure 1.

The most effective way to keep garage pollutants from entering the home is to design the home with a detached garage. Smaller lot dimensions are making that option less feasible but consideration should still be given in design selection to minimizing the number of shared walls and ceilings between the garage and living space. Any walls and ceilings that are shared between the garage and the home should be thoroughly air sealed and steps should be taken to ensure that the home is not depressurized with respect to the garage.

There are several types of appliances in the home that can cause the home to be depressurized because they pull air out of the home while operating, for example, exhaust fans, range hood fans, clothes dryers, central vacuum cleaners, fireplaces, atmospherically vented water heaters or furnaces, and HVAC supply registers located in a garage or unconditioned basement. If the home does not have a fresh air intake or a balanced ventilation system that brings in fresh air while exhausting stale air, such as an ERV, HRV, or central fan-integrated ventilation system, the home can become depressurized and could draw in outside air from other less desirable places, like the attic, crawlspace, or attached garage.
Recognizing this concern, the U.S. Environmental Protection Agency’s Indoor airPLUS requires homes in the program that rely on exhaust-only ventilation to either have a garage exhaust fan installed or have a blower door test conducted to test the air barrier between the house and the garage. An exhaust fan will remove exhaust and other fumes from the garage and slightly depressurize the garage with reference to the house, significantly decreasing the likelihood that garage air will be pulled into the house. The EPA program requires that the fan be wired for continuous operation or with automatic fan controls such as a motion detector that will activate the fan whenever the garage is occupied and for at least one hour after the garage has been vacated. The exhaust fan should have a minimum installed capacity of 70 cfm and it should be vented directly outdoors, either through the wall or via a duct through the roof. EPA recommends using an ENERGY STAR-labeled exhaust fan. See the Compliance tab for more information.

There are several additional steps builders can take to help keep garage fumes out of the house. Many of these steps are required or recommended by EPA’s Indoor airPLUS or ENERGY STAR Certified Home, both of which are requirements for certification to DOE’s Zero Energy Ready Home Program.

- Air-seal the common walls and ceilings between attached garages and living spaces before installing insulation (TES Sections 3 and 5).
- Use weather stripping or an equivalent gasket to ensure all doors between living spaces and attached garages are substantially air-tight.
- Install an automatic door closer on all connecting doors between living spaces and attached garages.

See the following Building America guides for more information:

- **Air Sealing Attached Garage**
- **Floor above Garage**
- **Garage Rim/Band Joist Adjoining Conditioned Space**
- **No Ducts or Air Handlers Located in Garage**
- **Air Sealing Doors Adjacent to Unconditioned Space**
- **Rigid Foam Insulation Installed Between Existing House and Garage Walls**
- **Insulating Existing Floors over Garage**
- **Air Leakage Testing of Garage-to-House Air Barrier**

**How to Install a Garage Exhaust Fan**

1. Ensure that any walls and ceilings separating the garage from living space are thoroughly air sealed and have a continuous air barrier. Seal drywall to top and bottom plates and at seams; use airtight electrical boxes; seal around all wiring and piping; install self-closing doors and weather strip the door framing. See Figure 2 and the guides listed above for more details.

![Figure 2 - Install a self-closing weather-stripped door and thoroughly airseal the shared house-garage walls to help keep auto exhaust](image-url)
and other pollutants out of the home. (Source: EPA Indoor airPLUS 2014).

2. Select a fan location that is not near any windows, doors, or air intakes. (See the guide Ventilation Air Inlet Locations for more information.)

3. Select an ENERGY STAR-rated exhaust fan that has a minimum installed capacity of 70 cfm and is wired for continuous operation or is equipped with a motion detector that will activate the fan when the garage is occupied and for at least 1 hour after the garage has been vacated. A list of ENERGY STAR-qualified fans can be found by visiting the ENERGY STAR website.

4. Remove siding if necessary and cut a hole for the fan in the wall or ceiling and roof; install flashing that is integrated with the exterior wall or roof drainage plane.

5. Install the fan per manufacturer’s instructions, re-install siding if needed, and flash around the fan. Integrate the flashing with exterior cladding.

6. Install an automatically closing louvered cover over the fan if desired and verify that it opens and closes.

7. Provide the homeowner with information regarding indoor air quality, the dangers of operating any combustion engines in the garage when the doors are closed, and the need for ventilation when working in the garage for extended periods of time.
Ensuring Success

The continuity of the air barrier between the house and the garage can be tested by using a blower door to 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. All operable garage openings should be closed during this test. See the guide Air Leakage Testing of Garage-to-House Air Barrier for more information on this test.
Climate

This information is applicable to all climate zones.
Training

Right and Wrong Images

Display Image: car exhaust garage.jpg
Compliance

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.

DOE Zero Energy Ready Home

DOE Zero Energy Ready Home (Rev. 06) Exhibit 1, requires certified homes comply with the ENERGY STAR Certified Homes Version 3/3.1 Rev. 08 and the EPA Indoor airPLUS checklist.

ENERGY STAR Certified Homes (Version 3, Rev. 08)

Rater Field Checklist,

2. Fully Aligned Air Barriers: a complete air barrier is provided...at 2.4 Walls adjoining porch roof or garages, 2.6 Floors above garages,....

4. Air Sealing 4.7 Walls that separate attached garages from occupiable space sealed and also an air barrier installed and sealed at floor cavities aligned with these walls.

4.9 Doors adjacent to unconditioned space (e.g., attics, garages, basements) or ambient conditions made substantially air tight with weather stripping or equivalent gasket.

7. Whole-House Mechanical Ventilation System

7.7.1 Air inlet location pulls air directly from outdoors and not from attic, crawlspace, garage, or adjacent dwelling unit.

EPA Indoor airPLUS Version 1 (Rev. 04)

5.4 Attached garages: In homes with exhaust-only whole-house ventilation EITHER

- 70 cfm exhaust fan installed in garage OR
- Pressure test conducted to verify the effectiveness of the garage-to-house air barrier.

5.4 Attached Garages

NOTE: Completion of the ENERGY STAR requirements satisfies the following Indoor airPLUS requirement:

Isolate attached garages from conditioned spaces as follows:

- Air-seal common walls and ceilings between attached garages and living spaces before installing insulation (Rater-F 2.4, 2.6, and 4.7).
- Use weather stripping or equivalent gasket to ensure all doors between living spaces and attached garages are substantially airtight (Rater F 4.9).

Additional Indoor airPLUS Requirements:

- Install an automatic door closer on all connecting doors between living spaces and attached garages, AND
- In homes with exhaust-only whole house ventilation meet one of the following two requirements:
  - Equip the attached garage with an exhaust fan with a minimum installed capacity of 70 cfm that is vented directly outdoors. The fan shall be wired for continuous operation or with automatic fan controls (e.g., a motion detector) that activate the fan whenever the garage is occupied and operate for at least 1 hour after the garage has been vacated. If a ducted fan (not through-the-wall) is used, test and verify minimum capacity of 70 cfm, OR
  - Verify that the garage-to-house air barrier can maintain a pressure difference of greater than 45 Pa while the home maintains a 50 Pascal pressure difference with respect to the outdoors. All operable garage openings shall be closed during this test.

Advisories:

1. EPA recommends installing a garage exhaust fan if the homebuyer is expected to occupy the garage for work or recreational activities over extended periods of time.

2. ENERGY STAR certified fans are highly recommended.

3. Provide occupants with information in the Buyer Information Kit on the importance of, and methods for, ensuring adequate ventilation in the garage while occupied for extended periods of time.
Other Considerations from EPA Indoor airPLUS:

4.3. No air-handling equipment or ductwork installed in garage.

4.3 Location of Air-Handling Equipment and Ductwork.

Indoor airPLUS Requirement:

- Do not locate air-handling equipment or ductwork in garages.

Note: Ducts and equipment may be located in framing spaces or building cavities adjacent to garage walls or ceilings if they are separated from the garage space with a continuous air barrier.

5.2 Carbon Monoxide Alarms

Indoor airPLUS Requirement:

- All homes equipped with combustion appliance(s) or an attached garage shall have a carbon monoxide (CO) alarm installed in a central location in the immediate vicinity of each separate sleeping zone (e.g., in a hallway adjacent to bedrooms.) The alarm(s) shall be hard-wired with a battery back-up function and placed according to NFPA 720.

7.3 Owner and Resident Information Kit

Advisory: Provide the homebuyer with information that addresses the importance of ensuring that manually controlled ventilation options (e.g., bathroom, garage (if applicable), kitchen exhaust fans; operable windows, and doors, etc.) are used when strong pollutant sources are present, such as when using common household products (e.g., cleaning products, pesticides) and when using the garage for hobbies or other pollutant generating activities.

**Air Sealing and Insulating Garage Walls - Code Compliance Brief**

**Overview:**

The intent of this brief is to provide code-specific information about air sealing and insulating garage walls to help ensure that the measure will be accepted as being in compliance with the code. Providing notes for code officials on how to plan reviews and conduct field inspections can help builders or remodelers with proposed designs and installations and provide jurisdictional officials with information for acceptance. Providing the same information to all interested parties (e.g., code officials, builders, designers, etc.) is expected to result in increased compliance and fewer innovations being questioned at the time of plan review and/or field inspection.

As in other parts of the home, sealing and insulating the walls and ceiling of your garage can be an effective way to improve energy efficiency in a home. In addition, properly isolating and air sealing attached garages from the living space is critical for preventing the potential infiltration of carbon monoxide and other contaminants into the home. Open joist bays above the garage that extend into living spaces need to be blocked and air sealed at the garage wall. Seams along the rim joist, top plate, sill plate, and foundation wall should be caulked or sealed. If there is living space above the garage, extra care should be taken to seal all seams and any holes in the subfloor, and any doors between the house and the garage should be weather stripped and have a tight-fitting threshold sweep.

Insulation and air-sealing requirements for garage walls shared with conditioned space are found in the International Energy Conservation Code (IECC) and International Residential Code (IRC). Even though each version of the 2009, 2012, and 2015 IECC/IRC codes has included provisions that the building thermal envelope should be durably sealed to limit infiltration, the language related to air barriers and insulation in the 2009 version was somewhat vague and did not specify specific components of the building thermal envelope. The 2012 IECC/IRC added more specific language regarding areas of the building thermal envelope that should be sealed and expanded upon those areas that are now included in the 2015 IECC/IRC as well. This brief provides an overview of the 2009 through 2015 IRC/IECC code requirements related to air sealing and insulating attached garage walls.

1“Building Thermal Envelope” is defined as the basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provide a boundary between conditioned space and exempt or unconditioned space.

**Plan Review:**

Per the IECC/IRC, Section R103.3/R106.3 Examination of documents. The code official/building official must examine or cause to be examined construction documents for code compliance.

This section lists applicable code requirements and details helpful for plan review regarding the provisions to meet the requirement for insulated and air sealed attached garage walls.

- **Construction Documentation.** Review the construction documents for details describing garage wall insulation, installation and construction techniques.
2015 IECC/IRC, Section R103.2/N1101.5 Information on Construction Documents. Construction documents should include:

- insulation materials and their R-values
- manufacturer specifications on garage door leading into conditioned space including rated and labeled U-factor
- air sealing details

Air Leakage and Insulation. Review the construction documents and confirm that the insulation material, R-value, and air-sealing technique meet applicable code requirements.
2015 IECC/IRC, R402.4./N1102.4. Air Leakage. The building thermal envelope should be constructed to limit air leakage.

R402.4./N1102.4.1 Building Thermal Envelope. The sealing methods between dissimilar materials should allow for differential expansion and contraction.

R402.4.1./N1102.4.1.1 Installation. The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer’s instructions and the criteria listed as the applicable method of construction. Below are the General Requirements and components from the table that are applicable to sealing and insulating attached garage walls.

R402.4.1.1/N1102.4.1.1 Air Barrier and Insulation Installation Table
- Air Barrier General Requirements. A continuous air barrier should be installed in the building envelope. The exterior thermal envelope contains a continuous air barrier. Breaks or joints in the air barrier should be sealed.
- Air Barrier Criteria:
  - Walls – The junction of the foundation and sill plate should be sealed. The junction of the top plate and top of exterior walls should be sealed.
  - Floors (including above garages) – The air barrier should be installed at any exposed edge of insulation.
  - Garage separation – Air sealing should be provided between the garage and conditioned space.

- Insulation Installation:
  - Walls – Cavities within corners and headers of frame walls should be insulated by completely filling the cavity with a material having a thermal resistance of R-3 per inch minimum. Exterior thermal envelope insulation for framed walls should be installed in substantial contact and continuous alignment with the air barrier.
  - Floors (including above garages) – Floor framing cavity insulation should be installed to maintain permanent contact with the underside of subfloor decking, or floor framing cavity insulation should be permitted to be in contact with the top side of sheathing, or continuous insulation installed on the underside of the floor framing and extends from the bottom to the top of all perimeter floor framing members.
  - Narrow cavities – Batts in narrow cavities should be cut to fit, or narrow cavities should be filled by insulation that on installation readily conforms to the available cavity space.

2012 IECC/IRC, R402.4./N1102.4 Air Leakage. The building thermal envelope should be constructed to limit air leakage.

R402.4./N1102.4.1 Building Thermal Envelope. The sealing methods between dissimilar materials should allow for differential expansion and contraction.

R402.4.1./N1102.4.1.1 Installation. The components listed in the Air Barrier and Insulation Installation Table should be installed in accordance with the manufacturer’s instructions and the criteria listed as the applicable method of construction. Below are the General Requirements and components from the table that are applicable to sealing and insulating attached garage walls.

R402.4.1.1/N1102.4.1.1 Air Barrier and Insulation Installation Table
- Walls – Corners and headers should be insulated and the junction of the foundation and sill plate should be sealed. The junction of the top plate and top of exterior walls should be sealed. Exterior thermal envelope insulation for framed walls should be installed in substantial contact and continuous alignment with the air barrier.
- Garage Separation – Air sealing should be provided between the garage and conditioned spaces.
- Floors (including above-garage floors) – Insulation should be installed to maintain permanent contact with the underside of subfloor decking. The air barrier should be installed at any exposed edge of insulation.
- Narrow Cavities – Batts in narrow cavities should be cut to fit, or narrow cavities should be filled by insulation that on installation readily conforms to the available cavity space.

2009 IECC/IRC, 402.4.1 Air leakage, Building Thermal Envelope
- The building thermal envelope should be constructed to limit air leakage. The sealing methods between dissimilar materials should allow for differential expansion and contraction. Sources of infiltration should be caulked, gasketed, weather stripped, or otherwise sealed with an air barrier material, suitable film, or solid material:
  - All joints, seams, and penetrations