Air infiltration can account for 30 percent or more of a home’s heating and cooling costs and contribute to problems with moisture, noise, dust, and the entry of pollutants, insects, and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment. The size of heating and cooling equipment can also be decreased, which saves additional dollars. Reducing air leakage in new homes, as required by the 1995 Model Energy Code (see page 4), typically costs less than $200 for the average home and does not require specialized labor.

The recommended strategy in both new and old homes is to reduce air leakage as much as possible and to provide controlled ventilation as needed. For simple house designs, effective spot ventilation, such as kitchen and bath fans that exhaust to the outside, may be adequate. For more complex houses or ones in colder climates, whole house ventilation systems may be appropriate. Such systems may incorporate heat recovery, moisture control, or air filtering.

Air sealing is energy efficient, comfortable, and affordable—that’s the goal of DOE’s Office of Building Technology, State and Community Programs (BTS). To accelerate the development and wide application of energy efficiency measures, BTS:
- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Works with State and local regulatory groups to improve building codes, appliance standards, and guidelines for energy efficient use
- Provides support and grants to States and communities for deployment of energy-efficient technologies and practices

What is Air Leakage?
Ventilation is fresh air that enters a house in a controlled manner to exhaust excess moisture and reduce odors and stuffiness. Air leakage, or infiltration, is outside air that enters a house uncontrollably through cracks and openings. It is unwise to rely on air leakage for ventilation. During cold or windy weather, too much air may enter the house and, during warm or calm weather, too little. Also, a leaky house that allows moldy, dusty crawlspaces or attic air to enter is not healthy.

What Are the Benefits of Air Sealing?
Air infiltration can account for 30 percent or more of a home’s heating and cooling costs and contribute to problems with moisture, noise, dust, and the entry of pollutants, insects, and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment. The size of heating and cooling equipment can also be decreased, which saves additional dollars. Reducing air leakage in new homes, as required by the 1995 Model Energy Code (see page 4), typically costs less than $200 for the average home and does not require specialized labor.

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**WHERE ARE THESE LEAKAGE SITES?**

Dropped ceilings and kitchen soffits, ductwork and plumbing chases, attic accesses and pull-down stairs, recessed light fixtures, holes in mechanical room closets, and wiring penetrations through the top plates of walls represent major connections between the attic and conditioned space. Many times unseen holes or pathways, called bypasses, occur at key junctures in the framing (such as at attic-to-knee wall transitions) and permit large quantities of air to leak in and out of the home.

Major leakage sites in the floor can be found around the tub drain and the numerous plumbing, HVAC, and wiring penetrations through the floor decking and bottom plates of walls. In walls, the band joist (for two-story homes), window and door rough openings, and penetrations through the drywall and exterior sheathing are primary leakage sites.

**AIR SEALING MATERIALS**

Use a combination of these different air sealing materials.

- **Caulk**: Seals gaps of less than ½”. Select grade (interior, exterior, high temperature) based on application.

- **Polyethylene plastic**: This inexpensive material for air sealing also stops vapor diffusion. All edges and penetrations must be completely sealed for an effective air barrier. Poly is fragile, and proper placement is climate specific.

- **Sheet metal**: Used with high-temperature caulk for sealing high-temperature components, such as flues and chimneys, to framing.

- **Sheet goods**: Used to seal moveable components, such as doors, windows, and attic accesses.

- **Mastic**: Seals air handlers and all duct connections and joints.

- **UL181 or foil-faced tape**: This inexpensive material for air sealing has a high vapor transmission rate and is effective in blocking air leaks at the joints between exterior sheathing and interior framing. It is easily applied to interior sheathing, framing, and exterior faces using metal nails, screws, or staples. This is an effective air sealing material and is not a vapor barrier.

- **Mineral fiber**: A type of insulation that can be used as an air barrier. It is soft and easy to work with, but it is not recommended for use in high-temperature areas.

- **Polyurethane foam**: This material is very effective at sealing air leaks, but it can be very messy to apply. It is often used in high-temperature areas, such as near flues and chimneys.

**DIAGNOSTIC TOOLS**

Testing the airtightness of a home using a special fan called a blower door can help to ensure that air sealing work is effective. Often, energy efficiency incentive programs, such as the DOE/EPAs Energy Star program, require a blower door test (usually performed in less than an hour) to confirm the tightness of the house.

**DON’T RELY ON THE INSULATION**

The most common insulation, fiberglass, does not stop air leakage. In older homes, dirty fiberglass is a clear sign of air movement (it simply collects dirt like a filter). Certain types of insulation, such as dense-packed cellulose and certain foams, can be effective at reducing air flow as well as heat flow.

**WHAT ARE THE PRIORITIES FOR AIR SEALING?**

Although windows, doors, and outside walls contribute to air leakage, the biggest holes are usually hidden from view and connect the house to the attic, crawlspace, or basement. The key is to identify these areas during the design process, assign responsibility for sealing holes, and check to ensure that the air sealing was done effectively. Usually, seal all the big holes first, then the large cracks and penetrations, and finally the smaller cracks and seams.
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WHERE ARE THESE LEAKAGE SITES?

Dropped ceilings and kitchen soffits, ductwork and plumbing chases, attic accesses and pull-down stairs, recessed light fixtures, holes in mechanical room closets and wiring penetrations through the top plates of walls represent major connections between the attic and conditioned space. Many times unseen holes or pathways, called bypasses, occur at key junctures in the framing (such as attic-to-kneewall transitions) and permit large quantities of air to leak in and out of the home.

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AIR SEALING MATERIALS

Use a combination of these different air sealing materials.

- **Caulk**: Seals gaps of less than 1/4”. Select grade (interior, exterior, high temperature) based on application.
- **Spray foam**: Fills large cracks and small holes. It can be messy; consider new liter-based foams. DO NOT USE near flammable applications (e.g., flue vents). DO NOT USE expanding types on windows and doors.
- **Backer rod**: Closed-cell foam or rope caulk. Press into crack or gap with screwdriver or putty knife. Often used with caulk around window and door rough openings.
- **Gaskets**: Apply under the bottom plate before an exterior wall is raised or use to seal drywall to framing instead of caulk or adhesive.
- **Housewrap**: Installed over exterior sheathing. Must be sealed with housewrap tape or caulk to form an airtight seal. Resists water but is not a vapor barrier.
- **Sheet goods**: (plywood, drywall, rigid foam insulation). These materials form the air barrier. Air leaks only at unsealed seams or penetrations.
- **Sheet metal**: Used with high-temperature caulk for sealing high-temperature components, such as flues and chimneys, to framing.
- **Polyethylene plastic**: This inexpensive material for air sealing also stops vapor diffusion. All edges and penetrations must be completely sealed for an effective air barrier. Poly is fragile, and proper placement is climate specific.
- **Weatherstripping**: Used to seal moveable components, such as doors, windows, and attic accesses.
- **Mastic**: Seals air handlers and all duct connections and joints.

DO WHAT ARE THE PRIORITIES FOR AIR SEALING?

- **UL181 or foil-faced tape**: Used to seal moveable components, such as doors, windows, and attic accesses.
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**DIAGNOSTIC TOOLS**

Testing the airtightness of a house using a special fan called a blower door can help to ensure that air sealing work is effective. Often, energy efficiency incentive programs, such as the DOE/EPAsemper new home program, require a blower door test (usually performed in less than an hour) to confirm the tightness of the house.

**Seal and insulate exterior wall before installing bath tubs.**

**Seal dropped soffit ceilings, plumbing and electrical penetrations, and utility chases.**

**Seal exterior sheathing joints, and top and bottom plates.**

**Seal plumbing and electrical penetrations.**

**Seal and insulated drywall to framing.**

**Insulate and air seal behind tub with sealed polyethylene plastic or sheet material.**
For more information, contact:

Energy Efficiency and Renewable Energy Clearinghouse (ERE)  
1-800-DOE-3732  
www.eren.doe.gov

Or visit the BTS Web site at  
www.eren.doe.gov/buildings

Or refer to the Builder’s Guide  
Energy Efficient Building Association, Inc.  
651-268-7585  
www.eeba.org

Written and prepared for the U.S. Department of Energy by:  
Southface Energy Institute  
404-872-3549  
www.southface.org

Oak Ridge National Laboratory  
Buildings Technology Center  
429-574-5178  
www.oak넷.gov/oml/btc

The Model Energy Code can be obtained from the International Code Council by calling  
703-931-4533

MECheck, a companion compliance software package, can be obtained from DOE by calling  
1-800-270-CODE or downloaded directly from the Web at  

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Seal air leaks and save energy!

Ventilation is fresh air that enters a house in a controlled manner to exhaust excess moisture and reduce odors and stuffiness. Air leakage, or infiltration, is outside air that enters a house uncontrollably through cracks and openings. It is unsafe to rely on air leakage for ventilation. During cold or windy weather, too much air may enter the house and, during warm or calm weather, too little. Also, a leaky house that allows moldy, dusty crawlspace or attic air to enter is not healthy.

The recommended strategy in both new and old homes is to reduce air leakage as much as possible and to provide controlled ventilation as needed. For simple house designs, effective spot ventilation, such as kitchen and bath fans that exhaust to the outside, may be adequate. For more complex houses or ones in colder climates, whole house ventilation systems may be appropriate. Such systems may incorporate heat recovery, moisture control, or air filtering.

**Kitchen**

**Bath**

Seal all plumbing or electrical wire penetrations with UL-approved airtight, IC-rated gasketing or UL-approved metal collar and high-temperature, fire-rated caulk.

Seal around the metal flue of combustion equipment using a UL-approved metal collar and high-temperature (450°F), fire-rated caulk.

Use only UL-approved airtight, IC-rated recessed light fixtures (that meet ASTM 283 requirements), seal between fixture and drywall with caulk.

Air sealing exterior:

Repair any damaged sheathing pieces.

Seal all exterior penetrations, such as porch light fixtures, phone, security, cable and electric service holes, with caulk or spray foam.

If not using housewrap, seal all sheathing seams with housewrap tape or caulk.

What is air leakage?

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Buildings for the 21st Century

Buildings that are more energy-efficient, comfortable, and affordable...that’s the goal of DOE’s Office of Building Technology, State and Community Programs (BTC) to accelerate the development and widespread application of energy efficiency measures, BTS. To accomplish this goal, DOE and the building industry work closely with the building industry and with manufacturers of materials, equipment, and appliances.

- Promote energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Work with State and local regulatory groups to improve building codes, appliance, and equipment standards, and guidelines for energy-efficient use
- Provide support and grants to States and communities for deployment of energy-efficient technologies and practices

Annual Energy Costs for 1300 sq. ft. house

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<td>$208</td>
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<tr>
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<td>$204</td>
<td>$122</td>
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</tbody>
</table>

* Estimated 12 air changes per hour at 50 Pascal pressure difference

Annual Energy Costs for 1300 sq. ft. house

- High: $311 $208 $122
- Low: $204 $122 $67

What is an air barrier?  
Air infiltration can account for 30 percent or more of a home’s heating and cooling costs and contribute to problems with moisture, noise, dust, and the entry of pollutants, insects, and rodents. Reducing infiltration can significantly cut annual heating and cooling costs, improve building durability, and create a healthier indoor environment.

Infiltration rate savings

- High: $196 $178 $67
- Low: $116 $78 $18

What are the benefits of air sealing?

For simple house designs, effective spot ventilation, such as kitchen and bath fans that exhaust to the outside, may be adequate. For more complex houses or ones in colder climates, whole house ventilation systems may be appropriate. Such systems may incorporate heat recovery, moisture control, or air filtering.

Kitchen and bath fans provide spot ventilation.

For more information, contact:

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www.eren.doe.gov

Or visit the BTS Web site at  
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Energy Efficient Building Association, Inc.  
651-268-7585  
www.eeba.org

Written and prepared for the U.S. Department of Energy by:  
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404-872-3549  
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Oak Ridge National Laboratory  
Buildings Technology Center  
429-574-5178  
www.oakネット.gov/oml/btc

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