AIR LEAKAGE BASICS

To properly utilize the diagnostic capabilities of your blower door, it is important to understand the basic dynamics of air leakage in buildings. For air leakage to occur, there must be both a hole or crack, and a driving force (pressure difference) to push the air through the hole. The five most common driving forces which operate in buildings are:

1. **Stack Effect**
   Stack effect is the tendency for warm buoyant air to rise and leak out the top of the building and be replaced by colder outside air entering the bottom of the building (note: when outside air is warmer than inside air, this process is reversed). In winter, the stack effect creates a small positive pressure at the top of the building and small negative pressures at the bottom of the building. Stack effect pressures are a function of the temperature difference between inside and outside, the height of the building, and are strongest in the winter and very weak in the summer. Stack induced air leakage accounts for the largest portion of infiltration in most buildings.

2. **Wind Pressure**
   Wind blowing on a building will cause outside air to enter on the windward side of the building, and building air to leak out on the leeward side. At exposed sites in windy climates, wind pressure can be a major driving force for air leakage.

3. **Point Source Exhaust or Supply Devices**
   Chimneys for combustion appliances and exhaust fans (e.g. kitchen and bath fans) push air out of the building when they are operating. Air leaving the building from these devices causes a negative pressure in the building which draws outside air into holes and cracks in the building envelope. Supply fans (e.g. positive pressure ventilation fan) deliver air into the building creating a positive pressure which pushes inside air out of the building through holes and cracks in the building envelope.

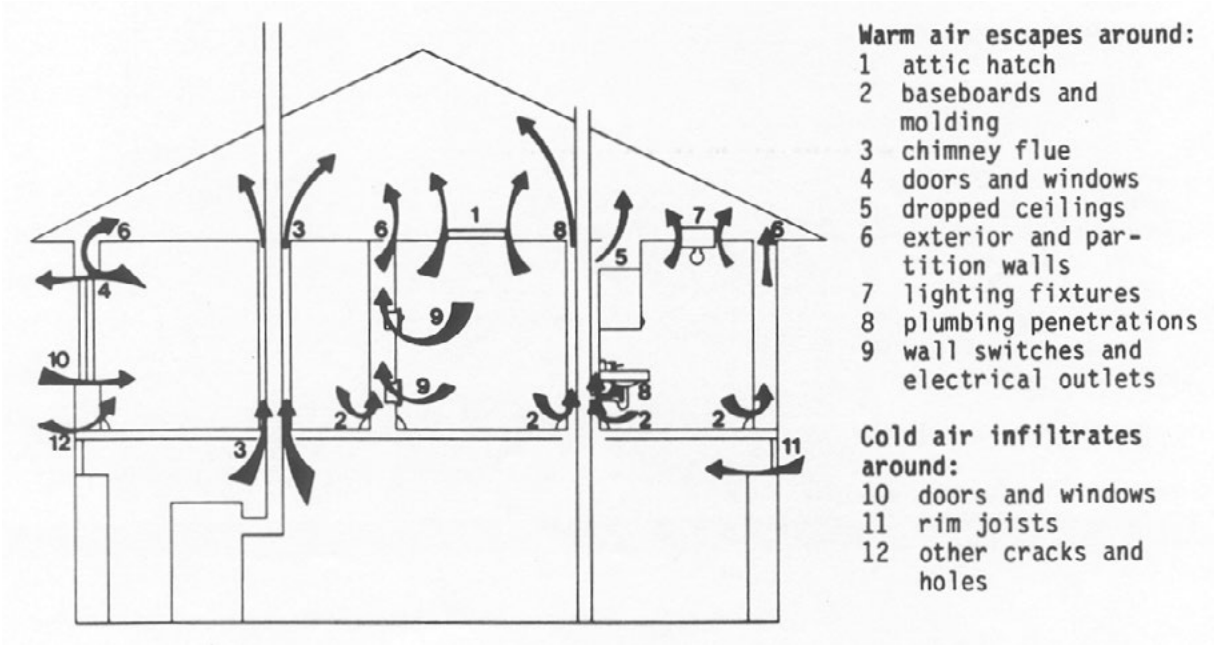
4. **Duct Leakage to the Outside**
   Leaks in forced air duct systems create pressures which increase air leakage in buildings. Leaks in supply ducts act like exhaust fans causing negative building pressures. Leaks in return ducts act like supply fans creating positive pressures in buildings.

5. **Door Closure Coupled with Forced Air Duct Systems**
   Research has shown that in buildings with forced air duct systems, imbalances between supply and return ducts can dramatically increase air leakage. For example, a study conducted in Florida showed that infiltration rates in many houses were doubled whenever the HVAC system fan was operating due to pressures caused by door closure.

Common Air Leakage Sites

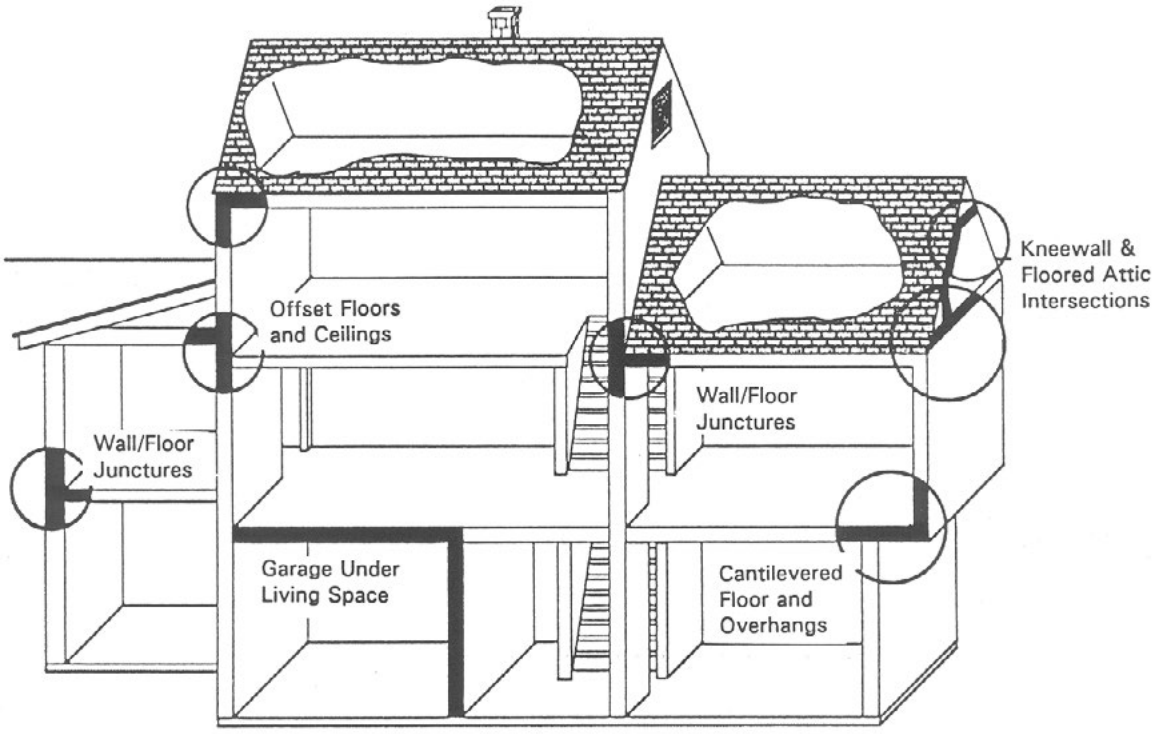
Common air leakage sites are shown below. Notice how as warm air rises due to the stack effect, it tends to escape through cracks and holes near the top of the building. This escaping air causes a slight negative pressure at the bottom of the building which pulls in cold air through holes in the lower level. Air sealing activities should usually begin at the top of the building because this is where the largest positive pressures exist and where many of the largest leakage sites (and potential condensation problems) can be found.

The next most important location of leaks is in the lowest part of the building. The bottom of the building is subject to the largest negative pressures, which induces cold air infiltration. Importantly, if spillage prone natural draft combustion appliances are present, do not seal lower level building leaks unless you have first addressed leaks in the attic or top part of the building. Sealing only lower level leakage areas while leaving large high level leaks could create large enough negative pressures to cause combustion appliance backdrafting.

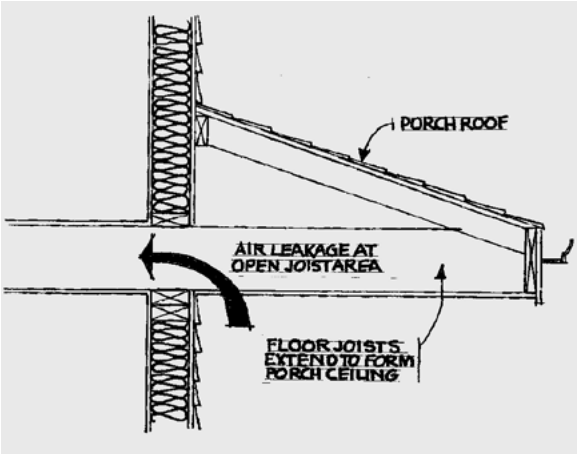


Common air leakage sites

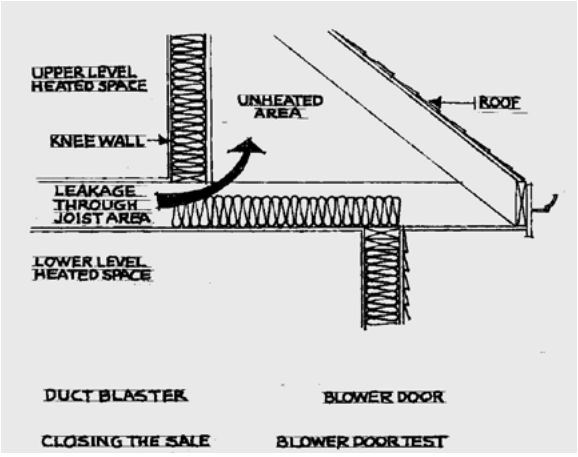
In addition to these common leakage sites, there can also be large leakage paths associated with hidden construction details such as attached porches, cantilevered floors and overhangs. Below show a number of potentially important leakage paths which are often overlooked by crews using traditional weatherization techniques. Use of densely blown cellulose insulation or other barrier-type air sealing techniques at these key junctures often result in dramatic air leakage reductions.



Hidden construction details



Leak from attached porch



Common kneewall leak

Forced air system ductwork can also be a major air leakage site. Even small leaks in ductwork can result in significant air leakage due to the high pressures found in ducts whenever the heating or cooling system is operating.

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