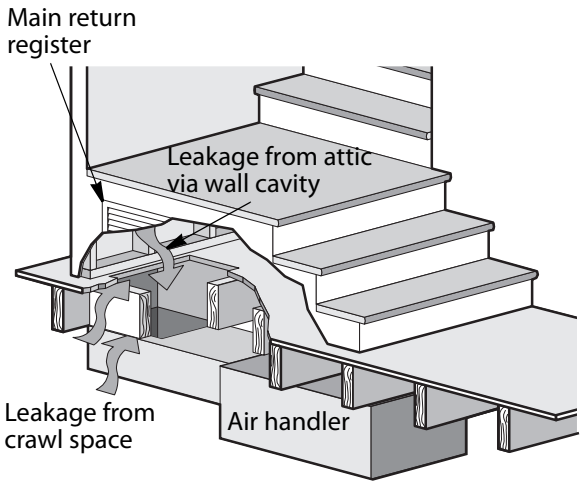
Duct Air Leakage

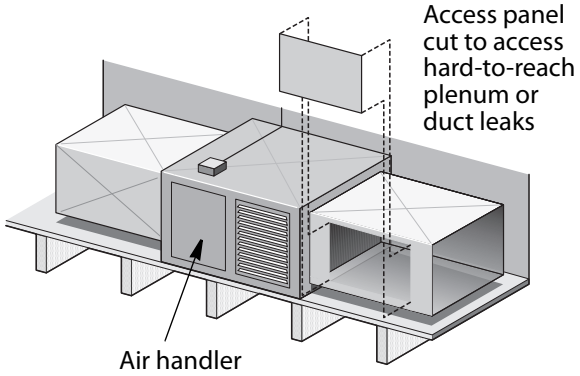
Studies from throughout North America indicate that duct leakage typically wastes 10% to 30% of the heating or cooling energy purchased by the homeowner.

When ducts are located in conditioned areas, duct leakage may cause minor inefficiency and indoor temperature variations, but it isn't a major energy problem. Duct sealing yields the biggest savings when the ducts are located in an intermediate zone where duct leaks exchange air freely with outdoor air. This air exchange between ducts and outdoor air wastes energy in two ways. First, conditioned air is lost, and second, outdoor air enters and needs to be conditioned.

Duct air leakage also pressurizes or depressurizes the home, providing a driving force for air leakage through the building shell. Operation of a leaky forced-air system increases home air leakage an average of two to five times.

Duct Leakage Around Air Handlers





Leaks in air handlers, plenums, and main duct connections near air handlers are particularly important because of high pressure there.

Leaky supply ducts are one of the most severe energy problems commonly found in homes because the leaking supply air is 20°F to 70°F warmer than indoor air in winter and 15°F to 25°F cooler in summer. Furnaces and packaged

air conditioners located on rooftops, the ground outdoors, crawl spaces, and attics are often major air-leakage sites.

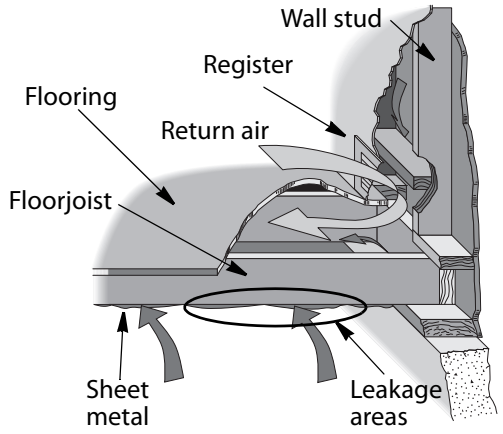
Since the sheet metal, fiberglass duct board, and insulated plastic flex ducts composing supply duct systems are all effective air barriers, air leakage only occurs at joints, seams, and ruptures. Metal ducts with no sealant are often the leakiest. Fiberglass ducts and flex ducts are often installed improperly or deteriorate with age, leading to significant supply-duct leakage.

Some of the worst duct air leaks occur in the air handler and at joints between the air handler and the main supply and return air ducts, which are called plenums. The plenums are sheet-metal boxes that connect to the top, bottom, or side of the air handling unit. Plenums serve as the main outlet and inlet to the air handler. Some return plenums use plywood or fiberglass duct-board boxes. These boxes frequently leak while being exposed to the duct system's highest pressures.

Mechanical contractors often use wall, floor, and ceiling cavities as return ducts. These cavities usually have serious air leaks. If a building cavity, used as a return duct, is somehow connected to the outdoors or an intermediate zone, then a significant percentage of return air may come from outdoors.

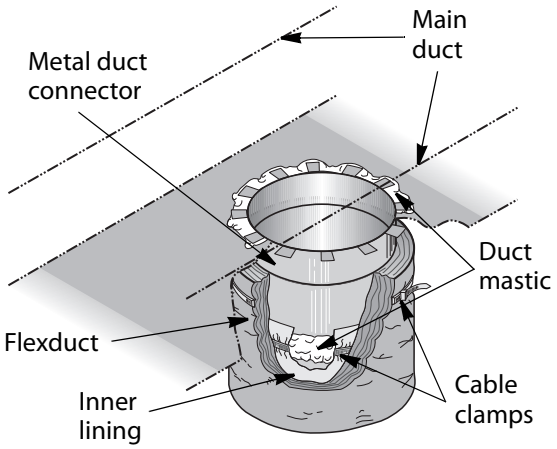
Sealing duct leaks near combustion furnaces is very important for the safety of the residents. A large return-air leak near the furnace can suck flue gases down the chimney into the living space — a very dangerous condition. The same depressurization can draw moisture or soil gases into the home.

Floor and Wall Cavities as Ducts



Return air passageways that use building cavities are prone to excessive air leakage through joints in the building materials that border the return air duct.

Sealing Flexduct



A short piece of 10- or 12-inch metal pipe is often used to connect the flexible crossover duct with the main duct. Two cable clamps fasten the flexduct to the metal pipe.

Duct-testing Strategies

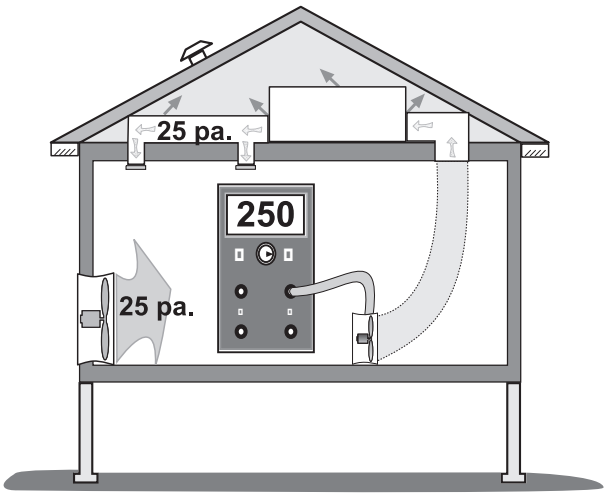
One of the simplest ways to detect duct leakage is to feel with your hand for air leaking out of supply ducts while the furnace blower is on. Use a smoke generator to detect return duct leaks pulling smoke in. A trouble light, flashlight, and mirror help visually pinpoint leaks inside ducts.

The blower door is a more sophisticated tool for finding duct leaks. Air flowing from registers during a blower-door test indicates air leakage from outdoors through the ducts. With the building depressurized, use your hand or a smoke generator to detect air leakage at registers.

A gasketed pan connected to a manometer, called a pressure pan, is used to temporarily block registers and measure the blower-door-induced duct pressure at the register. With the blower depressurizing the home to 50 pascals, technicians block registers one at a time and measure the pressure created by air leaking into the duct system. Technicians normally find pressures ranging from 1 to 30 pascals. The size of pressure measurements at registers indicates the severity of air leaks or nearness to the pressure pan. Registers of newly installed ducts should read less than 0.5 pascals and existing duct registers should read less than 1 pascal after being sealed. The pressure-pan method speeds up the process of finding and sealing duct leaks. Pinpointing the precise duct leakage location still requires visual or tactile duct inspection.

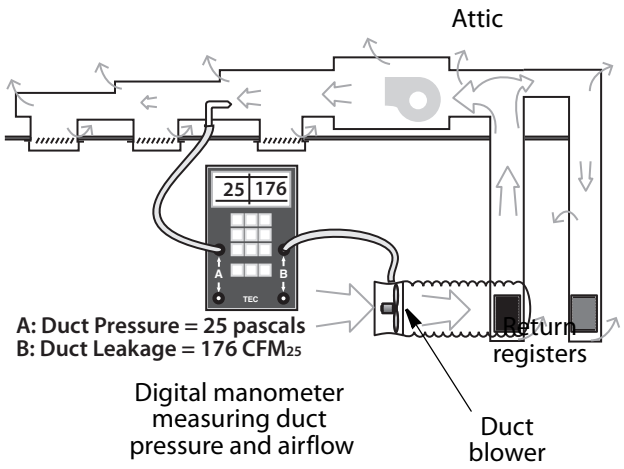
An accurate way to measure duct leakage is with a duct blower, a device that resembles a blower door. The duct blower connects to the air handler or a large return air register. The duct blower pressurizes the ducts after you block all the registers. Measuring the air flowing through the duct blower's fan housing gives an accurate measurement of duct air leakage. Duct leakage measured by this method can be occurring from inside or outside the thermal boundary.

Measuring Duct Leakage to Outdoors



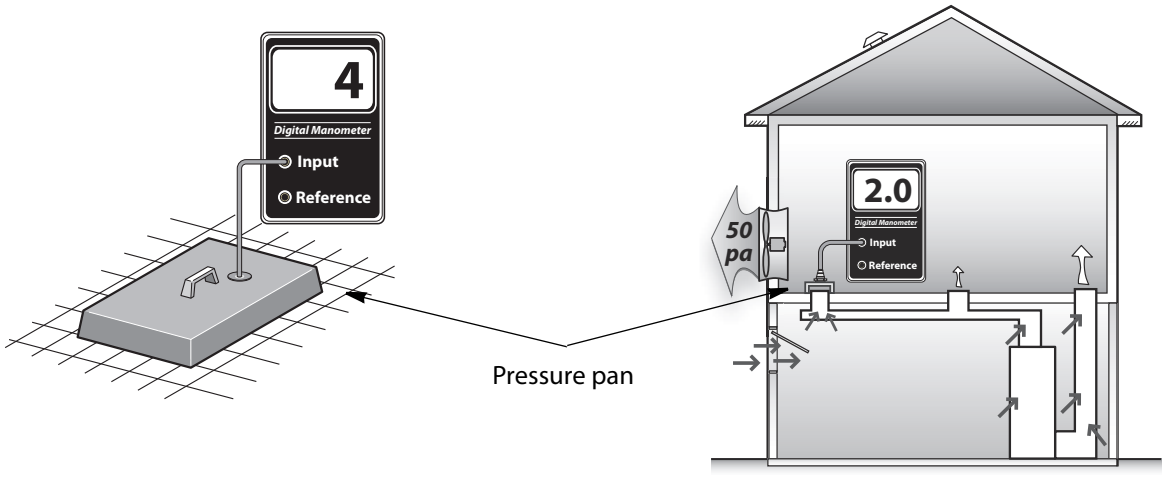
The house and its ducts are both pressurized to 25 pascals. When there is no pressure difference between the house and ducts, there should be no airflow between them. All the airflow going through the duct blower (250 CFM_{25}) is going outdoors. The same manometer measures both airflow and pressure differences, as required in this test.

Measuring Total Duct Air Leakage



The duct blower pressurizes the sealed duct system through one of two return registers. At 25 pascals of duct pressure, these ducts have 176 CFM_{25} of total duct air leakage.

Pressure Pan



A pressure pan is a device used to block registers and measure their pressure during a blower-door test. Registers near duct leaks will give higher readings than more distant registers.

Whether the ducts are inside or outside the thermal boundary affects air-sealing priorities. Ducts outside the thermal boundary are most important to seal. The airtightness of any air barrier outside the ducts — foundation walls, roof, garage doors — will affect their leakage. A tight space, like an unvented crawl space, inhibits duct leakage. A leaky space, like an attached garage with leaky garage doors, encourages duct leakage.

To measure how much duct air leaks outdoors, technicians pressurize the home with a blower door, while pressurizing the ducts with a duct blower — usually 25 pascals positive pressure each. The airflow indicated by the duct blower's manometer represents duct leakage to the outdoors, which is directly related to the possible energy savings from duct air sealing.

Leakage ranges from less than 50 CFM_{25} for a fairly tight residential duct system, to more than 500 CFM_{25} for a very leaky duct system. The higher the leakage, the better opportunity for energy savings.

See "Duct Airflow Problems" on page 165 and "Airflow and Performance in Central Air Conditioners" on page 217 for information on measuring ducted airflow.