#3974

WASHINGTON ENERGY EXTENSION SERVICE
TECHNOTE

**AIR INFILTRATION** **TN1507**

A considerable amount of confusion reigns regarding the issue of heat loss due to air changes, or infiltration, in buildings. The problem is not whether it happens, but how much and where, how it can be calculated, and how it can be measured. This Technote will address the first question.

Typically we say 25-30% of the heat loss from a typical home is due to infiltration. Yet, this figure could easily rise to 50% if the home is well insulated, but not well sealed. The total house heat loss could actually be lower, but the percentage attributed to infiltration would be larger. Formerly, we believed that houses experienced between one and three total air changes per hour (ACH), on the average. More recent information shows most homes in the U.S. fall between 0.5-1.5 ACH.

Air can get in (and out) through incredibly tiny holes. The 1981 ASHRAE Handbook of Fundamentals[1] distributes air leakage area by building component as follows:

| Component | Range | Average |
|---|---|---|
| Walls | 18-50% | 35% |
| Ceiling details | 3-30% | 18% |
| Heating system | 3-28% | 15% |
| Windows and doors | 6-22% | 15% |
| Fireplaces | 0-30% | 5% |
| Diffusion through walls | <1% | |

It is important to note that what is described here is leakage area, not infiltration. For the most part it is probably safe to assume the proportions would be the same, as long as you are referring to entire sets of components. That is, if the walls of a house represent 40% of the leakage area, they probably represent 40% of the infiltration as well. The term "leakage area" is not directional, however, while "infiltration" is. Air can leak out through the leakage areas as well as in. This distribution becomes important when considering calculation methods.

A number of recent studies update conventional wisdom regarding

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infiltration. In the 1970's a study done by Caffey for Texas Power and Light showed that electrical outlets accounted for 20+% of the total leakage. A study by Lawrence Berkeley Labs[2] (LBL) pressure testing 34 homes found the outlets were only responsible for only about 1% of the leakage. They concluded that, even allowing for error in the testing methods, the outlets were unlikely to account for more than 10%.

The same study found that the greatest source of leakage by far, was the building seams, doors, and windows (at 50-74%), though ductwork (13%) and fireplaces (9%) make large single contributions. A study done by Janssen, Pearman, and Hill[3] examining the ASHRAE Handbook models showed the infiltration flow in a home with ductwork in an uninsulated crawlspace increased from 0.13 Liters per second per linear meter (L/s.m.) to 0.75 L/s.m. when the heating system was turned on. This was the effect of the furnace fan inducing greater infiltration through leaks in the ducts. Atlanta homes tested in the LBL study[2] showed operation of the blower could increase infiltration rates as much as 50% through ductwork leakage. At a blower door test closer to home, the one duct running above the insulation in the attic of a superinsulated Bellingham house turned out to be the most significant leak, even though the sheet metal was carefully joined and all joints taped.

Forced air combustion heating systems contribute to heat loss in another way as well. Most of these systems draw house air for combustion--air which ultimately goes up the chimney. The combustion induced draft, in turn, increases infiltration through other building components. Furthermore, the momentum of the draft continues even after combustion has shut down. This factor is not accounted for in the methods used to calculate infiltration or leakage areas from homes.

It is possible to draw a number of conclusions from this. Even with the extremely low estimates of infiltration at outlets, gaskets are cheap enough to pay for their material cost fairly quickly. Installing furnace ductwork within the heated space would appear to make good sense in combating infiltration, as would supplying an outside air intake or retrofitting vented dampers on conventional furnaces. Tight fitting dampers and outside air intakes are very important for fireplaces and woodstoves as well. The average leakage area of a normal fireplace with its damper closed equaled 9% of the total house leakage, considered high for a single leakage area by the LBL researchers. If there was no damper, the average leakage area equaled 24% of the house total. Leaving a damper open increased leakage area by at least 37%.

**NOTES**

1. ASHRAE 1981 Handbook of Fundamentals, Chapter 22, 1983, American Society of Heating, Refrigeration, and Air-Conditioning Engineers, Atlanta.

2. Component Leakage Testing in Residential Buildings," D.J. Dickeroff, Energy and Environment Division, Lawrence Berkeley Labs.

3. "Calculation of Infiltration: An Examination of Handbook Models," John E. Janssen, ASHRAE Transactions, 1980, part II.

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