Pressure interactions in a house:
Precautions for Hearth Product Installers

by David Hill

In an ongoing quest for improved wintertime comfort, homes today are more airtight.

Besides code requirements, there are two additional market forces at work furthering this trend in multi-family dwellings. Upgraded draft-proofing not only improves fire and smoke protection between units, but is also one of the principal steps to improve suite livability; isolating the occupants from street noises and from adjoining neighbours. In urban areas, air sealing also eliminates the black perimeter carpet 'ghosting' that is becoming a major customer relations liability. In rural and suburban areas, draft-proofing can stop flies and insects from entering a house.

Combustion appliances are widely used for heating, cooking, and decorative purposes. They may be safe and functional, or present potential hazards.

It is important to identify good mechanical equipment and recognize professional installation workmanship, and understand how these affect the home into which we install them. With ongoing changes to construction practice and recent changes in the public attitude toward legal liability, we must broaden our knowledge beyond our own narrow commercial interest.

Three elements we must be cautious of are:

1. Large kitchen down draft exhaust fans
2. Leaky return air duct systems of forced air furnaces
3. Cold chimneys

Ignorance of any of these can expose you to safety liabilities and customer dissatisfaction. The following example may help explain the complex systems operating in a house.

The average new house built in BC today can be thought of as a 100,000 gallon steel oil storage drum. Consider the situation if during the last hunting season some hunters had shot the drum full of holes from all angles, even through the top. The bottom was untouched because it sits directly on a concrete pad. When assessing the repair cost it was determined that all the holes added up to about 1.6 sq. ft.

However, rather than having the holes plugged, the owner decides to put in a floor across the whole tank. The floor is put in halfway up between the top and bottom. The "house" has a kitchen exhaust fan, 2 bathroom fans, a clothes dryer, a fireplace and gas forced air furnace. Even without windows and insulation, this is an aerodynamic replica of a new 2000 sq. ft. home built to B.C. code standards. (The typical new prairie house would have a hole about ½ square foot, while in the typical new Ontario house it is about one square foot).

This example can be easily used to explain pressure interactions in a home, although in real life they do not appear so obvious.

Exhaust Fans

Experience has proven that large kitchen down draft exhaust fans interfere with the safe operation of many hearth products.

It is commonly, but incorrectly, believed that a fan will take from 15 minutes to one hour to affect pressures in the house. Not true! Even before one of these fans has reached full rpm, the house will feel outside pressure pushing inward as the final pressure is reached in about 5 seconds. That pressure depends only on the installed capacity of the fan and the combined leakage area of in the house. House volume will only determine whether the steady state is reached in 2 or 5 seconds.

In my experience, most BC homes are sufficiently leaky that only large exhaust fans become a threat to naturally vented chimneys. The exceptions are very small multi-family dwellings where even small fans may affect the draft in warm chimneys.

Return Air Leakage

Forced warm air heating systems complicate the situation since a house is compartmentalized into rooms and levels. We normally assume that a furnace will heat the whole house whatever its compartmentalization. We further assume, incorrectly as we have now learned, that the system delivers as much air to each compartment as it withdraws. However, because of its relatively large fan capacity, even a small mismatch between delivered and returned volumes to/from each room will cause one room to become pressurized, and its neighbour to become the opposite. These mechanically induced pressures can easily dwarf building stack action and even the slightly stronger forces of gravity acting on the chimney.

Cold Chimneys

A chimney can be considered as a 'special' large bore hole penetrating the wall or ceiling. It will be

a warm chimney if its inside, penetrating the house envelope at the ceiling. A cold chimney is mostly outside, penetrating the house envelope through the wall near the bottom of the house. A hole in the ceiling can be considered identical to a hole in the wall until winter begins and the heat is turned on. The moment the interior temperature rises above the outdoor temperature the hole in the ceiling will begin to draft upwards naturally; the strength of the draft increasing as the outdoor temperature falls.

A chimney penetrating the wall at low or even mid-height will very likely reverse and become a make-up air source replacing the air that leaks out through the ceiling. Unfortunately the performance (safety) of a mid-height wall chimney will be determined by whether most of the holes are on the upper or the lower portion of the wall. Only if most of the holes are low and big, will the special mid-height wall hole vent as intended.

How much depressurization acceptable?

The depressurization limit for a house is normally determined by its weakest chimney. In my experience any chimney penetrating the wall below its ceiling (cold chimney) will be a problem, providing poor or no draft during start-up and sometimes causing complete reversal during tail-out. This situation is aggravated at night when outdoor temperatures fall. Most houses have too many high-level holes that allow heated air to escape which can easily challenge the chimney's draft. The air loss in the upper portion of the structure makes draft performance of the cold chimney (penetrating a low wall) too questionable to count on for safe exhaust of combustion products.

Conclusion

We must always keep in mind the principle of *the house-as-a-system*. It is no longer enough just to focus on a single product and its specific installation codes. We must learn to foresee any possible interaction before it occurs.

- We will not be able to ensure health and safety if we connect naturally aspirating appliances to an exterior (cold) chimney.
- We will likely never be able to protect ourselves fully (without using absolutely sealed direct vent appliances) against the negative pressures induced by large kitchen exhaust appliances.
- We will never be able to protect ourselves against negative pressures when furnace duct systems are poorly sized/scaled/installed.

To deal with the later two conditions, we must foresee these problems by carefully reading plans for new construction or, in the case of retrofits, looking closely for clues during a walk-through. If other subcontractors install air-handing equipment after our work is complete, and problems then arise, we must have the conviction to place the costs of returning the home to a safe condition squarely on the shoulders of those responsible. ☼

Polybutylene Plumbing Alert

A North Vancouver lawyer is soliciting business from B.C. homeowners who have polybutylene plumbing pipe installed in their homes. The intent is to start class action suit against the companies that developed and sold the products.

This issue may be blown completely of proportion - but it is a word of caution.

In the USA there was a problem with fittings, but these have not been used for more than 15 years. Apparently, high levels of chlorine can accelerate degradation of the material. In some US locations, chlorine concentrations approach that found in a swimming pool! In the Vancouver area the chlorine concentrations used are too weak to affect the fittings.

In any event, polybutylene piping is no longer manufactured - cross linked polyethylene is used today.

Vancouver area homebuilders, plumbing contractors and suppliers have no knowledge of any problems with polybutylene pipes that would merit a class action lawsuit.

If anyone hears of any such action, keep your HBA association and the TRC informed.

Utility Deregulation Is No Use to Residential Customers

The American Gas Association says residential electricity customers will see little benefit from deregulation of utilities, but commercial and industrial users will be big winners. Across the USA it predicts that commercial users will see average savings of 26% while residential consumers will see a 10% drop.

As the Canadian energy market starts getting deregulated, we may well expect to see similar moves.