

## Combustion Gases in Your Home – Things You Should Know About Combustion Spillage

### ARE COMBUSTION GASES SPILLING INTO YOUR HOME?

Does your home have any of these combustion appliances?

- Gas-fired furnace, boiler, or water heater
- Oil-fired furnace, boiler or water heater
- Wood stove or fireplace
- Other fuel-burning device

If so, then combustion gases will be produced as the fuel burns. Normally, these combustion products—which can include both visible smoke and various invisible gases—should be vented to the outdoors through a chimney or vent pipe. Unfortunately, they may instead escape into your home, where they could raise a variety of health and other concerns.

*Combustion spillage* is the term used to describe the unwanted flow of combustion gases into your home. The quantities involved are usually small. However, the number of houses with potentially significant spillage is increasing, and on occasion the results can be extremely serious. This fact sheet provides some important information about combustion spillage. It alerts you to some of the

symptoms and outlines practical steps you can take to reduce the risks. In short, *this fact sheet is designed to help you keep combustion gases OUT of your home.*

### WHY THE CONCERN?

Because toxic compounds can be present in combustion gases, sharing your home with these gases can lead to problems ranging from nuisance headaches to serious illness, carbon monoxide poisoning and even death. The most likely health effects are chronic, low-grade, sometimes difficult-to-define ailments, and health deterioration due to long-term exposure to the combustion gases. These effects can occur even if concentrations are low.

Toxic and other harmful products in the combustion gases include:

- Carbon monoxide
- Polycyclic aromatic hydrocarbons (PAHs)
- Aldehydes
- Hydrocarbons
- Sulphur dioxide
- Nitrogen oxides
- Particulates

Carbon dioxide and water vapour, which are relatively harmless, are often present in larger quantities.

The exact composition and characteristics of combustion gases, and the severity of their effect on your house and its occupants, depend on several factors. These include the type of fuel being burned and the condition of your system.

### UNDERSTANDING VENTING AND SPILLAGE

#### When Things Go Right

A typical oil or gas forced-air heating system is shown schematically in Figure 1. When operating, the system generates two *separate* air flows:

#### Combustion air

Combustion is a process in which air and fuel combine to produce heat and various combustion products. Depending on the type of furnace, the air required for combustion may be drawn into the furnace from the surrounding room, or it may be ducted directly from outside the house. Furnaces should be designed to completely remove the resulting combustion gases from your home.

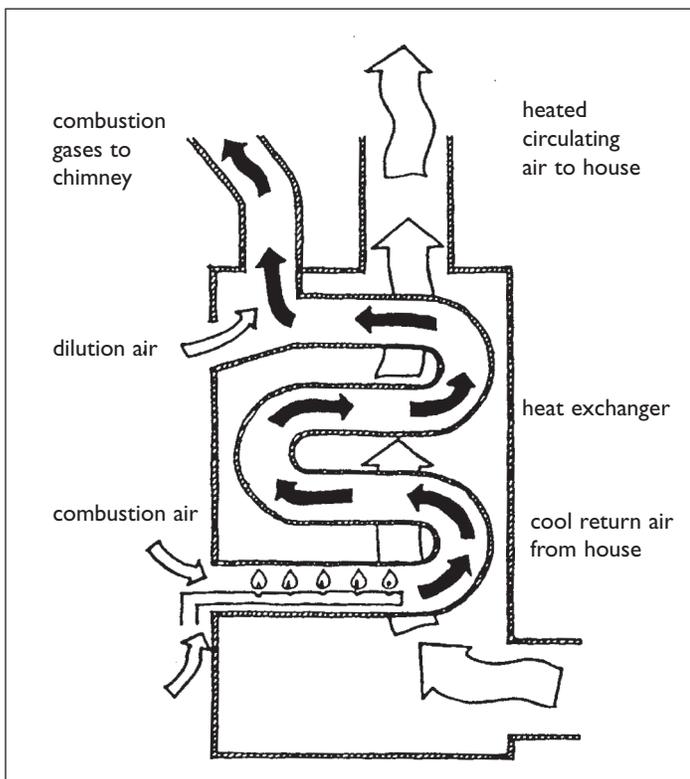


Figure 1 Basic forced-air heating system airflows

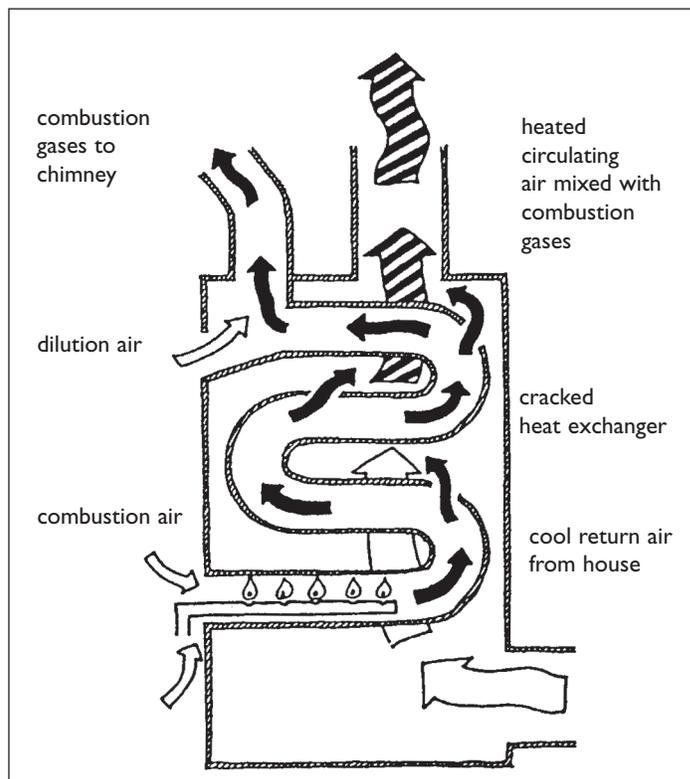


Figure 2 Combustion spillage due to a cracked heat exchanger

**Circulating air**

The heat generated in the furnace, if it is to have any value, must be transferred to the living areas of the home. In a forced-air system, this is accomplished by circulating heated household air. Cooler air is returned to the furnace, heated in a heat exchanger, and returned to the house via the heating ducts.

In a properly operating forced-air furnace, the combustion air and the circulating air both flow through the furnace as it operates, but do not mix at all (as shown in Figure 1).

Hydronic heating systems—systems that rely on water and radiators to distribute heat—don't have a circulating air stream. They do, however, require the same supply of combustion air and

removal of combustion gases as the forced-air systems.

Similarly, gas or oil water heaters, fireplaces, and wood stoves all require combustion air, and all require the combustion gases to be vented to the outdoors.

**When Things Go Wrong**

Unfortunately, combustion systems don't always work as they should, and combustion spillage is the result.

Sometimes this spillage is obvious—for instance, if you have a wood stove or a fireplace, you may occasionally see smoke escaping into the room. In other cases, spillage may not be so evident, in part because the furnace and water heater are usually located away from the main living areas of the home. In addition,

many combustion gases are hard to detect—they are invisible and have little or no odour.

Three major factors, working alone or together, can create conditions conducive to combustion spillage in your home.

In addition to these factors, unusual winds can also sometimes be at fault.

**Factor 1: Chimney Problems**

Your chimney's job is to remove combustion gases from your home. However, your chimney won't work properly if it is poorly designed, poorly installed or poorly maintained.

There are many causes of inadequate chimney performance or failure. Here are some examples:

- A chimney may be improperly sized—too small for the job or too large to maintain an adequate draft.
- Obstructions such as birds nests, broken bricks and ice can block a chimney's air flow.
- Corrosion may become a problem as a result of condensation or poor construction or installation.
- An uninsulated chimney on an exterior wall is a particular concern because it can become very cold when combustion gases are not present. This can lead to condensation of moisture from the air. When the chimney first fills with moist combustion gases, the condensation may increase, at least until the chimney warms up. Condensation can result in damage to the materials in the chimney and ice formation. This in turn leads to problems such as crumbling bricks, cracks and leaks, blockages, and poor draft.

### Factor 2: Equipment Problems

Your home's combustion appliances are made up of several components. Like chimneys, they should be well designed, properly installed, and regularly maintained. Otherwise, mechanical problems may prevent combustion gases from venting properly.

As an example, your furnace may be causing a spillage problem if the heat exchanger is corroded or cracked. This would allow crossover of circulating air into the combustion chamber or of combustion gases into the circulating air stream. Either way, combustion gases will end up being distributed through your home, as shown in Figure 2.

### Factor 3: Pressure Problems

In the winter, we close up our homes. At the same time, we run exhaust fans and numerous other devices that pump air out of the house. (In fact, many appliances, particularly fireplaces, exhaust a considerable amount of air even when not operating.) As a result, the air pressure indoors falls below the air pressure outdoors, and the house becomes depressurized. Pressure is balanced as fresh outdoor air is drawn into the house through available openings, such as cracks and gaps around windows, doors, and small openings in the building structure.

If your house is sufficiently depressurized, air may be sucked in through the chimney. When this happens, air flows down the chimney, rather than up—a condition known as backdrafting (see figure 3). If you have ever opened the damper

before lighting your fireplace and felt the big wash of cold air come into the living room, you have encountered backdrafting.

Backdrafting is most common during the “off” cycle of the combustion appliance. If the appliance starts up while backdrafting is occurring, the downward airflow in the chimney may be difficult to reverse. Combustion gas spillage could persist for as long after start up as it takes for the backdrafting to be reversed. In houses where the “on” cycle is short and the chimney is not insulated, this type of start up spillage may occur frequently, since the chimney has little opportunity to heat up and establish a good draft. Because the combustion products during start-up are particularly dirty, even minor spillage of this type should be considered undesirable.

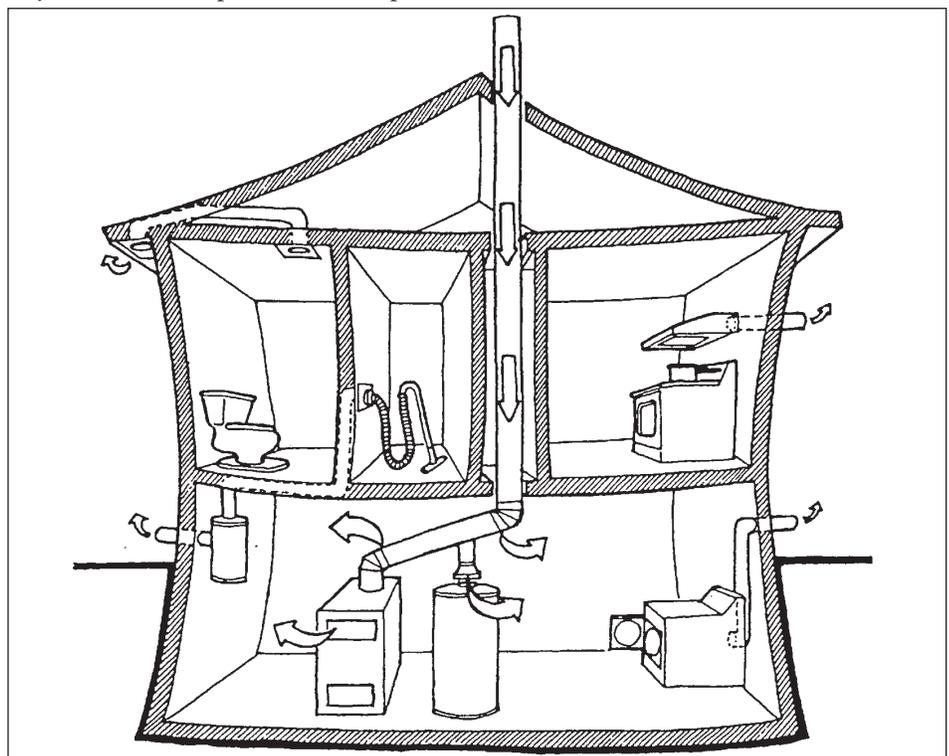


Figure 3 Backdrafting due to depressurization

In some circumstances, backdrafting can also take place while the combustion appliance is operating—for instance, in a fireplace with a smouldering fire. (See *What about Fireplaces?* on page 5.)

### Can We Control Combustion Gas Problems?

By reading this fact sheet, you have already made a start toward controlling your combustion gas problems, because increased awareness is the foundation for action. You can build on this foundation by taking measures to *prevent*, *detect*, and *correct* combustion spillage problems.

If you follow the recommendations below, you are unlikely to experience hazardous levels of combustion gases in your home. Some of the actions have costs—but that is a small price to pay for improving the quality of the air in your home and for ensuring your health and safety.

### PREVENTING COMBUSTION SPILLAGE

As the saying goes, prevention is the best cure. Some of the actions described below will be easier to implement if you are building, renovating or replacing existing equipment. Even if you are not, there is still a great deal you can do.

### Maintain Your Combustion Appliances

Start an annual maintenance routine for all your combustion appliances. Get professional assistance to do this. The service person should check for heat exchanger leakage, evidence of start up spillage, and condensation in chimneys.

Maintenance should include a tune-up—a properly tuned combustion appliance rarely produces carbon monoxide, the most serious threat. If necessary, have your furnace adjusted so that it operates on cycles that are six minutes or longer (to minimize start up spillage). Remember that a thorough maintenance check may cost a little more than a simple cleaning, but it is money well spent.

### Inspect and Maintain Your Chimney

A blocked chimney will not vent your furnace's combustion gases. Have a professional check that your chimney is not cracked and is clear of obstacles such as pieces of broken brick, or ice, or dead birds. This check should be done routinely as part of an annual or bi-annual service call.

### Upgrade Your Chimney

Talk to chimney professionals to find out how your chimney's performance can be improved. If you are building or renovating, try to have the new chimney located on an inside wall.

Have a specialist assess the air supply for your combustion appliances. Remember that even a properly designed combustion air duct will not, on its own, solve spillage or backdrafting problems; chimney problems and depressurization should also be resolved.

When replacing existing equipment or buying new equipment, invest in appliances that are less prone to spillage. Forced draft appliances, which rely on a fan to establish positive venting of

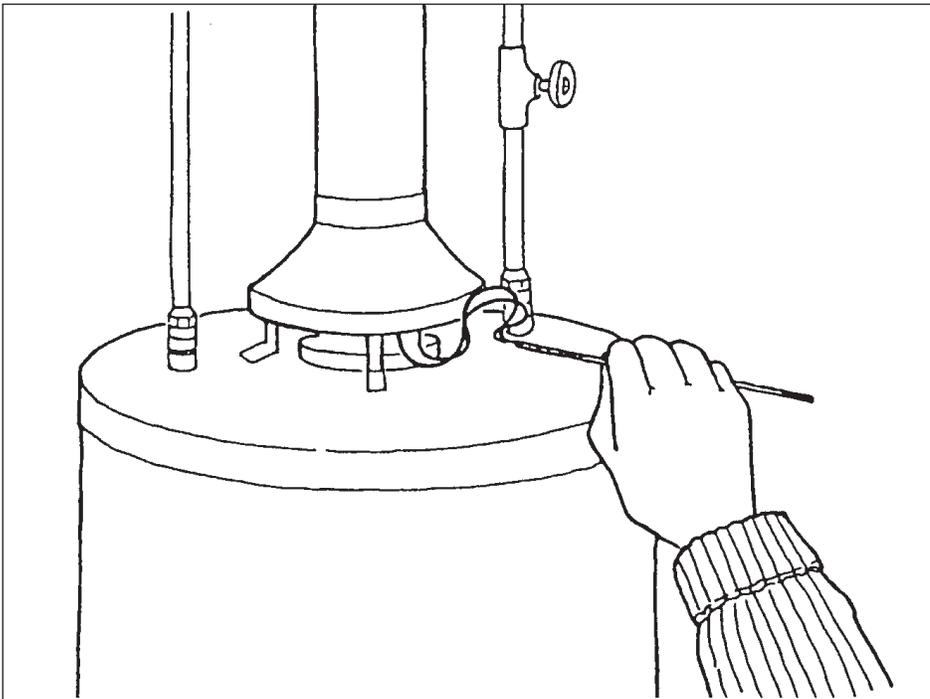
combustion gases, are often resistant to spillage. Sealed combustion appliances isolate the combustion air and combustion gases from the living areas. This further restricts the possibility of spillage. Ask the salesperson for advice.

### Avoid Conditions that Lead to Backdrafting

With a little care, conditions that might lead to backdrafting can be minimized by reducing indoor and outdoor pressure differences.

For instance:

- Be wary of operating several powerful exhaust devices simultaneously.
- If you install a new range-top barbecue with a powerful exhaust fan, get expert advice on how to balance this on the air supply side.
- Avoid combinations of appliances that are likely to create depressurized conditions—for instance, a natural draft furnace with a range-top barbecue exhaust fan.
- If your furnace or water heater is enclosed in a small separate room, allow air to move freely between the furnace room and the rest of the house. Louvred doors may be the answer.
- If you have a forced-air heating system, be sure you are not drawing return air from the immediate vicinity of your combustion appliances. Make sure the blower door on your furnace is in place.



Chimney Flow Test

1. Hold a smoke indicator (such as an incense stick) near the draft hood of a gas furnace or water heater, or near the barometric damper of an oil furnace when your furnace is operating. Watch the direction of the smoke.
2. Now switch on all exhaust fans and other exhaust equipment. Check again for smoke movement at the draft hood or damper.
3. If the smoke moves into the house, you may have a spillage problem. You should immediately call an experienced professional heating contractor for a thorough inspection.

Figure 4 Chimney flow test

## WHAT ABOUT FIREPLACES?

Fireplaces can be a significant combustion spillage threat and should be treated with great respect. Most people with a fireplace have experienced small puffs of smoke when the fire is lit. They may not know that the smouldering embers of a dying fire can release high concentrations of carbon monoxide (CO), a colourless, odourless and extremely toxic gas. This happens because when a fire is burning down, little heat is being released; the chimney draft may be very weak and the CO

easily spills into the home, sometimes after the family has gone to bed.

Fireplace safety measures include chimney maintenance, warning devices and avoiding conditions that are conducive to backdrafting. Extra air from outdoors should always be provided while the fireplace is burning strongly or smouldering. Keeping fireplace doors tightly shut as the fire burns down can also help reduce the potential for spillage. Consider adding tight-fitting doors if there are none or, better still, install an energy-efficient fireplace insert.

## BE CAREFUL WITH UNVENTED APPLIANCES

If you have an unvented gas range in your home, be sure to use your range hood, and provide extra ventilation whenever the appliance is operating.

Unvented portable space heaters should not be used except in heat emergencies, and then only with windows open to allow combustion gases to escape.

## DETECTING COMBUSTION SPILLAGE PROBLEMS

Even with a good prevention program, you should be on the look-out for combustion gas spillage.

Watch for warning signs such as:

- Repeated headaches, skin and throat irritations, and other low grade illnesses
- Combustion odours anywhere in the house
- Hot and muggy air around the furnace
- Soot stains around any combustion appliance, or unusual rumbling sounds when it is operating

Do the *Chimney Flow Test*, a quick and simple procedure that will give you an indication of how well your chimney is working (see figure 4). (This test is not suitable for sealed combustion appliances.)

Install warning devices. Standard smoke alarms are suitable for detecting combustion spillage from oil and wood furnaces and boilers.

Carbon monoxide (CO) alarms should be used with gas or oil furnaces and water heaters, and with fireplaces. CO alarms are sold in hardware and electronic stores. Buy one certified to a UL2034 or CAN/CGA6.19 standards. Electric powered units should also bear the CSA logo. These devices can be installed close to the combustion appliance being monitored. Having a CO detector close to bedrooms is also a good idea.

## CORRECTING COMBUSTION SPILLAGE PROBLEMS

If you have a combustion spillage problem, it is important to deal with it. Often, solutions to existing problems and prevention of future problems require similar strategies. Once you have determined that you have a problem and have identified a cause, consider the relevant actions described under *Preventing Combustion Spillage*. Ensure that all necessary repairs or improvements are done as quickly as possible, and by experienced professionals.

If you are unsure about your options, consult the Yellow Pages™ to find professionals who specialize in, for example, ducting, building inspection, indoor air quality, chimneys and heating equipment. Your fuel supply company should also be able to provide assistance.

**To find more About Your House fact sheets plus a wide variety of information products, visit our website at [www.cmhc.ca](http://www.cmhc.ca). You can also reach us by telephone at 1 800 668-2642 or by fax at 1 800 245-9274.**

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Order No. 61082

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*Assessing the Comfort and Safety of Mechanical Systems*

Order No. 62266

*Wood Safety in an Emergency*

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