Keeping the Heat In

9 Operating your house

9.1 OPERATING AND MAINTAINING THE HEATING, VENTILATING AND AIR-CONDITIONING SYSTEM

Follow the manufacturer's recommended maintenance procedures for cleaning and servicing heating and cooling equipment. Oil-fired furnaces and boilers require annual cleaning and tuning. Natural gas and propane furnaces and boilers and ground-source heat pumps should be serviced at least every two years. If your home has solid fuel burning equipment (e.g. wood stove or fireplace), have the equipment and chimney inspected annually and cleaned as often as necessary. (See the "Resources" chapter for more information.)

9.1.1 Homeowner maintenance

Although a qualified service technician should perform annual maintenance and efficiency tune-ups, homeowners can do some of the work.

OPERATING YOUR HOUSE

Like any system, your house will run only as efficiently as you operate and maintain it. Operating it efficiently will maximize your retrofit gains and can actually improve your home's heating, cooling and ventilation performance and overall durability. Even more important, you will create a healthier, more comfortable living environment. As part of your house as a system, a well-tuned and efficiently operating heating, ventilating and air-conditioning (HVAC) system can significantly reduce your annual energy bill.

SAFETY WARNING: Building codes now require that every home with a combustion appliance or attached garage must have a carbon monoxide (CO) detector, one located near the furnace or appliance or one within 5 m (15 ft.) of each bedroom door.

For a forced-air system, keep return-air grilles and warm-air vents clean and free of obstructions, and change or clean filters every three months or as they become loaded. Vacuum the radiators of electric or hydronic baseboard systems each autumn to prevent dust buildup. If the heating fins are bent, gently straighten them with a plastic comb to improve their efficiency.

Hydronic systems perform best when radiators are relatively free of air bubbles and operating at correct pressures. This means bleeding radiators regularly unless the system has an automatic bleeding capability. Automatically achieve further savings with an outdoor reset control that adjusts the operating temperature of the circulating water according to outdoor temperatures.

9.1.2 Thermostats

Except for some hydronic systems with slow response times, you can save energy by turning down your thermostat, and the best way to do this is to install a programmable setback thermostat. A basic programmable thermostat will provide a clock timer and allow at least two setback and reset periods a day.

For example, a temperature reduction could be programmed to start before bedtime and end before you get up in the morning. The second setback can reduce the temperature when everyone is away during the day and end just before you arrive in the evening.

A drop of 1°C (2°F) over an eight-hour period can save about 2 percent on your heating energy consumption. If you are away from home for more than three or four hours, it is worthwhile to turn down the temperature. In general, it is best not to reduce the temperature lower than 17°C (63°F), as there is a risk of moisture build-up in the exterior walls. If you want to reduce your temperature further, such as when you are away for extended periods of time (a week or longer), you must keep humidity levels low (see Section 2.4, Control of moisture flow).

Measure the relative humidity throughout the house with a hygrometer to ensure low levels exist, and if not, reduce the humidity by controlling moisture sources or by adding an ENERGY STAR® qualified dehumidifier.

9.1.3 Sizing and balancing an HVAC system

A newly retrofitted house will have reduced heat loss and will need a smaller heating and cooling system than before the retrofit. This means that any fuel-fired heating equipment is now oversized – a condition that can cause larger temperature fluctuations and inefficient short cycling, especially for mid-efficiency furnaces and boilers. High-efficiency furnaces and boilers are less affected efficiency-wise, but temperature fluctuations will still affect comfort for occupants, and the equipment will suffer more wear and tear.

When a mid-efficiency furnace or boiler operates less often, the chimney can get colder between firings, increasing the potential for down drafting and possible condensation and damage to the chimney. If your retrofit measures are extensive and you are concerned about this, have the system checked by a qualified heating-system technician.

A persistent problem for almost all new, existing and renovated homes is the need to have the heat distribution system balanced. Undersized ductwork, leaking ducts, inadequate or poorly placed return

air grilles and ducts can mean occupant discomfort and higher heating bills. Improved insulation and air sealing may make some previously hard-to-heat rooms easier to heat, while others may overheat.

Simple rebalancing of the system by either adjusting the dampers in a ducted system or adjusting valves in a hot water system may help. Otherwise, find a competent contractor to upgrade or balance your system.

Be warned, duct cleaning alone will not resolve balancing issues and generally has little effect on the HVAC system and indoor air quality.

If you have a central air conditioner that uses the same ductwork, it may have to be reset for the cooling season. Note the settings that were used for heat distribution as well as those for cooling so you can re-set the system yourself for each season.

Figure 9-1 Taping an air duct

9.1.4 Air distribution ducts

To improve comfort, safety and system balancing, seal all plenums and supply and return ducts with aluminum foil duct tape, approved flexible plastic tape or water-based mastic. Heating ducts running through unheated or cool basements and crawl spaces should be insulated. Cut RSI 2.1 (R-12) or more of batt or blanket insulation to size or use specially designed foil-faced fibreglass blanket insulation designed for this purpose. Wrap the insulation around the ducts and secure with string, wire or approved tape – do not use vinyl type duct tape.

Do not wrap the ducts within 1.8 m (6 ft.) of a wood-fired furnace unless you use a special, approved non-combustible insulation.

For houses with hydronic systems, place foil-covered insulation board between radiators and exterior walls to reflect heat back into the room. Metallic supply and return lines can be insulated with minimum RSI 0.7 (R-4) approved insulation. Insulated jackets are available for some types of boilers and may offer some efficiency gains for equipment installed in cold parts of the house.

9.1.5 Open hearth fireplaces

Open hearth gas- or wood-fired fireplaces are basically decorative; the heat supplied will not make up for the losses due to house air drawn up the chimney. Consequently, most fireplaces are unable to provide any net heat gain. Fireplace accessories such as tightly fitted glass doors only offer nominal improvements on efficiency. The hearth industry has a variety of efficient direct vent zero-clearance fireplaces and inserts: gas, propane, pellet and wood units that also look great and eliminate standby losses.

For more information on how to improve fireplace performance, see the "Resources" chapter.

9.2 DOMESTIC HOT WATER

Domestic water heaters (DWHs) consume about 20 percent of your home's energy – about the same as all your lights and appliances combined. Next to space heating, the water heater is the largest energy user in most homes.

9.2.1 Replacing your fuel-fired DWH system

The best energy performance option is to replace the existing system with a new high-efficiency system, including tank-type, instantaneous or combination space and water heating models. Compare carefully for your best selection. Match the size of the heater to your needs: bigger tank-type units are typically less efficient than smaller units, especially if your hot water demand is low. Use sizing charts available from the manufacturer or retailer.

There are more energy-efficient options now available, including ENERGY STAR® qualified units and solar hot water heating systems. See the "Resources" chapter for more information.

Energy saving tips for DWH systems

Here are some ways to save on hot water bills:

- Use less hot water: fix leaks and drips, wash clothes in cold water, use low-flow showerheads and restrictive aerators on faucets.
- Locate the water heater close to point-of-use or use small-diameter piping and run it directly from the tank to each point-of-use.
- If the point-of-use is 9 m (30 ft.) or more from the water heater, install a demand-type hot water recirculation system.
- Install an insulated base and an insulating kit around the tank for electric tank type water heaters located in basements.
- Insulate both metallic and plastic water lines with a minimum of RSI 0.7 (R-4) compatible insulation (i.e. pre-formed type).
- Install a drain water heat recovery unit on the main stack(s) serving the shower(s).
- Install a solar water heater to pre-heat the water for the DWH system.

9.3 COOLING SYSTEMS

Retrofitting also reduces the amount of energy needed to cool your home in the summer. Air conditioning lowers both air temperature and, very importantly, humidity levels. Air conditioning is a good example of where oversizing is clearly detrimental to comfort, cost of operation and equipment performance. An oversized system will lower house temperature too quickly without removing excess humidity. The result is a house that is cool and damp, which in turn can promote mould growth and musty odours. Higher indoor temperatures (e.g. 26°C/79°F) with reduced humidity levels are more comfortable and allow for more energy savings.

Air conditioners should be serviced and maintained regularly. They become inefficient when the inside coil is dirty, when the airways on the outdoor condenser unit are blocked and when the refrigerant level runs low. You can do some simple maintenance yourself.

For example, clean or change the air filter, keep the outside condenser free from obstructions such as plants and leaves. In addition, a service contractor should periodically maintain your unit. Check your owner's manual for information on maintenance.

9.4 VENTILATION AND COMBUSTION AIR

People need fresh ventilation air to control indoor air quality, and fuel-fired space and water heating systems need combustion air to burn properly. Yet, most Canadian homes have too much excess air. In fact, typically about 25 percent of heat loss can be due to excess air infiltration (leakage).

For most older homes, comprehensive air leakage control will lower heating bills without reducing the air supply enough to cause problems. Air leakage does not make for good ventilation.

A better approach is to install a ventilation system that is capable of changing the total household air once every three hours, plus providing separate combustion air for fuel-burning appliances.

Take a systematic look at the moisture balance and ventilation needs of your house. This involves listing moisture sources, symptoms of problems and ventilation requirements. Retrofits will affect the house, so if the house already shows signs of excessive condensation, find and reduce the moisture sources. If this cannot be done, any retrofit that makes the house more airtight will have to include a mechanical ventilation system.

Some systems exhaust stale air, some exhaust stale and supply fresh air and some are balanced to do both. The addition of balanced ventilation with heat recovery has a long list of benefits including ability to control the rate of ventilation, maximizing air tightening and increased home durability. Furthermore, improved indoor air quality from controlled ventilation has proven positive health effects.

9.4.1 Is your house susceptible to indoor air quality problems?

Be aware of potential problems, the symptoms to look for and some of the possible solutions. The following circumstances can make a house more susceptible:

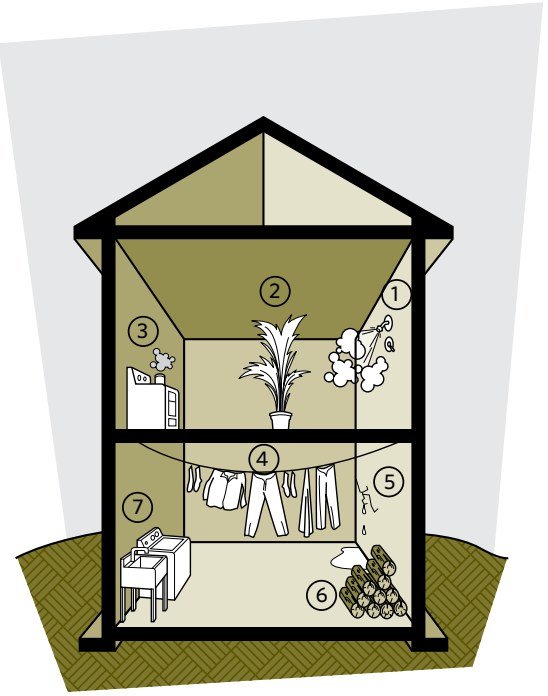
- houses without a conventional chimney and/or a circulating air duct system
- competition for air from fireplaces and/or powerful exhaust vents such as kitchen range hoods
- non-ducted range hoods or undersized or inoperable bathroom fans
- air sealing a home without adequate ventilation
- sources of air contamination (smokers, burning candles, hobbies, etc.)
- high humidity levels
- high radon levels (see Section 1.4, Health and safety considerations)

9.4.2 Some signs of indoor air quality and moisture problems

The following symptoms indicate that your house may have air quality or moisture problems:

- excessive condensation on double-paned windows
- staining and mould growth, which often appears in bathrooms, closets and on walls or ceilings situated on exterior walls

Figure 9-2 Sources of moisture in the home



1. Shower or bath
2. Plants
3. Cooking
4. Drying clothes
5. Foundation leaks
6. Drying fire wood
7. Hot water appliances

- stuffy, musty atmosphere and lingering odours
- back-puffing and odours from the space and water heating equipment
- backdrafts or odours from the fireplace

9.4.3 Solutions to moisture problems

If the problem is high humidity or condensation, the first step is to reduce the amount of water vapour in the air:

- Do not store firewood in the house.
- Avoid drying laundry in the house.
- Vent the clothes dryer to the exterior.
- Disconnect any humidifiers.
- Cover exposed earth floors in basements or crawl spaces with a moisture barrier.
- Install a sump pump with a cover to remove excess moisture from the soil under the slab.
- Fix all water leaks into the basement.
- Do not allow any standing water in the house or against the foundation wall.
- Make sure the ground slopes away from the foundation wall and that there are properly functioning eavestroughs around the house (see Figure 2-11).
- Operate kitchen and bathroom fans during use.
- Adjust your living habits to produce less humidity (cleaning, washing, number of houseplants and aquariums, etc.).

Table 9-1 shows the maximum levels of indoor relative humidity at 20°C (68°F) at which there will be no condensation on conventional double-glazed or energy-efficient windows at various outside temperatures.

It can be difficult to accurately measure and maintain the recommended humidity levels. One simple approach is to let your windows become your indicator. If excessive condensation appears on the interior surface of double-glazed windows (except those in the kitchen and bathroom), you have too much moisture in the air. Alternatively, you can also use a hygrometer to monitor humidity levels.

Occasional condensation does not pose a problem. Excessive condensation or frosting is an indication that you should reduce moisture production or increase ventilation (see the CMHC publication *About Your House: Measuring Humidity in Your Home* in the "Resources" chapter).

Finally, if you are replacing your space heating and DWH systems with high-efficiency sealed combustion equipment, this may affect indoor air quality. Combustion air from outside directly

Table 9-1 Maximum indoor relative humidity levels

Outdoor temperature	Maximum indoor relative humidity	
	Standard window	Energy-efficient window
0°C (32°F)	50%	68%
-10°C (14°F)	38%	50%
-20°C (-4°F)	26%	40%
-30°C (-22°F)	18%	30%
-40°C (-40°F)	12%	20%

connected to equipment helps reduce spillage and uncontrolled combustion air from entering the home. However, using outdoor air as part of the combustion process reduces air changes in the home and may cause humidity levels to rise.

9.4.4 Increasing ventilation

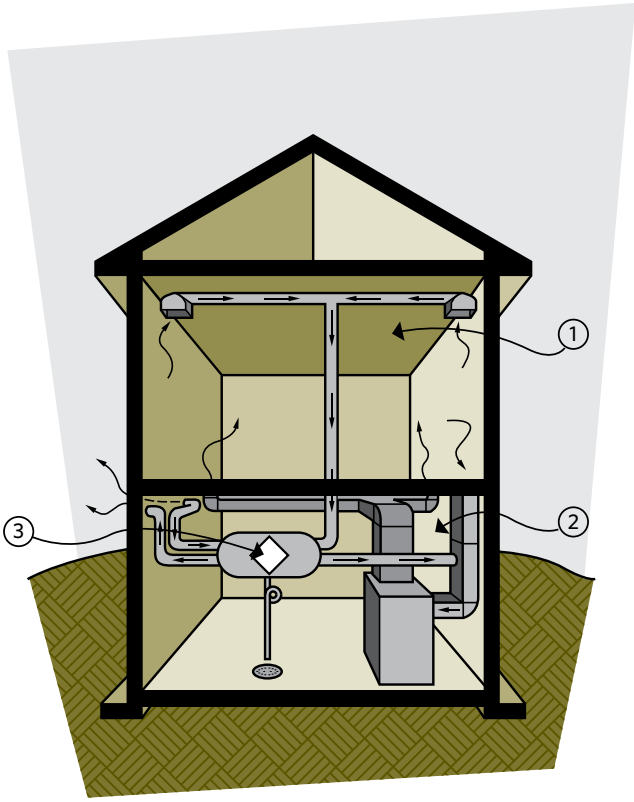
If you still have too much condensation even after reducing moisture production, or if indoor air quality is poor, you will have to increase the rate of ventilation or air change.

Ventilation systems work under two main categories: balanced and unbalanced. Unbalanced is most common where exhaust fans are used and replacement air comes from air leakage. This can result in reduced house pressures and limited success in ventilating the house properly. Balanced ventilation incorporates a system where exhausted air is replaced with a dedicated source of incoming air. This helps keep house pressures close to neutral and helps to ventilate the house more evenly.

Ventilation can be increased by

- turning on kitchen and bathroom fans when those rooms are used. A simple timer or humidity controller will turn the bathroom fan on or off automatically to ensure proper ventilation and avoid over-ventilation.
- installing ENERGY STAR® qualified fans. It is worth buying quieter models designed for continuous use. Noisy fans tend not to be used much because they are annoying.
- ensuring that all fans fully exhaust to the exterior and incorporate air sealing measures in their installation. Avoid kitchen range hoods that recirculate air back into the room.
- installing a balanced central system incorporating a heat or energy recovery ventilator (HRV or ERV) to ensure improved indoor air quality.

Figure 9-3 Ventilating a house with a heat recovery ventilator



Heat recovery ventilators
1. collect and exhaust stale, moist air
2. supply and distribute fresh air
3. use a heat exchanger to recover some of the heat from the outgoing air

A somewhat effective ventilation technique involves having a contractor install a fresh-air duct with a damper to the return-air plenum of a forced-air system. The forced air system should be interlocked to appropriate exhaust fans to avoid pressurizing the house and pushing moisture into the building envelope. Outdoor air is drawn in by the suction of the furnace fan, mixed with house air and preheated by the furnace. The contractor should ensure that the cold ventilation air does not adversely affect the furnace in any way.

Open the damper in the outdoor-air duct just enough to prevent window condensation. It will have to be adjusted periodically through the seasons. Alternatively, a motorized damper with a humidistat control can open the damper only when the house becomes too humid.

Some ventilation systems are designed with a central exhaust fan with several ducts pulling air from the kitchen and bathrooms. Better yet, incorporate a heat recovery ventilator that typically recovers 70 percent of the heat from the exhaust air and transfers the heat to the incoming air. Central ventilation systems should be designed, specified and installed by a professional.

9.4.5 Heat recovery ventilators and energy recovery ventilators

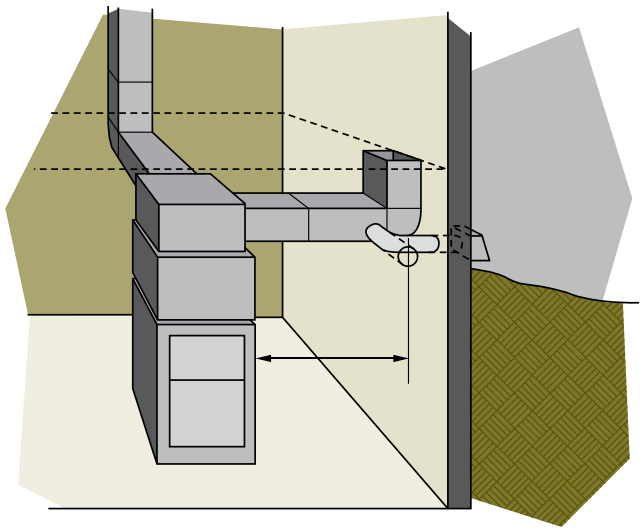
An energy-efficient HRV is one of the best ways to control indoor air quality. An HRV saves on energy costs compared to conventional ventilation systems because it recovers heat from exhausted air. The HRV exhausts stale air and passes it through a heat exchanger. The exchanger transfers the heat to the fresh incoming air before it exhausts the stale air to the outside. The HRV must be balanced to maximize performance and not affect the house pressure.

The warmed, outdoor air is distributed through an existing forced-air distribution system or a dedicated ductwork system in a balanced manner.

A balanced-flow ERV also recovers heat from exhausted air, but in comparison to an HRV, it does not remove as much moisture from the house. These features are recommended where cooling load demand is high or where the relative humidity (i.e. humidity level) tends to be on the low side (e.g. in northern Canada). Thus, an ERV can help to keep the house from drying out.

A major advantage of HRVs and ERVs is that their controls give the homeowner the ability to manage and even turn off the ventilation system instead of the weather controlling the rate of air change. Unfortunately, the majority of HRVs are not installed or maintained properly. HRVs and ERVs must be installed and commissioned properly by a certified technician. Like all HVAC equipment, once properly set up, HRVs and ERVs must be serviced regularly. The homeowner should be able to do this because this requires only cleaning filters and checking components as noted in the service manual for the unit (see the "Resources" chapter for more information).

Figure 9-4 Fresh-air duct to the cold-air return

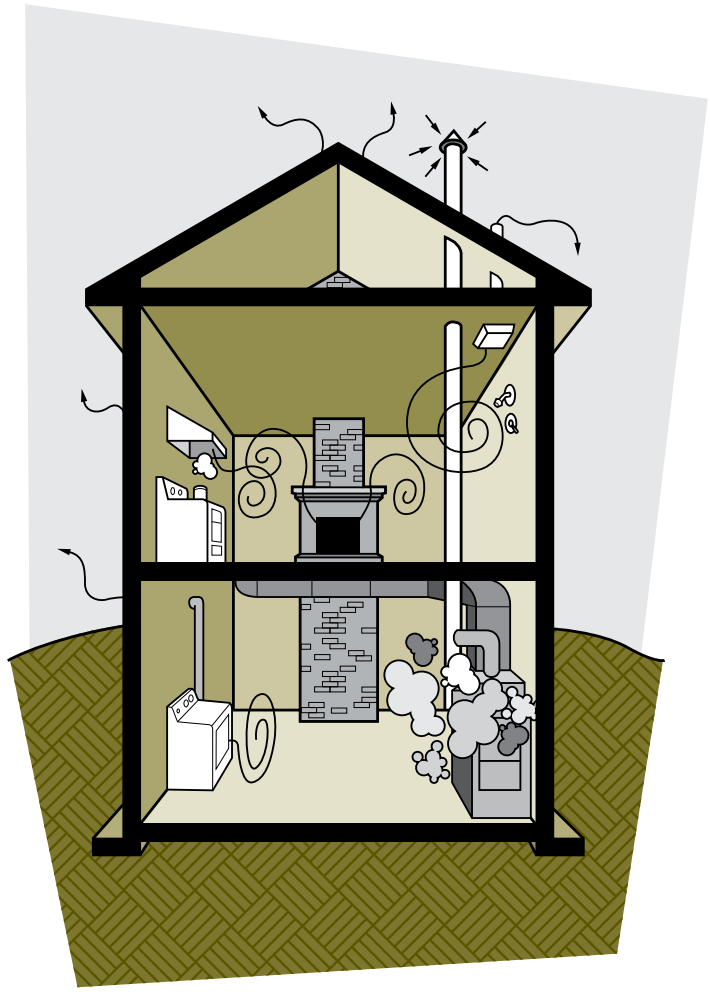


9.4.6 Combustion air

All fuel-burning appliances require air for combustion and for diluting and exhausting the products of combustion out of the house. If there is not enough air, the chimney or flue could reverse its flow and backdraft or spill dangerous gases back into the house (see Figure 9-5).

Backdrafts may be caused by competition for air. For example, a powerful kitchen fan, a barbeque-style down draft range or even a roaring open fireplace exhausts air from the house. The resulting

Figure 9-5 Many appliances compete for household air



negative pressure can pull air into the house down chimneys or vents.

Signs of combustion air problems include

- back-puffing of the furnace, boiler or water heater (indicated by soot or staining around the air intake, burner, barometric hood, damper or chimney connections), or melted plastic fittings on top of the tank-type water heater
- unusual odours or hot and muggy air around or from the combustion appliance
- difficulty starting or maintaining a fire in the fireplace
- occupants experiencing frequent headaches, skin or throat irritations or nausea

The first line of defence is to replace spillage-susceptible space and DWH equipment with direct vent or sealed combustion appliances. For example, electricity, or better yet, consider heat pump technologies.

Conventional open fireplaces can be a wonderful feature of a home, but they are also responsible for leaking heated air to the outside and are prone to backdrafting. When at the end of their burn cycles, fireplaces release large quantities of carbon monoxide and are also more vulnerable to backdrafting at this point. Minimize this problem by installing tight-fitting glass doors and consider opening a window slightly when you operate the fireplace.

9.5 MORE WAYS TO SAVE ENERGY

See the Natural Resources Canada section in the "Resources" chapter for information on how to access a wealth of additional tips on saving energy in your home.

SAFETY WARNING: Always install CO detectors in a home that has combustion appliances (fireplace, wood stove, fuel-burning furnace or water heater) or an attached garage. Properly installed, these detectors will help protect occupants from asphyxiation caused by a venting failure or malfunction of combustion appliances or automobile fumes leaking into the home from an attached garage. Never operate a vehicle in an enclosed space. Always open the garage door before starting a car inside.

Regularly replace batteries in CO and smoke detectors. These devices have limited life spans and must be replaced regularly. Check the manufacturer's literature for this information.

Figure 9-6 Direct-venting heating equipment