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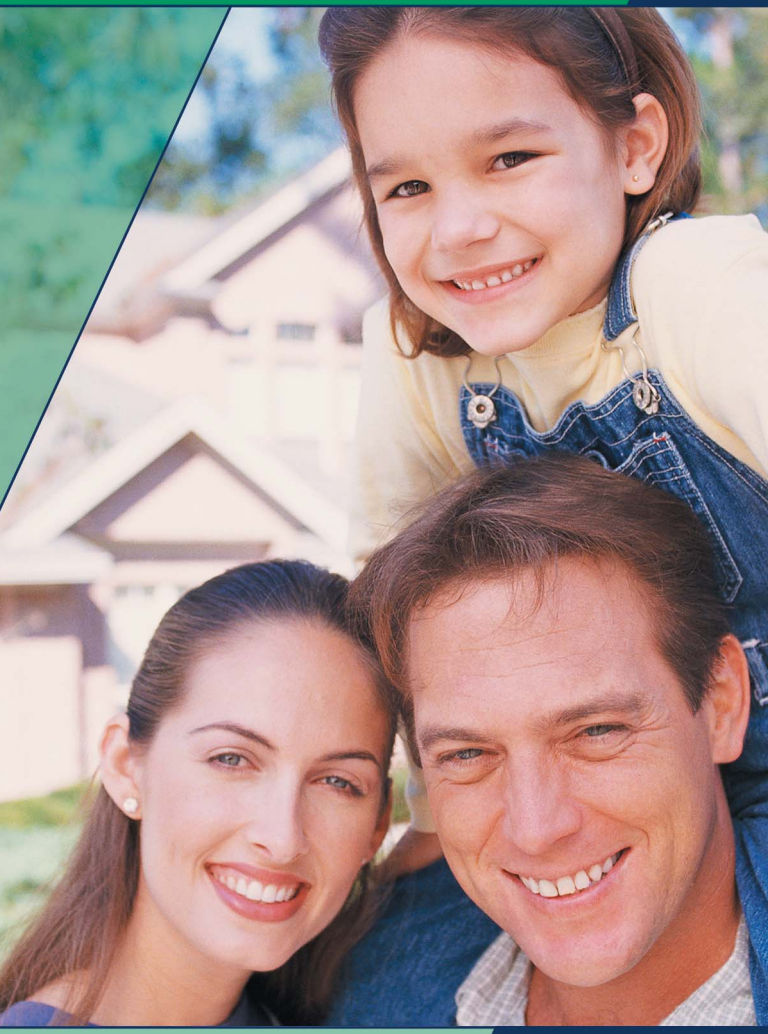
R-2000 Standard Homeowner's Manual

Making the Most of Your Investment



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The R-2000 Standard encourages the construction of energy-efficient houses that are environmentally friendly and healthy to live in. The initiative continually upgrades its energy efficiency standard for new houses, offers comprehensive training for house builders, and tests and certifies the energy efficiency of new houses. Visit the R-2000 Web site at r-2000.nrcan.gc.ca.

IF YOU SELL YOUR R-2000 HOME, PLEASE LEAVE THIS MANUAL WITH THE NEW OWNERS.

You should keep the following together in a safe, accessible place:

- this manual
- your New Home Warranty
- all appliance guides and manufacturers' warranties
- the publications *Heat Recovery Ventilator (HRV)* and *R-2000 Comfort, Energy Savings and a Healthier Environment*

Your R-2000 home identification number:

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Your builder's name, address and telephone number:

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Contractors:

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For more information, contact your R-2000 builder, local R-2000 office or Natural Resources Canada (NRCan) at 1-800-387-2000.

Revised March 2009

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Introduction

Congratulations! You have just become a proud owner of a new R-2000* home.

To meet the stringent requirements of the R-2000 Standard, your new home has been built using cost-effective, energy-efficient and environmentally friendly building practices and technologies. In addition, your home's energy-saving features help reduce greenhouse gas emissions that contribute to climate change.

A number of features – such as high levels of insulation, a continuous air barrier, a high-efficiency heating system, a mechanical ventilation system, energy-efficient windows and low-emissivity paints and finishes – help ensure that your R-2000 home gives you unmatched comfort and superior indoor air quality.

Licensed R-2000 professionals performance tested and inspected your new home after it was built. The R-2000 Home Certificate, issued by the Government of Canada, is your proof that your home has met the requirements of the R-2000 Standard.

This manual explains various features of your R-2000 home. It describes how your home works as a system and how to maintain and operate it at the optimum level. Refer to this manual and the manufacturers' operating and maintenance instructions for different features in your home to get the most out of your R-2000 home.

*R-2000 is an official mark of Natural Resources Canada.

General Instructions

- Read the manufacturers' instructions for all the equipment in your home, including your appliances and the various components of your heating and ventilating systems. Keep the instructions and this manual handy. If the manufacturers' instructions vary from those given here, follow their instructions.
- Operate the thermostat and the humidistat, if one is installed, according to the manufacturers' instructions. Allow only a qualified technician to service your furnace boiler, heat pump or central air conditioner.
- Run your ventilation system when you have all or most of your windows closed. If the furnace fan is part of the ventilation system, make sure that the fan is on when the ventilation system is active.
- If your home is equipped with a heat recovery ventilator, read the Natural Resources Canada (NRCan) publication titled *Heat Recovery Ventilator (HRV)*.
- Take care when drilling or altering insulated walls or ceilings. Repair any damage to the air barrier at once to prevent moisture damage inside wall cavities and to keep your home running efficiently. If you must make holes in insulated walls or ceilings, make them along studs or joists to reduce air leakage into the insulated cavities.
- When redecorating or choosing new appliances or fixtures, select environmentally preferred finishes – such as EcoLogo paints and low-emissivity materials – to maintain good indoor air quality. Always choose energy- or water-saving appliances and fixtures. Look for refrigerators, dishwashers and clothes washers that display the ENERGY STAR® mark, which identifies top energy-saving performers on the market.

- Never use the following appliances inside your R-2000 home: stand-alone kerosene, gasoline or propane heaters or gas or charcoal barbecues, hibachis, etc. These products release their smoke and combustion by-products directly into the surrounding air. **If you use them indoors, they can rapidly deplete oxygen levels or cause carbon monoxide poisoning.**
- In any of the following situations, you should contact your R-2000 builder:
  - you are planning additions or renovations;
  - your home is damaged by fire, water, wind, etc.;
  - you are adding or changing an air-exhausting appliance such as a clothes dryer or kitchen, bathroom and attic exhausts (they must be properly vented to the outdoors, and the ventilation system may need to be rebalanced); or
  - you are adding a combustion appliance such as a wood stove or a different fuel-fired furnace or hot water heater (combustion and make-up air supply needs must be carefully checked, and appliances must be properly vented to the outdoors).
- For more information or for a list of R-2000 builders, contact the R-2000 office in your area through NRCan's Office of Energy Efficiency at 1-800-387-2000 (toll-free) or visit the R-2000 Web site at r-2000.nrcan.gc.ca.

Environmental Benefits

Your home has been built with environmental benefits in mind. Some items don't need maintenance, but they are important for you to remember – especially when you are making changes or additions to your home.

- **Energy efficiency:** reduced energy consumption for space and water heating represents a significant contribution that homeowners can make toward conserving non-renewable energy resources. As well, by using less energy from fossil fuels such as coal, oil and gas, you reduce the production of the greenhouse gases that contribute to climate change. When you or your builder installs energy-efficient appliances and lighting, you add to your home's environmental performance.
- **Reduced water consumption:** toilets, shower heads and faucets installed by your builder meet low-flow specifications.
- **Material conservation:** recycled materials may be present in the insulation, roofing system, sheathing/drywall, studs and trims or under the slab drainage of your R-2000 home.
- **Indoor air quality:** a continuous air barrier, a vapour barrier and a mechanical ventilation system are features found in all R-2000 homes. To ensure superior indoor air quality, the R-2000 Standard encourages the use of environmentally friendly, low-VOC (volatile organic compound) paints and varnishes in every R-2000 home. This reduces the concentration of indoor air pollutants inside your home. See the section "Indoor Air Quality" (page 13) for more information.

Heating System

R-2000 homes use a variety of heating systems such as electric baseboards, an electric, gas- or oil-fired forced-air furnace or hydronic boiler, a heat pump or a combination space and hot water heating system. To get the maximum efficiency from the heating system, follow these recommended maintenance practices.

Furnaces and Boilers

- Refer to the instructions in your furnace or boiler guide to do the following:
  - change or clean the furnace filter as recommended by the manufacturer (usually once a month during the heating season). Make sure that filters are installed the right way; and
  - check to see if your system has a condensate drain or catch pan. Keep them clean and free of obstructions. Empty the catch pan, if required. Vent air from the boiler, baseboard heaters and all high points.
- Have a qualified service technician clean the circulating fan blades, lubricate the fan or pump motor and check any drive belts every year.
- Check your room registers or baseboard heaters to make sure that they are open, clean, and clear of rugs, furniture, etc.
- Check your heating appliance guide or ask your fuel supplier or utility for a recommended servicing schedule and have the appliance serviced accordingly.

Heat Pumps

A heat pump can be used as either a heating or cooling system. In winter, heat pumps extract heat from outside air, water or the ground and transfer it to the air inside your home. In summer, they run in reverse, extracting heat from inside air and pumping it into outside air, water or the ground.

- Familiarize yourself with the summer and winter operations of your heat pump as described in the manufacturer's instructions.
- Make sure that the pump's operating switch is set at heat pump mode and not on backup mode. Backup operation will result in high energy consumption. The reason is explained under "Thermostats" (see following).
- Have your heat pump serviced every year by a qualified technician.

Cooling Systems

Some R-2000 homes have a separate cooling system. If your home has central air conditioning, your manufacturer's instructions are your best source of information.

Remember to operate your mechanical ventilation system even when your air conditioner is on.

Thermostats

During the heating season, you should set your thermostat at 20°–21°C during the day and lower it to 17°–18°C at night unless your home has a heat pump. In this case, the extra energy demand to warm up your home in the

morning causes the heat pump to run for extended periods in its less-efficient backup mode, so you lose nighttime energy savings. If your home has in-floor radiant heating, the recommended thermostat temperature may also apply. It depends on the type of heating system control and floor finish. Ask your heating contractor for more information.

If you have a programmable setback thermostat, ensure that you get the most comfort and energy savings by following the manufacturer's instructions. Because heat loss is more gradual in R-2000 homes, avoid programming too many swings in temperature over short intervals (i.e., less than two hours).

- Program the thermostat so that the new (higher or lower) temperature comes into effect about one hour before you need it. For example, you may wish to program a nighttime temperature of 18°C but want the house to be warmer, say 20°C, when you get up. If you normally get up at 7:00 a.m., program your thermostat to have 20°C come into effect at 6:00 a.m. (You may find it takes less time for an R-2000 home to warm up and want to reprogram accordingly.) Similarly, if you go to bed at 11:00 p.m., program the setback temperature of 18°C to take effect an hour earlier, at 10:00 p.m.

Combustion Appliances

All combustion (fuel-burning) appliances in your home must have enough air for combustion and to prevent exhaust gases from back-drafting into your home. Appliances and systems approved for use in R-2000 homes – including oil, gas and propane appliances and wood- and pellet-burning appliances – are designed and installed to ensure that they don't interfere with your home's indoor air supply and balanced ventilation system.

These appliances are also designed to exhaust the by-products of combustion, such as carbon monoxide (CO), carbon dioxide (CO_2) and particulates, directly outside through a chimney or an exhaust vent.

For the safe and efficient operation of your combustion appliances, take note of the following:

- Always make sure that all outdoor supply and exhaust vents are free from obstructions, such as snow and frost, lint, birds' nests, shrubbery and debris.
- If there is an open duct that brings air into your furnace room, inspect it regularly to make sure that it is never blocked.
- A maintenance contract is recommended, particularly if you have an oil-fired furnace, boiler or hot water tank.

Wood-Burning Appliances

If you have a fireplace insert or wood or pellet stove in your home, it has been designed and installed to ensure that it has a safe supply of combustion air. Your appliance may have an intake damper to control the amount of air available to the burning fuel. A clay-lined flue or metal-insulated chimney takes the smoke and combustion products out of your home.

When operating a wood-burning appliance, always make sure you do the following:

- Read the manufacturer's instructions and carefully follow them when operating your appliance.
- Keep heat-resistant glass doors shut while the fire is burning and even when it is dying down. This prevents the loss of warm indoor air through the chimney or vent and prevents smoke and combustion products, such as CO, from entering the room.

- Don't burn anything other than seasoned wood in a wood-burning appliance. Store wood outside. Don't use manufactured fire logs if not recommended by the appliance manufacturer. If you do use them, choose better-quality logs that contain no wax and more wood.
- Once a year, have a qualified chimney expert inspect your wood-burning system and clean your chimney.
- If you have any of the above installations or an attached garage, your home will also be equipped with a CO detector. Make sure that fresh batteries are installed every year, and test the system according to the manufacturer's instructions.
- Replace the CO detector every five years or according to manufacturer's instructions, including battery-powered and hard-wired units. CO detectors have a limited life span, so regularly confirm that they are operating properly.

Mechanical Ventilation System

In a conventionally built home, air leaks in and out through cracks, holes and seams in the building shell. This uncontrolled ventilation may keep air in the home reasonably fresh, but it wastes energy. Because there is no control, the amount of air change in the house will vary dramatically with outdoor factors such as wind and temperature.

In an R-2000 home, a continuous air barrier eliminates this uncontrolled leakage. The mechanical ventilation system provides the controlled ventilation that is built into your R-2000 home, continuously bringing in fresh outdoor air and exhausting stale indoor air, odours and pollutants.

A minimum continuous ventilation setting has been set in accordance with technical guidelines for each R-2000 home. Check the appropriate setting for your home with your builder and write it down in the space provided at the end of this manual (page 34).

You can't rely on your mechanical ventilation system to remove combustion by-products such as CO or particulates from fireplace inserts or wood or pellet stoves. If combustion by-products are escaping into your home, the combustion appliance or venting system has a problem that must be repaired immediately. Also have your mechanical ventilation system checked to ensure that it is working normally.

Follow these important operating instructions for your mechanical ventilation system:

- Operate your mechanical ventilation system whenever your windows are closed – even when your air

conditioner is on. If you open several windows to ventilate your home, you may wish to shut off your mechanical ventilation system. But remember to turn it on when you close the windows.

- If your mechanical system doesn't work, refer to the "Troubleshooting Checklist" (pages 24–30). Have a reliable and knowledgeable service technician repair it immediately if you cannot find and fix the problem yourself.
- Take a walk around the exterior of your house with your builder and locate the air intake and exhaust vents for your mechanical ventilation system. Keep contaminants such as garbage containers, pesticides and oil-fill pipes away from the air intake. Keep your barbecue downwind and don't idle your car nearby.
- Check outside vents regularly to make sure that screens aren't blocked by snow or frost buildup, grass, leaves or other debris.
- Inspect vent grilles in each room at least once a year and clean if necessary.
- If the kitchen exhaust grille has a grease filter, clean it every month.

Any additional exhaust fans in the bathrooms or the kitchen can be operated as needed to control sporadic odours, excess humidity and stale air problems.

Heat Recovery Ventilators

Most R-2000 homes have a heat recovery ventilator (HRV) as part of the mechanical ventilation system. HRVs use the heat from outgoing stale indoor air to preheat incoming fresh outdoor air. This way, HRVs maintain superior air quality with a minimum impact on space-heating costs.

A properly installed, operated and maintained HRV exhausts stale indoor air, pollutants and excess humidity and provides fresh air for distribution throughout the house. Remember, you can't expect it to remove combustion by-products from faulty equipment.

Some R-2000 homes have an energy recovery ventilator (ERV) instead of an HRV. An ERV recovers some of the moisture exhausted to the outdoors by a regular HRV. This helps to maintain a comfortable humidity level within the home, avoiding static electricity, sore throats and other discomforts caused by air that is too dry.

During the air-conditioning season, the ERV helps keep excess moisture out of the home by extracting it from the incoming fresh air and transferring it to the exhaust air. Since less energy is required to lower the temperature of dry air compared with moist air, an ERV reduces the load on the air conditioner and saves you money.

If you aren't sure whether your home has an HRV or ERV, ask your builder. If you have an HRV or ERV, make a note of this in the space provided at the end of this manual. Make sure that you read and follow the instructions in NRCan's publication *Heat Recovery Ventilator (HRV)* (your builder can give you a copy). Also refer to the manufacturer's operating instructions and servicing recommendations. Finally, be sure to do the following:

- Regularly clean or replace the HRV's/ERV's filter(s). Also clean the HRV's/ERV's core heat exchanger.
- Inspect the condensate drain line to make sure that it is open, flowing freely and includes a water trap. Clean the drain line and interior drain pan, if required. ERVs do not have a drain.
- Never force any of the HRV/ERV dampers open or closed. Doing so will strip their gears.
- Your HRV needs to be serviced every year. Your builder or local R-2000 office can refer you to a qualified installer. Ask about service packages.

Indoor Air Quality

The air quality inside your home is affected by a range of different products: from products used in building the walls and floors and from paints, finishing products, carpets and glues to products used every day, such as household cleaners, tobacco, candles and air fresheners.

Superior indoor air quality of every R-2000 home is achieved through the following:

- continuous mechanical ventilation, which prevents the buildup of typical household air pollutants; and
- the use of environmentally friendly building products and low-VOC (volatile organic compound) paints and varnishes.

Speak to your builder about which of the "pick-list" features suggested in the R-2000 Standard have been used in your home. Ask if other options are available (e.g., high-efficiency dust filters).

For more information on indoor air quality, read the NRCan publication *R-2000 Comfort, Energy Savings and a Healthier Environment.*

Note the following:

- You can control the mechanical ventilation system and hence the rate of air change. Under certain circumstances, you may wish to increase the continuous ventilation rate above the minimum set by the installer for your R-2000 home. An increase may be helpful if you have a smoker in the house or have introduced new products, possibly in redecorating, that are producing noticeable odours.

Air and Vapour Barriers

All R-2000 homes contain an air barrier and a vapour barrier to protect the building structure and materials from moisture damage and reduce air leakage. In some cases, the same material may act as an air barrier and a vapour barrier. Ask the builder which types of air and vapour barriers have been used in your home. Make sure you know whether the air barrier is located against the back of the drywall or set further back into the wall and by how far. Knowing how far back it is set will tell you if you are likely to pierce the air barrier when you hang pictures or renovate. Write down the type of air and vapour barrier(s) and the location of the air barrier in the space provided at the end of this manual (page 34).

The Air Barrier

In order to be effective, the air barrier must be

- resistant to air movement;
- continuous, completely surrounding the envelope of the house and properly supported by rigid surfaces on the interior and exterior; and
- strong and durable.

Since almost all interior water vapour is carried outward by air movement and only a small amount diffuses through materials, the air barrier is the most important component that prevents condensation in insulated cavities in the building envelope. The air barrier is like a continuous sealed envelope that restricts the movement of air in and out of your home. It prevents moist indoor air from entering and accumulating in the insulation or in the enclosed cavities in the walls or roof (where it can cause mould and rot). It also cuts energy costs by reducing the flow of warm air to the outdoors in winter and makes your home more comfortable by reducing incoming cold drafts.

Various types of air barriers are used in R-2000 homes. When separate air and vapour barriers are installed, the most common air barrier used is spunbounded polyolefin house wrap. When the air barrier also acts as the vapour barrier, the most common material is polyethylene sheeting in combination with sealants and other materials to ensure its continuity. Another approach uses drywall in combination with sealants and gaskets sealed to framing components and other rigid materials.

The Vapour Barrier

In order to be effective, the vapour barrier must be

- resistant to the flow of water vapour;
- durable; and
- located on the warm side of the insulation.

The vapour barrier does not need to be perfectly continuous like an air barrier unless it also acts as the air barrier, but it should cover as much of the building envelope as possible. Although it needs to be located on the warm side of the insulation, the vapour barrier can be installed partway into the wall, provided that it meets the requirements of the building code in your area.

Like an air barrier, the vapour barrier can be made up of different materials. Materials that are considered to be effective vapour barriers include polyethylene, aluminum foil, some types of paints, some types and thicknesses of insulation, vinyl wallpaper and exterior-grade plywood.

Polyethylene Sheeting

This type of air barrier, as illustrated in Figure 1 (page 17), consists of a continuous layer of polyethylene sheeting sealed at all joints. It is located on the warm side (inside) of the insulation in walls, ceilings and some floors.

A polyethylene air barrier should need no upkeep. However, it can be damaged by extreme heat, exposure to sunlight (if not sunlight-resistant) or holes cut into your walls and ceilings. Avoid making any changes or additions to insulated walls and ceilings that could penetrate the air barrier.

To preserve the effectiveness of your home's air barrier, do the following:

- Take care when cutting or drilling holes in insulated walls or ceilings. Don't use a coarse-toothed saw or auger bits as they may cause major undetectable tears in the sheeting. Instead, use a heavy utility knife to cut the wallboard or drill a number of holes and cut between them by using a fine-toothed saw. Seal any breaks or tears in the air barrier with a high-quality material such as acoustical sealant.
- Make sure that installers and tradespeople understand how important your home's air barrier is before they install telephone or television cable, meters or appliances or renovate or repair your home. Try to supervise tradespeople to ensure that the above procedures are followed and that any holes are properly resealed. Inspect an existing fixture to see how this has been done or contact a knowledgeable tradesperson before proceeding with the work.
- For exterior walls, small holes should be drilled directly through the wall studs or joist headers. This method ensures less damage to the air barrier and the insulation while allowing for easier repairs and the sealing of the hole.

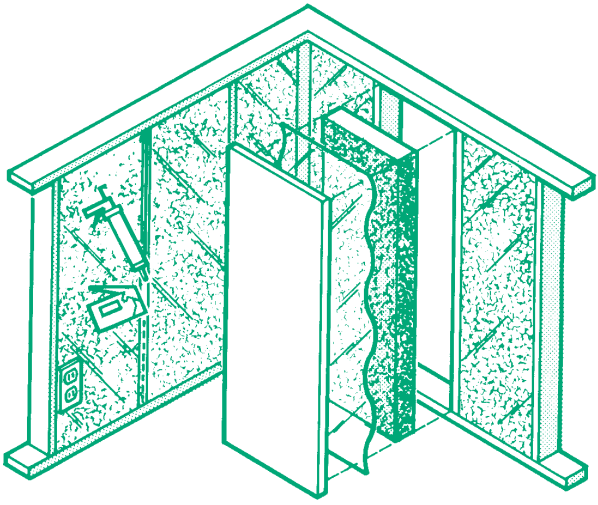

Figure 1. ***Polyethylene Air Barrier***

A continuous layer of polyethylene sheeting sealed at all joints and located on the warm (inside) side of the insulation in the walls and ceilings restricts the movement of air and moisture in and out of your home.

- If your home is damaged by fire, water, wind, etc., have an R-2000 professional examine the air barrier. Make sure that any defective sections of the barrier are properly repaired.
- If an insulated wall or wall component such as a window frame or door frame is removed or replaced for any reason (renovations, damage from storms or fire), make sure that the polyethylene isn't exposed to direct sunlight for more than a few days, even if the material is sunlight-resistant. If part of the air barrier is damaged, have it replaced with sunlight-resistant polyethylene sheeting if possible. Make sure that the air barrier is properly resealed. Exposed polyethylene is flammable – it should be covered in all living spaces, as required by local and national building codes.

Sealed Drywall

The sealed drywall approach to the R-2000 house construction means that the drywall (gypsum wallboard) in your home's walls and ceilings acts as an air barrier. The joints of the drywall have been carefully sealed to prevent air leakage and then covered with several coats of vapour-resistant paint to also act as a vapour barrier. Your drywall may also be foil-backed to provide extra vapour resistance.

You need to do a small amount of maintenance to keep sealed drywall working effectively:

- Once a year, inspect (if possible) the joints where the drywall meets the floor or ceiling and around door and window frames. This is particularly important in the first few years when the natural settling of a new home may produce small cracks. Cracks should be filled using crack filler. Check if this work is covered by your New Home Warranty. If not, seal the cracks and repaint, preferably, with a low-VOC paint.
- If the paint on your walls or ceiling is fading or chalky or if you see fine hairline cracking on the surface, prepare the wall for repainting by patching and sealing. Then paint with a vapour-barrier paint, preferably a low-VOC type.
- On exterior walls, you should patch holes from relocated paintings, wall hangings or fixtures with a standard patching compound (available in paint or hardware stores).

Making Changes

When planning to decorate, renovate or otherwise alter your R-2000 home, keep the following points in mind to ensure that you continue to maintain your home's high energy efficiency, superior indoor air quality, environmental benefits, comfort and quietness.

Energy

Renovations or additions such as whirlpools, saunas or extra rooms will increase your total energy consumption and related costs. At the same time, they could affect the quality of your indoor air. In addition, the heating and cooling systems may need to be modified to adapt to the changes. Check with your builder, your local R-2000 office or NRCan about any changes to your home.

Ventilation

Also check with your builder, local R-2000 office or NRCan if you are planning room additions or size alterations. The ventilation system will likely need to be modified as a result.

An R-2000 builder can refer you to knowledgeable tradespeople. Contact your builder or the R-2000 office in your area through NRCan's Office of Energy Efficiency at 1-800-387-2000 or through the R-2000 Web site at r-2000.nrcan.gc.ca.

Building Permits

Most additions and major renovations to any house need a building permit. Always check with your municipality before you start construction, major renovations or excavation. When required, obtain the permit from your city or town hall or municipal offices, and have the changes inspected by the local inspection office.

Excavations

Remember that excavating near a foundation wall can damage the exterior insulation, the waterproofing and the foundation drainage system. Take extra care when doing this type of work. Upon completion, ensure that the finished ground slopes away from the house to prevent water from pooling against your home.

Air Barrier Damage

Work that involves drilling or cutting into insulated walls or ceilings can damage the air barrier if not done correctly. The correct way to do this is described on page 16.

Decorating

When you are drilling holes to hang ornaments or fixtures, try to locate all holes on the wall studs and ceiling joists. This will minimize damage to the air barrier and avoid accidental drilling into a water pipe, duct or electrical wire.

Any decorating that involves changes to surface finishings should be considered carefully as it will affect indoor air quality. Select paints, varnishes, flooring adhesives, carpeting and underpads that are low in volatile organic compounds and consistent with R-2000 requirements – as are water-based finishes and glue-free carpets – to maintain superior indoor air quality. (Contact your builder or the R-2000 office in your area for more information if necessary).

Pay careful attention when selecting cabinets, vanities or other furniture made from manufactured wood products (e.g., particleboard). Choose ones made from formaldehyde-free particleboard or similar material that is low in toxic gases or that have all surfaces covered with a low-toxic sealant. Make sure to choose low-emissivity paints and finishes. An alternative is to choose products made from solid wood; this produces far fewer emissions. When in doubt, use your nose. If something has that "new" smell, it is releasing many potential toxic or irritating chemicals.

Wood-Burning Appliances

Given the controlled ventilation conditions of an R-2000 home, your fireplace appliances and wood or pellet stoves must be installed in accordance with the R-2000 Standard. This will maintain the comfort, superior indoor air quality and energy efficiency of your R-2000 home. Adding any of these major heat-producing and air-consuming appliances can upset the balance among temperature, humidity and incoming outdoor air if not done properly.

If you wish to install one of these appliances, make sure that it is certified for use in an R-2000 home and is properly installed by an R-2000 builder to ensure that it will perform efficiently and safely. This usually means selecting the smallest stove possible that meets your needs. Be sure

to have it installed according to both the manufacturer's instructions **and** the R-2000 Standard. Have your ventilation system checked for proper balancing.

For more information, contact your R-2000 builder or the R-2000 office in your area through NRCan's Office of Energy Efficiency at 1-800-387-2000 or through the R-2000 Web site at r-2000.nrcan.gc.ca.

New Appliances and Fixtures

If you are installing any new combustion appliance – such as a gas, oil or propane furnace, boiler, stove, water heater or clothes dryer; a fireplace; or a wood or pellet stove – you must ensure that it is installed properly. Take into account the requirements for combustion air, exhaust venting and make-up air to prevent back-drafting. Be sure that your ventilation system is re-balanced. Your builder or your local R-2000 office can refer you to a qualified professional.

Energy-efficient appliances and lights can contribute to your home's low energy consumption. Select appliances that are in the upper 33 percent of the EnerGuide ratings for their category and choose energy-efficient lighting. Look for refrigerators, freezers, dishwashers and clothes washers that have the ENERGY STAR® mark, which identifies top energy performers on the market. Other ENERGY STAR appliances may be available. Visit the ENERGY STAR Web site at energystar.gc.ca for more information.

Choose water-saving faucets, shower heads and toilets if you are adding or replacing any of them. They will keep your water-heating bills and consumption low.

Landscaping

Distinctive landscaping can add greatly to your enjoyment of your home. It can also affect its energy performance. If your home is exposed to a prevailing wind, consider planting a hedge of coniferous shrubs to act as a windbreak.

Your builder may have taken advantage of the sun's heat by orienting your home toward the sun and angling roof overhangs to let in winter sunlight and block summer sunlight. More windows may have been placed on the south- or sun-facing walls, with fewer on the north-facing walls. Deciduous (leaf-bearing) rather than coniferous (evergreen) trees planted on the south side of your home will provide welcome summer shade and will let the sun shine into your home in winter. If you are planting new trees, make sure to plant them far enough from the house to avoid damage to the house structure when the trees have reached maturity. Choose a variety that can be planted near your house.

Avoid planting large or strong-smelling flowering plants or placing compost refuge close to your home's air intakes.

The environment has been taken into account in the design and construction of your R-2000 home. You can extend this by applying environmentally preferred landscaping and maintenance practices to your surrounding property.

Consider using indigenous grasses and shrubbery and hardy types of vegetation to help conserve water (non-indigenous plants tend to need excessive watering).

Use a composter to provide rich soil for your garden. Sidewalks can be made from recycled bricks.

Troubleshooting Checklist

R-2000 homes are built to exceed standard code practices but, like any home, some problems may occur over the years. This chart provides some troubleshooting tips. More can be found in your manufacturers' information. Check each possible cause until you find the source of your problem. If you can't figure out what is causing the symptoms or if they recur, call an R-2000 professional or a qualified individual in the field.

Symptom	Possible Cause	Action
1. Poor air quality and/or excess moisture in parts of the house	• Poor air circulation • Particular activities are producing moisture and pollutants locally (e.g., in bathroom, workshop)	• Make sure ventilation system is turned on • Make sure vent grilles are free of obstructions and that you can feel the airflow as it is being drawn in and exhausted • Increase the continuous ventilation rate • Use a hygrometer to check if the humidistat is working properly • Have a humidistat or manual switch installed to provide high-speed ventilation as needed • Undercut doors to allow a gap for air to circulate between rooms or install a door grille, especially if carpet was added after construction.

Symptom	Possible Cause	Action
2. Condensation or ice on inner surfaces of sealed windows, on metal sashes, hinges or door handles; stuffy atmosphere or lingering odours; damp spots or mildew on walls, ceilings or floors; moisture on or collecting in light fixtures; peeling paint	• Not enough ventilation or too much humidity	• Reduce amount of moisture generated. • Reduce use of humidifiers • Make sure clothes dryer is properly ventilated to the outdoors • Cover aquariums • Reduce the number of potted plants or cover the soil with light gravel to reduce evaporation • Don't hang clothes to dry inside the house • Ensure that earth floors in crawl spaces are covered by a sheet of polyethylene that is sealed to the edges of the foundation • Use kitchen and bathroom fans when cooking, cleaning and washing • Never dry or store firewood indoors • Increase the ventilation system rates and length of operating time • Increase continuous speed setting of furnace fan • Use a hygrometer to check if humidity levels are within the recommended range and, if not, call a ventilation technician to check the system operation. Your builder or your local R-2000 office can refer you to a qualified technician

Symptom	Possible Cause	Action
3. Mechanical ventilation system or heat recovery ventilator (HRV/ERV) is not working	• Breaker off, electrical connection faulty	• Check manufacturer's manual • Check that unit is plugged in, electrical cord isn't damaged and service door is closed • Check controls, circuit breakers and electrical outlet • Call technician if problem persists
4. Mechanical ventilation system or HRV/ERV is operating, but there is little or no airflow in one or both air streams	• Blocked core • Clogged filters • Blocked exterior hoods • Leaking ducts • Exhaust side frozen • Fan slipping on motor shaft • Frozen intake screen • Damper motor not working	• Check manufacturer's manual for troubleshooting information • Unit may be on defrost cycle; wait 15–20 minutes and check again • Check filters and clean or replace if necessary • **Check internal dampers BUT DO NOT force them open or closed, as small gears may be stripped in the process** • Examine core and clean or defrost by hand if required (call installer if blockage from frost re-occurs) • Check, clean and defrost hoods and screens if required • Inspect ducts and, if required, tape or seal loose joints • Check that all dampers are open and that ducts are clear • Defrost (if your unit has automatic defrost, call technician to check defrost controls) • Call technician if problem persists

Symptom	Possible Cause	Action
5. Mechanical ventilation system or HRV/ERV runs continually at high speed.	• High-speed switch is left on continuously • Dehumidistat setting is too low • Remote control switches are left on high	• Check switch and, if required, turn off high speed • Raise dehumidistat setting • Check remote switches and, if needed, turn down • Call technician if problem persists
6. Mechanical ventilation system or HRV/ERV doesn't respond when high-speed switch is on	• Faulty wiring or component damage	• Call technician
7. Supply fan not working	• Unit may be in defrost cycle • Switches and/or power switched off • Motor burned out • HRV/ERV cover is loose or open	• Fan will turn on again when the cycle is completed • Check power switches and, if needed, turn on • Close door and check door switch • Call technician
8. Unusual noise or vibrations	• Loose screws, fittings, etc. • Dirty, blocked or clogged fan blades or core • Fan needs lubricating	• Inspect and, if required, tighten • Check and, if required, clean • Lubricate as per manufacturer's instructions
9. Fresh-air supply unusually cold; cold drafts in living quarters	• Exhaust air duct blocked • Clogged or frozen core • Exhaust motor burned out	• Clean ducts and exterior hoods and check dampers • Defrost or clean core • Provide diffusers, relocate fresh-air outlets, add more outlets or add a pre-heater, as appropriate • Call technician if problem persists
10. Excessive noise in living quarters	• Inadequate soundproofing	• Ask installer to move unit or to install vibration isolators, ducts or soundproofing, as required

Symptom	Possible Cause	Action
11. Unit continually cycles into defrost	• Defective defrost control sensor	• Replace control • Call technician if problem persists
12. Discomfort due to dry indoor air	• Mechanical ventilation system may be set too high	• Adjust mechanical ventilation system dehumidistat to either slightly lower setting or to intermittent setting • Consider installing an ERV • Consult technician

Windows and Doors

Symptom	Possible Cause	Action
1. Condensation between sealed window panes	• Window seal broken	• Replace thermal pane glazing unit • Check warranty to see if replacement costs are covered

Roof

Symptom	Possible Cause	Action
1. Bubbles in tar layer of tar and gravel roofing	• Moisture leakage	• Inspect roof and attic to find source of moisture; if necessary, call a qualified roofing contractor to confirm and repair • Inspect ceiling air barrier in region of leak to ensure that it isn't damaged; seal any cracks or holes, if necessary

Roof (continued)

Symptom	Possible Cause	Action
2. Summer dampness or winter frost inside roof structure	• Moisture entering attic cavity from living area or from roof leaks • Moisture trapped in attic cavity due to inadequate attic ventilation	• Check for sources of moisture • Repair roof damage or seal interior paths for moisture, as required • Increase ventilation in attic cavity

Heating and Cooling System

Symptom	Possible Cause	Action
1. Heating or cooling system suddenly stops working	• Circuit breaker tripped • Out of fuel • Thermal-spill switch has shut down the furnace or boiler • Problem with burner, elements, wiring, controls or coils • Limit switches have been activated by overheating	• Reset circuit breaker • Check fuel supply • Press Reset button on oil-fired equipment • Call heating or cooling system contractor
2. Odours from combustion appliances	• Back-spillage of combustion gases or not enough combustion and/or make-up air • Fuel leak	• Use caution: call gas company or fire department if gas smell is noticeable • Stop, decrease or limit exhausting fan that is causing negative pressure in house • Have fuel leak fixed by contractor • Have installer check for the block in air supply or exhaust
3. Heat pump using excessive amount of energy	• Operating switch set for backup mode	• Set and leave switch on heat pump mode

Walls, Ceilings and Floors

Symptom	Possible Cause	Action
1. Cracking drywall	• Drying and settling of house, especially in the first year after construction	• Check New Home Warranty to see if it covers crack filling • Check for water leaks – especially from ceiling, below plumbing and around windows – and then repair • Use crack filler to seal cracks and then repaint
2. Chalky, fading paint; hairline cracks in paint	• Aging paint • Mould behind drywall	• Correct mould problem and then repair • Repaint (for airtight drywall, use vapour-barrier paint)
3. White powder on walls or floors of concrete basement	• Salts in the materials used to make concrete come to the surface as water evaporates from the surface	• If problem persists, contact a building consultant

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Ask Your Builder

1. What is the minimum continuous ventilation setting for the mechanical ventilation system?

   Number setting _____

   or Dial position (make indelible mark)

2. Is the furnace fan part of the mechanical ventilation system?

   Yes _____ No _____

3. Does this house have a heat recovery ventilator (HRV) or energy recovery ventilator (ERV)?

   Yes _____ No _____

   If so, what type? _____

4. What type of air barrier has been installed?

   Polyethylene sheeting _____

   Sealed drywall _____

   Other _____

5. Where is the air barrier located within the wall?

   Against back of drywall _____

   Behind room surface of drywall
   Number of centimetres (inches): _____

6. What type of vapour barrier has been installed?

   Polyethylene sheeting _____

   Aluminum foil _____

   Vapour-barrier paint _____

   Other: _____

Important Notice

A great deal of care and attention has gone into building your R-2000 home. Proper care and maintenance is important to ensure that your home continues to meet high standards of performance and protect its environmental features. This is your responsibility. Be sure you follow the directions and guidelines in this manual and the manufacturers' operating instructions.

Your R-2000 builder will be pleased to help you if you have any questions. You may also contact the R-2000 office in your area through NRCan's Office of Energy Efficiency at 1-800-387-2000 or through the R-2000 Web site at r-2000.nrcan.gc.ca.

NRCan works with R-2000 builders to produce some of the highest quality, most energy-efficient houses built today. Your R-2000 house is certified to show that it meets the R-2000 Standard. NRCan does not assume liability for failure or damage resulting from improper building practices or maintenance of these houses or for the failure to maintain or operate installed equipment according to manufacturers' instructions.

Notes

Natural Resources Canada's Office of Energy Efficiency

Leading Canadians to Energy Efficiency at Home, at Work and on the Road

Canada