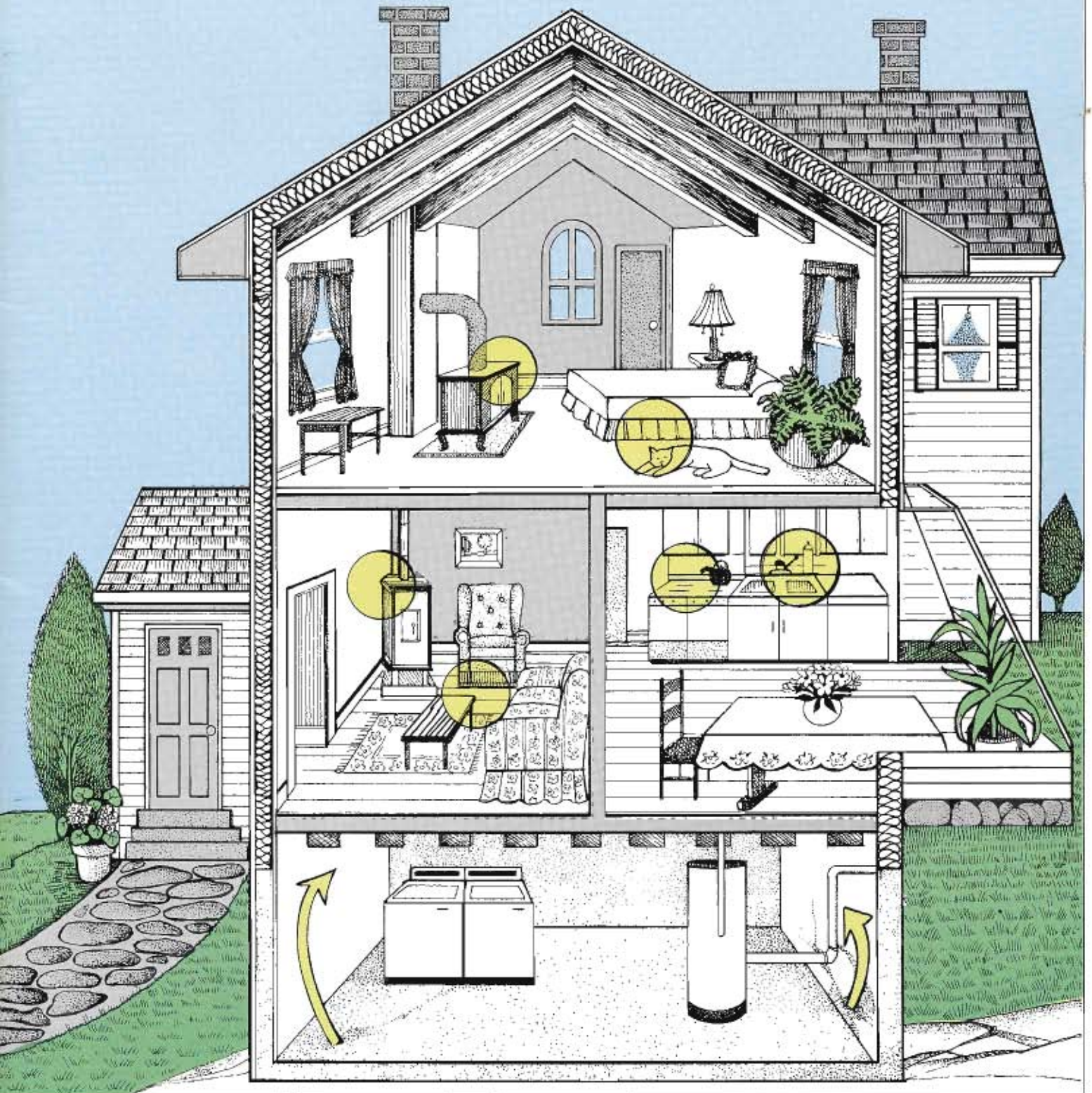


INDOOR AIR QUALITY AND YOUR HEALTH



STATE OF MAINE

OFFICE OF ENERGY RESOURCES
State House Station #53
Augusta, ME 04333



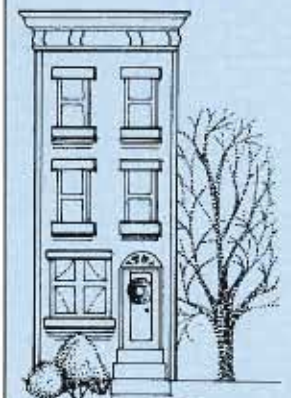
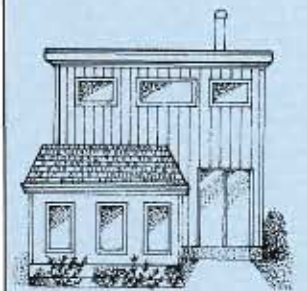
Introduction

A study by researchers for the Federal Environmental Protection Agency found that the indoor levels of all the studied pollutants were greater than the outdoor levels — in some cases, 70 times greater. Another study found that many homes built on a geological formation running from eastern Pennsylvania across northern New Jersey and into southern New York contain extraordinarily high levels of radioactive radon gas. The levels may be high enough to cause lung damage equivalent to smoking 22 packs of cigarettes per day. In some areas of our state, it has been estimated that one Maine house in four may have dangerously high levels of radon. According to Charles T. Hess, a professor of physics at the University of Maine at Orono, radon is second only to smoking as a cause of lung cancer.

Our homes and places of business contain pollutants given off by common building materials and furnishings. We pump scores of pollutants into the indoor air we breathe when we use cleaning products and aerosols.

More and more people complain about allergies, eye irritation, headaches, feelings of confusion, and drowsiness. These and other ailments can be symptoms of poor indoor air quality.

These facts are not meant to alarm but to point out the importance of assessing all buildings to determine the quality of indoor air. This booklet discusses many important facts about indoor air quality and will help you determine the condition of the air in your house or place of business. Agencies which will assist you with more information and testing services are listed on pages 14 and 15.



Acknowledgements

On behalf of the Energy Committee/Time & Tide Resource Conservation and Development, I wish to express a sincere thank you to the author Richard Karg for the fine work done in this booklet and for graciously accepting our reviews and criticisms of the booklet's earlier drafts. Credit is also due to those Maine State agencies and governmental offices who participated in the review of the booklet, and certainly to the Maine State Office of Energy Resources, through which funding for this project was made possible. Particular thanks is due to its staff member Danuta Fishman for her hours invested in seeing this booklet become reality. We are also grateful to John Morrill of the American Council for an Energy Efficient Economy and to Bill Turner of Harriman Associates for comprehensive review and comments. I wish to thank the R.C. & D. Council for accepting this measure initially, and the R.C. & D. Coordinator, Norris Braley, for his constant commitment and dedication to all committee matters. Lastly, I wish to thank Central Maine Power Company for support, review and funding for printing.

Respectfully Submitted:
Anthony Frank DiGregorio
Chairman, Energy Committee

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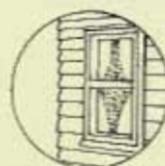
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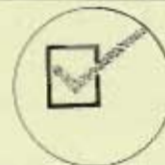
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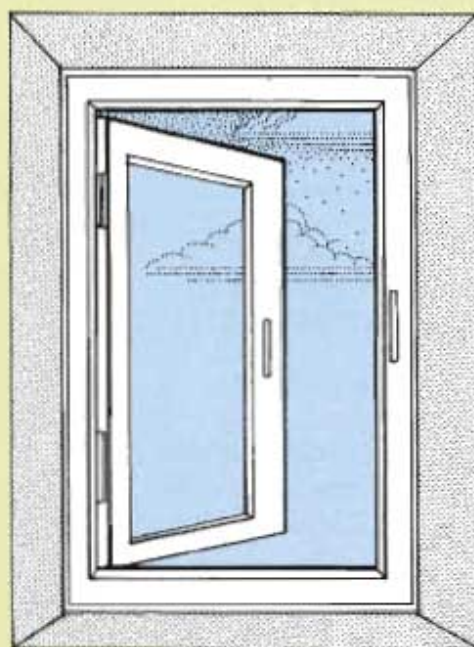
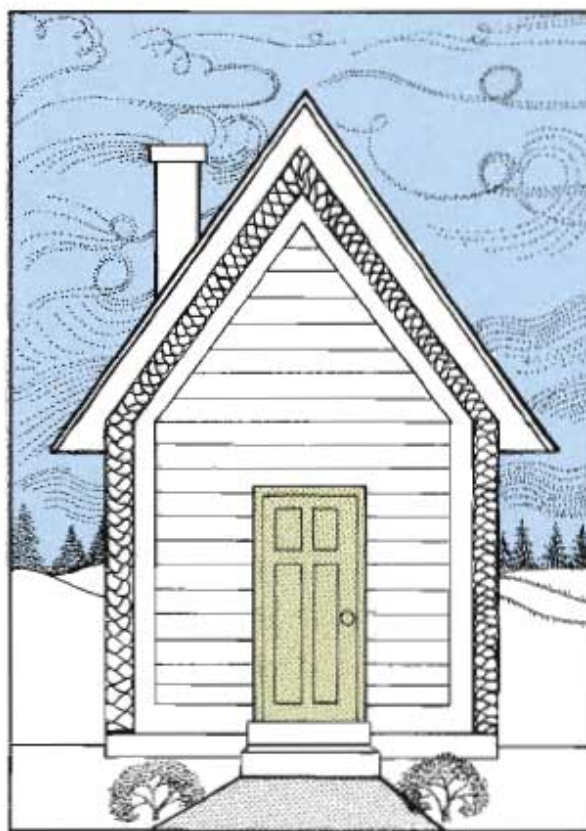
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The Problem

Over the last few decades buildings have been made tighter as a response to increasing energy prices. Often a large part of heat loss in a building during cold weather can be attributed to natural infiltration — air leaking in and out of the structure through holes and cracks. With fewer leaks, fuel bills go down but so does the amount of uncontrolled fresh outside air entering the occupied space.

During the same period there have been increases in the types and quantities of pollutants we have brought into our buildings. Radon gas is being found in more homes in Maine and across the country. Formaldehyde is omitted from some wood paneling, certain insulation, carpeting and furniture. Harmful chemicals are found in cleaning agents, aerosols, paints, hair sprays, fabric softeners, perfumes, and deodorizers.

Because more pollutants are being put into the air in our buildings at a time when less fresh outside air normally blows in, the potential for worsening indoor air quality is considerable.



There Are Solutions to the Problem

These guidelines should always be considered:

- A. Avoid building materials, furnishings or household chemicals that emit pollutants;
- B. Use construction techniques that keep pollutants out of the buildings;
- C. Ventilate the space near pollutant sources so that concentrations are extracted from the building or diluted with fresh outside air; and, if necessary
- D. Clean the air. The last option is usually not required if the first three are implemented. These methods of pollution control are discussed in more detail later.

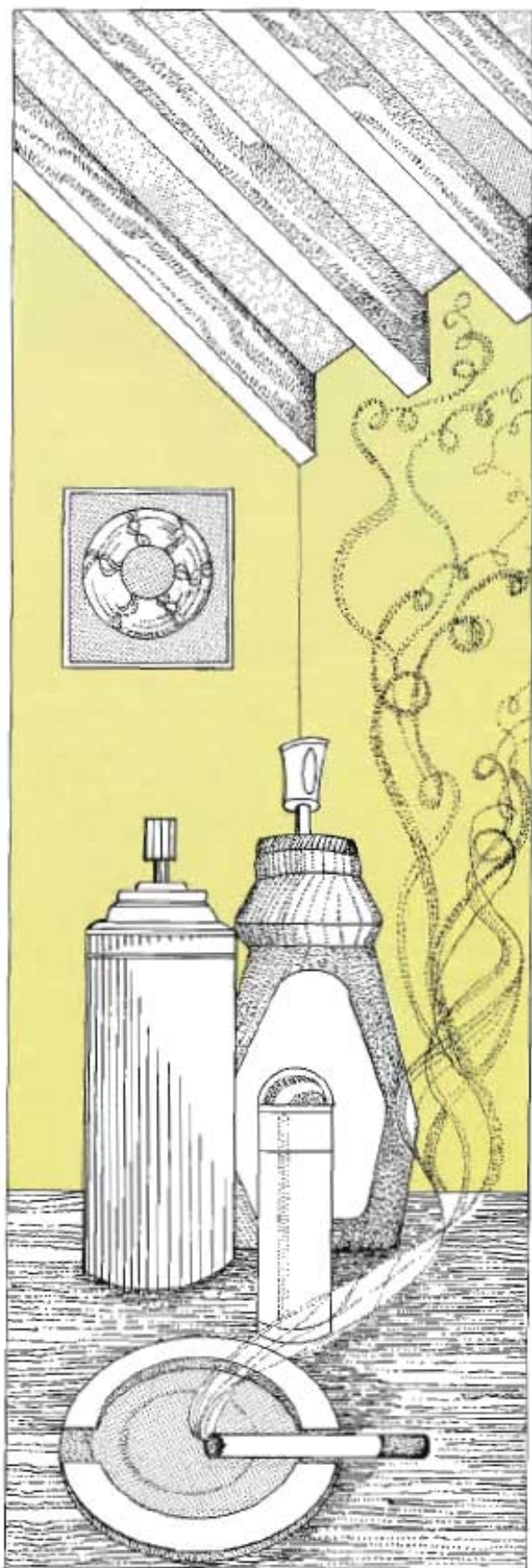
Indoor Air Pollutants and Their Sources

A pollutant is anything that makes the air "dirty" so that it is unpleasant or becomes unsafe to breathe. Pollutants affect human health to varying degrees depending upon the particular pollutant, the level of concentration in the air, and the interaction with other substances.

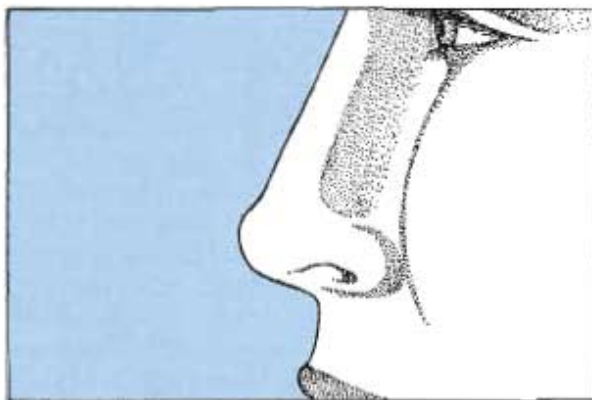
Many indoor air pollutants have been identified and perhaps more will be discovered. By source, the most common types:

1. are given off by building materials and furnishings. Formaldehyde is emitted from some particle board, plywood paneling and urea formaldehyde insulation; radioactive radon gas may be released from granite; and asbestos fibers are often found in the air near asbestos insulation.
2. result from our use of various chemicals such as cleaning agents, perfumes, and pesticides.
3. are created when we burn (combust) something in the house and do not vent the waste products to the outside. Some sources are unvented gas ranges, unvented kerosene heaters, cigarette smoking and defective flues and vents.
4. enter buildings through cracks and holes in cellars or crawlspaces or other parts of the structure. Radon gas, water vapor and auto exhaust fumes are examples.
5. are given off by people. Examples are water vapor, carbon dioxide and odors.

Table I, on pages 8 and 9, Some Significant Indoor Air Pollutants, lists the major pollutants, the potential health effects, and other important facts.



Is The Indoor Air I Breathe Polluted?



Unfortunately, most air pollutants are not detectable by sight or smell. Radon gas, carbon monoxide and nitric oxide are examples. Other pollutants are evident only in high concentrations. Formaldehyde, for example, has a sweet smell at high levels but no smell at lower — yet still harmful — levels. Excessive humidity (high concentrations of water vapor) is considered a pollutant because it facilitates the growth and concentration of molds, algae and fungi.

There are some simple, although imprecise, ways of detecting poor indoor air quality. One is by assuming that if humidity in the air is excessive, the ventilation rate resulting from natural infiltration is too low and, therefore, the concentrations of other pollutants might also be excessive. If your home or place of business feels damp during the winter months or if you notice abnormally large amounts of condensation on your windows, walls, or ceiling surfaces, you might have indoor air pollution as well as high humidity.

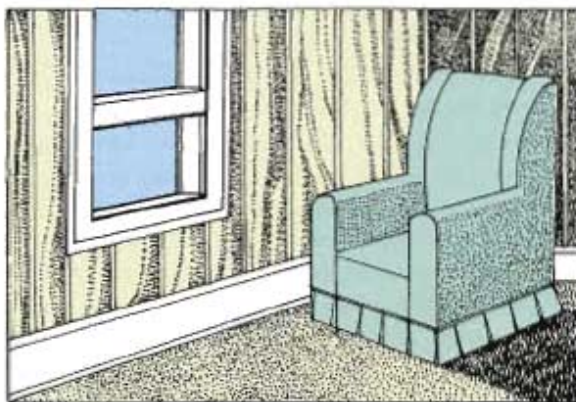
Another simple method of detecting poor air quality is with your nose. If your nose senses a high "stuffiness level" and if the odors of cooking linger too long, the ventilation rate in your house might be too low.

On page 16 of this booklet is a list titled **Check Your Indoor Air Quality**. Use it for your place of business or home. If you think the condition of the air might be hazardous to your health, contact the appropriate agencies listed at the end of this booklet.

Ways To Improve Air Quality

There are three basic GUIDELINES for lowering the concentrations of indoor air pollutants:

- A. SOURCE CONTROL,
 - B. PROPER BUILDING CONSTRUCTION TECHNIQUES, and
 - C. VENTILATION.
- A fourth method, D. AIR CLEANING, is used in special cases. The first three methods should always be used.



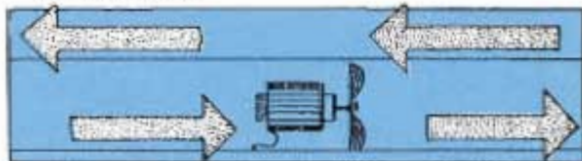
A. SOURCE CONTROL includes reducing the sources of pollution within buildings and addressing existing sources which cannot be removed. For example, products that emit formaldehyde, such as some particle boards and plywood paneling, should not be used in the interior of a house. If particle board is already in the house, the hazardous effects may be eliminated by sealing the surfaces exposed to air.

Some sources are difficult to eliminate or control. For example, some carpeting and furniture emit formaldehyde. Cooking, especially on a gas range, can pollute the air. People and pets exhale water vapor and carbon dioxide.

B. PROPER BUILDING TECHNIQUES should be used to prevent pollutant entry from the outside environment. For example, an attached garage should be constructed so that auto exhaust fumes cannot enter the home.

Radioactive radon gas, a relatively common pollutant in Maine, is emitted from radium, a naturally occurring element in soil and groundwater. It enters indoor air through holes and cracks in the cellar floor and walls or by the indoor use of radon-contaminated well water. Researchers are currently studying Maine lung cancer patients to determine if the state's high lung cancer rate can be linked to the gas.

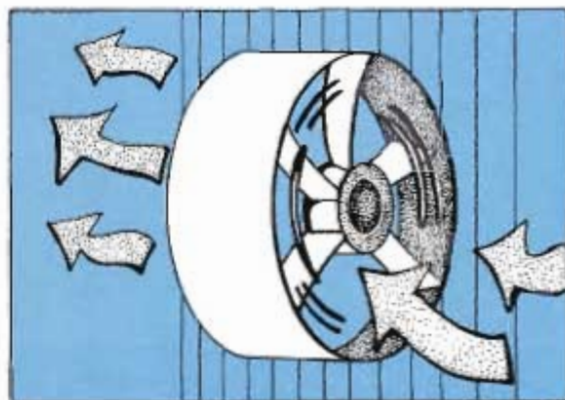
Most occupied buildings in Maine should be tested for radon; well water should be analyzed first, then the air should be checked. (It is not necessary to test water from municipal facilities because the radioactivity of the gas ceases before the water reaches the home.) If levels of radon are found above prescribed, safe amounts, help should be sought from the agencies listed in this booklet. There are special filters that can eliminate radon in well water. Ridding indoor air of radon is more complex. The task might be as simple as plugging cracks and holes in the cellar walls and floor, or as difficult as installing a special ventilation system under the slab.



C. VENTILATION reduces indoor air pollution 1) by exhausting contaminated air to the outside and 2) by diluting indoor concentrations with fresh outside air. Both processes occur simultaneously.

During cold weather when windows are closed, there are two ways fresh air gets into a building and stale air gets out: *Infiltration* and *Mechanical ventilation*. *Infiltration* is a result of 1) air entering a building through cracks and holes in the outer envelope as a result of natural pressure variations and 2) the exterior doors being opened.

Mechanical ventilation is induced by fans or blowers. Common examples are kitchen and bathroom exhaust fans. Air-to-air heat exchangers, available since approximately 1980, are also used. These machines simultaneously exhaust stale air and supply fresh air while transferring most of the heat energy in the exhaust air to the supply air stream.



Today the widely accepted standard for a healthy amount of fresh-air ventilation is 0.5 air changes per hour (AC/h) which should be supplied *continuously*, either by infiltration, by mechanical means, or both. This means that one half house volume of fresh air is brought into the house each hour while the same amount of stale air simultaneously leaves. For example, a one-story house measuring 40 feet by 25 feet with ceilings 8 feet high has a volume of 8000 cubic feet. The standard 0.5 AC/h is, therefore, 4000 cubic feet of air each hour. This is 67 cubic feet of air each minute (cfm). Typical bathroom fans exhaust at a rate of 65 cfm, kitchen range hood fans at a rate of 120 cfm.

Standards developed for *intermittent* residential ventilation by the American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) are listed in **Table 2** on page 10. These standards indicate that bathrooms and kitchens should have exhaust fans installed which will exhaust at least 50 cfm and 100 cfm, respectively, on an as-needed basis. Other ventilation devices, such as air-to-air heat exchangers (exhaust and supply ventilators) with heat recovery capabilities, are also recommended for this purpose. Please refer to **Table 1, Some Significant Indoor Air Pollutants** (on pages 8 and 9), for source control and ventilation strategy suggestions.

D. AIR CLEANING is the fourth method of controlling indoor air pollution. It is not a substitute for fresh outside air. Air filters, ionizers, and electrostatic precipitators can effectively rid indoor air of some microscopic particles like dust and combustion products, but they *do not* totally purify and revitalize the air. These devices must be sized and maintained properly in order to work effectively. An advantage of some air cleaners is their ability to remove some particles, such as pollen, which originate outside.

SOME SIGNIFICANT INDOOR AIR POLLUTANTS

POLLUTANT	POLLUTANT SOURCES	HOW TO DETECT POLLUTANT
Asbestos	<ul style="list-style-type: none"> • Insulation on heating pipes and old heating equipment. Disturbing this asbestos insulation creates asbestos dust. • Wood stove gaskets. 	<ul style="list-style-type: none"> • Not detectable. If you have asbestos in the open which is disturbed by vibration or contact, it is probably in the air.
Cleaning Agents and Aerosols	<ul style="list-style-type: none"> • Cleaners, paints, hair sprays, glues, fabric softeners, pesticides, perfumes, deodorizers. 	<ul style="list-style-type: none"> • Odor. • Feeling of malaise. • Experiencing ill effects.
Formaldehyde	<ul style="list-style-type: none"> • Some particle board, plywood and paneling, carpeting, furniture, some insulations, some glues. 	<ul style="list-style-type: none"> • Sweet smell of particle board or paneling. • Experiencing ill effects. • Special test equipment.
Organisms and Microbes	<ul style="list-style-type: none"> • Dust mites, molds, fungi, bacteria, virus, animal dander, etc.. 	<ul style="list-style-type: none"> • Most cannot be detected. • Odor of mold and mildew.
Products of Combustion including Particles, Carbon Monoxide (CO), Carbon Dioxide (CO ₂), Nitric Oxide (NO), and Nitrogen Dioxide (NO ₂).	<ul style="list-style-type: none"> • Unvented gas appliances. • Unvented kerosene or gas heaters. • Woodstoves and fireplaces. • Cigarettes, cigars, pipes. • Outside air, auto exhaust, dust. 	<ul style="list-style-type: none"> • Many particles have detectable odors. • CO, CO₂, NO, and NO₂ are odorless, colorless and tasteless.
Radon and Progeny	<ul style="list-style-type: none"> • Earth and rock beneath some houses. Enters through cracks and holes in the foundation, slab, or dirt floor. • Some well water. 	<ul style="list-style-type: none"> • Odorless, colorless and tasteless. • Special radioactive film pod attached to wall can detect excessive concentrations. • State conducted water test.
Water Vapor	<ul style="list-style-type: none"> • Household activities such as showering, bathing and cooking. • Human respiration. • Unvented combustion. • Improper drainings around house. 	<ul style="list-style-type: none"> • Excessive condensation on windows. • Condensation on walls and ceilings.

TABLE 1

EFFECTS	EQUIPMENT AND MATERIAL SELECTION FOR CONTROL	VENTILATION STRATEGIES FOR CONTROL	OCCUPANT INVOLVEMENT
<ul style="list-style-type: none"> • Causes lung cancer. 	<ul style="list-style-type: none"> • Do not use any materials containing asbestos. • Coat existing asbestos with sealant. Wrap asbestos-insulated pipes with aluminum foil. • Use fiberglass wood stove gaskets. 	<ul style="list-style-type: none"> • Ventilate area where asbestos is located. 	<ul style="list-style-type: none"> • Do not disturb asbestos insulation.
<ul style="list-style-type: none"> • Headaches. • Heartburn and abdominal pain. • Mental confusion. • Possible serious long-term effects. 	<ul style="list-style-type: none"> • Difficult to escape the pollutant hazards entirely. • Read labels before purchasing and using products. 	<ul style="list-style-type: none"> • Ventilate areas of use according to manufacturers' recommendations and your discretion. 	<ul style="list-style-type: none"> • Follow directions and always ventilate. • Use safest products.
<ul style="list-style-type: none"> • Burning eyes and upper respiratory irritation. • High concentration can cause coughing, constriction of chest and wheezing. • Might cause cancer. 	<ul style="list-style-type: none"> • Use building materials containing no or low concentrations. • Seal particle board and paneling exposed to indoor air. 	<ul style="list-style-type: none"> • Ventilate areas of use according to manufacturers' recommendations and your discretion. 	<ul style="list-style-type: none"> • Avoid products containing formaldehyde.
<ul style="list-style-type: none"> • Allergies and other illnesses. 	<ul style="list-style-type: none"> • Control relative humidity in house by proper construction practices and occupant activities. • Control source of irritants. 	<ul style="list-style-type: none"> • Install and use exhaust fans in bathrooms and kitchens. • Ventilate crawlspace and cellar during warm weather. 	<ul style="list-style-type: none"> • Maintain relative humidity between 30% and 50%.
<ul style="list-style-type: none"> • Drowsiness. • Respiratory distress. • Long-term adverse effects such as lung cancer. 	<ul style="list-style-type: none"> • Pilotless ignition. • Do not use in living space. • Use proper chimney and supply enough combustion air. • Ventilate smoking areas. • Isolate garage from house air. 	<ul style="list-style-type: none"> • Install and use range hood exhaust fan. • Ventilate smoking room with exhaust fans. 	<ul style="list-style-type: none"> • Use range hood exhaust fan. • Use vented heating units instead. • Keep chimneys, stoves and fireplaces properly maintained. • Use air cleaners. • Isolate smoking areas. • Do not leave motor vehicles running close to house.
<ul style="list-style-type: none"> • Causes lung cancer. • Enters air during showering and other water use and then might be inhaled to cause lung cancer. 	<ul style="list-style-type: none"> • Vapor air barrier (6 mil polyethylene or better) under slab or above dirt floor in cellar. • Good damp-proofing. • Seal cracks and holes in foundation. • Install traps in floor drains. 	<ul style="list-style-type: none"> • Ventilate cellar. • Ventilate crawlspace. • Ventilate sump hole to outside (special cases only). • Ventilate bathrooms and laundry rooms. 	<ul style="list-style-type: none"> • Maintain seals and fans used to exhaust radon-filled air. • Maintain water filtration system.
<ul style="list-style-type: none"> • Formaldehyde levels increase at high levels of humidity. • At relative humidity below 30% and above 50% sensitive individuals suffer from the effects of allergies, bacteria and viruses. • Growth of mites, molds, etc., increase at high levels of humidity. 	<ul style="list-style-type: none"> • Drain water away from foundation. • Control water vapor inside house. 	<ul style="list-style-type: none"> • Ventilate bathrooms and kitchens when the rooms are in use. 	<ul style="list-style-type: none"> • Keep indoor relative humidity between 30% and 50%. • Do not vent dryer inside, especially a gas dryer.

Should Houses Be Built Tightly?

Most experts agree that the answer to this question is "yes." But many homeowners then ask: "If I build my new home tightly or tighten up my existing home, isn't it likely that the indoor air quality will worsen?" The answer to this second question is "no" *provided* you follow the **GUIDELINES** listed in this booklet:

- A. ELIMINATE MOST OF THE POLLUTION SOURCES,
- B. CONSTRUCT THE HOUSE PROPERLY,
- C. INSTALL A VENTILATION SYSTEM
and, if necessary
- D. CLEAN THE AIR.

These guidelines require extra work and planning, but can result in a healthier, more comfortable and cost-effective environment than is found in most older, leakier homes.

The extra work cannot be avoided. Maine winters are cold and fuel to heat our homes and businesses is expensive. As a result, we tighten and insulate our buildings to increase our level of comfort and decrease our heating bills. Any house built in the state that contains insulation should have an air/vapor barrier to protect the insulation and the framing materials from water-condensation damage. Because this barrier reduces the number of cracks and holes in the building envelope, the amount of outside air coming inside — infiltration — is reduced. Less infiltration may result in higher concentrations of indoor air pollutants. However, higher pollutant levels are seldom experienced if the **GUIDELINES** are followed.

On the other hand, if a new house is built loosely or if an existing house is insulated without being tightened, the heating bills will be higher and the insulation and the framework might be damaged by water vapor condensation within the walls, ceilings, and floors. In addition, the possibility of high concentrations of some pollutants is greater in a loosely



constructed building. Radon, for example, can enter the house through cracks in the cellar floor or walls. Also, the *quality* of ventilation provided through natural infiltration is inferior to that provided mechanically; infiltration is both inconsistent and uncontrollable.

If you are constructing a new structure or renovating an existing one, insulate, tighten, and follow the basic **GUIDELINES**. You will be healthier, save heating dollars, feel more comfortable, and enjoy a more durable building.

Table 2



Residential Ventilation Standards*

Residential Area	Cubic feet per minute (cfm) minimum
General living areas	10
Bedrooms	10
Kitchens	100
Bathrooms	50
All other rooms	10
Basements, utility rooms	NA
Garage, attached	1.5 cfm/ft. ²

*ASHRAE Standard 62-1981 for single or multiple units.

Glossary for Indoor Air Quality

Acceptable Air Quality. Air in which there are no known contaminants at harmful concentrations and with which a substantial majority — usually 80% — of the people exposed do not express dissatisfaction. (ASHRAE 62-1981)

Acetone. A common indoor air pollutant. Used as a solvent for acetylene gas, therefore often found where welding is done.

AC/h. An abbreviation for air changes per hour. The ratio of the volumetric rate at which air enters and exits a building, divided by the volume of the building.

Aerosol. A gaseous suspension of fine liquid or solid particles.

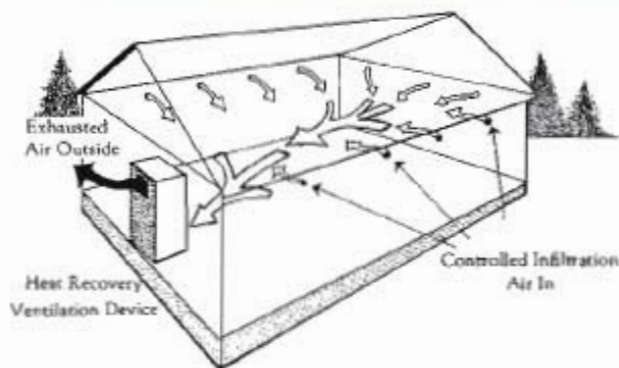
Air-to-Air Heat Exchanger. A mechanical ventilation device which exhausts stale air from and supplies fresh air to an occupied space. These machines have the advantage of transferring most of the heat energy from the exhaust air to the supply air stream. Small, wall-installed types and larger centrally installed types are available, the latter being the most effective. The effectiveness of heat recovery ranges from 50% to 85%.

Air/Vapor Barrier. An air and moisture impervious material — usually 4 to 20 mil polyethylene — installed on the warm side of the building envelope. The air/vapor barrier can also be created by constructing an interior air-tight building envelope with a combination of drywall and gaskets or caulking, and then painting the drywall with a vapor barrier paint. This method is referred to as the Airtight Drywall Approach (ADA).

Aldehydes. Any of a class of highly reactive organic compounds containing the chemical group -CHO, used in the making of resins and dyes, and having strong odor.

Alpha Particle Radiation. The primary radioactive radiation emitted from the progeny or daughters of radon. By virtue of its relatively large mass, charge and energy, alpha particle radiation causes ionization — the displacement of electrons — along its path, but it has low penetrating power. When the source is outside the body, the particles do not penetrate the skin. But when inhaled, alpha particles may cause damage to the soft tissue of the lungs. Cancer may result over time.

Ammonia (NH₃). A common indoor pollutant whose source may be cleaning products or the metabolic activity of occupants.



Animal Dander. Minute scales of animal skin (similar to human dandruff) found in housedust. It causes most allergies to animals.

Asbestos. A natural mineral used in various building materials including pipe insulation, fire board, woodstove gaskets and some plaster products. If an asbestos fiber is inhaled, it gets trapped in the lungs. Asbestos exposure is cumulative, and high exposures cause cancer of the lung.

ASHRAE. An acronym for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers.

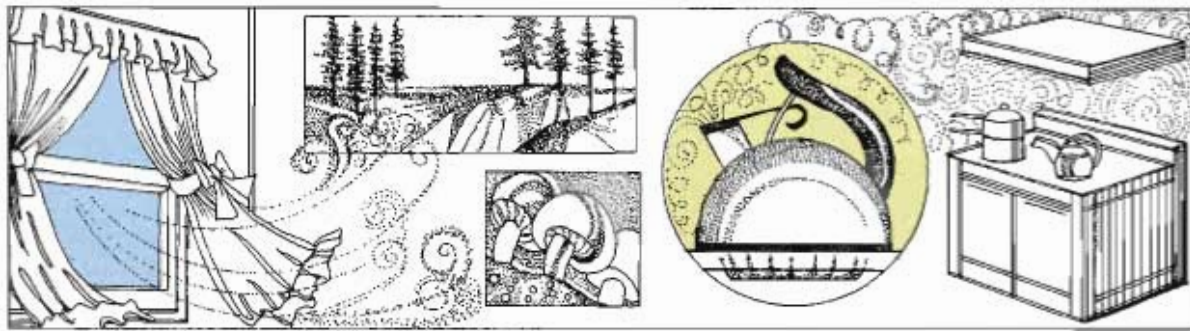
Building Envelope. All exterior surfaces and parts of a building exposed to the outside environment; specifically, roofs or ceilings, walls, windows, exterior doors, and floors. If the cellar or basement is a living space or heated, its walls, windows and floor are part of the building envelope; otherwise, the floor above the cellar or crawlspace is the lowermost boundary of the building envelope. Sometimes referred to as the "thermal envelope."

Carbon Dioxide (CO₂). Minor constituent of the atmosphere and common indoor air pollutant resulting from unvented combustion and human respiration. High concentrations are dangerous.

Carbon Monoxide (CO). A colorless, odorless, highly toxic gas produced by the incomplete combustion of natural gas, oil, wood, coal, tobacco, and other materials. Because it combines with blood hemoglobin far more readily than oxygen, carbon monoxide can prevent normal oxygen uptake and distribution to the body. Mild deficiencies of oxygen can impair vision and brain functions, while more severe deficiencies can cause irregular heart functioning, headaches, ringing in the ears, nausea, weakness, confusion, and death.

CFM. An abbreviation for Cubic Feet per Minute. Used as a unit of measure for natural mechanical ventilation.

Combustion Air. The air required to provide adequate oxygen for fossil fuel burning appliances in a building. If adequate quantities of oxygen are not supplied, combustion will not be complete.



Combustion Appliance. A fuel-burning device used for space heating, water heating, or cooking. If combustion appliances are not vented properly to the outside, indoor air is polluted with the products of combustion.

Condensation on Windows. The precipitation of water vapor on a relatively cold window glass surface. If the glass is extremely cold, frost or ice will form. If condensation occurs frequently on window glass, it is a sign of high relative humidity and, perhaps, high concentrations of air pollutants.

Contaminant. An undesirable airborne constituent that reduces acceptability of the air, a pollutant.

Daughters (Progeny). The new radioactive element formed by the radioactive decay of a parent radioactive element. The radioactive daughters of RADON 222 are Polonium 218, Lead 214, Bismuth 214 and Polonium 214. When radon is in the air, its daughters (progeny) are present also.

Dust Mites (Household Mites). A microscopic animal found in the dust of most homes with high levels of humidity. Many people are more allergic to mites than the other housedust components.

Electronic Air Cleaner. An electrostatic filter for removing small particles, pollen, fibers and other small particulates. Several manufacturers supply them for homes as well as large buildings.

Electronic Ignition. A device which replaces the burning pilot flame of a natural gas or LP gas appliance. Sometimes called pilotless ignition, these devices do not contribute to indoor air pollution; they also save energy.

Exhaust Fan. A mechanical ventilation device used to eliminate air from a building. The negative inside pressure created by the exhaust fan causes outside air to enter the building through existing holes and cracks, wherever they may be.

Formaldehyde (HCHO). A colorless, gaseous compound, with a detectable, sweet odor at high concentrations. It is used in the manufacture of resins and dyes, as a preservative and disinfectant, and is present in many synthetic materials.

Fresh Air. Outside air that is generally assumed to be sufficiently uncontaminated to be used for ventilation and healthful human consumption.

Fungi. Any of a group of parasitic, lower plants that lack chlorophyll including molds, mildews, mushrooms, and bacteria. Can cause a wide variety of adverse reactions in humans.

Granite. A crystalline rock found in Maine and other parts of the country. Can contain uranium of which radioactive radon is a daughter or progeny. Granite rock is probably the primary source of radon in Maine.

Humidity. The water vapor content of the air.

Hydrocarbons. Air pollutants resulting from the use of paints, solvents, and wood preservatives. Exposure to these pollutants may cause fatigue, liver ailments, loss of appetite, and skin irritations.

Indoor Air Pollution. Noxious gases or dust particles from any source that makes indoor air unpleasant or unfit to breathe.

Infiltration (Exfiltration). Uncontrolled air leakage into (infiltration) and out of (exfiltration) a building through cracks, gaps, and holes in the building envelope. Sometimes incorrectly referred to as "natural ventilation."

Kitchen Range Hood Exhaust Fan. A hood, usually made of sheet metal, installed above the kitchen range for the purpose of exhausting to the outside the harmful by-products of cooking and baking. This should not be confused with a circulating range hood which does not exhaust to the outside.

Mechanical Ventilation. Ventilation forced by means of one or more fans or blowers. Examples are bathroom and kitchen exhaust fans and air-to-air exchangers.

Microbes. A broad term encompassing most microscopic particles and organisms including fungi, pollen, bacteria, and viruses.

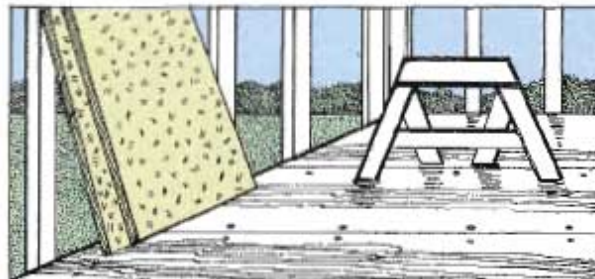
Natural Ventilation. The unaided movement of air into and out of an enclosed space through intentionally provided openings, such as doors, windows, or other openings. Sometimes incorrectly referred to as "infiltration" or "exfiltration."

Nitric Oxide (NO). A colorless gas formed during combustion. It is often irritating to the skin, eyes, and respiratory tract.

Nitrogen Dioxide (NO₂). A common indoor air pollutant originating from unvented or incorrectly vented gas appliances. Highly irritating and damaging to the respiratory tract.

Occupied Space. An enclosed space that is occupied by people, either in a residence or place of business.

Ozone (O₃). An oxygen compound with a pungent odor which, at low concentrations, irritates the eyes, skin, mucous membranes and upper respiratory tract. At high concentrations it can cause headaches and chest pain. Common indoor sources include photocopying machines, electronic air cleaners, and direct current electric motors, such as those used in electric trains.



Particle Board. A building panel consisting of small pieces of wood bonded together with resins. Sometimes a source of formaldehyde.

PicoCuries Per Liter (pCi/L). A unit of measure used to evaluate concentrations of radioactive elements, such as radon and its progeny. One working level (WL) of exposure to radon is equal to 200 pCi/L.

Plywood. A wood panel made from a number of thin layers of wood glued together with resins. Sometimes a source of formaldehyde.

Progeny. see **Daughters.**

Radium 226. The parent of **Radon 222**, with a half life of 1600 years. Found in granite.

Radon 222. A radioactive gas formed in the decay chain of uranium 238, with a half life of 3.8 days (every 3.8 days the concentration of radon falls by a factor of one-half). A common indoor and well-water pollutant in Maine, found in granite and some other materials. The **Daughters** of radon become attached to dust particles; if inhaled, they can cause lung cancer.

Relative Humidity. The amount of water vapor in the air compared to the maximum amount of water vapor the air is able to hold at a particular temperature. It has been found that the healthiest range of relative humidity is from 30% to 50%.

Respirable Particulates. Common indoor air pollutants. The usual sources are tobacco, coal, and wood smoke. Inhalation may increase blood pressure and pulse, cause allergic reactions, reduce respiratory capacity, and cause lung cancer.

Smoke. A visible cloud of airborne particles derived from combustion or chemical reactions.

Source. The point of emission of a contaminant or pollutant.

Source Control. Eliminating or abating the emission of a pollutant within an enclosed, occupied space.

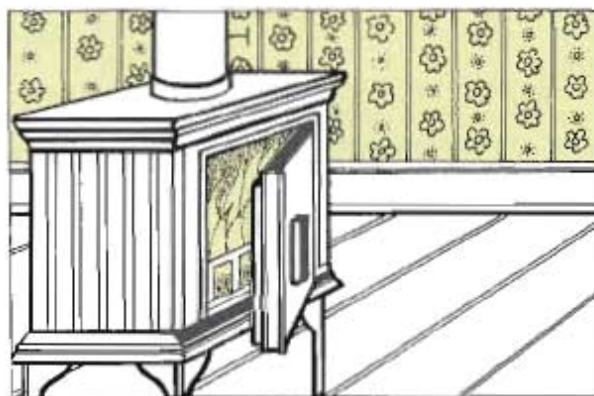
Stale Air. Air contaminated with any pollutant at low concentrations in an unventilated space.

Sulfur Dioxide (SO₂). A product of combustion of sulfur-containing fuel, a common air pollutant from kerosene heaters and other combustion appliances burning oil or coal containing sulfur. (Gas seldom contains sulfur).

Ventilation. The process of supplying and/or removing air by natural or mechanical means to and from any enclosed space.

Ventilation Rate. The number of building changes of fresh air per unit of time — air changes per hour (AC/h) — or the volume flow rate of fresh air into a room or building per unit of time — cubic feet per minute (cfm).

Water Vapor. A common constituent of indoor air. Insufficient quantities (less than 30% relative humidity) may cause discomfort. If too much is present (more than 50% relative humidity), it may cause condensation, mold growth, rot, and discomfort.



Wood Stove Gaskets. The fibrous material used in air-tight wood stoves to make doors fit tightly when closed. These gaskets are usually made from asbestos fibers and may be hazardous. Fiberglass gaskets are available and can be used to replace the asbestos ones.

Working Level (WL). A term used to describe the radioactive exposure resulting from radon. One WL represents the amount of radioactive energy an individual is exposed to from 200 pCi/L of radon. The WL is often associated with exposure over time, referred to as a working level month (WLM). One WLM represents exposure to 200 pCi/L of radon for the usual number of working hours in one month — 173 hours.

Organizations and State Agencies Offering Information, Help, and Testing Services

MAINE OFFICE OF ENERGY RESOURCES

State House Station 53
Augusta, Maine 04333
Telephone: 289-6000

Information offered regarding:

- Ventilation strategies
- Ventilation equipment suppliers
- Ventilation consultants
- Indoor air quality consultants
- Energy efficient house design and construction

ENERGY EXTENSION SERVICE

The Office of Energy Resources maintains five Extension Offices around the state. Each office serves a regional area.

For Androscoggin and Northern Penobscot,
Somerset and Piscataquis Counties:

Energy Extension Service
157 State Street
Presque Isle, ME 04769
(207) 764-2050

For Washington, Hancock, and Southern
Somerset, Piscataquis and Penobscot Counties:

Energy Extension Service
Room 315
106 Hogan Road
Bangor, ME 04401
(207) 941-4567

For Androscoggin, Oxford, and
Franklin Counties:

Energy Extension Service
Multipurpose Center
522 Lisbon Street
Lewiston, Maine 04240
(207) 783-5419

For York and Cumberland Counties:

Energy Extension Service
233 Oxford Street
Portland, ME 04101
(207) 879-4199



For Kennebec, Knox, Lincoln, Sagadahoc and
Waldo Counties:

Energy Extension Service
State House Station #53
Augusta, ME 04333
(207) 269-6026

MAINE DEPARTMENT OF HUMAN SERVICES

Division of Health Engineering
Occupational and Residential Health Program
State House Station 10
Augusta, Maine 04333
Telephone: 289-3826

The Division of Health Engineering is responsible for testing and information about indoor air quality. In the effort to provide the best service possible for Maine, the Division evaluates new testing equipment and devices for accuracy, convenience of use and affordability as they appear on the market. A radon test recently approved for use takes an accurate reading in one week; previous devices had to remain in the home for two months. The new test is also less expensive.

The Division of Health Engineering will help Maine residents to improve indoor air quality when testing confirms a problem.

Information offered regarding:

- Air and water quality consultants
- Ventilation consultants
- Ventilation equipment suppliers and installers
- Air cleaning equipment suppliers and installers
- Air cleaning consultants

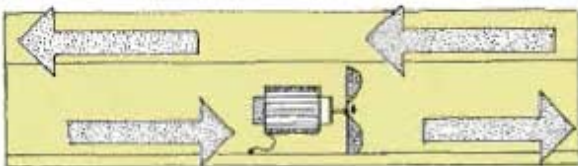
DEPARTMENT OF HUMAN SERVICES PUBLIC HEALTH LABORATORY

221 State Street
State House Station #12
Augusta, ME 04333
Telephone: 289-2727

The Public Health Lab works with the Division of Health Engineering supplying tests and analyzing test results. Some of the tests offered are:

- Radon water test
- Radon air test
- Formaldehyde test
- Gross alpha test
- Complete air test

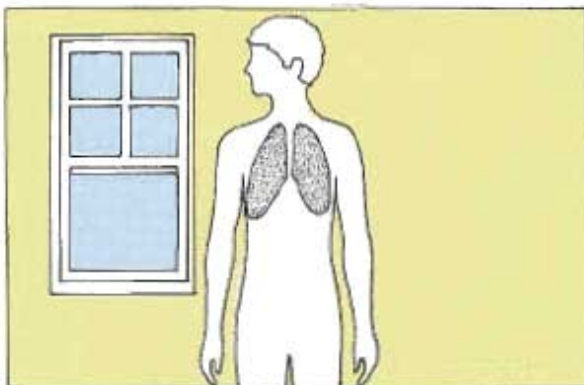
Tests currently* range in cost from \$20 to \$80.
(Radon air test is \$20.00; radon water test is \$22.50;
formaldehyde test is \$55.00). *March 1986.



DEPARTMENT OF ENVIRONMENTAL PROTECTION

Bureau of Air Quality Control
State House Station #17
Augusta, ME 04333
Telephone: 289-2437

D.E.P. coordinates inspection and enforcement programs for Asbestos Abatement Projects. It also distributes publications about asbestos.



MAINE LUNG ASSOCIATION

128 Sewall Street
Augusta, ME 04330
Telephone: 622-6394

The Maine Lung Association is primarily an educational organization whose mission is the prevention and control of lung disease. Its resource materials include publications and audio visual aids. Maine Lung can respond to requests for resource materials for public, professional and school educational programs; it also offers information and referral services to individuals.

NATURAL RESOURCES COUNCIL OF MAINE

271 State Street
Augusta, ME 04330
Telephone: 622-6394

N.R.C. distributes a booklet entitled "The World is full of Toxic Waste. Your Home Shouldn't Be", about toxic chemicals used in the home. For a copy send NRC a stamped self addressed envelope or pick one up at the Augusta office.

CENTRAL MAINE POWER CO.

Edison Drive
Augusta, ME 04336
1-800-233-BITE

Central Maine Power provides energy services to its customers including:

- Fact sheets on technologies such as air-to-air heat exchangers
- Energy efficient home construction techniques
- Energy audits

BANGOR HYDRO-ELECTRIC CO.

42 Broadway
Bangor, ME 04401
1-800-253-9200
945-5621 ext. 332

Bangor Hydro-Electric offers information on ventilation strategies to its customers and the utility's "Energy House" scheduled to open in September 1986 at 42 Broadway, Bangor will contain exhibits of ventilation equipment.

Check Your Indoor Air Quality



- | | Yes | No |
|--|--------------------------|--------------------------|
| 1. Is asbestos insulation exposed in an occupied area? | <input type="checkbox"/> | <input type="checkbox"/> |
| 2. Does your building contain large amounts of particle board, plywood paneling, new carpeting, or new furniture? | <input type="checkbox"/> | <input type="checkbox"/> |
| 3. Do you or does anyone in your household experience any of the following symptoms when home but not when away from home? | | |
| a. Headaches | <input type="checkbox"/> | <input type="checkbox"/> |
| b. Burning eyes | <input type="checkbox"/> | <input type="checkbox"/> |
| c. Feelings of confusion | <input type="checkbox"/> | <input type="checkbox"/> |
| d. Heartburn or abdominal pain | <input type="checkbox"/> | <input type="checkbox"/> |
| e. Breathing difficulties | <input type="checkbox"/> | <input type="checkbox"/> |
| f. Allergies | <input type="checkbox"/> | <input type="checkbox"/> |
| g. Drowsiness | <input type="checkbox"/> | <input type="checkbox"/> |
| 4. During cold weather do you notice excessive condensation of water or ice on windows, walls or ceilings? | <input type="checkbox"/> | <input type="checkbox"/> |
| 5. Does your dwelling usually smell stuffy when you enter from the outside? | <input type="checkbox"/> | <input type="checkbox"/> |
| 6. Do the odors of cooking linger? | <input type="checkbox"/> | <input type="checkbox"/> |
| 7. Is your foundation constructed of granite stones? | <input type="checkbox"/> | <input type="checkbox"/> |
| 8. Do you have a dirt floor in your cellar? | <input type="checkbox"/> | <input type="checkbox"/> |
| 9. Do you often use potentially hazardous chemicals in your home or place of business? Examples are hair sprays, cleaning agents, glues, pesticides, fabric softeners, paints, perfumes, solvents and deodorizers. | <input type="checkbox"/> | <input type="checkbox"/> |
| 10. Is your water supply from a deep well drilled in granite bedrock? | <input type="checkbox"/> | <input type="checkbox"/> |
| 11. Do you live with people who smoke cigarettes, cigars, or pipes? | <input type="checkbox"/> | <input type="checkbox"/> |
| 12. If you heat your home with a gas or oil hot air furnace, do you ever smell gas or oil fumes? | <input type="checkbox"/> | <input type="checkbox"/> |
| 13. If you heat with wood, do you often smell wood smoke? | <input type="checkbox"/> | <input type="checkbox"/> |

If your answer to any of these questions is "yes," the air quality in your dwelling or place of business might be hazardous. Contact the agencies listed on page 15 for information, help and testing.