How to Protect Against Radon Exposure in Homes and Commercial Buildings

An Online Continuing Education Course for Engineers

Course Number: BD-1009

Credit: 1 Hour / 1 PDH / 1 CPD

How to Protect Against Radon Exposure in Buildings

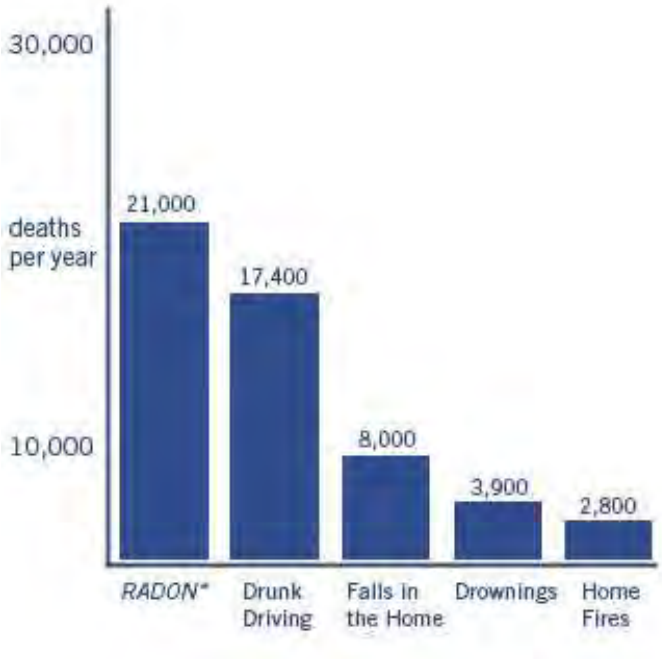
Overview

Radon is a chemical element with symbol Rn and atomic number 86. It is a radioactive, colorless, odorless, noble gas, occurring naturally as an indirect decay product of uranium or thorium. Its most stable isotope, 222Rn, has a half-life of 3.8 days. Radon is one of the densest substances that remains a gas under normal conditions. It is also the only gas under normal conditions that only has radioactive isotopes, and is considered a health hazard due to its radioactivity.

You can't see radon. And you can't smell it or taste it. But it may be a problem in your home or commercial structure.

Radon is estimated to cause many thousands of deaths each year. That's because when you breathe air containing radon, you can get lung cancer. In fact, the Surgeon General has warned that radon is the second leading cause of lung cancer in the United States today. Only smoking causes more lung cancer deaths. **If you smoke and your home or work environment has high radon levels, your risk of lung cancer is especially high.**

Radon is estimated to cause thousands of lung cancer deaths in the U.S. each year.



* Radon is estimated to cause about 21,000 lung cancer deaths per year, according to EPA's 2003 Assessment of Risks from Radon in Homes (EPA 402-R-03-003). The numbers of deaths from other causes are taken from the Centers for Disease Control and Prevention's 2005-2006 National Center for Injury Prevention and Control Report and 2006 National Safety Council Reports.

Radon can be found all over the U.S.

Radon is produced by the radioactive decay of radium-226, which is found in uranium ores; phosphate rock; shales; igneous and metamorphic rocks such as granite, gneiss, and schist; and, to a lesser degree, in common rocks such as

limestone. Every square mile of surface soil, to a depth of 6 inches, contains approximately 1 gram of radium, which releases radon in small amounts to the atmosphere. On a global scale, it is estimated that 2,400 million curies (90 TBq) of radon are released from soil annually.

Radon concentration varies widely from place to place. In the open air, it ranges from 1 to 100 Bq/m3, even less (0.1 Bq/m3) above the ocean. Radon can be found all over the U.S. It can get into any type of building — homes, offices, and schools — and result in a high indoor radon level. But you are most likely to get your greatest exposure at home, where you spend most of your time.

You should test for radon.

Testing is the only way to know if occupants of a home or business are at risk from radon. EPA and the Surgeon General recommend testing all homes below the third floor for radon. Testing is inexpensive and easy — it takes only a few minutes of time.

You can fix a radon problem.

Radon reduction systems work and they are not too costly. Some radon reduction systems can reduce radon levels in a home or office by up to 99%. Even very high levels can be reduced to acceptable levels.

New buildings can be built with radon-resistant features.

Radon-resistant construction techniques can be effective in preventing radon entry. When installed properly and completely, these simple and inexpensive techniques can help reduce indoor radon levels in buildings. In addition, installing them at the time of construction makes it easier and less expensive to reduce radon levels further if these passive techniques don't reduce radon levels to below 4 pCi/L. **Every new home should be tested after occupancy, even if it was built radon-resistant.** If radon levels are still in excess of 4 pCi/L, the passive system should be activated by having a qualified mitigator install a vent fan.

How Does Radon Get Into a Building?

Any structure can have a radon problem.

Radon is a radioactive gas. It comes from the natural decay of uranium that is found in nearly all soils. It typically moves up through the ground to the air above and into a building through cracks and other holes in the foundation. The building then traps radon inside, where it can build up. Any home or commercial building can have a radon problem. This means new and old buildings, well-sealed and drafty buildings, and buildings with or without basements.

The phenomenon of heightened radon contamination in homes was discovered by chance in 1985 after the stringent radiation testing conducted at a nuclear power plant entrance revealed

that Stanley Watras, an engineer entering the plant, was contaminated by radioactive substances. Typical domestic exposures are of approximately 100 Bq/m3 indoors. Depending on how houses are built and ventilated, radon may accumulate in basements and dwellings. Radon can also seep into an indoor environment through cracks in solid floors, construction joints, cracks in walls, gaps in suspended floors, gaps around service pipes, cavities inside walls, and the water supply. Radon concentrations in the same location may differ by a factor of two over a period of 1 hour. Also, the concentration in one room of a building may be significantly different than the concentration in an adjoining room.

Radon from soil gas is the main cause of radon problems. Sometimes radon enters a home through well water. In a small number of buildings, the building materials can give off radon, too. However, building materials rarely cause radon problems by themselves.

RADON GETS IN THROUGH:

1. Cracks in solid floors
2. Construction joints
3. Cracks in walls
4. Gaps in suspended floors
5. Gaps around service pipes
6. Cavities inside walls
7. The water supply

Nearly 1 out of every 15 homes in the U.S. is estimated to have elevated radon levels. While radon problems may be more common in some areas, any home may have a problem. Radon can also be a problem in schools and workplaces.

Concentration scale

Bq/m^3	pCi/L	Occurrence example
1	~0.03	Radon concentration at the shores of large oceans is typically 1 Bq/m^3. Radon trace concentration above oceans or in Antarctica can be lower than 0.1 Bq/m^3.
10	0.27	Mean continental concentration in the open air: 10 to 30 Bq/m^3. Based on a series of surveys, the global mean indoor radon concentration is estimated to be 39 Bq/m^3.
100	2.7	Typical indoor domestic exposure. Most countries have adopted a radon concentration of 200–400 Bq/m^3 for indoor air as an Action or Reference Level. If testing shows levels less than 4 picocuries radon per liter of air (150 Bq/m^3), then no action is necessary. A cumulated exposure of 230 Bq/m^3 of radon gas concentration during a period of 1 year corresponds to 1 WLM.
1,000	27	Very high radon concentrations (>1000 Bq/m^3) have been found in houses built on soils with a high uranium content and/or high permeability of the ground. If levels are 20 picocuries radon per liter of air (800 Bq/m^3) or higher, the home owner should consider some type of procedure to decrease indoor radon levels.
10,000	270	The "Working Level" in uranium mines corresponds to a 7000 Bq/m^3 concentration. The concentration in the air at the (unventilated) Gastein Healing Gallery averages 43 kBq/m^3 (about 1.2 nCi/L) with maximal value of 160 kBq/m^3 (about 4.3 nCi/L).
100,000	~2700	About 100,000 Bq/m^3 (2.7 nCi/L) was measured in Stanley Watras' basement.
1,000,000	27000	Concentrations reaching 1,000,000 Bq/m^3 can be found in unventilated uranium mines.

How to Test For Radon

You can't see radon, but it's not hard to find out if you have a radon problem in a building. All you need to do is test for radon. Testing is easy and should only take a few minutes of your time.

The amount of radon in the air is measured in "picocuries per liter of air," or "pCi/L." There are many kinds of low-cost "do-it-yourself" radon test kits you can get through the mail and in some hardware stores and other retail outlets. If you prefer, or if you are buying or selling a home, you can hire a qualified tester to do the testing for you.

There are Two General Ways to Test for Radon:

Testing is easy and should only take a few minutes of your time.

SHORT-TERM TESTING:

The quickest way to test is with short-term tests. Short-term tests remain in the building for two days to 90 days, depending on the device. "Charcoal canisters," "alpha track," "electret ion chamber," "continuous monitors," and "charcoal li n" detectors are most commonly used for short-term te o vary from day to day and season to season st to tell you your year-round average radon le erm test followed by a second short-term test m are needed.

How to Use a Tes

Follow the instruct short-term test, close the windows and outsi during the test. Heating and air-conditionin Do not operate fans or other machines whi radon-reduction system or small exhaust fans c ing the test. If you are doing a short-term te lows and outside doors at least 12 hours **befor** ort-term tests lasting just 2 or 3 days during ur winds. The test kit should be placed in t e, the basement if it is frequently used, othe is used regularly (like a living room, playroo om. Place the kit at least 20 inches above the floo disturbed - away from drafts, high heat, high humidity, and ex s. Leave the kit in place for as long as the package says. Once you've finished the test, reseal the package and send it to the lab specified on the package right away for analysis. You should receive your test results within a few weeks.

LONG-TERM TESTING:

Long-term tests remain in the building for more than 90 days. "Alpha track" and "electret" detectors are commonly used for this type of testing. A long-term test will give you a reading that is more likely to tell you a building's year-round average radon level than a short-term test.

EPA Recommends the Following Testing Steps:

Step 1. Take a short-term test. If the results indicate a level of 4 pCi/L or higher, take a follow-up test (Step 2) to be sure.