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By Greg Pohlman

Radon gas: Health Effects, Radon Testing, Radon-Resistant Features in New Construction and Mitigation Techniques

Radon gas, what is it?

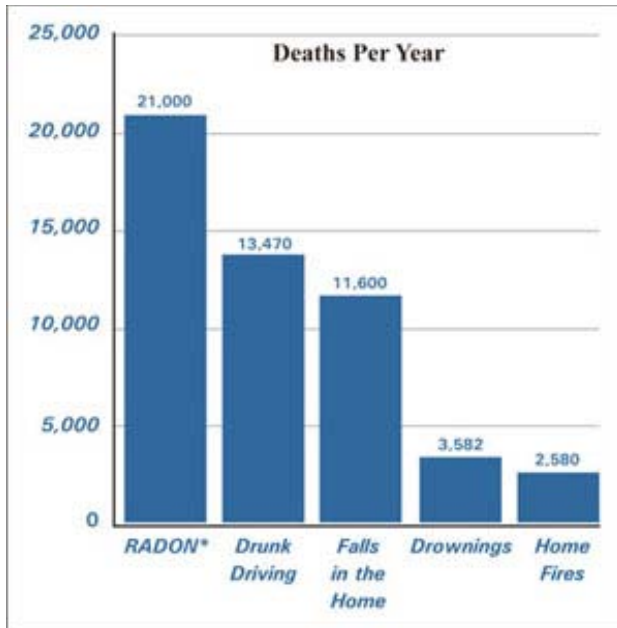
Radon gas is a radioactive gas that comes from natural deposits of uranium in the soil. Radon is an odorless, tasteless, and invisible gas, a byproduct of decaying uranium in the soil. It seeps up into homes and buildings and gets into the air we breathe. Although there are some rare cases where the major source for radon is emitted from building materials such as granite counter tops and stonework around fireplaces, the major source for radon in Colorado is the soil beneath our homes, schools and businesses.



How does radon get into your home?

Radon gets into your home 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



Radon is the second leading cause of lung cancer in the United States, second to lung cancer caused by smoking. Radon gas is estimated by the EPA to cause approximately 20,000 deaths in the U.S. each year. If you smoke and your home has high levels of radon, your risk for lung cancer is especially high.

The EPA action level for Radon is 4.0 pCi/L (picocuries per liter). The EPA recommends homes be fixed if the average radon level is 4.0 pCi/L or greater. The average outdoor radon level is .4 pCi/L. The national average indoor radon level is 1.3 pCi/L. Surveys conducted by the Colorado Department of Public Health and Environment indicate that 4 out of 10 homes in Colorado have levels that exceed 4.0 pCi/L. Foot note 1.

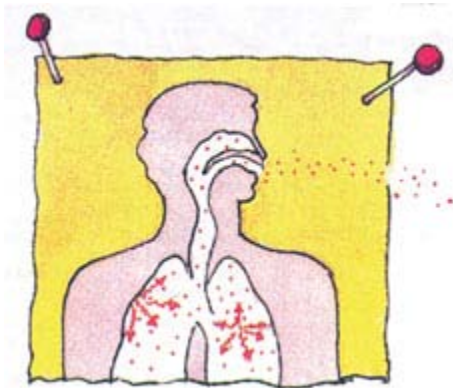
Greg Pohlman, a Certified Radon Mitigation Contractor with Northwest Radon Mitigation Services and a Certified Radon Measurement Provider with Complete Home Inspection Services, LLC in Steamboat Springs has conducted over 600 radon tests in Steamboat Springs and outlying areas over the past 12 years. He has found that based upon his records, approximately 45% of homes he has tested are at 4.0 pCi/L or greater.

Some common misconceptions about radon gas is it only affects certain types of homes or homes of a certain age. The truth is radon can be a problem in homes of all types; old homes, new homes, drafty homes, well insulated homes, homes with a basement, or homes with properly ventilated crawl spaces. Also, radon levels can vary from one house to another depending on the concentration of uranium in the soil beneath your home. Your home may have an average radon level of less than 4.0 pCi/L, while your neighbor's home could have an average radon level well in excess of 4.0 pCi/L.



How can exposure to Radon gas cause lung cancer?

Radon gas is considered a Group A carcinogen, which means it is known to cause cancer in humans with prolonged exposure. Radon enters the interior space of a building. Radon is an unstable atom and will break down into radon decay products. Since radon gas is in the air, radon decay products formed will also be in the air. Radon decay products are electrostatically charged. When you inhale you breathe in both radon gas and radon decay products. The radon gas is exhaled and the radon decay products will stick to the tissue inside your lungs. Before your lungs can clear the radon decay products they can further break down and irradiate the lung tissue. It is the radon decay products that actually present the health risk associated with radon gas. Foot note 2.



What if I find a home I want to purchase and it has a radon problem?

EPA recommends that you know what the indoor radon level is in any home you consider buying. Ask the seller for their radon test results. If the home has a radon-reduction system, ask the seller for information they have about the system. If the home has not yet been tested, you should have the house tested.

So, if you like a home you should have it properly tested and then consider taking a reasoned approach that will reduce the radon inside the home. To do this you should contact a Certified Radon Mitigation Contractor to meet with you at the home and discuss how you can go about installing a radon reduction system that will not only be effective in reducing radon, but also be placed in the best aesthetically pleasing location and

durable in design. Radon mitigation contractors that have gone through the National Environmental Health Association National Radon Proficiency Program can be found online at; www.radongas.org.

The EPA recommends:

- Test your home for radon, it's easy and inexpensive
- Fix your home if your radon level is 4 picocuries per liter (4.0 pCi/L) or greater.
- Radon levels less than 4 pCi/L still pose a risk, and in many cases may be reduced.

Testing is the only way to know if you and your family are at risk from radon. EPA and the Surgeon General recommend testing all homes below the third floor for radon. EPA also recommends testing in schools.

How to test your home for radon?

There are two general ways you can test for radon.

Short-term testing:

Short term testing is done in your home for two to 90 days depending on the device. Short term test devices consist of “charcoal canisters”, “alpha track”, “continuous monitors”, “electret ion chambers”, and “charcoal liquid scintillation” detectors are the most common.

How to use a short term test kit –

Be sure to follow the directions that come with the device since some test devices have slightly different directions. When performing a short term test, close ALL windows in the home 12 hours prior to starting the test. Place the test device on the lowest living level of the home that could be used regularly, whether it is finished or unfinished. Choose an area that could be used as a bedroom, play room, family room, office, and den or exercise room. **Do not** place test devices in closets, crawl spaces, kitchens, laundry rooms or bathrooms. Find a location at least 2 feet above the floor and at least three feet from any door, wall or window, and 4” inches from any other object. (Note: If this test is associated with a real estate sale of a home, the EPA Real Estate Simultaneous Testing Protocol requires two passive devices to be placed side-by-side, 4” inches apart in the selected area, or use a ‘continuous monitor’.) Place the test kit away from high heat, high humidity, direct sun light, or any drafts. Leave the test kit(s) in place for as long as the directions require. Once the test is complete, reseal the kit, completely fill out the data sheet and mail to the lab right away. You should receive the results within a few days or longer depending on the test kit and laboratory that is used.

Long term testing:

Long term testing must remain in your home for 91 to 360 days during normal living conditions, meaning that windows can be opened, air conditioning can be operated, etc. Test devices that are used for long term testing include “alpha track” or “electret” detectors. Long term testing will give you a better idea of your year round exposure to radon as compared to a short term test. Foot note 3

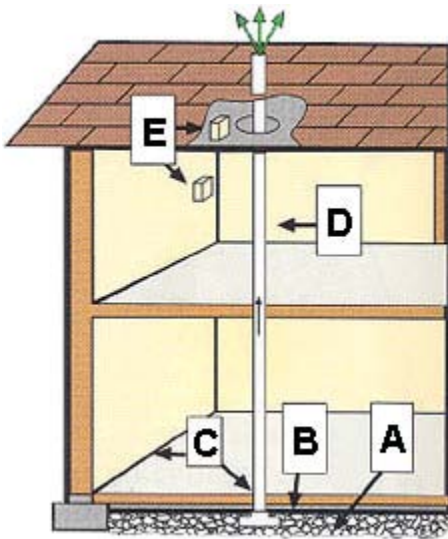
Where can you find a radon test kit?

Locally, in Steamboat Springs, one can find free (if still available) or inexpensive short term radon test kits at the CSU Extension Office in the Routt County Annex Building. Other locations include local Hardware stores, or purchasing test kits online. One online source for radon test kits is; www.radongas.org.

New homes can be built with radon-resistant features:

What are radon-resistant features?

Radon-resistant techniques (features) may vary for different foundations and site requirements. If you're having a house built, ask your builder if they're using EPA's recommended approach ([International Residential Code, Appendix F, or ASTM E 1465-08](#)). If your new house was built (or will be built) to be radon-resistant, it *should* include these basic elements:



A. Gas Permeable Layer

This layer is placed beneath the slab or flooring system to allow the soil gas to move freely underneath the house. In many cases, the material used is a 4-inch layer of clean gravel. This gas-permeable layer is used only in homes with basement and slab-on-grade foundations; it is not used in homes with

crawlspace foundations.

B. Plastic Sheetting

Plastic sheeting with seams sealed is placed on top of the gas permeable layer and under the slab to help prevent the soil gas from entering the home. In crawlspaces, the sheeting is placed over the crawlspace floor.

C. Sealing and Caulking

All below-grade openings in the concrete foundation floor are to be sealed with polyurethane caulking to reduce soil gas entry into the home.

D. Vent Pipe

A 3- or 4-inch gas-tight or PVC pipe (or other gas-tight pipe) runs from the gas permeable layer through the house to the roof to safely vent radon and other soil gases above the house.

E. Junction Box

An electrical junction box is included in the attic to make the wiring and installation of a 'future' vent fan easier. For example, you decide to activate the passive system because your test result showed an elevated radon level (4 pCi/L or more). A separate breaker is placed in the electric panel to power the vent fan. An alarm or system indicator is installed along the vent fan to indicate when the vent fan is not operating properly. Foot note 4

Most Common Radon Mitigation Techniques - Basic Principles & Design:

1. Sub Slab Depressurization (SSD) –

Sub Slab Depressurization is employed when you have a home that is constructed with a basement on a concrete slab. A hole is drilled through the concrete slab in a location that is hopefully out of sight, such as in a utility or mechanical room. Every home poses a challenge in placing the radon system in an existing home such that it does not detract from the value or aesthetics of the home. Next, 4" inch PVC piping is connected to the hole in the slab and routed to the exterior of the home. An inline turbo fan is attached to the piping, exhaust piping then is routed vertically along the exterior of the house to the roof line to safely exhaust radon gases.



(Piping connected to hole in slab; fan attached to piping on exterior)

2. Sub Membrane Depressurization (SMD) -

Sub Membrane Depressurization is employed when your home has a crawl space. Homes with crawl spaces typically cost more to install a radon system since there are more materials required and more labor to install the system. A perforated plastic pipe is laid on the soil in the crawl space. Next, a plastic radon barrier is placed over the piping and soil and sealed at the seams and around the interior of the foundation, concrete pads, posts, water lines, etc. A fan is then connected to the perforated piping to draw radon from beneath the plastic. The radon can then be exhausted harmlessly outdoors.



(Radon barrier covering soil & perforated piping in crawl space; fan attached on exterior)

3. Sump Pit Depressurization -

An existing sump pit can also be used for collection and removal of radon gases. Where you have an existing sump pit located on an interior basement slab, a sealed cover can be

installed over the sump pit in such a manner that piping is routed to the exterior where a fan is attached for removal of radon gases. Consideration must be made for connections to be installed on the sump cover to allow sump pump discharge piping and electrical cords to exit cover while ensuring an air tight seal over the pit.



(Sump pit connection; system indicator & power converter)

4. Perimeter Drainage System -

A radon reduction system may also be employed by connecting to an existing perimeter drainage system on the exterior of the foundation. A fan can be connected to a cleanout pipe on the exterior of the foundation. Considerations for this type of system to be effective require closing off the day light drain pipe with a special one-way flapper valve that allow drainage when water is flowing, but otherwise close off pipe to allow a proper vacuum. Also, if garage floor drains or basement floor drains are connected to the perimeter drain pipe, special one-way drain valves must also be installed.



(Fan is connected to perimeter drain pipe; one-way valve installed on day light drain)

Requirements for radon systems to meet EPA's Radon Mitigation Standards:

1. The discharge point of the radon system can contain very elevated levels of radon. To avoid exposure to occupants and neighbors, the discharge of the pipe must be;

- At least 10 feet above grade.
 - At least 10 feet away from any opening which is two feet below discharge.
 - Above or at eave of roof.
2. Fans should not be located inside home or in a crawl space. They can be located in an attic, outdoors, or in a garage, provided there is no living space above the garage.
 3. There should be an indicator in a prominent location that will easily indicate to the occupant if the system is functioning properly.
 4. Power to the fan should be in accordance with local building codes; including permits where required.
 5. All portions of the system are to be labeled and a simple instructions manual with warranties are provided to the homeowner.
 6. All homes with radon mitigation systems should be retested no sooner than 24 hours (nor later than 30 days) after installation to verify adequate reduction in radon levels. The home should also be retested every two years. Foot note 2.

You may find out more information on radon gas on the EPA's website at;
www.epa.gov/radon.

Foot note 1, Source is from EPA's website, www.epa.gov/radon.

Foot note 2, Source is from Colorado Department of Public Health and Environment, "Dealing with Radon in Realestate Transactions", revised 2004.

Foot note 3, Source is from EPA, "A Citizens Guide to Radon".

Foot note 4, Source is from EPA, "Home Buyers and Sellers Guide to Radon".