

Home Inspector Training Academy

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What You Need to Know About:

Radon

Radon-222 is an invisible, odorless, radioactive soil gas. EPA has determined it to be a Group 1 carcinogen, which means that it causes cancer in humans. The Surgeon General has warned that it is the second leading cause of cancer in the United States and that tobacco smoking significantly increases the risk.

EPA recommends that every home involved in a real estate transaction be tested for radon. The test is to be done at the lowest *livable* level – usually the basement. By *livable*, EPA means an area of the home that could conceivably be converted to living space. *This does not include crawl spaces.*

Exposure is a function of two factors – concentration and time. Testing determines concentration. Lifestyle determines time.

Average outdoor concentration is estimated to be about 0.4 pCi/l (pico Curies per liter) of air.

Average indoor concentration is estimated to be about 1.3 pCi/l.

EPA action level is 4.0 pCi/l. This means that EPA has recommended that houses that have concentrations of 4.0 or greater be mitigated.

The nuclear physics part: The nuclei of radioactive elements emit particles. Each event in which a particle is emitted is called a decay. Every time a decay takes place, a new element is formed. The result then is a chain of elements beginning with uranium 238 and ending with lead 206, which is a stable element. Each element in this decay chain is a solid except for radon 222. Radon and two of its progeny, polonium 214 and polonium 218 are especially dangerous because they emit alpha particles. We measure radioactivity in Curies. A Curie is a rate of radioactive decay. A pico Curie (pCi) is a trillionth of a Curie.

The mobility part: Because radon is a gas, it has the ability to move readily in nature. Because soil gases are typically at a higher pressure than the atmosphere and gases move in nature from areas of high pressure to areas of low pressure, there is a tendency for radon gas to move from the ground into the atmosphere. There is a natural tendency for air currents to move upward through a house. We refer to this as the stack effect. The stack effect places lower levels of the house under negative pressure which tends to draw air into the house through cracks and openings in basement floors and foundations. Radon is

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therefore, often drawn into the house at a higher rate than it escapes into the outdoor atmosphere.

The health part: Because radon is a gas, it is breathed into the lungs and then breathed right back out. The progeny however, being solids, adhere to the lung lining where they decay. The two poloniums emit alpha, which poses the greatest health risk of all the radioactive emissions. Alpha particles are relatively large (2 protons & 2 neutrons) and slow moving. Alpha particles impact the nucleolus of the cells of the lung lining, causing mutations – cancer.

Mitigation: Given the discussion of mobility above, it makes sense that mitigation would involve reversing the pressure difference between the house and the soil. Pressurizing the house is problematic. Every time someone opened a door or a window, pressure would be lost. Depressurizing the earth is problematic as well. However, depressurizing the gravel bed below the basement floor slab is often relatively simple:

- Seal the openings between the basement and the ground – concrete cracks, plumbing pipe and air duct penetrations, sump crocks...
- Drill a hole into the slab and install a pipe that runs to the outdoors.
- Place a fan on the pipe that draws air from the gravel bed.
- Test to confirm success.

Testing includes allowing the house to reach dynamic equilibrium. This is the state at which radon entering the house is equal to that leaving the house. It usually takes about twelve hours to accomplish this. Hence the requirement for closed house conditions twelve hours prior to the test. **EPA protocol** requires:

- Closed house conditions for 12 hours prior to a test less than four days in duration and throughout the test period. In the event that closed house conditions were not observed for the twelve hours prior to the scheduled test time, there are two viable options:
 - Close house and return after 12 hours to start the test
 - Deploy devices for 96 hours (four days)
- Do not run indoor-outdoor air exchange systems – whole house fans or window fans. Attic, bathroom and kitchen exhaust fans are okay. Window air conditioners should be set to recirculate.
- Existing installed radon mitigation systems should be left running during the test.
- Two passive devices placed 4” apart or one continuous monitor
- Do not test during extreme weather conditions - sustained winds of over 30 MPH.
- Device location:
 - Where it will not be disturbed (away from children...)
 - Away from drafts, excessive heat, sunlight, areas of high humidity
 - 3 feet from windows and doors

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- 1 foot from exterior wall
- 20 inches from floor
- 4 inches from other objects
- Not in kitchens, laundry rooms, closets, or bathrooms

Radon Myths:

We don't really know that radon is a problem:

The Center for Disease Control (CDC), American Lung Association and the American Medical Association (AMA) agree that radon causes thousands of preventable deaths every year.

We do have significant hard data based on health studies of underground miners as well as animal studies.

Radon only affects certain types of houses:

Local geological conditions and construction methods and materials are significant factors in radon concentrations. However, EPA's position is that the only house that does not have a transport mechanism from the ground is one on piers. It is recommended therefore, that any house, except those on piers, be tested.

Geologic conditions include distance from uranium deposits and the porosity of the soil between the source and the house. Uranium is found in hard rock like granite and shale.