

Basic Guide to Radon-Resistant New Construction (RRNC)

Purpose: Prevent occupant lung cancer by preventing radon gas from entering home

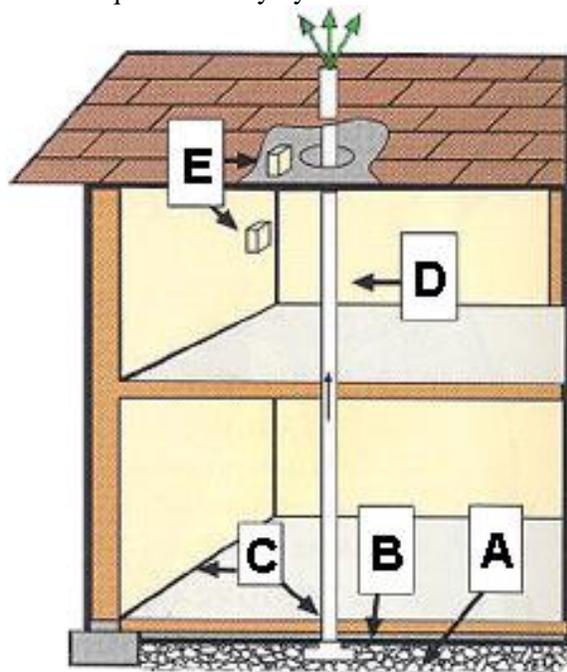
What can be done to prevent radon exposure in a new home?

Homebuilders can install features during new home construction to create a **passive radon-resistance system**. **If elevated radon levels persist the system can be upgraded to an active system by installing a fan (about \$300)**. Radon-resistant new construction is much more cost-effective than installing a radon reduction system in an existing home (\$350 - \$500 vs. \$800 - \$2,500). RRNC is also:

- o Consistent with energy-efficiency standards for weatherization
- o Included in the Energy Star Indoor Air Quality program
- o Recognized as a standard practice for Green Building
- o Fulfills Appendix F of the International Residential Code

How does radon-resistant new construction work?

The techniques will vary by site and foundation design, but the basic elements are:



A. Gas Permeable Layer

Place material such as a 4" layer of clean gravel beneath the slab or flooring system to allow the soil gas to move freely underneath the house.

B. Plastic Sheeting

Place plastic sheeting (6 mil or better) on the gas permeable layer to block soil gas from entering the home. In crawlspaces, place sheeting over the crawlspace floor.

C. Sealing and Caulking

Seal all openings in the concrete foundation floor to block soil gas.

D. Vent Pipe

Run 3" or 4" gas-tight or PVC pipe 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

Install an extra electrical junction box in case a venting fan is needed later.

What standards and guidance are available for builders?

Appendix F of the International Residential Code is the standard for many jurisdictions. EPA has published guidance, "Building Radon Out: A Step-by-Step Guide," with detailed advice and examples of RRNC features, and "Radon Resistant Construction Architectural Drawings" (in .pdf and CAD-compatible program). **A new Code specific standard is being developed and is expected for release in 2012 – the ANSI-AARST RRNC 2.0 Standard.**

How many homes are built with radon-reducing features?

Since 1990, more than one million single-family detached homes have been built with radon-reducing features, according to the National Association of Home Builders. To date, about 875,000 homes have been with RRNC in Zone 1 (highest risk) areas of the country.

To contact your state's radon program, find a contractor, or learn more: <http://www.epa.gov/iaq/whereyoulive.html>

Basic Guide to Radon Mitigation in Existing Buildings

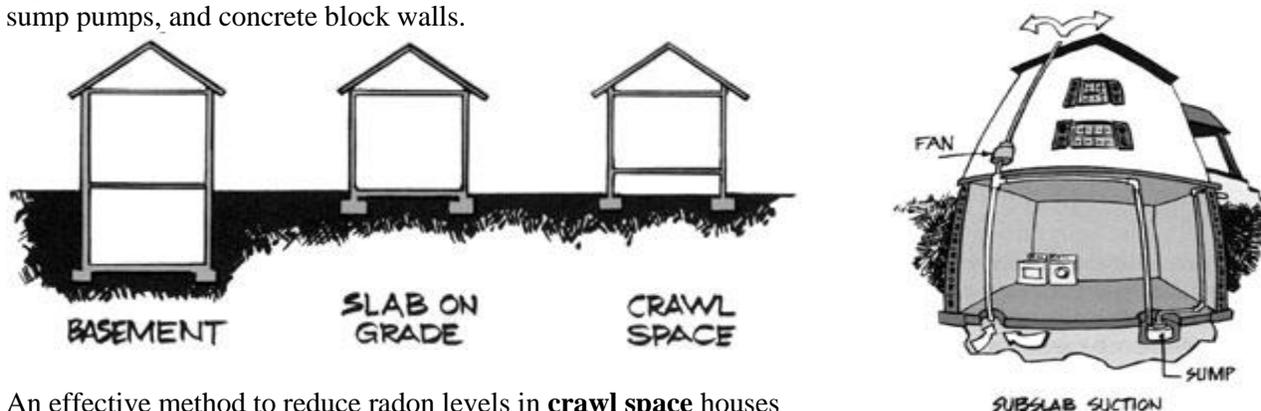
Purpose: Prevent occupant lung cancer by preventing radon gas from entering home

What can be done if high radon levels are found in an existing home?

Radon mitigation can lower the levels of radon, and the risk of lung cancer, by drawing radon gas out from under the concrete floor, crawlspace, or foundation before it can enter the home. Installing a radon reduction system in an existing home generally costs \$800 - \$2,500, and requires special knowledge and skills (usually installed by a licensed or certified contractor). Radon mitigation is recognized as a standard practice for green building and is consistent with energy-efficiency weatherization.

How does radon mitigation work?

The techniques vary by site and foundation style. For structures with a **basement** or **slab-on-grade** foundations, the most common method is **sub-slab suction** or “depressurization” – pipes are inserted through the basement floor or slab into the soil or crushed rock underneath, and a fan connected to the pipe pulls up the radon and releases it to the outside. Other methods for basement and slab construction apply suction on existing building components such as perforated drain pipes surrounding a foundation, sump pumps, and concrete block walls.



An effective method to reduce radon levels in **crawl space** houses involves covering the earth floor with a high-density plastic sheet and using a vent pipe and fan to draw the radon from under the sheet and vent it outdoors. This form of mitigation is called **submembrane suction**.

What are the standards for radon mitigation?

“Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings,” ASTM E-2121, is the consensus-based standard for radon mitigation. One free printed copy can be ordered at <http://yosemite.epa.gov/ncepihom/nsCatalog.nsf/SearchPubs?OpenForm> (ask for EPA document number 402-K-03-007). The AARST Radon Mitigation Standard (RMS) is another accepted consensus standard and can be found at <http://www.aarst.org/bookstore.shtml>

Who can mitigate radon?

EPA recommends that property owners use a qualified radon mitigation contractor trained to fix radon problems. Many states require radon professionals to be licensed, certified, or registered, and to install radon mitigation systems that meet state requirements; radon programs in these states can provide a list of qualified providers. Private proficiency programs may have lists of certified radon professionals in states without licensing requirements. All contractors should follow their state regulations or such standards such as ASTM E-2121 or the AARST RMS and ensure that a radon test is performed to confirm the effectiveness of the mitigation.

To contact your state’s radon program, find a contractor or learn more: <http://www.epa.gov/iaq/whereyoulive.html>

Radon is Radioactive - Health Risks of Radon Exposure

Is exposure to radon really the second leading cause of lung cancer?

Yes. Lung cancer kills thousands of Americans every year. The untimely deaths of Peter Jennings and Dana Reeve have raised public awareness about lung cancer, especially among people who have never smoked. Although lung cancer can be treated, the survival rate is one of the lowest for those with cancer. After diagnosis, only 11-15% of lung cancer victims live beyond five years.

- o **Smoking** is the leading cause of lung cancer. On January 11, 1964, the U.S. Surgeon General, issued the first warning on the link between smoking and lung cancer. Smoking causes an estimated 160,000 deaths in the U.S. every year (American Cancer Society, 2004). Lung cancer now surpasses breast cancer as the number one cause of death among women. A smoker who is also exposed to radon has a much higher risk of lung cancer.
- o **Radon is the number one cause of lung cancer among non-smokers, and the second leading cause of lung cancer.** Radon is responsible for about 21,000 lung cancer deaths every year. In 1988, the U.S. Surgeon General issued a warning about radon, urging Americans to test their homes and to reduce the radon level when necessary; in January 2005, the U.S. Surgeon General, issued a national health advisory on radon. Two recent studies show definitive evidence of an association between residential radon exposure and lung cancer, confirming that the radon health risks predicted by occupational studies of underground miners who breathed radon for a period of years. These findings effectively end any doubts about the risks to Americans of having radon in their homes. This research confirms that breathing low levels of radon can lead to lung cancer.
- o **Secondhand smoke** is the third leading cause of lung cancer and responsible for an estimated 3,000 lung cancer deaths every year. About 1,000 of these are people that never smoked, and about 2,000 are former smokers.

The World Health Organization (WHO) says radon causes up to 15% of lung cancers worldwide.

In an effort to reduce the rate of lung cancer around the world, WHO has launched an international radon project to help countries increase awareness, collect data and encourage action to reduce radon-related risks. The U.S. EPA is one of several government agencies and countries supporting this initiative. "Radon poses an easily reducible health risk to populations all over the world, but has not up to now received widespread attention," says Dr. Michael Repacholi, coordinator of WHO's Radiation and Environmental Health Unit. "Radon in our homes is the main source of exposure to ionizing radiation, and accounts for 50% of the public's exposure to naturally-occurring sources of radiation in many countries."

Why is radon the public health risk that it is?

Radon is an odorless, tasteless and invisible gas produced by the decay of naturally occurring uranium in soil and water. Radon is a form of ionizing radiation and a proven carcinogen. Radon is found in outdoor air and in the indoor air of buildings of all kinds. EPA recommends homes be fixed if the radon level in the indoor air is 4 pCi/L (picoCuries per Liter) or more. The average concentration of radon in outdoor air is .4 pCi/L or 1/10th of EPA's 4 pCi/L action level. Because there is no known safe level of exposure to radon, EPA also recommends that households consider fixing their homes for radon levels between 2 pCi/L and 4 pCi/L. Unfortunately, many consumers and real estate professional presume that, because the action level is 4 pCi/L, a radon level of less than 4 pCi/L is 'safe.' This perception is incorrect. The greatest radon exposure risk is in the home, and especially in rooms that are below grade (e.g., basements), rooms that are in contact with the ground and those rooms immediately above them.

What's the risk of getting lung cancer from radon exposure?

Radon Level	If 1,000 people who never smoked were exposed to this level over a lifetime*...	The risk of cancer from radon exposure compares to**...	WHAT TO DO:
20 pCi/L	About 36 people could get lung cancer	35 times the risk of drowning	Fix your home
10 pCi/L	About 18 people could get lung cancer	20 times the risk of dying in a home fire	Fix your home
8 pCi/L	About 15 people could get lung cancer	4 times the risk of dying in a fall	Fix your home
4 pCi/L	About 7 people could get lung cancer	The risk of dying in a car crash	Fix your home
2 pCi/L	About 4 people could get lung cancer	The risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	About 2 people could get lung cancer	(Average indoor radon level)	(Reducing radon levels below 2 pCi/L is difficult.)
0.4 pCi/L		(Average outdoor radon level)	

Note: If you are a smoker or former smoker, your risk may be much higher.
pCi/L (pico Curies per Liter)
 * Lifetime risk of lung cancer deaths from EPA Assessment of Risks from Radon in Homes (EPA 402-R-03-003).
 ** Comparison data calculated using the Centers for Disease Control and Prevention's 1999-2001 National Center for Injury Prevention and Control Reports.

To contact your state's radon program, find a contractor or learn more: <http://www.epa.gov/iaq/whereyoulive.html>

Testing A Home for Radon

A. Test Kits

1. Radon test kits are available from the <http://sosradon.org/test-kits> (or call 1-800-SOS-RADON).
2. Some radon programs offer test kits. <http://www.epa.gov/iaq/wherelive.html>
3. Most home improvement stores sell test kits.

B. To find a qualified testing contractor:

1. Contact the state's radon program and determine what are, or whether there are, requirements associated with providing radon measurement and or radon mitigations/reductions, and proficiency programs or requirements. State programs' contact information is available through <http://www.epa.gov/iaq/wherelive.html> Some States maintain lists of contractors available in their state.

2. If your state has no radon program or the program has no list of contractors, contact one of the two privately-run National Radon Proficiency Programs (listed below alphabetically) that are offering proficiency listing/accreditation/certification in radon testing and mitigation:

National Environmental Health Association (NEHA) *Radon Proficiency Program*
Toll Free: (800) 269-4174 or (828) 890-4117
Website: www.neha-nrpp.org/
E-Mail Address: angel@neha-nrpp.org

National Radon Safety Board (NRSB)
Toll Free: (866) 329-3474
Fax: (914) 345-1169
WebSite: www.nrsb.org
E-mail Address: info@NRSB.org