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RADON TESTING BUILDINGS 130H, 131H, 132H, 1007 NS GREAT LAKES IL
9/1/2005
NAVFAC MIDWEST



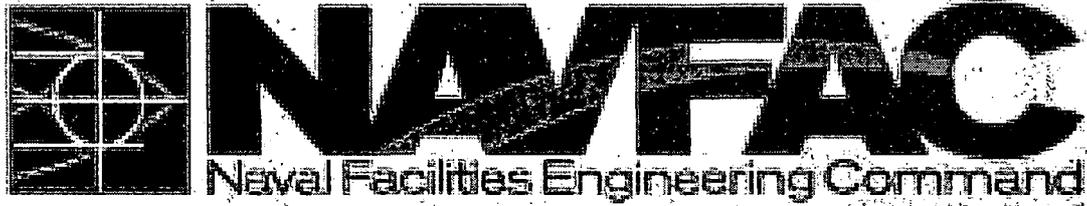
NAVFAC MIDWEST

**RADON TESTING
BUILDINGS 130H, 131H, 132H, 1007
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS**

PREPARED BY:

**NAVFAC MIDWEST
ENVIRONMENTAL DEPARTMENT
GREAT LAKES, ILLINOIS**

SEPTEMBER 2005



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SEPTEMBER 2005

Table of Contents

- 1. Summary**
- 2. Table 1 – Units Tested**
- 3. Table 2 – Lost Detectors**
- 4. Enclosure 1 – Laboratory Results**
- 5. Enclosure 2 – OPNAVINST – Chapter 26**
- 6. Enclosure 3 – A Citizens Guide to Radon**

Summary

Radon is colorless, odorless, tasteless radioactive gas that occurs naturally in soil, rock, groundwater and air. Radon is the natural decay product of solid radium, a which is part of the uranium family. When created underground, the pressure of radium increases and tries to reach the surface through cracks in soil and earth's surface.

Radon naturally breaks down and forms radioactive decay products, or particles. During the process of breathing, these particles enter the lungs, where they continue to decay releasing small burst of energy that can damage lung tissue and lead to cancer. Not everyone exposed to radon will develop lung cancer; which will depend upon – radon level, total length of exposure, individual health conditions and personal habits.

United States Environmental Protection Agency (USEPA) guidelines suggest that remedial action be considered when radon concentrations inside a house exceed an annual average of 4 picocuries per liter (pCi/L).

Use contractors that are listed by the USEPA's Radon Contractor Proficiency (RCP) Program. For more detailed information and for a complete listing of USEPA radon mitigation contractors, view the US EPA's Radon Web Page at <http://epa.gov/iaq/radon/>

USEPA recommends that a qualified contractor be required to design and install radon mitigation systems because lowering high radon levels requires specific technical knowledge and special skills. Without the proper equipment or technical knowledge, you could actually increase your radon level or create other potential hazards. Qualified radon contractors will guarantee that levels will be reduced to less than 4.0 pCi/L and may be able to achieve levels less than 2 pCi/L.

Radon mitigation system is any system or steps designed to reduced radon concentration in the indoor air of a building.

In many cases, simple systems using underground pipes and an exhaust fan may be used to reduce radon. Such systems are called "sub-slab depressurization," and do not require major changes to a building. These systems remove radon gas from below the concrete floor and the foundation before it can enter the building.

The Naval Facilities Midwest (NAVFAC MW) Environmental Department was tasked to install long-term radon alpha track detectors in the following Bldg's: 130H (New Wing Only), 131H, 132H and 1007, in which the Radon detectors will remained inside the house for more than 90 days. After more than 90 days, on August 05, 2005 the long-term radon alpha track detectors were retrieved and send to a laboratory (AccuStar Labs) for analysis. Test results of the analysis were received by NAVFAC MW on August 20, 2005 (Enclosure 1).

A total of 51 Radon Detectors were installed, none have elevated readings of more than 4 Pci/L, and 10 of the detectors were missing.

It is recommended to retest units with missing/lost detectors.

Units that were tested for Radon are tabulated in Table 1, and units that were missing/lost are tabulated in Table 2.

Below is the mitigation steps conforming to the following priority scheme:

Category	Radon Levels (pCi/L)	Action
1	0 to 4	No action required
2	4 to 20	Mitigation within 5 years
3	20 to 200	Mitigation within 6 months
4	> 200	Mitigation within 3 weeks

All the units that were tested for Radon falls under Category 1.

TABLE 1

BUILDING 130H (NEW WING)

AREA TESTED	RADON RESULTS (pCi/L)
ROOM 192	0.9
ROOM 174	0.7
ROOM 125	<0.4
ROOM 101C	<0.4
ROOM 153	<0.4
ROOM 166	1.1
ROOM 111	0.8
ROOM 117	<0.4
ROOM 126	0.5
ROOM 161 E	0.9
ROOM 131	1.0
ROOM183	1.0
ROOM113	LOST
ROOM 121	LOST
ROOM 135	<0.4

BUILDING 131H

AREA TESTED	RADON RESULTS (pCi/L)
ROOM 147S	0.5
ROOM LOUNGE	<0.4
ROOM 5148	<0.4
ROOM B163S	<0.4
ROOM 122N	<0.4
ROOM S116N	0.4
ROOM B11N	LOST
ROOM B108N	LOST
ROOM B101N	LOST
ROOM B165S	LOST

BUILDING 132H

AREA TESTED	RADON RESULTS (pCi/L)
ROOM LOUNGE 1	<0.4
ROOM KITCHEN	<0.4
ROOM 105	<0.4
ROOM 111	<0.4
EXERCISE ROOM	0.4
ROOM 108	<0.4
ROOM 155	0.5
ROOM 110	<0.4
ROOM 109	<0.4
ROOM 112	<0.4
ROOM 114	LOST
ROOM 106	LOST
ROOM 153	LOST

BUILDING 1007

AREA TESTED	RADON RESULTS (pCi/L)
ROOM 1098	<0.4
ROOM 1015	<0.4
ROOM 1036	0.6
ROOM 1059	2.8
ROOM 1106	0.5
ROOM 1147	0.7
ROOM 1127	0.8
ROOM 1073	<0.4
ROOM 1085	0.5
ROOM 1108	<0.4
ROOM 1024	0.5
ROOM 1021	<0.4
PHARMACY	LOST

TABLE 2

29 AUGUST 2005

**MISSING RADON DETECTOR
LOCATIONS**

Radon Detector #	Building #	Room Detector Placed
141644	130 H	Room 113
141667	130 H	Room 121
141670	1007	Pharmacy
141680	132 H	Room 114
141652	131 H	B111N
141653	131 H	B108N
141651	131 H	B101N
141643	131 H	B165S
141681	132 H	Room 106
141688	132 H	Room 153

ENCLOSURE 1

NEHA NRPP #101193 AL

EPA Method #402-R-93-004 079
 NEHA Device # 8205
 NRSB Device # 12001

Laboratory Report For

Property Tested

ACOS Installation & Environment-N. Lucas
 201 Decatur Avenue
 Great Lakes IL 60088-5600

Navy Public Works

Laboratory ID	Device Number	Area Tested	Test Start	Test End	Result pCi/L
675865	141658	Building 130 H Room 192	04/06/05	07/12/05	0.9
675866	141659	Building 130 H Room 174	04/06/05	07/12/05	0.7
675867	141660	Building 1007 Room 1098	04/11/05	07/14/05	< 0.4
675868	141661	Building 132 H Room 105	04/11/05	07/12/05	< 0.4
675869	141662	Building 1007 Room 1015	04/11/05	07/14/05	< 0.4
675870	141663	Building 132 H Room Lounge 1	04/11/05	07/12/05	< 0.4
675871	141665	Building 132 H Room Kitchen	04/11/05	07/12/05	< 0.4
675872	141666	Building 1007 Room 1036	04/11/05	07/14/05	0.6
675873	141668	Building 130 H Room 125	04/06/05	07/12/05	< 0.4
675874	141669	Building 130 H Room 101C	04/06/05	07/12/05	< 0.4
675875	141671	Building 1007 Room 1059	04/11/05	07/14/05	2.8
675876	141672	Building 130 H Room 153	04/06/05	07/12/05	< 0.4
675877	141673	Building 1007 Room 1106	04/11/05	07/14/05	0.5
675878	141674	Building 130 H Room 166	04/06/05	07/12/05	1.1

A copy of this report was faxed to 847-688-6910.

Date Received: 8/5/2005 Date Analyzed: 8/18/2005 Date Reported: 8/19/2005

Report Reviewed By: 

Disclaimer: The uncertainty of this radon measurement is +/- 15%. Factors contributing to uncertainty include, statistical variations, daily and seasonal variations in radon concentrations, and operation of the dwelling. Interference with test conditions may influence the test results.

This report may only be transferred to a third party in its entirety. Results shown on this report represent levels of radon gas measured between the dates shown in the room or area of the site identified above as "Property Tested". Incorrect information will affect results. The results may not be construed as either predictive or supportive of measurements conducted in any area of this structure at any other time. AccuStar Labs, its employees and agents are not responsible for the consequences of any action taken or not taken based upon the results reported or any verbal or written interpretation of the results.

NEHA NRPP #101193 AL

EPA Method #402-R-93-004 079
 NEHA Device # 8205
 NRSB Device # 12001

Laboratory Report For

Property Tested

ACOS Installation & Environment-N. Lucas
 201 Decatur Avenue
 Great Lakes IL 60088-5600

Navy Public Works

Laboratory ID	Device Number	Area Tested	Test Start	Test End	Result pCi/L
675851	141639	Building 131 H Room 147S	04/06/05	07/12/05	0.5
675852	141640	Building 131 H Room Lounge	04/06/05	07/12/05	< 0.4
675853	141641	Building 131 H Room 5148	04/06/05	07/12/05	< 0.4
675854	141642	Building 130 H Room 111	04/06/05	07/12/05	0.8
675855	141645	Building 130 H Room 117	04/06/05	07/12/05	< 0.4
675856	141646	Building 130 H Room 126	04/06/05	07/12/05	0.5
675857	141647	Building 131 H Room B163S	04/06/05	07/12/05	< 0.4
675858	141648	Building 131 H Room 122N	04/06/05	07/12/05	< 0.4
675859	141649	Building 131 H Room S116N	04/06/05	07/12/05	0.4
675860	141650	Building 1007 Room 1147	04/11/05	07/14/05	0.7
675861	141654	Building 132 H Room 111	04/11/05	07/12/05	< 0.4
675862	141655	Building 130 H Room 161E	04/06/05	07/12/05	0.9
675863	141656	Building 130 H Room 131	04/06/05	07/12/05	1.0
675864	141657	Building 130 H Room 183	04/06/05	07/12/05	1.0

A copy of this report was faxed to 847-688-6910.

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NEHA NRPP #101193 AL

EPA Method #402-R-93-004 079
 NEHA Device # 8205
 NRSB Device # 12001

Laboratory Report For

Property Tested

ACOS Installation & Environment-N. Lucas
 201 Decatur Avenue
 Great Lakes IL 60088-5600

Navy Public Works

Laboratory ID	Device Number	Area Tested	Test Start	Test End	Result pCi/L
675879	141675	Building 1007 Room 1127	04/11/05	07/14/05	0.8
675880	141676	Building 1007 Room 1073	04/11/05	07/14/05	< 0.4
675881	141677	Building 1007 Room 1085	04/11/05	07/14/05	0.5
675882	141678	Building 1007 Room 1108	04/11/05	07/14/05	< 0.4
675883	141679	Building 132 H Exercise Room	04/11/05	07/12/05	0.4
675884	141682	Building 132 H Room 108	04/11/05	07/12/05	< 0.4
675885	141683	Building 1007 Room 1024	04/11/05	07/14/05	0.5
675886	141684	Building 132 H Room 155	04/11/05	07/12/05	0.5
675887	141685	Building 132 H Room 110	04/11/05	07/12/05	< 0.4
675888	141686	Building 132 H Room 109	04/11/05	07/12/05	< 0.4
675889	141687	Building 1007 Room 1021	04/11/05	07/14/05	< 0.4
675890	141689	Building 132 H Room 112	04/11/05	07/12/05	< 0.4
675891	141690	Building 1304 Room 135	04/06/05	07/12/05	< 0.4

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Date Received: 8/5/2005 Date Analyzed: 8/18/2005 Date Reported: 8/19/2005

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ENCLOSURE 2

CHAPTER 26

RADON ASSESSMENT AND MITIGATION

26-1 Scope

This chapter discusses the Navy aspects of the Department of the Navy's Radon Assessment and Mitigation Program (NAVRAMP). The purpose of NAVRAMP is to identify, assess, and mitigate the effects of infiltration of radon into existing Navy buildings and to incorporate preventive practices in the design and construction of new buildings. NAVRAMP provides for compliance with the procedural requirements of the Toxic Substances Control Act (TSCA).

Mitigation and Prevention requirements of section 26-5.3b and c, respectively, do not apply to non-Navy owned buildings. Navy tenant activities should consider mitigation and advise the lessor when applicable radon action levels exceed the action limit. Activities should adhere to the prevention requirements of section 26-5.3c when considering the design and construction of new buildings for long term leases (e.g., lease, limited partnerships, etc.). Activities must evaluate all existing and new lease agreements to ensure Navy occupancy is or will be under similar radon exposure protection obtained by implementing NAVRAMP in Navy owned buildings.

26-1.1 References. Relevant references are:

- a. Toxic Substance Control Act (TSCA) 15 U.S.C. 2601 et seq.;
- b. 29 CFR 1910.20C (8) OSHA Access to Employee Exposure and Medical Records.

26-2 Legislation

26-2.1 Toxic Substance Control Act (TSCA). TSCA (reference (a)) required that all Federal departments or agencies that own Federal buildings conduct a study to determine the extent

of radon contamination in such buildings. They must provide results of the study to the Environmental Protection Agency (EPA). As required by the TSCA, EPA submitted to Congress a consolidated report of the studies from Federal departments or agencies, including one submitted by the Navy.

26-3 Terms and Definitions

26-3.1 Mitigation System. Any system or steps designed to reduce radon concentrations in the indoor air of a building.

26-3.2 Occupied Building. A building occupied more than 4 hours per day.

26-3.3 Picocuries. A unit of measurement used to describe certain types of nuclear radiation. A curie is the amount of any radionuclide that undergoes exactly 3.7×10^{10} radioactive disintegrations per second. A picocurie is one trillionth (10^{-12}) of a curie, or 0.037 disintegrations per second.

26-3.4 Picocurie per liter (pCi/L). A common unit of measurement of the concentration of radioactivity in a fluid (liquid or gas). A picocurie per liter corresponds to 0.037 radioactive disintegrations per second in every liter of fluid.

26-3.5 Radon. A colorless, odorless, radioactive gas formed by the decay of radium. Radon exists in soils, rocks, and some groundwater supplies. It can infiltrate into buildings.

26-3.6 Validated Monitoring Results. A radon test that meets the requirements of NAVRAMP (e.g., a type of radon detection device; sampling strategies, procedures, and

2 February 1998

intervals; quality assurance/quality control (QA/QC); etc.).

26-4 Requirements

26-4.1 General. Section 309(a) of TSCA required the head of each Federal department or agency that owned Federal buildings to conduct a study to determine the extent of radon in such buildings. In the case of Federal buildings using a nonpublic water source (such as a well or other groundwater), TSCA also required an evaluation of radon in the water.

The TSCA required the study submitted to the EPA not later than 1 June 1990. The Navy submitted the results available at that date, and submitted updated information two times since to EPA. Besides assessing the level of radon in Navy buildings, NAVRAMP, under certain conditions requires the mitigation of radon in existing buildings and the prevention of radon buildup in new buildings.

26-5 Navy Policy

26-5.1 General. The EPA approved NAVRAMP as the plan to identify, mitigate, and prevent radon in Navy-occupied buildings. All Navy installations shall implement the NAVRAMP testing program to identify the level of indoor radon. Navy installations shall undertake mitigation measures in buildings determined to have indoor radon levels above 4pCi/L. They shall incorporate appropriate radon reduction techniques into the design and construction phases of new structures as a preventive measure where necessary because of regulatory requirements, historical data, or geological conditions.

Naturally occurring radon exposure is part of natural radiation background, and background exposures are not considered occupational exposure. Reference (b) notes that, "Exposure or exposed means that an employee is subjected to a toxic substance or harmful physical agent in the

course of employment ... but does not include situations where the employer can demonstrate that the toxic substance or harmful physical agent is not used, handled, stored, generated, or present in the workspace in any manner different from typical non-occupational situations."

26-5.2 Applicable Provisions. The U.S. Navy shall institute the following provisions under NAVRAMP:

a. Identify activities where indoor concentration of radon in occupied buildings exceeds the Environmental Protection Agency (EPA)-recommended action level, currently 4 picocuries per liter(4pCi/L).

b. Maintain a central data management system containing all validated monitoring results of Navy and Marine Corps buildings (both housing and non-housing) tested for radon under NAVRAMP.

c. Mitigate the indoor radon levels in buildings to below EPA-recommended action level.

d. Ensure that building designs include appropriate radon resistant (prevention) techniques where necessary due to applicable regulatory requirements, historical data, and geological conditions at the location.

26-5.3 The NAVRAMP Program. The NAVRAMP consists of testing, mitigation, and prevention.

a. **Testing.** Activities shall test occupied buildings to determine indoor levels of radon. Radon testing of buildings in an activity typically consists of the following phases:

(1) **Screening.** Activities shall select a statistically significant sample of structures, mainly housing, hospitals, bachelor quarters, schools, child-care centers, and brigs. A "screening" becomes an "assessment" if the

minimum statistically significant number of buildings (31 buildings per installation or 31 housing units per housing area) is equal to or greater than the total number of occupied buildings.

(2) **Assessment.** If during the screening process activities detect radon and confirm the level exceeds the EPA-recommended action level, then the activity shall measure every occupied building in the activity for radon.

(3) **Periodically Monitoring.**

Activities shall periodically monitor mitigated structures. They shall re-test structures that have been significantly modified to ensure that levels are below the action level. Incorporate re-testing as part of the project. A "modified structure" is one significantly altered by either changing the original number or type of windows, doors, ground slabs, walls, or otherwise making modifications in any manner to significantly affect the air change or flow in the structure.

b. **Mitigation.** Activities shall use a mitigation system in buildings determined to have indoor radon levels above the EPA-recommended action level to reduce levels below the EPA-recommended action level. They shall schedule mitigation steps conforming to the following priority scheme:

<u>Cat.</u>	<u>Radon Levels</u> <u>(pCi/L)</u>	<u>Action</u>
1	0 to 4	No action required
2	4 to 20	Mitigation within 5 yr.
3	20 to 200	Mitigation within 6 mo.
4	> 200	Mitigation within 3 wk.

c. **Prevention.** Activities shall incorporate appropriate radon reduction techniques into the design and construction phases of new structures (where necessary due to applicable regulatory requirements, historical data, and geological conditions at the location) to prevent indoor radon levels from exceeding the action level.

26-5.4 **Program Funding Requirements**

a. CNO will centrally fund the cost of managing NAVRAMP as part of the Naval Environmental Protection Support Service (NEPSS) centrally-managed funds.

b. The cost of providing technical support (e.g., testing, diagnostics, mitigation, and prevention) specifically related to an activity, is reimbursable to COMNAVFACENGCOM by the activity or its chain of command.

c. Projects for mitigation and prevention beyond the funding capability of the activity may be eligible for centrally-managed funds in the Operations and Maintenance, Navy (O&MN), Housing, and Military Construction (MCON) appropriations. Conditions covered in OPNAVINST 11010.20F, Facilities Projects Manual, further restrict the availability of centrally managed funds in O&MN appropriations.

26-6 **Responsibilities**

26-6.1 **Deputy Chief of Naval Operations (Logistics) (N4) shall:**

a. Assess the impact of proposed radon legislation and regulations on the Navy.

b. Issue radon policy and guidance as needed.

26-6.2 **Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM) shall:**

a. Manage NAVRAMP

b. Designate within its organization a Radon Center of Expertise.

2 February 1998

c. Develop and manage a Navy-wide radon testing data system.

d. Revise technical documents and manuals to reflect designs required to reduce indoor radon levels in buildings.

e. Provide technical assistance regarding:

(1) Monitoring of radon levels within buildings

(2) Diagnostics for selection of mitigation practices

(3) Design of mitigation and prevention practices

(4) Construction of mitigation and prevention practices

(5) Operation and maintenance plans for mitigation equipment.

f. Implement as requested the requirements of NAVRAMP at Navy activities.

g. Ensure that testing data meets the requirements of NAVRAMP (i.e., quality assurance/quality control (QA/QC)).

h. Maintain an integrated Navy-wide database and management information on radon testing data and mitigation projects planned and performed.

i. Produce an annual Navy-wide radon testing and mitigation summary report.

26-6.3 Chief, Bureau of Medicine and Surgery shall:

a. Assist COMNAVFACENGCOM in areas of radon public health assessment and communication.

b. Evaluate the appropriateness of radon action levels and mitigation schedules for Navy installations.

26-6.4 Commanding officers of shore activities shall:

a. Identify and submit environmental compliance projects required to bring activities into compliance with applicable regulations and Navy policy requirements.

b. Budget sufficient resources to maintain and demonstrate compliance with Navy policy and Federal radon monitoring, mitigation, and prevention requirements.

ENCLOSURE 3



U.S. Environmental Protection Agency Radon - Publications

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[A to Z Subject Index](#)

[Radon \(Rn\)](#)

[Frequent Questions](#)

[Health Risks](#)

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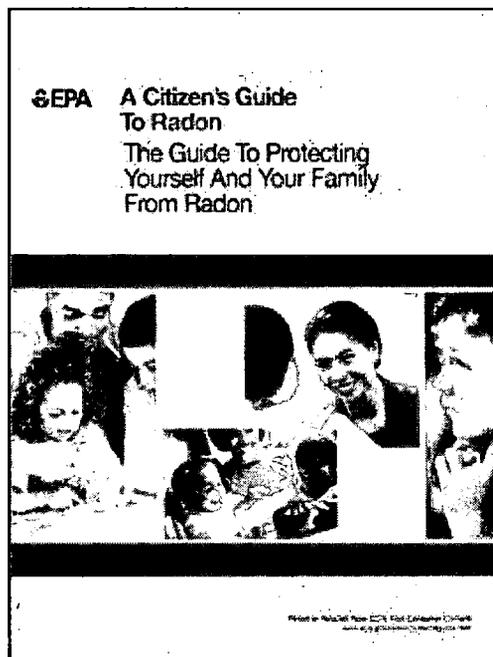
[Radon Resistant New Construction \(RRNC\)](#)

[EPA Map of Radon Zones](#)

[Radon in Drinking Water](#)

"A Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family From Radon"

This document was prepared by the U.S. EPA, Indoor Environments Division (6609J), Washington, D.C. 20460
U.S. EPA 402-K-02-006; Revised May 2004



Contents

Overview

[How Does Radon Get Into Your Home?](#)

[How to Test Your Home](#)

-- [There are Two General Ways to Test for Radon](#)

-- [How to Use a Test Kit](#)

[What Your Test Results Mean](#)

-- [Radon and Home Sales](#)

-- [Radon in Water](#)

[How to Lower the Radon Levels in Your Home](#)

-- [Radon and Home Renovations](#)

[The Risk of Living With Radon](#)

[Radon Risk Charts](#)

[Radon Myths](#)

[State Radon Contacts](#)

[For Further Information](#)

[How to Order Publications](#)

A PDF version of this guidance is available at [citizensguide.pdf](#) (a 4.3MB file).

When you order a copy of this document, please ask for "**A Citizen's Guide to Radon**" EPA document number 402-K-02-006, Revised May 2004

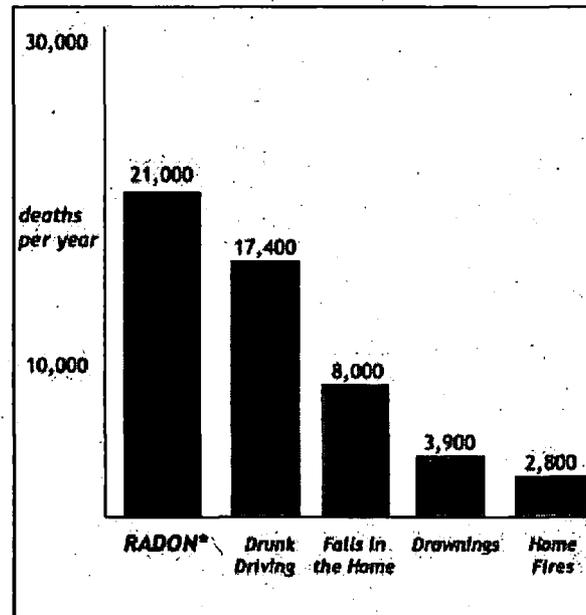
Please Note: The Spanish version of this publication, *El Radon*, reflects information that has NOT been updated. A translation of this version into Spanish has been planned.

For KIDS

EPA Recommends:

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

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* (EP/402-R-03-003). The numbers of deaths from other causes are taken from the Centers for Disease Control and Prevention's 1999-2001 *National Center for Injury Prevention and Control Report* and 2002 *National Safety Council Reports*.

[Go to top](#)

Overview

Radon is a cancer-causing, radioactive gas.

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

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 has high radon levels, your risk of lung cancer is especially high.**

Radon can be found all over the U.S.

Radon comes from the natural (radioactive) breakdown of uranium in soil, rock and water and gets into the air you breathe. 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 and your family 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 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.

Testing is inexpensive and easy - it should only take a few minutes of your time. Millions of Americans have already tested their homes for radon (see

How to Test Your Home).

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 your home by up to 99%. Even very high levels can be reduced to acceptable levels.

New homes 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 homes. 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. For more explanation of radon resistant construction techniques, refer to EPA publication, *Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes* (see EPA Publications).

Go to top

How Does Radon Get Into Your Home?

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 your home through cracks and other holes in the foundation. Your home traps radon inside, where it can build up. Any home may have a radon problem. This means new and old homes, well-sealed and drafty homes, and homes with or without basements.

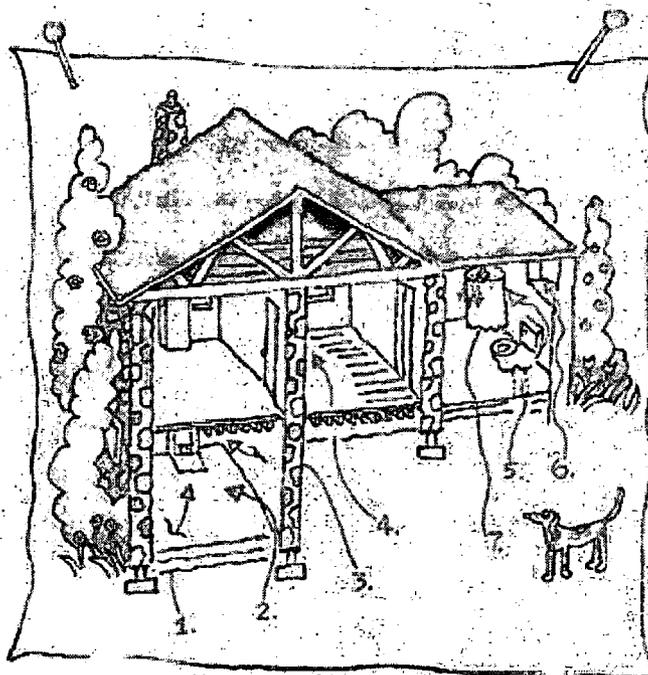
Any home may have a radon problem.

Radon from soil gas is the main cause of radon problems. Sometimes radon enters the home through well water (see "Radon in Water" below). In a small number of homes, 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. Elevated levels of radon gas have been found in homes in your state. Contact your state radon office for general information about radon in your area. While radon problems may be more common in some areas, any home may have a problem. The only way to know about your home is to test.

Radon can also be a problem in schools and workplaces. Ask your state radon office about radon problems in schools, daycare and childcare facilities, and workplaces in your area.

[Go to top](#)

How to Test Your Home

You can't see radon, but it's not hard to find out if you have a radon problem in your home. 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." Sometimes test results are expressed in Working Levels (WL) rather than picoCuries per liter (pCi/L) (4 pCi/L equals to 0.016 WL). There are many kinds of low-cost "do-it-yourself" radon test kits you can get through the mail and in 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. You should first contact your state radon office about obtaining a list of qualified testers. You can also contact a private radon proficiency program for lists of privately certified radon professionals serving your area. For links and information, visit www.epa.gov/radon/proficiency.html.

There are Two General Ways to Test for Radon:

SHORT-TERM TESTING:

The quickest way to test is with short-term tests. Short-term tests remain in your home for two days to 90 days, depending on the device. "Charcoal canisters," "alpha track," "electret ion chamber," "continuous monitors," and "charcoal liquid scintillation" detectors are most commonly used for short-term testing. Because radon levels tend to vary from day to day and season to season, a short-term test is less likely than a long-term test to tell you your year-round average radon level. If you need results quickly, however, a short-term test followed by a second short-term test may be used to decide whether to fix your home (see [Home Sales](#)).

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

LONG-TERM TESTING:

Long-term tests remain in your home 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 your home's year-round average radon level than a short-term test.

How To Use a Test Kit:

Follow the instructions that come with your test kit. If you are doing a short-term test, close your windows and outside doors and keep them closed as much as possible during the test. Heating and air-conditioning system fans that re-circulate air may be operated. Do not operate fans or other machines which bring in air from outside. Fans that are part of a radon-reduction system or small exhaust fans operating only for short periods of time may run during the test. If you are doing a short-term test lasting just 2 or 3 days, be sure to close your windows and outside doors at least 12 hours **before** beginning the test, too. You should not conduct short-term tests lasting just 2 or 3 days during unusually severe storms or periods of unusually high winds. The test kit should be placed in the lowest lived-in level of the home (for example, the basement if it is frequently used, otherwise the first floor). It should be put in a room that is used regularly (like a living room, playroom, den or bedroom) but not your kitchen or bathroom. Place the kit at least 20 inches above the floor in a location where it won't be disturbed - away from drafts, high heat, high humidity, and exterior walls. 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.

EPA Recommends the Following Testing Steps:

Step 1. Take a short-term test. If your result is 4 pCi/L or higher take a follow-up test (Step 2) to be sure.

Step 2. Follow up with either a long-term test or a second short-term test:

- **For a better understanding of your year-round average radon level take a long-term test.**
- **If you need results quickly, take a second short-term test.**

The higher your initial short-term test result, the more certain you can be that you should take a short-term rather than a long-term follow up test. If your first short-term test result is more than twice EPA's 4 pCi/L action level, you should take a second short-term test immediately.

Step If you followed up with a long-term test: **Fix your home if your long-term**

3. **test result is 4 pCi/L or more. If you followed up with a second short-term test: The higher your short-term results, the more certain you can be that you should fix your home.** Consider fixing your home if the average of your first and second test is 4 pCi/L or higher. (see also [Home Sales](#))



[Go to top](#)

What Your Test Results Mean

The average indoor radon level is estimated to be about 1.3 pCi/L, and about 0.4 pCi/L of radon is normally found in the outside air. The U.S. Congress has set a long-term goal that indoor radon levels be no more than outdoor levels. While this goal is not yet technologically achievable in all cases, most homes today *can* be reduced to 2 pCi/L or below.

Test your home now and save your results. If you find high radon levels, fix your home before you decide to sell it.

Sometimes short-term tests are less definitive about whether or not your home is above 4 pCi/L. This can happen when your results are close to 4 pCi/L. For example, if the average of your two short-term test results is 4.1 pCi/L, there is about a 50% chance that your year-round average is somewhat below 4 pCi/L. However, EPA believes that any radon exposure carries some risk - no level of radon is safe. Even radon levels below 4 pCi/L pose some risk, and you can reduce your risk of lung cancer by lowering your radon level.

If your living patterns change and you begin occupying a lower level of your home (such as a basement) you should retest your home on that level.

Even if your test result is below 4 pCi/L, you may want to test again sometime in the future.

[Go to top](#)

Radon and Home Sales

More and more, home buyers and renters are asking about radon levels before they buy or rent a home. Because real estate sales happen quickly, there is often little time to deal with radon and other issues. The best thing to do is to test for radon NOW and save the results in case the buyer is interested in them. Fix

a problem if it exists so it won't complicate your home sale. If you are planning to move, call your state radon office for EPA's pamphlet "Home Buyer's and Seller's Guide to Radon," which addresses some common questions. You can also use the results of two short-term tests done side-by-side (four inches apart) to decide whether to fix your home.

During home sales:

- Buyers often ask if a home has been tested, and if elevated levels were reduced.
- Buyers frequently want tests made by someone who is not involved in the home sale. Your state radon office can assist you in identifying a qualified tester.
- Buyers might want to know the radon levels in areas of the home (like a basement they plan to finish) that the seller might not otherwise test.

Today many homes are built to prevent radon from coming in. Your state or local area may require these radon-resistant construction features. If you are buying or renting a new home, ask the owner or builder if it has radon-resistant features. The EPA recommends building new homes with radon-resistant features in high radon potential (Zone 1) areas. Even if built radon-resistant, every new home should be tested for radon after occupancy. If you have a test result of 4 pCi/L or more, you can have a qualified mitigator easily add a vent fan to an existing passive system for about \$300 and further reduce the radon level in your home. For more information, refer to EPA's Map of Radon Zones and other useful EPA documents on radon-resistant new construction (see publications), or visit www.epa.gov/radon

[Go to top](#)

Radon in Water



There are two main sources for the radon in your home's indoor air, the soil and the water supply. Compared to radon entering the home through water, radon entering your home through the soil is usually a much larger risk.

If you've tested the air in your home and found a radon problem, and your water comes from a well, have your water tested.

The radon in your water supply poses an inhalation risk and an ingestion risk. Research has shown that your risk of lung cancer from breathing radon in air is much larger than your risk of stomach cancer from swallowing water with radon in it. Most of your risk from radon in water comes from radon released into the air when water is used for showering and other household purposes.

Radon in your home's water is not usually a problem when its source is surface water. A radon in water problem is more likely when its source is ground water, e.g. a private well or a public water supply system that uses ground water. If you are concerned that radon may be entering your home through the water and your water comes from a public water supply,

contact your water supplier.

If you've tested your private well and have a radon in water problem, it can be fixed. Your water supply can be treated in two ways. Point-of-entry treatment can effectively remove radon from the water before it enters your home. Point-of-use treatment devices remove radon water at the tap, but only treat a small portion of the water you use and are not effective against the risk from breathing radon released into the air from all water used in the home.

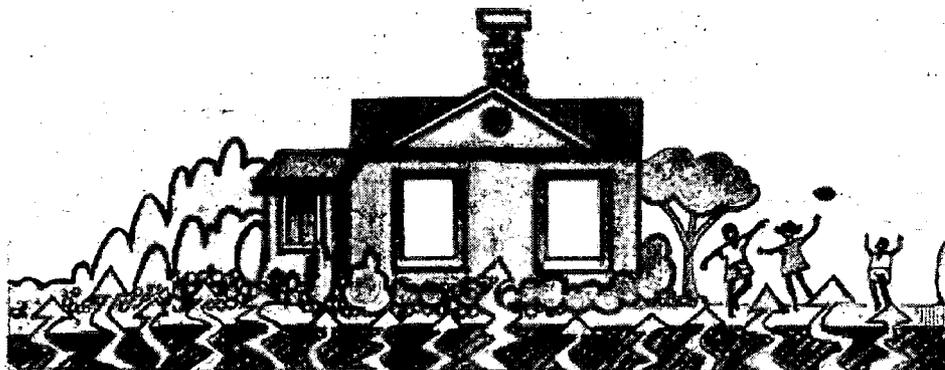
For more information, call EPA's Drinking Water Hotline at (800) 426-4791 or visit www.epa.gov/safewater/radon.html. If your water comes from a private well, you can also contact your state radon office.

[Go to top](#)

How to Lower the Radon Level in Your Home

Since there is no known safe level of radon, there can always be some risk. But that risk can be reduced by lowering the radon level in your home.

There are several proven methods to reduce radon in your home, but the one primarily used is a vent pipe system and fan, which pulls radon from beneath the house and vents it to the outside. This system, known as a soil suction radon reduction system, does not require major changes to your home. Sealing foundation cracks and other openings makes this kind of system more effective and cost-efficient. Similar systems can also be installed in houses with crawl spaces. Radon contractors can use other methods that may also work in your home. The right system depends on the design of your home and other factors.



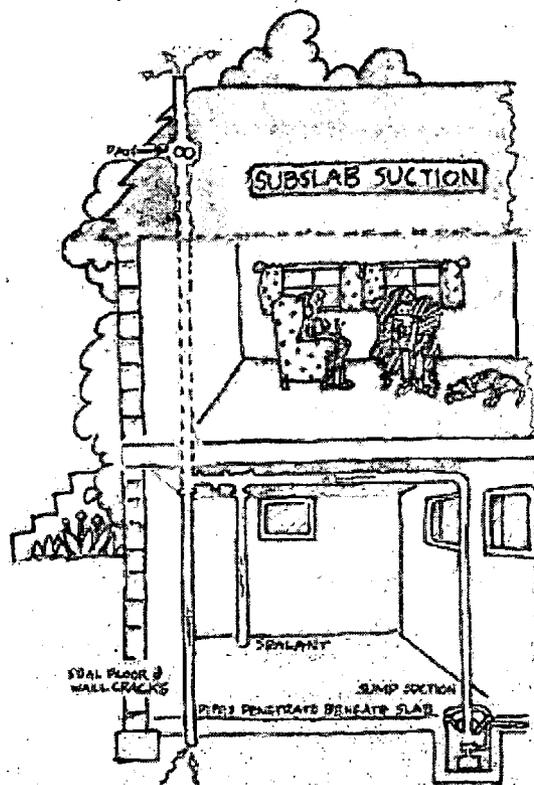
Ways to reduce radon in your home are discussed in EPA's "[Consumer's Guide to Radon Reduction](#)." You can get a copy from your state radon office.

The cost of reducing radon in your home depends on how your home was built and the extent of the radon problem. Most homes can be fixed for about the same cost as other common home repairs. The average house costs about \$1,200 for a contractor to fix, although this can range from about \$800 to about \$2,500. The cost is much less if a passive system was installed during construction.

Radon and Home Renovations

If you are planning any major structural renovation, such as converting an unfinished basement area into living space, it is especially important to test the area for radon before you begin the renovation. If your test

results indicate a radon problem, radon-resistant techniques can be inexpensively included as part of the renovation. Because major renovations can change the level of radon in any home, always test again after work is completed.



Lowering high radon levels requires technical knowledge and special skills. You should use a contractor who is trained to fix radon problems. A qualified contractor can study the radon problem in your home and help you pick the right treatment method.

Most homes can be fixed for about the same cost as other common home repairs.

Check with your state radon office for names of qualified or state certified radon contractors in your area. You can also contact private radon proficiency programs for lists of privately certified radon professionals in your area. For more information on private radon proficiency programs, visit www.epa.gov/radon/proficiency.html Picking someone to fix your radon problem is much like choosing a contractor for other home repairs - you may want to get references and more than one estimate.

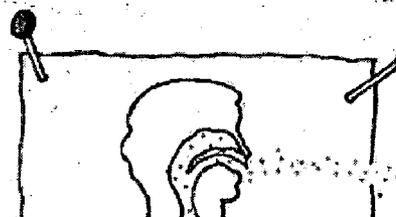
If you are considering fixing your home's radon problem yourself, you should first contact your state radon office for guidance and assistance.

You should also test your home again after it is fixed to be sure that radon levels have been reduced. Most soil suction radon reduction systems include a monitor that will indicate whether the system is operating properly. In addition, it's a good idea to retest your home every two years to be sure radon levels remain low.

Note: This diagram is a composite view of several mitigation options. The typical mitigation system usually has only one pipe penetration through the basement floor; the pipe may be installed on the outside of the house.

The Risk of Living With Radon

Radon gas decays into radioactive particles that can get trapped in your lungs when you breathe. As they break down further, these particles release small bursts of energy. This



can damage lung tissue and lead to lung cancer over the course of your lifetime. Not everyone exposed to elevated levels of radon will develop lung cancer. And the amount of time between exposure and the onset of the disease may be many years.

Like other environmental pollutants, there is some uncertainty about the magnitude of radon health risks. However, we know more about radon risks than risks from most other cancer-causing substances. This is because estimates of radon risks are based on studies of cancer in humans (underground miners).

Smoking combined with radon is an especially serious health risk. Stop smoking and lower your radon level to reduce your lung cancer risk.

Children have been reported to have greater risk than adults of certain types of cancer from radiation, but there are currently no conclusive data on whether children are at greater risk than adults from radon.

Scientists are more certain about radon risks than risks from most other cancer-causing substances.

Your chances of getting lung cancer from radon depend mostly on:

- **How much radon is in your home**
- **The amount of time you spend in your home**
- **Whether you are a smoker or have ever smoked**

[Go to top](#)

Radon Risk If You Smoke

Radon Level	If 1,000 people who smoked were exposed to this level over a lifetime*...	The risk of cancer from radon exposure compares to**...	WHAT TO DO Stop smoking and...
20 pCi/L	About 260 people could get lung cancer	250 times the risk of drowning	Fix your home
10 pCi/L	About 150 people could get lung cancer	200 times the risk of dying in a home fire	Fix your home
8 pCi/L	About 120 people could get lung cancer	30 times the risk of dying in a fall	Fix your home
4 pCi/L	About 62 people could get lung cancer.	5 times the risk of dying in a car crash	Fix your home
2 pCi/L	About 32 people could get lung cancer	6 times the risk of dying from poison	Consider fixing between 2 and 4 pCi/L
1.3 pCi/L	About 20 people could get lung cancer	(Average indoor radon level)	(Reducing radon levels below 2 pCi/L is difficult.)
0.4 pCi/L	About 3 people could get lung cancer	(Average outdoor radon level)	

Note: If you are a former smoker, your risk may be lower.

* 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.

Radon Risk If You've Never Smoked

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 person 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 former smoker, your risk may be higher.

* 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.

It's never too late to reduce your risk of lung cancer. Don't wait to test and fix a radon problem. If you are a smoker, stop smoking.

[Go to top](#)

Radon Myths

MYTH: Scientists are not sure that radon really is a problem.

FACT: Although some scientists dispute the precise number of deaths due to radon, all the major health organizations (like the Centers for Disease Control and Prevention, the American Lung Association and the American Medical Association) agree with estimates that radon causes thousands of preventable lung cancer deaths every year. This is especially true among smokers, since the risk to smokers is much greater than to non-smokers.

MYTH: Radon testing is difficult, time-consuming and expensive.

FACT: Radon testing is easy. You can test your home yourself or hire a qualified radon test company. Either approach takes only a small amount of time and effort.

MYTH: Radon testing devices are not reliable and are difficult to find.

FACT: *Reliable testing devices are available from qualified radon testers and companies. Reliable testing devices are also available by phone or mail-order, and can be purchased in hardware stores and other retail outlets. Call your state radon office for help in identifying radon testing companies.*

MYTH: Homes with radon problems can't be fixed.

FACT: *There are simple solutions to radon problems in homes. Hundreds of thousands of homeowners have already fixed radon problems in their homes. Radon levels can be readily lowered for \$800 to \$2,500 (with an average cost of \$1,200).. Call your state radon office for help in identifying qualified mitigation contractors.*

MYTH: Radon affects only certain kinds of homes.

FACT: *House construction can affect radon levels. However, radon can be a problem in homes of all types: old homes, new homes, drafty homes, insulated homes, homes with basements, and homes without basements. Local geology, construction materials, and how the home was built are among the factors that can affect radon levels in homes.*

MYTH: Radon is only a problem in certain parts of the country.

FACT: *High radon levels have been found in every state. Radon problems do vary from area to area, but the only way to know your radon level is to test.*

MYTH: A neighbor's test result is a good indication of whether your home has a problem.

FACT: *It's not. Radon levels can vary greatly from home to home. The only way to know if your home has a radon problem is to test it.*

MYTH: Everyone should test their water for radon.

FACT: *Although radon gets into some homes through water, it is important to first test the air in the home for radon. If your water comes from a public water supply that uses ground water, call your water supplier. If high radon levels are found and the home has a private well, call the Safe Drinking Water Hotline at 1 800-426-4791 for information on testing your water.*

MYTH: It's difficult to sell homes where radon problems have been discovered.

FACT: *Where radon problems have been fixed, home sales have not been blocked or frustrated. The added protection is some times a good selling point.*

MYTH: I've lived in my home for so long, it doesn't make sense to take action now.

FACT: *You will reduce your risk of lung cancer when you reduce radon levels, even if you've lived with a radon problem for a long time.*

MYTH: Short-term tests can't be used for making a decision about whether to fix y home.

FACT: A short-term test, followed by a second short-term test* can be used to decide whether to fix your home. However, the closer the average of your two short-term tests is to 4 pCi/L, the less certain you can be about whether your year-round average is above or below that level. Keep in mind that radon levels below 4 pCi/L still pose some risk. Radon levels can be reduced in most homes to 2 pCi/L or below.

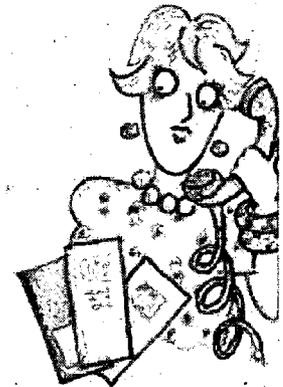
* If the radon test is part of a real estate transaction, the result of two short-term tests can be used in deciding whether to mitigate. For more information, see EPA's "Home Buyer's and Seller's Guide to Radon".

[Go to top](#)

For Further Information

www.epa.gov/radon EPA's main radon page. Includes links to publications, hotlines, private radon proficiency programs and more.

- [Home Buyer's and Seller's Guide to Radon \[En Español\]](#)
- [Consumer's Guide to Radon Reduction](#)
- [Radon Guide for Tenants](#)
- [Application of Radon Reduction Techniques for Detached Homes](#)
- [EPA Map of Radon Zones and Fact Sheet](#)
- [Buying a New Home? How to Protect Your Family From Radon](#)
- [Building a New Home, Have You Considered Radon?](#)
- [Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes](#)
- [EPA Assessment of Risks from Radon in Homes](#)
- [Technical Support Document to the 1992 Citizens Guide to Radon](#)
- Other Radon-specific publications are located at: www.epa.gov/radon/pubs/
- Other Indoor Air Quality-specific publications are located at: www.epa.gov/iaq/pubs/



SURGEON GENERAL HEALTH ADVISORY:

"Indoor radon gas is a national health problem. Radon causes thousands of deaths each year. Millions of homes have elevated radon levels. Homes should be tested for radon. When elevated levels are confirmed, the problem should be corrected." (1988)

U.S. EPA Assessment of Risks from Radon in Homes

In June 2003, the EPA revised its risk assessment for radon exposure in homes. EPA estimates that about 21,000 annual lung cancer deaths are radon related. EPA also concluded that the effects of radon and

cigarette smoking are synergistic, so that smokers are at higher risk from radon. EPA's revised estimates are based on the National Academy of Sciences 1999 BEIR IV (Biological Effects of Ionizing Radiation) Report which concluded that radon is the second leading cause of lung cancer after smoking.

State and Regional Radon and Indoor Air Quality Contacts

Call your state radon office for additional help with any of your radon questions. Up-to-date information on how to contact your state radon office is also available on EPA's web site at www.epa.gov/iaq/whereyoulive.html, or call EPA's toll free Indoor Air Quality Information Clearinghouse (IAQINFO) at (800) 438-4318 to obtain the current listing.

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