NORTH Dakota

Be Legendary.™

STATE OF NORTH DAKOTA WEATHERIZATION ASSISTANCE CLIENT EDUCATION INFORMATION BOOKLET

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Any of the following that are checked yes are to be discussed with client.	**YES**	**NO**	**N/A**
1. Suspected asbestos containing materials present?	☐	☐	☐
2. Any structurally compromised areas?	☐	☐	☐
3. Any code issues present?	☐	☐	☐
4. Are any fuel or gas leaks present?	☐	☐	☐
5. Are there any issues with gas ovens or stoves?	☐	☐	☐
6. Are gutters clean and maintained?	☐	☐	☐
7. Are downspouts and extensions present?	☐	☐	☐
8. Are there any landscaping issues?	☐	☐	☐
9. Are there any issues with solid fuel vents?	☐	☐	☐
10. Does ventilation need to be added?	☐	☐	☐
11. Does existing ventilation operate correctly?	☐	☐	☐
12. Are CO and smoke alarms needed?	☐	☐	☐
13. Are any pests present?	☐	☐	☐
14. Any electrical or plumbing problems present?	☐	☐	☐
15. Any issues with the heating system?	☐	☐	☐
16. Any issues with the water heater?	☐	☐	☐
17. Any biologicals or sanitation issues?	☐	☐	☐
18. Any VOC’s or other air pollutants present?	☐	☐	☐
19. Are there any hazardous materials to be disposed of?	☐	☐	☐
20. Is lead-based paint present that will be disturbed?	☐	☐	☐
21. Are there any issues present that will cause deferral?	☐	☐	☐
Any other issues identified or other comments for documentation?			

EPA 402/K-12/002 | 2016 | www.epa.gov/radon

EPA
United States
Environmental Protection
Agency

A Citizen's Guide to Radon

The Guide to Protecting Yourself and Your Family from Radon

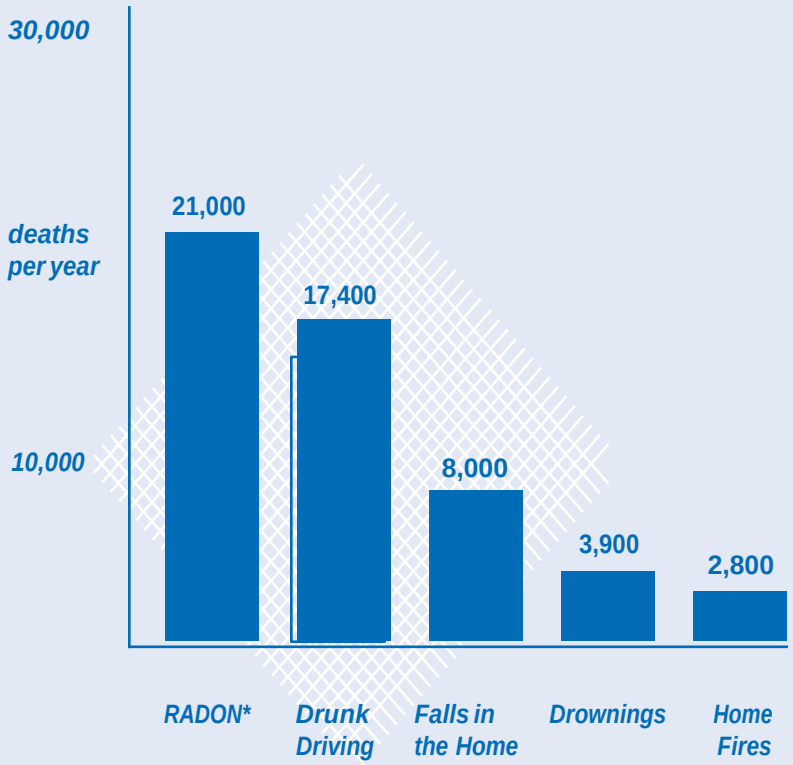
CDC
CENTERS FOR DISEASE CONTROL

Indoor Air Quality (IAQ)

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 (EPA 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.*

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 page 5).

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 page 15).

HOW DOES RADON GET INTO YOUR HOME?

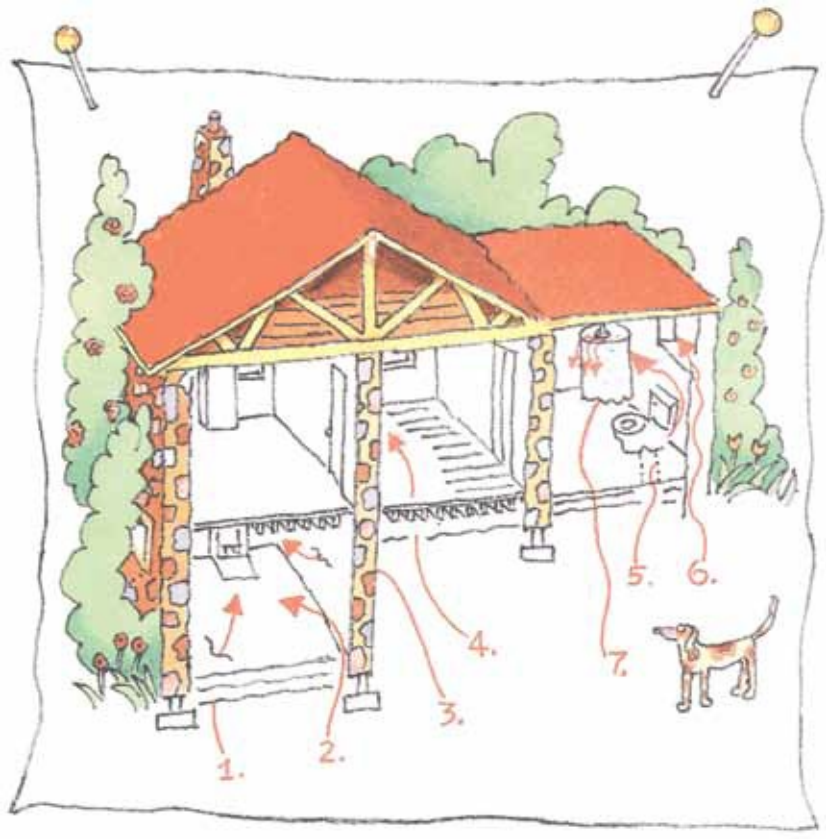
Any home may have a radon problem.

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 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.

Radon from soil gas is the main cause of radon problems. Sometimes radon enters the home through well water (see page 8). 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 (*https://www.epa.gov/radon/find-information-about-local-radon-zones-and-state-contact-information)* 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 (www.epa.gov/radon/whereyoulive.html) about radon problems in schools, daycare and childcare facilities, and workplaces in your area (also visit *https://www.epa.gov/radon*).

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." 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. 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 more information, visit *https://www.epa.gov/radon/find-radon-test-kit-or-measurement-and-mitigation-professional.*

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 also page 7 under 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 3.

- *If you followed up with a long-term test: Fix your home if your long-* ***term 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 page 7 under Home Sales).***

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.

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.

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

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, review EPA's pamphlet "Home Buyer's and Seller's Guide to Radon," which addresses some common questions (https://www.epa.gov/radon/home-buyers-and-sellers-guide-radon). 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 https://www.epa.gov/radon/find-information-about-local-radon-zones-and-state-contact-information) 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 help prevent radon from coming in. Building codes 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, consult a qualified mitigator (http://www. epa.gov/radon/find-radon-test-kit-or-measurement-and-mitigation-professional#who) to estimate the cost of upgrading to an active system by adding a vent fan to reduce the radon level. In an existing home, the cost to install a radon mitigation system is about the same as for other common home repairs.

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.

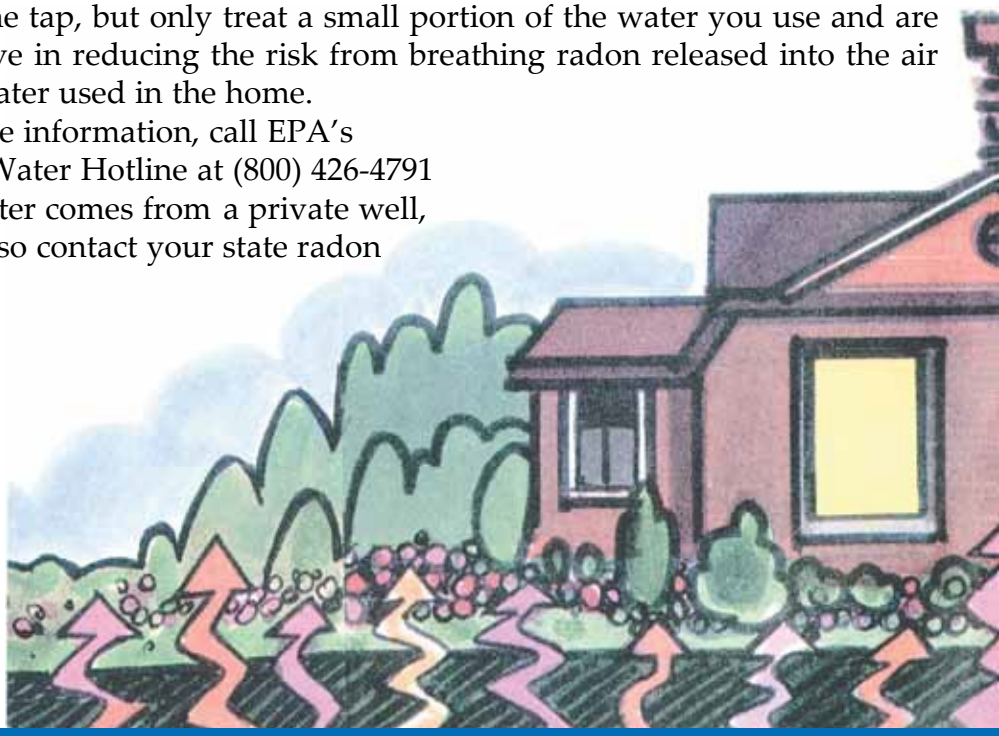
The radon in your water supply poses an inhalation risk and an ingestion risk. Research has shown that your risk of lung cancer from breathing radon in air is much larger than your risk of stomach cancer from swallowing water with radon in it. Most of your risk from radon in water comes from radon released 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 the air in your home and found a radon problem, and your water comes from a well, have your water tested.

If you've tested your private well and have a radon in water problem, it can be fixed. Your home's 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 from your water at the tap, but only treat a small portion of the water you use and are not effective in reducing 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 If your water comes from a private well, you can also contact your state radon office.



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 the 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 at –about-radon *https://www.epa.gov/radon/publications-about-radon.*

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 cost to fix can vary widely; consult with your state radon office or get one or more estimates from qualified mitigators. 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.

HOW TO LOWER THE RADON LEVEL IN YOUR HOME *continued*

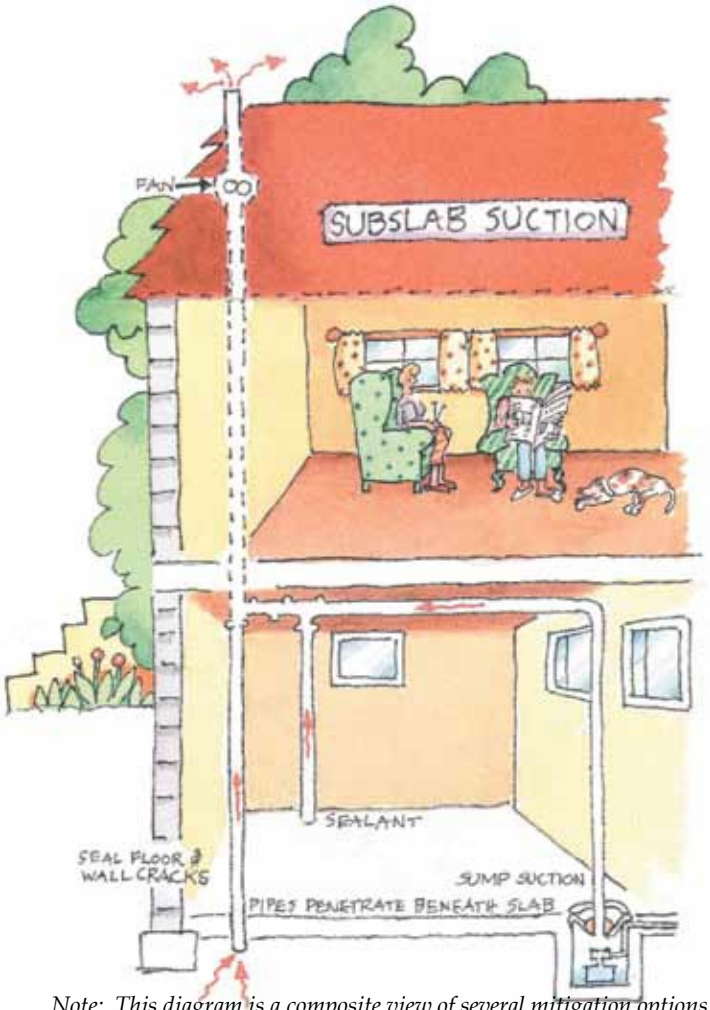
Most homes can be fixed for about the same cost as other common home repairs.

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.

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 https://www.epa.gov/radon/find-radon-test-kit-or-measurement-and-mitigation-professional. 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 https://www.epa.gov/radon/find-information-about-local-radon-zones-and-state-contact-information).

You should also test your home again after it is fixed to be sure that adon 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 also be installed on the outside ohe 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).

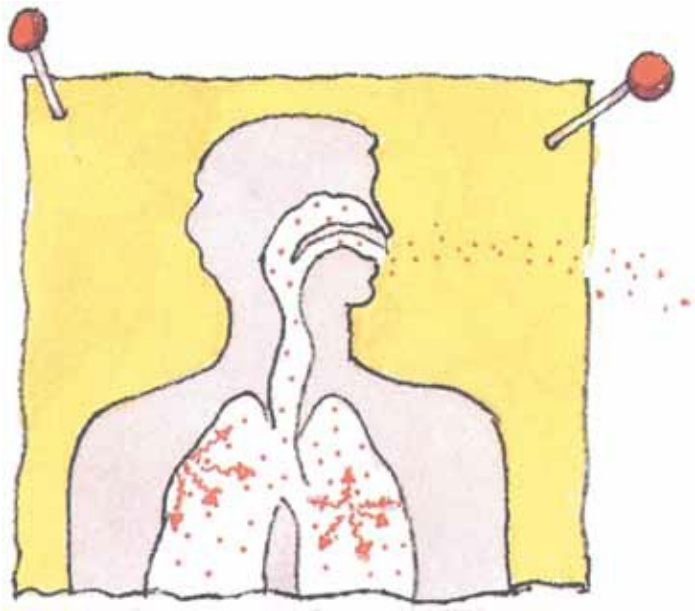
Smoking combined with radon is an especially serious health risk. Stop smoking and lower your radon level to reduce your lung cancer risk.

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***



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		(Average outdoor radon level)	

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

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.

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 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 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.

RADON MYTHS AND FACTS

MYTH: *Scientists aren't sure radon really is a problem.*	***FACT:*** ***Although some scientists dispute the precise number of deaths due to radon, all major health organizations (like the Centers for Disease Control, 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: *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. Most homes can be fixed for about the same cost as other common home repairs;*** *check with one or more qualified mitigators. Call your* ***state radon office (www.epa.gov/radon/whereyoulive.*** *html) for help in identifying qualified mitigation contractors.*
MYTH: *Radon only affects 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, 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.***

RADON MYTHS AND FACTS *continued*

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 system 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 (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 sometimes 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 your 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."*

FOR FURTHER INFORMATION

EPA Radon Website

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

Frequent Questions:
https://iaq.zendesk.com/hc/en-us/sections/202349927

Radon Hotlines

1-800-SOS-RADON (767-7236)*
Purchase radon test kits by phone.

1-800-55RADON (557-2366)*
Get live help for your radon questions.

1-800-644-6999*
Radon Fix-It Hotline. For general information on fi or reducing the radon level in your home.

1-866-528-3187*
Línea Directa de Información sobre Radón en Español. Hay operadores disponibles desde las 9:00 AM hasta las 5:00 PM para darle información sobre radón y como ordenar un kit para hacer la prueba de radón en su hogar.

1-800-426-4791
Safe Drinking Water Hotline. For general information on drinking water, radon in water, testing and treatment, and standards for radon in drinking water. Operated under a contract with EPA.

*Operated by Kansas State University in partnership with EPA.

EPA Regional Offices

https://www.epa.gov/radon/find-information-about-local-radon-zones-and-state-contact-information. Check the above website for a listing of your EPA regional office.

Ordering Radon Publications

Many EPA radon publications are available from https://*www.epa.gov /radon/ publications-about-radon*

Radon publications may be ordered through the National Service Center for Environmental Publications (NSCEP) by calling 1-800-490-9198, by visiting the NSCEP website at *https://www.epa.gov/nscep* or by email at nscep@lmsolas.com.

Surgeon General Health Advisory

"Indoor radon is the second-leading cause of lung cancer in the United States and breathing it over prolonged periods can present a significant health risk to families all over the country. It's important to know that this threat is completely preventable. Radon can be detected with a simple test and fixed through well-established venting techniques."

January 2005

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

In June 2003, the EPA revised its risk estimates 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 1998 BEIR VI (Biological Effects of Ionizing Radiation) Report which concluded that radon is the second leading cause of lung cancer after smoking.

EPA
United States
Environmental Protection
Agency

Indoor Environments Division (6609J)
EP 402/K-12/002 | May 2012 | www.epa.gov/radon

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Environmental Protection
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Healthy Indoor Environment Protocols for Home Energy Upgrades

GUIDANCE FOR ACHIEVING SAFE AND HEALTHY INDOOR ENVIRONMENTS DURING HOME ENERGY RETROFITS

HEALTHY INDOOR ENVIRONMENT PROTOCOLS FOR HOME ENERGY UPGRADES

Purpose and Scope

Millions of American homes will be retrofitted in the coming years to improve their energy efficiency, make them more "green" or add features their owners want. Integrated healthy home and energy-efficiency retrofit activities can simultaneously lower utility costs and improve indoor air quality. Leading energy-efficiency retrofit programs have demonstrated the feasibility of integrating many indoor air quality and safety improvements. However, home energy retrofit activities might negatively affect indoor air quality if the appropriate home assessment is not made before work begins and issues that may affect indoor air quality are not identified and properly addressed. The U.S. Environmental Protection Agency (EPA) developed **Healthy Indoor Environment Protocols for Home Energy Upgrades** to provide practical guidance on improving or maintaining indoor air quality and indoor environments during home energy upgrades, retrofits or remodeling.

The protocols apply to existing single-family and multi-family low-rise residential buildings. They provide guidance for conducting home assessments and undertaking the responses necessary to maintain or improve indoor air quality and safety. The protocols also can help improve the quality of home weatherization projects and other energy-efficiency retrofit or remodeling jobs, thus reducing failures and call-backs.

The protocols are intended for use by the home energy retrofit industry, including energy-efficiency retrofit and housing rehabilitation professionals and contractors, and others engaged in energy-focused residential retrofit, renovation or remodeling efforts. They are also intended for voluntary adoption by federal, state, tribal and local weatherization assistance programs, federally funded housing programs, industry standards organizations, private sector home performance contracting organizations and public and environmental health professionals.

EPA developed these voluntary protocols in coordination with the U.S. Department of Energy (DOE) Workforce Guidelines for Home Energy Upgrades (http://www.weatherization.energy.gov/retrofit_guidelines) and the White House Council on Environmental Quality (CEQ) Recovery Through Retrofit initiative (http://www.whitehouse.gov/sites/default/files/Recovery_Through_Retrofit_Final_Report.pdf).

Programs and contractors undertaking energy retrofits and renovations are encouraged to coordinate their services with local health and housing resources to provide families the support they may need.

This document is not intended to 1) set new EPA regulatory standards, 2) provide guidance on diagnosing occupant health problems or building-related illness, 3) address emerging issues that have not been linked to adverse health effects, 4) make training or training documents unnecessary, 5) provide detailed guidance on how to achieve the intent of each recommendation in all situations or 6) identify funding availability or which programmatic funding sources should be used.

How the Protocols Are Organized

This document is organized into four sections to highlight priority indoor environmental issues that may relate to home energy-efficiency retrofits.

1. **Priority Issues** are listed in Column 1.
2. The **Assessment Protocols** in Column 2 are EPA-recommended or EPA-required protocols for evaluating existing conditions of concern and the potential for additional concerns that may arise from retrofit activities.
3. The **Minimum Actions** in Column 3 include critical actions that home energy retrofit contractors should take to help ensure their work does not introduce new indoor air quality concerns or make existing conditions worse. These actions often refer to national standards and guidance; however, work should be conducted in compliance with state and local requirements as well. All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.
4. The **Expanded Actions** in Column 4 include additional actions to promote healthy indoor environments that can be taken during many home energy retrofit projects. They can be performed by properly trained home energy retrofit workers who have sufficient resources. National standards and guidance are also referenced; however, work should be conducted in compliance with state and local requirements as well. All equipment removals should include proper disposal so that hazardous units are not reinstalled or used elsewhere.

Relevant standards and guidance documents are listed in the Assessment Protocols, Minimum Actions and Expanded Actions columns for each priority issue in an abbreviated format that can be identified with more detailed information in the References section.

The icons used in these protocols are:

Indicates an issue where worker safety is a primary concern. See **Appendix A: Worker Protection** for information on assessing the risks to workers, recommended actions to minimize risks to workers' health and safety and additional resources.

Indicates an issue where occupant education is especially important. If the icon appears in a priority issue section, appropriate occupant education about health and safety is strongly recommended as part of the retrofit activities. See **Appendix B: Client Education** for recommended occupant health messages and additional resources.

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HEALTHY INDOOR ENVIRONMENT PROTOCOLS FOR HOME ENERGY UPGRADES

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
	Measures to help home energy retrofit contractors identify common indoor air quality and safety concerns in homes. This document is not a guide to diagnosing occupant health problems or building-related illnesses.	Critical actions intended to ensure work does not potentially cause or worsen indoor air quality or safety problems for occupants or workers (i.e., "Do No Harm"). EPA recommends these protections for ALL retrofit projects.	Additional actions to promote healthy indoor environments that can be taken during energy-efficiency retrofit projects. EPA recommends considering these improvements when feasible.
CONTAMINANTS			
ASBESTOS			
	Determine potential asbestos hazard. Consider the age of the structure; homes built after 1930 and before the 1970s especially may have asbestos insulation. Asbestos may also be present in other building materials in homes built or renovated prior to the 1990s. ***Note*** *Possible sources of asbestos are:* • *Attic insulation (especially vermiculite).* • *Wall insulation (e.g., vermiculite, insulation blocks).* • *Insulation on steam pipes, boilers and furnace ducts.* • *Vinyl flooring (including 9-inch by 9-inch or 12-inch by 12-inch floor tiles, vinyl sheet flooring and the mastics and other adhesives used to secure the flooring).* • *Cement sheet, millboard and paper used as insulation around furnaces and wood- or coal-burning appliances.* • *Door gaskets in furnaces and wood- or coal-burning appliances (seals may contain asbestos).* • *Soundproofing or decorative surface materials sprayed on walls or ceilings, including popcorn ceilings.* • *Patching and joint compounds and textured paints on walls and ceilings.* • *Roofing, shingles and siding (including cement or adhesives).* • *Artificial ashes and embers (used in gas-fired fireplaces).* • *Transite (cement and asbestos) combustion vent or transite flue.* • *Original plaster or plaster that is old enough to potentially contain asbestos.*	If suspected asbestos-containing material (ACM) is in good condition, do not disturb. If suspected ACM is damaged (e.g., unraveling, frayed, breaking apart), immediately isolate the area(s). For example, separate work area in question from occupied portions of the building using appropriate containment practices AND do not disturb. For suspected ACM that is damaged or that must be disturbed as part of the retrofit activity, contact an asbestos professional for abatement or repair, in accordance with federal, state and local requirements. Only a licensed or trained professional may abate, repair or remove ACM.  ***Note*** *Typically, trained professionals can repair asbestos by:* • *Sealing or Encapsulating: Treating the material with a sealant that either binds the asbestos fibers together or coats the material so fibers are not released. Pipe, furnace and boiler insulation can often be repaired this way.* • *Covering or Enclosing: Placing a protective layer over OR around the ACM to prevent release of fibers. Exposed insulated piping may be covered with a protective wrap or jacket.* • *Removing: Removing ACM may be advantageous when remodeling OR making major changes to a home that will disturb ACM, or if ACM is damaged extensively and cannot be otherwise repaired (by covering, enclosing, sealing or encapsulating).*	This cell is intentionally blank.

(Continued on next page)

ASBESTOS *(continued)*

ASSESSMENT PROTOCOLS

If unsure whether material contains asbestos, contact a qualified asbestos professional to assess the material. Sample and test as needed.

Note
The EPA vermiculate guidance referenced below includes photos to aid the identification of vermiculite insulation.

Relevant Guidance/Standards
The National Institute of Standards and Technology (NIST) maintains a list of asbestos laboratories accredited under the National Voluntary Laboratory Accreditation Program (NVLAP):

- Call NIST at (301) 975-4016 or email NVLAP@nist.gov.
- NIST/NVLAP: Accredited Laboratories for the Polarized Light Microscopy (PLM) Test Method.
- NIST/NVLAP: Accredited Laboratories for the Transmission Electron Microscopy (TEM) Test Method.

DOL, OSHA, 29 CFR Part 1926, subpart Z.

EPA Asbestos: Asbestos in Your Home.

EPA Asbestos: Regional and State Asbestos Contacts.

EPA Vermiculite.

If working in a pre-1980 building, see: Appendix A: Worker Protection – Asbestos and Confined Spaces.

Minimum Actions

When working around ACM, do not:

- Dust, sweep or vacuum ACM debris.
- Saw, sand, scrape or drill holes in the material.
- Use abrasive pads or brushes to strip materials.

Do not remove OR disturb attic insulation that looks like vermiculite unless the material has been tested and found not to contain asbestos.

Any asbestos abatement or repair work should be completed prior to blower door testing. Exercise appropriate caution when conducting blower door testing where friable asbestos or vermiculite attic insulation is present to avoid drawing asbestos fibers into the living space (i.e., use positively pressurized blower door testing) unless the material has been tested and found not to contain asbestos.

Notes
Appropriate identification of ACM is necessary to ensure the continued safety of the occupants and the safety of workers, who may not be aware of asbestos hazards.

If ACM may be disturbed during a planned retrofit, a competent person needs to conduct an initial exposure assessment to determine potential worker exposures and required exposure controls.

Asbestos awareness training is recommended for retrofit workers, especially auditors and crew chiefs.

Relevant Guidance/Standards
BPI Technical Standards: Technical Standards for the Heating Professional.

DOL, OSHA, Asbestos.

DOL, OSHA, Asbestos – Construction.

EPA Asbestos: Asbestos in Your Home.

EPA Vermiculite.

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
BELOWGROUND CONTAMINANTS (except radon)	Visually evaluate potential sources AND check for odors of gasoline, sewer gas or fuel oil. Visually evaluate the integrity of sewer vent system (e.g., ensure drain traps have water in them, inspect drain lines for breaks or leaks), particularly if there is the odor of sewer gas in the home (e.g., during the initial assessment or a fan depressurization test). If you detect an odor but cannot identify its source and the house is in a known contaminated area, notify local or state authorities AND/OR pursue additional assessment before making additional energy upgrades. If soil or groundwater contamination is suspected on or near the building site (e.g., former industrial site), volatile contaminants or breakdown products may pose an indoor air quality risk through soil gas intrusion. In such cases, EPA recommends further assessment before air sealing. Consult your state OR tribal voluntary brownfield cleanup program OR environmental regulatory agency for information on the risks of vapor intrusion in your area. **Relevant Guidance/Standards** ASTM E2600. EPA OSWER Draft Guidance for Evaluating Vapor Intrusion.	Repair or replace failed or unattached sewer vent system components before proceeding with energy retrofits. If the assessments reveal sewer gas odors from drain traps that are dry due to infrequent use, fill the traps with a non-toxic liquid that has a slow evaporation rate (e.g., mineral oil). If soil gas vapor intrusion is suspected, assess AND mitigate in compliance with state or local standards. If there are no such standards, follow EPA guidance, below, for vapor intrusion evaluation and mitigation. ***Note*** *The causes or sources of contaminants must be identified and corrected before air sealing or other weatherization retrofit actions are performed to ensure the problem is not exacerbated.* **Relevant Guidance/Standards** ASPE Data Book. Conduct work in compliance with state and local standards. Otherwise follow: ASTM E2600. EPA OSWER Draft Guidance for Evaluating Vapor Intrusion. EPA Vapor Intrusion Mitigation Approaches.	If there is an untrapped floor drain, consider installing a low-cost floor drain seal like those often used during radon mitigations, as described in ASTM E2121. **Relevant Guidance/Standards** ASTM E2121.

BUILDING PRODUCTS/ MATERIALS EMISSIONS

Review information on the contents of products being considered for purchase and installation during an energy upgrade project to determine whether they contain potentially hazardous compounds. Many of these products and materials (e.g., paints, particle board, pressed wood, insulation, sealants, plywood and cleaning supplies) may contain volatile organic compounds (VOCs), including formaldehyde, or other hazardous compounds to which exposure should be minimized or eliminated during and after an energy upgrade.

Assess ventilation to determine compliance with the Minimum Actions and Whole-House Ventilation for Distributed Contaminant Sources (page 22).

Note:
Dilution using whole-house ventilation will help reduce VOCs and other airborne contaminants from indoor sources in most homes.

In most circumstances, testing for VOCs is not necessary. If odors or occupant complaints indicate potential VOCs or other airborne contaminants, follow the source control and ventilation actions under Minimum Actions and Expanded Actions.

If working with materials associated with chemical emissions or dust generation, including spray polyurethane foam insulation, see Jobsite Safety (page 24) and Appendix A: Worker Protection.

Relevant Guidance/Standards
American Chemistry Council: Spray Polyurethane Foam Health and Safety.

DOL, OSHA, Green Jobs Hazards.

EPA SPF: Spray Polyurethane Foam, Building Occupants and Other Workers Should Vacate During SPF Installation.

Whole-House Ventilation for Distributed Contaminant Sources (page 22).

Minimize occupant and worker exposure to VOCs or other airborne contaminants by:

- Ensuring that work areas are properly isolated (e.g., by sealing with plastic sheeting) and ventilated to the outdoors during activities that result in VOC emissions (e.g., installing spray foam insulation, painting, sealing, finishing) AND that they are ventilated as close as possible to the source of those emissions.
- Using appropriate dust-control and protective equipment.
- Thoroughly cleaning work areas and allowing any odors to dissipate before re-occupancy.
- Following manufacturers' recommendations, which may indicate the need to evacuate building occupants and other unprotected individuals from work areas during and for some period after the use of a product.

Source Control
When installing new products and materials, consider using the least toxic product or material feasible to effectively do the job. For example, use products and materials that indicate they have (or are certified as having) low VOC content or low VOC emissions.

Note:
California Title 17 requires reduced formaldehyde emissions from composite wood products and finished goods that contain composite wood products sold, offered for sale, supplied, used or manufactured for sale in California.

Ventilation
Ensure the home meets the Minimum Actions in the Whole-House Ventilation for Distributed Contaminant Sources section (page 22).

Ventilate the building with as much outside air as possible before permanently occupying. Do not conduct a "bake-out" in an attempt to reduce VOC emissions after the building is occupied, because it may cause VOCs to be absorbed by other interior materials and may damage building components.

New Products Source Control
When available, specify products and materials that meet independent certification and testing protocols, such as:

- California Department of Public Health, Emission Testing Method for California Specification 01350.
- Carpet and Rug Institute (CRI) Green Label or Green Label Plus program criteria or equivalent standards for carpet.
- Collaborative for High Performance Schools (CHPS) High Performance Products Database.
- Green Seal Standard GS-11.
- Greenguard Children and Schools Certification Program.
- Master Painters Institute (MPI) Green Performance Standards GPS-1 or GPS-2.
- Scientific Certification Systems (SCS) Standard EC-10.2-2007, Indoor Advantage Gold.

When installing structural plywood or pressed or composite wood products, select those that are certified compliant with California Title 17. If California Title 17 compliant materials are not available, use products that meet section 6.1 of EPA's Indoor airPLUS Construction Specifications.

Existing Condition Source Control/ Supplemental Ventilation
If odors, complaints or testing indicate potential VOCs or other airborne contaminants, remove any potential sources (e.g., hobby materials, fiberglass that may contain formaldehyde) from the room or area. If removal is not feasible, consider installing local exhaust ventilation for sources that are isolated in a specific room or area.

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
BUILDING PRODUCTS/ MATERIALS EMISSIONS *(continued)*			
		Relevant Guidance/Standards American Chemistry Council: Spray Polyurethane Foam Health and Safety. California Title 17. EPA SPF: Spray Polyurethane Foam. Whole-House Ventilation for Distributed Contaminant Sources (page 22).	Seal composite wood products (e.g., particle board and pressed wood) that are not compliant with California Title 17 or that do not meet section 6.1 of EPA's Indoor airPLUS Construction Specifications with a sealant intended to reduce VOC emissions. Seal all exposed surfaces and holes, as appropriate. Check with vendors for recommendations on sealing their engineered wood products. If these actions do not solve the problem (e.g., persistent odors, occupant complaints), hiring an environmental professional and testing may be necessary. **Testing** If VOCs appear to be present based on odors or complaints and source control or ventilation do not alleviate the problem, testing by a qualified professional may be useful. **Relevant Guidance/Standards** California Department of Public Health, Emission Testing Method for California Specification 01350. California Title 17. CARB: Formaldehyde. CHPS. CRI. EPA Design for the Environment. EPA Indoor airPLUS Specification Section 6. Green Seal Standard GS-11. Greenguard Children and Schools Certification Program. MPI GPS-1 and GPS-2. SCS Standard EC-10.2-2007. Whole-House Ventilation for Distributed Contaminant Sources (page 22).

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
CARBON MONOXIDE (CO) AND OTHER COMBUSTION APPLIANCE EMISSIONS (NITROGEN OXIDES, VOLATILE ORGANIC COMPOUNDS [VOCs] AND PARTICULATES)			
	Locate and identify any fuel-burning combustion appliances in the home (e.g., gas, oil, kerosene, wood- or coal-burning appliances). See Combustion Safety (page 18) and Wood Smoke and Other Solid Fuel Emissions (page 16) for assessment protocols to complete safety inspections of all combustion appliances in a dwelling. Determine if there is an attached garage. See Garage Air Pollutants (page 8) for ways to locate air leaks from a garage to occupied spaces. Determine whether there are working carbon monoxide (CO) alarms and smoke alarms. Ask occupants whether they have supplemental portable combustion equipment (e.g., generators, unvented gas or kerosene space heaters). Test interior living space for CO. Avoid testing near combustion equipment that has already undergone CO testing. Test for CO outside of the home (e.g., near front entrance) to document general outdoor levels. Avoid testing near obvious sources of CO (e.g., motor vehicles, lawn equipment). **Relevant Guidance/Standards** BPI-1100-T-2010, Combustion Appliance Testing section. Combustion Safety (page 18). Garage Air Pollutants (page 8). Wood Smoke and Other Solid Fuel Emissions (page 16).	If CO levels in interior living spaces exceed outdoor levels, investigate potential sources and take appropriate action to reduce them (e.g., have a qualified professional tune, repair or replace improperly operating combustion appliances; apply weatherstripping or conduct air sealing between the garage and the home). Specify and install CO alarms in all homes. See Home Safety (page 23) for details. See Garage Air Pollutants (page 8) for recommendations on how to minimize the movement of air and contaminants (including CO and other combustion appliance emissions) from the garage to the house. See Combustion Safety (page 18) and Heating, Ventilating and Air Conditioning (HVAC) Equipment (page 17), as appropriate, for recommendations on repairing, removing or replacing combustion appliances. **Relevant Guidance/Standards** Combustion Safety (page 18). Garage Air Pollutants (page 8). Heating, Ventilating and Air Conditioning (HVAC) Equipment (page 17). Home Safety (page 23).	See Home Safety (page 23) for recommended installation of CO alarms that can detect and store peak CO levels of less than 30 ppm. See the Expanded Actions for Garage Air Pollutants (page 8) for additional recommendations on minimizing airflow from the garage to the house. See the Expanded Actions for Combustion Safety (page 18) for additional recommendations on repairing, removing or replacing combustion appliances. **Relevant Guidance/Standards** Combustion Safety (page 18). Garage Air Pollutants (page 8). Home Safety (page 23).

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
ENVIRONMENTAL TOBACCO SMOKE (ETS)			

	Single Family Dwelling: Look for signs of smoking indoors (e.g., ashtrays, cigarette packs, odors).
	
	Multi-Family Dwelling: Determine whether there is a smoke-free housing policy. Determine whether tenants have complained about smoking odors or smoking related concerns.
		Single-Family Dwelling: See Appendix B: Client Education.
		
		Multi-Family Dwelling: If there have been complaints, ask the owner if a smoke-free housing policy is being considered. If a policy has not been adopted, address the complaints through the following actions:
		• Reduce unintended excess airflow from common exhaust ventilation systems due to duct and shaft leakage, excess fan flow and unbalanced unit flows.
		• Seal enough to enable ventilation systems to increase capture in smokers' units, match flows to remove fan-induced pressure difference between units, and increase outdoor air supply ventilation rates in non-smokers' units.
		• Reduce ETS transfer from smokers' units by:
		  • Air sealing the walls, ceilings and floors that separate the unit from neighboring units, corridors, chases and stairwells. Seal smoker's unit as tightly as possible.
		  • Adjusting outdoor air and exhaust flows so the unit is negative relative to bounding wall and ceiling cavities and the overall ventilation rate for the unit has increased. Smoke current tubes or other air flow tests should show that air flows into the dwelling unit through openings in bounding walls (e.g., electrical outlets).
		
		Note
		The above air sealing strategies are intended to help reduce the exposure of occupants in the non-smoking units adjacent to the smokers' units. These actions may not reduce the risks of ETS to occupants living in the smokers' units.
		
		Relevant Guidance/Standards
		ASHRAE 62.2-2010.
		
		MNCEE: Reduction of Environmental Tobacco Smoke Transfer in Minnesota Multifamily Buildings Using Air Sealing and Ventilation Treatments.
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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
ENVIRONMENTAL TOBACCO SMOKE (ETS) *(continued)*			
		NCHH Fact Sheet: Improving Ventilation in Existing or New Buildings with Central Roof Exhaust. NCHH Fact Sheet: Improving Ventilation in Multi-Family Buildings That Do Not Have Fan-Powered Ventilation Systems. NCHH Fact Sheet: Improving Ventilation in New and Existing Multi-Family Buildings with Individual Unit Ventilation Systems.	
GARAGE AIR POLLUTANTS (CO, BENZENE AND VOCS)			
	If there is an attached garage (i.e., sharing at least one wall, ceiling, ductwork, etc.), identify the location of any air leaks from the garage to the occupied spaces that may provide pathways for hazardous emissions to enter the occupied spaces. Look for leaks around walls, doors, ceilings, ductwork, air conditioners, furnaces, chimneys and electrical and pipe penetrations. Determine (visual inspection and/or occupant inquiry) if there are unvented combustion appliances or hobby equipment that may be used in the garage. ***Note*** *If combustion appliances are present, see Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6), Vented Combustion Appliances (page 18) and Unvented Combustion Appliances (page 20) for recommended actions.* **Relevant Guidance/Standards** Carbon Monoxide (CO) and Other Combustion Appliance Emissions (page 6). Energy Conservatory: Blower Door. Unvented Combustion Appliances (page 20). Vented Combustion Appliances (page 18).	To minimize the movement of air and contaminants from the attached garage to the house, air seal walls and ceilings separating the garage from the living spaces.  At a minimum, air seal these locations (if present): • Doors (ensure tight closure AND install weather-stripping). • Electrical, plumbing and duct penetrations. • Cracks between mud sill, rim joists, subfloors and/or bottom of gypsum board. • Leaks in the ductwork and air handlers and gaps around the ductwork penetrating from the garage to the occupied space. To keep garage air from being drawn into the home, eliminate or disconnect supply diffusers and return grilles in the garage that connect to air handlers serving the occupied space. If heat is needed in the garage, use a properly installed supplemental heating system. **Relevant Guidance/Standards** ACCA 5 QI-2010. ASHRAE 62.2-2010.	Steps that can reduce air pressure in the garage and minimize flow from the garage to the house include the following: • If occupants spend significant time in the garage (e.g., the garage is used as a workshop or playroom), at a minimum, install local exhaust fan(s) rated for continuous operation and vented outdoors in attached garages in accordance with section 5.6 of EPA's Indoor airPLUS Construction Specifications or 2009 International Mechanical Code, table 403.3. • Relocate the air handling equipment and associated ductwork from the garage to an area within a conditioned space. • If accessible, add blocking in the floor system to assist with air sealing between the garage and living space in homes that have a room above the garage. • Use advanced blower door techniques (see guidance listed below) to identify air leakage pathways between the house and garage and to verify the effectiveness of air sealing. **Relevant Guidance/Standards** EPA Indoor airPLUS Specification 5.6. Home Energy, Advanced Blower Door Techniques. International Mechanical Code, 2009.

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
LEAD			
	Assume there is lead-based paint in homes built before 1978 unless testing shows otherwise. Determine whether paint will be disturbed by the work or the assessment. Consider using an EPA-recognized testing method (e.g., X-ray fluorescence [XRF] testing, or an on-site test kit) on suspect surfaces that will be disturbed in order to determine whether the paint is lead-based. The lead-safe work practices minimum and expanded actions apply only to paint assumed to be or tested to confirm that it is lead-based. **Relevant Guidance/Standards** HUD Title 24. EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. EPA Lead. EPA Lead-Based Paint Renovation, Repair, and Painting Program: Small Entity Compliance Guide to Renovate Right. If working in a pre-1978 building, see Appendix A: Worker Protection – Lead. 	Comply with EPA's Lead-Based Paint Renovation, Repair, and Painting (RRP) Program Rule. Among the rule's key elements are: • Use a Certified Renovator. • Follow lead-safe work practices if disturbing more than 6 ft^2 of interior or 20 ft^2 of exterior painted surfaces. • Contain the work area to avoid resident exposure. • Minimize lead dust and leave no dust or debris behind. • Achieve visual post-cleaning criteria. Comply with state and local lead-related regulations, which may be applicable to lead hazard reduction activities and may require additional certified personnel. ***Note*** *This is not a complete summary of the regulatory requirements. The intent of this protocol is to promote the most health-protective steps that are feasible and practical. The minimum action recommended in this protocol is to comply with whatever the most current version of the RRP Program Rule prescribes.* **Relevant Guidance/Standards** DOL, OSHA, Lead. EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. EPA Renovation, Repair and Painting (RRP) Program Rule: 40 CFR Part 745. EPA Lead Accredited Training Programs.	Follow the U.S. Department of Housing and Urban Development (HUD) lead-safe rehabilitation practices. In addition to EPA's RRP, these HUD practices: • Lower the thresholds for interior painted surface area from 6 ft^2 to 2 ft^2. • Require repair of painted surfaces that are disturbed when using lead-safe work practices. • Require meeting lead dust clearance testing standards if more than 2 ft^2 of paint is disturbed. ***Note*** *Lead dust clearance testing includes measuring for lead dust on floors, windowsills and window troughs. See NCHH Fact Sheet: Testing for Lead-Contaminated Dust.* **Relevant Guidance/Standards** EPA Renovation, Repair and Painting (RRP) Program Rule: 24 CFR Part 25, subpart J. HUD Lead Safe Work Practices. NCHH Fact Sheet: Testing for Lead-Contaminated Dust.
MOISTURE (MOLD AND OTHER BIOLOGICALS)			
	Inspect the interior and exterior of the building for evidence of moisture problems. Document the extent and location of the problems, and the proposed repairs, to avoid exacerbating the problems when the repairs are made. Examples of moisture and mold problems are: • Water damage or stains. • Foundation cracks that leak water. • Visible mold growth.	Repair roof leaks before air sealing or insulating the attic. Address surface water pooling near the foundation before insulating basement or crawlspace walls near wet areas.	Repair additional moisture problems identified during the assessment (e.g., plumbing leaks, rain leaks including leaks around windows and flashing, and foundation leaks). Retrofit crawlspaces so that they are unvented, sealed, insulated, properly drained and waterproofed, following guidance in section 1.4 of EPA's Indoor airPLUS Construction Specifications.

(Continued on next page)

PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MOISTURE (MOLD AND OTHER BIOLOGICALS) *(continued)*			

	• Wet or damp spots.
	• Musty odor.
	• Moisture damage on windows.
	• Groundwater, surface water and rainwater intrusion.
	• Plumbing leaks.
	• Condensation.
	• Consider temperature, relative humidity and absolute humidity (e.g., dew point temperature and humidity ratio [i.e., pounds or grains of water vapor per pound of dry air]).
	
	Determine whether the project requires mold remediation and additional moisture control measures (e.g., as determined during a Weatherization Assistance Program audit).
	
	Document which moisture problems will be addressed as part of the energy-conserving project, and which must be repaired by the homeowner or another contractor before certain, specific energy conserving measures can be implemented.
	
	If moisture issues cannot be addressed, do not install energy upgrades that will reduce the home's air infiltration rate. Homes where this may be the case include those that have significant condensation or humidity problems, such as condensation on multiple windows, condensation in attics or significant moisture or mold problems that are beyond the scope of the remedies under Minimum Actions.
	
	See Appendix A: Worker Protection – Mold and Confined Spaces as appropriate.
		Manage rainwater in assemblies receiving retrofits (e.g., drainage planes and flashings), following guidance in EPA's Indoor airPLUS Construction Specifications 1.5 and 1.6.
		
		Ensure proper HVAC condensate drainage.
		
		Prevent condensation in the enclosure by:
		• Air sealing the enclosure. *Note: This also prevents ice dams in cold, snowy climates.*
		• Managing water vapor flow and condensing surface temperatures to avoid dew point conditions (achieved by selection of materials with appropriate combination of R-value and vapor permeability).
		• Managing air pressure relationships as needed.
		• Controlling indoor humidity sources, for example:
		  • Ensuring bath fans are operating properly and vented to the outdoors.
		  • Ensuring clothes dryers are correctly vented to the outdoors.
		  • Covering earthen floors in basements and crawlspaces with sealed vapor barriers; seal sump crocks.
		  • If adding an air conditioning (AC) unit, ensure it is sized properly. If the relative humidity or moisture in the air is high, evaluate whether the AC unit is oversized.
		  • Install dehumidifiers, if appropriate.
		  • Remove unvented combustion space heaters.
		  • Ensure proper crawlspace ventilation.
		  • Ensure proper attic ventilation, unless sealed or conditioned.
		
		Conduct any required mold remediation following EPA or other professional guidance (see see Appendix A, Mold section, page 34).
		
		See Mold and Moisture section in Appendix B: Client Education.
			Perform additional activities, beyond those required for the weatherization project, in order to remediate any mold growth. Follow EPA or other professional guidance (see Appendix A, Mold section, page 34).
			
			Relevant Guidance/Standards
			EPA Indoor airPLUS Specification: 1.4.
			
			EPA Mold Remediation.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
MOISTURE (MOLD AND OTHER BIOLOGICALS) *(continued)*			
	Relevant Guidance/Standards DOE: Workforce Guidelines for Home Energy Upgrades (under development).	***Notes*** *Replacing an atmospherically vented or fan-powered combustion device that draws combustion air from inside the home with a high-efficiency sealed combustion device can reduce the ventilation rate, which could result in cold-weather condensation in some building enclosures.* *If an atmospherically vented combustion device is causing an indoor humidity problem, it should be repaired in accordance with the Combustion Safety section (page 18).* **Relevant Guidance/Standards** Combustion Safety (page 18). DOE: Workforce Guidelines for Home Energy Upgrades (under development). EPA Indoor airPLUS Specifications 1.5 and 1.6.	
OZONE			
	Determine if there is any air-cleaning equipment designed to intentionally produce ozone (i.e., ozone generators) in the house. **Relevant Guidance/Standards** CARB: Ozone.	Do not install air-cleaning equipment designed to intentionally produce ozone (i.e., ozone generators). Recommend removal of air-cleaning equipment designed to intentionally produce ozone, if present. **Relevant Guidance/Standards** EPA Indoor airPLUS Specification 4.7. EPA IAQ: Ozone Generators that are Sold as Air Cleaners.	This cell is intentionally blank.
PESTS			
	Identify evidence of mice, squirrels or other rodents; termites; birds; bats; cockroaches or other pests. Note the location and identify pest-contaminated materials (e.g., nests, feces). Determine whether rodenticides or pesticides are being used. Remove pest-infested materials OR determine if professional assistance is needed to do so before conducting energy retrofit work in pest-infested areas.	Alert owner of any termite infestations and inform owner of the need to seek assistance from an integrated pest management (IPM) professional (e.g., Greenpro, Greenshield or equivalently trained IPM professional). In areas with evidence of rodent infestations, patch with pest-resistant materials (e.g., copper mesh, hardware cloth, sheet metal, concrete) exterior holes that are larger than ¼ inch by ⅜ inch before applying air sealing materials (e.g., caulk or foam) OR before insulating.	Protect air intakes from potential bird and pest entry (e.g., cover openings with ½-inch screen or galvanized mesh). Protect exhaust vents from rodent, bird and pest entry (e.g., cover openings with louvers). Avoid creating conditions that can clog exhaust, particularly dryer vents.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
PESTS *(continued)*	***Note*** *Termite and some other types of pest infestations are often an indication of moisture problems. See Moisture (page 9) for diagnosing moisture problems.* **Relevant Guidance/Standards** AFHH. CDC Resource on Rodents.	Advise owner/resident to regularly clean/fix screens or dampers over exterior air intakes and exhausts (e.g., at least semi-annually or when replacing HVAC filters). Remove clutter, eliminate wood piles near house, and remove bushes, trees or other vegetation closer than two feet from the structure.  **Relevant Guidance/Standards** EPA IPM. NCHH IPM. New York City Department of Health and Mental Hygiene.	Follow IPM guidelines for roach control AND, if feasible, apply boric acid or gels in holes for roach issues. Follow relevant state pesticide applicator standards. ***Note*** *Some states require that pest management professionals be licensed.* Provide sealable outside garbage cans OR advise clients to use them. **Relevant Guidance/Standards** ASHRAE 62.2-2010. EPA IPM. New York City Department of Health and Mental Hygiene.
POLYCHLORINATED BIPHENYLS (PCBs)	Determine whether fluorescent light ballasts containing polychlorinated biphenyls (PCBs) are present. ***Note*** *Some homes may contain fluorescent light fixtures with ballasts manufactured before 1979 that contain polychlorinated biphenyls (PCBs). Ballasts manufactured between 1979 and 1998 that do not contain PCBs were required to be labeled "No PCBs." Newer fluorescent lighting typically uses electronic ballasts that do not contain PCBs and should be clearly marked as electronic.* **Relevant Guidance/Standards** EPA PCB-Containing Light Ballasts.	If fluorescent light ballasts do not have the statement "No PCBs" or are not marked as electronic, assume that the ballasts contain PCBs and replace with new lighting fixtures OR contact the manufacturer to determine whether the ballasts contain PCBs. If the manufacturer is not sure whether the ballasts contain PCBs, assume that they do and replace with new lighting fixtures. **Relevant Guidance/Standards** EPA PCB. EPA PCB-Containing Light Ballasts.	The presence of PCBs may not be limited to fluorescent light ballasts. PCBs were also used in other products, including caulk. See EPA's website on PCBs for a complete list of products of concern, and where possible, remove and replace them. **Relevant Guidance/Standards** EPA PCB. EPA PCBs in Caulk.
RADON	Follow one of two testing options to determine the radon level as summarized below and in Table 1. **Option 1: Test-In/Test-Out** – Test for radon before and after energy upgrade work. **Option 2: Post-Work Test** – Test for radon only after completing energy upgrade work.	Before completing retrofit activities, take precautionary measures listed below in Column 1 of Table 1, depending on pre-work test results. After work, follow the appropriate Minimum and/or Expanded Actions outlined in Table 1, depending on post-work test results.	Additional actions to reduce radon exposure are summarized below and outlined in Table 1. • Mitigate according to ASTM E2121 when the post-work radon level is ≥ 4 pCi/L. • If the post-work radon level is between 2 and 4 pCi/L, refer the client to EPA's Citizen's Guide to Radon or mitigate in accordance with ASTM E2121.

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PRIORITY ISSUES	ASSESSMENT PROTOCOLS	Minimum Actions	Expanded Actions
RADON *(continued)*			

Perform radon testing in accordance with applicable state requirements or federal guidance. Individuals conducting tests should be trained or certified by either of these groups:

- National Environmental Health Association (NEHA) National Radon Proficiency Program.
- National Radon Safety Board (NRSB).

Notes

Two radon tests may be performed simultaneously and averaged to increase confidence in the short-term test result. This approach can be used for both pre- and post-work testing. Another option is to take two tests sequentially. DO NOT average the pre-work and post-work test results.

Long-term testing is the most accurate way to test for radon, but it may not be feasible. See EPA's Citizen's Guide to Radon for information on long-term testing.

The recommended testing protocols are designed to ensure that radon exposure does not increase above EPA thresholds in homes where radon levels are initially below those thresholds. This protocol is not designed to mitigate radon risks that existed prior to the energy upgrade. All clients should be provided with radon testing results.

Determine whether the home has an active or passive radon mitigation system.

Note

Active mitigation systems include a radon vent fan, usually located in an attic, in an attached garage or on the building exterior.

Relevant Guidance/Standards

ASHI Radon Mitigation System Inspection Checklist.

EPA Radon Guidance: Guidance for Radon Testing and Mitigation.

EPA Radon: State Radon Contact Information.

When the pre-work radon level is ≥ 2 pCi/L, complete precautionary foundation air sealing strategies:

- Cover exposed earthen floors in basements and crawlspaces according to section 1.2 of EPA's Indoor airPLUS Construction Specifications.
- Air seal sumps (e.g., install an airtight sump cover) in such a way that water can drain from above and below the sump cover.
- Install airtight drain fittings (e.g., trap or flange system) in foundation floor drains.
- Seal and caulk penetrations, openings or cracks in below-grade walls and floors that contact the ground with a sealant that meets the requirements of ASTM C920.

Note

These foundation air sealing strategies are also important elements of radon mitigation according to ASTM E2121, which addresses both foundation air sealing and fan-powered radon mitigation systems.

Educate the client about the test results and radon reduction measures that were followed. Inform the client that the radon testing protocols were completed to ensure that the energy upgrade work did not introduce indoor radon problems, but the protocols do not necessarily mitigate a prior indoor radon problem in the home. Advise the client to refer to EPA's Citizen's Guide to Radon for more information about radon risk.

Mitigate in accordance with ASTM E2121 if:

- Option 1: Post-work radon level is ≥4pCi/L AND it exceeds the pre-work radon level OR
- Option 2: Post-work radon level is ≥4pCi/L AND no pre-work levels were taken.

Relevant Guidance/Standards

ASTM C920.

ASTM E2121.

EPA Radon. State Radon Contact Information.

EPA Radon Guidance: Citizen's Guide to Radon.

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