



# Radon

Keep your home safe from radon



**Indiana**  
Department  
of  
**Health**

# What is radon?

Radon is a colorless, odorless, and tasteless gas that comes from the breakdown of uranium in soil. Radon gas decays into radioactive particles that cause damage to lungs when inhaled. Exposure to radon is the second leading cause of lung cancer, and it is estimated that **21,000 people die each year in the United States from lung cancer due to radon** exposure.

The only way to know if your home has high levels of radon is to conduct a radon test. If your home has high radon levels, a radon mitigation system can be installed to reduce radon concentrations.

The Indiana Department of Health (IDOH) has created this guide to explain:

- how radon accumulates in homes
- the health risks of radon exposure
- how to test your home for radon
- what to do if your home has high radon, and
- radon policies and professional licensing.



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# Where does radon come from?

Radon is produced from the natural decay of uranium and radium, found in rocks and soil. Uranium breaks down to radium and radium eventually decays into radon gas. Because soil is porous, radon moves up from the soil and into a home or building. Radon gas can become a health concern as it accumulates to high levels in the air we breathe.

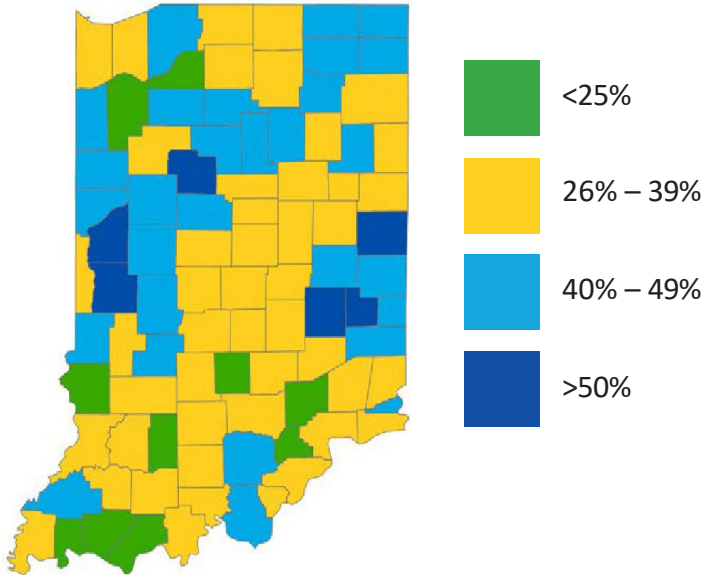
## Radon in Indiana

Radon is a serious public health concern in Indiana. Nation-wide, radon is the second leading cause of lung cancer, contributing to the death of **21,000 people per year**. **In Indiana, it is estimated that 1 in 3 homes have radon levels that pose a serious health risk.**



*Any home can have high radon, whether old or new, well-sealed or drafty, with or without a basement.*

## Percent of IN Properties Tested for Radon that are $\geq 4$ pCi/L (2010 – 2016)

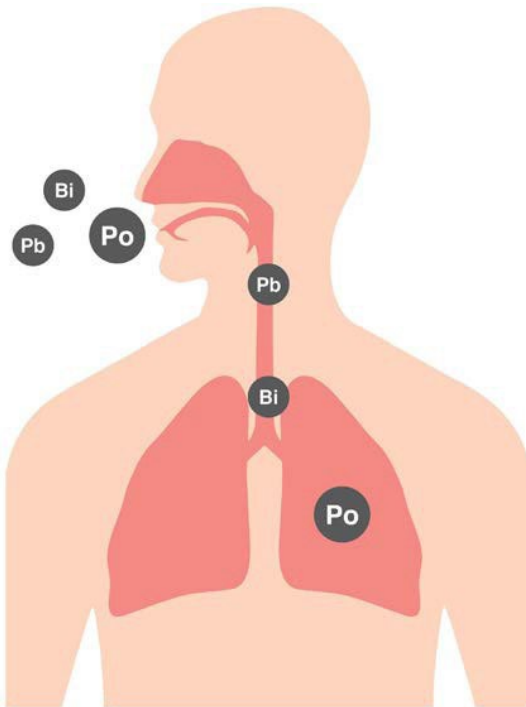


## Is there a safe level of radon?

Any radon level poses some health risk. While it is not possible to remove radon completely, the best approach is to lower radon levels as much as possible. The Environmental Protection Agency (EPA) has set the action level at 4 pCi/L (picocuries of radon per liter of air). It is highly recommended that residents with homes that test at or above 4 pCi/L install radon mitigation systems to decrease radon levels.

# Radon health risks

Radon is the leading cause of lung cancer in non-smokers and the second leading cause of lung cancer in smokers. Your risk for lung cancer increases with higher levels of radon and longer periods of exposure. If you smoke, the combined risk for developing lung cancer due to smoking and radon exposure is much higher. Reducing smoking and radon exposure greatly reduces your lung cancer risk.



# How radon enters the home

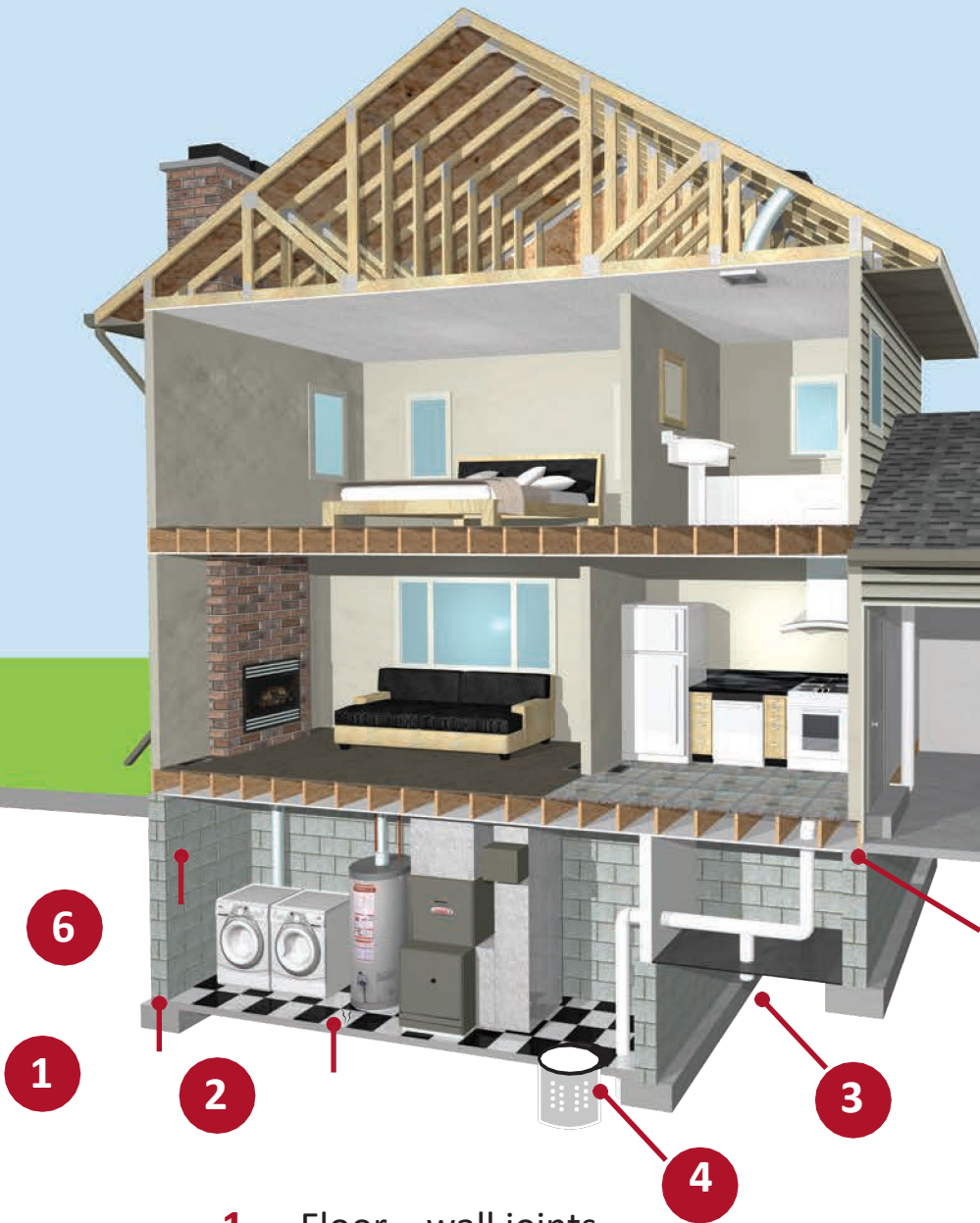
Ambient outdoor radon levels are very low, but radon can accumulate to high concentrations in a home. Indoor radon concentrations depend on radon levels in the soil, pathways for radon to enter the home, and air pressure differentials. Air pressure differences between outdoor and indoor air act to drive radon into a home or building. Some homes pull more radon into the home than others due to greater pressure differences and available pathways.



**Source** – High levels of radon are naturally found in Indiana soils.

**Pathways** – Routes the gas takes to enter the home, usually through openings between the soil and the home. These may include cracks in the concrete slab, floor-wall joints, an open sump pit, or untreated crawl space.

**Air Pressure** – Differences in air pressure between the home's interior and the soil can pull radon gas into the home through the pathways.



- 1** Floor – wall joints
- 2** Pores and cracks in concrete blocks or slabs
- 3** Exposed soil, such as in a crawlspace





# Radon Pathways



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The examples provided here are the most common pathways.

- 4 Sump pit
- 5 Open tops of block walls
- 6 Mortar joints

## Air pressure

Homes commonly operate at a lower ('negative') pressure compared to the outside air. This pressure difference creates a vacuum and outside air can be pulled into the home through openings like doors, windows, and common radon pathways beneath a home. There are three main components contributing to air pressure changes in the home that can bring in radon gas.



**Stack Effect** – Warm air rises to the upper portion of the home and is lost to the outside air. Make up air enters the lower part of the home, and some make-up air comes from the soil.



**Down Wind Draft Effect** – Strong winds can blow over the top of a home, pushing and pulling air into and out of the house.



**Vacuum Effect** – Appliances (water heaters, fireplaces, clothes dryers, older furnaces, etc.) and exhaust fans remove air from a home. This can drive soil gas into a home as make-up air enters the lower part of the house.

# Foundations

Any home can have a radon problem, no matter the type of foundation.



A **basement** provides a large surface area in contact with the soil and radon can enter through different pathways. Taller homes also add potential for a greater stack effect.

Homes built **slab-on-grade** have many openings that allow radon to enter, similar to a basement.



Homes built with **crawl spaces** are directly connected to the soil and create a pathway for radon to enter the home.

**Manufactured homes with solid skirting** act like crawl spaces and provide a direct connection to the soil.



# Radon testing

IDOH recommends that all Indiana residents test their homes for radon. Radon is colorless, odorless, and tasteless, which means that conducting a radon test is the only way to find out how much radon is in your home. You can test your home yourself or hire a professional. Most radon tests can be performed on your own, once you familiarize yourself with the instructions. Hiring a radon measurement professional is recommended when an unbiased third party is needed, such as in a real estate transaction.

## Types of radon test kits



### Short-term

A short-term test measures radon levels for 2 – 7 days and is a quick way to screen a home for radon. When you test for radon you should start with a short-term test.

## Long-term

A long-term test measures radon levels for a period greater than 90 days. Long-term tests are the best way to estimate the annual average radon level in the home. Long-term testing should include part of the heating and non-heating seasons.

## How often should I test for radon?

- All homes should be tested for radon every 2 – 5 years.
- It is recommended that you retest after adding a radon mitigation system to make sure it is working properly.
- Test before and after you make changes to your home, like finishing a basement, adding an addition, installing a vent hood in your kitchen, or modifying your home's central air conditioning or heating system.

## Where can I get a radon test kit?

A radon test kit costs between \$5 and \$30, depending on the type of kit. Some test kits may also require an analysis fee paid after mailing the kit to the lab. Your local health department or government agency may also offer test kits at reduced prices. You may also call the Indiana Radon Hotline at (800) 272-9723 to inquire about discounted radon test kits.

# RADON TESTING GUIDELINES

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**Instructions** – Read the instructions that come with the radon test kit and fill out the information. Check the expiration date on the kit.

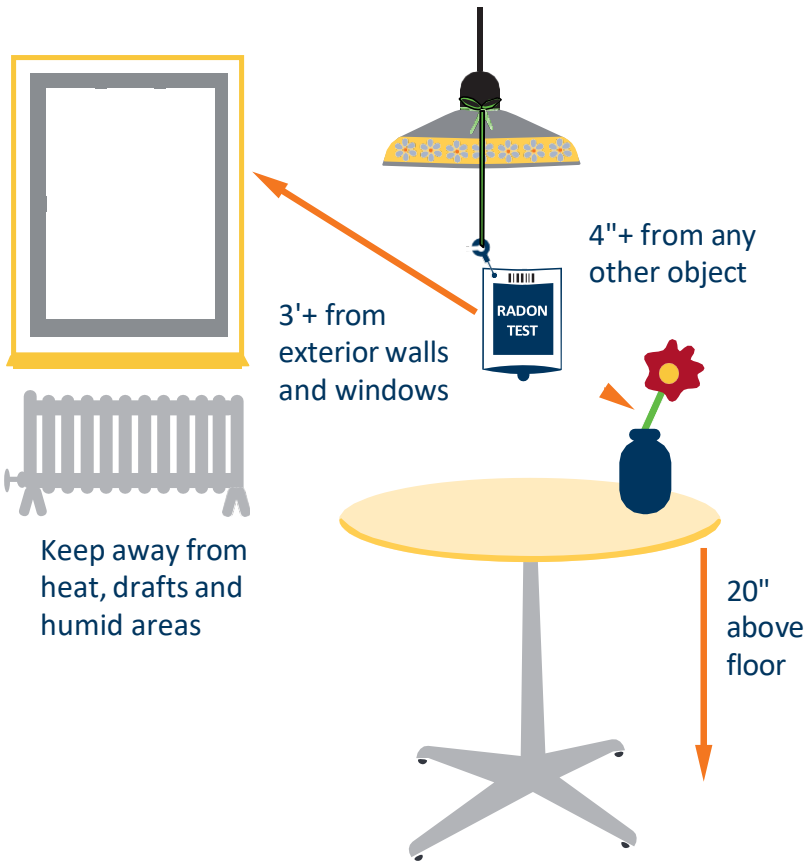
**Time of Year** – Short-term tests can be completed any time of year, but the heating season is the best time to test. Long-term tests should include some of the heating and non-heating seasons.

**Weather** – Weather can affect the radon levels in the home. If there is severe or unusually windy weather, wait to perform a short-term test.

**Test Location** – Test the lowest level of the home that is regularly used. For example, if you have a finished basement with a regularly used living area, we recommend testing the basement. For real estate transactions, test the lowest level that can be occupied (livable). Place the test kit at least 20 inches off the floor where it will not be disturbed. Keep the kit at least 3 feet from exterior walls and windows and away from drafts. Keep away from high humidity areas like kitchens, baths, and laundry rooms. Keep away from heat sources, like fireplaces and furnaces.

**Home Conditions** – Any test lasting fewer than 3 months requires closed-house conditions. This means keeping all windows and exterior doors closed, except for normal entry and exit.

# Test Device Placement



Once the test is finished, seal the package and send to the lab immediately. Make sure all information is completed and note the test kit ID number for future reference.

# Radon test results

You should **complete two tests** before deciding to install a radon mitigation system, except when a professional uses a continuous radon monitor. **Start with a short-term test.**




## Initial short-term test

| Result (pCi/L) | Action                                                           |
|----------------|------------------------------------------------------------------|
| 0 – 1.9        | Retest every 2 to 5 years                                        |
| 2 – 8          | Perform a follow-up long-term test                               |
| Greater than 8 | Perform a follow-up short-term test or consider radon mitigation |





## Second test (either short or long-term test)

| Result (pCi/L)                                                                                   | Action                                     |
|--------------------------------------------------------------------------------------------------|--------------------------------------------|
| 0 – 1.9         | Retest every 2 to 5 years*                 |
| 2 – 3.9        | Consider a radon mitigation system         |
| 4 or greater  | Highly recommend a radon mitigation system |

*\* If the initial test was 8 pCi/L or above, consider performing a long-term test.*

# Radon mitigation systems

Radon mitigation is any process or system used to reduce radon concentrations in buildings. The goal of a radon mitigation system is to reduce indoor radon concentrations as much as possible. All systems should reduce radon below the EPA action level of 4 pCi/L. A quality radon mitigation system may reduce year-round levels to below 2 pCi/L.

A home's foundation type helps determine the radon mitigation system that will work best. A radon professional should determine the type of mitigation system to install and may conduct diagnostic testing. Radon mitigation systems use a fan to continuously pull air from the soil and exhaust it outdoors through a pipe. The pipe can either run inside or outside the home and discharges outside, away from windows and openings. In addition, cracks and openings in the foundation are sealed. Sealing cracks and openings in the foundation limits the flow of radon into a home and makes the radon mitigation system more efficient.

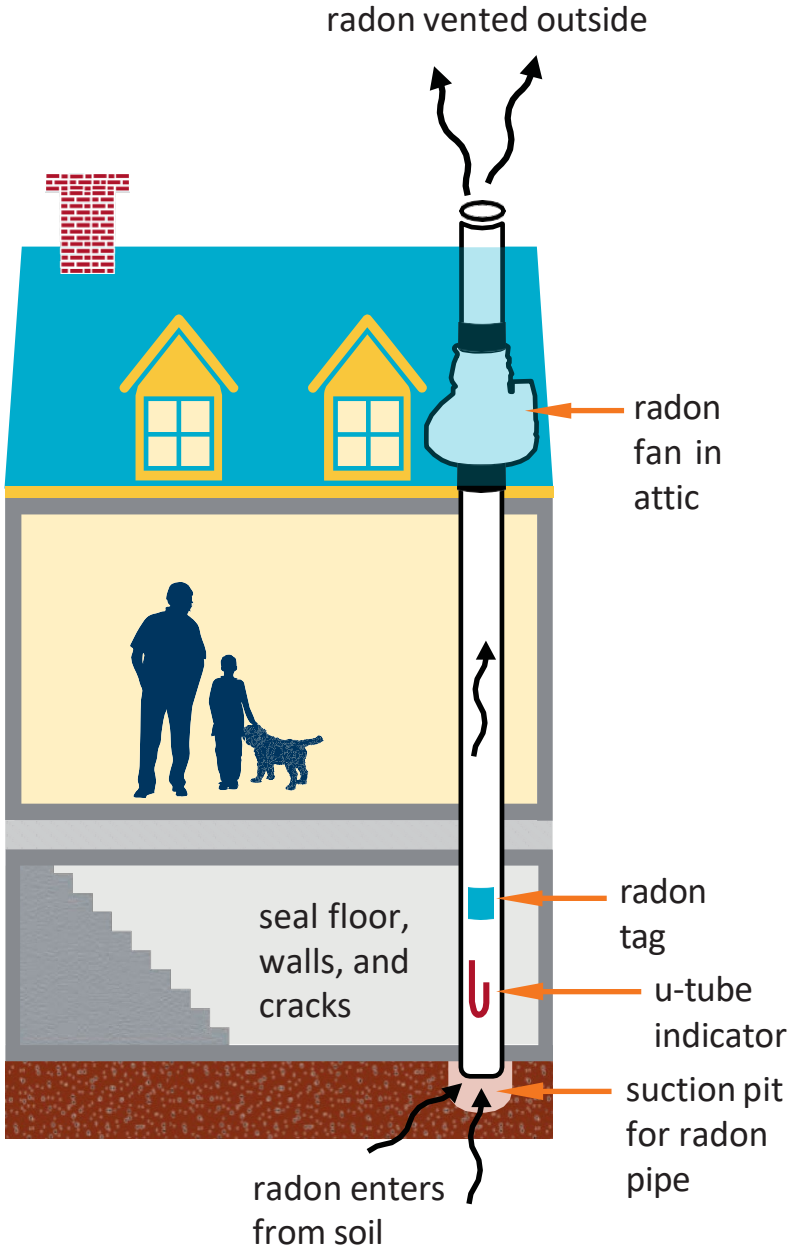
Prior to the installation of a radon mitigation system, homeowners should request that the licensed radon mitigation professional provide a detailed explanation of the system's components and how it will operate.



## Three of the most common types of radon mitigation systems

1. **Sub-slab suction** – This radon mitigation system pulls radon directly beneath the home's foundation and vents it outside.
2. **Drain tile suction** – This radon mitigation system's pipe penetrates into the drain tile and vents the soil gases outside. Covers are placed on the sump baskets.
3. **Sub-membrane** – Used in crawl spaces, a plastic sheet covers exposed dirt on the floor, extends up onto the wall and is sealed. A radon pipe penetrates the plastic sheeting, pulls the soil gas from the crawl space, and vents it outside.

# Radon mitigation system diagram



# Understanding basic radon mitigation system components



The **radon fan** is located in an unconditioned space, like an attic or outside, to prevent radon from leaking back into the home. The fan is plugged into an electrical junction box or hard wired.

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The **U-tube manometer** is a monitoring device that is installed with every system. The u-tube visually indicates if the fan is working.

"J" shape shows fan is **working**



"U" shape shows fan is **not working**



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The **radon pipe vent discharge** should be:



- 10+ feet above ground
- 10+ feet away from windows, openings, doors, and openings to adjacent buildings
- Above the edge of the roof

## Finding a professional to install a radon mitigation system

Professionals that install radon mitigation systems or measure for radon must be licensed in Indiana. A licensed professional has completed training, passed an examination, and completes continuing education. A list of licensed radon professionals is available on IDOH's website (<https://www.in.gov/health/lead-and-healthy-homes-division/>).

## Cost of a radon mitigation system

The cost of a radon mitigation system can depend on many factors including the type of radon system to be installed and how your home was built. In general, costs can range from \$1,500 to \$2,500.

# KEY QUESTIONS

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to ask a radon professional before installing a radon mitigation system

- Will a licensed Indiana radon mitigation professional install the system?
- Will diagnostics be performed to determine the best location for the radon pipe and fan size?
- Will permits be required, and who is responsible for obtaining the permits if they are necessary?
- If needed, who will do the licensed electrical work?
- Will a contract be provided?
- Is there a warranty on materials or workmanship? If so, for how long?
- Will an explanation of how the radon mitigation system works be given?
- Will the mitigation professional conduct a follow-up test to ensure that radon levels have been reduced?
- Will they guarantee levels below the EPA action level? And if the level is not reduced, how will it be fixed?
- Will a list of references be provided?
- Is the quoted price guaranteed?



# 10 STEP GUIDE

to the radon mitigation process

## Before mitigation

1



Radon test reveals the home has a radon problem.

2



Contact licensed radon mitigation professionals to request bids.

3



Professional does a walk-through of the home to identify the mitigation system to install.

4



Review key questions with professional, and request a proposal.

5



Review bids and select a professional.



## Before mitigation • During mitigation

### After mitigation

#### During mitigation

6



Professional may perform diagnostic testing to ensure proper fan size and correct installation.

7



Professional seals cracks and openings in the basement.

8



Professional installs the radon mitigation system.

#### After mitigation

9



Professional provides a full explanation of how the system operates to the homeowner.

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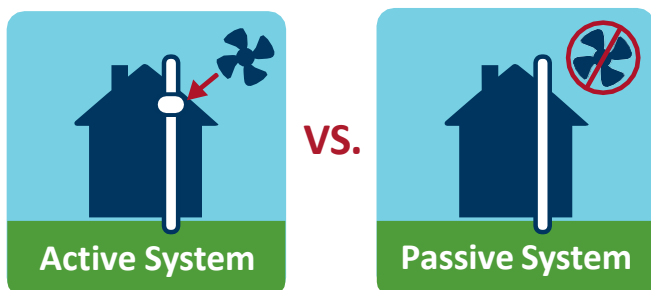
Retest the home to ensure the system has reduced radon levels.

# Radon resistant new construction

Indiana does not require radon resistant new construction (RRNC), but it is recommended. RRNC home builders must use materials and techniques to help prevent radon from entering a home. Common RRNC practices include sealing radon entry points and installing passive radon mitigation systems that do not include radon fans. Passive radon mitigation systems rely on the natural upward flow of air to exhaust radon through the pipe.

Home builders in Indiana may offer an option to activate a passive radon mitigation system by installing a radon fan. An active radon mitigation system that includes a fan is more effective than a passive radon system. An active system may have the added benefit of decreasing moisture and soil vapors that may be present. If you are building a new home, ask your builder about adding an active or passive radon mitigation to your home.





## Homes built with an active system will be required to have:

1. All passive radon system features. This includes a vent pipe that travels from below the foundation through the roof. It also includes the sealing of openings, joints and penetrations in the foundation.
2. A fan installed in an unconditioned space, such as an attic.
3. A device to monitor whether the fan is working.
4. An outlet label installed next to the radon pipe.
5. A checklist affixed to the radon pipe explaining the radon system.
6. A label on the radon pipe providing a description of the fan size and its estimated energy usage.
7. A post-construction radon test to confirm that the system is operable, and the radon levels are low.

# Radon in real estate

## Radon testing and mitigation in real estate

Radon testing and mitigation are not required during real estate transactions, but testing is highly recommended. A buyer may request that a radon test be included in the home's inspection. However, IDOH recommends a hiring a licensed radon professional to conduct testing during real estate transactions when an unbiased third-party is desired.

## Radon testing procedures

Any real estate testing requires closed-house conditions. This means that all windows and doors must be kept closed, except for normal entry and exit. Home heating and cooling systems may be operated normally throughout the test. It is recommended that radon tests conducted for real estate transactions be performed in a way that includes all occupiable foundations of the home.

For example, if a home has both a crawlspace and a basement, a test would need to be conducted over each foundation type.



# Conducting the radon test in real estate transactions

A radon professional should conduct the test. Tests are conducted for a minimum of 48 hours. The average concentration reported over the duration of the test is the concentration that will be used to determine if mitigation is necessary. For real estate transactions, continuous radon monitors or simultaneous short-term tests are most commonly used.



## Continuous radon monitor (CRM)

This calibrated electronic monitor measures hourly levels. Other data may also be collected to ensure a valid test.



## Simultaneous short-term testing

Two short-term test kits are used at the same time, placed 4 inches apart. Tests are sent to the lab for analysis. The two test results are averaged to give an overall radon level.



## Recommendations for buyers

### If the home has been tested

The buyer must decide if the results of past tests are acceptable. Items to consider include:

- What was the level of radon found?
- What was the duration of the test?
- When was the test performed?
- What area of the home was tested?
- Who performed the test?

### If the home has not been tested

The buyer should decide if they wish to request testing. If yes, some items to consider include:

- Who will perform the test?
- What type of test will be performed?
- What area of the home will be tested?
- How will the results be shared?
- At what level will a radon mitigation system be installed?
- Who will pay for it?





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Radon Hotline: 1-800-272-9723

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