

American Lung Association of the Upper Midwest

Radon Measurement Devices and Protocols

*Presented by
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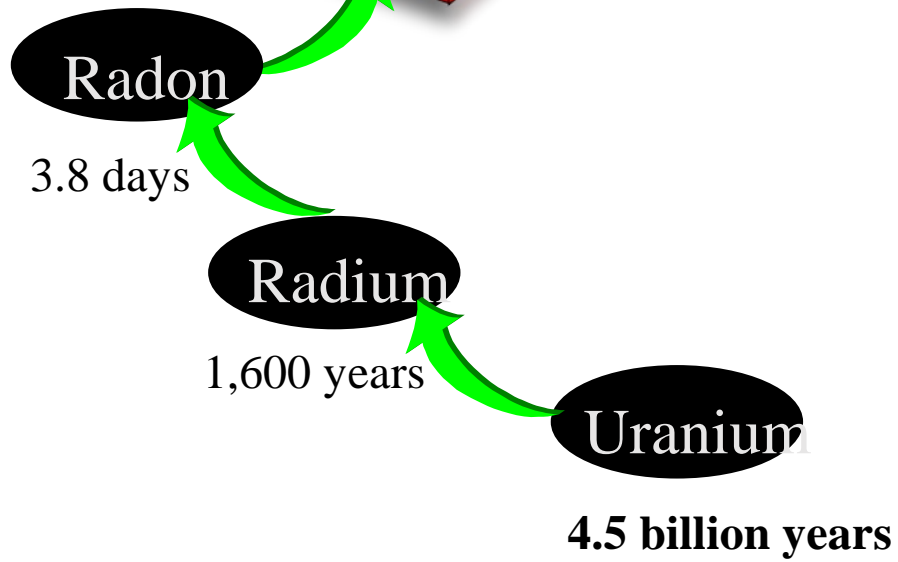
June 27, 2014

 **AMERICAN LUNG ASSOCIATION[®]**
of the Upper Midwest

In partnership with:



What is Radon?



- Naturally occurring (not man-made)
- Tasteless
- Odorless
- Colorless
- Radioactive decay of uranium in rock, soil, and water



USEPA Action Level for Radon

MEDIA	BACKGROUND CONCENTRATION (ave)
Outdoor air	0.2 pCi/L
Indoor air	1-2 pCi/L
Soil gas	100 – 3M pCi/L

EPA action level is 4.0 pCi/L

**Technology based action level
No level is considered SAFE!**



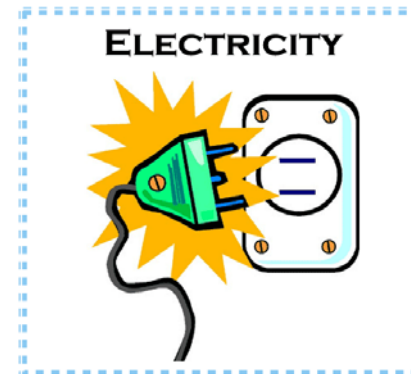
Why Test for Radon in Schools?

- New Iowa legislation
- USEPA (1988) National School Radon Survey
 - ✓ showed that 19.3% of all U.S. schools (nearly one in five) have at least one frequently occupied room with short-term radon levels above the USEPA Action Level
- In total USEPA estimates that there are over
 - ✓ 70,000 school rooms that are impacted by radon
- Ultimate goal is to reduce the exposure of radon for children, faculty, staff
- Iowa is significantly impacted by radon – 7/10 homes may already be impacted
 - ✓ add to that the hours that children spend in school



Radon Measurement Devices

- Passive
 - ✓ Do not require external power to operate
- Active
 - ✓ Require power to function (i.e. batteries, DC adaptors, or electricity from outlet)



Radon Detection Devices



Passive Devices

- Activated Charcoal Adsorption (AC)
- Charcoal Liquid Scintillation (LS)
- Alpha Track Detection (AT) (filtered)

Can be used by homeowners/schools and IDPH Certified Specialists

- Electret Ion Chambers
- Active Devices

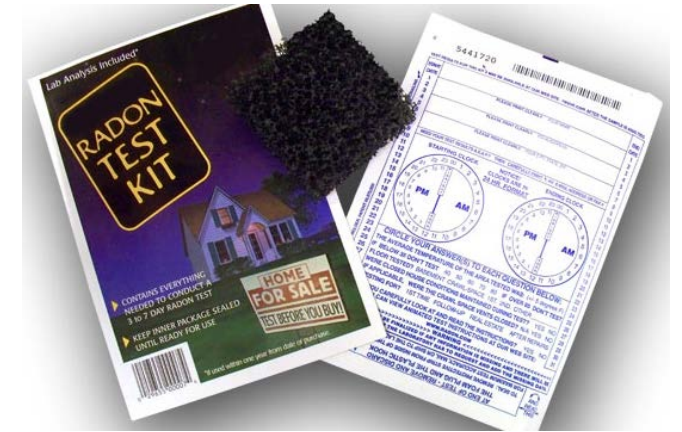
Can ONLY be used by IDPH Certified Measurement/Mitigation Specialists



Activated Charcoal (AC)

How it Works:

- Open in the area to be sampled for 2 to 7 days.
- Radon gas enters passively into the envelope/charcoal and remains trapped along with subsequent radon decay products
- At the end of sampling period, it is sealed and sent for analysis
- The lab counts the decay from the radon adsorbed to the charcoal on a gamma detector and a calculation based on calibration information is used to calculate the radon concentration



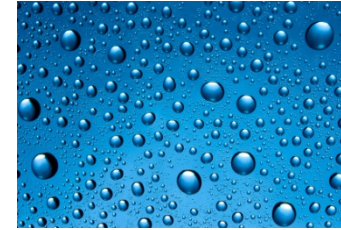
AC Protocol

Advantages:



- Can be deployed by anyone

Disadvantages:



- Results biased towards last 24 hours of testing period



Charcoal Liquid Scintillation (LS)



How it Works:

- LS samples are collected in a small plastic vial with a screw cap, and uses charcoal as a collection medium
- Radon gas enters, or diffuses, into the charcoal and remains trapped along with the subsequent radon decay products
- The exposure period is 2 to 7 days, depending on design
- The vial sealed and sent to lab
- Analysis is different –the charcoal is treated with a scintillation fluid, then analyzed using a scintillation counter, and the radon concentration determined by converting from counts per minute



LS Protocol

Same advantages & disadvantages as AC devices with 1 additional disadvantage:

- LS testing uses less charcoal in the canisters, so the device **MUST** be analyzed very quickly after the measurement period is complete.



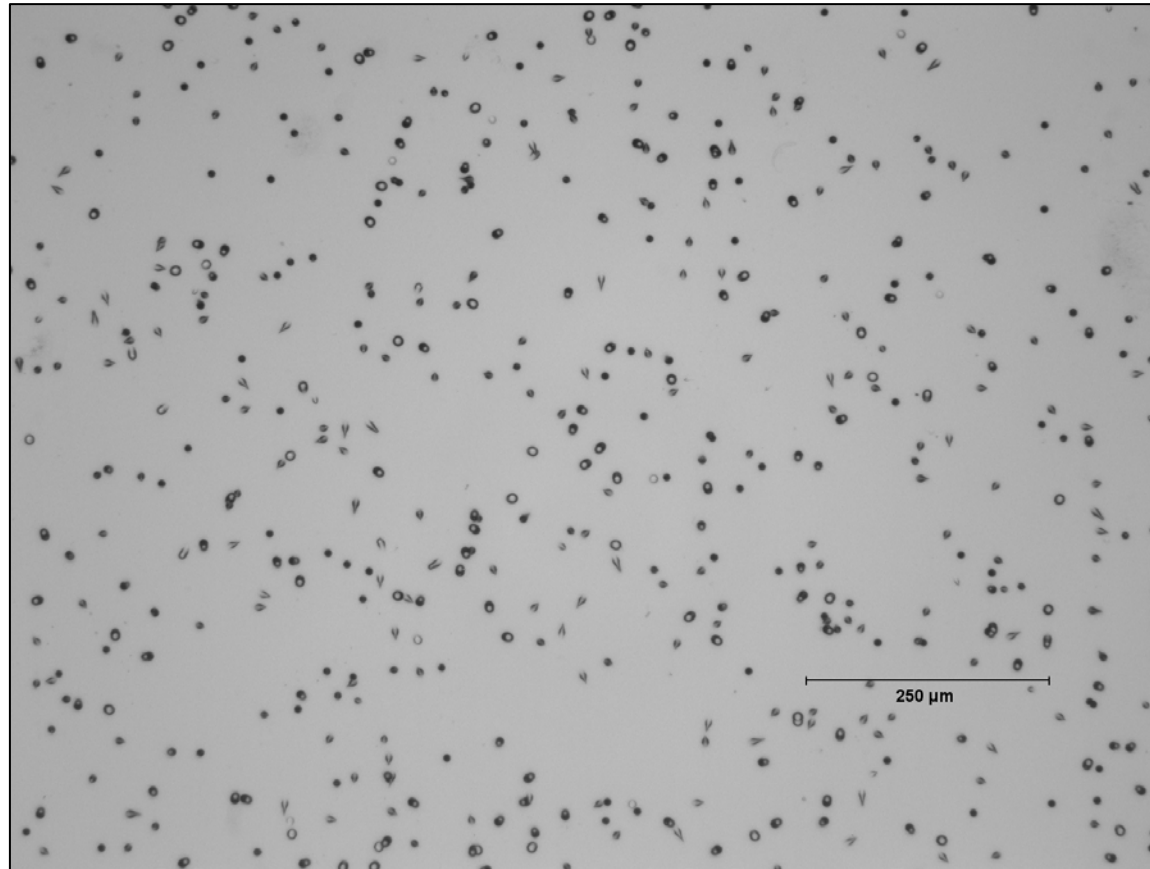
Alpha Track Detectors (AT)

How it Works:

- Radon gas enters the device through small openings covered by a filter and begins to decay
- The small particles produced during the radon decay process hit the plastic detector(s) and cause a tiny dent (tracks) on the plastic surface
- At the end of the sampling period (3-12 months) the AT is sealed and returned to lab for analysis
- The plastic detector is treated to enhance the damaged tracks, and then the tracks are counted using a microscope or optical reader
- The number of tracks is used to extrapolate the radon concentration



Alpha Track Detectors (AT)



AT Protocol

Advantages



- Can be deployed by anyone

Disadvantages



- Can only be used for long term testing – *cannot be used for real estate transactions where quick results are needed*



Electret Ion Chamber (ES)(EL)

- 2 types of Passive Electret Ion Chambers:
 - ✓ ES (short-term device – deployed 2 to 7 days)
 - ✓ EL (long-term device – deployed 1 to 12 months)
- Plastic & larger than AC devices
 - ✓ Include plunger, ion chamber and paper filter
- Detectors contain an electrostatically charged Teflon disk (called an electret) located inside the main (ion) chamber



ES/EL

How it works:

- The plunger at the top opens and closes the device; with the plunger open the radon gas enters the main chamber through a filter
- The radon gas decays in the chamber creating electrically particles, which reduce the voltage on the disc by small increments
- The voltage of the disk before and after deployment is read – the difference between the two readings is used to calculate radon exposure.



ES/EL Protocol

Advantages



- Results can be given immediately

Disadvantages



- Sensitive background gamma radiation and altitude
- Before & after voltage measurements should be done at the same temperature





Active Radon Detection Devices

Active Devices:

There are 2 types of active monitors requiring power to function:

- Active Continuous Radon Monitors (CR)
- Continuous Working Level Monitors (CW)



Continuous Radon Monitor (CR)

- Active monitor measuring radon gas is a Continuous Radon Monitor
- These devices record real-time continuous measurements
- There are a variety of this type of monitor on the market



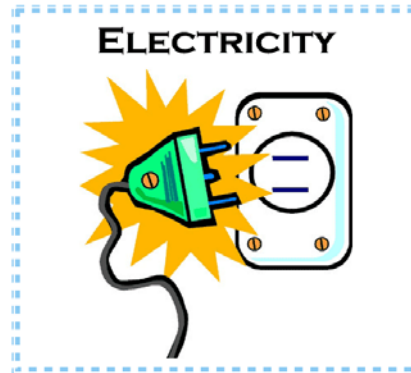
CR Protocol

Advantages



- Increased accuracy (record at least once every hour)

Disadvantages



- Must be operated by IDPH certified radon specialists



Types of Radon Testing

Short-term Test

- Quickest way to test for radon
- The testing device remains in an area for a period of 2 to 90 days depending on the device
- Because radon levels tend to vary from day to day and from season to season, a short-term test does not provide an average radon level



Types of Radon Testing

Long-Term Test

- Any test lasting between 90 days and 1 year
- Provides a more accurate indication of the annual average radon level





What type of testing should be done at schools?



- Initial measurements can be short-term screening measurements of at least 48 hours to 90 days (depending on the device used)
- Option 1: Radon screening by school
- Option 2: Hire a IDPH certified measurement specialist
- Option 3: Combination of 1 & 2





What is the purpose of radon testing done at schools?



The purpose of initial screening measurements is to identify rooms that have a potential for elevated radon levels (e.g., levels of 4 pCi/L or greater) during the occupied school year





What should be done before the test and who is kept informed?



- Gather known information about building or buildings
- Gather printed information (blueprints, re-modeling, repairs, etc.)
- A walk through of the building(s)
(prior to making decisions or placement of devices)
- All teachers/adults should be aware that the room is being tested
- Consider letting students know that testing will occur
- Consider letting parents know that testing will occur





What rooms should be tested?



- Radon levels often vary greatly from room to room in the same building
- A known radon measurement result in one classroom cannot be used as an indicator of the radon level in adjacent rooms
- Initial measurements in *all frequently occupied rooms in contact with the soil*





What rooms should be tested?



- *Slab-on-Grade Design:* Measure only frequently occupied rooms in contact with the ground
- *Crawl Space Design:* If classrooms are above an enclosed crawl space, measure rooms directly above the crawl space
- *Basement Design:* In addition to measuring all frequently occupied basement rooms, measure all frequently occupied rooms above the basement that have at least one wall with substantial contact with the ground





What rooms should be tested?



- *Open-Plan or Pod Design:* If sections of a pod have moveable walls that can physically separate them from other sections, measure each section separately
- If moveable walls are absent or inoperable, measure the pod as one room placing test kits every 2000 square feet





What rooms should be tested?



- 1 detector every 2000 sq. ft. open floor





What rooms need not be tested?



- Radon levels on upper floors are not likely to exceed the levels found in ground-contact rooms (EPA studies -caution)
- Testing rooms on the ground-contact floor may be sufficient for initial school radon screening





What rooms need not be tested?



- These areas may be important for diagnostic testing if elevated levels of radon is found





How many tests kits are required?

The appropriate number must be determined in advance

= The number of rooms required to be tested

+ The additional number for QA/QC (duplicates and blanks)

- Total test kits used, (including duplicates and blanks) must be documented on the Device Placement Log and Floor Plan by serial number
- The test-kits must be purchased from an approved source
- Testing must be conducted following the directions on the test kit





Where Do I Buy Testkits?



- IDPH Helpline 1-800-383-5992
- Hardware Stores
- Some Concerns:
 - ✓ Expiration dates
 - ✓ May result in additional analytical/shipping costs
 - ✓ Higher prices for smaller quantities
 - ✓ Some testing equipment is not allowed in Iowa





When is testing to be done?



- When the HVAC system is **operating** (normally when the buildings are occupied)
- If testing is done when school is not in session or during long holidays, the HVAC must be operating





When is testing to be done?



- Under closed building conditions
(closed windows/doors except for normal exit/entry)
 - ✓ Closed building conditions should be maintained for at least 12-hours prior to the start of 2 to 5-day measurements (e.g., initiate testing after a weekend).
 - ✓ All external doors should be closed except for normal use
 - ✓ Structural defects need to be repaired prior to testing





Where should tests kits be placed?

- Test kits may be suspended in the breathing zone, (20 inches to 6 feet above the floor, at least 1 foot below the ceiling)
- Test kit placement should be:
 - ✓ Where they are least likely to be disturbed or covered up
 - ✓ At least 3 feet from doors, outside windows, ventilation ducts
 - ✓ At least 1 feet from exterior walls
 - ✓ At least 20 inches to 6 feet from floor
 - ✓ About every 2,000 square feet for large spaces





When should testing occur?

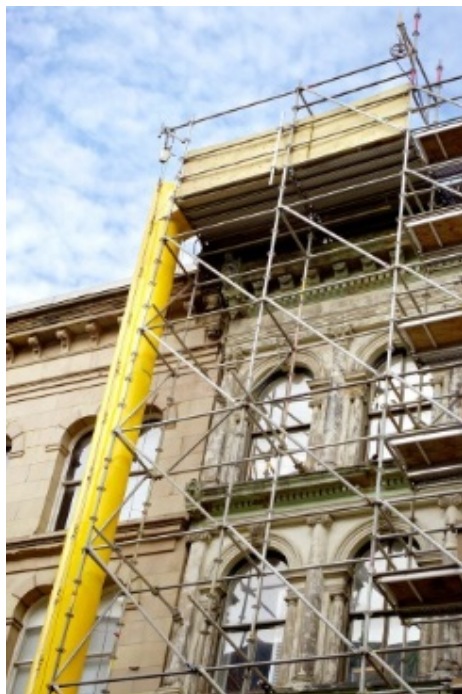


- Test kits are generally placed during colder months (October through March, depending on geographical location)
- Check and document local weather forecasts prior to placing test kits.
 - ✓ Do not conduct measurements of less than 96 hours during severe storms or period of high winds
 - ✓ The definition of severe storm by the National Weather Service is one that generates winds of 58 mph and/or $\frac{3}{4}$ inch diameter hail and may produce tornadoes





When should testing not occur?



- If temporary radon reduction measures are in place





In what conditions can testing occur?



- Any air conditioning systems
 - ✓ that recycle interior air may be operated
- Window air conditioning units in a re-circulating mode and
 - ✓ must be greater than 20 feet from the test kit
- Ceiling fans, portable humidifiers, dehumidifiers and air filters
 - ✓ should be greater than 20 feet from the test kit





In what conditions can testing occur?

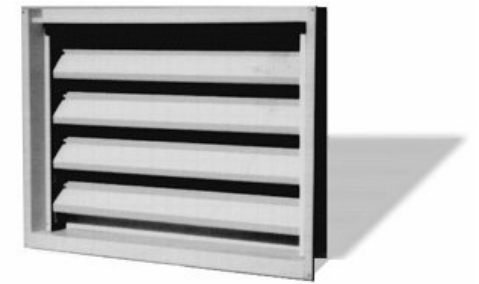
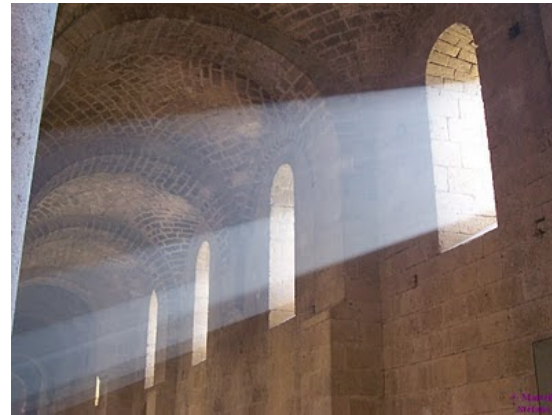


- Portable window fans
 - ✓ removed or sealed in place
- Fireplaces or combustion appliances (other than water heaters/cooking appliances)
 - ✓ should not be used
 - ✓ unless they are the primary source of heat for the building
- If radon mitigation systems are in place in the school
 - ✓ they should be in operation

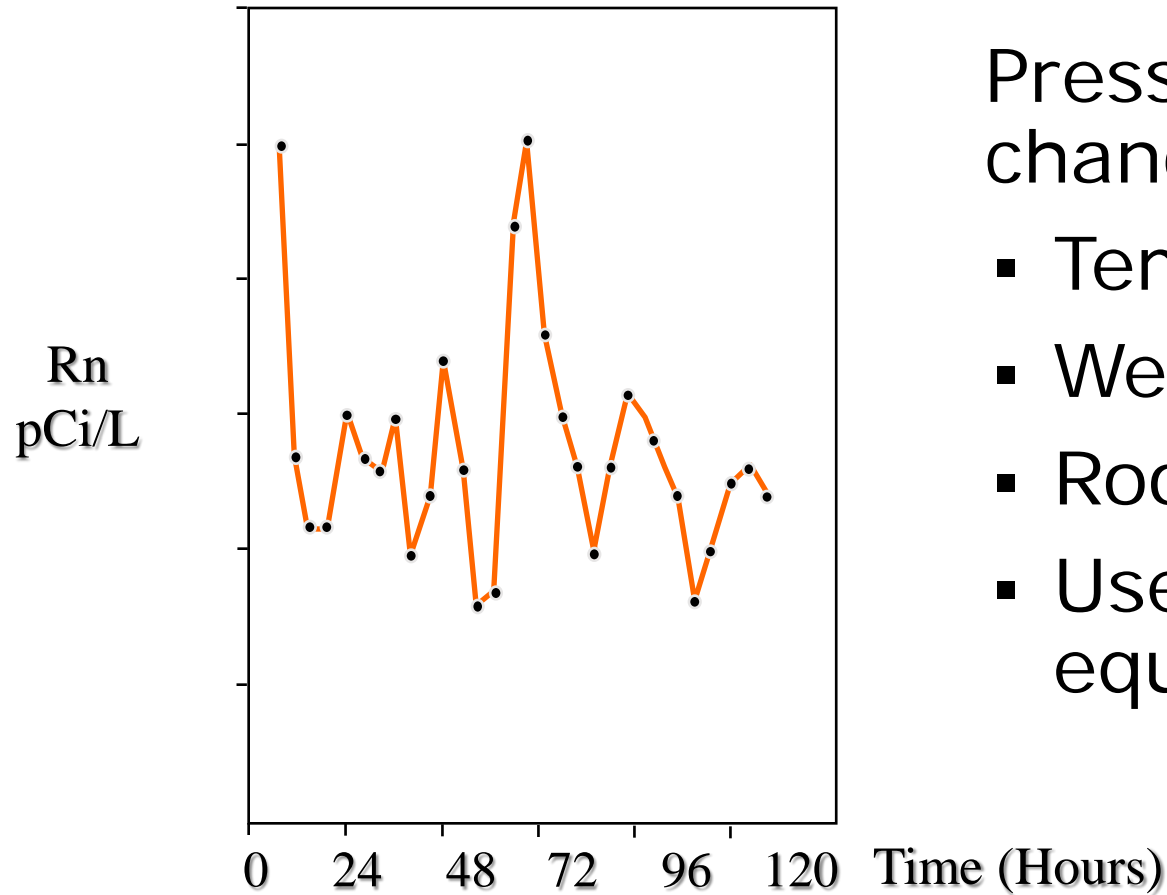




Where should I not place the tests kits?



Radon Levels are variable because the driving forces are variable

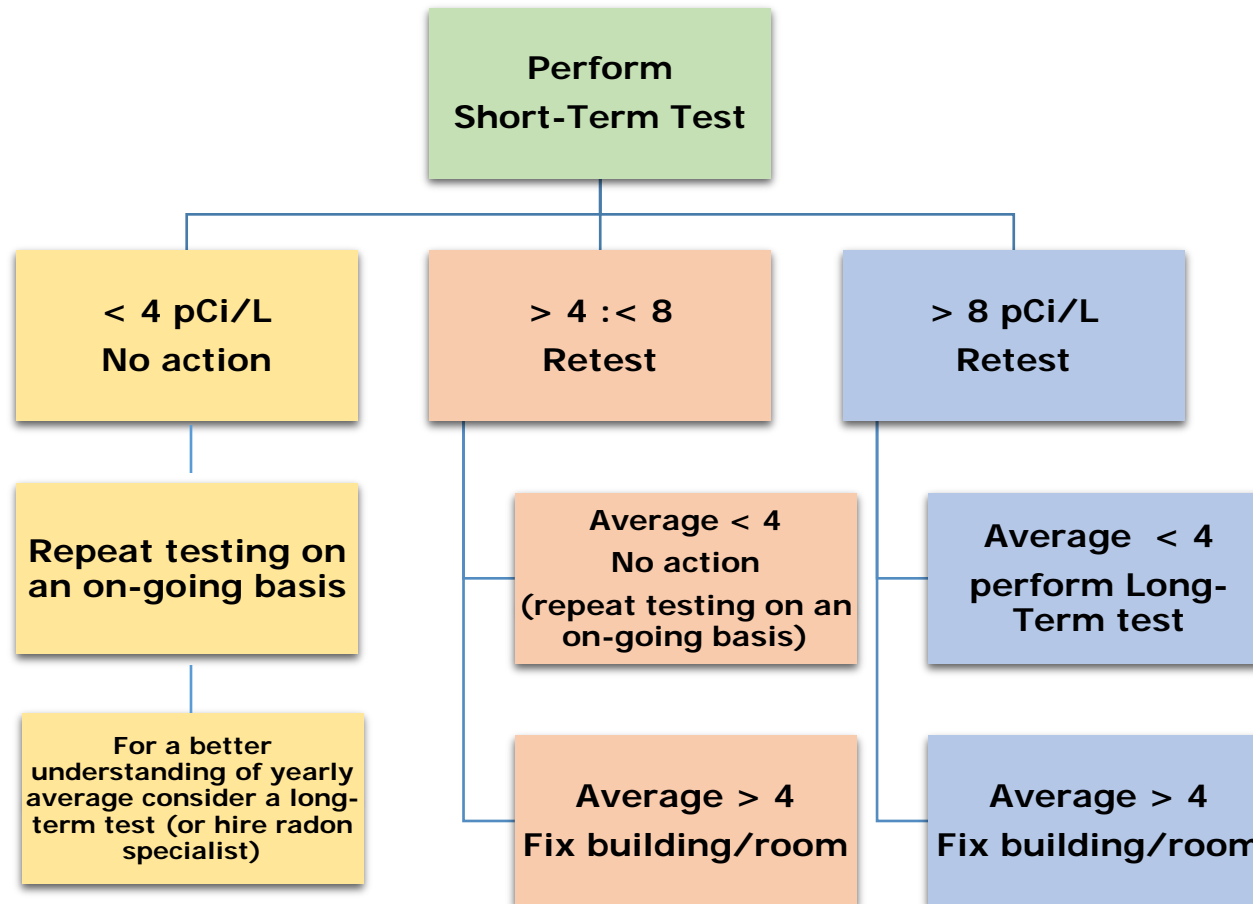


Pressure differentials can change rapidly

- Temperature changes
- Weather changes
- Room use & occupancy
- Use of HVAC & exhaust equipment



Testing Strategy Chart:





How do I interpret the results?



- All follow-up measurements in a school – done simultaneously and in the same locations & conditions of the initial measurements (to the extent possible)
- Recommended - hire a IDPH certified radon specialists to perform follow-up measurements before any mitigation decisions are made





How do I interpret the results?



- The specialist will perform *diagnostic testing* and ultimately help make decisions for *mitigation*
- Diagnostics
 - ✓ involve the evaluation of radon entry points and
 - ✓ the identification of the appropriate radon reduction technique.





What are Quality Assurance Measurements?

- Maintaining the minimum acceptable standards of precision and accuracy during the entire data collection process
- When radon measurement test kits are being placed at the school, additional test kits which serve as quality assurance measurements should be deployed
- When using passive devices, QA include the need to collect
 - ✓ duplicate and
 - ✓ field blank measurements



Radon Measurement Protocols for Schools Guide and Sample QAP



RADON MEASUREMENT PROTOCOLS FOR SCHOOLS



Sample School District #123
Quality Assurance Project Plan

Radon Measurements of
Sample Elementary School
123 Sample Street
Sample, IA 60000



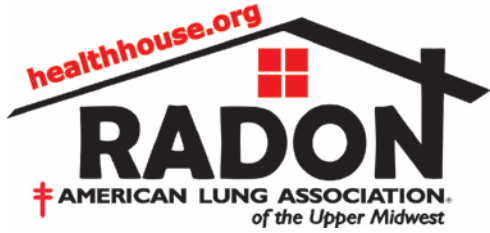
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Version 1.0

A Guide for Iowa Schools

The purpose of this document is to provide Iowa local public health departments with protocol for accurately measuring radon levels in school buildings.





For More Information Contact:

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