**Section 422.130 Measurement Protocol**

a) Measurement Location

1) Short-term or long-term measurements shall be made, at the same time, in each lowest structural area suitable for occupancy. For example, a split-level building with a basement, a slab-on-grade room and a room over crawlspace shall have measurements made in each of the foundation types: the basement, a slab-on-grade room and a room over the crawlspace.

A) Measurements shall be made in rooms that can be regularly occupied by individuals, such as family rooms, living rooms, dens, playrooms and bedrooms.

B) Charcoal canisters of any type shall not be placed in bathrooms, kitchens, laundry rooms, spa rooms or other areas of high humidity.

C) When the area of the home being tested is over 2000 square feet, an additional test location is required for each 2000 square feet of the area being tested.

D) Measurement devices shall be placed in the general breathing zone and shall be:

i) Undisturbed during the measurement period;

ii) At least 3 feet from exterior doors, windows to the outside, or ventilation ducts;

iii) Out of the direct flow of air from the ventilation duct;

iv) At least 1 foot from exterior walls;

v) 20 inches to 6 feet from the floor;

vi) At least 4 inches away from other objects horizontally or vertically above the detector;

vii) At least 4 feet from heat, fireplaces and furnaces, out of direct sunlight, etc.;

 viii) At least 7 feet from sump pits.

E) Measurement devices may be suspended in the general breathing zone and, if suspended, shall be 20 inches to 6 feet above the floor and at least 1 foot below the ceiling.

F) Measurements made in closets, cupboards, sumps, crawlspaces or nooks within the foundation shall not be used as a representative measurement and shall not be the basis for a decision to, or not to, mitigate the radon level within a building.

b) Measurements

1) A short-term measurement shall range in duration from 48 hours to 90 days, depending upon the measurement device used. Unoccupied homes shall be tested with the HVAC system set and operating throughout the measurement interval in the normal range, such as 72 degrees F plus or minus 5 degrees F.

A) Short-term measurements shall be made under closed-building conditions. In measurements lasting more than seven days and less than 90 days, closed-house conditions shall be maintained as much as possible while the measurement is in progress.

B) Closed building conditions shall begin at least 12 hours prior to the beginning of the measurement period for measurements lasting less than 96 hours.

C) The following conditions shall be complied with during closed-building conditions:

i) Operation of permanently installed HVAC systems shall continue during closed-building conditions. Radon Measurement licensees shall inform the resident in writing that operation of dryers, range hoods, bathroom fans and other mechanical systems that draw air out of the building may adversely affect the measurement results.

ii) In buildings having permanently installed radon mitigation systems, the mitigation system shall be functioning during the measurement interval.

iii) Air conditioning systems that recycle interior air may be operated during closed-building conditions.

iv) All windows shall be kept closed. Individuals licensed in accordance with the Home Inspector License Act [225 ILCS 441] may momentarily open and reclose windows when performing an inspection, after informing the measurement licensee of the inspection.

v) All external doors shall be closed except for normal entry and exit. Structural openings due to disrepair or structural defects shall be repaired to correct their condition prior to initiation of closed-building conditions. All exterior windows and doors shall be inspected by a Radon Measurement Professional licensee or Radon Measurement Technician at the placement and retrieval of the detectors and the result of the inspection documented for the measurement file.

vi) Whole-house fans shall not be operated. Portable window fans shall be removed from the window or sealed in place. Window air conditioning units shall only be operated in a recirculating mode. If the building contains an air handling system, the air handling system shall not be set for continuous operation unless the air handling equipment is specifically used for radon control and is so labeled.

vii) Fireplaces or combustion appliances, except water heaters and cooking appliances, shall not be operated unless they are the primary sources of heat for the building.

viii) Ceiling fans, portable dehumidifiers, portable humidifiers, portable air filters and window air conditioners shall not be operated within 20 feet of the detector.

D) Short-term measurements of less than 96 hours shall not be conducted during severe storms or periods of sustained high winds (30 miles per hour or more). Radon Measurement licensees shall check and document local weather forecasts prior to placing short-term measurement devices when the measurement period is less than 96 hours.

 AGENCY NOTE: The National Weather Service defines a severe storm as a storm that generates winds of 58 mph and/or ¾-inch diameter hail and that may produce tornadoes – not necessarily in that order.

E) The Radon Measurement licensee shall document that instructions describing closed-building conditions in subsection (b)(1) were provided for the person who controls the building in accordance with subsections (d)(1) and (2).

2) The Radon Measurement licensee shall advise the resident in accordance with Appendix A.

3) Follow-up measurements shall be conducted in the same location as the initial measurement, provided the initial measurement was performed in accordance with acceptable measurement placement protocol.

4) The results of both initial and follow-up measurements and the average of duplicate measurements shall be reported. The average shall be considered appropriate as the basis for determining the need for mitigation.

c) Options for Real Estate Testing

1) Option 1: Simultaneous Testing

A) Simultaneous testing shall be comprised of a minimum of 2 indoor radon measurements conducted simultaneously with similar measurement devices (see Appendix C).

B) Simultaneous tests shall be:

i) Co-located and spaced 4 to 5 inches apart;

ii) Exposed for the same measurement period; and

iii) Produce results in the same units (pCi/L or WL).

C) The results of both measurements and the average of the simultaneous measurements shall be reported and shall be considered appropriate as the basis for determining the need for mitigation.

D) Simultaneous measurement results that are both less than 4.0 pCi/L shall agree with a Relative Percent Difference (RPD) of less than 67 percent. RPD is the difference between the 2 results divided by the average of the 2 results times 100. If the RPD is greater than 67 percent, the Radon Measurement Professional licensee shall investigate, document and correct the sources of the error.

E) When one of the measurements is equal to or greater than 4.0 pCi/L and one is less than 4.0 pCi/L, and the higher result is greater than twice the lower result, the client shall be informed of the large discrepancy and the simultaneous measurements repeated at no added cost to the client.

F) Simultaneous measurement results that are both equal to or greater than 4.0 pCi/L shall agree with a RPD of less than 36 percent. If the RPD is greater than 36 percent, the Radon Measurement Professional licensee shall investigate, document and correct the sources of the error.

G) The precision of simultaneous measurements shall be monitored and recorded in the quality assurance records. The analysis of data from simultaneous measurements shall be plotted on range control charts. If the precision estimated by the user is not within the precision expected of the measurement method, the cause of the problem shall be investigated and corrective action taken in accordance with the licensee's Agency-approved quality program.

2) Option 2: Continuous Monitor Testing

A) This option requires an active continuous monitor that has the capability to integrate and record a new result at least hourly. Shorter integration periods and more frequent data logging afford greater ability to detect unusual variations in radon or radon progeny concentrations.

B) The minimum test measurement period shall be 48 hours. The first 4 hours of data from a continuous monitor may be discarded or incorporated into the result using system correction factors. There shall be at least 44 contiguous hours of usable data to produce a valid average.

i) The "backing out" of data (i.e., removal of portions imbedded in the 44 contiguous hours of monitoring) shall invalidate the measurement.

ii) The periodic results shall be averaged to produce a result that is reported to the client.

3) Additional Requirement for Real Estate Option Testing

A) Real Estate Option tests shall be conducted in accordance with subsections (a)(1) and (b)(1).

B) The measurement exposure time shall be a minimum of 48 hours.

C) Measurement licensees shall establish controls consistent with the devices used in their measurements to prevent interference and document those controls in accordance with subsection (l)(1).

d) Non-Interference Agreement

1) The buyer, seller, occupant, real estate professional or other individual in control of the property shall sign a non-interference agreement indicating an understanding of the testing conditions, the penalties for interference with an in-progress radon measurement, and that any test interference that is detected will be documented in the report and will invalidate the measurement results.

2) If such an agreement cannot be or will not be signed by the buyer, seller, occupant, real estate professional or other individual in control of the property, the Radon Measurement licensee shall document on the agreement why the signature was not obtained. The agreement shall be retained for inspection by the Agency.

e) Radon Measurement In Progress Notification. The licensee shall post at every building entry and in a conspicuous location a Radon Measurement In Progress Notification. The Notice shall be posted upon initiation of a radon measurement. A copy of a Radon Measurement In Progress Notice is provided in Appendix D.

f) Multi-Family Building Measurements. Professional licensees shall submit standard operating procedures for the performance of multi-family building measurements.

AGENCY NOTE: This subsection does not apply to measurements in an individual condominium unit.

1) Initial measurements shall be short-term measurements of at least 48 hours to 90 days, depending on the device used, and shall be made in regularly occupied rooms in contact with the soil, whether the contact is slab-on-grade, a basement, a berm, a room above a crawlspace or any combination.

A) Regularly occupied rooms include bedrooms, offices, dens, family rooms, work areas and play rooms.

B) A minimum of one detector shall be placed per every 2000 square feet of open floor area.

2) Regularly occupied rooms shall be tested simultaneously.

A) The licensee shall ensure that each occupant/resident is provided information regarding necessary test conditions.

B) The licensee shall perform and document a surveillance of the building to determine the rooms needing testing prior to placement.

3) Follow-up Measurements

A) Follow-up measurements shall be performed in every room with a short-term, initial measurement result of 4.0 pCi/L or greater, unless measurements are during a real estate transaction. Refer to Appendix A.

B) If performing measurements in accordance with subsection (c), Options for Real Estate Testing, follow-up measurements are not required. Refer to Appendix B.

4) During both initial and follow-up measurements, the HVAC system shall be operated normally. An understanding of the design, operation and maintenance of a building's HVAC system and how it influences indoor air conditions is essential for understanding, managing and developing a measurement strategy in multi-family buildings. If the units of a building have a common HVAC system, the building shall be tested by a licensee licensed to perform measurements in commercial buildings.

5) The Radon Measurement Professional licensee shall recommend in writing to the multi-family building management, owners or representatives that a decision to mitigate be based on Appendix A or Appendix B, as applicable.

6) Multi-family building measurements shall be performed in accordance with subsections (a) through (e) and (h) through (n).

A) A Device Placement Log and Floor Plan shall be finalized for each multi-family building in which radon or radon progeny measurements are made.

B) All measurements devices, including duplicate measures and blanks, shall be noted on the Device Placement Log and by serial number.

7) Requirements for Specific Multi-Family Building Designs

A) Slab-on-Grade Design. Measure a regularly-occupied room in each unit in contact with the ground.

B) Crawlspace Design. Measure a regularly-occupied room directly in each unit above an enclosed crawlspace.

C) Basement Design. In addition to measuring a regularly-occupied basement room in each unit, measure a regularly-occupied room in each unit above the basement that has at least one wall with substantial contact with the ground.

g) School and Commercial Building Measurements. Professional licensees shall submit standard operating procedures for the performance of school and commercial building measurements.

1) Initial measurements shall be short-term measurements of at least 48 hours to 90 days, depending on the device used, and shall be made in all frequently occupied rooms in contact with the soil, whether the contact is slab-on-grade, a basement, berm, a room above a crawlspace or any combination.

A) Frequently occupied rooms include classrooms, offices, conference rooms, gymnasiums, auditoriums, cafeterias and break rooms.

B) Testing need not be conducted in infrequently used areas such as storage rooms, stairwells, restrooms, utility closets, elevator shafts or hallways.

C) A minimum of one detector shall be placed per every 2000 square feet of open floor area.

D) Schools and commercial buildings shall only be tested for radon during periods when the HVAC system is operating as it does normally when the buildings are occupied, even if the testing occurs when school is not in session or during long holidays.

2) All frequently occupied rooms shall be tested simultaneously.

A) The licensee shall ensure that the teacher or frequent adult user of the room being tested is aware of the detector.

B) The licensee shall perform and document a surveillance of the building to determine the rooms needing testing prior to placement.

C) The measurement professional shall review any School Screening Measurements available and may accept those measurements as valid in determining any additional appropriate testing strategies.

3) Follow-up measurements shall be performed in every room with a short-term, initial measurement result of 4.0 pCi/L or greater. Refer to Appendix A.

4) During both initial and follow-up measurements, the HVAC system shall be operated normally.

5) The Radon Measurement Professional licensee shall recommend in writing to the school or commercial building management, owners or representatives that a decision to mitigate not be based on initial measurement results.

6) School and commercial building measurements shall be performed in accordance with subsections (a) and (b).

A) School and commercial building measurements of less than 96 hours duration shall be performed under closed-building conditions as described in subsection (b)(1).

B) Duplicate measurements shall be performed and shall represent 10 percent of all the detectors deployed, or a maximum of 50 detectors, whichever is less, within the building.

C) Blank measurements shall be performed and shall represent 5 percent of all the detectors deployed, or a maximum of 25 detectors, whichever is less, within the building.

D) Licensees using passive monitors shall conduct spiked measurements at the rate required in Section 422.140(a)(2)(B)(ii).

E) A Device Placement Log and Floor Plan shall be finalized for each school or commercial building in which radon or radon progeny measurements are made. All measurement devices, including duplicate measures and blanks, shall be noted on the Device Placement Log and Floor Plan by serial number.

7) Requirements for Specific School and Commercial Building Designs

A) Slab-on-Grade Design. Measure all frequently-occupied rooms in contact with the ground.

B) 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 detectors every 2000 square feet.

C) Crawlspace Design. Measure all rooms directly above an enclosed crawlspace.

D) 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.

8) The on-site presence of the Licensed Radon Measurement Professional providing supervision is required for all radon measurement activities at schools and commercial buildings.

h) New Construction Testing Conditions

1) Newly constructed buildings shall not be tested for radon or radon progeny unless the installation of the following items is completed:

A) All insulation;

B) All exterior doors with associated hardware shall be installed prior to testing;

C) All windows;

D) All fireplaces and fireplace dampers;

E) All heating, air conditioning, and plumbing appliances;

F) All ceiling covers;

G) All interior trim and coverings for the exterior walls;

H) All exterior siding, weatherproofing and caulking;

I) All interior and exterior structural components; and

J) Any interior or exterior work that may adversely affect the measurement validity.

2) Unoccupied homes shall be tested with the HVAC system set and operating in the normal range, such as 72 degrees F plus or minus 5 degrees F.

i) Post-Mitigation Testing

1) Post-mitigation measurements shall not be conducted if temporary radon reduction measures are in use.

2) Post-mitigation measurements shall be conducted to determine a system's effectiveness after a permanent radon reduction system has been fully operational for at least 24 hours but not later than 30 days following completion and activation of a mitigation system. The mitigation system shall be operated normally and continuously during the entire measurement period.

3) Post-mitigation measurements shall be conducted in accordance with subsections (a), (b) and (c).

j) Temporary Radon Reduction Measures

1) Temporary radon reduction measures include:

A) The introduction of unconditioned air into the building; or

B) Closure of normally accessible areas of the building; or

C) Lowering the thermostat below its normal use range, such as 72 degrees F plus or minus 5 degrees F.

2) Any of the conditions listed in subsection (k) of this Section shall invalidate measurement results. The Radon Measurement licensee shall not conduct a measurement until the conditions have been corrected. The Radon Measurement licensee shall inform the client and other parties involved in a real estate transaction that these conditions invalidate the measurement results.

3) Any improper radon reduction efforts that may affect the measurement results identified prior to, during, or after initial, follow-up, real estate option or post-mitigation measurements shall invalidate the measurement results. The Radon Measurement licensee shall not conduct a measurement until the improper conditions have been corrected.

4) Post-mitigation measurements shall not be conducted if any improper radon reduction efforts that may affect the measurement results are identified.

k) When Radon Measurements Shall Not Be Made

1) Short-term radon measurements of less than 96 hours shall not be conducted during severe storms or periods of sustained high winds (30 miles per hour or more). Radon Measurement licensees shall check and document local weather forecasts prior to placing short-term measurement devices when the measurement period is less than 96 hours.

AGENCY NOTE: The National Weather Service defines a severe storm as a storm that generates winds of 58 mph, and/or ¾-inch diameter hail and that may produce tornadoes – not necessarily in that order.

2) Radon measurements of any duration shall not be made during renovation of a building, especially renovations involving structural changes, or during renovations of the HVAC systems or any change that disturbs the normal airflow of the building.

AGENCY NOTE: When renovations are planned, radon measurements should be made prior to renovations and immediately upon the completion of renovations.

l) Quality Assurance for Radon Measurements.

1) Radon Measurement licensees shall abide by the Quality Assurance Program described in Section 422.60(a)(5)(I).

2) Measurements not performed in accordance with subsections (a), (b) and (c) shall be considered inappropriate for the purpose of determining the need for mitigation or the effectiveness of a mitigation service.

m) Measurement Documentation

1) Radon Measurement Professional licensees shall ensure that sufficient information on each measurement is recorded in a permanent record to allow for future data comparisons, interpretations and reporting to clients.

2) Radon Measurement Professional licensees shall keep the following information in a measurement record that shall be maintained for inspection for a minimum of 5 years. Additional method-specific documentation is outlined in Section 422.140.

A) A complete copy of the measurement report.

B) A description of any non-interference controls used and copies of non-interference agreements completed in accordance with subsection (d); and

C) A record of any quality control measures associated with the test, such as the results of simultaneous measurements, diagnostic measurements, duplicate measurements and calculations associated with the measurement.

n) Measurement Results

1) Measurement results shall be reported in the units that the device measures.

2) Any measurement results based on radon gas shall be reported to no more than one decimal place, e.g., 4.3 pCi/L.

3) All valid individual measurement results shall be reported.

4) When using continuous radon monitors, hourly readings shall be included.

5) Measurements made in separate locations shall not be averaged.

6) The average of collocated measurement devices shall be reported, as well as the individual results. Standard mathematical rules shall be followed; i.e., if the average of two measurements produces a result of 3.95 pCi/L, the result shall be reported as 4.0 pCi/L.

7) Any quality control measurements shall be reported as such.

o) Measurement Reports

1) Radon Measurement Professional licensees shall return radon measurement results to the occupant, the owner of the building, his/her representatives or the client within 45 days after retrieving exposed devices. As a minimum, the measurement report shall contain:

A) Measurement results reported in accordance with subsection (n).

B) The exact start and stop dates and times of the measurement period.

C) The address of the building measured, including the zip code.

D) A description of the measurement device used, its manufacturer, model or type, and serial numbers or other unique device identification numbers.

E) The names and Illinois radon license numbers of the licensees placing and retrieving the devices.

F) The name and Illinois license number of the laboratory analyzing the device, if applicable.

G) A statement describing recommendations concerning retesting or mitigation provided to the occupant, the owner of the building, his/her representatives or the client in accordance with Appendix A or B, as appropriate.

H) A statement of whether a mitigation system was observed in the building during placement or retrieval. The statement shall indicate whether the system is PNC or ASD. If the system is ASD, the statement shall indicate whether the mitigation system is operating and the mitigation tag number for systems installed after November 1, 2009.

I) A statement describing any observed tampering, interference or deviations from the required measurement conditions.

J) A description of the condition of any permanent vents that allow outdoor air into the building, such as crawlspace vents or combustion air supply to combustive appliances.

K) A description of any severe weather conditions.

L) The exact locations of all measurement devices deployed and any information that would allow for future data comparisons and interpretations. Licensees shall provide the exact locations by one of the following methods:

i) A scale diagram of the footprint of the building identifying the windows and doors, finished and unfinished areas, room use, furnaces, hot water heaters, dryers, combustion appliances, crawlspace vents, fireplaces, mitigation systems, floor drains and foundation types, indicating the front of the home and any other pertinent information that may affect the measurement.

ii) A copy of Appendix E for each foundation type measured.

2) Laboratories receiving an exposed device that has been delivered for analysis shall return results to the client within 45 days. At a minimum, the measurement report shall contain:

A) Measurement results reported in accordance with subsection (n).

B) The exact start and stop dates of the measurement period.

C) The address of the building measured, including the zip code.

D) A description of the measurement device used, its manufacturer, model or type, and serial numbers or other unique device identification numbers.

E) The name and Illinois license number of the laboratory analyzing the device.

p) Devices Placed by Clients. Radon licensees shall provide the client with the following:

1) For licensees providing measurement devices to clients, sufficient detectors to ensure that testing is performed consistent with this Part.

2) The Agency's address and telephone number.

3) Devices that will be placed by the client shall be accompanied by instructions on how to use the device. These instructions shall be consistent with this Section and include specific information on the minimum and maximum length of time that the device shall be exposed.

(Source: Amended at 37 Ill. Reg. 20240, effective December 9, 2013)