



C-NRPP Protocol for Conducting Short-Term Radon Measurements in Air

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Canadian National Radon Proficiency Program (C-NRPP) is a certification program designed to establish guidelines for training professionals in radon services.

Protocol for Conducting Short-Term Radon Measurements in Air

1. Introduction

Reducing radiation from radon exposure at home should be a priority for all Canadians in order to protect themselves from radon-induced lung cancer. In order to do this, a homeowner must first have their dwelling tested for radon and then mitigate the dwelling if levels are elevated. Health Canada and C-NRPP strongly urges any measurement that is to be used for a decision to mitigate be a long-term measurement, however there are times when a short-term measurement is useful. This document provides guidance for C-NRPP Radon Professionals on conducting a short-term radon measurement. If the radon test is being conducting for a real estate transaction additional guidance provided by the document, "CARST Guideline for Conducting a Radon Screening Assessment as Part of a Real Estate Transaction of a Residential Dwelling in Canada" should be followed.

A short-term radon measurement can be conducted using greatly different test lengths. The purpose of the radon measurement should provide some context for the length of the measurement. The minimum duration of a short-term radon measurement is 48 hours and it can last as long as 90 days, the longer the duration of the test, the more representative of the average annual radon concentration. See the definitions below for durations.

Short term measurements should always be part of a two-step process of short-term and long-term follow up measurement. C-NRPP and Health Canada strongly recommend that any and all short-term radon measurements be followed up with a long-term radon measurement.

2. Scope

This protocol is intended for use by C-NRPP Radon Professionals. It includes procedures, and general guidance for measuring radon concentrations in residential dwellings from a short-term test. The guidance contained within is based on the recommendations as stated in the Health Canada measurement guidance for Radon Measurements in Residential Dwellings ⁽¹⁾.

3. Radon Action Levels

The current Canadian guideline for radon in indoor air for dwellings is 200 becquerels per cubic meter (200 Bq/m³) as set by the Government of Canada (Canada Gazette Part 1, June 9, 2007).

4. Conventions

"shall", "will" and "must": Are terms that stipulate a prescribed action are provisions that are considered mandatory.

“should”, “may” and “recommended”: indicate provisions considered helpful or good practice, but are not considered mandatory.

“shall not”, and “must not”: indicates the action is prohibited.

“test”: Within the scope of this document means the act of sampling and measuring the radon concentration.

5. Definitions

CRT – C-NRPP Radon Measurement Professional

CRMT – C-NRPP Radon Mitigation Professional

CAL - C-NRPP Certified Radon Analytical Laboratory

C-NRPP Approved Measurement Devices - Only C-NRPP listed as Short-Term Radon Measurement devices shall be used to perform radon measurements. No substitutions may be made. Listed devices may be found on the C-NRPP website. <http://c-nrpp.ca/approved-radon-measurement-devices>

Continuous Radon Monitors are radon measurement devices that can provide radon measurements in increments of one hour or shorter. The device must be capable of logging and producing a report of the data.

True Passive Integrating measurement devices - radon measurement devices which are true passive time or dose integrating devices which do not require power to conduct measurements. These include alpha track detectors and electret ion chambers.

Post Mitigation Radon Measurement - is a radon test which is of duration of at least 48 hours and conducted at least 24 hours after radon mitigation measures have been undertaken.

Short-Term Radon Measurement – is a radon test which is of duration of at least 48 hours but up to 90 days

Long-Term Radon Measurement – is a radon test which is of duration of longer than 90 days

Residential Dwelling/Home – a dwelling of 4 units or less

Responsible Person – individual responsible for the dwelling to ensure all requirements of the radon test are followed.

2. LEGAL DISCLAIMER

Disclaimer: This guideline is a resource; it is not legal advice. This document will be reviewed periodically and may be updated as required.

3. Guidance for Radon Measurements

It is recommended that a Short-Term Radon Measurement be conducted at a duration which meets its intended purpose and that it be conducted using a C-NRPP Listed Short-Term Radon Measurement Device.

3.1. Radon Measurement Procedures

All measurement devices should be used in accordance with manufacturers instructions.

3.1.1. Placement Instructions

The radon detector shall be placed in the lowest occupied level, where occupied is defined as a space that is used for a minimum of 4 hours per day or more. In most cases this will dictate that the test is placed in the basement.

If the occupants are anticipating renovating their basement or moving out of the home and this space is not currently being occupied, but it could be occupied in the future, the test should be placed in the area which would be occupied in the future for a possible of 4 hours per day or more.

Devices should not be placed in bathrooms, kitchen, crawlspaces, sump pits, laundry rooms. Detailed guidance on where not to test and placement protocols should follow those found in Annex: Radon Measurement Procedure for Residential Dwellings (Homes) from [Health Canada's Guide for Radon Measurements in Residential Dwellings\(Homes\)](#). Please note, these have been recorded in Appendix A.

3.1.2. Post-Mitigation Radon Measurement

A post-mitigation radon measurement provides a rapid indication of the effectiveness of a radon mitigation system and should be placed in the same location as the radon measurement that was used as a basis for the decision to mitigate. It should then also be followed up with a long-term radon test during the first winter season following installation of the radon mitigation system.

3.1.3. Additional Considerations

3.1.3.1. *Homes with Multiple Heating, Ventilation or Air Conditioning Systems*

One test location may not be representative of radon levels if the dwelling is serviced by multiple HVAC systems or ducting systems, therefore an additional device shall be used in a second occupied location in the dwelling if it has multiple ventilation zones. The two locations should reflect a sample from each ventilation zone. Proper placement location guidance (Appendix A) should be followed. All levels shall be reported on the test report with reference to the location of device placement.

3.1.3.2. *Homes with combination foundations*

The radon concentrations may not be the same in a building where the building possesses a split-level foundation, a slab on grade room, or a room over a crawlspace. These issues should be identified and an additional device should also be placed in these locations.

Proper placement location guidance (Appendix A) should be followed. If additional devices are used, all levels shall be reported on the test report with reference to the location of device placement.

3.1.3.3. *Severe Weather*

Periods of unusually high winds, 50 km/h gusting winds or rapid changes in barometric pressure can cause rapid changes to radon levels in the dwelling. Short-term measurements of 4 days or less, shall not be conducted during periods of severe weather. The measurement should be delayed until or repeated when severe weather is no longer in effect.

3.1.3.4. *Occupancy*

It is important to understand that the use and operation of the home may affect the radon measurement results. Because the radon test is meant to provide an understanding of occupant exposure, it is important to ensure the test is conducted during a time that is representative of their typical living conditions. This should be considered when choosing when, where and how long to conduct the radon test. Consideration should be given to the homes use both during the day, evening and weekend. As a result, a 7-day test, may provide a better representation of the occupant's weekly use of the home.

3.1.4. **Side by Side (Co-located) Measurement**

When Passive Radon Measurement Devices are used in measurement, duplicate devices shall be used. Two detectors shall be placed side by side not more than 20 cm (8 inches) apart, or as per the manufacturer's recommendations. A single device is adequate when a continuous radon monitor is used.

3.1.5. **Closed-house Conditions**

Closed-house conditions are necessary to allow the radon levels to stabilise. This will provide a more representative estimate of the level of radiation that the homeowner could be exposed to.

Closed-house conditions include:

- Windows should stay closed at all times,
- External doors opened only for entry and exit,
- Attached garage doors should be opened only for entry and exit,
- Fireplaces should not be operated during the radon test, unless it's a primary heat source.
- Clothes dryer, range hood, and bathroom fan operation should be limited to the minimum necessary,
- Heat-Recovery Ventilator (HRV) and Energy Recovery Ventilator (ERV) shall be left to operate (or not operate) as found.
For example, if an HRV is plugged in and working it should be left working, if unplugged, should be left unplugged.
- Radon mitigation systems shall be operated as normal.

When a radon measurement is less than 4 days in duration, closed-house conditions shall be established for the 12 hours immediately prior to starting the test and maintained for the duration of the test. If a radon measurement is 4 days or more in duration, closed-house conditions shall be established at the time of the start of the test and should be maintained for the duration of the test.

The longer the duration (i.e. 7 - 90 days) of the measurement, consideration should be given to having closed house conditions be more representative of regular occupational use and operation of the dwelling.

The C-NRPP Measurement Professional shall inform the occupant and/or responsible person of the closed-house requirements (see a sample in Appendix B) and will document on the radon test report any concerns, suspicions or observed variances regarding closed-house conditions, however, the C-NRPP Measurement Professional is not responsible or liable for actions or inactions outside of their control.

3.1.6. Signage

A notification stating “Radon Measurement in Progress” or “Indoor Air Quality Test in Progress” shall be posted in conspicuous locations such as the inside of all exterior doors stating the required conditions of the measurement and contact information of the C-NRPP Radon Measurement Professional. See Appendix B for an example.

3.1.7. Preliminary Inspection

A visual inspection of the dwelling shall be conducted before device placement to ensure all closed-house conditions are met.

If closed-house conditions are not met, or have not been in place for 12 hours before the radon measurement begins, one of the following options is required depending on the type of the device used.

- Postpone the start of the radon measurement until 12 hours of closed-house conditions have been met.
- Extend the radon measurement to 4 days or more with an appropriate detector after closed-house conditions are initiated.
- Activate device features on a continuous radon monitor to delay the start time of the test and ensure it is left in place for a minimum of 60 hours (12 pre-test + 48 hr minimum testing period)

3.1.8. Post-Test Inspection

A visual inspection of the dwelling shall be conducted upon device retrieval to ensure all closed-house conditions are still met and all anti-interference measures have been maintained or undisturbed.

If closed-house conditions were not met the radon test is void and must be repeated.

3.1.9. Retesting

A retest may be required due to interference, severe weather, or other quality assurance concerns. The additional test shall be performed in the same location as the initial sampling location unless the location was the cause of the interference, or is no longer suitable. Then a similar location should be chosen and proper placement location guidance should be followed.

3.1.10. Quality Assurance Plans

Quality Assurance must be considered in the placement of all radon measurement devices. A C-NRPP Measurement Professional shall have developed a Quality Assurance Plan in accordance with C-NRPP Quality Control and Quality Assurance Manual for Radon Sampling and Analysis conducted by Radon Measurement Professionals and Laboratories (10) When passive integrating devices are used duplicate detectors will be placed for 100% of the placements rather than the recommended amounts in the C-NRPP Quality Assurance Manual.

3.2. Radon Measurement Report

The following information must be included on a **Radon Measurement Report** when provided to the client. A sample report can be found in Appendix C.

3.2.1. Address

The complete physical address of the dwelling measured.

3.2.2. Measurement Professional Information

The name of the company, contact information, and identification of the C-NRPP Radon Measurement Professional(s) involved in the radon measurement process and their current C-NRPP identification numbers.

3.2.3. Detector Information

The detector model and type, the detector serial number(s), and the name and current C-NRPP identification number of the service or organization or laboratory used to analyze detectors. If a continuous radon monitor was used, the calibration date shall be listed. If an electret ion chamber was used, the reader calibration date shall be listed.

The radon test report should also disclose if the test was a duplicate, (part of QA Process), and if it was conducted before or after (pre or post) mitigation.

Placement location of the detectors must be reported using a description (including Level and room) and can include either a diagram or photo.

3.2.4. Time and Date

The beginning and ending time and dates of the radon measurement period.

3.2.5. Radon Test Duration

The title of the report must include a statement as to if the test is a Post-Mitigation or Short-term (see 1.5 Definitions for duration for short-term and long-term radon measurement)

3.2.6. Device details

The radon test report must have details of the type of device listed, and state, “C-NRPP Listed” as confirmation that the device is listed on C-NRPP’s device list. Find a list online: <http://c-nrpp.ca/approved-radon-measurement-devices/>

The device serial number must be listed on the report and for electron ion devices the voltage meter serial number must also be on the report.

3.2.7. Recommendations

The following statement must be included on the report. “When reducing radon levels through Radon Mitigation, look for a certified C-NRPP Mitigation Professional. Find a list online: <http://c-nrpp.ca/find-a-professional/>” and references or links locations to get Health Canada’s “[Radon Reduction Guide for Canadians](#)”, should be included in the report.

3.2.8. Measurement Results

The radon measurement must be reported using Bq/m³.

If the radon level is below or above the detection capability of the device, it must have at a statement saying, either:

“The detector reached its maximum radon concentration, the radon level is above xx Bq/m³.” **OR**

“The radon level is below the lower limit of detection of the detector, the radon level is less than xx Bq/m³”.

3.2.9. Temporary Conditions

Dwelling conditions or other factors which may affect the measurement results shall be reported. These may include, but are not limited to conditions such as vacancy or renovation of the dwelling.

Note the presence of an HRV or ERV in the dwelling and note any unusual circumstances regarding the HRV or ERV.

3.2.10. Deviations

Any deviation from the prescribed guidance deemed necessary to complete the test should be reported and explained.

3.2.11. Radon Mitigation System Status

The presence and status of any known radon mitigation systems installed in the dwelling shall be reported.

4. Maintaining Records

Radon measurements reports shall be kept for as long as required by law in the location and at the time of the radon measurement. All records shall be maintained and stored in accordance with the privacy regulations in force for the location and at the time of the radon measurement. If no guidance or requirement for length of time to maintain records is specified by law, considering radon exposure's long latency period, CARST's recommendation is to keep records for 10 years, at the minimum.

A. Placement Guidance

– From [Health Canada's Guide for Radon Measurements in Residential Dwellings \(Homes\)](#)

Radon Measurement Procedure for Residential Dwellings (Homes)

Where to Test

Place the radon detector in the normal occupancy area of the lowest lived-in level of the home.

IF the basement has finished rooms such as bedroom, playrooms, family room,

THEN place the device in the area occupied for more than 4 hours each day.

IF the basement does **not have** any areas where people work, play or sleep,

THEN test on the main level.

Where to Locate the Detector

The preferred device location is by an interior wall at a height of 0.8 m to 2 m (3 to 6.5 feet) from the floor in the typical breathing zone, however, at least 50 cm (20 inches) from the ceiling and 20 cm (8 inches) from other objects so as to allow normal airflow around the detector. Detector should be placed approximately 40 cm (16 inches) from an interior wall or approximately 50 cm (20 inches) from an exterior wall.

Do **not** place the detector in kitchens, laundry rooms, bathrooms, closets, cupboards, sumps, crawl spaces or nooks within the foundation.

Do **not** place detector by heating, ventilating and air conditioning vents, doors, fans, windows, fireplaces, electrically powered equipment, on television sets, stereos or speakers, or in direct sunlight.

B. Occupant Information - sample

(for a test which is 4 days or less)

RADON SCREENING IN PROGRESS

Please, **DO NOT MOVE** the radon measurement device or devices.

If you have any questions, please contact:

Name of C-NRPP Professional

Phone Number

The following conditions must be maintained in order to achieve a valid screening test:

1. All exterior windows must be kept closed. Exterior doors must be kept closed except for **momentary** entry and exit.
2. The “closed-house conditions” described above must have been maintained for 12 hours prior to the beginning of the test and sustained for the duration of the test.
3. The radon measurement device or devices cannot be moved, covered, or tampered with in any way.
4. Fireplaces or wood stoves shall not be operated unless they are a primary heat source.
5. Heat-Recovery Ventilator (HRV) and Energy Recovery Ventilator (ERV) shall be left to operate (or not operate) as found. For example, if an HRV is plugged in and working it should be left working, if unplugged, should be left unplugged.
6. Heating and air conditioning operate normally. Window-unit air conditioners shall operate only in the re-circulation mode.
7. Radon mitigation systems shall be in normal operation.

C. Sample Radon Test Report

Short Term Radon Test Report

Report Date: October 6, 2018

Certified Company Name
Address
Contact information
C-NRPP Certification #

Customer Contact Information:

First Name
Mailing Address
Phone
Email

Test Site:

11 Canoe Street
Prairie Town, SK S0V 2K4

Device Location:

Basement Bedroom

*Test Device Used: Detector type (S/N of Voltage Meter if applicable) C-NRPP Listed
Quality Assurance Plan in place.*

Detector S/N	Detector Type	Analyzed By: or Calibration Expiry Date	Test Start Date	Test End Date	Test Duration	Test Result (Bq/m ³)
123456	AlphaTrack	AAA Manufacturer	3:05pm July 30, 2018	3:30pm October 8, 2018	70 Days	190
123457	AlphaTrack	AAA Manufacturer	3:05pm July 30, 2018	3:30pm October 8, 2018	70 Days	175

Temporary Conditions: *Dwelling conditions or other factors which may affect the measurement results shall be reported. These may include, but are not limited to conditions such as vacancy or renovation of the dwelling.*

Note the presence of an HRV or ERV in the dwelling and note any unusual circumstances regarding the HRV or ERV.

Deviations: *Any deviation from the prescribed guidance deemed necessary to complete the test should be reported and explained.*

Radon Mitigation System Status: *The presence and status of any known radon mitigation systems installed in the dwelling shall be reported.*

Recommendations: This is a short-term test, we recommend following up with a long-term test conducted during the heating season.

Health Canada recommendation for remedial action:

1. Remediate within 2 years: Results between 200 and 600 Bq/m³, Health Canada recommends taking steps to reduce the radon level within 2 years.
2. Remediate within 1 year: Results greater than 600 Bq/m³, Health Canada recommends taking steps to reduce the level within 1 year.

While the health risk from radon exposure below the Canadian Guideline is small, there is no safe level of radon. It is the choice of each homeowner to decide what level of radon exposure they are willing to accept.



D. Reference Documents

Health Canada Publications for Professionals:

1. Radon Measurements in Residential Dwellings (Homes),
http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_homes-maisons/index-eng.php
2. Radon Measurements in Public Buildings
(Workplaces, Schools, Day Cares, Hospitals, Care Facilities, Correctional Centres),
http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_building-edifices/index-eng.php
3. Radon - What you need to know,
<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/radon/index-eng.php>
4. Radon Reduction Guide for Canadians,
http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_canadians-canadiens/index-eng.php

Health Canada Publications for Consumers:

5. Cross Canada Survey of Radon Concentrations in Homes, <http://www.hc-sc.gc.ca/ewh-semt/radiation/radon/survey-sondage-eng.php>
6. Radon - Another Reason to Quit, http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_smokers-fumeurs/index-eng.php
7. Radon - Is it in Your Home?, http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_brochure/index-eng.php
8. Radon - What you need to know, <http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/radon/index-eng.php>
9. Radon Reduction Guide for Canadians, http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radon_canadians-canadiens/index-eng.php

C-NRPP Documents

10. C-NRPP Quality Control and Quality Assurance Manual for Radon Sampling and Analysis conducted by Radon Measurement Professionals and Laboratories, May 2018
11. C-NRPP Listed Radon Measurement Devices, <https://c-nrpp.ca/approved-radon-measurement-devices/>

Other Canadian Publications

12. 2006 Report of the Radon Working Group in Canada,
<http://carst.ca/Resources/Documents/2006%20Report%20of%20the%20Radon%20Working%20Group%20in%20Canada.pdf>
13. Canada Living with Radiation, Atomic Energy Control Board, 1995,
http://publications.gc.ca/collections/collection_2014/eacl-aecl/CC172-7-1995-eng.pdf
14. Exposure Sources for Collective Effective Dose, 2006
<http://www.diagnosticimaging.com/articles/ionizing-radiation-exposure-skyrockets-1980s-0>

EPA Documents

15. Citizen's Guide to Radon: The Guide to Protecting Yourself and Your Family from Radon
https://www.epa.gov/sites/production/files/2016-02/documents/2012_a_citizens_guide_to_radon.pdf
16. Technical Support Document for the 1992 Citizen's Guide to Radon, Radon Division, Office of Radiation Program, US Environmental Protection Agency, May 20, 1991 EPA 400-R-92-011 Section 1.3.3
<https://nepis.epa.gov/Exe/ZyNET.exe/000001L3.TXT?ZyActionD=ZyDocument&Client=EPA&Index=1991+Thru+1994&Docs=&Query=&Time=&EndTime=&SearchMethod=1&TocRestrict=n&Toc=&TocEntry=&QField=&QFieldYear=&QFieldMonth=&QFieldDay=&IntQFieldOp=0&ExtQFieldOp=0&XmlQuery=&File=D%3A%5Czyfiles%5CIndex%20Data%5C91thru94%5CTxt%5C00000002%5C00001L3.txt&User=ANONYMOUS&Password=anonymous&SortMethod=h%7C-&MaximumDocuments=1&FuzzyDegree=0&ImageQuality=r75g8/r75g8/x150y150g16/i425&Display=hpfr&DefSeekPage=x&SearchBack=ZyActionL&Back=ZyActionS&BackDesc=Results%20page&MaximumPages=1&ZyEntry=1&SeekPage=x&ZyPURL>

Other Documents

17. WHO Reference: WHO Handbook on Indoor Radon,
http://apps.who.int/iris/bitstream/10665/44149/1/9789241547673_eng.pdf
18. Guidelines for the Retention of Laboratory Records & Materials, June 2006
<http://oaml.com/wp-content/uploads/2016/05/Guideline-for-the-Retention-of-Records-Materials-June-06.pdf>

Research Documents:

19. Comparative Analysis of Radon Measurements of Various Durations in Dwelling, Presentation
http://www.npl.co.uk/upload/pdf/20051008_armug_gillmore_1.pdf
20. An Evaluation of the Screening Measurement as an Indicator of Average Annual Indoor Radon Exposure, LaFontaine, M 1996
21. Making Mitigation Decisions Based on Short-term Tests of ²²²Rn, White, S. B
22. Reliability of Inexpensive Charcoal and Alpha-Track Radon Monitors, Mose, D; Mushrush, G; and Chrosniak, C, 3 November 1989
23. Reliability of Integrating Radon Gas Measurements in the Domestic Environment – An InterComparison between One-Week, One-Month and Three-Month Sampling, Denman, A. R. , Crockett, R.G.M, Groves-Kirkby, C.J., Phillips, P.S., Woolridge, A,
<http://irpa11.irpa.net/pdfs/6a27.pdf>
24. Residential Radon Risk Assessment: How Well is it Working in a High Radon Region?, Steck, D
25. Review of domestic and international methods of measuring radon in residential buildings, Lee, D., Lee, C 23 February 2016, <https://aoemj.biomedcentral.com/articles/10.1186/s40557-016-0097-0>
26. Utility of Short-term Basement Screening Radon Measurements to Predict Year-Long Residential Radon Concentrations on Upper Floor, Barros, N. Steck, D, Field, R. W., 29 July 2015
27. Winnipeg radon testing: comparison of test durations, effects of house characteristics, and efficacy of floor-drain seals, Warkentin, P. E., Johnson H. M.,
<https://www.ncbi.nlm.nih.gov/pubmed/25706136>