

Residential Radon Measurement Course

Canadian-NRPP Minimum Criteria

- I. OBJECTIVES OF THE COURSE (0.25 hr.)**
- A. Individuals holding the Residential Measurement Service Provider certification have demonstrated knowledge of Health Canada Radon Measurement Protocols for the professional placement and retrieval of radon measurement devices. They have also demonstrated knowledge of the proper interpretation of results obtained in residential settings.**
- B. To prepare potential radon measurement providers with the basic knowledge in preparation for taking the radon measurement exam.**
- II. National Radon Proficiency Program (0.25 hr.)**
- A. Overview**
- B. Specifics**
- 1. Explanation of the Program**
 - 2. Benefits**
 - 3. NEHA Policies**
 - a) Certification***
 - b) Decertification***

III. Introduction to Radiation and Radioactivity

(0.5 hr.)

A. Atomic Structure

1. Periodic Table
2. Electrons, Neutrons, Protons
3. Isotopes

B. Radiation

1. Radiation versus Radioactivity
2. Types
 - a) *Alpha*
 - b) *Beta*
 - c) *Gamma*
3. Ionization
4. Penetrating Ability
5. Radioactive Decay
6. Half-life
7. Background Radiation
 - a) *Natural*
 - b) *Man-made*

IV. Health Effects and Risk Assessment

(1.0 hr.)

A. Damage to the Body

B. Studies

1. Miners
2. Residential
3. Animal

C. Comparison to Other Life and Health Risks

D. Hazard Communications {reference Health Canada and EPA Publications: Radon a Guide for Canadian Homeowners, Guide for Radon Measurement in Dwellings(Homes),Guide for Radon Measurements in Public Buildings }

V. Radon, Radon Decay Chain, and Radon Behavior (2.0 hr.)

A. Radon Gas versus Radon Decay Products

B. Radon Decay Chain

1. Types of Radiation Emitted
2. Half-Life Significance
3. Decay Chain

C. Equilibrium Ratio

D. Radon Entry into Occupied Areas

1. Radon Source and Concentration
2. Transport Mechanisms
 - a) *Differential Air Pressure*
 - b) *Differential concentrations*
 - c) *Well Water*
 - d) *Building Materials*
 - e) *Pathways into Living Spaces*

E. Indoor Radon Concentration

1. Daily and Seasonal Variations in Radon Concentrations
 - a) *Reasons for Fluctuations*
 - b) *Causes of Abnormal Fluctuations*
 - (1) Fans
 - (2) Tampering
 - (3) Other

2. Ventilation Rates and Radon Concentration

- a) Ventilation Rates*
- b) Stack Effect*
- c) Differential Pressure Effects*
- d) Differential Temperature Effects*
- e) Wind Effects*
- f) Other Environmental Factors (Precipitation)*
- g) Importance of Closed-House Conditions*

VI. Introduction to Radon Measurement

(1.0 hr.)

A. Overview

B. Introduction to Measurement Devices

1. Device Types

- a) Alpha Track*
- b) Electret Ion Chamber*
 - (1) Short Term**
 - (2) Long Term**
- c) Activated Charcoal*
 - (1) Open-Face**
 - (2) Diffusion Barrier**
 - (3) Bags**
 - (4) Vials - Liquid Scintillation**
- d) Continuous Radon Monitor*
 - (1) Scintillation Cell**
 - (2) Solid State**
 - (3) Ionization Chamber**

- e) *Introduction to Continuous Working Level Monitors*
- 2. Theory of Operation for Each Device Type
- 3. Advantages and Disadvantages of Measurement Devices

VII. Measurement Protocols

(3.5 hrs.)

A. Overview

- 1. Measurement Units
 - a) *SI Units*
 - b) *Working Level*
 - c) *Conversion: WL and Bq/m³*
 - d) *Picocuries per Liter*
- 2. Health Canada Publications
 - a) *Radon a Guide for Canadian Homeowners*
 - b) *Guide for Radon Measurement in Dwellings (Homes)*
 - c) *Guide for Radon Measurements in Public buildings (Schools, Hospitals, Care facilities, Detention Centres)*

B. Performing Measurements

- 1. Routine Measurements
 - a) *Normal Testing*
 - b) *Pre and Post-Mitigation Testing*
 - c) *Homeowner Testing*
- 2. House Conditions
 - a) *Short-Term Test*
 - b) *Long-Term Test*
- 3. Measurement Location
- 4. Measurement Strategy
- 5. Factors Affecting Reproducible Test Results

- a) *Explanation*
- b) *Factors Involved*
 - (1) Environmental
 - (2) Protocols
 - (3) Tampering
 - (4) Location

C. Interpretation of Results

- 1. Less than 200Bq/m³
- 2. Results between 200-600 Bq/m³
- 3. Greater than 600 Bq/m³

D. Quality Assurance/Quality Control

- 1. Terminology and Explanation
 - a) *Blanks*
 - b) *Duplicates*
 - c) *Spikes*
 - d) *Calibration*
 - e) *Cross Checks*
 - f) *Intercomparisons*
 - g) *Background Measurements*
 - h) *Precision*
 - i) *Accuracy*
 - j) *Bias*
 - k) *Control Charts and Record Keeping*
 - l) *Corrective Actions*
- 2. Creating a Quality Assurance/Quality Control Plan
- 3. Implementation of a Quality Assurance/Quality Control Plan

VIII. Introduction to Health and Safety (0.5 hr.)

- A. Introduction to Occupational Exposure**
- B. Introduction to Monitoring for Exposure**
- C. Introduction to Calculating Exposure**
- D. Introduction to Record Keeping**

IX. Introduction to Radon in Water (0.25 hr.)

- A. Testing**
 - 1. Devices**
 - 2. Sampling**
- B. Guidance**
 - 1. Conversion (10,000 to 1)**
 - 2. Documents**

X. Introduction to Mitigation (0.5 hr.)

A. Overview

1. Assessing the Need for a Mitigation System
2. Designing a Mitigation System
3. Installation of a Mitigation System

B. Types of Systems and Advantages/Disadvantages

1. Active

- a) *Depressurization*
- b) *Pressurization*
- c) *Ventilation*

2. Passive

- a) *Sealing (not a recommended stand-alone action)*
- b) *Stack with No Fan Installed*

XI. Industry Overview (1.0 hr.)

A. Ethics

1. NEHA's Code of Ethics
2. Grievance Procedures
3. Fiduciary Issues
 - a) *Confidentiality*
 - b) *Contract Details*
 - c) *Test Results*

B. Professional Conduct

1. Certification
2. Continuing Education
3. Professional Image

4. **Records Management**
 - a) *Need for Written Contracts*
 - b) *Reporting Results*
 - c) *Maintaining Records for Legal Purposes*
 - d) *Exposure Records*
 - e) *Electronic versus Paper Records*

XII. Review and Questions (1.0 hr.)

XIII. Student Evaluations (0.25 hr.)

Additional Reference Material for the Canadian Radon Measurement Exam

Exposure to Atmospheric Radon, Daniel J Steck, R William Field, Charles F Lynch, Environmental Health Perspectives, Volume 107, Number 2, February 1999

Effects of Meteorological Conditions on Outdoor Radon Daughters Concentrations in Montreal, L Zikovsky, B Chah, Journal of Radio analytical and Nuclear Chemistry, Articles, Vol 161, No 2(1992) 351-353

Summer Outdoor Radon Variations in Canada and Their Relation to Soil Moisture, R L Grasty, Health Physics, 66(2): 185-193, February 1994

Radon—A Guide for Canadian Homeowners, Canada Mortgage & Housing Corporation, <https://www03.cmhcschl.gc.ca/b2c/b2c/init.do?language=en&shop=Z01EN&areaID=000000016&productID=00000000160000000036>

Control of Radon in Houses, National Research Council Canada, Document CBD-247, 1988

<http://www.nrc-cnrc.gc.ca/eng/ibp/irc/cbd/building-digest-247.html>

²¹⁰Pb in Home Dust as a Possible Marker for Radon Exposure in Air, Chunsheng Li, Yong-Lai Feng, Jing Chen, Stephen Kiser, Weihua Zhang, Jiping Zhu, Health Physics, 95(4): 436-439; 2008

Radon exposure: Can we make a difference?, Ray Copes, Jeff Scott, Canadian Medical Association Journal, November 6, 2007, 177(10)

<http://www.cmaj.ca/cgi/reprint/177/10/1229>

Radon: Frequently Asked Questions, Health Canada website,

http://www.hc-sc.gc.ca/ewh-semt/radiation/radon/faq_fq-eng.php

Estimated Risks of Radon-Induced Lung Cancer for different exposure profiles based on the new EPA model, Jing Chen, Health Physics, 88(4): 232-333; 2005

A Creeping Suspicion about Radon, Environmental Health Perspectives, Volume 102, No. 10, October 1994.

<http://ehp.niehs.nih.gov/docs/1994/102-10/focus.html>

PALCAN Policy on Traceability Requirements for Calibration Sources Used by Accredited Testing Laboratories, CAN-P-1626, March 2008.

http://www.scc.ca/en/c/document_library/get_file?uuid=37789cb6-a9fd-4dc2-b420-56e698cdd7bf&groupId=10817

Occupational Safety & Health Answers: 2-Units and Measures, Canada's National Occupational Health & Safety Resource.

<http://www.ccohs.ca/oshanswers/prevention/ventilation/units.html>

Guide for Radon Measurements in Residential Dwellings (Homes), Health Canada, 2008, ISBN: 978-1-100-10182-8,

http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/radiation/radon_homes-maisons/radon_homes-maisons-eng.pdf

Guide for Radon Measurements in Public Buildings (Schools, Hospitals, Care Facilities, and Detention Centres), Health Canada, 2008, ISBN: 978-1-100-10183-5,

http://www.hc-sc.gc.ca/ewh-semt/alt_formats/hecs-sesc/pdf/pubs/radiation/radon_building-edifices/radon_building-edifices-eng.pdf

Palcan Interpretation and Guidance on the Estimation of Uncertainty of Measurement in Testing, February 2009, http://www.scc.ca/en/c/document_library/get_file?uuid=fc73320e-fe4b-4933-92e0-ff0078ccee11&groupId=10817

Radon Occurrence and Health Risk, R William Field, Virtual Hospital: Radon Occurrence and Health Risk, June 1999, <http://www.rst2.edu/ties/RADON/ramfordu/pdffiles/med5.pdf>