



**Radiation Safety
Institute of Canada**
Institut de radioprotection du Canada

Radiation Safety &
Wellness Webinars



November 30, 2023

C-NRPP Test of Consumer-Grade Electronic Radon Monitors

RSIC Presenter: Lynn MacDonald

Invited Guests: Pam Warkentin (C-NRPP, CARST)

Brian Bjorndal (RSIC National Laboratories)

Health Canada Representatives

Good Science in Plain Language®



- Audio and video
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 - Topics covered, time of attendance
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- Radon
- C-NRPP
- Radon Reduction Sweepstakes Report
- Overview of Study
 - Purpose
 - Methodology
- Video Tour of Radon Chamber
 - Fergal Nolan National Laboratories
- Study Results
- Q&A
 - Pam Warkentin
 - Brian Bjorndal
 - Health Canada





Si Silicon 28.086	P Phosphorus 30.974	S Sulfur 32.065	Cl Chlorine 35.453	Ar Argon 39.948
Ge Germanium 72.64	As Arsenic 74.922	Se Selenium 78.96	Xenon 131.29	
Sn Tin 118.71	Sb Antimony 121.76			
Pb Lead 207.2	Bi Bismuth 208.98			
Uuq Ununquadium (289)	Uup Ununpentium (288)			
Ho Holmium 164.93	Er Erbium 167.26	Tm Thulium 168.93	Yb Ytterbium 173.04	Lu Lutetium 174.97

- Naturally-occurring radioactive gas
- Decay product in uranium-238 series
 - Uranium is common on Earth
- Emits alpha particle
 - 2 protons, 2 neutrons
 - Highly damaging to living tissue
- Decays into other radioactive progeny
 - Stick in lungs
- 2nd leading cause of lung cancer
- Primary cause of lung cancer in non-smokers



- Lung cancer is the leading cause of cancer for Canadians
 - 1 in 14 during their life
 - 5-year net survival rate 22%
- ~16% of lung cancer deaths in Canada attributable to high levels of radon



Comparison of Consumer-Grade Electronic Radon Monitors

Pam Warkentin, C-NRPP

Brian Bjorndal, RSIC

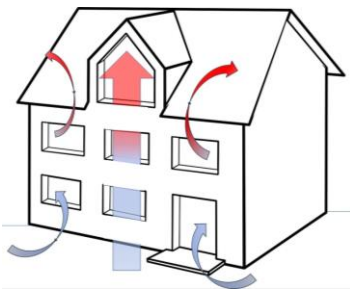




Radon is a radioactive gas which is naturally occurring in soil and can accumulate to concentrated levels in homes and buildings due to the contact of these homes and buildings with the soil and to construction characteristics.

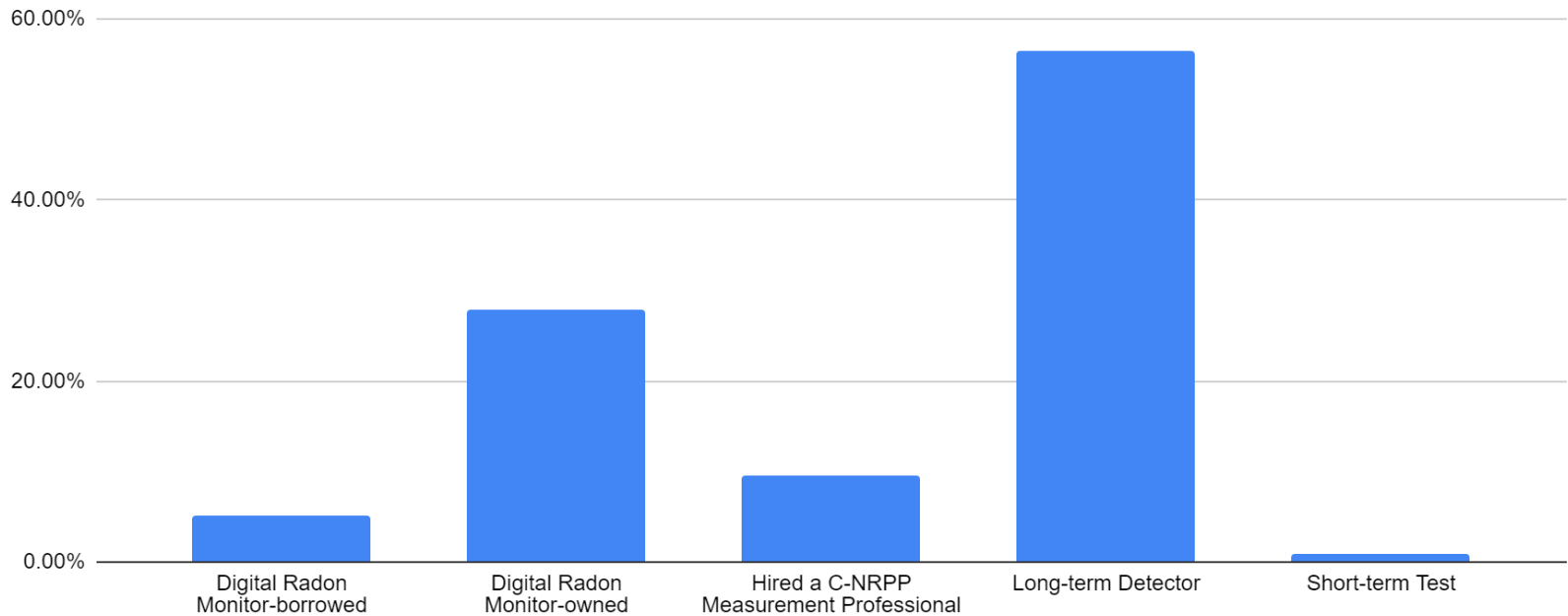


Exposure to elevated levels of radon leads to an increased risk of developing lung cancer.



Radon enters through a difference in air pressure between the soil beneath the ground and the air pressure inside the building. Radon levels can change as factors affect the balance including use of home, temperatures and weather conditions outside.

2023 Radon Reduction Sweepstakes report





Canadian National Radon Proficiency Program

- C-NRPP oversees the certification program of certified measurement professionals and mitigation professionals.
- We also have a list of approved professional devices.
- In 2019 we started the process of evaluating consumer devices as well.



Radon Chamber



Radiation Safety Institute of Canada Fergal Nolan National Laboratories
Innovation Place, Saskatoon, Saskatchewan

Chosen exposures:

1. **Round 1 – Radon Chamber**
 - a. Radon concentration: 200 Bq/m³
 - b. Temperature: 18-22° C
 - c. Humidity: 20-50% RH
 - d. Duration: 7 days
2. **Round 2 – Radon Chamber**
 - a. Radon concentration: 200 Bq/m³
 - b. Temperature: 30° C
 - c. Humidity: 70% RH
 - d. Duration: 7 days
3. **Round 3 – Radon Chamber**
 - a. Radon concentration: 400 Bq/m³
 - b. Temperature: 18-22° C
 - c. Humidity: 20-50% RH
 - d. Duration: 7 days
4. **Round 4 – Radon Chamber**
 - a. Radon concentration: 1000 Bq/m³
 - b. Temperature: 18-22° C
 - c. Humidity: 20-50% RH
 - d. Duration: 7 days



Accuracy – Relative Percent Error between the average radon monitor radon concentration and radon chamber reference radon gas concentration

$$\begin{aligned} & \text{Relative Percent Error (\%)} \\ &= \frac{(\text{Measured Mean} - \text{Reference Value})}{\text{Reference Value}} \times 100\% \end{aligned}$$

Precision – Relative Standard Deviation for the results measured for each model of individual radon monitor tested

$$\text{Relative Standard Deviation (\%)} = \frac{\text{Standard Deviation}}{\text{Measured Mean}} \times 100\%$$



Methodology is based on Public Health England's Intercomparison of Passive Radon Detectors

Measurement Error

$$\text{Measurement Error (\%)} = \sqrt{(\text{Relative Percent Error})^2 + (\text{Relative Standard Deviation})^2}$$

Measurement Error (%)	Performance Grade
≤ 10	A
> 10 and ≤ 20	B
> 20 and ≤ 30	C
> 30 and ≤ 40	D
> 40	E



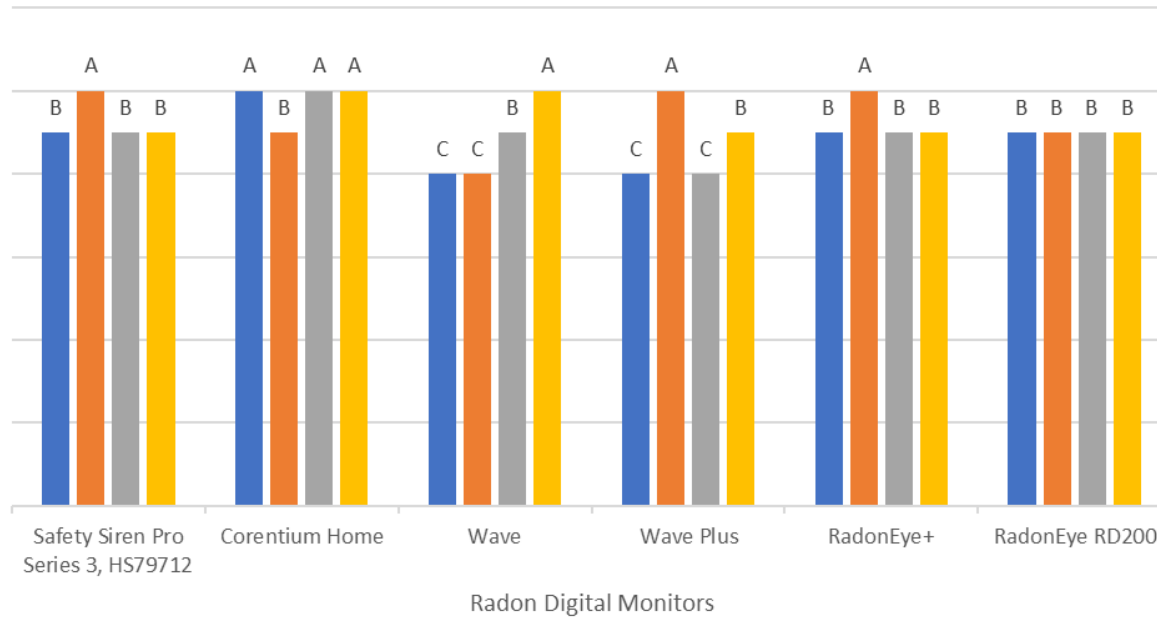
In Year 1 and 2, C-NRPP Purchased a sample of Digital Radon Monitors commonly used in Canada.



Manufacturer's Name	Device Name	Radon Sampling Method	Detection Method
Airthings AS	2900 Wave	Passive diffusion chamber	Alpha spectrometry
Airthings	Wave Plus	Passive diffusion chamber	Alpha spectrometry
Corentium	Home	Passive diffusion chamber	Alpha spectrometry
Safety Siren (Year 1)	Pro Series 3		Ionization Chamber
Safety Siren (Year 2)	Pro Series 4		Ionization Chamber
Radon Eye	Radon Eye Plus		Pulsed ion chamber
Radon Eye	Radon Eye RD200		pulsed ion chamber
Air Steward (year 2)	Air Steward	Uncertain	uncertain



Cummulative Grades on Devices



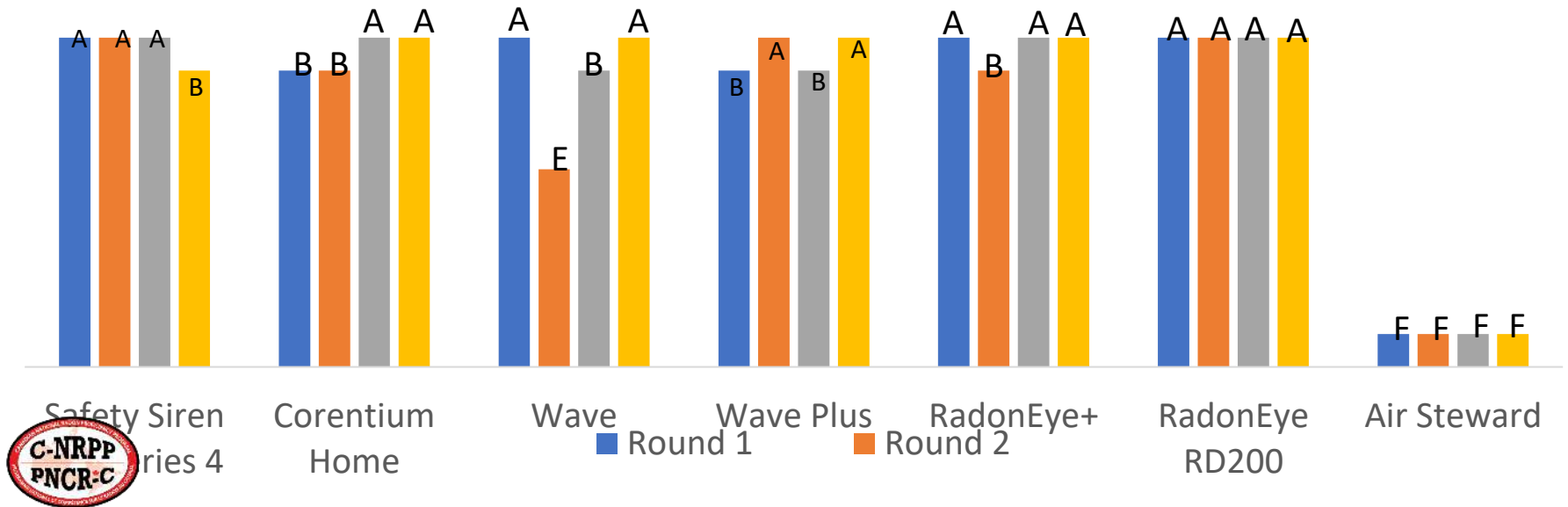
Digital
Radon
Monitors

Year 1 Grades



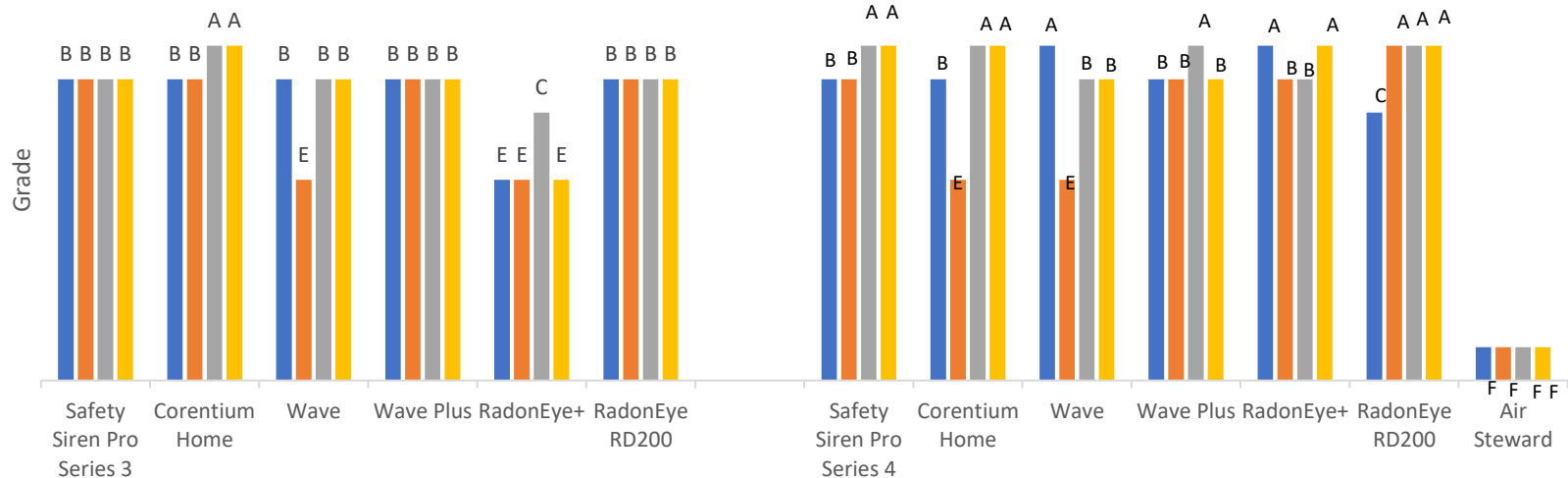
Year 2 – Grade Summary

Cumulative Grades on Devices



Year 3 – Grade Summary








Cummulative Grades on Devices



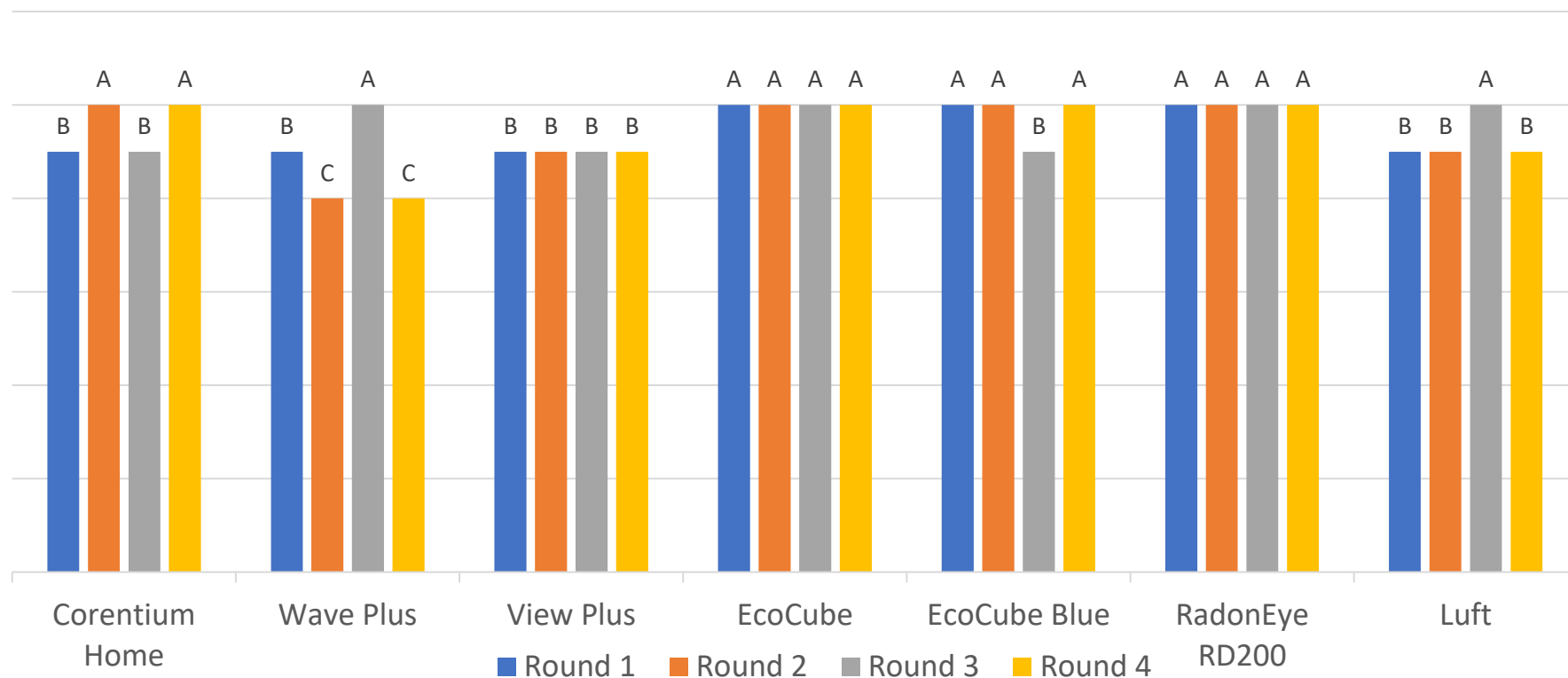
Grouped by Test devices on different Test Condition



In Year 4, C-NRPP reached out to manufacturers and invited them to participate and had them supply the detectors.

		Manufacturers stated Accuracy	Frequency of Reading	Digital Display or cell-phone app	Battery or Plug-in	Passed C-NRPP Performance Test For more details click here.
	Airthings Corentium Home	±10% (after 7 days at 200 Bq/m ³), ±5% after 2 months of monitoring	12 hours 24 hours 7 days (first reading will take 24 hrs)	Short-term and long-term average shown on monitor display.	Battery	✓
	Airthings Wave Plus	±10% (after 7 days at 200 Bq/m ³), ±5% after 2 months of monitoring	Hourly	Long-term average shown on cell phone app. Color-coded indication of levels on monitor.	Battery	✓
	Airthings View Plus	After 30 days at 200 Bq/m ³ , ±10% on the 7 day average and ±1-5% on the 2 month average	Hourly	Short-term average shown on monitor display; long-term average shown on app.	Battery or plug in (USB-C)	✓
	EcoSense EcoQube	+/-10% at 370 Bq/m ³ after 10 hours	Measures every 10 minutes and displays an hourly rolling average.	Hourly level shown on display, long term average available on the app.	Plug in	✓
	EcoSense EcoQube Blue	+/-14% at 370Bq/m ³	10 mins	Device displays 1 hour, 1 day, 1 week and 1 month rolling averages.	Plug in	✓
	EcoSense Radon Eye RD200	±10% at 370 Bq/m ³ after 10 hours	10 mins	Displays 1 hour rolling average; long-term display on app.	Plug-in	✓
	SunRadon Luft	±10% (after 7 days at 200 Bq/m ³)	Initial reading takes 90 mins, hourly.	Long-term and short-term averages shown on the app. Color coded indication of levels on monitor display.	Plug-in	✓

Cumulative Grades on Digital Radon Monitors by Model and by Round





Canadian National Radon Proficiency Program

2023 Intercomparison Report

Radon levels vary from day to day and week to week. Although the electronic monitors listed here provide results quickly, it is important to leave them in place for at least 3 months to get an accurate representation of your average radon level. Short-term radon measurements can be misleading (either much lower or much higher than your actual average radon level).

Follow these guidelines when testing your home for radon:

- Place your radon monitor in a room that is occupied for at least 4 hours each day. For detailed instructions on placing your radon monitor, [click here](#).
- Test your home for a minimum of 3 months, preferably during the heating season when indoor radon levels are typically the highest.
- If you only have access to a digital monitor for less than 91 days, we recommend that you follow up with a long-term radon test. You can find a list of online retailers here: <https://takeactiononradon.ca/test-for-radon/radon-test-kits/>
- Consider the long-term average radon level when deciding whether to mitigate your home. Electronic radon monitors each have a different method of averaging the data; we recommend you read the manufacturer's user guide to determine how to read the long-term average radon level.

Over the past few years, electronic radon monitors have become increasingly available and popular with consumers. In order to provide Canadian consumers with an unbiased performance-based comparison of these monitors, the Canadian National Radon Proficiency Program (C-NRPP) regularly conducts a series of performance tests. [Details of the tests can be found here](#).






The table below summarizes the different devices that have been tested. These devices cannot be professionally calibrated and are not approved by C-NRPP for use by radon measurement professionals.

info@c-nrpp.ca www.c-nrpp.ca



Canadian National Radon Proficiency Program

2023 Intercomparison Report

		Manufacturers stated Accuracy	Frequency of Reading	Digital Display or cell-phone app	Battery or Plug-in	Passed C-NRPP Performance Test For more details click here.
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	Airthings Wave Plus	$\pm 10\%$ (after 7 days at 200 Bq/m ³), $\pm 5\%$ after 2 months of monitoring	Hourly	Long-term average shown on cell phone app. Color coded indication of levels on monitor.	Battery	✓
	Airthings View Plus	After 30 days at 200 Bq/m ³ , $\pm 10\%$ on the 7 day average and $\pm 5\%$ on the 2 month average	Hourly	Short-term average shown on monitor display; long-term average shown on app.	Battery or plug in (USB-C)	✓
	EcoSense EcoQube	$\pm 10\%$ at 370 Bq/m ³ after 10 hours	Measures every 10 minutes and displays an hourly rolling average	Hourly level shown on display, long term average available on the app.	Plug in	✓
	EcoSense EcoQube Blue	$\pm 14\%$ at 370 Bq/m ³	10 mins	Device displays 1 hour, 1 day, 1 week and 1 month rolling averages.	Plug in	✓
	EcoSense Radon Eye RD200	$\pm 10\%$ at 370 Bq/m ³ after 10 hours	10 mins	Displays 1 hour rolling average; long term display on app.	Plug-in	✓
	SunRadon Luft	$\pm 10\%$ (after 7 days at 200 Bq/m ³)	Initial reading takes 90 mins, hourly.	Long-term and short-term averages shown on the app. Color coded indication of levels on monitor display.	Plug-in	✓

The following devices are not recommended by C-NRPP

Air Steward		Check out the recall at: Air Steward: https://recalls-rappels.canada.ca/en/alert-recall/air-steward-portable-radon-monitor-recalled-due-inaccurate-radon-detection
Radon Guard		Check out the recall at: Radon Guard Monitor https://recalls-rappels.canada.ca/en/alert-recall/health-canada-warns-elifecity-portable-radon-meter-may-post-health-and-safety-risk-0



- First addressing questions posted in the Q&A
- To ask/comment on a question
 - use “raise hand” button
 - When asked, press spacebar or unmute to speak
 - If you prefer to type, do so and I will read it out
- Questions we do not get to
 - Answers will be posted to our website and link to resources emailed out





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Thank you for listening!

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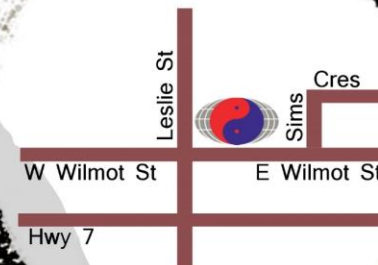
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- Canadian Association of Radon Scientists and Technologists: <https://carst.ca/>
- Canadian – National Radon Proficiency Program: <https://c-nrpp.ca/>
- C-NRPP 2023 Intercomparison Report: <https://c-nrpp.ca/wp-content/uploads/2023/10/Digital-Device-Report-Oct-2023.pdf>
- C-NRPP Consumer-Grade Electronic Radon Monitors: Summary of Methods and Detailed Results: <https://c-nrpp.ca/wp-content/uploads/2023/10/Digital-Device-Report-Oct-2023.pdf>



- Health Canada Radon: <https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radon.html>
- Health Canada Radon Action Guide for Municipalities: <https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radon/action-guides/municipalities.html>
- Health Canada: Long-term Test Instructions: <https://www.canada.ca/content/dam/hc-sc/documents/services/publications/health-risks-safety/radon-long-term-test-instructions/radon-eng.pdf>
- A Calculated Risk: Radon Exposure in Indoor Environments (Interview with Jing Chen, Health Canada): <https://science.gc.ca/site/science/en/blogs/science-health/calculated-risk-radon-exposure-indoor-environments>
- National Research Council Canada Radon Research in Conjunction with Health Canada: <https://nrc.canada.ca/en/stories/get-know-nrcs-radon-research-radon-action-month>



- RSIC Canadian Radon Reference Chamber: <https://radiationsafety.ca/laboratory-services/radon-chamber/>
- RSIC Factsheet – Radon Gas: <https://radiationsafety.ca/radon-gas/>
- RSIC Factsheet – Radon in Your Home: https://radiationsafety.ca/wp-content/uploads/2009/05/radon_factsheet.pdf
- Statistics Canada *Households and the Environment: Radon awareness and testing, 2021*: https://www150.statcan.gc.ca/n1/en/daily-quotidien/221018/dq221018d-eng.pdf?st=Z8j_ozqf
- Canadian Cancer Statistics 2023: https://cdn.cancer.ca/-/media/files/research/cancer-statistics/2023-statistics/2023_pdf_en.pdf