C-NRPP Device Listing Policy

C-NRPP Device Listing Policy

1.0 Purpose

The purpose of this policy is to define the process whereby radon measurement devices (both passive and electronic) are evaluated and approved (or listed, in the case of homeowner-grade electronic devices) by the C-NRPP.

The C-NRPP evaluates devices in order to maintain high standards for radon measurement devices in Canada and protect Canadians from faulty devices and poor-quality radon measurements. Consistent performance reviews and an up-to-date device listing serve to increase public confidence in the radon measurement industry and protect public health.
The C-NRPP List of Radon Devices is published on the C-NRPP website and is referenced by organizations such as Health Canada and public health organizations. The C-NRPP list of approved devices is also a reference for radon measurement professionals, who can rely on the C-NRPP to monitor the performance of the radon measurement devices available to them. In addition, C-NRPP publishes a list of consumer-grade devices which it has evaluated and recommends.

2.0 Definitions

Alpha track detectors: Alpha track detectors use a small piece of special plastic or film inside a container to measure an average of radon levels over the full duration of the testing period. These detectors are shipped in a sealed package, which is torn open to start the test. Once the test is completed, the detector is returned to the laboratory for analysis. Testing duration depends on the manufacturer, but generally ranges from 10 days to 12 months.

Calibration: is the process of establishing that the equipment is functioning properly. During calibration monitors are evaluated for accuracy, cleaned, serviced and sent back to the owner with a certificate or sticker showing that calibration has been completed successfully.

Consumer-grade electronic radon monitors (ERM): Consumer-grade electronic radon monitors record a series of radon measurements at regular time intervals (hourly or shorter) and record and report the results. These devices have methods for storing and displaying radon measurements. These devices cannot be calibrated by the manufacturer and should have an expiry date. These devices can be used for short- term or long -term measurements but may not be used by C-NRPP certified radon measurement and mitigation professionals to perform radon measurements for clients. C-NRPP professionals may, however, sell these devices for use by homeowners.

Professional-grade electronic radon monitor (Continuous radon monitors or CRM): Professional-grade electronic radon monitors record a series of radon measurements at regular

time intervals (hourly or shorter) and record and report the results. In order for a professional-grade electronic radon monitor to be approved by the C-NRPP, it must be capable of storing, displaying, and retrieving the radon measurement data and shall also have the ability to measure and track additional environmental parameters such as temperature, barometric pressure, relative humidity, and motion. These devices must be calibrated annually by the manufacturer or a manufacturer approved facility. These devices can be used for short- term or long -term measurements by C-NRPP certified radon measurement and mitigation professionals.

Electret ion chambers: Electret ion chamber detectors consist of a special plastic canister (ion chamber) containing an electrostatically charged disk detector (electret). This type of detector may be deployed for 48 hrs to 12 months.

Laboratory: An organization that provides and analyzes detectors used for radon measurement.

Long-Term Radon Test: A radon test of 91 days or longer. Devices typically used for long-term radon tests are alpha track, electret ion and consumer-grade electronic radon monitor.

Proficiency testing: Proficiency testing is used to establish the performance of a device. The process that C-NRPP uses for proficiency testing is detailed in Appendix A.

QA/QC Coordinator: The individual in an organization who is responsible for ensuring C-NRPP quality assurance and quality control measures are followed by all radon measurement professionals in the organization and for all the devices used in an organization.

Radon Measurement Service: An organization that offers radon measurement services. This includes both laboratories and suppliers.

Registration: Registration is formal recognition by C-NRPP that a supplier or laboratory has demonstrated a level of competency in relation to carrying out three-month measurements of radon in air, interpreting those results and advising customers accordingly.

Short-Term Radon Test: A radon test of at least 48 hours but less than 3 months. Devices typically used for short term radon tests are professional-grade electronic radon monitor, consumer-grade electronic radon monitors, electret ion, or alpha track.

Supplier: An organization that offers radon measurement devices to the public; a supplier may offer detectors sourced from a third party or a supplier could also be a manufacturer.

3.0 Relevant Documents:

This document should be read in conjunction with the following documents:

C-NRPP Quality Control and Quality Assurance Manual for Radon Sampling and Analysis conducted by Radon Measurement Professionals and Laboratories

Health Canada's Guide for Radon Measurements in Residential Buildings

Health Canada's Guide for Radon Measurements in Public Buildings
C-NRPP Protocol for Conducting Short-Term Radon Measurements in Air

CARST's Guideline for Conducting a Radon Screening Assessment as part of a Real Estate Transaction

4.0 Listing Requirements:

The listing requirements for each type of device are specified in section 4.2. Prior to having any of their devices listed, a manufacturer must meet certain requirements as well.

4.1 Listing requirements for Manufacturers

In order to have devices approved by the C-NRPP and listed accordingly, a manufacturer must meet the following requirements:

- The manufacturer must designate a QA/QC Coordinator, who is C-NRPP Measurement Certified
- The manufacturer must have liability insurance for operating in Canada
- The manufacturer must follow a proper Quality Assurance Program
- It is recommended (though not required) that manufacturers be ISO9001 and/or ISO17025 certified.

Prior to having any devices listed by the C-NRPP, a manufacturer must complete the online registration form – https://form.jotform.com/240845805373056

The form will ask for information such as:

- Proof of liability insurance for operating in Canada
- Proof of any ISO certifications
- Name of QA/QC Coordinator, certified with C-NRPP for radon measurement
- Copy of Quality Assurance program
- Link to device user manual

Along with these documents, the manufacturer will need to submit a record of performance testing for each device submitted, using the process specified in Appendix A, as well as the technical specifications as specified per device type in section 4.2. All of the documentation listed above, as well as the technical documentation listed per device type below, will be kept confidential by C-NRPP except where noted that it will be listed on C-NRPP's website.

4.2 Listing Requirement for Devices

For each device submitted for evaluation by the C-NRPP, the manufacturer must submit the following documents relating to performance testing of the device:

- Name, model number and country of manufacturer.
- Documentation of performance for each device. The results required to be listed by C-NRPP are specified in Appendix B. (If the testing process used was different than C-NRPP's protocol in Appendix A, details on the testing protocol followed and reasons for differences must be detailed and pre-approved.)
- Information about any published or unpublished technical reports, including participation in any international intercomparisons.

In addition to the documentation regarding the performance testing, the manufacturer must submit the information as specified by device type in the sub-sections below.

4.2.1 Passive Alpha Track Detectors

For passive alpha track detectors, manufacturers are required to provide the following technical information for evaluation by the C-NRPP. This technical information will be kept confidential except where noted with an asterisk.

- A complete description of the device including: name*, model number*, country of manufacture*, detector type*, type and source material used in the track detector, type of material used in the chamber and other components, chamber volume, external characteristics such as dimensions, * and weight*.
- A photo and description of the device which highlights features and applications/uses for potential purchasers.
- Details of the measurement system including measurement range* (Bq/m^3), including the Lower and Upper Limit of Detection* (Bq/m^3), normal or recommended exposure duration* (including the minimum and maximum exposure time, e.g. range of days), time necessary for radon's diffusion into the detector, Standard Deviation of Error, % Uncertainty at low (200), medium (600) and high (1000-4000) radon concentrations*
- A complete description of the method of track counting including the etching method (solution, temperature, agitation or stirring, etc.) and the track counting method (manual or automated, protocol for areas scanned, etc.).
- A description of the quality control procedures used during production including:
    - The procedures used to check the internal variability of efficiency and background of each batch of track detection material;
    - The type and frequency of quality control measurements made during each step of the analysis process; and
    - The corrective action limits used for assessing the results of the quality control measurements.
- A general description of the technical basis for the calibration factors and background used in the analysis including:
    - The typical range of efficiency
    - The typical background and range of values generally found

    - The results of field studies on background and effects of storage and shipment time and procedures
    - The results of studies of the effects of altitude on efficiency
    - The algorithms used for calculating results
- A copy of the user manual, which will be shared publicly. This manual should include the procedures for deploying the device, resealing it, packaging it and returning it to the analysis laboratory, recommendations for storing devices prior to use, and recommended quality assurance procedures.
- Any additional information such as any ANSI, ISO or other recognized standards the device complies with (provide proof of compliance to C-NRPP) and any published or unpublished technical reports, research papers, and field studies including any participation in any international intercomparisons.

4.2.2 Electret Ion Chamber Systems:

For electret ion chamber systems, manufacturers are required to provide the following technical information for evaluation by the C-NRPP. This technical information will be kept confidential; items noted with an * may be noted publicly as part of the device listing on C-NRPP's website.

- A complete description of the device including name*, model number*, and country of manufacture*, detector type*, type and source material used in the sensor(electret), type of material used in the chamber and other components, chamber volume, external characteristics such as dimensions* and weight*.
- A photo and description of the device which highlights features and applications/uses for potential purchasers.
- Details of the measurement system including: measurement range* in Bq/m^3 (including the Lower and Upper Limit of Detection*, normal or recommended exposure duration* (including the minimum and maximum exposure time) e.g., range of days, time necessary for radon's diffusion into the detector, Standard Deviation of Error, % Uncertainty at low (200), medium (600) and high (1000-4000) radon concentrations*
- A description of the quality control procedures used during production including the procedures used to check the internal variability of efficiency and background of sensor(electret) material;
- A copy of the user manual, which will be shared publicly. This manual should include the procedures for deploying, retrieving and analyzing the device, recommendations for storing device system prior to, or in-between uses (including temperature and relative humidity), and recommendation quality assurance procedures, as well as recommended corrective actions.
- Any additional information such as any ANSI, ISO or other recognized standards the device complies with (and provide proof of compliance to C-NRPP) and any published or unpublished technical reports, research papers, and field studies including any participation in any international intercomparisons.

4.2.3 Professional-grade electronic monitors

For professional-grade electronic monitors (continuous radon monitors), manufacturers are required to provide the following technical information for evaluation by the C-NRPP. This technical information will be kept confidential, items noted with an asterisk may be noted publicly as part of the device listing on C-NRPP's website.

- A complete description of the device including name*, model number*, and country of manufacture*, detector type*, type and source material used in the sensor (e.g., ionization chamber, passive diffusion chamber, diffused junction photodiode), type of material used in the chamber and other components, and chamber volume: (total / active).
- Other characteristics such as external dimensions* and weight*, power supply, battery power back up*. Other sensors included on the monitor including things such as barometric pressure* (range and typical error), relative humidity* (range and typical error), temperature* (range and typical error), anti- tampering* (sensor type and typical indication) and any other features including type and measurement units.
- A photo and description of the device which highlights features and applications/uses for potential purchasers.
- Details of the measurement system including measurement range* (Bq/m^3) (including the lower and upper limit of detection), measurement intervals* (e.g., 1, 2, 4, 24 hours), Sensitivity* (cpm or cph per Bq/m^3), detection efficiency or calibration factor, normal or recommended exposure duration* (including the minimum and maximum exposure time e.g., range of days), standard deviation of error, % uncertainty at low (200), medium (600) and high (1000-4000) radon concentrations*.
- Details of data management including maximum number of records stored*, response time (10 to 90% total value)*, display* (e.g., number of digits, type (LCD, LED, etc.)), user/operator controls*, I/O* (e.g., USB, IR, Bluetooth), and process of printing a report.
- A description of the quality control procedures used during production including:
    - The procedures used to check the internal variability of efficiency and background of sensor(electret) material; recommended frequency for calibration.
- A copy of the user manual, which will be shared publicly. This manual should include: instructions on initial setup of the unit's operating instructions for proper operation of the unit and troubleshooting common issues, and procedure for initial verification to ensure the unit is working as intended; the procedures for deploying, retrieving, and analyzing the monitor, recommendations for operating environment including temperature range*, relative humidity*, barometric pressure*. The user manual should also include a complete description of the continuous counting and transient response data (e.g., ramp-up and tail data and any related time requirements), manufacturer's recommendations regarding the minimization of effects due to shock or vibration and external electromagnetic fields (e.g., criteria for placing devices) and procedures to account for changes in response due to high humidity environments, if relevant.

Recommendations for storing monitor prior to, or in-between uses (including temperature and relative humidity), and recommendation quality assurance procedures, as well as recommended corrective actions should also be included.

- Any ANSI, ISO or other recognized standards the device complies with (and provide proof of compliance to C-NRPP) and any published or unpublished technical reports, research papers, and field studies including any participation in any international intercomparisons.

4.3 Consumer-Grade Electronic Radon Monitor Report

To add a device to the C-NRPP Consumer-grade electronic radon monitor report, the following steps are required:

- Manufacturers can complete the C-NRPP's Intercomparison Project – Intent to participate form and submit devices within required timeframe. The intent to participate form changes each year, contact the C-NRPP office.
- C-NRPP reserves the right to purchase devices and include in the Intercomparison.
- A device receives a "recommended" status when it achieves a Grade of A or B as part of the intercomparison project.

5.0 C-NRPP's List of Approved Device List

C-NRPP maintains a list of radon devices which are recommended for use by C-NRPP professionals. This includes alpha track detectors, electret ion detectors and professional-grade electronic radon monitors.

5.1 Results of Intercomparison - Measures of Success

For a device to be considered successful by C-NRPP for listing on the C-NRPP list of Approved Devices or to be considered "Recommended" on the C-NRPP Consumer-grade electronic radon report, it must have achieved the minimum requirements as specified in Table 1.

Performance Indicator	Acceptable Range
Accuracy – RPE (%)	Less than or equal to 20%
Precision – Relative Standard Deviation (%)	Less than or equal to 20%
Measurement Error (%)	Grade of A or B

Table 1: Minimum performance requirements for C-NRPP listed devices

5.2 Initial Registration:

To add a device to the C-NRPP list of approved devices, the following steps are required:

- Complete the application form.
- Provide the technical documentation as specified in sections 4.1 and 4.2.

5.3 On-going Registration

To maintain registration of each device a manufacturer must:

- Participate in the annual inter-comparison exercise organized by C-NRPP.

In addition, every two years the manufacturer must complete the following by April 30th:

- Complete the renewal form including evidence of appropriate public and employers' liability insurance and confirmation of intent to participate in annual C-NRPP continual intercomparison exercises.

5.4 De-registration

Any of the following situations will result in de-registration of a device:

- Failure to provide the documents and data required on a biennial basis by the deadline.
- In the event that a device fails a C-NRPP Annual Intercomparison test, the test must be repeated independently within 4 months. If this testing is failed a second time, the registrant will be deregistered until the matter is resolved.
- In the event that any complaints are raised against a device or a manufacturer, these complaints will be discussed by the C-NRPP Ethics Committee. The manufacturer must comply with the prescribed actions to maintain registration.

Any decision to de-register a device will be made by the C-NRPP Ethics Committee. During the de-registration period, any companies issuing and/ or processing the device must do so in a way that clearly specifies that the device is not a C-NRPP listed device.
A request for re-registration should include evidence that the basis for de-registration has been addressed and that the registrant has taken the necessary steps to ensure that it will not occur again.

5.5 General

- C-NRPP reserves the right to audit a registrant for consistency with the agreed procedures from time to time.
- C-NRPP reserves the right to de-register a listed device where the conditions of registration are not met.
- C-NRPP reserves the right to update the listing protocol as required; registrants will be notified of updates.

6.0 Conclusion

This testing protocol may be updated periodically to continue to meet the objectives of maintaining high radon measurement standards in Canada and protecting Canadian consumers. Changes will be communicated to all manufacturers currently included on the C-NRPP list of approved devices.

Appendix A: C-NRPP Listing Proficiency Testing and C-NRPP Annual Intercomparison Protocol

The number of specified detectors/devices of the same model to be evaluated is included in Table 1.

Table 1: Number of devices required to participate:

Type of Project	**Number of Devices**
Alpha Track detectors	33 per detector model
Consumer-grade electronic Radon monitors	3 devices per model
Professional-grade electronic radon monitor	3 devices per model

5. Inspection of Devices

Alpha Track Devices:

Prior to exposing the passive radon detectors under the testing protocol, detectors will be inspected to ensure the package is properly sealed and no holes or leaks are observed.

Radon detectors that appear to have packages which are not sealed during the initial inspection will not be exposed in the radon chamber and the manufacturer will be contacted to resubmit additional devices in time for the start of the exposures.

Consumer-grade and Professional grade electronic radon monitors:

Prior to exposing the professional-grade radon monitors under the testing protocol, RSIC staff will perform the following tasks:

- Log each radon monitor, make, model serial number and manufacturer contact information.
- Inspect each monitor for visible damage.
- Review the operating manuals for each monitor, and as applicable, download manufacturer applications and connect to the monitors.
- Check the function of the monitor.

Radon monitors that appear to have been damaged during shipment or do not appear to be operating properly during the initial inspection will not be exposed in the radon chamber. In such instances, RSIC will contact the C-NRPP for a replacement device(s).

6. Testing Scenarios

Alpha Track Devices:

During testing, all monitors will be placed in the National Radon Chamber and exposed simultaneously to the same radon concentrations and environmental conditions. Detectors will be spaced apart a minimum of 10 cm to ensure no interference effects during the exposures.

The radon monitors will be subjected to three rounds of test scenarios at various concentrations and exposure durations. The target concentration will be kept confidential, and the exposure duration will range from 96 hours to 600 hours. At the end of the exposure, the devices will be removed from the chamber and set in the chambers office for 24 hrs to allow for off gassing before being returned to the labs by mail following instructions provided by the lab. Each lab will be provided with information on the start and end time and date of the exposure and will be required to provide C-NRPP with a complete report of the calculated radon concentration for each of the devices.

All test scenarios will be conducted in accordance with the RSIC National Radon Chamber operational and quality control procedures.

Consumer-grade electronic radon monitors and Professional grade continuous radon monitors:

During testing, all monitors will be placed in the National Radon Chamber and exposed simultaneously to the same radon concentrations, and environmental conditions. Monitors will be spaced apart a minimum of 10 cm to ensure no interference effects during the exposures.

The radon monitors will be subjected to the following test scenarios:

1. **Ambient Levels Check – National Laboratories**

a. RSIC National Laboratories ambient radon concentrations: 30-50 Bq/m^3
b. Temperature: 21-22° C
c. Humidity: 20-30% RH
d. Duration: 7 days

During the ambient levels check, consumer-grade radon monitor measurements will be compared against co-located calibrated C-NRPP approved Professional-grade electronic radon monitor. This test is only intended as a general check on the operation of the devices.

2. **Static Test 1 – Radon Chamber**

a. Radon concentration: 200 Bq/m^3
b. Temperature: 18-22° C
c. Humidity: 20-50% RH
d. Duration: 7 days

3. **Static Test 2 – Radon Chamber**

a. Radon concentration: 200 Bq/m^3
b. Temperature: 30° C
c. Humidity: 70% RH

d. Duration: 7 days

4. Static Test 3 – Radon Chamber

a. Radon concentration: 400 Bq/m^3
b. Temperature: 18-22° C
c. Humidity: 20-50% RH
d. Duration: 7 days

5. Static Test 4 – Radon Chamber

a. Radon concentration: 1000 Bq/m^3
b. Temperature: 18-22° C
c. Humidity: 20-50% RH
d. Duration: 7 days

All test scenarios will be conducted in accordance with the RSIC National Radon Chamber operational and quality control procedures.

7. Performance Grading Criteria

For each model of radon monitor tested, the following performance data will be collected:

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

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

Accuracy

$$Relative\ Percent\ Error\ (\%) = \frac{(Measured\ Mean - Reference\ Value)}{Reference\ Value} \times 100\%$$

Precision

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

From the calculated Relative Percent Error and Relative Standard Deviation for each instrument model an overall measurement error will be calculated.

Measurement Error

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

The calculated radon monitor Measurement Errors from the tests will be used as the basis for grading each instrument. The grading system that will be employed is presented in Table 2.

Table 2: Radon Monitor Performance Classification Grade

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

8. Reporting

Upon completion of the testing protocol, RSIC will submit all test data to the C-NRPP. For the C-NRPP Annual Intercomparison, C-NRPP will prepare a publicly available report outlining the relative performance of the radon monitor models tested based on the Performance Grade. A more detailed report will be provided to each participant.

Appendix C: C-NRPP Technical Specification Sheet for Alpha Track Detectors

Note: *Fields marked with an asterisk * will be shared on the C-NRPP device listing webpage to help differentiate between products.*

Please also include a photo of the device and a brief textual description that highlights features and applications/uses*.

DEVICE

Name*: _____
Model Number:*: _____
Country of Manufacturer*: _____

SENSOR

Detector Type*: _____
e.g., alpha track
Type and Source material used in the track detector: _____
Type of material used in the chamber and other components: _____
Chamber Volume: (total / active) _____
Please attach an annotated schematic of the device, including dimensions. Attached: ☐
Brief textual description that highlights features and applications/uses.

MEASUREMENT

Measurement Range*: (Bq/m^3) (including the **Lower and Upper Limit of Detection*:** (Bq/m^3)_____
Normal or Recommended Exposure Duration* (including the Minimum and Maximum Exposure Time : e.g., range of days **_____**
Time necessary for radon's diffusion into the detector: _____
Standard Deviation of Error: _____

EXTERNAL CHARACTERISTICS: **Dimensions*: _____**
Weight*: _____

PROCESSING COMPLIANCE

A complete description of the method of track counting including:

- The etching method (solution, temperature, agitation or stirring, etc.)
- The track counting method (manual or automated, protocol for areas scanned, etc.)

QUALITY ASSURANCE

- A description of the quality control procedures used:
  - The procedures used to check the internal variability of efficiency and background of new track detection material;
  - The type and frequency of quality control measurements made during each step of the analysis process; and
  - The corrective action limits used for assessing the results of the quality control measurements

- A general description of the technical basis for the calibration factors and background used in the analysis including:
    - The typical range of efficiency
    - The typical background and range of values generally found
    - The results of field studies on background and effects of storage and shipment time and procedures
    - The results of studies of the effects of altitude on efficiency
    - The algorithms used for calculating results

USER MANUAL

Manufacturers are also asked to submit a user manual, which will be shared publicly. This manual should include:

- The procedures for deploying the device, resealing it, packaging it and returning it to the analysis laboratory.
- Recommendations for storing devices prior to use.

ADDITIONAL INFORMATION

List any ANSI, ISO or other recognized standards the device complies with (and provide proof of compliance to C-NRPP).*

- Information about any published or unpublished technical reports, research papers, and field studies including any participation in any international intercomparisons.

_____
_____
_____
_____

Appendix D: C-NRPP Technical Specification Sheet for Electret Ion Systems

Note: *Fields marked with an asterisk * may be shared on the C-NRPP device listing webpage to help differentiate between products.*

Please include a photo of the device and a brief textual description that highlights features and applications/uses.

DEVICE

Name*: _____
Model No.*: _____
Country of Manufacture*: _____

SENSOR

Detector Type(s)*: _____
Type and Source material used in the detector: _____
Type of material used in the chamber and other components: _____
Chamber Volume: (total / active) _____
Please attach an annotated schematic of the device, including dimensions. Attached: ☐

MEASUREMENT

Measurement Range*: (Bq/m^3) (including the **Lower and Upper Limit of Detection*:** (Bq/m^3)_____
Normal or Recommended Exposure Duration* (including the Minimum and Maximum Exposure Time : e.g., range of days _____
Time necessary for radon's diffusion into the detector: _____
Standard Deviation of Error: _____

STORAGE ENVIRONMENT

Temperature Range*: _____
Relative Humidity*: _____

EXTERNAL CHARICTERISTICS:

Dimensions*: _____
Weight*: _____

QUALITY ASSURANCE by MANUFACTURER:

- A description of the quality control procedures used for manufacturer of the chambers and the electrets

USER MANUAL and QUALITY ASSURANCE RECOMMENDATIONS:
Manufacturers are also asked to submit a user manual, which will be shared publicly. This manual should include:

- The procedures for deploying the device,
- The procedures for storing, deploying, packaging and labeling the devices and, if appropriate, returning them to the analysis laboratory

-
    - Complete procedures for using the voltage reader.

- **QUALITY ASSURANCE**
- A description of the quality control procedures used:
    - The procedures used to check for voltage drift of stored devices
    - Recommended checks of electrets (eg. For dust)
    - Recommendations for accommodating for potential background gamma exposure (ex. Including location, elevation, etc.)
    - Recommendations for accommodating barometric pressure differences
    - Quality assurances recommendations for the voltage reader
    - Quality assurance recommendations for each step of the measurement/analysis process
    - Suggested troubleshooting when corrective actions required
-

ADDITIONAL INFORMATION

Information about any published or unpublished technical reports, research papers, and field studies including any participation in any international intercomparisons.

List any CSA, ISO, ANSI or other recognized standards the device complies with (and provide proof of compliance to C-NRPP).*

_____
_____
_____
_____

Appendix E: C-NRPP Technical Specification Sheet for Professional-grade electronic radon monitor

Note: *Fields marked with an asterisk * may be shared on the C-NRPP device listing webpage to help differentiate between products.*

Please also include a photo of the device and a brief textual description that highlights features and applications/uses for potential purchasers.

DEVICE

Name*: _____
Model No.*: _____
Country of Manufacture*: _____

SENSOR

Detector Type*: _____
e.g., ionization chamber, passive diffusion chamber, diffused junction photodiode
Chamber Volume: (~~total / active~~) _____

MEASUREMENT

Measurement Range*(including lower and upper limit of detection): (Bq/m^3)
_____
Measurement Intervals*: e.g., 1, 2, 4, 24 hours _____
Sensitivity*: (cpm or cph per Bq/m^3) _____
Detection Efficiency or Calibration Factor: _____
Standard Deviation of Error: _____
Normal or Recommended Exposure Duration* (including minimum and maximum exposure time): e.g., range of days **_____**

DATA MANAGEMENT:

Maximum Number of Records Stored*: _____
Response Time (10 to 90% total value)***:** minutes _____
Display*: e.g., number of digits, type (LCD, LED, etc.) _____
User/Operator Controls*: _____
I/O*: e.g., USB, IR, Bluetooth _____
Process of printing a report*: _____

OPERATING ENVIRONMENT

Temperature Range*: _____
Relative Humidity*: _____
Barometric Pressure *: _____

STORAGE ENVIRONMENT

Temperature Range*: _____
Relative Humidity*: _____

ELECTRONICS and OTHER SENSORS:

Power Supply*: _____
Battery Power Back up*: _____
Barometric Pressure*: range and typical error **_____**
Relative Humidity*: range and typical error **_____**
Temperature*: range and typical error **_____**
Tampering*: sensor type and typical indication **_____**
Other*: (type and range of measurements) _____

EXTERNAL CHARECTERISTICS:

Dimensions*: _____
Weight*: _____

CALIBRATION/RECALIBRATION PROCESS:

Procedure for determining the calibration factor: _____
Procedure for obtaining and rechecking the background of the system: _____
Procedure for adjusting voltage to obtain a plateau curve: _____
Recommended Frequency of recalibration*: _____
Procedure for determining dead time corrections, if relevant: _____

USER MANUAL

Manufacturers are also asked to submit a user manual, which will be shared publicly. This manual should include:

- A list of other features important to the operation of the system including all items listed with * above.
- Instructions regarding initial setup of the units, operating instruction for proper operation of the unit and troubleshooting common issues, and procedure for initial verification to ensure the unit is working as intended.
- The procedures for deploying, retrieving, and analyzing the monitor, recommendations for operating environment including temperature range*, relative humidity*, barometric pressure *.
- A complete description of the continuous counting and transient response data (e.g., ramp-up and tail data and any related time requirements)
- The recommended frequency for calibration
- Manufacturer recommendations regarding the minimization of effects due to shock or vibration and external electromagnetic fields (e.g., criteria for placing devices).
- Procedures to account for changes in response due to high humidity environments, if relevant.

COMPLIANCE

Information about any published or unpublished technical reports, research papers, and field studies including any participation in any international intercomparisons.

List any ANSI, ISO or other recognized standards the device complies with (and provide proof of compliance to C-NRPP).*