National Radon Safety Board
NRSB
Certified Radon Professionals

Radon Chamber Accreditation Policy

1.0 Introduction

To assess the radon exposure of the general public and to effectively support a measurement quality assurance plan, the reliability and comparability of radon measurement data must be assured. Accurate calibration of radon instruments and radon collection or test devices in a standard test facility under conditions similar to their intended use in the field is essential to ensure quality measurements of radon. The NRSB radon chamber accreditation program ensures that providers of quality assurance exposures for radon test devices and instruments meet standardized design and operating characteristics.

1.1 Chamber requirements for quality assurance exposures for thoron measuring devices or the effects of thoron are not addressed in this document. Indoor concentrations of thoron (radon-220) can be a source of interference in the measurement of radon (radon-222).

1.2 The criteria in this document are intended to support quality assurance exposures of devices used by certified radon testers and mitigators. The measurements conducted by these radon practitioners are typically carried out in an indoor environment in residences, schools, or commercial buildings.

1.3 This document addresses requirements for radon and radon decay product chambers to be able to perform quality assurance exposures of devices typically carried out in an indoor environment in residences, schools or commercial buildings.

1.4 This document does not address criteria for exposing measurement devices that are used in the varied environmental conditions that occur outdoors, or in harsh industrial environments.

2.0 Radon Chambers & Reference Facilities

2.1 Primary Reference Facility: considered the source for all traceability of radon measurements. At present NRSB recognizes the United States Environmental Protection Agency (USEPA), National Analytical Radiation Environmental Laboratory (NAREL) as the primary radon reference. The NAREL radon calibrations are traceable to the National Institute of Standards and Technology (NIST). NRSB does not provide accreditation for the primary reference facility.

2.2 Secondary Chamber: a facility that meets the requirements of this document and successfully performs annual inter-comparisons with a primary reference facility. A secondary chamber may perform exposures for quality assurance, authorized calibrations, new device evaluations, blind spiking tests and proficiency tests for radon devices and instruments within the scope of its accreditation.

2.3 Tertiary Chamber: a facility that meets the requirements of this document and successfully performs annual inter-comparisons with the primary reference facility or an accredited secondary chamber. A tertiary chamber may perform exposures for quality assurance, blind spiking tests and authorized calibration for radon devices and instruments within the scope of its accreditation. Tertiary radon chambers shall not be used for proficiency testing or initial acceptance evaluations.

3.0 Chamber Design

NRSB cannot anticipate every chamber design or application thereof and will review each application on a case-by case basis to ensure that the facility meets the appropriate criteria required for the stated application.

3.1 Radon Source

3.1.1 When used in a secondary radon chamber the radon source must be traceable to a primary reference standard.

3.1.2 The radon source should consist of pure, dry radium-226 which may be mixed with dry materials to facilitate handling and air flow.

3.1.3 Radium in a liquid solution can be difficult to handle and present potential contamination problems. Liquid radium solutions must not be used as a radon source unless adsorbed onto a dry material or sealed in an emanation capsule.

3.1.4 Radon sources containing natural radium enriched soils should be avoided due to uncertainties in their characterization and origin. If a natural product radon source or non-commercial source is used it potentially could contain radon-220 (thoron) and the operator must demonstrate and document that the contribution of thoron is negligible. Radon sources that use natural ores may be used only in tertiary chambers.

3.1.5 The radon source must be of known concentration. The activity of the source must be chosen based on the design and operation of the chamber. With the proper design a source with an activity in the range of 1 micro-curie (μCi) to 10 μCi should yield a range of radon chamber concentrations between 2 and 50 pCi/L.

3.1.6 For working level chambers the concentration of radon decay products must be controllable and should be in the range of 0.01 to 0.4 WL with equilibrium factors ranging from 0.3 to 0.7.

3.1.7 Radon sources used in radon chambers must meet all applicable State and Federal radiation regulations for licensing, handling, storage, disposal and documentation. The chamber specifications must differentiate between licensed and exempt quantity of radium used in the radon sources.

3.1.8 Radon sources must be sealed to prevent leakage of the radium source material into the nearby environs.

3.1.9 Radon sources must be adequately shielded to reduce exposure to personnel and devices to an elevated field of gamma radiation.

3.2 Chamber Size

3.2.1 The size of the radon chamber must be adequate to accommodate the instruments or devices placed in the chamber during an exposure period.

The chamber should be larger than 0.5 m^3 in volume, and preferably greater than 5 m^3 when exposing multiple devices simultaneously.

A large walk- in chamber is preferred when many devices must be exposed simultaneously or instruments inside the chamber need to be operated by personnel.

3.2.2 Active continuous radon monitors that use a pump to sample test air through a probe, or a single entry point such as a valve on a scintillation cell, may not require an enclosed chamber. The procedure used by a radon chamber facility evaluating or calibrating devices in this manner must be evaluated on a case-by-case basis

3.2.3 Depending upon the specific design of the chamber, the ability to stabilize the radon concentration in the chamber may be affected by charcoal devices as this type of device adsorbs radon from the air. Chambers exposing charcoal devices must document the effect of charcoal loading on the concentration of radon in the chamber.

3.3 Air Flow

3.3.1 The chamber design must show how the air flow affects the radon concentration in a dynamic chamber. For dynamic chambers it is essential to have control of the air flow in the chamber as variation in ventilation rate controls the concentration of radon in the chamber.

3.3.2 The design of a static chamber must show how a specific radon concentration is transferred from the radon source to the chamber.

3.3.3 The chamber design must show how the air flow is controlled to accommodate devices sensitive to the velocity of the surrounding air or environmental conditions, such as open face charcoal type devices and electret ion chambers.

3.3.4 The chamber design must show how exposure of personnel to radon leakage from the chamber in the immediate vicinity of the chamber or from the exhaust air is avoided.

3.3.5 The chamber design must show how the exhaust air from the radon chamber is diluted. Exhaust vented outdoors should avoid radon reentry to the indoors.

3.4 Chamber Environmental Conditions

3.4.1 The chamber must demonstrate consistent, homogeneous, and well defined concentrations of radon inside for a period of time sufficient for the type of test being conducted.

3.4.2 A secondary chamber must have control of environmental conditions to test the effects of temperature and humidity that may affect the performance of instruments and devices.

3.4.3 The chamber must demonstrate the capability of maintaining a stable temperature between 18 - 27 ° C (64 – 80°F) and relative humidity values between 20 – 75 % for the duration of an exposure period.

3.5 Chamber Monitoring Instruments

3.5.1 The conditions in the radon chamber must be monitored continuously during exposures. Any radon monitoring instruments used in the accredited chamber must either be listed as NRSB approved devices, or be continuously corroborated by a monitor that is NRSB approved.

3.5.2 Continuously operated radon monitoring instruments must be capable of recording the hourly and the average value over the entire period of an exposure.

3.5.3 If grab samples, such as scintillation cell devices are used to monitor a radon chamber, samples must be taken in a manner that demonstrates the radon concentration during the exposure period.

3.5.4 When used in secondary chambers temperature and humidity measurement instruments must be traceable to a standard and calibrated to the manufacturers' specifications. When used for reporting, temperature and humidity readings must be logged hourly.

3.5.5 The sensitivity and precision of any chamber monitoring instrument must be documented and equal to or better than that of any instrument or device that is being exposed.

3.5.6 Any chamber monitoring instrument must maintain a current calibration during the period used for chamber exposures. Calibration of chamber radon monitoring instruments must be performed at least annually.

3.5.7 Chambers must successfully pass a blind inter-comparison test at least annually. A secondary chamber must inter-compare with the primary reference facility. A tertiary chamber must inter-compare with either a secondary chamber or the primary reference facility. The average concentration measured by the device(s) provided for the blind inter-comparison must be within ±10% of the reported value of the reference chamber instrument.

3.5.8 Any instrument or device used to perform inter-comparisons between radon chambers must be listed as an NRSB approved device.

3.6 Test Chamber for Radon and Radon Decay Products

This category of chamber is more sophisticated than that for chambers intended for testing devices that measure radon only. These more sophisticated chambers can be used not only for the measurement of radon, but also for the measurement of individual radon decay product concentrations, the collective radon decay product concentration in the unit of Working Level (WL), the concentration of particles in the air and the particle size distribution.

3.6.1 The main characteristics of a radon and radon decay product chamber include all of the characteristics described above for a secondary radon chamber with the following additions or modifications:

3.6.2 Chamber Size

The chamber must have a minimum volume of 10 m^3 to prevent significant losses of radon decay products from the air due to plate-out. It is preferable that the chamber design be of the walk-in type to allow the entry of personnel and the placement and operation of measurement instruments.

3.6.3 Particle Generator

Because radon decay product instruments may be sensitive to particle size and concentration, a particle generator, particle counting equipment and particle sizing equipment are needed to evaluate the conditions under which the instruments are exposed.

Particle concentrations in homes can vary significantly with time and are usually very low at night. This factor can significantly affect a measurement of radon decay product concentration conducted over a period of 48 hours

3.6.4 A particle generator and a particle counter are required to achieve and control concentrations in the range of 2000 to 100,000 particles/cm^3 inside the test chamber.

3.6.5 When the effects of plate-out on instruments that measure radon decay product concentration are investigated, filtration may be required to achieve the low particle concentration and equilibrium factor that are necessary for such testing.

3.6.6 Chamber Monitoring Instruments

The radon decay product concentration must be monitored continuously throughout an entire exposure and logged on an hourly basis.

3.6.7 The instrument that is used to monitor the radon decay product concentration in the chamber must have been tested in a primary reference facility with known radon decay product concentrations under different equilibrium conditions, or its measurements must be normalized to a series of radon decay product grab measurements collected throughout the test period using instruments that are traceable to primary methods and have been tested at a primary laboratory.

4.0 Personnel

4.1 Qualifications

4.1.1 Director: The director of chamber operations must have combination of formal education, such as a college degree in one of the physical sciences, and experience in nuclear detection methods, statistics and quality assurance. The director of a radon chamber must be certified as an NRSB Radon Measurement Specialist.

4.1.2 Supervisor: An NRSB radon measurement specialist must be supervising the entire chamber operation. The chamber director may perform the role of the supervisor.

4.1.3 Operator: The operator must be knowledgeable in the principles of operation of each device submitted for exposure, including its performance characteristics and protocol application.

4.2 Training

Training and qualifications of all personnel engaged in chamber operations must be documented.

4.3 Contractors or Subcontractors

Any contractors or subcontractors performing work for the operation of a radon chamber must meet the same requirements as personnel employed directly by the entity operating the radon chamber.

5.0 Documentation

5.1.1 The NRSB will review the documented information and act accordingly to see that the required criteria are addressed.

5.1.2 Documentation must be maintained to show proof of traceability of the reported chamber values to an accredited primary reference facility or secondary radon chamber.

5.1.3 Traceability is demonstrated by annual inter-comparisons with a primary reference facility. Chamber measurements must be within +/- 10% of the primary reference facility.

5.1.4 In a secondary chamber traceability is established with internal standard methods and calibrated instruments that have traceability to a primary reference facility. In a tertiary chamber traceability is established with internal standard methods and calibrated instruments from a facility that has traceability to the primary reference facility or an accredited secondary radon chamber.

5.1.5 The accredited chamber must provide a point of contact (management representative) within top level management.

5.1.6 All quality related documentation must be made available to the NRSB upon request.

5.1.7 The chamber facility must provide the written authorization of the manufacturer to perform a calibration of the listed CR or WL instrument.

6.0 Quality Assurance Program

Accredited chambers are required to abide by a Quality Assurance program which includes the maintenance of these documents: Quality Assurance Plan, Standard Operating Procedures, and a Worker Safety Plan.

6.1 Quality Assurance Plan

6.1.1 The quality assurance plan must include, but is not limited to,

- Statements establishing the certified body as a legal entity
- Definition of the organizational structure,
- The assigned responsibilities of personnel
- A system of document control including record retention policies, records of qualifications, training and experience of personnel
- A system for performing internal audits
- A system for managerial review

6.2 Standard Operating Procedures

6.2.1 Standard operating procedures must be documented and followed describing the process used to receive devices and instruments, to provide the appropriate exposure environment for the calibration, spikes and proficiency tests, and reporting for radon devices and instruments within the scope of its accreditation.

6.2.2 Criteria used to determine the successful calibration, spike or proficiency test of a device or instrument within the scope of accreditation must be documented.

6.2.3 Documented procedures must be established describing how the device that is used to monitor the chamber is calibrated and inter-compared with an accredited primary reference facility or radon chamber.

6.3 Worker Safety Plan

6.3.1 A worker safety program must be in place to protect personnel from exposure to radon and radon decay products in the workplace.

6.3.2 A personnel or area radon monitor such as a long-term alpha track detector or occasional short term tests with integrating devices must be used near the radon chamber for quarterly or annual determination of exposure to radon.

6.3.3 Documentation of personnel exposure must be available for a minimum of five years.

6.3.4 Other applicable safety considerations, such as electrical safety, fire safety, safety from tools and confined space environments must be addressed and maintained at all times.

7.0 Reporting

7.1.1 All chamber exposure reports must include the following items:

- Organization name, address and phone number of calibration facility
- NRSB credentials (including device code, Radon Measurement Specialist Certification Number and Chamber Accreditation Number) in accordance with section 9.2.1
- Instrument or device manufacturer model number
- Instrument or device type
- Serial Number(s) of items exposed
- Dates & Times of Chamber Exposures
- Signature of Radon Measurement Specialist responsible for chamber
- Chamber conditions during exposure (radon conc., temp., humidity, etc.)

7.1.2 If a certificate of calibration is issued the following items should be included in addition to the items listed in 7.1.1:

- Date of last calibration
- "As found" calibration settings
- Final calibration settings
- Parameter(s) calibrated for: "radon gas concentration" and/or "radon progeny concentration"
- Clear indication if an instrument met or failed to meet standards
- Conversion Factor
- Instrument background when exposed to a radon free environment
- Units of calibration factor (e.g. "cpm/(pCi/L))"
- Units of instrument background (e.g. "cpm")
- Date of current calibration
- Due date for next calibration

7.1.3 A mark or sticker must be attached to the calibrated instrument indicating the calibration date.

7.1.4 Proficiency test reports and blind spiking test reports must include these additional items:

- Individual Relative Error (IRE) of each test sample result value compared to the chamber reference value, with its associated Pass / Fail designation. ("Pass" is an IRE within +/- 25%.)
- The Pass / Fail designation of the complete proficiency test

8.0 Accreditation Application

8.1 Upon request the applicant is sent a copy of the radon chamber requirements and the application for radon chamber accreditation.

8.2 The completed application form and application fee are returned to the NRSB.

8.3 The National Radon Safety Board administrative office reviews all applications for completeness. If the documentation is in order the application is forwarded for technical review and the candidate is notified that the application is in process.

8.4 If an application is incomplete the applicant is notified and given an opportunity to provide additional information.

8.5 The technical reviewers may reject, compile a list of deficiencies, or grant accreditation to the radon chamber. The applicant is notified of the decision.

8.6 If the application is rejected the applicant may send a written appeal to the NRSB. Any written appeal must be received by the NRSB within 30 days after the applicant's receipt of the notification of rejection.

8.7 If the chamber design or operating procedures are found to be deficient or non-compliant with NRSB radon policies the applicant will be notified of the findings and must respond within 30 days with a written plan to correct the deficiencies and bring the chamber operating procedures into compliance or the application will be rejected. The deficiency correction plan will be reviewed and if found acceptable the applicant has 90 days to document that the deficiencies have been corrected and the chamber operating procedures have been brought into compliance. The application and additional documentation will again be reviewed as in section 8.3.

8.8 Upon issuance of radon chamber accreditation the applicant is notified, sent a copy of the certificate of accreditation and the accreditation is posted on the NRSB website.

9.0 Scope of Accreditation

A radon chamber is NRSB accredited for the ability to safely contain, reliably regulate and document the measured concentration of radon gas and/or radon progeny, relative humidity and temperature levels. The scope of accreditation specifies the services the chamber may perform and the type of devices exposed in an accredited chamber, as outlined in sections 3.6, 9.1.2.1, 9.1.2.2, and 9.1.3.1.

9.1 Exposure Services

9.1.1 Spikes (known exposure quality control measurements)

Devices are exposed to a known concentration of radon for routine quality control purposes such as checking instrument accuracy or stability in relation to a reference standard.

9.1.2 Proficiency Test

Devices are exposed to a concentration of radon to provide a single blind exposure (unknown to the operator) of a device to demonstrate the analytical proficiency of a laboratory or operator.

9.1.2.1 Only secondary chambers are accredited to perform proficiency tests. The secondary chamber provides procedures acceptable to the NRSB for performing blind exposures.

9.1.2.2 An NRSB accredited secondary chamber may not perform proficiency tests for an affiliated business. An affiliated business is a company related by common ownership or control.

9.1.2.3 The chamber shall provide the radon measurement specialist with a written report of the results of the proficiency test, in compliance with sections 7.1.1 and 7.1.4.

9.1.2.4 In the case that the proficiency test results in two consecutive “Fails”, the chamber must provide a copy of the written proficiency test result reports to NRSB within one week.

9.1.3 Calibration

Devices are exposed to one or more known concentrations of radon. Device results are compared to known radon concentrations in order to establish the relation between the measuring device results and the reference values for the purpose of adjusting the measuring device to correspond to the reference value.

9.1.3.1 NRSB accredited chamber calibration services for CR devices are limited to CR devices having manufactures’ written authorization granting the chamber permission to perform calibrations on the listed device as described in the NRSB Policy on Instrument Calibration.

9.1.3.2 The NRSB does not accredit radon chambers to calibrate individual passive devices. NRSB radon chamber accreditation allows approved passive devices to be exposed in the chamber for the purposes of developing and validating calibration curves.

9.1.3.3 Chambers offering calibration exposure services for devices that are affected by humidity such as the AC and LS device types must be capable of controlling the relative humidity in the chamber to three evenly separated ranges.

9.1.4 Blind Spiking Test

A set of blind spike exposures of electret ion chambers (device type ES or EL) performed by an NRSB accredited secondary or tertiary radon chamber, in compliance with the following requirements:

9.1.4.1 An NRSB accredited radon chamber may not perform blind spiking tests for an affiliated business. An affiliated business is a company related by common ownership or control.

9.1.4.2 A minimum of 5 devices shall be exposed during the renewal period.

9.1.4.3 The devices may be exposed at two or more radon concentrations.

9.1.4.4 The chamber shall follow device deployment and retrieval instructions provided by the radon measurement specialist.

9.1.4.5 The chamber may provide the radon measurement specialist client with the incidental environmental conditions of the exposure (temperature, humidity, altitude, etc.) upon the client's request.

9.1.4.6 The exposure radon concentration(s) shall be blind (unknown to the client).

9.1.4.7 Upon completion of the exposure, the radon measurement specialist shall read out the devices and report the radon concentration values as measured to the chamber.

9.1.4.8 The chamber shall provide the radon measurement specialist with a written report of the results of the blind spiking test in compliance with sections 7.1.1 and 7.1.4.

9.1.4.9 In the case that the Blind Spiking test results in two consecutive "Fails", the chamber must provide a copy of the written Bling Spiking test result reports to NRSB within one week.

9.1.4.10 The chamber should provide (but is not required) a waiver on their application that blind spiking "Fails" will be reported to the NRSB.

9.2 Devices

The scope of NRSB accreditation restricts the accredited services of a chamber to the NRSB approved devices listed in the chamber application.

9.2.1 Non-Approved Devices

Exposure services may be performed for devices not approved by the NRSB provided exposure reports, certificates of calibration, and other relevant chamber documentation related to the exposure comply with at least one of the following three policies:

9.2.1.1 The statement, "The device exposed, (insert manufacturer/model), has not been approved by the NRSB" shall clearly appear on every page of the document in at least 10 point type.

9.2.1.2 Space(s) on the document reserved for the NSRB Device Code of the exposed device shall be filled with either "Not approved" or "Not listed".

9.2.1.3 No reference shall be made to either National Radon Safety Board, NRSB, NRSB chamber accreditation, NRSB device approval, NRSB Device Code, NRSB business registration, NRSB Radon Measurement Specialist, or any other NRSB certification at any place within the document.

10.0 Accreditation Renewal

10.1 To ensure that NRSB accredited radon chambers are maintaining the standard of accreditation an annual renewal application is required.

10.2 Notice will be sent out approximately 60 days in advance of expiration; follow-up notification will be sent out approximately 30 days in advance of expiration.

10.3 Each renewal application will be reviewed in the same manner as an initial application.

11.0 Accreditation Revocation

11.1 Revocations and denials of accreditation may be made for failure to meet the accreditation requirements.

11.2 Any chamber accreditation revocation will be preceded by notification prior to such action. The applicant has a right to appeal any rejection or revocation. All appeals must be made in writing and must be received by the NRSB within 30 days after the applicant's receipt of the notification of rejection.

12.0 Use of Accreditation and Logo

12.1 The accredited entity will not make claims about accreditation in a manner inconsistent with the scope of the accreditation issued. They will not use accreditation status in any manner that would be misleading or bring disrepute on the NRSB.

12.2 The accredited entity will agree to discontinue any claims of accreditation including use of the NRSB logo, accreditation numbers, and references to the NRSB that may be misleading upon non-renewal, suspension or revocation of accreditation.

12.3 The accredited entity agrees to abide by the conditions set in the application for radon chamber accreditation.

13.0 Glossary

Affiliated: an affiliated entity is owned or substantially controlled by another entity

Background Exposure: exposure of the device to a radon-free environment of nitrogen or aged air for the determination of background counts

Blind Exposure: devices exposed to a concentration known to the chamber but unknown to the chambers client

Blind Spiking Test: a Blind Exposure of at least five devices to demonstrate analytical proficiency of the laboratory or radon measurement specialist.

Calibration or **Calibration Exposure:** Exposure of an instrument to one or more known radon (or RDP) concentrations under known environmental conditions in an accredited chamber facility, followed by the alignment and adjustment of the instrument according to the manufacturer's authorized instructions to bring its accuracy to within the manufacturer's predetermined tolerances, as well as the issuance of a "certificate of calibration".

Chamber inter-comparison: a quality assurance method of comparing the results of different instrument measurements to a reference value

Initial acceptance evaluation: exposure of a device or instrument for the purpose of acceptance as a certified device.

Proficiency test: a single blind exposure of a device or instrument to demonstrate analytical proficiency of the laboratory or operator.

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Radon: a naturally occurring, colorless, odorless radioactive gas that is formed from the decay of radium. The only gas in the uranium series, radon-222 has a half-life of 3.8 days

Radon Chamber: A radon chamber is considered to be a system capable of safely containing and reliably regulating the concentration of radon gas and/or radon progeny. Radon chambers may also regulate other environmental conditions such as temperature and relative humidity.

Radon collection device: a device that adsorbs radon gas and retains radon/radon progeny. A second detection instrument is required to measure radon/radon progeny in equilibrium in the sealed device.

Radon decay products (radon progeny): isotopes that are formed in the decay chain of radon gas.

Spike (known exposure quality control measurement): exposure of devices used for routine quality control purposes. Spikes are often used to check instrument stability in relation to a reference standard.

Thoron: radioactive isotope of radon, radon-220, having a half-life of 54.5 seconds, produced by the disintegration of thorium