

TITLE 32: ENERGY
CHAPTER II: ILLINOIS EMERGENCY MANAGEMENT AGENCY
SUBCHAPTER b: RADIATION PROTECTION

PART 420
RADON LABORATORY LICENSING AND REQUIREMENTS

Section	
420.10	Purpose and Scope
420.15	Incorporations by Reference
420.20	Definitions
420.30	Exemptions from Requirements for a License
420.45	Form, Location and Retention of Records
420.50	Application for Licenses
420.60	Requirements for Issuance or Renewal of Licenses
420.65	Terminating a License
420.70	Conditions of Licenses
420.80	Continuing Education Requirements
420.100	Fees
420.110	Reports to the Agency
420.120	Disciplinary Action by the Agency
420.130	Requirements for providing devices to clients.
420.140	Quality Control Requirements for the Use of Devices

AUTHORITY: Implementing and authorized by Section 20 of the Radon Industry Licensing Act [420 ILCS 44/20] and Section 10 of the Radon Resistant Construction Act [420 ILCS 52/10].

Section 420.10 Purpose and Scope

- a) This Part establishes licensing requirements for laboratories that perform analysis of radon and radon progeny detection or measurement devices and specifies minimum requirements for quality systems designed to quantify the concentration of radon gas in air by radon contractors and laboratories, whose data are intended to be used to determine the need for, or success of, radon mitigation.
- b) This Part is applicable to the wide variety of radon measurement devices used for indoor measurements, primarily in residential environments or buildings not associated with the possession or handling of radioactive materials.
- c) Nothing in the Radon Industry Licensing Act [420 ILCS 44/] or this Part shall be construed to limit or affect in any respect the practice of persons properly licensed under other statutes or regulations with respect to their professions.

Section 420.15 Incorporations by Reference

- a) All rules, standards and guidelines of agencies of the United States or nationally recognized organizations or associations that are incorporated by reference in this Part are incorporated as of the date specified in the reference and do not include any later amendments or editions. Copies of these rules, standards and guidelines that have been incorporated by reference are available for public inspection and copying at the Illinois Emergency Management Agency-Office of Homeland Security (IEMA-OHS), 1035 Outer Park Drive, Springfield, Illinois.
- b) In addition, copies of ISO/IEC 17025, General Requirements for the Competence of Testing and Calibration Laboratories Compliance may be obtained through the American National Standards Institute (ANSI), 1430 Broadway, New York, New York 10018 and directly from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Copies of ISO/IEC 17025 are available for public inspection and copying at the Illinois Emergency Management Agency-Office of Homeland Security (IEMA-OHS), 1035 Outer Park Drive, Springfield, Illinois 62704.

Section 420.20 Definitions

As used in this Part:

"AARST-NRPP" means the American Association of Radon Scientist and Technologists National Radon Proficiency Program.

"Act" means the Radon Industry Licensing Act [420 ILCS 44].

"Agency" means the Illinois Emergency Management Agency-Office of Homeland Security (IEMA-OHS).

"Alpha Track (AT)" means a radon detector constructed from a piece of plastic, typically of either allyl diglycol carbonate or cellulose nitrate, inside a chamber usually made of electrically conducting plastic. Radon diffuses passively into the chamber, where it subsequently decays. Alpha particles emitted from radon and two of its short-lived progeny, polonium-218 and polonium-214, strike the plastic detector and create damaged volumes or "latent tracks." The plastic is etched in a caustic solution, which produces tracks that are visible with a microscope because the latent tracks are more soluble than the surrounding undamaged material in such a solution.

"Altering" means to change or modify a building or building design, or to revise, rather than repair, a mitigation system or mitigation system design.

“ANSI” means American National Standards Institute.

"Batch" means a group of passive detectors manufactured by the same entity at the same time.

“Blank Measurements” means a detector deployed to verify and document the absence of effects on the measurement resulting from sources other than the air being tested. Since blanks are not exposed (i.e., not left open to permit radon to enter the detector), their measurement value should be below the minimum detectable concentration of the measurement system. See field blanks, office blanks, and lab-transit blanks.

"Calibration" means the determination of the response or reading of an instrument relative to a series of known radiation values over the range of the instrument; or the strength of a source of radiation relative to a standard.

“Activated Charcoal” or “AC” means a class of device that employs a material such as activated charcoal that adsorbs radon from the air. The amount of radon adsorbed depends on the design of the device, the type of charcoal, the exposure time and the radon concentration, temperature and relative humidity in the surrounding air. This class of device can provide an accurate representation of the average radon concentration during the exposure period if there are no large changes in radon concentration or the environment (e.g., temperature, humidity) during the exposure.

“Calibration Measurement” means any radon or radon progeny tests, laboratory analysis, or exposure in a known radon or radon progeny environment, as in a radon chamber.

"Client" means any person who contracts for measurement or mitigation services.

“Collocated” means two or more simultaneous measurements within 4-8 inches of each other in the same location or side-by-side.

“Continuous Radon-Monitor” or “CRM” means a measurement tool that can integrate, record and produce reviewable readings in time increments of 1 hour, and can be recalibrated periodically. means an electronic device that is capable of automatically recording a retrievable time series of numeric measurements of radon concentration averaged over time intervals of one hour or less.

“Duplicates” means collocated, simultaneous measurements conducted with instruments or devices that are identical, including manufacturer, model, and, for continuous monitors, the same most recent calibration facility and schedule, for the purpose of assessing and monitoring the measurement system imprecision.

"Electret Ion Chamber” or “EIC" means a device that uses an ion chamber made of, or lined with, an electrically conductive material with an electret as the detecting

mechanism. The surface voltage of the positively charged electret is measured before and after the exposure to radon. During the exposure, radon passively diffuses into the ion chamber and subsequently decays. The radon decay and its short-lived progeny ionize the air inside the chamber. Electrons are attracted to the electret and discharge it. From the surface voltage of the electret measured before and after the exposure, and the duration of the exposure, the average radon concentration during the exposure can be calculated using calibration factors determined through exposures of devices in a STAR. Ambient gamma rays also ionize air inside the chamber, and the effects of ambient gamma radiation must be taken into account. Different electret sensitivities and chamber sizes can be used in combination to measure a range of radon concentration ranging from 2 days to 1 year. The EIC QA requirements apply to all combinations of electrets and chambers used to measure radon concentration in ambient air.

“Field Blanks” means an unopened detector placed to reveal any unexpected exposures that might result onsite or from handling procedures.

“Home Environment Measurement” means a ~~short term or long term~~ measurement of radon in a single family home, duplex or an individual condominium unit which is not involved in and not done in anticipation of a real estate transaction. Since there is only one party and there is no real estate transaction in process or expected, the extended testing measurement strategy is appropriate.

“Individual” means any human being.

“Interfere” means *to adversely or potentially adversely impact the successful completion of an indoor radon measurement by changing the radon or radon progeny concentrations or altering the performance of measurement equipment or an indoor radon mitigation system installation or operation.* [420 ILCS 44/15]

“ISO/IEC” means International Organization for Standardization and International Electrotechnical Commission.

“Lab-transit Blanks” means an unopened detector placed to evaluate the quality of the laboratory and to look for unexpected exposures that might result from shipping or handling.

“Laboratory” means any organization that analyzes or calibrates radon or radon progeny measurement devices or detectors.

“Laboratory Analysis” means *the act of analyzing the radon or radon progeny concentrations with passive devices, or the act of calibrating radon or radon progeny measurement devices, or the act of exposing radon or radon progeny devices to known concentrations of radon or radon progeny as a compensated service.* [420 ILCS 44/15]

"Long Term Measurement" means measurements lasting 91 days or more; closed building conditions are not required, but are recommended.

"Measurement" means any radon or radon progeny tests, laboratory analysis, or exposure ~~in a known~~of radon or radon progeny in the environment, ~~as in a radon chamber~~.

"NRSB" means the National Radon Safety Board.

"Office Blank" means an unopened detector placed to reveal any unexpected exposures that might result from storage or handling.

"Passive Devices" means a measurement tool that collects a time-weighted average and do not provide hourly readings, that does not require external power or batteries to operate.

"Performance Audit" means an examination of a program, function or operation or of the management systems, procedures and records of a radon contractor to assess whether the entity is complying with the Radon Industry Licensing Act [420 ILCS 44], this Part and its Quality Assurance Program.

"Person" means *entities, including, but not limited to, an individual, company, corporation, firm, group, association, partnership, joint venture, trust, or government agency or subdivision.* [420 ILCS 44/15]

"Pecurie Per Liter" or "pCi/L" means 2.2 disintegrations per minute of radioactive material per liter of air.

"Quality Assurance Program" or "QAP" means the overall program or management system established to assign responsibilities and authorities, define policies and requirements, and provide for the performance and assessment of work."QAP" means Quality Assurance-Program.

"Quality Control" or "QC" means the system of activities to ensure a quality measurement is made. This includes calibrations, backgrounds, duplicates, blank and spiked measurements; inter-laboratory comparisons; audits; and other control activities.

"Radon" means a *gaseous radioactive decay product of uranium or thorium.* [420 ILCS 44/15]

"Radon Chamber" means a standard test atmosphere for radon. See STAR.

"Radon Contractor" or "Contractor" means a *person licensed to perform radon or radon progeny mitigation or to perform measurements of radon or radon progeny in an indoor atmosphere.* [420 ILCS 44/15]

"Radon Progeny" means *any combination of the radioactive decay products of radon.* [420 ILCS 44/15]

"Radon Service Provider" means a radon contractor, laboratory, or person who performs laboratory analysis.

"Relative Percent Difference" or "RPD" means a statistic used to evaluate the difference between two measurements when there is no evidence to support one being more accurate than the other. The RPD normalizes the difference between two measurements by dividing by the best estimate of the true value, which in this case is the mean of the two results. The difference is normalized, compared as a fraction, to the mean of the two results as there is no reason to assume that one measurement is more accurate than the other, and over time a set of RPD values can be used as an estimate of precision.

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"Renewal" means issuance of a license that is expiring, has expired or has been previously terminated.

"Research" means Agency-approved scientific investigation by testing and/or mitigating for radon or radon progeny.

"Short Term Measurement" means measurements conducted for at least 48 hours and up to 90 days; closed building conditions are required for measurements lasting 7 days or less. In measurements lasting more than seven days and less than 90 days, closed building conditions shall be maintained as much as possible while the measurement is in progress.~~"Short Term Measurement" means measurements conducted for at least 48 hours and up to 90 days; closed building conditions are required for measurements lasting 90 days or less.~~

"Standard Test Atmosphere for Radon" or "STAR" means a standard test atmosphere for radon, often called a radon chamber and termed STAR by ISO/IEC standards, including the standard for generating reference radon atmospheres.

"USEPA" means the United States Environmental Protection Agency.

"Working Level" or "WL" means any combination of short-lived radon progeny in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha particle energy. The short-lived radon progeny for radon-222 are: polonium-218, lead-214, bismuth-214 and polonium-214.

"Working Level Month" or "WLM" means a unit of exposure used to express the accumulated human exposure to radon decay products. It is calculated by multiplying the average working level to which a person has been exposed by the number of hours exposed and dividing the product by 170.

Section 420.30 Exemptions from Requirements for a License

- a) The Agency may, upon application or upon its own initiative, grant such exemptions or exceptions from the requirements of this Part as it determines are authorized by law and will not result in a hazard to public health and safety.
- b) Retail stores that only sell or distribute radon sampling devices, but are not engaged in a relationship with the client for other services such as home inspection or representation as in a real estate transaction, and that do not perform laboratory analysis, measurement or mitigation services, are exempt from licensing requirements.

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Section 420.45 Form, Location and Retention of Records

- a) Each record required by this Part and other applicable Parts of Title 32 shall be legible throughout the specific retention period. The record may be the original or a reproduced copy provided that the copy is authenticated by authorized personnel and legible. The record may also be stored in electronic media with the capability for producing legible, accurate and complete records during the required retention period. Records such as letters, drawings, and specifications shall include all pertinent information, stamps, initials, and signatures. Adequate safeguards against tampering with and loss of records shall be maintained throughout the retention period, even if the license expires or is terminated.
- b) Each laboratory licensee shall maintain the records required by this Part and, at the request of the Agency, make his or her records required in accordance with this Part, and make himself or herself, available during normal business hours, in the offices of the Agency, for a performance audit of the license.
- c) At the time of application for a license or renewal, the applicant shall specify, for Agency approval, a location where records required by this Part and other applicable Parts of Title 32 Ill. Adm. Code shall be maintained for inspection by the Agency.
- d) Records required by this Part or other Parts of Title 32, including but not limited to records of radon measurements, Quality Assurance Programs, calibration measurements, equipment repairs and worker protection plans, shall be retained by the licensee for at least 5 years or the length of time of any warranty or guarantees, whichever is longer.

Section 420.50 Application for Licenses

- a) Any person applying to the Agency for a new license or a renewal of a license to perform radon-related laboratory analysis services shall:
 - 1) Submit a complete and legible application through the ~~HEMA~~IEMA-OHS Radon Licensing Portal: <https://public.iema.state.il.us/Radon/>;
 - 2) Pay the appropriate non-refundable fee prescribed in Section 420.100; and
 - 3) Meet the licensing requirements, as applicable, and as set forth in Section 420.60.
- b) Any person who anticipates conducting radon-related laboratory analysis services shall receive the license prior to providing such services in Illinois.
- c) The Agency may at any time after the filing of the original application, and before the expiration or termination of the license, require further statements in order to enable the Agency to determine whether the application should be granted or denied or whether an existing license should be modified or revoked.
- d) An application for renewal of a license shall be submitted at least 30 days prior to the expiration date of the license. An application shall be deemed filed on the date that it is received by the Agency. A radon service provider shall not provide radon services after the expiration date of a license.
- e) The application for renewal shall satisfactory inspection or audit results, submittal of a complete and accurate application form for renewal and the payment of the appropriate fee as specified in Section 420.100.

Section 420.60 Requirements for Issuance or Renewal of Licenses

- a) The Agency shall issue a Laboratory Analysis license to any person who submits a complete and accurate application form prescribed by the Agency that includes:
 - 1) The name of one individual who is responsible for the laboratory radon analytical activities;
 - 2) A description of all measurement devices used and services offered; and
 - 3) Documentation of a Quality Assurance Program that meets one of the following:
 - A) A quality assurance program description consistent with ISO/IEC 17025, General Requirements for the Competence of Testing and

Calibration Laboratories Compliance published June 29, 2005,
exclusive of subsequent amendments or editions; or

- B) Is successfully enrolled in an independent third party accreditation/certification program consistent with national laboratory accreditation and certification standards, or an equivalent program approved by the Agency, for the devices listed in subsection (a)(2).

Section 420.65 Terminating a License

- a) Any person licensed by the Agency may cease licensed activities and terminate his or her license at any time.
- b) The licensee desiring to terminate his or her license shall submit to the Agency, within 15 days after ceasing to provide licensed services, the following information:
 - 1) A request in writing stating the last date of any licensed activity;
 - 2) The original license document; and
 - 3) The location where records will be maintained in compliance with Section 420.45.
- c) The licensee shall allow the Agency to perform an audit that was scheduled before the licensee submitted a request to terminate the license.

AGENCY NOTE: Failure to pay the annual fee DOES NOT automatically terminate an Illinois radon license. The Agency must be notified in writing if a license is to be terminated.

Section 420.70 Conditions of Licenses

- a) Within 45 days after providing laboratory services, the laboratory providing the service shall report the results in picocuries per liter (pCi/L) to the occupant, the owner of the building, his/her representatives, or the client.
- b) Records of radon measurements, quality assurance programs, calibration measurements, and equipment repairs shall be retained by the licensee for a least 5 years or the length of time of any warranty or guarantees, whichever is longer.
- c) The radon laboratory licensee shall notify the Agency in writing within 5 working

days when it loses or replaces the individual named pursuant to Subsection 420.60(a)(1).

- d) Within 45 days after providing radon measurements, the person providing the service shall report the results in picocuries per liter (pCi/L) to the client or their representative.
- e) The person providing the service shall report the results in picocuries per liter (pCi/L) to the owner or occupant of the building upon written request.
- f) Licensees shall inform the Agency of changes in contact information, such as addresses, email address, and telephone numbers within 10 days after the change is effective.
- g) Substantive changes to license application representations require an amendment to the license and Agency approval. Licensees shall request amendments to documents at least 30 days prior to the effective date of the desired revision.
- h) The licensee shall comply with all the applicable provisions of this Part.
- i) The licensee shall comply with its Agency-approved Quality Assurance Program.

Section 420.100 Fees

- a) Application fees shall be submitted as follows:
 - 1) Initial application for laboratory analysis \$500
 - 2) Annual fee of Laboratory Analysis \$500
- b) Billing year is May 1 through April 30 for annual fees. Fees assessed in accordance with this Section are non-refundable.
- c) Annual fees will continue to accrue until license expiration, the license is terminated in accordance with Section 420.65, or the license is suspended or revoked. Failure to terminate the license prior to the start of the billing year will result in that year's fees to be owed the Agency.
- e) The appropriate fees shall be paid within 60 days of the date on the invoice issued by the Agency.

Section 420.110 Reports to the Agency

- a) All individuals licensed to perform laboratory analysis who report results to home occupants, owners, or their representative shall submit to the Agency annually on ~~February~~ March 31st a listing of all complete radon and radon progeny measurements. The following information shall be submitted by a method prescribed by the Agency:

- 1) Address, city, state, zip code;
- 2) Start date and time the measurement began;
- 3) End date and time the measurement was completed;
- 4) Result of the measurements taken in pCi/L;
- 5) Device used (i.e., AC, AT, CR, LS, ES, etc.);
- 6) Serial number of the device used; and

AGENCY NOTE: Guidance for the required information and formatting are available from the [IEMA/IEMA-OHS](#) Radon Licensing Portal or on the Agency's website.

Section 420.120 Disciplinary Action by the Agency

- a) The Agency may refuse to issue or to renew, or may suspend or revoke, a person's license, or take other disciplinary action as the Agency may deem proper, including fines not to exceed \$1,000 for each violation, with regard to any license for any one or a combination of the following causes or those listed in Section 45 of the Radon Industry Licensing Act [420 ILCS 44/45]:
- 1) Knowingly causing a material misstatement or misrepresentation to be made in the application for a license, if such misstatement or misrepresentation would impair the Agency's ability to assess and evaluate the applicant's qualifications for a license pursuant to this Part, such as a misstatement or misrepresentation regarding training or experience;
 - 2) Willfully evading the statute or regulations pertaining to a license, or willfully aiding another person in evading the statute or regulations pertaining to a license;
 - 3) Conviction of a crime under the laws of any United States jurisdiction that is a felony or of any crime that directly relates to the practice of detecting or reducing the presence of radon or radon progeny. Consideration of such

- conviction of an applicant shall be in accordance with 420 ILCS 44/46;
- 4) Misrepresenting the capabilities of a device for detecting and measuring radon or radon progeny or misrepresenting the results of a test to detect or measure radon or radon progeny;
 - 5) Gross and willful overcharging for professional services, including filing false statements for collection of fees or moneys for which services are not rendered;
 - 6) A person knowingly makes a false material statement to an Agency employee during the course of official Agency business;
 - 7) Failure to make records available for audit or inspection at all reasonable times, such as during usual business hours;
 - 8) *Failing, within 60 days, to provide information in response to a written request made by the Agency that has been sent by mail to the licensee's last known address [420 ILCS 44/45(g)];*
 - 9) *Failure to file a return or to pay the tax, penalty or interest shown in a filed return, or to pay any final assessment of tax, penalty, or interest, as required by a tax Act administered by the Department of Revenue, until such time as the requirements of any such tax Act are satisfied [420 ILCS 44/45(q)]; or*
 - 10) Failing to meet child support orders as required in Section 10-65 of the Illinois Administrative Procedure Act [5 ILCS 100/10-65]. The action will be based solely upon the certification of delinquency made by the Department of Healthcare and Family Services, Division of Child Support Enforcement, or the certification of violation made by the court. Further process, hearing or redetermination of the delinquency or violation by the Agency shall not be required (see IAPA Section 10-65(c)).
- b) If, based upon any of the grounds in subsection (a) of this Section or Section 45 of the Radon Industry Licensing Act, disciplinary action is initiated, the Agency shall notify the person and shall provide an opportunity for a hearing in accordance with 32 Ill. Adm. Code 200. An opportunity for a hearing shall be provided before the Agency takes action to suspend or revoke a person's license, unless the Agency has evidence of imminent danger as provided in subsection (d) of this Section.
- c) If the Agency finds that removal or refusal to issue or renew accreditation is

warranted, the usual action shall be a suspension or denial of licensure for up to one year. The term of suspension or denial may be reduced by the Director, based upon evidence presented, if the conditions leading to the Preliminary Order for Suspension can be cured in less than 1 year. However, if the Agency finds that the causes are of a serious or continuous nature, such as past actions that posed an immediate threat to public health or safety, deficiencies that cannot be cured within one year or frequent child support arrearages, the Agency shall revoke the person's license or deny the application.

- d) The Director may summarily suspend the license of a licensee without a hearing, simultaneously with the institution of proceedings for a hearing, if the Director finds that evidence in his or her possession indicates that continuation of the contractor in practice would constitute an imminent danger to the public. *If the Director summarily suspends a license without a hearing, a hearing by the Agency shall be held within 30 days after the suspension has occurred and shall be concluded without appreciable delay.* [420 ILCS 44/50] The hearing shall be held in accordance with 32 Ill. Adm. Code 200.
- e) When a person's license is suspended or revoked, the person shall surrender the license to the Agency and cease licensed activities.
- f) A person whose license has been revoked may seek reinstatement of the license by filing with the Agency a petition for reinstatement. Petitions may be filed one year or more after the beginning of the revocation period. The person shall be afforded a hearing in accordance with 32 Ill. Adm. Code 200 and shall bear the burden of proof of establishing that the license should be reinstated due to rehabilitation or other just cause.
- g) A person who violates any provisions of this Part shall be guilty of a business offense and shall be assessed a penalty in accordance with Section 35 of the Act.

Section 420.130 Requirements for devices to be placed by clients.

- a) Radon licensees shall provide the client with the following:
 - 1) The Agency's address and telephone number.
 - 2) Devices that will be placed by the client shall be accompanied by instructions on how to use the device. These instructions shall be consistent with this 32 Ill. Adm. Code 422 and include specific information on the minimum and maximum length of time that the device shall be exposed.
- b) Laboratories receiving an exposed device that has been delivered for analysis shall return results to the client within 45 days. At a minimum, the measurement report

shall contain:

- 1) Measurement results reported in accordance with 32 Ill. Adm. Code 422;
- 2) The exact start and stop dates of the measurement period;
- 3) The address of the building measured, including the zip code;
- 4) A description of the measurement device used, its manufacturer, model or type, and serial numbers or other unique device identification numbers; and
- 5) The name and Illinois license number of the laboratory analyzing the device.

Section 420.140 Quality Control Requirements for the Use of Devices

- a) Any person licensed by the Agency to perform radon measurements shall use devices approved by AARST-NRPP, NRSB, any entity operating a Personnel Certification Body in accordance with ISO/IEC 17024: Conformity assessment - General requirements for bodies operating certification of persons.
- b) Quality Assurance
 - 1) Licensees providing measurement services using radon and radon product measurement devices shall establish and maintain a Quality Assurance Program (QAP). These programs shall include written procedures for attaining quality assurance objectives and a system for recording and monitoring the results of the quality assurance measurements for each device used. The QAP shall include the maintenance of control charts and related statistical data.
 - 2) The purpose of quality assurance is to ensure that data are scientifically sound and of known precision and accuracy. This subsection discusses the 6 general categories of quality control measurements. Specific guidance is provided for each method.
 - A) Calibration measurements are samples collected or measurements made in a known radon environment, such as a radon chamber. Instruments providing immediate results, such as continuous working level and radon monitors, shall be operated in a radon chamber to establish individual instrument calibration factors.

atmospheric pressure or integrated radon concentrations greater than or less than those for which the specific device type has been:

- evaluated for capacity to achieve stable, in-control response or readings within warning and control limits established herein, which may include using the physical principles of the device and theoretical extrapolations based on the device design; and
 - calibrated in a manner to support expectations of in- control response or readings within warning and control limits established herein across the ranges of temperature, relative humidity, atmospheric pressure and integrated radon concentrations specified for use in product instructions.
- ii) If there are documented evaluations, such as from the manufacturer, demonstrating the lack of effect of an interference such as temperature or relative humidity, and the evaluation reports are available to auditors or other credentialing authorities (subject to confidentiality agreements), then calibration for these devices does not need to include exposures in different magnitudes of these interferences.
- iii) Calibration procedures shall be agreed upon between the manufacturer of the device and the calibration facility.
- iv) Determination of calibration factors is a necessary part of laboratory analysis and is the responsibility of the laboratory. Calibration measurement procedures, including the frequency of tests and the number of devices to be tested, shall be specified in the QAP maintained by the analysis laboratories.
- B) Known exposure measurements or spiked samples consist of passive detectors that have been exposed to known concentrations in a radon chamber.
- i) Analysis laboratories shall provide for the blind introduction of spiked samples into their measurement processes and the monitoring of the results in their QAP.

- ii) The results of analyses of detectors exposed to known radon concentrations shall be monitored and recorded.
 - iii) Any significant deviation from the known concentration to which they were exposed shall be investigated and corrective action taken.
 - C) Background Measurements. Background measurements are required both for continuous monitors and for passive detectors requiring laboratory analysis.
 - i) Calibration laboratories shall perform background measurements of continuous monitors during the calibration of instruments.
 - ii) Laboratories shall measure the background of a statistically significant number of unexposed detectors from each batch or lot to establish the laboratory background for the batch and the entire measurement system. This laboratory blank value is subtracted (by the laboratory) from the field sample results reported to the user, and shall be made available to the users for quality assurance purposes.
 - iv) Laboratories performing these measurements shall calculate the lower limit of detection (LLD) for their measurement systems. This LLD is based on the detector and analysis system's background and can restrict the ability of some measurement systems to measure low concentrations.
 - E) Routine analysis instrument checks shall be performed. Performance checks shall include the frequent use of an instrument check source.
 - i) Components of the device (such as a pump, battery or electronics) shall be checked regularly and the results noted in a record.
 - ii) Each laboratory analysis licensee shall develop methods for regularly monitoring (preferably daily with use) their measurement system and for recording and reviewing results.
- c) Protocol for using continuous radon monitors (CRs) to measure indoor radon concentrations.

- 1) Calibration durations shall be 24 hours or longer, starting after the radon and decay product concentrations in the detection volume of the instrument have reached equilibrium and the device has reached count-rate equilibrium (typically 4 hours after the device exposure begins and as indicated by the operating instructions) and for a duration consistent with the manufacturer's instructions. Sufficient counts need to be accrued during the calibration exposure to ensure that the uncertainty due to few counts (i.e., counting statistics) are not the largest component of uncertainty.
- 2) The calibration concentration is to be between 10 and 80 pCi/L.
- 3) The CR being calibrated is to have a proportional response to radon concentrations in the range of environmental conditions and radon concentrations to which it is exposed during routine use; this proportional response is assumed by the calibration facility.
- 4) CR calibration shall include the following components
 - A) Verification of the "as received" status.
 - B) Device readiness evaluation and operating parameters check, such as replacing batteries and verifying voltages and currents for some methods.
 - C) Background assessments, using aged air or nitrogen, for at least 24 hours (including an initial 4 hours to bring the CR to equilibrium) or as agreed upon between the calibration facility and the CR provider, such as for 16 hours.
 - D) Adjustment of device response, if necessary, including a second exposure if needed to verify that the adjustment was successful according to the device manufacturer's instructions.
- 5) The calibrating facility is responsible to have obtained written authority from the manufacturer or the provider to conduct the calibration, because calibrations may often include adjusting the device response, replacing parts or other procedures indicated by the manufacturer.
- 6) Background measurements shall be performed of scintillation cell-type CRs. The background shall be checked by purging the monitor with clean, aged air or nitrogen in accordance with the manufacturer's instructions. In addition, the background count rate shall be monitored in accordance with

- d) Protocol for using alpha track (AT) detectors to measure indoor radon concentrations
- 1) The laboratory background level for each batch of ATs shall be established by each laboratory licensed by the Agency.
 - 2) Every AT laboratory system shall be calibrated in a radon chamber at least once every 12 months. Determination of a calibration factor requires exposures of ATs to a known radon concentration in a radon chamber. These calibration exposures shall be used to obtain or verify the conversion factor between net tracks per unit area and radon concentration.
 - A) ATs shall be exposed in a radon chamber at a minimum of 3 different radon concentrations such as approximately 4.0, 10-30 and 30-100 pCi/L or exposure levels similar to those found in the tested buildings.
 - B) Expose a minimum of 10 detectors at each radon concentration of the chamber.
 - C) A calibration factor shall be determined for each batch or sheet of detector material received from the supplier. Alternatively, calibration factors may be established for several sheets, and these factors extended to detectors from sheets exhibiting similar sensitivities (within pre-established tolerance limits).
 - D) Analysis instruments shall be checked at least daily for operability prior to operation. Analysis instruments do not need to be checked on days not used.
- e) Protocol for using electret ion chamber radon (ES or EL) detectors to measure indoor radon concentration.
- 1) Determination of calibration factors for short-term or long-term detectors requires exposure of detectors to known concentrations of radon-222 in a radon exposure chamber. Since short-term and long-term electret detector systems are also sensitive to gamma radiation, a gamma exposure rate measurement in the test chamber is also required annually.
 - 2) Analysis laboratories of ES or EL services shall as minimum requirements in determining the calibration factor:
 - A) Detectors shall be exposed in a radon chamber at a minimum of 3

different radon concentrations, such as approximately 4.0, 10-30 and 30-100 pCi/L, or exposure levels similar to those found in the tested buildings.

- B) Expose a minimum of 10 detectors at each radon concentration of the chamber.
 - C) Ensure a period of exposure sufficient to allow the detector to achieve equilibrium with the radon chamber atmosphere.
- 3) Laboratory Analysis licensees providing recharging services of short-term or long-term electrets shall only provide those services for devices they manufacture or for devices for which they have written authorization from the manufacturer.
- f) Protocol for using activated charcoal adsorption (AC) devices to measure indoor radon concentrations
- 1) Every activated charcoal adsorption system shall be calibrated in a radon chamber at least once every 12 months. Determination of calibration factors for ACs requires exposure of the detectors to known concentrations of radon-222 in a radon chamber. The calibration factors depend on the exposure time and may also depend on the amount of water adsorbed by the charcoal container during exposure. Calibration factors shall be determined for each AC measurement system (container type, amount of charcoal, gamma detector type, etc.).
 - 2) The laboratory background level for each batch of ACs shall be established by each laboratory. Laboratories shall measure the background of a statistically significant number of unexposed detectors that have been processed according to their standard operating procedures (laboratory blanks). The analysis laboratory calculates the net readings, that are used to calculate the reported sample radon concentrations, by subtracting the laboratory blank values from the results obtained from the field detectors.
 - 3) Counting equipment shall be subject to daily operability checks by counting an instrument check source and determining whether the reference source is constant to within established limits (2 standard deviations). Daily operability checks do not need to be performed on days the instrument is not used. The characteristics of the check source (geometry, type of radiation emitted, etc.) shall be similar to those of the samples analyzed. The count rate of the check sources shall be high enough to yield good counting statistics in a short time (for example, 1000 to 10,000 counts per minute) to provide a maximum random uncertainty of 5 percent.

- g) Protocol for using charcoal liquid scintillation (LS) devices to measure indoor radon concentrations.
- 1) Every LS laboratory system shall be calibrated in a radon chamber at least once every 12 months. Determination of calibration factors for LS devices requires exposure of calibration devices to known concentrations of radon-222 in a radon chamber at carefully measured radon concentrations. The calibration factors depend on the exposure time and may also depend on the amount of water adsorbed by the device during exposure. Calibration factors shall be determined for a range of different exposure times and, as appropriate, humidity's.
 - 2) The laboratory background level for each batch of LS devices shall be established by each laboratory. Laboratories shall measure the background of a statistically significant number of unexposed LS devices that have been processed according to their standard operating procedures (laboratory blanks). The analysis laboratory calculates the net readings, are used to calculate the reported sample radon concentrations, by subtracting the laboratory blank values from the results obtained from the field detectors.
 - 3) Counting equipment shall be subject to daily operability checks by counting an instrument check source and determining whether the reference source is constant to within established limits (2 standard deviations). Daily operability checks do not need to be performed on days the instrument is not used. The characteristics of the check source (geometry, type of radiation emitted, etc.) shall be similar to those of the samples analyzed. The count rate of the check sources shall be high enough to yield good counting statistics in a short time (for example, 1000 to 10,000 counts per minute) to provide a maximum random uncertainty of 5 percent.