Public Review: MAMF *- Proposed Revision 09/2016*

Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily Buildings

COMMENT DEADLINE: November 7th, 2016

REQUESTED PROCESS AND FORM FOR FORMAL PUBLIC REVIEW COMMENTS

Submittals *(MS Word preferred) may be attached by email to StandardsAssist@gmail.com or submitted in paper form by fax to (913) 780-2090*

1) *Do not submit marked-up or highlighted copies of the entire document.*

2) *If a new provision is proposed, text of the proposed provision must be submitted in writing. If modification of a provision is proposed, the proposed text must be submitted utilizing the strikeout/underline format.*

3) *For substantiating statements: Be brief. Provide abstract of lengthy substantiation. (If appropriate, full text may be enclosed for project committee reference.)*

REQUESTED FORMAT

Title of Public Review Draft: **MAMF Proposed Revision 09-2016**

- **Name:** Affiliation:
- **Clause or Subclause**:
- **Comment/Recommendation**:
- **Substantiating Statements**:
- [___] Check here if your comment is supportive in nature and does not require substantive changes in the current proposal in order to resolve your comment.

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Contact information:
AARST Consortium on National Radon Standards.
Email: standards@aarst.org
Efax: 913-780-2090
Website: www.radonstandards.us
P.O. Box 2109, Fletcher, North Carolina 28732

Rev. 06-01-2008

Proposed Revisions 2016

ANSI/AARST **Designation: MAMF-201x**

An Approved American National Standard

Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily Buildings

For Residence Managers and Measurement Professionals

AARST CONSORTIUM ON NATIONAL RADON STANDARDS
www.radonstandards.us
standards@aarst.org

Scope Summary and Introduction

This standard of practice contains procedures, minimum requirements and general guidance for measurement of radon in buildings having more than one attached dwelling or other occupied unit that were under the same ownership or designated maintenance or management authority for the purpose of determining if radon mitigation is necessary in order to protect current or future occupants.

These protocols address testing in multifamily structures that can include those with shared ownership or maintenance such as co-op units, townhouses, condominiums or vacation timeshare properties and structures, or a portion thereof that are used, for example, as apartment houses, dormitories, military congregate residences, fraternities and sororities, nontransient boarding houses, hotels, convents, monasteries, motels and live/work units. These protocols also address testing a single dwelling within a multifamily building.

Included are informational pages for an *"Introduction to Radon"* and an *"MAMF Companion Guidance"* document for aiding residence managers, citizens and professionals.

Significance of Purpose

Radon is the second leading cause of lung cancer in the general population and the leading cause of lung cancer among nonsmokers.[1] Most people receive their greatest exposure to radon in their home or dwelling. Radon concentrations in ground-contact apartments have been found to be similar to those in low-rise residential buildings located in the same area.[2] Radon in homes and dwellings is the cause of approximately 21,000 U.S. lung cancer deaths each year.[3] This risk is largely preventable.

Significance of Use

This document contains protocols and guidance designed to respond to the health threat of radon in dwellings in multifamily buildings. This standard addresses the needs of citizens, radon measurement professionals, property owners, residence/facility managers, consultants, manufacturers and regulators concerned with radon measurements in multifamily buildings.

Applicability

If the minimum requirements of this document exceed local, state or federal requirements for the locale in which the radon test is conducted, then this document's minimum requirements should be followed. These guidelines can be adopted as part of a state program or can be provided as recommendations by states to testing companies and interested individuals. AARST recommends that any authority or jurisdiction that is considering substantial modifications of this document as a condition of its use seek consensus within the consortium process at AARST Consortium on National Radon Standards prior to adopting a modified version. This provides the jurisdiction with a higher degree of expertise and an opportunity for the Consortium on National Radon Standards to update its document if appropriate.

Historical Perspective on Radon

Since 1988, the Indoor Radon Abatement Act has authorized U.S. state and federal activities to reduce citizen risk of lung cancer caused by indoor radon concentrations.

Since the early 1990s, the U.S. Environmental Protection Agency (EPA) has advised all U.S. schools to test for radon and to reduce levels to below 4 pCi/L[3].

In 1999, the National Academy of Sciences confirmed that any exposure to radon holds a degree of risk with publication of BEIR VI.[3] In addition, the Academy's BEIR VII committee stated that exposure to radiation, including any concentration of radon, carries risk.

In 2009, the World Health Organization's *WHO Handbook on Indoor Radon* confirmed the association between indoor radon exposure and lung cancer, even at the relatively low radon levels found in residential buildings.[1]

Initiated in 2010, the U.S. *Federal Radon Action Plan* (FRAP), followed by the *National Radon Action Plan* (NRAP), has highlighted an *ultimate* public health goal of eliminating preventable radon-induced cancer. The FRAP is the result of a collaborative effort led by EPA with the U.S. Departments of Health and Human Services (HHS), Agriculture (USDA), Defense (DOD), Energy (DOE), Housing and Urban Development (HUD), Interior (DOI), Veterans Affairs (VA) and the General Services Administration (GSA). And the NRAP, led by the American Lung Association, represents a collaborative effort between several federal and national organizations including AARST and the Conference of Radon Control Program Directors (CRCPD).

Development and Maintenance of this Standard

The consortium consensus processes developed for the AARST Consortium on National Radon Standards and as accredited to meet essential requirements for American National Standards by the American National Standards Institute (ANSI) have been applied throughout the process of approving this document.

This standard is under continuous maintenance by the AARST Consortium on National Radon Standards for which the Executive Stakeholder Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. The change submittal form and instructions may be obtained in electronic form at **www.radonstandards.us**

[1] World Health Organization, "WHO Handbook on Indoor Radon: A Public Health Perspective" 2009

[2] Swedish Radiation Protection Authority, "Radon in Estonia Dwellings, Stockholm" 2003; and Valmari, T, Arvela, T and Reisbacka, "Radon in Finnish Apartment Buildings, Radiation Protection Dosimetry" 2012

[3] National Academy of Sciences, "Biological Effects of Ionizing Radiation" (BEIR VI Report) 1999

Contact Information

AARST Consortium on National Radon Standards.
Email: standards@aarst.org Fax: 913-780-2090
Website: www.radonstandards.us
P.O. Box 2109, Fletcher, NC 28732

Notice of right to appeal: **(**See Bylaws for the AARST Consortium on National Radon Standards available at www.radonstandards.us .) Section 2.1 of Operating Procedures for Appeals (Appendix B) states, "Persons or representatives who have materially affected interests and who have been or will be adversely affected by any substantive or procedural action or inaction by the AARST Consortium on National Radon Standards committee(s), committee participant(s), or AARST have the right to appeal (3.1). Appeals shall first be directed to the committee responsible for the action or inaction."

Keywords

Radon Gas, Radon Test, Multifamily, Radon Measurement, Radon Testing, Radon, Multifamily Housing

Metric Conversions

Conversions from English-American measurement units to the International System of Units (SI) are rendered herein with literal conversion. The conversions are not always provided in informational text or tables. It is acknowledged that rounding off to a similar numeric conversion is common (i.e., 4.0 pCi/L rounded to 150 Bq/m^3 rather than literal conversion to 148 Bq/m^3) for locations where the International System of Units (SI) are used in standard practice. Conversions should apply as commonly used in such locations or jurisdictions.

Normative References:

- EPA Guidance on Quality Assurance (402-R-95-012, October 1997) *For the latest versions of USEPA documents see:* https://www.epa.gov/radon/publications-about-radon

Document History

At the request of Congress, EPA developed the document "Radon Measurement in HUD Multifamily Buildings" to enable HUD to comply with the requirements of the Stewart McKinney Amendments to the 1988 Indoor Radon Abatement Act. In 2004, the American Association of Radon Scientists and Technologists published the "AARST Interim Protocols for Conducting Radon Measurements in Multifamily Buildings" that built on EPA's work and added consortium review and revision.

ANSI/AARST MAMF 2012 was published after more extensive due process and public review required for American National Standards and ANSI accreditation.

Summary of Document Updates for 2016

The significant review and amendments contained in this document are the result of scheduled review for AARST MAMF 2012 and include:

1) Procedural clarity when conducting measurements. The committee deliberated for more than a year with recurring focus on procedural clarity. Experiences during the last 5 years revealed text provisions intended to be informative that were witnessed to cause confusion. Each provision was reviewed and truncated or expanded as appropriate to provide clarity on intended requirements.
2) Consistency with newer AARST measurement protocols: Two years of work by other radon measurement committees was compared for harvesting the benefits of deeper deliberations on certain topics (e.g., ANSI/AARST MAH 2014 and ANSI/AARST MALB). Amended revisions resulted in:
   a) Clarification on individuals considered qualified to design and conduct test programs;
   b) Summary reports and report language requirements;
   c) Expanded detail on building components as related to closed-building requirements; and
   d) Reconciliation for the use of radon decay monitors.
3) New options when complex HVAC systems are present.
4) Testing procedures when all locations stipulated in MAMF (e.g., all ground-contact dwellings) were not tested in previous testing.

Table of Contents **Page**

NOTE:

The following two-page *"Introduction to Radon"* is provided with the intent to inform those who are unfamiliar with radon.

The content is formatted with the intent to allow copying and distribution of this general information to citizens, property owners, residence/facility managers, consultants and any other person concerned with radon in multifamily buildings.

Introduction to Radon

A. Radon Facts

Radon is a naturally-occurring radioactive gas which is a part of the uranium-238 decay chain. The immediate parent of radon-222 is radium-226. Radon comes from the breakdown (radioactive decay) of uranium that is found in soil and rock all over the United States. Radon is a component of the air in soil that enters buildings through cracks and other pathways in the foundation. Eventually, it decays into radioactive particles (decay products) that can become trapped in your lungs when you inhale. As these particles decay in turn, they release small bursts of radiation. This radiation can damage lung tissue and lead to lung cancer over the course of your lifetime. EPA studies have found that radon concentrations in outdoor air average about 0.4 pCi/L (picocuries per liter) of air. However, radon and its decay products can reach much higher concentrations inside a building.

Radon gas is colorless, odorless, and tasteless. The only way to know whether elevated concentrations of radon are present in any building is to test.

B. Radon's Health Effects

Radon is a known human carcinogen. Prolonged exposure to elevated radon concentrations causes an increased risk of lung cancer. Like other environmental pollutants, there is some uncertainty about the magnitude of radon health risks. EPA calculates that radon may cause 21,000 lung cancer deaths in the U.S. each year. The U.S. Surgeon General has warned that radon is the leading cause of lung cancer deaths in non-smokers in the U.S. Only smoking causes more lung cancer deaths than radon.

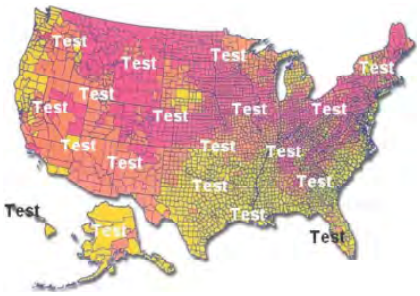
Not everyone who breathes radon decay products will develop lung cancer. An individual's risk of getting lung cancer from radon depends mostly on three factors: the concentration of radon, the duration of exposure and the individual's smoking habits. In addition, some people are more susceptible to lung cancer than others.

Risk increases as an individual is exposed to higher concentrations of radon over a longer period of time. Smoking combined with radon is an especially serious health risk. The risk of dying from lung cancer caused by radon is much greater for smokers than it is for non-smokers.

C. Radon Exposure

Because many people spend much of their time at home, the home is likely to be the most significant source of radon exposure. According to EPA, nearly 1 out of every 15 homes in the United States is estimated to have radon concentrations that exceed the EPA action level.

Elevated concentrations of radon have been found in homes and buildings in every state. While elevated radon may be more common in some areas, any building can have a problem. EPA recommends that ALL buildings should be tested regardless of the area of the country and that maps should not be used to determine whether to test. More specific information on the likelihood of elevated radon in your area can frequently be found at your state or county radon offices.



The concentration of radon in the air within a building should be reduced below **EPA's radon action level of 4 pCi/L.** Any radon exposure creates some risk; no concentration of radon is safe. Even radon concentrations below 4 pCi/L pose some risk, and the risk of lung cancer can be reduced by lowering indoor radon concentrations. This action level is based largely on the ability of current mitigation technologies to consistently reduce radon concentrations below 4 pCi/L. Depending on the building characteristics, radon concentrations in some buildings can be reduced well below 4 pCi/L. In others, reducing radon concentrations to below 4 pCi/L may be more difficult.

D. Radon Entry into Buildings

Radon in soil gas is the main source of radon problems. Pathways for radon to enter a building include cracks in the slabs and walls, the expansion joints between floor and walls, porous concrete block walls, open sump pits, crawlspaces and openings around utility penetrations. Some buildings have other pathways for radon to enter a building such as sub-slab utility tunnels and heating, ventilating and air conditioning (HVAC) ducts.

Radon gas can also enter buildings in well water. Radon from well water used in a building can off-gas and raise the concentrations. For dwellings or small communities serviced by well water, a test of the water for radon should be considered especially if the building is vacant or there is no water use during the test in the dwellings. Radon in water testing is covered in a separate document and is beyond the scope of this testing protocol. For more information on radon in drinking water you can contact your state radon contact, your state drinking water program, EPA's Drinking Water Hotline (800) 426-4791, or visit http://www.epa.gov/safewater/radon.html.

Sometimes building materials that contain uranium and radium can produce radon. A radiation professional or your state radiation program can help you evaluate this possibility.

Factors Influencing Radon Entry

Many factors contribute to the entry of radon gas into buildings. As a result, residence managers cannot know without testing if elevated concentrations of radon are present in their building complex. The following factors determine why some buildings have elevated radon concentrations and others do not:

- The concentration of radon in the soil gas **(source strength);**
- The permeability of the soil or sub-surface geology **(gas mobility)** under the building;
- The **structure and construction** of a building; and,
- The type, design, operation, and maintenance of the heating, ventilating and air-conditioning **(HVAC)** system.

Source strength: The radon concentration in soil gas can vary greatly from building to building. It can even vary greatly under different parts of the same building.

Gas mobility: Certain geological features beneath a building, such as cracks, fissures, or solution cavities, can serve as a direct connection between the radon-producing minerals and the building's foundation. Such a direct connection can cause one unit of a building to have a radon concentration significantly higher than other units in the area. The permeability of the soil under a building, along with the differences between the air pressure inside a building and the air pressure under a building's foundation influence the rate at which radon enters a building. For example, if the air pressure in the building is greater than the air pressure under the building's foundation, radon should not enter through the openings of a building's foundation. If the air pressure in the building is less than the air pressure under the building's foundation, radon in the soil gas will enter through any openings in the building's foundation.

Structure and construction: Any building design can have a radon problem. Without testing, you cannot know if elevated concentrations of radon are present.

Heating, cooling and ventilation systems (HVAC): Depending on their design and operation, HVAC systems can influence radon concentrations in buildings:

- Fresh air ventilation serves to dilute indoor radon concentrations with outdoor air; however radon's source strength commonly overwhelms the practical limits of increasing ventilation to reduce occupant exposure.
- Poor ventilation provides less dilution to indoor radon concentrations.
- Depressurized buildings draw radon inside.
- Pressurizing a building helps keep radon out.

The frequency and thoroughness of HVAC maintenance can sometimes play an important role. For example, air intake filters that are not periodically cleaned and changed can significantly reduce the amount of outdoor air ventilating the indoor air environment. An understanding of the design, operation, and maintenance of a building's HVAC system and how it influences indoor air conditions is helpful for understanding and managing a radon problem, as well as many other indoor air quality concerns in buildings. However, since HVAC systems are only one of many factors that affect radon concentrations in a building, HVAC system modifications alone are often not an effective radon mitigation strategy.

E. Contacts for Additional Information

- EPA Website http://www.epa.gov/radon
- State radon offices: http://www.epa.gov/iaq/whereyoulive.html
- Indian Nation radon offices: http://www.epa.gov/epahome/tribal.htm
- Regional EPA offices: http://www.epa.gov/epahome/locate2.htm
- The National Radon Safety Board (NRSB) - Radon Proficiency Program: www.nrsb.org
- The AARST National Radon Proficiency Program (AARST-NRPP): http://aarst-nrpp.com/wp/

MAMF-2016

Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily Buildings

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of conducting radon measurements is to identify locations that have elevated radon concentrations and to determine if radon mitigation is necessary in order to protect current or future occupants. The purpose of test protocols is to produce reliable and repeatable radon measurements.

1.2 Scope

These protocols address radon measurements in buildings having more than one attached dwelling or other occupied unit under the same ownership or designated maintenance or management authority.

These protocols address radon measurements in buildings or structures, or a portion thereof that are used, for example, as apartment houses, dormitories, military congregate residences, fraternities and sororities, nontransient boarding houses, hotels, convents, monasteries, motels, and live/work units. [4]

These protocols address testing in multifamily structures that can include those with shared ownership or maintenance such as co-op units, townhouses, condominiums or vacation timeshare properties. To the extent practicable, these protocols should be recommended for whole building application regardless if different portions of the building are owned by different parties.

1.2.1 These protocols address testing in multifamily structures, whether conducted for non-real estate purposes or when associated with a real estate transaction.

1.2.2 ***Single Dwellings***

When testing a single dwelling in a multifamily building, see Section **4.6.2** for specific requirements.

1.2.3 ***Multi-Use Buildings***

When testing multi-use buildings that also contain educational or commercial facilities, see the most current version of ANSI/AARST **MALB** *"Protocols for Conducting Measurements of Radon and Radon Decay Products in Schools and Large Buildings"* for additional requirements in addition to, or as otherwise required by, local statutes.

1.3 Limitations

Suggested best practices to help ensure testing quality have been included, however:

1.3.1 These protocols do not address all detailed technical aspects of measurement device technology or quality assurance.

1.3.2 These protocols do not address measurement techniques to specifically identify radon sources such as radon concentrations in water supplies, the possession or handling of radioactive materials, or building materials.

1.3.3 These protocols do not address measurement techniques associated with building diagnostics.

1.4 Radon Action Levels

Countries worldwide have adopted Action Levels for radon exposures. Most are similar to the 4 pCi/L (148 Bq/m^3) recommended by the United States Environmental Protection Agency (EPA). The Action Level cited should comply with guidance of the country, state or other local jurisdiction of authority where the test is being conducted.

1.5 Conventions

The term "shall" and phrases that stipulate a prescribed action are provisions herein that are considered mandatory, while terms such as "should" or "recommended" indicate provisions considered good practice, but which are not mandatory.

2.0 PREPARING FOR THE MEASUREMENT

2.1 Devices and Personnel

2.1.1 ***Approved Testing Ddevices***

All devices used for measuring radon and radon decay products shall be listed as having met minimum requirements established by the National Radon Proficiency Program (NRPP) or the National Radon Safety Board (NRSB) if the jurisdiction has no program for evaluating or approving devices where the testing is conducted.

2.1.2 ***Device Instructions***

Detectors and devices shall be used in compliance with device-specific instructions provided by the manufacturer. It is recommended to consult the manufacturer to determine if the measurement system(s) or devices fulfill the requirements of the chosen testing strategy.

2.1.3 ***Device Types***

For the purpose of this document:

a) *Passive Devices* refers to those that do not provide hourly readings; and

b) *Continuous Monitors* are monitors that can integrate, record and produce reviewable readings in time increments of 1 hour. If a device is not capable of these functions or is not set to record readings each hour, it is functioning as a passive device and is not considered a continuous monitor under this protocol. For continuous monitors, the first 4 hours of data may be discarded or incorporated into the result using system correction factors (EPA 402-R-92-004; EPA 1992). It is recommended to check with the manufacturer when evaluating hourly readings.

[4] As point of reference, see the International Building Code (IBC) Section 310 for Residential Group R2 (as published by the International Code Council).

2.1.4 ***Quality Control Prior to Testing***
For large testing projects, additional Quality Control procedures should begin prior to deployment. (See Sections **5.0** and **5.4**.)

2.1.5 ***Qualified Measurement Professionals*** *(*multifamily*)*
All individuals conducting radon measurement activities in multifamily buildings shall be qualified for their apportioned task. For the purpose of this testing protocol, a "Qualified Measurement Professional" is defined as:

"An individual who has demonstrated a minimum degree of appropriate technical knowledge and skills sufficient both to place, retrieve and analyze (as applicable) radon detectors and to design, plan, and implement quality procedures when conducting radon measurements in multifamily buildings:

a) as established in certification requirements of the National Radon Proficiency Program (NRPP) or the National Radon Safety Board (NRSB); and
b) as required by statute, state licensure or certification program, where applicable."

2.1.5.1 A "Qualified Measurement Professional" shall be physically present onsite during activities for placement and retrieval of radon detectors and shall be immediately available to direct, instruct, oversee and control activities of any other individuals placing or retrieving detectors.

2.1.5.2 Individuals who are not "Qualified Measurement Professionals" are permitted to assist in placement and retrieval of detectors provided their participation is permitted by statute, state licensure or certification program and approved by the Qualified Measurement Professional. Participant names and qualifications or preparations shall be retained in quality control records and made available to the client upon request.

If noncertified individuals are to conduct placement and retrieval of detectors, the Qualified Measurement Professional shall either:

a) Create and present a written work plan specific to apportioned tasks and verify that it is understood by all participants (see Companion Guidance); or
b) Verify that individuals have demonstrated, within the last 2 years, appropriate training and skills specific to detector placement and retrieval in multifamily buildings such as completion of a training class:
   i) as approved by the NRPP or NRSB; and
   ii) as required by statute, state licensure or certification program, where applicable.

2.2 Initial Client Interactions or Proposals

2.2.1 ***Inform the Client*** of required closed-building conditions and to identify facilitating staff responsibilities associated with preparation for the testing. (See Exhibit **3**.)

2.2.2 It is recommended to confirm who is authorized by the Client to receive test data and also, any limits the client requests or requires on disclosing test data or results.

2.2.3 It is recommended to confirm at which junctures during the testing process the client requests or requires data to be provided. This is especially important to have confirmed in advance for testing strategies when the final results are inherently not conclusive until follow-up or other additional measurements are complete. (See Section **4.5**.)

2.2.4 If the Extended Test Protocol is chosen for use under a Time-Sensitive situation, Clients shall be informed in writing prior to testing that when test results from the first phase of testing (i.e., **Step 1**) indicate occupants may be exposed to elevated concentrations:

a) The test result from Steps 1 and 2 of this testing protocol are to be used for mitigation decisions and the nature of time-sensitive situations will often not permit long-term testing as an option for Step 2; and
b) Any untested ground-contact dwellings in the building shall be included in the second phase (**Step 2**) of testing. See Section **3.0** and Section **7.1.8.1 f**.

2.3 Assemble Building Information Prior to Testing

Requirements include:

2.3.1 ***Occupancy***
Determine which portions of the building are occupied and who will be responsible for closed-building conditions prior to and during the measurement period.

2.3.2 ***Diagrams***
Create or procure a floor plan diagram(s) that should identify all ground-contact dwellings and building foundation types such as slab-on-grade, basement and crawl space areas.

2.3.3 ***Determine the Nature of Heating, Cooling and Ventilation Systems (HVAC)***
If not already known, request that facilitating staff provide a written description of HVAC system designs in each area of the building. (See Exhibit **1** and Exhibit **3**.)
Classify each of the following areas as a "**Unique Sector**":

a) Each area of the building where dwellings are served by individual but similar heating and cooling technology (as described in Exhibit **1** for Group 1 *Basic Heating and Cooling* or Group 2 *Multi-zone Systems*); and
b) Each ground-contact area of the building served by a central HVAC air handling system (as described in Exhibit **1** for Group 3 *Variable Air Distribution and/or Variable Outdoor Air Ventilation*).

If it is unclear what type of system is present, consult with the building representative, a mechanical engineer or a qualified heating and air conditioning contractor.

2.4 Prior Notifications

The following steps shall be taken to help ensure *closed-building protocols* are maintained for Short-Term tests. (See Section **6** for Closed-building protocols.) Failure to comply with required conditions is most likely to occur when residents are not properly informed about the necessary test conditions.

2.4.1 ***Notice of Radon Testing to Facilitating Staff***
Once a testing activity has been confirmed, direct the property management team in a timely manner to distribute a

notice of radon testing that is appropriate to inform and instruct facilitating staff. (See an example of this notice in Exhibit **4**.) This notification shall include instructions for distributing notices to both tested and non-tested locations and site-specific or sample ***notices to occupants*** that reflect Exhibits **5** through **9**.

The notice to facilitating staff should also describe:

a) duties required of facilitating or maintenance staff that can include providing access and, if needed, adjustments to HVAC units; and

b) consequences for failure to achieve prior notification and closed-building conditions, which can include strained occupant relations and increased test costs.

2.4.2 ***Notices of Radon Testing for Occupants***

Direct the property management team to distribute notices of radon testing for all occupants in all buildings being tested that reflect Exhibits **5, 6** and **7** no less than 24 hours prior to testing. It is recommended to verify prior to testing that facilitating staff have distributed the notices.

3.0 WHERE TO TEST (Protocol Requirements)

3.1 Ground-Contact Dwellings

Conduct a measurement in each ground-contact apartment, dwelling and other occupied units such as those used as office space. This means each unit that has floor(s) and/or wall(s) in contact with the ground or is over crawlspaces, utility tunnels or parking garages.

Within each dwelling, test a room located in the lowest livable level that is in contact with the ground or above a crawlspace, utility tunnel or garage. If the lowest level is not currently used but could serve as a den, playroom, office, work area or an additional bedroom at some time in the future, conduct a test in this level.

3.2 Other Ground-Contact Locations

Also conduct a measurement in non-residential ground-contact rooms or areas (e.g. utility rooms, storage rooms, and maintenance rooms) that:

a) are occupiable with little or no modification; or

b) have air communication with occupiable areas by way of stairwells, elevator shafts or other unoccupied location that may serve as a pathway for radon into occupied spaces on upper floors

When in doubt, it is recommended to test the area. These unoccupied areas may serve as a pathway for radon into apartments and offices of upper floors.

3.3 Large Rooms or Open Areas

Place one detector every 2,000 square feet (186 m^2).

3.4 Upper Floors

On the upper floors, conduct a measurement in at least one apartment on each floor; include measurements in at least 10% of the dwellings on each of the higher floors. It is recommended that the upper floor test locations be selected so that units on one floor are not directly above or below units being tested on other floors.

Figure 3.4

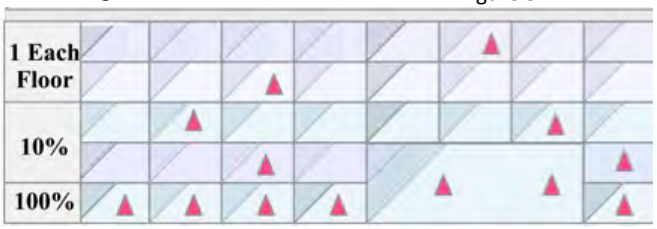


Figure 3.1a
Basements and Walls

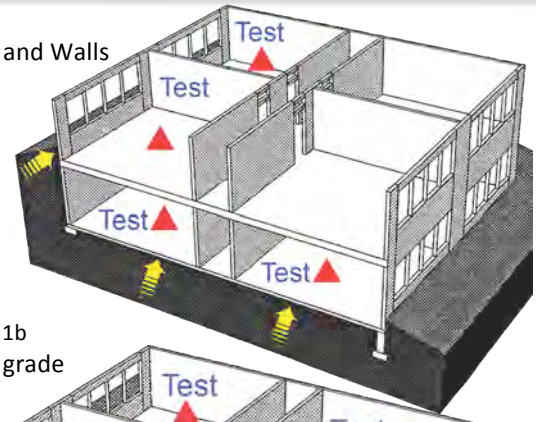


Figure 3.1b
Slab on grade

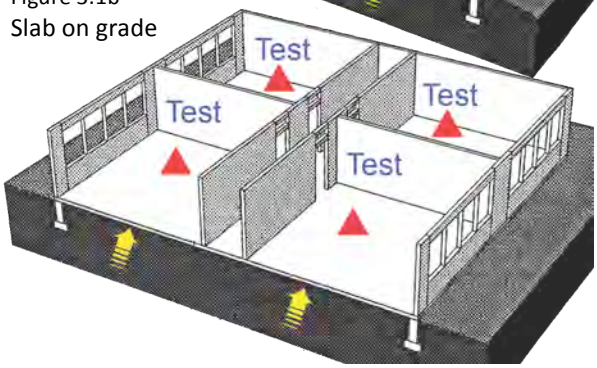


Figure 3.1c
Over Crawl Spaces

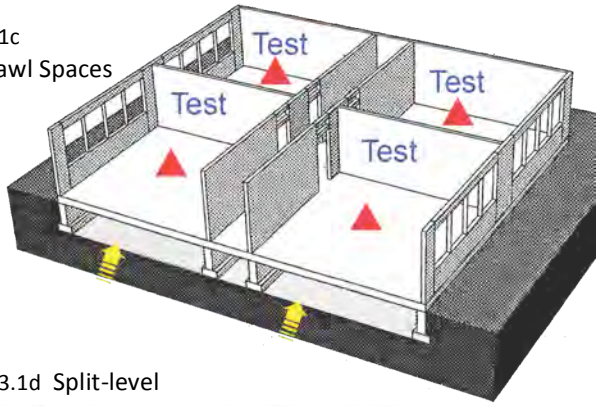
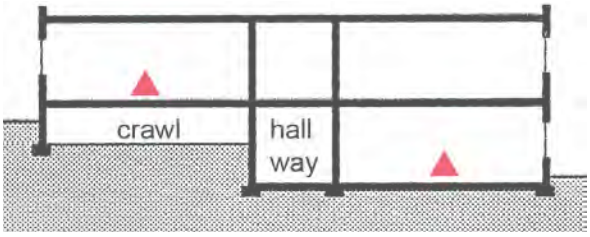


Figure 3.1d Split-level



3.5 Additional Protocols for Complex Heating, Cooling and Ventilation Systems

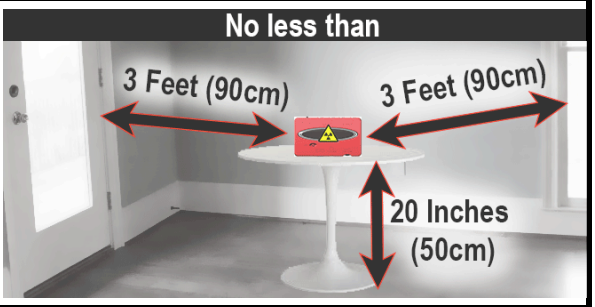
See Section **4.4**. Whenever additional test locations are warranted, preferred rooms are bedrooms, general living areas and any other major area that can be closed off from the main part of the dwelling. When in doubt, it is recommended to test the area.

3.6 Choosing a Test Location in a Room

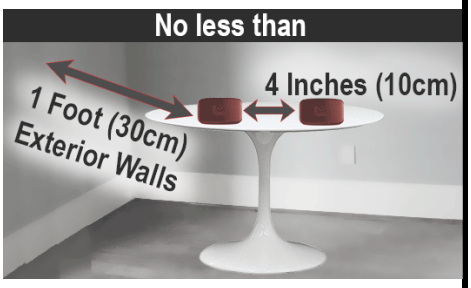
Table 3.6

Requirements For Test Locations Within A Room

<table>
<tr><td rowspan="4">Place detectors within the general breathing zone and locate detectors no less than:</td><td>3 feet (90 cm) from exterior doors and windows or other potential openings to the outdoors.

20 inches (50 cm) above the floor.</td><td> 
</td></tr>
<tr><td>1 foot (30 cm) from the exterior wall of the building.

4 inches (10 cm) from other test detectors and objects that are above or to the side of the detector.

Exception: Less than 4 inches (10 cm) is permitted for detectors that are not affected by close proximity to other objects. Confirm manufacturer or laboratory requirements or recommendations prior to exercising this exception.</td><td> 
</td></tr>
<tr><td colspan="2">1 foot (30 cm) below the ceiling, with a preferred height being less than 8 feet (2.5 m) above the floor.</td></tr>
<tr><td>Place detectors where they are not easily disturbed:</td><td colspan="2">Select a position where the detectors will not be disturbed during the measurement period. Occupied areas are preferred, but choose a location where the detectors are not likely to be moved or have their performance altered during the test.</td></tr>
<tr><td rowspan="6">Place detectors where they are not influenced by other factors:</td><td colspan="2">Do not place detectors inside closets, crawlspaces, and mechanical/furnace closets.</td></tr>
<tr><td colspan="2">Do not place detectors within enclosed areas of high humidity. Examples include bathrooms, laundry rooms and kitchens isolated by partitions or other enclosures.
Exception: Such locations should be avoided but are permitted for detector types that are virtually unaffected by high humidity. Confirm manufacturer or laboratory requirements or recommendations prior to exercising this exception.</td></tr>
<tr><td colspan="2">Do not place detectors inside cupboards, sumps or nooks within the building foundation.</td></tr>
<tr><td colspan="2">Do not place detectors near drafts caused by heating and air conditioning vents, or fans.</td></tr>
<tr><td colspan="2">Do not place detectors near heat sources, such as on appliances, radiators, near fireplaces or in direct sunlight.</td></tr>
<tr><td colspan="2">Avoid placing detectors on or near objects that may produce radiation such as natural stone (e.g. rock collections, granite counter tops, hearths or slate pool tables).</td></tr>
</table>

4.0 TESTING PROCEDURES AND OPTIONS

Acceptable Testing Strategies

A. The ***Extended testing protocol*** *(corresponding to EPA's Citizen's Guide to Radon)* entails a quick and cost-effective initial test with follow-up testing in locations where elevated radon concentrations were initially measured. The ***Extended testing protocol*** is an option when time constraints are not prohibitive and when occupant relations allow the performance of a second test when needed.

B. ***Time-Sensitive testing protocols*** (*corresponding to EPA's Home Buyer's and Seller's Guide to Radon)* require additional controls to aid reliability of results during a single phase of testing. ***Time-Sensitive testing protocols*** may be appropriate for situations where quick decisions are needed or when other strategies are unacceptable. Time-Sensitive situations may include: real estate transactions, planned renovations, or other situations that require a quick evaluation of whether radon mitigation is needed.

C. ***Additional Protocols for Complex HVAC*** address challenging situations that can occur as a result of Multi-zone systems, Variable Air Distribution and Variable Outdoor Air Ventilation Systems. (See Exhibit **1**, for descriptions of these HVAC systems.

D. ***Post-mitigation testing protocols*** address procedures for verification of mitigation system(s) effectiveness.

4.1 Detector Deployment Periods

4.1.1 ***Test all areas*** during the same time period (days or phase).

4.1.2 ***Short-Term Testing***

For short-term tests, detectors shall be deployed for two to 90 days under closed-building protocol conditions in accordance with Section **6**. Deployment periods should optimally collect at least 48 hours of valid sampling time. Deployment periods shall not be less than 46 hours. In addition: If a short-term test is longer than 2 days, whenever practical it is recommended, but not required, to terminate the test nominally at 24-hour increments to reflect day to night fluctuations in radon concentrations within a dwelling.

4.1.3 ***Long-Term Testing***

For long-term tests, detectors shall be deployed for 91 days or more, and closed-building conditions are not required. Closed-building conditions should, however, represent a percentage of the test duration not less than the percentage of time across the year that buildings are kept closed due to the local climate. For a better understanding of the year-round average radon concentration, long-term tests should be conducted a minimum of 6 months over different seasons (one of which is a heating season) **or** as close to a year as possible to reflect seasonal changes in radon concentrations and building operation.

4.1.4 ***Heating Season Testing***

Tests conducted when outdoor temperatures are less than 65˚ F (18˚ C) for no less than half of the test duration.

4.1.5 ***Cooling Season Testing***

Tests conducted when outdoor daytime temperatures exceed 83˚ F (28˚ C).

4.2 Extended Testing Protocol

Table 4.2 Extended Testing Protocol
(corresponding to EPA's "*Citizen's Guide to Radon*" as a choice for homeowners not currently involved in a home sale)

Step 1	***Single Short-Term Test*** **(**Conduct an initial test with a single passive short-term detector at each location)
Step 2	***Retest*** each location where the initial short-term tests meet or exceed the action level, e.g., 4 pCi/L.
	* If the first short-term test is more than twice the action level (e.g. 8 pCi/L [296 Bq/m3] or greater), conduct a second short-term test immediately or as soon as possible. * If the first short-term test is less than twice the action level (e.g. 4 to 8 pCi/L [148 to 296 Bq/m3]), conduct either a short-term or a long-term test.
Step 3	***Mitigation Decisions*** Base mitigation decisions on the results of testing in step 1 and step 2.
	If the average of 2 short-term tests or the long-term test meets or exceed the action level, e.g., 4 pCi/L. ***Fix the building***
	If less than the action level, e.g., 4 pCi/L: Consider fixing if test results indicate radon concentrations greater than half the action level, (e.g., between 2 and 4 pCi/L). Any low test result should be confirmed by testing again during a different season or with a long-term test device. Be certain to test again whenever significant changes to the home's structure or mechanical systems occur. Also, it is recommended to retest at least every five years.

4.2.1 **Step 1:** ***Initial Measurements*** *(Extended Protocol)*
Conduct initial measurements for two to 90 days under closed-building protocol conditions in accordance with Section **6** to provide a quick answer to whether high radon concentrations are present.

4.2.1.1 Quality Control *(Extended Protocol)*
The required number of duplicate measurements is no less than **10 percent** of all testing locations. The number of blank measurements required is no less than **5 percent** of all testing locations. (See Section **5.0** for additional quality control requirements including spiked measurements and Appendix **A** in the Companion Guidance for additional information.)

4.2.2 **Step 2:** ***Follow-up Measurements***
Conduct a follow-up test, at a minimum, in every testing location with an initial short-term test result of 4 pCi/L (148 Bq/m^3) or greater. Conduct quality control measurements in accordance with Section **4.2.1.1**. Detectors should be placed in the same locations as the initial measurements. Test additional locations as necessary, for example, invalid tests from the original testing series, other locations surrounding original elevated locations, or locations or pathways that may influence elevated radon concentrations in the building. Initiate follow-up measurements for all areas during the same time period (days or phase).

4.2.2.1 Short-Term, Follow-up Testing
If the initial short-term measurement for a testing location is 8.0 pCi/L (296 Bq/m^3) or greater (twice the EPA's radon action level of 4 pCi/L [148 Bq/m^3] or more) conduct a short-term follow-up test.

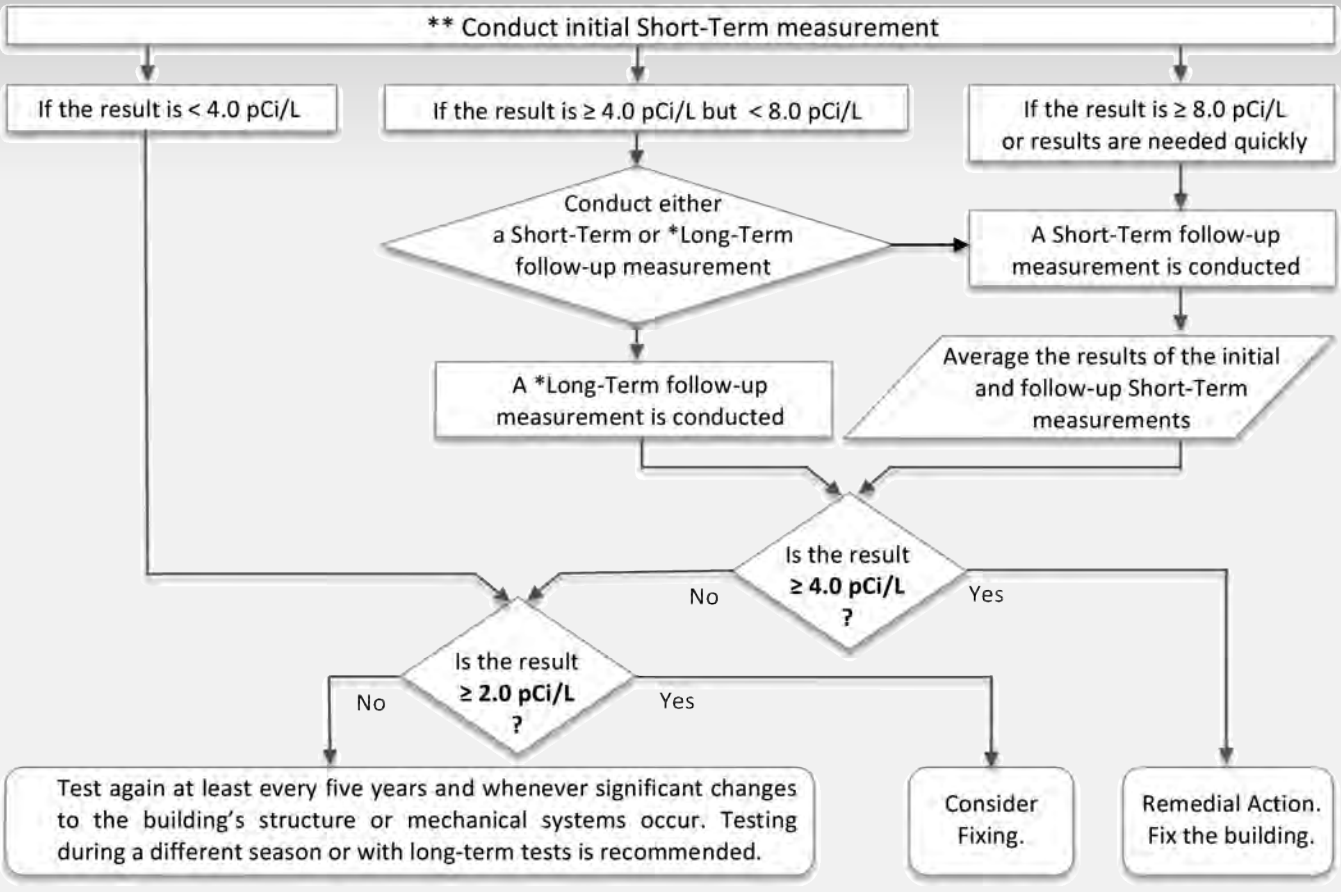
4.2.2.2 Long-Term, Follow-up Testing
When an initial test is less than twice the action level (e.g., 4.0 to 8.0 pCi/L [148 to 296 Bq/m^3]), long-term follow-up testing can be considered instead of short-term testing.

4.2.3 **Step 3:** ***Mitigation Decisions*** *(Extended Protocol)*
For Short-Term, Follow-up Testing: Use the average of the initial and follow-up test results to determine if this location needs mitigation.

For Long-Term, Follow-up Testing: Use the result of the long-term test to determine if this location needs mitigation.

4.2.3.1 When the Extended Protocol is used in Time-Sensitive situations: The results of Steps 1 and 2 are to be used for mitigation decisions.

Figure 4.2 Extended Testing Protocol



** *Choosing a time when closed-building conditions are a normal condition will aid in reliable measurements.*
* *Long-term tests should be conducted as close to a year as possible*

4.3 Time-Sensitive Protocol

Table 4.3 Time-Sensitive Testing Protocol (corresponding to EPA's "*Home Buyer's and Seller's Guide to Radon*" for situations where decisions are needed quickly)		
Step 1 Options	***Simultaneous Testing:***	(Conduct two short-term tests at the same time at each location.)
	Continuous Monitor Test	(These monitors record hourly measurements.)
Step 2	***Mitigation Decisions***	
	If the average of 2 short-term tests or a Continuous Monitor meets or exceed the action level, e.g., 4 pCi/L. ***Fix the building***	
	If less than the action level, e.g., 4 pCi/L: Consider fixing if test results indicate radon concentrations greater than half the action level, (e.g., between 2 and 4 pCi/L). Any low test result should be confirmed by testing again during a different season or with a long-term test device. Be certain to test again whenever significant changes to the home's structure or mechanical systems occur. Also, it is recommended to retest at least every five years.	

4.3.1 **Step 1:** ***Initial Measurements*** *(Time-Sensitive)*

4.3.1.1 Simultaneous Testing Option

Conduct the measurement at each location with two short-term passive test detectors at the same time in the same location for two to 90 days under closed-building protocol conditions in accordance with Section **6**.

4.3.1.1.1 Quality Control: This option inherently results in **100 percent** duplicates. The number of blank measurements required is no less than **5 percent** of all testing locations. (See Section **5.0** for additional quality control requirements including spiked measurements.)

4.3.1.2 Continuous Monitor Option

Conduct short-term tests for two to 90 days under closed-building protocol conditions in accordance with Section **6**.

A continuous monitor is capable of providing and averaging reviewable hourly readings which can provide due to changes in building pressures or ventilation.. They can also be useful when integrated into the testing plan as control monitors (e.g., Section **6.3.3)**.

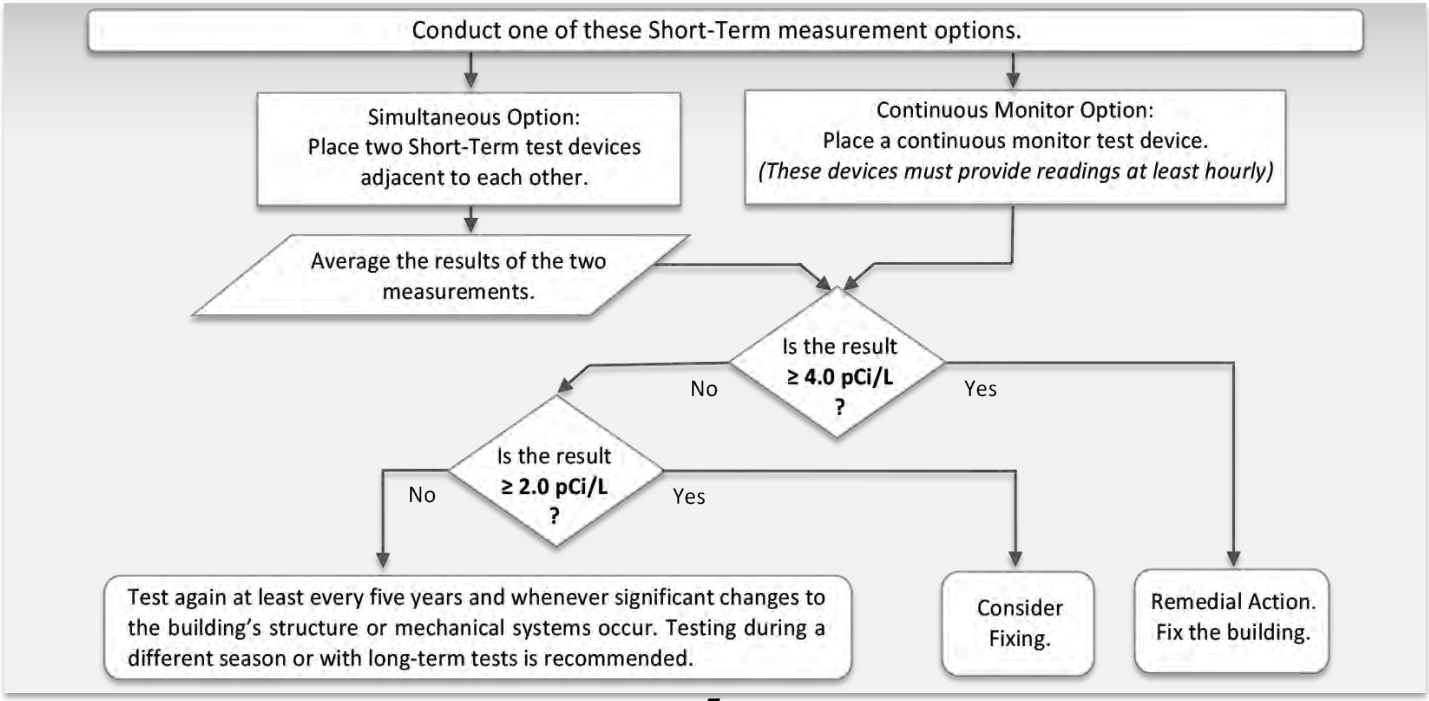
4.3.1.2.1 Quality control: The required number of duplicate measurements is no less than **10 percent** of all testing locations.

4.3.2 **Step 2:** ***Mitigation Decisions*** *(Time-Sensitive)*

Simultaneous Testing Option*:* Use the average of the two results to determine if this location needs mitigation.

Continuous Monitor Option: Use the average result of this test to determine if the location needs mitigation.

Figure 4.3 Time-Sensitive Testing Protocol



4.4 Additional Protocols for Complex HVAC (See **Exhibit 1** for HVAC group descriptions.)

Table 4.4	Additional Protocols for Complex HVAC
Step 1	4.4.1 ***Group 1:*** In accordance with Section **2.3.3**, identify each unique area or dwellings not served by a dedicated (*Group 1*) basic heating and cooling system.
Step 2	4.4.2 ***Group 2: Multi-zone HVAC Systems*** It is recommended to place enough additional detectors to adequately characterize and record differences between rooms that are served by different HVAC systems within the same dwelling or unique sector.
	4.4.3 ***Group 3a: Variable Distribution Systems*** When Variable Distribution Systems are a component of the HVAC system, it is recommended that each bedroom, general living area and any other major area that can be closed off from the main part of the dwelling or unique sector be tested.
	4.4.4 ***Group 3: Variable Distribution and/or Variable Ventilation HVAC Systems*** In addition to all other provisions in Section **6**, *Conditions required before and during the test*: a) Thermostats shall be set to a normal occupied temperature of 65-80˚ F (18-27˚ C) in all ground-contact and upper floor rooms or unique sectors being tested that are served by the system; and b) Outside air inlet dampers that are adjusted for seasonal comfort or energy savings shall be set to minimum ventilation settings when systems are designed to provide a degree of outside air ventilation throughout the year. For other system, dampers to outside air shall be closed.
Step 3	4.4.5 ***Mitigation Decisions:*** Base decisions on the results of testing as stipulated for the chosen test protocol (e.g., Extended, Time-Sensitive or Group 3 Alternative Options 1 or 2).

4.4.6 ***Alternate Option 1*** *(Group 3 HVAC)*
Conduct tests in accordance with ANSI/AARST **MALB**.

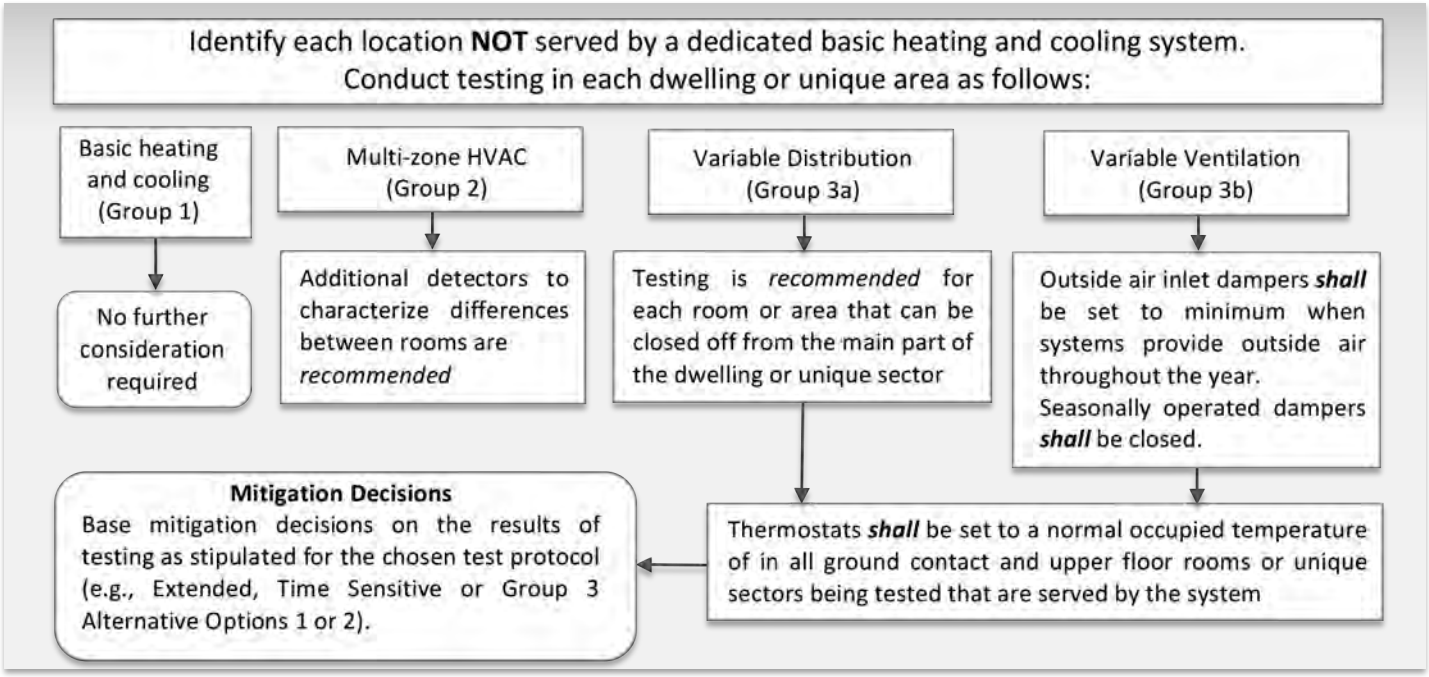
4.4.7 ***Alternate Option 2*** *(Group 3 HVAC)*
Place both a short-term detector and a long-term detector simultaneously in each test location for initial testing. Conduct quality control for each detector type in accordance with Section **4.2.1.1**. Deploy long-term test devices for the following time periods and use only the results from long-term detectors for decisions to mitigate:

a) If the highest short-term test result is 8 pCi/L (296 Bq/m^3) or greater, leave all long-term detectors in place for at least 91 days;

b) If the highest short-term test result is 4.0 pCi/L (148 Bq/m^3) or greater but less than 8 pCi/L (296 Bq/m^3), leave all the long-term detectors in place for at least 180 days; and

c) If the highest short-term test result is less than 4.0 pCi/L (148 Bq/m^3), leave all the long-term detectors in place for one year.

Figure 4.4.5 Complex HVAC (See **Exhibit 1** for HVAC group descriptions)



4.5 Post-mitigation Testing Protocols

4.5.1 ***New Construction***
Buildings constructed with radon resistant new construction or rough-in systems that have not been activated with a fan shall be tested in accordance with Sections **4.2**, **4.3** or **4.4**.

4.5.2 ***Systems Operational*** *(active radon reduction systems)*
Prior to short-term test periods of not less than two days, active radon reduction system(s) shall have been operating for at least 24 hours and shall continue to operate during the test period. In addition, closed-building conditions shall be maintained 12 hours prior to short-term test periods and throughout the test.

4.5.3 ***Initial Post-mitigation Testing*** *(active systems)*
Conduct short-term testing for initial post-mitigation evaluations with no less than a single short-term detector or device at each test location. This procedure is also required for buildings constructed with radon resistant new construction when fans have been installed regardless if prior testing of the building has been conducted.

4.5.4 ***Subsequent Post-mitigation Testing***
Conduct no less than a single short-term or long-term detector at each test location to evaluate continued effectiveness of the mitigation system.

4.5.5 ***Quality Control***
The required number of duplicate measurements is no less than 10 percent of all testing locations. The number of blank measurements required is no less than 5 percent of all testing locations.

4.5.6 ***Diagnostic Radon Testing***
Diagnostic testing is not sufficient to verify mitigation effectiveness. Diagnostic testing with a limited number of radon detectors in mitigated and surrounding areas may however be recommended prior to post-mitigation testing and during different seasons to evaluate if further optimization of the system is needed.

4.5.7 ***Test Procedures to Verify System Effectiveness***
See Sections **7.1.8.1**, **7.1.8.2** and **7.1.8.3** for required advisories and additional post-mitigation protocol requirements.

4.6 Special Considerations

4.6.1 ***Limits on Disagreement Between Collocated or Duplicate Test Results***
Some variation between the results of collocated or duplicate detectors is expected. If test results from two collocated detectors are either both above the action level or below the action level, use the average of the test results to determine if this location needs mitigation.

Special consideration is required when one test result is above the action level (e.g., 4.0 pCi/L or greater) and the other test result is below the action level:

a) If the higher result for collocated (or duplicate) detectors is less than twice the lower result, use the average of the test results to determine if this location needs mitigation.

b) If the higher result is twice or more the lower result, **a repeat test for this location is required** in order to obtain a valid measurement.

4.6.2 ***Considerations for Taking Mitigation Action Prior to Completing All Test Procedures***
When multiple test locations in close proximity to each other indicate elevated concentrations, recommendations to mitigate are permitted prior to completion of all planned test procedures. Due to the sensitive and sometimes challenging nature of such considerations, interim test data shall be reported or disclosed in a manner approved by the client and reported in accordance with a client's pre-established directives on disclosures of test data. (See Section **2.2**.)

4.6.1.1 When data suggests that mitigation could be warranted, recommendations or response to inquiries shall include the following or equivalent statement: “Decisions on whether to mitigate are more fully informed once all testing is complete, and all information has been analyzed.”

4.6.1.2 Retesting the mitigated areas: Prior to post-mitigation testing of the building, it is recommended to conduct diagnostic radon testing with short-term detectors placed in mitigated areas described in Section **4.5.3** to characterize mitigation effectiveness and its affect on adjoining areas of the building.

4.6.3 ***Testing Single Dwellings***
Tests conducted in only one or a portion of individual dwellings that are above or below adjoining units require closed-building conditions for all portions of the building. Tests conducted without closed-building compliance in all adjoined dwellings unit(s), including those directly above and below the tested dwellings(s), shall not be considered valid measurements.

Exception: When testing a single dwelling in a multifamily building that is not above or below another attached dwelling, it shall be permitted to conduct the test in accordance with the most current version of ANSI/AARST **MAH** “Protocols for Conducting Measurements of Radon and Radon Decay Products in Homes” in addition to, or as otherwise required by, local statutes.

4.6.3 ***Testing in Areas with Geologic Considerations***
Local geologic and topographic characteristics have been correlated with unusual or sizable variations in indoor radon concentrations. If a foundation is connected to a sub-surface cavity system, which connects to the radon-producing strata, large variations can occur. The most common examples are buildings found in limestone-rich areas where groundwater has eroded passages in the underlying rock (karst) or areas with faulting, which could allow radon to be transported in an unusual manner.
Structures in regions where these geologic characteristics exist have been shown to have the potential for wide variations in radon concentrations. Confirming low results by repeating tests during different seasons and weather conditions or with long-term testing is especially important for such regions.

Radon offices in some states may have information on the presence of geologic characteristics that can create unpredictable radon entry behavior. If you are uncertain whether these conditions exist in your area, it is recommended to contact your State Radon Office.

5.0 QUALITY CONTROL IN TESTING MULTIFAMILY BUILDINGS

Testing requires an overall quality assurance plan for tracking precision and bias that includes duplicate, blank and spiked measurements as stipulated in certification requirements of the AARST-NRPP or NRSB, or as required by the State Radon Office or other local jurisdiction where testing is conducted. These requirements apply to both Short-Term and Long-Term devices. Evaluate and report these measurements as they represent an "early warning system" to identify problems. See Companion Guidance Appendix **A** for general information.

5.1 Duplicate (or Collocated) Test Results

Some variation between the results of duplicate detectors is expected. However, if the variation is unusually large, it may indicate problems in the measurement system that could adversely affect the entire testing series.

See Section **4.6.1** for special considerations that can require retesting a location. See Appendix **A** for general information on the use of Duplicate measurement results in a quality assurance plan.

5.2 Blanks and Duplicates

Blanks and duplicates shall be part of a radon measurement professional's quality assurance plan and shall be included in the final report in accordance with Section **7.3.1**.

Table 5.2
General Quality Control (QC) Measurements

Duplicate Measurements (side-by-side detectors)	**Blank Measurements** (unexposed detectors)
The number of duplicate measurements shall be equal to or greater than 10% of all testing locations (or as specified by the test strategy chosen).	The number of blank measurements shall be equal to or greater than 5% of all testing locations. Field blanks (deployed at the testing location) are required. Allocating 3% field blanks and 2% lab-transit/office blanks is recommended.

5.3 Blanks

Radon measurement professionals should consider deploying 3% field blanks and 2% office blanks to evaluate background exposures throughout the sampling process. Office blanks remain in the office setting. Field blanks are taken to the site.

5.4 Special Considerations for Blank Detectors in Large Deployments

As the number of units to be tested in a complex increases, the need for specialized blank procedures also becomes greater. With a larger number of testing locations and detectors, the investiture of time and money for the client and the radon measurement professional becomes great enough to warrant that an early detection procedure is included in the blank deployment protocol.

Table 5.4
Additional QC Measurements for Larger Projects

At a minimum of 50 test locations deployed, testers shall increase the number of blanks to nine detectors:

- Three lab-transit blanks shall be returned to the laboratory immediately to evaluate quality prior to beginning detector deployment. These detectors serve both to evaluate the quality of the laboratory and to look for unexpected exposures that might result from shipping or handling;
- Three office blanks shall remain in office locations where detectors are stored or handled and then returned to the laboratory with the sampling detectors per normal procedure for field detectors. These detectors serve to reveal any unexpected exposures that might result from storage, and handling; and
- Three field blanks shall be deployed in the field with the sampling detectors and be returned to the laboratory per normal procedure for field detectors. These detectors serve to reveal any unexpected exposures that might result onsite or from handling procedures.

If more than 180 test detectors are deployed, the standard 5% blanks number can be resumed, however, the practice of using pre-test blank evaluation and lab-transit, office and field blanks shall be continued.

NOTE: Consult with the manufacturer/laboratory to ensure detector-specific procedures approved by the manufacturer/laboratory are used when conducting blank measurements.

See Appendix **A** for additional information on both Quality Assurance (QA) and Quality Control (QC).

5.5 Spiked Measurements and Special Considerations for Large Deployments

Spiked measurements for the testing project (or from the radon measurement professional's ongoing QC plan) shall also be included in the final report documentation in accordance with Section **7.3**. As the number of locations to

be tested for the project increases, the need for specialized spike procedures also becomes greater. With a larger number of testing locations and detectors, the investiture of time and money for the client and the radon measurement professional becomes great enough that an early detection procedure should be included in the spike protocol. At a minimum of 100 locations to be tested, testers should ensure that the results of three spiked detectors from the sampling program batch have been received and are satisfactory (±25% of the chamber's reference value) prior to beginning the sample deployment.

6.0 CONDITIONS REQUIRED BEFORE AND DURING THE TEST

6.1 Closed-building Protocol

This table (6.0-A) provides information that would normally be provided to occupants.

Additional specifications are provided in Tables 6.0-B and 6.0-C

Table 6.0-A **CLOSED-BUILDING PROTOCOL REQUIREMENTS**	
For tests lasting less than 4 days, initiate closed-building conditions 12 hours prior to the test. **MAINTAIN CLOSED-BUILDING CONDITIONS THROUGHOUT THE TEST PERIOD.**	
REQUIRED CLOSED-BUILDING CONDITIONS	
Windows	**Keep closed** *on all levels of the building including areas not being tested.*
Exterior doors (except for momentary use)	
Heating and Cooling Systems	**Set to normal** *with occupied operating conditions as normal (e.g., temperatures between 65˚ and 80˚ F).*
Window Air Conditioners and Unit Ventilators	**Operate in recirculation mode only** *with outside air dampers closed.*
Window fans, whole building ventilation fans or systems that temporarily bring air into or out of the building for seasonal energy savings or comfort.	**Do not operate**
Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary/normal sources of heat for the building	
Bathroom Fans	**Operate Normally**
Ventilation components set for use in all seasons	
Systems that temporarily draw air from the building such as exhaust from laundries, shops or for control of fumes from community kitchens.	**Avoid excessive operation**

Table 6.0-B ADDITIONAL SPECIFICATIONS (CLOSED-BUILDING PROTOCOL REQUIREMENTS)	
Windows and Doors	
Broken windows or doors	Seal closed
Interior partition doors	No special requirements
Doors leading into a garage or to exterior	Keep closed, except for momentary entry and exit
Garage doors	Operate normally *(Should retain closed condition except where normal operation requires otherwise.)*
Stairwell and Fire Doors	
Small Appliances	
Ceiling fans and portable fans	Do not blow directly on the testing device
Window fans	Remove or seal shut. Do not operate
Humidifiers	Operate normally
Dehumidifiers	
Central vacuum cleaner systems	
Portable Air cleaners [1]	
Crawl Spaces	
Passive crawlspace vents [1]	Operation of vent dampers should reasonably reflect average yearlong operation.
Crawlspace exhaust systems for humidity control [1]	Operate normally
Major Mechanical Systems	
Passive vents for combustion air makeup	Leave open
Combustion appliance fans	Operate normally
Air cleaners [1]	
Passive solar systems	
Attic Ventilation Fans that control only attic air	
Evaporative (swamp) cooling systems	Do not operate
Heat Recovery Ventilators (HRV) [1] Energy Recovery Ventilators (ERV) [1]	Do not operate. Exception: Operate as normal if the system is configured to operate every day of the year for introducing a specified amount of outdoor air into the building. For ERV, this often requires disabled dampers that can otherwise deactivate a system during cold or hot weather.
NOTE: [1] *Indicates items that require notation in reports for condition observed*	

Table 6.0-C NEW CONSTRUCTION, RENOVATIONS AND REPAIRS.	
All openings to the exterior as a result of incomplete construction, structural defect or disrepair	**Close or Seal** at least 12 hours prior to initiating the test
All heating/cooling appliances (functioning and set to run at normal occupied temperatures)	**Items that shall be completed or installed** at least 12 hours prior to initiating the test
All insulation	
All exterior doors and hardware	
All windows	
All wall and ceiling coverings to be completed including interior drywall or paneling, excluding decorative finishing of walls, floors or ceilings.	
All door and window seals shall be installed	
All exterior siding, weatherproofing and caulking	
All components of fire-rated assemblies to include doors, walls, ceilings and other components required to achieving fire-rated separation(s)	

6.2 Test Condition Verification

The test should include methods to prevent or detect interference with testing conditions or the testing detector. The radon measurement professional or occupant should be able to verify or provide documentation asserting that testing conditions were not violated during the testing period. A test company's minimum requirements for verifying test conditions shall be fulfilled by the following:

a) Informing the person responsible for building operation of the required test conditions;
b) Obtaining or attempting to obtain a signed noninterference agreement (See Exhibits **8** and **9**);
c) Posting a *Radon Test in Progress* notification form;
d) Conducting a visual inspection of the dwelling upon placement to assure all closed-building conditions are intact;
e) Conducting a visual inspection of the dwelling upon retrieval of the detector including:
   i Maintenance of closed-building conditions,
   ii Changes in the detector placement, and
   iii The condition of all tamper seals.

6.2.1 ***Surveillance not required***

The radon measurement professional is not responsible for inspecting for closed-building conditions 12 hours before the start of the test or between placement and retrieval of the detectors.

6.2.2 ***Closed-building conditions when initiating the test***

If, at the initiation of the test, the radon measurement professional discovers or observes that closed-building conditions have not been maintained, one of the following options is required:

a) The radon test can be postponed until at least 12 hours of closed-building conditions have been maintained prior to the test;
b) The radon test period can be extended to 4 days or more with an appropriate detector after closed-building conditions are initiated;
c) For continuous monitors, detector features or methods may be used to obtain an average reading that represents at least 48 hours of contiguous data collected after at least 12 hours of closed-building conditions have been maintained (e.g. a test may be run for 60 hours, the first 12 hours discarded and the last 48 averaged manually).

6.2.3 ***If closed-building conditions cannot be maintained***

Do not conduct short-term tests if closed building conditions in accordance with Section **6** cannot be reasonably maintained across the test period. Clients should be advised to reschedule the test at a time when required conditions can be maintained.

6.2.3.1 Occupant Health and Safety: In the event that complying with closed conditions would present health hazards to occupants:

a) The client should be informed and provided a recommendation to test at a time when closed-building conditions can be reasonably achieved; and
b) Summary reports shall prominently identify any short-term test location conducted in absence of closed-building conditions as invalid and include a recommendation to test at a time when closed-building conditions can be reasonably achieved.

Examples of situations that could present health hazards to occupants include during hot weather for buildings that have no cooling systems or where cooling systems require

seasonal enhancement of outdoor air ventilation such as evaporative (swamp) cooling systems or window fans.

6.2.4 ***Severe Weather***
Short-term tests lasting less than 4 days should not be conducted during unusually severe storms or periods of unusually high winds.

6.3 Aids for Detecting Failed Compliance or Interference

6.3.1 ***Placement Indicators***
A position for the detector can be chosen and noted so that, upon retrieval, any handling or covering of the detector can be detected.

6.3.2 ***Seals***
Non-re-sealable caulks and/or tapes can be used to verify that detectors have not been altered or moved; in addition, they can be used to verify that windows or non-primary exterior doors have not been opened during the test. If broken, seals may help determine if testing conditions were altered or a detector was disturbed. For a seal to be effective:

a) It must adhere readily to a multitude of surfaces yet be easily removed without marring the surface;
b) It needs to be non-re-sealable or show evidence of disturbance;
c) It must be unique enough to prevent easy duplication; and
d) It should be visible enough to discourage tampering.

Most paper or plastic tapes and caulks have only some of these qualities. There are, however, a number of seals manufactured specifically for radon testing. It would be advisable to use one of these products and follow the manufacturer's recommendations for installation. The best caulking to use as a seal is a removable weather-stripping caulk. This type of caulking adheres readily to most surfaces yet comes off easily without leaving a mark or being re-sealable.

6.3.3 ***Control Monitors:*** The inclusion of at least a few detectors that provide hourly data indicating fluctuations in radon can aid confidence that no unusual conditions affected the measurement results. Hourly data for fluctuations of environmental factors such as temperature, humidity and barometric pressure can also aid identification of unusual conditions.

7.0 DOCUMENTATION, PROTOCOLS AND GUIDANCE
Final report documentation shall include:

7.1 A Summary Report
The following information shall be provided in a prominent location on a summary report.

7.1.1 ***Site Location***
The address of the building(s) tested, including zip code.

7.1.2 ***Measurement Company:***
a) name and
b) contact information.

7.1.3 ***The Measurement Professional's Identification and Certification of Quality Practices:***
a) name, address and phone number;
b) relevant radon measurement certification and/or licensing number; and
c) signature (manual, or electronic in conformance with the Electronic Signatures in Global and National Commerce [E-SIGN] Act).

7.1.4 ***Laboratory Identification***
The name, address and relevant certification and/or licensing number of the service or organization used to analyze detectors.

7.1.5 ***Radon Information Sources*:**
a) Include contact information of the State Radon Office where the test is conducted or other local authority; and
b) Include information for obtaining federal or state guidance documents.

7.1.6 ***Conventions***
Radon gas results reported in picocuries per liter (pCi/L) shall be reported to only one figure after the decimal (e.g., 3.2 pCi/L). If, for example, the average of two measurements produces a result of 3.95 pCi/L, standard mathematical rules should be followed and such average shall be reported as 4.0 pCi/L.

7.1.7 ***Duplicate and Collocated Detectors Reporting***
When duplicate or collocated tests were conducted at a location, the average of those results shall be reported as the location's test result for that phase (e.g., Step 1 or Step 2) of testing. See Section **4.6.1** for special considerations.
Measurements made in separate locations shall NOT be averaged. Detectors located more than 8 inches from each other shall be considered in a separate location. They shall be reported individually.

7.1.8 ***A Summary of:*** **Test Results, Recommended Actions and Additional Protocols**

Identify the locations where test results indicate radon levels are equal to or greater than the action level with recommendations for follow-up actions that address these locations as well as the entire building. In addition, furnish or provide health information and action-level information in accordance with federal guidance or as required by the state

or other jurisdiction of authority where the test is being conducted.

The summary report shall include the statements in the following tables, or their equivalent, for each of the directives that apply to the test. These tables include:

a) appropriate guidance related to radon testing and mitigation; and
b) additional protocols for minimum practices required by this standard.

An example of an appropriate equivalent message:

"The radon measurement indicates that occupants may be exposed to radon concentrations that equal or exceed the EPA action level of 4.0 pCi/L. It is recommended to fix the building."

7.1.8.1 Elevated Radon Concentrations (e.g., ≥ 4 pCi/L)

INCLUDE THESE ADVISORIES IN THE SUMMARY REPORT

a) Fix the building (when a test location indicates average concentrations that equal or exceed the action level, e.g., 4 pCi/L).

b) Know that mitigation is not complete until retests provide evidence for the initial status of system effectiveness.

c) Initiate short-term radon testing no sooner than 24 hours after a mitigation system is operational and within 30 days after installation of the system(s).

d) If testing at any time indicates concentrations above the action level, it is recommended to conduct evaluations of the mitigation systems(s), corrections and further testing until testing indicates radon concentrations have been mitigated to below the action level.

Include this advisory in summary reports when testing indicates a radon source other than soil gas.

e) The test results indicate needs for an evaluation of radon sources other than soil, such as building materials or water supplies. Diagnostic radon testing and evaluation of soil gas transport mechanisms are commonly employed when making this evaluation.

PROTOCOL REQUIREMENT WITH ADVISORY REQUIRED

Include this advisory in summary reports when initial testing strategy did not include all ground-contact dwellings and/or upper floors as prescribed in Section 4.

f) Repeat testing procedures to include all ground-contact areas and dwellings, and not less than 10% of the dwellings on each upper floor in all buildings associated with the testing survey. When mitigation actions need to begin quickly, conduct this testing no later than during the initial post-mitigation testing.

7.1.8.2 Initial Post-Mitigation Testing

PROTOCOL REQUIREMENT WITH ADVISORY REQUIRED

Test locations after soil gas mitigation:

Include this advisory in test proposals and summary reports that recommend mitigation of ground-contact areas.

a) In all buildings that demonstrated elevated radon concentrations in ground-contact areas during the initial testing phase(s) and evaluations, post-mitigation testing conducted is required to include all ground-contact areas and dwellings, and not less than 10% of the dwellings on each upper floor.

PROTOCOL REQUIREMENT WITH ADVISORY REQUIRED

Test locations after mitigating sources other than soil gas:

Include this advisory in test proposals and summary reports that recommend mitigation of sources other than soil gas.

b) Conduct post-mitigation testing sufficient to characterize the initial status of mitigation effectiveness for all affected dwellings or areas.

ADVISORY REQUIRED

Seasonal verification for soil gas mitigation:

Include this advisory in test proposals and summary reports if post-mitigation testing was not conducted during the heating season.

c) It is recommended to repeat testing of mitigated buildings under heating season conditions no later than within the first year after mitigation.

PROTOCOL REQUIREMENT WITH ADVISORY REQUIRED

Passive, pressurization or dilution mitigation methods:

Include in test proposals and summary reports when mitigation systems rely on passive methods or active pressurization or dilution of indoor building air.

d) Mitigation is not complete for mitigation systems that rely on passive methods or active pressurization or dilution of indoor building air until post-mitigation testing procedures are repeated to verify that effectiveness is retained for both the heating season and the cooling season.

e) In addition, conduct additional testing in all dwellings on the floor where elevated concentrations were found and in all vertically adjoining dwellings.

7.1.8.3 Subsequent Post-Mitigation Retests

ADVISORIES REQUIRED

Include these advisories in summary reports to include reports that recommend mitigation, post-mitigation reports, and whenever mitigation systems are found to be present in a building.

Include these advisories on frequency of retesting

- Conduct post-mitigation tests every 2 years in all previously tested locations for mitigated areas to ensure that the system remains effective.
- Retest all building(s) at least every 5 years and in conjunction with any sale of a building. Conduct this testing with procedures to include testing of all ground-contact areas and dwellings, and not less than 10% of the dwellings on each upper floor.

Include advisories on seasonal testing as applicably defined in Sections **7.1.8.2 c** and **d**, and Sections **7.1.8.4 b** and **c**.

Include advisories on other situations that warrant retesting identified in Sections **7.1.8.4 a**, **d** and **e**.

7.1.8.4 Low Concentrations (e.g., < 4 pCi/L)

ADVISORIES REQUIRED

Include this advisory in the summary report for low test results that are greater than half the action level.

a) Consider fixing if test results indicate radon concentrations greater than half the action level, (e.g., between 2 and 4 pCi/L).

Include this advisory in summary reports that report low test results but testing has not been conducted in the heating season.

b) It is recommended to repeat testing of all buildings under heating season conditions at the earliest opportunity and no later than within 5 years after initial testing.

Include this advisory in the summary report if testing has been conducted during the heating season but no test has been conducted during other seasons.

c) It is recommended to alternate the season for future testing events to obtain at least one test under a different season that represents a significant portion of the yearlong operating condition for the building (e.g., cooling season conditions).

Include these advisories in all summary reports that report for low test results, including post-mitigation reports.

d) Retest all building(s) at least every 5 years and in conjunction with any sale of a building.

e) In addition, be certain to test again when any of the following circumstances occur:
   - ✓ A new addition is constructed or alterations for building reconfiguration or rehabilitation occur;
   - ✓ A ground-contact area not previously tested is occupied;
   - ✓ Heating or cooling systems are altered with changes to air distribution or pressure relationships;
   - ✓ Ventilation is altered by extensive weatherization, changes to mechanical systems or comparable procedures;
   - ✓ Sizable openings to soil occur due to:
     - ground water or slab surface water control systems are added or altered (e.g., sumps, perimeter drain tile, shower/tub retrofits, etc.); or
     - natural settlement causing major cracks to develop;
   - ✓ Earthquakes, construction blasting or formation of sink holes nearby; or
   - ✓ A mitigation system is altered, modified or repaired.

7.1.9 ***Observance of Extenuating Factors***

The summary of measurement results shall describe locations that were intended to be tested but did not result in valid measurements and observance of protocol non-compliance or temporary conditions that may affect mitigation decisions. It is not uncommon when testing multiple dwellings that test efforts will encounter a small number of locations with missing detectors upon retrieval, denied access or inappropriate test conditions. Such incidences do not invalidate other measurements when considering the needs of mitigation. However, the narrative should recommend retesting a building:

a) if the number of valid test measurements in the building is inadequate to reasonably characterize radon concentrations for the building; or
b) if the number of locations in a building where required closed-building conditions were compromised is sufficient to cast doubt on the validity of all measurements in that building.

The narrative can also recommend retesting individual locations, versus the building, if neither of the above conditions (a or b) were met.

When such tests of a location or building are conducted, test conditions that affect building operation such as outdoor seasonal weather should reflect average building operating conditions across the year or be similar to the previous testing. If different weather and/or building operating conditions occur, such conditions shall be reported for consideration and comparison with previous test reports for the property.

7.1.10 ***Mitigation System Status***

If applicable, a statement shall be provided in the summary report to identify:

a) if a mitigation system was observed in a building; and
b) additional observations, if any. It is permitted that a statement be included in the report that the test company offers no findings as to the proper operation of the system.

7.1.11 ***Statement of Test Limitations***

The summary report should also describe the general limitations of the test. An example is the following: *"There is an uncertainty with any measurement result due to statistical variations and other factors such as daily and seasonal variations in radon concentrations. Variations may be due to changes in the weather, operation of the dwelling or possible interference with the necessary test conditions."*

7.2 In Addition to the Summary Report:

The Report shall contain sufficient information to allow clients to evaluate the data, interpretations and also make comparisons to any previous or future tests in accordance with Sections 7.3 through 7.7.

7.3 Report All Individual Valid Measurement Results

7.3.1 ***Report QC Measurements***

All individual quality control measurements directly associated with the testing project shall also be reported and should be annotated as such (e.g., "B" for blanks, "D" for duplicates, "S" for spikes).

7.3.2 ***When Using Continuous Radon Monitors:***

a) Hourly readings shall be included.
b) The calibration date of continuous monitor(s) shall be included on the test reports. Proof of calibration shall be made available upon request.

7.3.3 ***QA Summary Statement***

A summary statement regarding quality control measurements directly associated with the testing project shall be provided that summarizes:

a) the overall degree of agreement for the quality control measurements observed as compared to control tolerances established in national standards (e.g., EPA Guidance on Quality Assurance [402-R-95-012, October 1997]); and
b) a description, if deemed needed, for quality control measurements that fell outside of control perimeters established in national standards.

7.3.4 ***Protocol for Testing***

Identify the test protocol employed for conducting the test (e.g., *"ANSI/AARST MAMF 2016"*).

7.3.5 ***Existing Tests***

Include observation of any other reports or test data acquired from residents who have independently tested. Observations regarding placement locations and test conditions should be included for comparison.

7.4 Report Detector and Test Location Information

7.4.1 ***Dates/Times***

The appropriate start and stop dates and times of the measurement exposure period for each detector.

7.4.2 ***Detector Description and Identification***

A description of the devices and detectors used including identification/serial numbers.

7.4.3 ***Locations***

Include documentation of the locations of all detectors deployed. It is advisable to diagram the test area noting the location of the detector and measurement results. Specific detail is recommended for greater clarity during review of test data that may also include supplemental photographic records. (See Exhibit 3 for an example *floor-plan log*.)

7.4.3.1 In addition, include documentation regarding:

a) locations that should have been tested, but were not tested, with an explanation of the reasons why tests were not conducted;
b) missing, lost, non-retrievable or otherwise invalidated detectors;
c) identification of locations tested that are not expected to be occupiable (e.g., furnace or laundry rooms); and
d) identification of units tested that could be occupied with minor renovation.

7.5 Report Noninterference Controls

a) Include a description of any noninterference controls used such as tamper seals, control monitors that may include continuous radon monitors or other methods.
b) Include information on whether responsible individuals signed declarations of observed compliance (see Exhibits **8** and **9**), and include copies of signed declarations of observed compliance.

7.6 Report Protocol Deviations

Include a description of any observed deviations from appropriate measurement procedures that may affect the measurement results including:

a) observed noncompliance with or deviations from required conditions such as closed-building conditions, prior to or during the test period;
b) observed deviations from a normal indoor occupied temperature;
c) changes in the detector's placement or indications from other noninterference controls that might indicate interference with the test; and
d) any observed anomalies in data printed from a continuous radon monitor that may indicate interference with the detector or test conditions or noncompliant testing conditions.

7.7 Report Temporary Conditions

Include a description of observed building conditions or other factors that are temporary in nature and may affect the measurement results. The report shall also document for the client that the test may not reflect the client's risk from radon if such conditions are altered from the condition existing during the test period.

7.7.1 ***Temporary conditions to report include:***

a) units that were tested but were vacant during the test period;
b) the condition of any temporary radon mitigation methods that are not permanent installations;
c) the condition (i.e., open/closed) of any permanent vents such as crawlspace vents;
d) HVAC operations that are inconsistent with normal operating conditions;
e) the condition of active or passive air supplies to the building or to combustive appliances; and
f) If a permanently installed ventilation system, such as a heat recovery ventilator or air-to-air heat exchanger, is active during the test but ready access exists for deactivation, or it functions intermittently.

7.7.2 ***Report Weather Conditions***

To allow clients to evaluate test data and also make comparisons to any previous or future tests, sufficient information regarding weather conditions as they existed 12 hours prior to and during the test period shall be provided, including:

a) outdoor conditions:
   - minimum, maximum and average outdoor temperature
   - precipitation, humidity, wind
   - ground cover such as snow, ice or saturated soil; and
b) conditions of unusually severe storms or periods of unusually high winds.

7.8 Retention of Records

The detector placement log and supporting documentation shall be maintained for at least 6 years after testing. Sufficient information about each measurement shall be recorded in this log to allow for future comparisons, interpretations and reporting to residence managers.

8.0 RADON DECAY PRODUCT (RDP) MEASUREMENTS

There are situations where the simultaneous measurement of radon gas and its decay products may be appropriate for a more detailed characterization of the radon risk as a function of a building's characteristics. The purpose of this section is to provide protocols on how radon decay product measurements are to be performed in conjunction with radon gas measurements.

8.1 Training Required

The use of RDP measurement devices requires specific training in order to properly account for a wide variety of site-specific conditions and technology considerations. See Companion Guidance Appendix **D** for more information.

Individuals placing, retrieving and analyzing RDP detectors shall have demonstrated a minimum degree of appropriate technical knowledge and skills specific to radon decay product measurement:

a) as established in certification requirements NRPP or the NRSB; and/or

b) as required by statute, state licensure or certification program, where applicable.

8.2 Units of Measurement and Action Level

When radon decay products are measured, the unit of measurement provided by devices is in Working Level (WL). Historically the action level has been cited as 0.02 WL.

8.3 Gas Measurement Also Required

RDP measurement devices shall not be used unless accompanied with a simultaneous radon gas measurement when the test is for determining the need for mitigation. This allows evaluation of ventilation conditions that can affect the solid decay product concentrations as compared to gas concentrations.

8.4 Reporting Requirements When Using RDP Monitors

8.4.1 ***Conventions****:* Radon decay product results reported in Working Level (WL) shall be reported to no more than three figures after the decimal (e.g. 0.012 WL).

8.4.2 ***Conversions***

Conversions shall not be made between measurements of radon gas (pCi/L or Bq/m³) and measurements of radon decay products (WL) for the purpose of determining if mitigation is needed.

8.4.3 ***Recommended Actions***

Both radon gas and radon decay products measurements shall be reported along with reference to their respective action levels and *recommended actions* (in accordance with Section **7.1.7**) that apply collectively or individually to each measurement.

8.4.4 ***Report observed conditions***

In addition to all other requirements in Section **7.0**, the report shall include a listing of all items from Table **8.0** and the condition of each during the test.

8.4.5 ***Special Situation***

If one collocated measurement (either radon gas or radon decay products) meets or exceeds the action level, and the other does not:

8.4.5.1 Further interpretation is not required in the report.

8.4.5.2 Interpretations

When an interpretation is requested or reported regarding such discrepancy and decisions to mitigate, reports shall include an assessment of observed from Table **8.0**, or as determined by more thorough investigation. The assessment shall evaluate characteristics of the building that can affect RDP concentrations and, at a minimum, identify both:

a) characteristics of the specific building as they might be expected to either increase or decrease suspended radon decay products concentrations; and

b) the degree to which such characteristics are either temporary in duration or reasonably stable conditions for that building.

Table 8.0 RDP MEASUREMENT ADDITIONAL CLOSED-BUILDING PROTOCOL AND REPORTING REQUIREMENTS		
For Local airspace "Local airspace" is defined as: The room and any adjoining rooms that are not physically isolated by partitions and closed doors.		
Item	Action	Reporting Requirements
❑ Ceiling Fans	Disallow use Or Choose a different test location	✓ List each item on the report ✓ Report existence of any items present and any deviations in required action
❑ Circulating fans		
❑ Filtration and Electrostatic Air Cleaners		
❑ Unvented fireplaces		
❑ Vacuum cleaners		
❑ Humidifiers or Dehumidifiers		
❑ Particulate Creation such as: ❑ - smoking, ❑ - cooking ❑ - burning candles/other ❑ - pets	Recommend occupants avoid activities of these natures that are in excess of normal activities	✓ List each item on report ✓ Report condition
❑ Proximity to electrostatic fields such as tube TV or computer screens	Choose a location in the room no less than 10 feet away from the item	
For Whole Building or Zone "Whole Building or Zone" is defined as: The entire building or local zone that is served by an air handler.		
❑ HVAC Blowers activity	Evaluate	✓ Report deviations from expected normal use
❑ Occupied or unoccupied	Evaluate	Report condition
❑ HVAC Filtration and Electrostatic Air Cleaners	Evaluate	✓ Document all systems present. ✓ Report their conditions
❑ HVAC combustion byproducts	Evaluate	
❑ HVAC Duct cleanliness	Evaluate	
❑ Split systems	Evaluate	
❑ Humidifiers or Dehumidifiers	Evaluate	
Outside the building		
❑ Atypical outdoor air pollution	Evaluate	✓ Report condition
❑ Humidity	Evaluate	✓ Report deviations from normal yearly average

9.0 DEFINITION OF TERMS

Basic Heating and Cooling	See Exhibit 1, Group 1. A dedicated HAC system for each room or unique area that does not supply additional fresh air for ventilation.
Becquerel per cubic meter (Bq/m³):	A unit of radioactivity representing one disintegration per second per cubic meter: 1 Bq/m^3 (0.027 pCi/l).
Blank Measurements:	Blanks are integrating or equilibrating detectors that not intentionally exposed for sampling (i.e. not left open to permit radon to enter the detector during the deployment period). Blanks help evaluate any detector response from sources other than radon exposure at a testing location such as in the manufacturing process or during shipping, storage, analysis and handling. See Appendix A and Section III for more information.
Client:	The individual or parties who hire(s) and/or pay(s) for the radon test.
Collocated:	Two or more simultaneous measurements in the same location, or side-by-side
Complex HVAC	See Exhibit 1.
Continuous Radon Monitor (CR or CRM):	Test devices that are capable of, and set to, record and review radon in time increments of one hour or less.
Crawlspace:	An open area beneath part or all of the livable space of a dwelling that typically has either a concrete slab or dirt floor. The dirt floor may be covered with gravel or a membrane. The crawlspace can have an open height of a few inches to several feet. The crawlspace can be storage space but is not living space, and may or may not be ventilated to the outside.
Duplicate Measurements:	Duplicates are pairs of detectors or monitors deployed in the same location, side-by-side for the same measurement period. The purpose of duplicates is to evaluate precision or agreement between detectors. See Appendix A and Section III for more information.
Equilibrating detector:	A detector that functions by adsorbing and/or desorbing radon from or to the ambient air until an equilibrium condition is reached between the radon concentration in the detector and the radon concentration in the ambient air. Equilibrating detectors include 1) activated charcoal in containers, such as canisters, bags or trays, which are analyzed in a laboratory using gamma-ray spectroscopy and 2) activated charcoal in containers, such as cartridges or vials, which are analyzed in a laboratory using liquid scintillation spectroscopy.
Exposure time:	The length of time a detector must sample radon to get an accurate measurement. Also called "exposure period," or "duration of exposure."
Extended testing:	An initial short-term test is followed by a short- or long-term test if a radon concentration is found to be elevated. The decision to mitigate is based on the average of two short-term tests or the result of the long-term test.
HAC Systems:	Heating and cooling (air conditioning) systems that are not designed to also supply fresh air ventilation. HAC systems are common to single-family residences. If they also provide fresh air ventilation, they are more technically referred to as HVAC systems.
HVAC System:	Heating and cooling (air conditioning) systems that are additionally capable of supplying fresh air ventilation. If they do not supply fresh air ventilation, they are more technically referred to as HAC systems.
Integrating device:	A device that records, or registers in some manner, information that is directly related to the integral of ambient radon concentration over time within the operating range of the device. Integrating devices include 1) electret ion chambers which are analyzed after the fact by measuring a decrease in electrical potential on the electret, 2) alpha-track detectors which are analyzed after the fact by etching and measuring the track density in a plastic matrix and 3) electronic devices that are not set to, or are incapable of, recording radon concentration in time increments of one hour or less.
Measurement professional	(See Radon Measurement Professional)
Mitigation system:	Any system designed to reduce radon concentrations in the indoor air of a building.
Multifamily building:	A building with more than three attached dwellings.

Multi-zone Systems See Exhibit 1, Group 2. Independent systems and controls for different areas within the same room or unique sector.

Picocurie (pCi): One pCi is one trillionth of a curie (10^{-12}) or 0.037 disintegrations per second or 2.22 disintegrations per minute.

Picocurie per liter (pCi/L): A unit of concentration of radioactivity corresponding to 0.037 decays per second or 2.22 decays per minute in a liter of air or water. 1 pCi/L = 37 becquerels per cubic meter (Bq/m^3).

Quality Assurance (QA): A complete program designed to produce results that are valid, scientifically defensible, and of known precision, bias, and accuracy. Includes planning, documentation, and quality control (QC) activities.

Quality Control (QC): The system of activities to ensure a quality product, including measurements made to ensure and monitor data quality. Includes calibrations and backgrounds, duplicate, blank, and spiked measurements, inter-laboratory comparisons, audits, and other control activities.

Radon (Rn): A colorless, odorless, naturally occurring, radioactive, inert, gaseous element formed by radioactive decay of radium (Ra-226) atoms. The atomic number is 86. Although other isotopes of radon occur in nature, in this document, radon refers to the gas Rn-222.

Radon measurement professional: Any state licensed or nationally certified person or entity that conducts radon testing for remuneration. A professional holds a current radon license from a state where radon testing services are regulated or current national certification recognized by the state in which the test is being conducted. Or, if the testing is being conducted in a non-regulated state, then the professional should have current certification recognized by the non-regulated state.

Relative Percent Difference (calculations): The relative percent difference between a pair of duplicate measurement detectors is calculated by dividing the difference between the two results by the average of the two results and multiplying by 100.

$RPD = [(|X_1 - X_2|)/X_{ave}] \times 100\%$

where:

X_1 = result of detector 1

X_2 = result of detector 2

$|X_1 - X_2|$ = absolute value of the difference between detectors 1 and 2

X_{ave} = average concentration = $((X_1 + X_2)/2)$

Example:

$X_1 = 9.0$ and $X_2 = 8.0$

$RPD = [(|9 - 8|)/8.5] \times 100\% = 1/8.5 \times 100\% = 11.8\%$

Relative Percent Error (calculations): The relative percent error (RPE) is the difference between the known or reference concentration of radon used by a chamber to spike a detector and the resulting measurement value after analysis of the spiked sample, expressed as a percentage of the known concentration. The RPE may be either a positive or negative number, indicating whether the measured concentration is higher or lower than the known concentration. RPE is calculated by subtracting the known concentration from the measured concentration, dividing by the known concentration, and multiplying the result by 100%.

$RPE = (MV - TV)/TV \times 100\%$

where:

MV = measured value of detector

TV = target value of radon chamber

Example:

MV = 11.0 and TV = 10.0

$RPE = (11\text{-}10)/10 \times 100\% = 10\%$

Single family dwelling: A residence or home intended to house a single family and requiring discrete testing location(s).

Spiked Measurements: Spikes are detectors that have been exposed in an approved chamber to a known concentration of radon (i.e. "spiked" with radon). Using spiked measurements can help evaluate the accuracy of a laboratory analysis and/or how accurately detectors supplied by a laboratory measure radon. See Appendix A and Section III for more information.

Standard Operating A written document that details an operation, analysis, or action whose mechanisms

Procedure:	are prescribed thoroughly and which is commonly accepted as the practice to be followed for conducting certain routine or repetitive tasks.
Test interference:	The altering of test conditions prior to or during the measurement in order to change the radon or radon decay product concentrations, or the altering of the performance of the measurement equipment.
Time-Sensitive:	A measurement strategy that involves a single phase of testing, requiring enhanced quality control measures. Time-sensitive tests include Simultaneous, and Continuous Monitor testing.
Variable Air Distribution	See Exhibit 1, Group 3-b. Systems where airflow from a single air handler is distributed among multiple dwellings with independent thermostat controls in each dwelling that variably open and close dampers for heated or cooled supply air.
Variable Outdoor Air Ventilation	See Exhibit 1, Group 3-b. Systems that seasonally vary outdoor air ventilation for: individual dwellings; multiple dwellings; or the whole building.
Working Level (WL)	A unit of radon decay product concentration. One WL equals any combination of short-lived radon decay products in one liter of air that will result in the ultimate emission of 1.3 x 105 MeV of potential-alpha energy. It is approximately the alpha-particle energy released from the decay products in equilibrium with 100 pCi of Rn-222.

EXHIBITS

EXHIBIT 1 (NORMATIVE DEFINITION)

Definitions of basic and complex HVAC systems as applicable to this standard of practice.

If it is unclear what type of system is present, consult with the building representative, a mechanical engineer or a qualified heating and air conditioning contractor.

HVAC - DEFINITIONS AND SPECIAL CONSIDERATIONS	
Group 1: Basic Heating and Cooling **A dedicated system for each room or unique area that does not supply additional fresh air for ventilation.** • **Forced-air** heating and air conditioning (HAC) systems (such as normally seen in single-family residences). • **Ductless Systems** - Non-Forced-Air Hot and Cold Water Circulation (sometimes called radiator systems). - Window AC (w/fresh air closed). - Unit Ventilators (w/fresh air closed). - Wall or Baseboard heating/cooling. • **Ductless Split Systems:** One system for cooling and one for heat (e.g., Window AC for cooling and Baseboard heat).	No Special Consideration
Group 2: Multi-zone Systems Independent systems and controls for different areas within the same room or unique sector.	See Section **4.4.2** for testing recommendations
Group 3-a: Variable Air Distribution Systems where airflow from a single air handler is distributed among multiple dwellings with independent thermostat controls in each dwelling that variably open and close dampers for heated or cooled supply air. Such systems are commonly called Variable Air Volume (VAV) systems.	See Section **4.4.3** for additional testing requirements
Group 3-b: Variable Outdoor Air Ventilation Systems that seasonally vary outdoor air ventilation for: - individual dwellings; - multiple dwellings; or - the whole building. Such systems include: Energy Economizer systems, Energy Recovery Ventilators (ERV) and Evaporative (swamp) cooling systems.	See Section **4.4.4** for additional testing requirements

EXHIBIT 1 Informational Descriptions of Heating, Cooling and Ventilation Systems

Group 1: Basic Heating and Cooling

Dedicated system(s) for each room that do not supply additional outdoor air for ventilation.

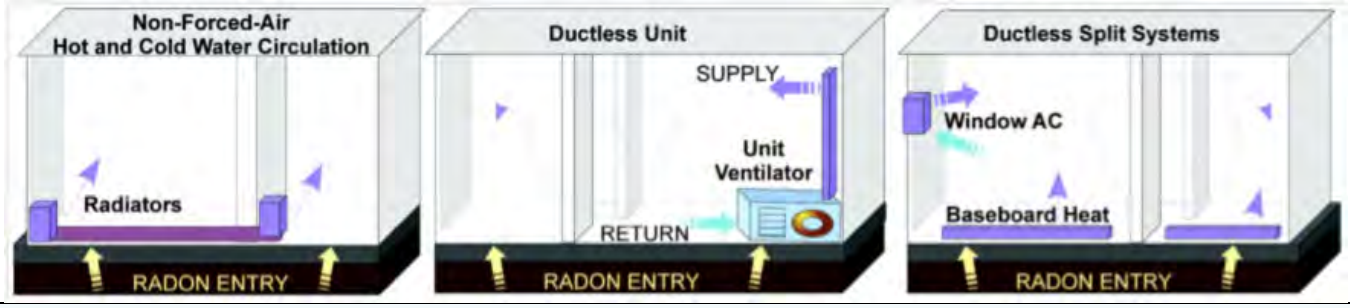
HAC Systems:

Many buildings have forced-air heating and air conditioning (HAC) systems for each room or area. These are systems that might be commonly seen in single-family residences.

Ductless Systems:

Some buildings have rooms or areas where systems do not have forced-air ducted distribution.

- **Non-Forced-Air Hot and Cold Water Circulation** (sometimes referred to as radiator systems).
- **Window Air Conditioners.**
- **Wall or Baseboard Heating/Cooling Systems.**
- **Ductless Split Systems** with one unit for cooling and another unit for heat (i.e. Window AC for cooling and Baseboard or Wall units for heat).



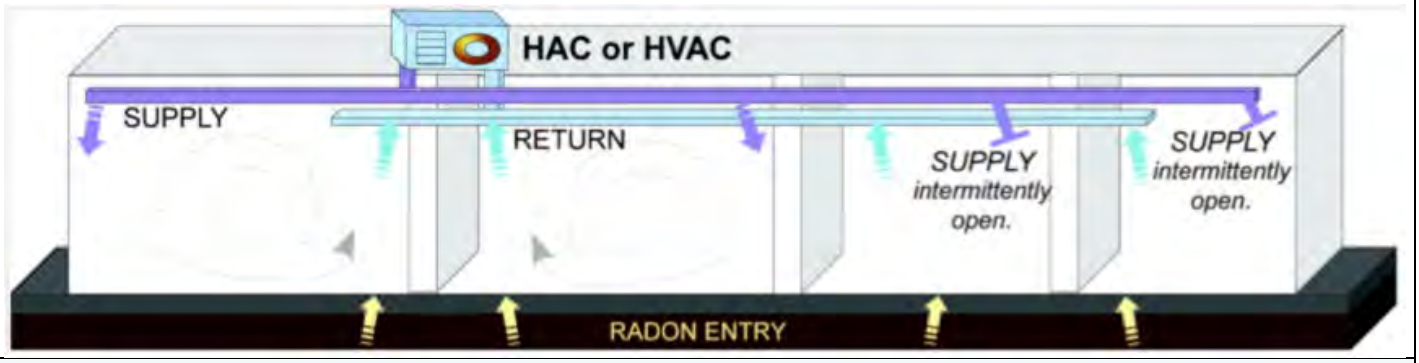
Group 2: Multi-zone Systems

Multi-zone systems are those where different air handlers or systems are employed and independently controlled for different areas within the same room or portions of a building. Such configurations may have been designed originally or added due to modifications of a building or use of an area. Radon concentrations can vary widely room to room based upon variances in system operations.

Group 3-a: Variable Air Distribution

The normal operation of these systems can cause changes in distribution of radon or ventilation air and can also affect pressure relationships that can enhance or diminish radon entry. Depending on the open or closed operating conditions for supply vents and returns vents, radon concentrations can vary widely from test to test (or room to room).

Variable Air Distribution:
Systems where the airflow from a single air handler is distributed to multiple rooms or locations with independent controls within each room for duct dampering. Such systems include Variable Air Volume (VAV) systems or systems with fixed volume return vents in each room and controls for dampering supply air.



Group 3-b: Variable Outdoor Air Ventilation

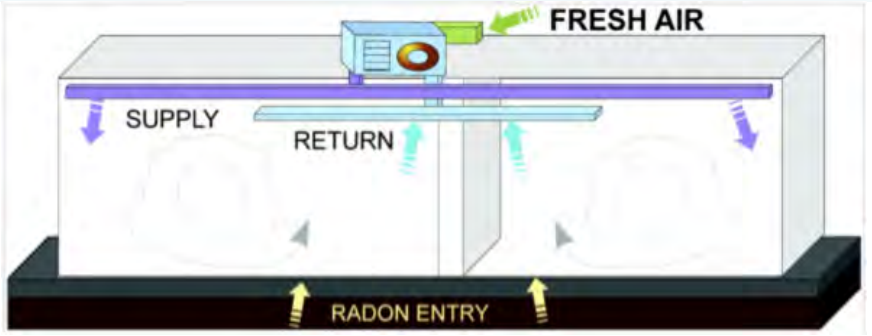
The normal operation of these systems can cause varying changes in fresh air ventilation that can dilute radon concentrations and also affect pressure relationships that can enhance or diminish radon entry. Depending on the extent of open or closed intake dampers for outdoor air, radon concentrations can vary widely from test to test or room to room.

Outdoor Air Ventilation (HVAC):

Some buildings have heating, ventilating and air conditioning systems that add fresh air ventilation to the building.

Such systems may exist for service to a whole building, multiple rooms or as single unit ventilators.

Radon concentrations can vary widely from test to test based the volume of fresh air supplied to room at any given time.



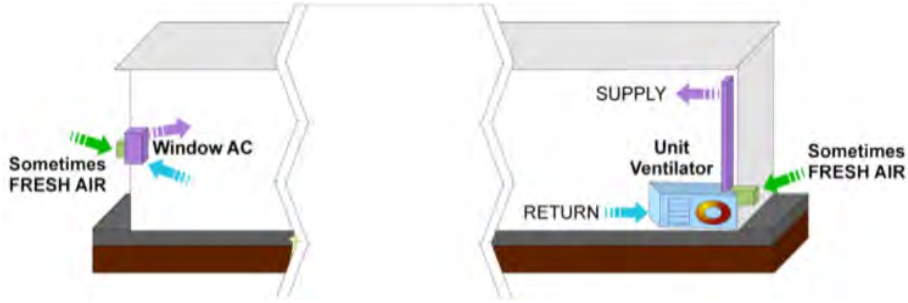


EXHIBIT 2

EXAMPLE: FLOOR PLAN DRAWING/LOG

"X" = Detectors
"D" = Duplicate Detectors
"B" = Field Blank Detectors

Add additional notation as appropriate (i.e. mechanical system notes and continuous or long-term detectors).

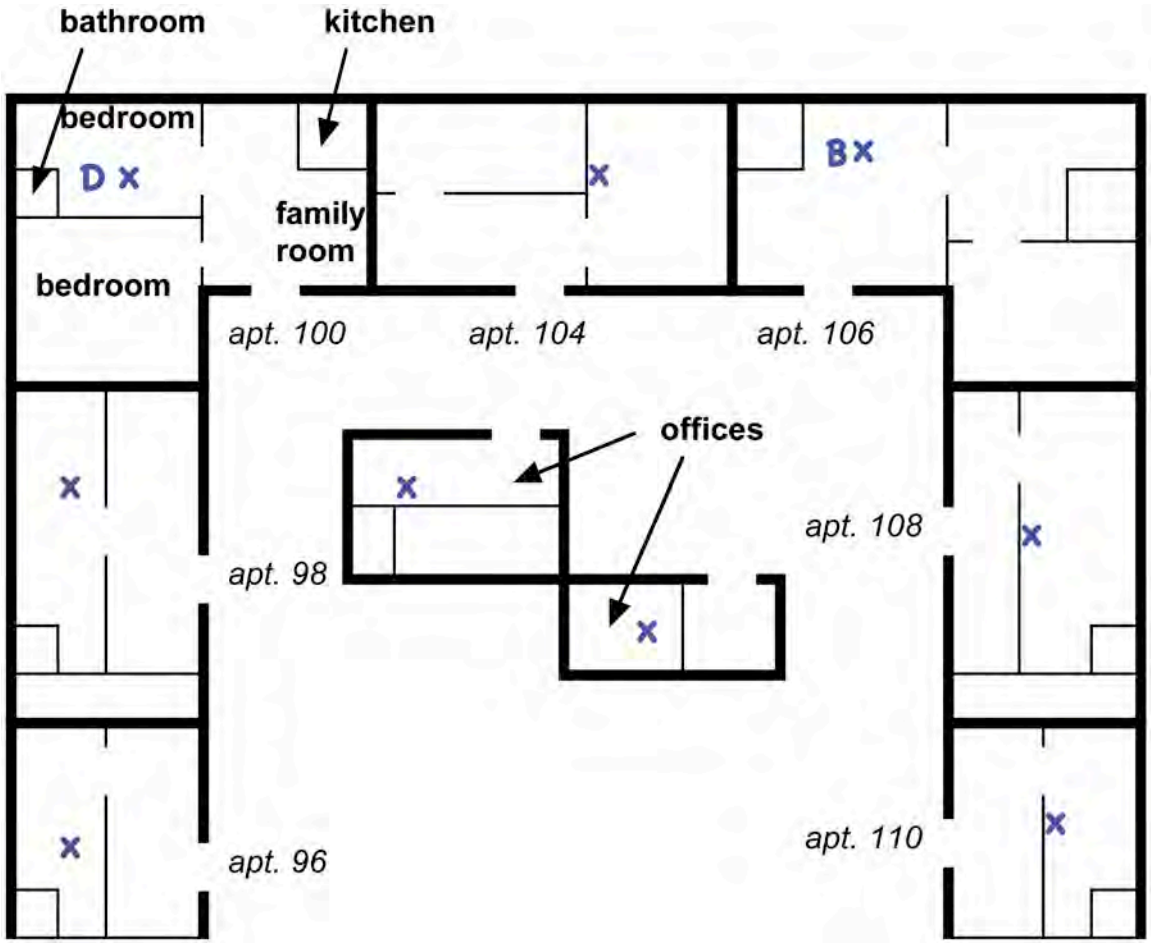


EXHIBIT 3

SAMPLE: SITE LOGISTICS INQUIRY TO CLIENT AND MANAGING STAFF

Management or Radon Company
Anytown, USA 800-000-0000

Dear client and managing staff,

Please return this form as soon as possible to help us clarify lines of communication, responsibilities and building details needed for conducting the radon tests.

Your building staff member contacts:

For logistics of onsite activities, contact: _____ Phn#_____

For building/dwelling access, contact: _____ Phn#_____

Other contact title/name: _____ Phn#_____

Client Authorizations

Staff authorized for responding to occupant and public inquiries:

Title/name: _____ Phn#_____

Title/name: _____ Phn#_____

Person(s) authorized to receive report data and any incremental reports:

Title/name: _____ Phn#_____

Title/name: _____ Phn#_____

Frequency of reports: ( ) Prior to testing ( ) After each phase of testing ( ) When testing is complete

Client or Authorized Agent Name: _____

Signature: _____ Date _____

Please ensure all contacts and authorizations are provided prior to testing events.

Request for Building Information

Please provide floor plan diagrams that identify all ground-contact dwellings and information regarding building foundation types such as slab-on-grade, basement and crawl space areas. Information about upper floor dwellings is also requested.

In addition, please provide answers for the following questions:

( )Yes ( ) No	Do all dwellings have individual heating or cooling systems?
( )Yes ( ) No	Do any dwellings have two or more heating or cooling systems?
( )Yes ( ) No	Are any dwellings or common areas equipped with heating or cooling systems that introduce outside air to the building for seasonal comfort, energy savings or other seasonal need? If yes, provide a detailed description? If yes, provide a detailed description
( )Yes ( ) No	Are any dwellings or common areas equipped with automated dampers that open or closed heating or cooling systems ducts depending on thermostat temperature settings? If yes, provide a detailed description

Please note: Failure to accurately provide this information can result in significant consequences for occupants and cost of retesting testing if discovered to be needed.

EXHIBIT 4

SAMPLE: NOTICE OF INSPECTION FOR ALL FACILITATING STAFF

*(***Note:** *Facilitating staff are people responsible for building oversight and public relations with occupants. Facilitating staff normally include: building managers, maintenance managers and managerial support staff.)*

Management or Radon Company
Anytown, USA 800-000-0000

Dear facilitating staff,

An important step is being taken to protect the health of building occupants. A radon test is being conducted.

Radon is a naturally occurring radioactive gas often found in soil that can be present in some buildings at concentrations greater than recommended. Radon gas is the second leading cause of lung cancer and the leading cause of lung cancer in nonsmokers in the United States.

The only way to know what the radon concentrations are for any building is to test.

Facilitating staff responsibilities:

Initial preparation for testing - Logistics

Information is needed about the building prior to testing, to include: Addresses and floor plan diagrams if possible (e.g., fire-exit diagrams or other floor plan drawings), with descriptions of occupied and unoccupied dwellings; descriptions of heating and cooling systems; and contact information for those personnel responsible for coordination and dwelling access.

Prior Notifications

Notices must to be distributed to all tested and non-tested dwellings no later than required by local law for gaining access to a dwelling or not later than the day before testing. Notices should also be posted at this time in publicly accessible areas such as in corridors, elevators and offices. It is also recommended that advance notices be distributed a week or more prior to testing.

Warning: Failure to distribute notices in a timely manner can strain occupant relations and increase testing costs. Occupant interference with the test devices or building conditions can invalidate the test results. Occupant failure to comply with required test conditions is most likely to occur when residents are not properly informed about the necessary test conditions.

Prior building preparations

Facilitating or maintenance staff should prepare for providing access. Facilitating or maintenance staff must ensure that temporary conditions due to repairs, broken windows or doors, or seasonal outside air entry (e.g., adjustments to HVAC units), meet required closed-building conditions 12 hours before testing begins.

Please help to maintain the required test conditions throughout the building (12 hours before testing and for the duration of the test).

Your building staff member contacts:

Staff authorized for responding to public inquiries: _____ Phn#_____

For logistics of onsite activities, contact: _____ Phn#_____

For general health more information:

Copies of EPA's *A Citizen's Guide to Radon* can be found online at http://www.epa.gov/radon.

Test devices are not dangerous in any way and a sample test device is available to view upon request.

We thank you for your cooperation in helping to ensure safe and healthy buildings.

EXHIBIT 4 SAMPLE (CONTINUED): NOTICE FOR FACILITATING STAFF

More Detailed Guidance Provided For Staff

Management or Radon Company
Anytown, USA 800-000-0000

Please help to maintain these required test conditions throughout the building (12 hours prior the test and during the test).	
Keep closed	**Windows** *(on all levels of the building)*
	Exterior doors *(except for momentary use)*
Set to normal	**Heating and cooling Systems** *(normal occupied conditions: 65˚ - 80˚ F)*
Operate normally	**Bathroom fans**
	Ventilation components used in all seasons
Avoid excessive operation	**Exhaust systems** such as from laundries or for control of fumes from community kitchens
Outside air dampers closed	**Window air conditioners and unit ventilators**
Do not operate	**Window fans, whole building ventilation fans or systems** that temporarily bring air into or out of the building for seasonal energy savings or comfort
	Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary and normal sources of heat for the building

Actions Required at least 12 hours prior to initiating the test	
All heating/cooling appliances	**Action Required** Functioning and set to run at normal occupied temperatures
Variable Outdoor Air Ventilation Systems Systems that seasonally vary outdoor air ventilation for: - individual dwellings - multiple dwellings; or - the whole building. Such systems include: Energy Economizer systems, Energy Recovery Ventilators (ERV) and Evaporative (swamp) cooling systems.	**Action Required** a) Thermostats shall be set to a normal occupied temperature of 65-80˚ F (18-27˚ C) in all ground-contact and upper floor rooms or unique sectors being tested that are served by the system; and b) Outside air inlet dampers that are adjusted for seasonal comfort or energy savings shall be set to minimum ventilation settings when systems are designed to provide a degree of outside air ventilation throughout the year. For other system, dampers to outside air shall be closed.
All openings to the exterior as a result of incomplete construction, structural defect or disrepair	**Action Required** Close or Seal

Note for testing professionals:
*It is recommended to additionally provide Tables **6.0-A**, **6.0-B** and **6.0-C** for helping to instruct facilitating staff.*

EXHIBIT 5. SAMPLE PRIOR NOTICE - DWELLINGS BEING TESTED

Management or Radon Company
Anytown, USA 800-000-0000

Dear Resident,

An important step is being taken to protect your health. Radon testing is being conducted for this building.

Radon is a naturally occurring radioactive gas often found in soil that can be present in some buildings at concentrations greater than recommended. Radon gas is the second leading cause of lung cancer and the leading cause of lung cancer for nonsmokers in the United States.

The only way to know what the radon concentrations are for any building is to test.

It is important that staff gains access to place and retrieve radon test detectors

Tentative detector placement: Day _____ Date_____ (please close windows the night before)

Tentative detector pick-up Day _____ Date_____ Time_____

Please help to maintain the required test conditions throughout the building.

Required closed-building conditions (12 hours prior the test and during the test).	
Keep closed	**Windows** *(on all levels of the building)*
	Exterior doors *(except for momentary use)*
Set to normal	**Heating and cooling systems** *(normal occupied conditions: 65˚ - 80˚ F)*
Operate normally	**Bathroom fans**
	Ventilation components used in all seasons
Avoid excessive operation	**Exhaust systems** such as from laundries or for control of fumes from community kitchens
Outside air dampers closed	**Window air conditioners and unit ventilators**
Do not operate	**Window fans, whole building ventilation fans or systems** that temporarily bring air into or out of the building for seasonal energy savings or comfort
	Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary and normal sources of heat for the building

We will request your signature to help us verify if these conditions were maintained.

For more information:

Copies of EPA's *A Citizen's Guide to Radon* can be found online at http://www.epa.gov/radon.

Test detectors are not dangerous in any way. If you have questions and if you have independently conducted radon testing in your residence, please contact:

Contact Person: _____Phone: _____

We thank you for your cooperation in helping to ensure a safe and healthy building.

EXHIBIT 6. SAMPLE PRIOR NOTICE - DWELLINGS NOT BEING TESTED

Management or Radon Company
Anytown, USA 800-000-0000

Dear Resident,

An important step is being taken to protect the health of residents in this building. A radon test is being scheduled for lower floors where the radon might normally be found. Radon is a naturally occurring radioactive gas often found in soil that can be present in some buildings at concentrations greater than recommended.

The only way to know what the radon concentrations are for any building is to test.

Radon test detectors will be placed in the lower areas of the building and other strategic locations:

Starting Day: _____ Date_____ (please close windows the night before)

Ending Day: _____ Date_____ Ending Time: Close of business hours.

Please help to maintain the required test conditions throughout the building.

Required closed-building conditions (12 hours prior the test and during the test).	
Keep closed	**Windows** *(on all levels of the building)*
	Exterior doors *(except for momentary use)*
Set to normal	**Heating and cooling systems** *(normal occupied conditions: 65˚ - 80˚ F)*
Operate normally	**Bathroom fans**
	Ventilation components used in all seasons
Avoid excessive operation	**Exhaust systems** such as from laundries or for control of fumes from community kitchens
Outside air dampers closed	**Window air conditioners and unit ventilators**
Do not operate	**Window fans, whole building ventilation fans or systems** that temporarily bring air into or out of the building for seasonal energy savings or comfort
	Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary and normal sources of heat for the building

We will request your signature to help us verify if these conditions were maintained.

Even though ground contact areas are tested for initial surveys, you are encouraged to consider testing your own dwelling for personal verification of low radon exposures. Inexpensive home test detectors are readily available and tests can be conducted at any time the required closed-building conditions are a normal condition for the building.

For more information:

Copies of EPA's *A Citizen's Guide to Radon* can be found online at http://www.epa.gov/radon.

If you have questions or if you have independently conducted radon testing in your residence, please contact:

Contact Person: _____Phone: _____

We thank you for your cooperation in helping to ensure a safe and healthy building.

EXHIBIT 7. SAMPLE PUBLIC NOTICE POSTER

Radon Survey in Progress

Management or Radon Company
Anytown, USA 800-000-0000

Dear Residents,

An important step is being taken to protect your health. Radon testing is being conducted for this building.

Radon is a naturally occurring radioactive gas that can be present in some buildings at concentrations greater than recommended. Testing for radon is recommended for all homes. Radon gas is the second leading cause of lung cancer and the leading cause of lung cancer for nonsmokers in the United States.

The only way to know what the radon concentrations are for any building is to test.

Radon testing is scheduled for:

Building(s): _____

Building Area(s): _____

Test Deployment: Day_____ Date _____ (please close windows the night before)

Test Completion: Day_____ Date _____ Time: Before close of business hours

Please help to maintain the required test conditions throughout the building.

Required closed-building conditions (12 hours prior the test and during the test).	
Keep closed	**Windows** *(on all levels of the building)*
	Exterior doors *(except for momentary use)*
Set to normal	**Heating and cooling systems** *(normal occupied conditions: 65˚ - 80˚ F)*
Operate normally	**Bathroom fans**
	Ventilation components used in all seasons
Avoid excessive operation	**Exhaust systems** such as from laundries or for control of fumes from community kitchens
Outside air dampers closed	**Window air conditioners and unit ventilators**
Do not operate	**Window fans, whole building ventilation fans or systems** that temporarily bring air into or out of the building for seasonal energy savings or comfort
	Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary and normal sources of heat for the building

For more information:

Copies of EPA's *A Citizen's Guide to Radon* can be found online at http://www.epa.gov/radon

If you have questions or if you have independently conducted radon testing in your residence, please contact:

Contact Person: _____Phone: _____

We thank you for your cooperation in helping to ensure a safe and healthy building.

EXHIBIT 8. SAMPLE COMPLIANCE DECLARATION - TESTED DWELLINGS

Radon Survey in Progress

Management or Radon Company
Anytown, USA 800-000-0000

Dear Resident,

An important step is being taken to protect your health. Radon testing is being conducted for this building.

Radon is a naturally occurring radioactive gas often found in soil that can be present in some buildings at concentrations greater than recommended. Radon gas is the second leading cause of lung cancer and the leading cause of lung cancer for nonsmokers in the United States.

The only way to know what the radon concentrations are for any building is to test.

It is important that required test conditions stated below are maintained.

➥ **Please sign this form** and add any comments to help ensure accurate tests.

➥ **Please leave this signed form with the test kit or return to:** *In example: "The management office"*

Declaration of Observed Compliance: To the best of my knowledge, the required conditions stated below were maintained during the test.

Occupant Signature: _____ **Date** _____

Address: _____

Comments if any: _____

_____

➥ **Detector Pick-up** Day_____ Date _____Time_____

Required closed-building conditions (12 hours prior the test and during the test).	
Keep closed	**Windows** *(on all levels of the building)*
	Exterior doors *(except for momentary use)*
Set to normal	**Heating and cooling systems** *(normal occupied conditions: 65˚ - 80˚ F)*
Operate normally	**Bathroom fans**
	Ventilation components used in all seasons
Avoid excessive operation	**Exhaust systems** such as from laundries or for control of fumes from community kitchens
Outside air dampers closed	**Window air conditioners and unit ventilators**
Do not operate	**Window fans, whole building ventilation fans or systems** that temporarily bring air into or out of the building for seasonal energy savings or comfort
	Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary and normal sources of heat for the building

If you have questions or if you have independently conducted radon testing in your residence, please contact:

Contact Person: _____Phone: _____

We thank you for your cooperation in helping to ensure safe and healthy homes.

EXHIBIT 9. SAMPLE COMPLIANCE DECLARATION - NONTESTED DWELLING

Radon Survey in Progress

Management or Radon Company
Anytown, USA 800-000-0000

Dear Resident,

An important step is being taken to protect the health of residents in this building. A radon test is being conducted for lower floors where the radon might normally be found. Radon is a naturally occurring radioactive gas often found in soil that can be present in some buildings at concentrations greater than recommended.

Starting Day: _____ Date_____ (please close windows the night before)

Ending Day: _____ Date_____ Ending Time: Close of business hours.

Please help to maintain the required test conditions throughout the building.

➥ **Please sign this form** and add any comments to help ensure accurate tests.

➥ **Please leave the signed form with the test kit or return to:** *In example: "The management office"*

Declaration of Observed Compliance: To the best of my knowledge, the required conditions stated below were maintained during the test.

Occupant Signature: _____ **Date** _____

Address: _____

Comments if any: _____

_____

Required closed-building conditions (12 hours prior the test and during the test).	
Keep closed	**Windows** *(on all levels of the building)*
	Exterior doors *(except for momentary use)*
Set to normal	**Heating and cooling systems** *(normal occupied conditions: 65˚ - 80˚ F)*
Operate normally	**Bathroom fans**
	Ventilation components used in all seasons
Avoid excessive operation	**Exhaust systems** such as from laundries or for control of fumes from community kitchens
Outside air dampers closed	**Window air conditioners and unit ventilators**
Do not operate	**Window fans, whole building ventilation fans or systems** that temporarily bring air into or out of the building for seasonal energy savings or comfort
	Fireplaces, including those that burn solid, liquid or gas fuels, unless they are the primary and normal sources of heat for the building

Copies of EPA's *A Citizen's Guide to Radon* can be found online at http://www.epa.gov/radon.

If you have independently conducted radon testing in your residence or have any questions, please contact:

Contact Person: _____Phone: _____

We thank you for your cooperation in helping to ensure safe and healthy homes.

MAMF

Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily Buildings

Acknowledgement

This standard and the revisions embodied in this document were developed through the efforts and deliberations of the consensus body for MAMF, representing a cross-section of stakeholder interests and vantage points.

Deep appreciation is both expressed and deserved for contributions in time and wisdom provided by all previous committee members, contributors and this list of consensus body members and staff in 2016:

Chair: Shawn Price (NC)

Assistance Team: Gary Hodgden (KS)

Stakeholder Group	Delegate	Affiliation
(Educators)	Doug Kladder (CO)	Center for Env. Research & Technology (CERTI),
(Non-regulated States)	Chrys Kelley (CO)	Colorado Department of Health and Environment
(Regulated States)	Patrick Daniels (IL)	Illinois Emergency Management Agency (IEMA)
(Health NGO)	Kevin Stewart (PA)	American Lung Association
(Federal EPA)	Jani Palmer (DC)	U.S. Environmental Protection Agency (EPA)
(Federal HUD)	Sara Jensen (DC)	HUD Office of Housing
(Federal HUD)	Hilary Atkin (DC)	HUD Office of Housing
(Proficiency Program)	Kyle Hoylman (KY)	AARST-NRPP (Credentialing Committee)
(Proficiency Program)	Bill Angell (MN)	AARST-NRPP (Credentialing Consultant)
(Mitigation Prof.)	Tim Pittman (SC)	Professional Service Provider
(Measurement Prof.)	Wally Dorsey (VA)	Professional Service Provider
(Measurement Prof.)	Jessica Karns (OH)	Professional Service Provider
(Building Inspectors)	Matt Koch (GA)	Professional Service Provider
(Building Scientist)	Mort Schmidt (OH	Professional Service Provider
(Environmental Consultant)	Kim Dingledine (VA)	Professional Service Provider
(Environmental Consultant)	Mike Walther (MD)	Professional Service Provider
(Manufacturer)	Alex Stieff (MD)	Rad Elec, Inc.
(Manufacturer)	Rick Straub (OH)	femto-TECH, Inc.

ANSI/AARST Designation: MAMF-201x

An Approved American National Standard

Companion Guidance

Examples of informational content being prepared for the MAMF Companion Guidance document that will not contain requirements necessary for conformance to the MAMF standard and are therefore not included for public review:

Informational: INTRODUCTORY GUIDANCE FOR RESIDENCE MANAGERS
Informational Appendix A: DESCRIPTIONS OF MEASUREMENT DEVICES AND QUALITY CONTROL
Informational Appendix B: EXAMPLE DATA LOGS
Informational Appendix C: CHECKLIST FOR SELECTING A SERVICE
Informational Appendix D: PROJECT PLAN: PROCEDURAL CHECKLIST FOR TESTING
Informational Appendix E: INFORMATION ON RADON DECAY PRODUCT MEASUREMENT

The information contained in the MAMF Companion Guidance document will not part of this ANSI/AARST American National Standard (ANS).