Proposed New Standard

Long-Term Stewardship of Radon and Soil Gas Hazards

Public Review: SG-OMM *2-24*

COMMENT DEADLINE: **April 1st, 2024**

REQUESTED PROCESS AND FORM FOR FORMAL PUBLIC REVIEW COMMENTS

Submittals (MS Word preferred) may be attached by email to StandardsAssist@gmail.com

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: **SG-OMM *2-24***

- **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.

Repeat the five bullet items above for <u>each</u> comment.

Notice regarding unresolved objections: While each committee seeks to resolve objections, please notify the committee responsible for an action or inaction if you desire to recirculate any unresolved objections to the committee for further consideration. Notice of right to appeal. (See Bylaws for the AARST Consortium on National Radon Standards - Operating Procedures for Appeals available at www.radonstandards.us, Standards Forum, Bylaws): (2.1) 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 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.

AARST SG-OMM 202x



PROPOSED STANDARD

Long-Term Stewardship of Radon and Soil Gas Hazards

AARST CONSORTIUM ON NATIONAL RADON STANDARDS

SG-OMM 202x

Long-Term Stewardship of Radon and Soil Gas Hazards

Scope Summary and Introduction

This standard of practice provides prescriptive requirements and guidance for long-term management of hazards associated exposure to indoor *radon* gas and chemical vapors, to include:

a) monitoring *radon* and soil gas *hazards* across time to protect building occupants, and

b) continued operation and maintenance of systems designed to reduce soil gas hazards.

The requirements in this standard of practice are applicable to all buildings intended for occupancy including the use of a buildings or structures, or a portion thereof, for single family, multifamily or congregate residential occupancies and non-residential occupancies such as educational and commercial occupancies.

Exception: Dwellings where the owner is both the occupant and responsible party for maintaining stewardship of radon and soil gas hazards.

Significance of Purpose

This document contains minimum requirements and guidance designed to respond to the health threat of radon gas, chemical vapors, and other hazardous soil gases.

Designation: SG-OMM

As used for catalogue identification, "SG-OMM" stands for Soil Gas-Operation, Maintenance and Monitoring.

Normative References

ANSI/AARST MAH	(Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes)
ANSI/AARST MA-MFLB	(Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial and Mixed-Use Buildings)
ANSI/AARST MW-RN	(Protocol for the Collection, Transfer and Measurement of Radon in Water)
EPA TO-15:	(EPA/600/4-90/010 1990 Compendium of Methods for the Determination of Air Pollutants in Indoor Air)
EPA TO-17:	(EPA/625/R-96/01b 1999 Compendium of Methods for the Determination of Toxic Organic *Compounds in Ambient Air - Second Edition*)

Other ANSI/AARST standards developed to respond to the health threat of radon gas, chemical vapors, and other hazardous soil gases:

ANSI/AARST SGM-SF	(Soil Gas Mitigation Standards for Existing Homes)
ANSI/AARST SGM-MFLB	(Soil Gas Mitigation Standards for Existing Multifamily, School, Commercial and Mixed-Use Buildings)
ANSI/AARST CC-1000	(Soil Gas Control Systems in New Construction of Multifamily, School, Commercial and Mixed-Use Buildings)

Other ANSI/AARST standards developed to respond to the threat of cancer caused by radon:

ANSI/AARST MS-QA	(Radon Measurement Systems Quality Assurance)
ANSI/AARST MS-PC	(Performance Specifications for Instrumentation Systems Designed to Measure Radon Gas in Air)
ANSI/AARST MW-RN	(Protocol for the Collection, Transfer and Measurement of Radon in Water)
ANSI/AARST CCAH	(Reducing Radon in New Construction of One- & Two-Family Dwellings and Townhouses)
ANSI/AARST RRNC	(Rough-in of Radon Control Components in New Construction of 1 & 2 Family Dwellings and Townhouses)

The Consensus Process

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

AARST Consortium on National Standards

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Notice of right to appeal: Bylaws for the AARST Consortium on National Standards are available at www.standards.aarst.org/public-review . 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 AARST Consortium on National 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."

SG-OMM Contents

SG-OMM

Long-Term Stewardship of Radon and Soil Gas Hazards

SECTION 1 SCOPE

1.1 Scope and Purpose

This standard of practice provides prescriptive requirements and guidance for long-term management of hazards associated with exposure to indoor *radon* gas and chemical vapors, to include:

a) monitoring *radon* and soil gas *hazards* across time to protect building occupants, and

b) continued operation and maintenance of systems designed to reduce soil gas hazards.

1.1.1 *Applicability*

The requirements in this standard of practice are applicable to all buildings intended for occupancy including the use of a buildings or structures, or a portion thereof, for single family, multifamily or congregate residential occupancies and nonresidential occupancies such as educational and commercial occupancies.

Exception: Dwellings where the owner is both the occupant and responsible party for maintaining stewardship of radon and soil gas hazards.

1.1.2 *Applicable mitigation methods*

This standard of practice addresses monitoring to confirm low hazard conditions across time, to include:

a) *Operation, maintenance, and monitoring (OM&M)* for *mitigation systems* based on *active soil depressurization (ASD)*; and

b) *OM&M* for *non-ASD mitigation* methods and systems.

1.2 Limitations

1.2.1 *Jurisdictional compliance*

This standard of practice does not contain all code or other jurisdictional requirements where a *mitigation system* is installed. Adherence to this standard does not guarantee or supersede compliance with applicable codes or regulations of any federal, state, or other *authority having jurisdiction (AHJ)*.

1.2.2 *Source materials*

This standard does not address *OM&M* practices associated with hazardous gases or substances in outside air, combustible soil gases, or characterization, possession, handling, containment, generation, or disposal of radioactive or chemically contaminated materials.

1.2.3 *Combustible gases and contaminated source materials*

This standard does not address practices associated with combustible soil gases and removal of contaminated source materials, including:

a) Capture, containment and disposal of chemically contaminated vapor or condensate; and

b) Chemical products stored or associated with building materials.

1.2.4 *Safety and regulatory authorities*

This standard of practice is not intended to address all safety concerns associated with its use. The user of this standard is responsible to establish appropriate health and safety practices and for determining the applicability of regulatory limitations prior to using the standard.

SECTION 2 DEFINITION OF TERMS

Terms not defined herein have their ordinary meaning as defined in "Webster's Collegiate Dictionary."

2.1 action level (radon), n—A threshold that warrants taking action to protect occupants. The radon action level in the U.S. is 4 pCi/L (150 Bq/m^2) or greater, as published by the United States Environmental Protection Agency (USEPA).

2.2 action level (VI), n—The concentration of any specific *chemical of concern* that warrants taking action to reduce occupant exposure, as published by *authorities having jurisdiction (AHJ)*.

2.3 acute hazard, n—Concerns of harmful effects from immediate or short-term exposure (e.g., ≤ 30 days).

2.4 active soil depressurization (ASD), n—A fan-driven system to create a vacuum in soils that is greater in strength than the vacuum applied to the soil by air pressures within the building. ASD systems include, but are not limited to, sub-slab depressurization (SSD), sub-membrane depressurization (SMD), and depressurization of non-habitable airspaces.

2.5 attenuation factor, n—Calculations for estimating indoor concentrations of soil gas hazards based on subsurface concentrations of *chemicals of concern*.

2.6 authority having jurisdiction (AHJ), n—Federal, state, province, township, or other jurisdictional body having authority over practices or products.

2.7 chemical of concern (COC), n—A chemical in vapor, liquid, or soil that has been identified at a site location to potentially pose health and safety hazards.

2.8 chemicals of concern (COCs), n—More than one *chemical of concern*.

2.9 chronic or continuous hazard, n—Repeated exposure by the oral, dermal, or inhalation route for more than approximately 10% of the life span in humans or repeated exposure events (e.g., ≥ 26 years) to somewhat higher concentrations to result in a similar degree of hazardous exposure.

2.10 hazardous soil gas, n—Soil gases and vapors regulated by the jurisdiction having authority due to toxic, flammable, or explosive hazards.

2.11 Jobsite logs, n—Records of actions taken or verification of compliance with standards or design features that may be recorded by staff, subcontractor staff, supervisors, third-party inspectors, or the *AHJ*.

2.12 mitigation, n—Reducing occupant exposure to indoor concentrations of airborne *radon* gas or other hazardous gases or vapors that enter a building with other soil gases or enter a building from water that is exposed to indoor air.

2.13 mitigation system, n—Any system designed to reduce indoor air concentrations of *radon* gas, *chemicals of concern* or other soil gas pollutants.

2.14 non-ASD, n—Mitigation methods that rely on passive methods, mechanical dilution or pressurization of indoor air, or cleaning of air or water. If used as stand-alone methods, non-ASD methods do not rely on *active soil* depressurization.

2.15 operation, maintenance, and monitoring (OM&M), n—The process of surveillance for continued operation and maintenance of installed components and performance measurements to verify continued low hazard conditions.

2.16 performance test, n—A test procedure to characterize the general degree of effectiveness for mitigation efforts within a specific area of a building.

2.17 picocuries per liter (pCi/L), unit of measurement— A unit of measurement for the amount of radioactivity in a liter of air. CONVERSION: 1.0 *pCi/L = 37 Bq/m^3*.

2.18 pressure field extension (PFE): The distance a pressure change, created by drawing soil-gas through a suction point, extends outward across a sub-slab gas permeable layer, under a membrane, behind a solid wall, or within a hollow wall.

2.19 radon (Rn), n—A colorless, odorless, naturally occurring, radioactive, inert gaseous element formed by radioactive decay of radium-226 (Ra-226) atoms. Its atomic number is 86. Although other isotopes of radon occur in nature, this document refers to radon gas Rn-222. Rn-222 is measured in picocuries per liter (pCi/L) or in Becquerel per cubic meter (Bq/m^3)

2.20 soil gas, n—Air within soil that can contain *radon* gas, *chemicals of concern*, or other hazardous gases or vapors.

2.21 soil gas vent system, n—A designed configuration installed during construction for soil gas venting that includes soil gas inlets within gas permeable layers adjoining the structure that connect to exhaust vent piping.

2.22 subchronic hazards, n—Repeated exposure by the oral, dermal, or inhalation route for more than 30 days up to approximately 90 days, or more than approximately 10% of the life span in humans.

SECTION 3 MEASURING CONCENTRATIONS AND AIR PRESSURE RELATIONSHIPS.

3.1 Measuring Radon Gas

Radon gas measurement events shall be conducted, as applicable to the building, in accordance with:

a) ANSI/AARST MAH: *Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes*; or

b) ANSI/AARST MA-MFLB: *Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial, and Mixed-Use Buildings*.

3.2 Measuring Chemicals of Concern (COCs)

3.2.1 *Measurement methods*

Measurement to characterize *COC* concentrations shall be conducted using one of the following methods:

a) EPA TO-15: EPA/600/4-90/010 1990 *Compendium of Methods for the Determination of Air Pollutants in Indoor Air*;

b) EPA TO-17: EPA/625/R-96/01b 1999 *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition*); or

c) Other existing or new methodology approved by the *AHJ*.

3.2.2 *Indoor air measurement*

Indoor measurements to characterize indoor *COC* concentrations shall be conducted in accordance with methods and procedures required in this Section 3.2.1 and in Normative Annex A.

3.2.3 *Soil gas measurements*

Measurement events that intend to characterize *COC* concentrations in soil gas shall be conducted in accordance with standard industry practices deemed acceptable to the *AHJ*.

3.2.4 *Characterization of COCs*

Where characterizing health risks from chemical vapor, measurements shall be conducted in accordance with requirements in a), b), c) and d) in this Section 3.2.4.

a) Measurements that provide a full suite for possible *COCs* concentrations in soil or groundwater in proximity to the building foundation shall be conducted or available for review.

   Exception: Where *COCs* are known based upon previous sampling or characterizations, a full suite of measurements for possible *COCs* concentrations is not required.

b) Where required by the *AHJ* or by contract, indoor measurements shall be conducted.

c) Based on measurements that included a full suite of possible *COCs* present in soil or groundwater, it is permissible to conduct future soil gas and indoor measurements that are limited to *COCs* identified as the primary or representative concern.

d) Additional lines of evidence, acceptable to the *AHJ*, shall be permitted for characterizing health risks. Additional measurements of tracer gases, such as *radon*, are among many examples.

3.3 Test Conditions

Test conditions during indoor air measurements and during air pressure measurements conducted for *performance testing* purposes shall be conducted and recorded in accordance with this Section 3.3.

3.3.1 *Test conditions for indoor air sampling of COCs*

Indoor air measurements for *COCs* shall be conducted under conditions required in Normative Annex A.

3.3.2 *Test conditions for air pressure measurements*

Additional test condition information shall be recorded when conducting air pressure measurements, in accordance with Normative Annex B.

3.3.3 *Record seasonal conditions*

For *radon* tests and sampling of indoor air for *COCs* and air pressure measurement events, Table 3.3.3 specifies information that shall be provided with reports of the event. The information provided shall compare test conditions to annual average conditions, as defined in a), b) and c) of this Section 3.3.3.

Table 3.3.3 ***Reporting Comparison of Building Operating Conditions*** * Required data

		Prevailing Annually	Prevailing During the Test
Outdoor Temperatures	*Average*	*Average annual outdoor temperature* *	*Average outdoor temperature during test* *
Operating Condition			
	Heating Conditions	*yearly percentage* *	*percentage during test* *
	Cooling Conditions	*yearly percentage* *	*percentage during test* *
	Mixed Conditions	*yearly percentage* *	*percentage during test* *
Prevailing Operating Condition			
	Average	*prevailing operating condition* *	*prevailing during test* *
Condition less likely to inhibit characterization of *radon* or soil gas hazard in indoor air		*conditions for clear characterization* *	*conditions during test* *
Water table (general status)			[ ] *average* [ ] *low* [ ] *high* *
All exterior windows and doors closed			[ ] *yes* [ ] *no* *
Indoor temperatures of between 65°and 80° F (18° - 27° C)			[ ] *yes* [ ] *no* *

a) Seasonal Changes in Building Operation (defined)

Outdoor temperature conditions that dictate the building operation condition at any point in time shall be used to estimate the percentage of time that each building operation condition occurs during a test or period of interest. Local conditions shall be estimated and recorded as follows.

1. Heating season conditions shall be based on durations when outdoor temperatures are less than 65°F (18° C).
2. Cooling season conditions shall be based on durations when outdoor temperatures exceed 83° F (28° C).
3. Mixed conditions, where neither heating nor cooling conditions prevail, shall be based on durations when outdoor temperatures are in the range of 65° F - 83° F (18° C - 28° C).
4. Coldest season shall be expressed based on the climate zone, as identified in Exhibit 3.4.

b) Annual Average Building Operating Conditions (defined)

The annual average building operating conditions shall be determined, in accordance with Exhibit 3.4, as the building operating conditions that prevail during the greatest amount of time each year.

Note—For conditions during the test:

The percentage of heating, cooling and mixed conditions during the test can be derived by matching the average outdoor temperature during the test to other climate zone annual average temperatures, as provided in Exhibit 3.4.

c) Seasonal Changes to Soil Permeability

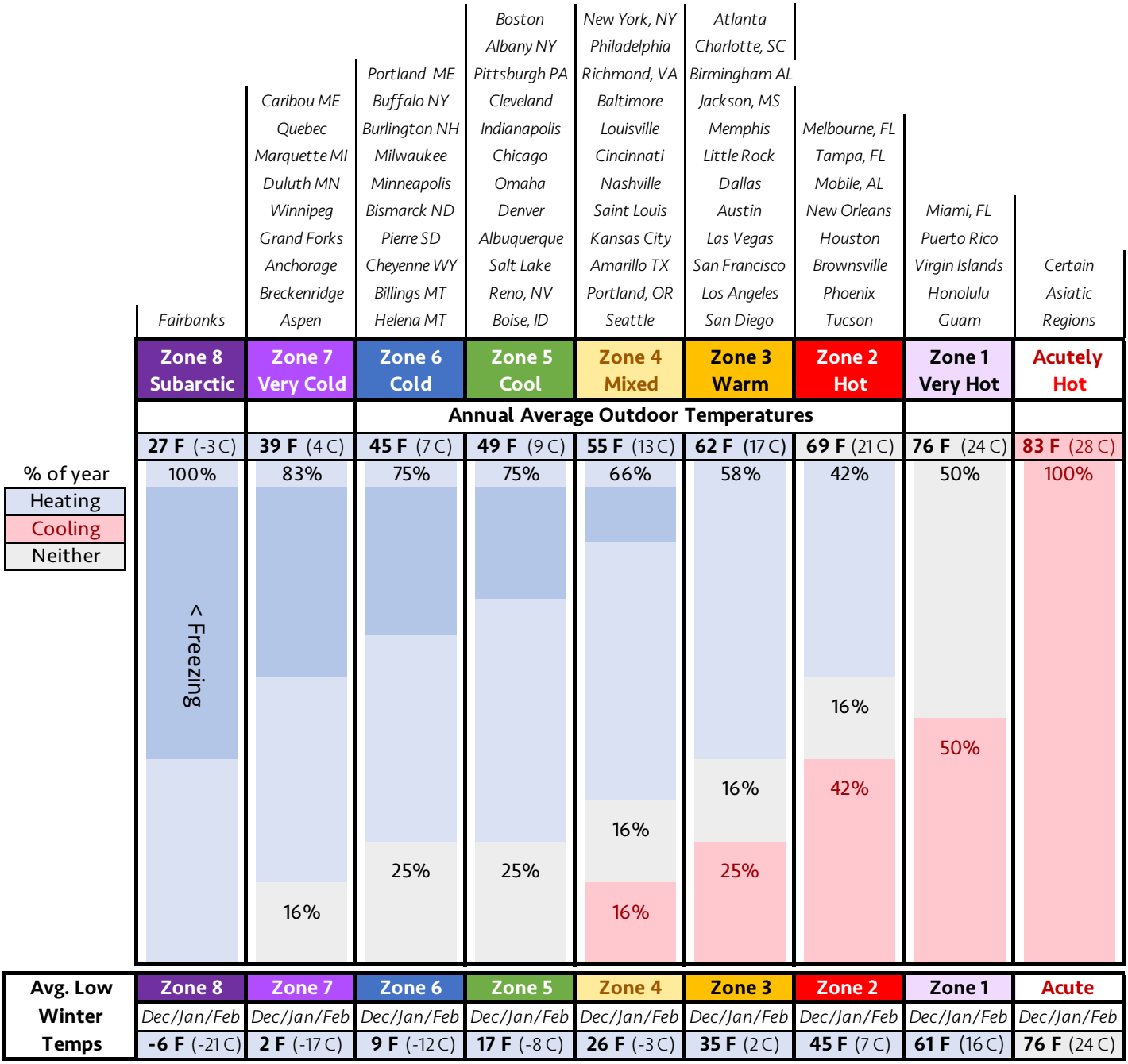
A general statement shall be recorded on whether the local water table is close to annual average elevations or if it is higher or lower than average. Based on observed current and recent weather events, the characterization shall be rendered as a general observation with consideration that:

1. Across extended periods when spring rainfall is plentiful and accumulated snow starts to melt, the water table commonly rises, and
2. An extended period of dry weather commonly causes the water table to fall.

Note—The WaterWatch website published by the United States Geological Survey (USGS) can provide current details relative to estimating local or regional water table status.

Exhibit 3.4 Seasonal Building Operating Conditions (By Climate Zone)

Informative advisory—While estimates can be made, it is not possible to predict worst case conditions based on a single *diagnostic* event or measurement. To know, one must test under conditions of concern.



Climate zone temperatures based on 30-year averages published online (e.g., the National Centers for Environmental Information-NOAA) for a major city located within each climate zone. Zone classifications reflect ASHRAE standards 90.1 / 90.2 (The American Society of Heating, Refrigerating and Air-Conditioning Engineers) https://www.ashrae.org

SECTION 4 INITIAL AND FOLLOW-UP ASSESSMENTS

4.1 Initial Assessment

Though *mitigation* efforts are not prohibited at any time, assessments, testing, and performance testing shall comply with Section 3. Where passive *mitigation* methods are included during construction of a building, measurements of indoor air shall be conducted prior to or within 90 days of occupancy.

4.2 Where Below Action Levels

Where decisions to not mitigate *radon* or vapor concentrations rely on indoor air measurements that have indicated occupant hazards are below the *action level*, testing shall be conducted again:

a) within 1 year after initial testing or assumption of *OM&M* duties, if tests have not been conducted under conditions that represent the predominant annual average building operating condition, as defined in Section 3.3.3 b;

b) no less than every 5 years, or as required by the *AHJ* for vapor intrusion; and

c) where testing is necessary due to a cause, as required in Table 4.5.

4.3 Decisions to Mitigate

Mitigation efforts shall be undertaken where measured concentrations equal or exceed the national *action level* for *radon* or the *action level* established by the *AHJ* for *COCs* until occupant hazard exposure is below the *action level.*

For *COC* vapor intrusion, decisions to mitigate are permitted to be based on any of the following evaluations relative to hazards attributable to soil gas entry:

a) Measurements of soil gas adjoining a building foundation with consideration for *attenuation factors* acceptable to the *AHJ*;

b) Measurements of indoor air confirmed to be coming from soil with consideration for action levels established by the *AHJ* and where required by the *AHJ*; or

c) Lines of evidence indicating that vapor intrusion hazards exceed the *action level* established by the *AHJ*.

4.4 Initial Post-Mitigation (Commissioning) Evaluation

4.4.1 *Initial mitigation effectiveness*

Mitigation efforts shall not be regarded as complete until an initial verification for *mitigation* effectiveness is achieved. Verification efforts shall meet requirements of a) or b) of this Section 4.2.1.

a) Radon Gas

Post-*mitigation radon gas* measurements shall be conducted in accordance with the applicable measurement standard listed in Section 3.1.

b) COC

Post-*mitigation COC* evaluations for *mitigation* effectiveness shall be conducted to include:

1. Air pressure measurements in soil relative to indoor air where *ASD* systems are employed and, where required by the *AHJ* or client, indoor air measurements;
2. Indoor air measurements where *non-ASD* methods are employed; and
3. Where used to make *mitigation* decisions, other lines of evidence to demonstrate *mitigation* effectiveness.

4.4.2 *Additional mitigation actions*

Whenever *mitigation* systems or methods are found to not reduce hazards to below the action level:

a) The *mitigation* efforts shall be evaluated by a trained and qualified *mitigation* professional, and

b) Additional *mitigation* efforts shall be undertaken until occupant exposure to the indoor air hazard is below the action level.

4.4.3 *OM&M manuals*

Where systems are not maintained by the owner/occupant of a home, a plan for *OM&M* shall be acquired from the *mitigation* contractor(s) or created by a qualified professional. The OM&M plan shall be embodied in an *OM&M* manual that complies with, or is updated to comply with, requirements in Normative Annex C. The *OM&M* manual shall be retained and updated with maintenance logs, records of repairs and measurement reports.

4.4.3.1 Ownership/Management Changes

Whenever the party responsible for system maintenance and monitoring changes to another party who is not the owner/occupant of the property:

a. The *OM&M* manual and logs shall be provided to the newly responsible party, and
b. Newly *responsible parties* shall update contact information on system labels.

4.5 Monitoring Due to Cause

Regardless of whether mitigation efforts have occurred or the type of mitigation method, procedures that comply with applicable portions of Section 3 shall be conducted as required in Table 4.5.

Table 4.5 Stewardship Monitoring Due to Cause

Procedures to verify continued low hazard conditions shall be conducted in conjunction with any sale of a building and after any of the following events occur:

- ✓ New adjoining additions, structures, or parking lots;
- ✓ Building reconfiguration or rehabilitation;
- ✓ A ground contact area not previously tested is occupied or a building is newly occupied;
- ✓ Heating or cooling systems are altered with changes to air distribution or pressure relationships;
- ✓ Ventilation is altered by extensive weatherization efforts;
- ✓ Sizable openings to soil occur due to:
  - — groundwater or slab surface water control systems or sewer lines are added or altered (e.g., sumps, drain tiles, shower/tub retrofits, etc.) or
  - — natural settlement causing major cracks to develop;
- ✓ Earthquakes, blasting, fracking, or formation of sink holes nearby; or
- ✓ An installed *mitigation* system is altered.

SECTION 5 SUBSEQUENT BUILDING CHARACTERIZATIONS

5.1 Seasonal Characterization

Within one year after *mitigation* efforts appear to meet *mitigation* goals, actions required in this Section 5 shall be taken to ensure *mitigation* effectiveness across seasons. These actions shall be taken by the party assuming stewardship obligations, unless already conducted and included in an OM&M manual.

5.1.1 *Characterizing seasonal effects*

Steps to characterize building hazards shall be based on expectations resulting from initial testing or assessments. Methods for verifying seasonal effectiveness shall include one or more methods identified in a) and b) of this Section 5.1.1.

a) Seasonal testing, as required in Section 5.2. Testing a full year duration is alternatively permissible for radon hazards if previous concentrations measured are less than twice the action level.

b) Seasonal or yearlong air pressure testing of indoor air relative to air within soils or, as applicable, air within adjoining indoor or outdoor air spaces.

5.2 Steps for Confirming the Degree of Hazard

Steps for seasonal characterizations shall include compliance with provisions in this Section 5.2. Though risk classifications are described herein, classifications of potential hazards, such as *chronic*, *subchronic*, or *acute* risk hazards shall be determined by or meet approval of the *AHJ*.

5.2.1 *Class 1 risk— Chronic or continuous risk*

Where radon testing has indicated less than 20 pCi/L (740 Bq/m^3), or where vapor intrusion assessments have indicated potential for harmful effects from continuous exposure to *COCs* across many years, seasonal building characterizations shall include not less than:

a. One *performance test* for indoor concentration or *pressure field extension (PFE)* test conducted under conditions that are representative of the predominant normal occupied building operating condition, as indicated in Exhibit 3.4, and

b. Another *performance test* for indoor concentration or *PFE* conducted under the alternate seasonal condition of longest annual duration.

The initial post-*mitigation* testing shall be allowed to qualify for one of the seasonal tests if representing a seasonal test condition required in this Section 5.2.1.

5.2.2 *Class 2 and 3 risk—Subchronic or acute risk*

Where radon testing has indicated 20 pCi/L (740 Bq/m^3) or greater, or where vapor intrusion assessments have indicated potential harmful effects from repeated exposure events to *COCs* for more than 30-days up to approximately 90-days, or across 10% of a life span, seasonal building characterizations shall include testing as required in Section 5.2.1, and:

a. Testing to evaluate the effects of changing water tables and precipitation where they occur for prolonged periods of weeks or months:

   1. when both heating season and lower *water tables* occur;
   2. when both heating season and capped soil, due to snow or ice occurs; and
   3. when high *water tables* occur that have the potential to impede system performance or transport *COCs* closer to the structure; and

b. Testing during an intermediate building operating condition under conditions that do not represent the two most predominant building operation conditions, as identified in Exhibit 3.4.

Exception: Where local seasonal weather conditions do not include the specific condition otherwise required to be evaluated in this Section 5.2.2. See informational Annex D.

SECTION 6: MONITORING TO VERIFY LONG-TERM MITIGATION EFFECTIVENESS

6.1 ASD Systems

Where active soil depressurization (ASD) systems are installed, ongoing validation of performance shall comply with this Section 6.1. Targeted monitoring periods shall include during building operating conditions known to render the system most vulnerable to compromised effectiveness.

6.1.1 *ASD in homes*

Where an ASD system is installed or found in a home, the applicable ongoing monitoring shall comply with Tables 6.1.1-A and 6.1.1-B.

Table 6.1.1-A **For Homes**
Ongoing Monitoring Methods and Frequency

ASD Systems	Radon
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify ASD fans are operating.
2. Mechanical Inspections 3. Indoor Air Measurements	Radon testing shall be conducted every 2 years to verify continued effectiveness. Prior to initiating the testing, inspections shall be conducted to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air.
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.5, indoor radon measurements shall be conducted.
Monitoring Relative to Risk	Where radon testing has indicated 20 pCi/L (740 Bq/m^3) or greater, radon testing shall be conducted annually.

Table 6.1.1-B **For Homes**
Ongoing Monitoring Methods and Frequency

ASD Systems	Vapor Intrusion
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify ASD fans are operating.
2. Mechanical Inspections	*Pressure field extension (PFE) performance testing* shall be conducted annually to verify continued effectiveness. Prior to initiating the *PFE* measurements, inspections shall be conducted to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air.
3. Air Pressure Measurements	
4. Indoor Air Measurements	Indoor air measurements shall be conducted as required by the *AHJ* relative to methods and frequency.
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.5, *PFE performance testing*, and indoor measurements where required, shall be conducted.
Monitoring Relative to Risk	Where assessments indicate exposure to COCs represent an *acute* hazard, a method shall be configured to achieve continuous monitoring of system operation

6.1.2 *ASD in larger buildings*

Where an ASD system is installed or found in a multifamily, school, commercial, or mixed-use building, the applicable ongoing monitoring shall comply with Tables 6.1.2-A and 6.1.2-B.

Table 6.1.2-A **For Multifamily, School, Commercial and Mixed-Use Buildings**
Ongoing Monitoring Methods and Frequency

ASD Systems	Radon
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify ASD fans are operating.
2. Mechanical Inspections 3. Indoor Air Measurements	Prior to initiating indoor air testing, inspections shall be conducted to verify appropriate functionality and integrity of components, including closure for openings between soil and indoor air.
	a) All buildings at the property shall be retested at least every 5 years in accordance with ANSI/AARST MA-MAMF *clearance test* procedures. b) After initial post-*mitigation clearance testing,* testing shall be conducted at approximately 2-year intervals (in between 5-year *clearance test* events) for all previously tested locations for mitigated areas. c) It is permitted to suspend 2-year interval testing for mitigate areas where the required effectiveness of a *mitigation* system has been verified for at least eight years, and such systems continue to be: 1. Visually inspected twice each year to verify fan operation, 2. Mechanically inspected at 2-year intervals to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air, and 3. *Clearance testing* procedures for all buildings at the property are conducted at least every 5 years.
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.3, indoor air measurements shall be conducted.
Monitoring Relative to Risk	Where radon testing has indicated 20 pCi/L (740 Bq/m^3) or greater, radon testing shall be conducted annually.

Table 6.1.2-B	**For Multifamily, School, Commercial and Mixed-Use Buildings** Ongoing Monitoring Methods and Frequency
ASD Systems	**Vapor Intrusion**
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify ASD fans are operating.
2. Mechanical Inspections	*Pressure field extension (PFE) performance testing* shall be conducted annually to verify continued system effectiveness. Prior to initiating the testing, inspections shall be conducted to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air.
3. Air Pressure Measurements	
4. Indoor Air Measurements	Indoor air measurements shall be conducted as required by the *AHJ* relative to methods and frequency.
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.5, *PFE performance testing* procedures, and indoor measurements where required, shall be conducted.
Monitoring Relative to Risk	Where assessments indicate exposure to COCs represent an *acute* hazard, a method shall be configured to achieve continuous monitoring of system operation.

6.2 Non-ASD Systems or Methods

Where non-ASD systems or methods are employed, ongoing validation of performance shall include all applicable provisions required in this Section 6.2. Targeted monitoring periods shall include during building operating conditions known to render the system most vulnerable to compromised effectiveness.

Note—*Non-ASD mitigation* methods are those that rely on:

a) passive methods,
b) mechanical dilution or pressurization of indoor air, or
c) cleaning of air or water.

6.2.1 *Non-ASD in homes*

Where a *mitigation* design that relies on *non-ASD* methods is implemented, installed, or found in a home, the applicable ongoing monitoring shall comply with Tables 6.2.1-A and 6.2.1-B.

Table 6.2.1-A **For Homes**
Ongoing Monitoring Methods and Frequency

Non-ASD Methods	Radon
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify system operation, control settings and general integrity of system components.
2. Mechanical Inspections	Radon testing shall be conducted every 2 years to verify continued system effectiveness. Prior to initiating the testing, inspections shall be conducted to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air. Exception: Where *mitigation* methods include mitigating *radon* or chemical contaminants from water supplies, biennial measurements shall include measurements of contaminants in water*. Where determined to be the only *mitigation* method needed, indoor air testing is not required.
3. Indoor Air Measurements	
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.5, indoor measurements shall be conducted.
Monitoring Relative to Risk	Where radon testing has indicated 20 pCi/L (740 Bq/m^3) or greater, radon testing shall be conducted annually.

* Measurements of *radon* in water that enters a dwelling through groundwater supplies, such as a well, shall be conducted in compliance with ANSI/AARST MW-RN *(Protocol for the Collection, Transfer and Measurement of Radon in Water)*

Table 6.2.1-B	**For Homes** Ongoing Monitoring Methods and Frequency
Non-ASD Methods	**Vapor Intrusion**
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify system operation, control settings and general integrity of system components.
2. Mechanical Inspections	Indoor air measurements of *COCs* shall be conducted annually, or as required by the *AHJ,* to verify continued effectiveness. Prior to initiating the testing, inspections shall be conducted to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air.
3. Indoor Air Measurements	
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.5, indoor measurements shall be conducted.
Monitoring Relative to Risk	Where assessments indicate exposure to COCs represent an *acute* hazard, a method shall be configured to achieve continuous monitoring of system operation.

6.2.2 *Non-ASD in larger buildings*

Where a *mitigation* design that relies on *non-ASD* methods is implemented, installed, or found in a multifamily, school, commercial, or mixed-use building, the applicable ongoing monitoring shall comply with Tables 6.2.2-A and 6.2.2-B.

Table 6.2.2-A **For Multifamily, School, Commercial and Mixed-Use Buildings**
Ongoing Monitoring Methods and Frequency

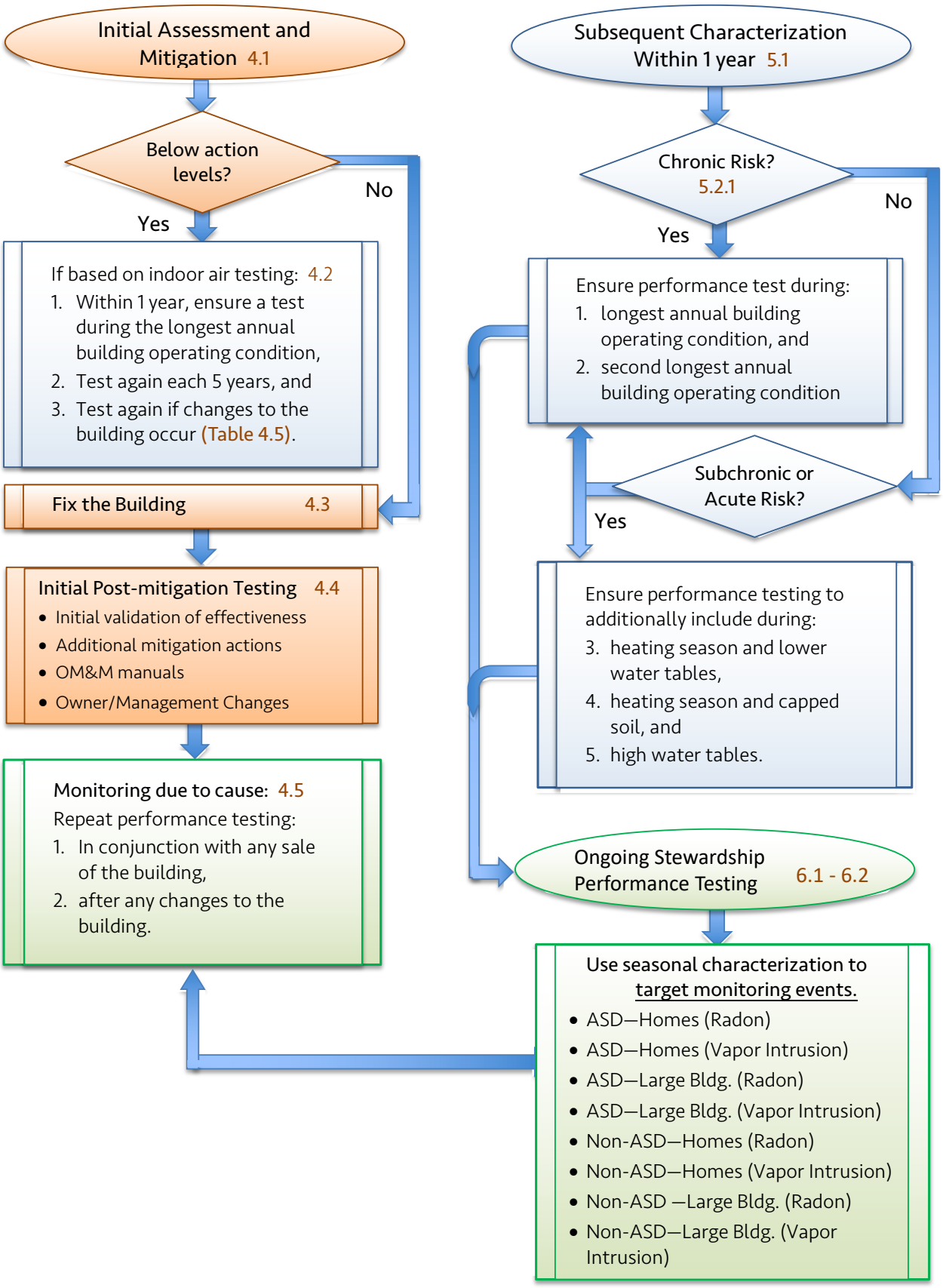
Non-ASD Methods	Radon
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify system operation, control settings and general integrity of system components.
2. Mechanical Inspections 3. Indoor air Measurements	Prior to initiating indoor air testing, inspections shall be conducted to verify appropriate functionality and integrity of components, including closure for openings between soil and indoor air. a) All buildings at the property shall be retested at least every 5 years in accordance with ANSI/AARST MA-MAMF *clearance test* procedures. b) After initial post-*mitigation clearance testing,* testing shall be conducted at approximately 2-year intervals (in between 5-year *clearance test* events) for all previously tested locations for mitigated areas. c) It is permitted to suspend 2-year interval testing for mitigate areas where the required effectiveness of a *mitigation* system has been verified for at least eight years, and such systems continue to be: 1. Visually inspected quarterly to verify fan operation, 2. Mechanically inspected at 2-year intervals to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air, and 3. *Clearance testing* procedures for all buildings at the property are conducted at least every 5 years. Exception: Where *mitigation* methods include mitigating *radon* or chemical contaminants from water supplies, biennial measurements shall include measurements of contaminants in water. Where determined to be the only *mitigation* method needed, indoor air testing is not required.
Monitoring Due to Cause	Whenever changes to the building occur, as specified in **Table 4.5**, indoor measurements shall be conducted.
Monitoring relative to risk	Where radon testing has indicated 20 pCi/L (740 Bq/m^3) or greater, radon testing shall be conducted annually.

* Measurements of *radon* in water that enters a dwelling through groundwater supplies, such as a well, shall be conducted in compliance with ANSI/AARST MW-RN *(Protocol for the Collection, Transfer and Measurement of Radon in Water)*

Table 6.2.2-B	**For Multifamily, School, Commercial and Mixed-Use Buildings** Ongoing Monitoring Methods and Frequency
Non-ASD Methods	**Vapor Intrusion**
1. Functionality Inspections	Not less than annually, visual inspections or remote monitoring shall verify system operation, control settings and general integrity of system components.
2. Mechanical Inspections	Indoor air measurements of *COCs* shall be conducted annually, or as required by the *AHJ,* to verify continued effectiveness. Prior to initiating the testing, inspections shall be conducted to verify appropriate functionality and integrity of system components, including closure for openings between soil and indoor air.
3. Indoor air Measurements	
Monitoring Due to Cause	Whenever changes to the building occur, as specified in Table 4.5, indoor measurements shall be conducted.
Monitoring relative to risk	Where assessments indicate exposure to COCs represent an *acute* hazard, a method shall be configured to achieve continuous monitoring of system operation

6.3 Procedural Summary Flowchart (Informative)

Note—This exhibit provides an informational overview for the flow of stewardship procedures.



6.4 Informative Summary of Ongoing Stewardship Events

Note—Exhibit 6.4 provides a summary of methods and frequency of stewardship events for different situations.

Exhibit 6.4 **Informative Summary of Ongoing Stewardship Events**

Table	System Type	Building Type	Hazard	Verify System Operating	Inspect System Components	Conduct Performance Testing
6.1.1-A	ASD	Homes	Radon	Yearly	Prior to Initiating Tests	Radon test every 2 years.
6.1.1-B	ASD	Homes	Vapor	""	""	PFE verification yearly. Indoor air test as required.
6.1.2-A	ASD	Lg. Bldg.	Radon	""	""	Radon tests at ~2 yrs in between "Clearance" testing every 5 years.
6.1.2-B	ASD	Lg. Bldg.	Vapor	""	""	PFE verification yearly. Indoor air test as required.
6.2.1-A	Non-ASD	Homes	Radon	Yearly	Prior to Initiating Tests	Radon Test every 2 yrs.
6.2.1-B	Non-ASD	Homes	Vapor	""	""	Indoor Air Test yearly.
6.2.2-A	Non-ASD	Lg. Bldg.	Radon	""	""	Radon tests at ~2 yrs in between "Clearance" testing every 5 years.
6.2.2-B	Non-ASD	Lg. Bldg.	Vapor	""	""	Indoor Air Test yearly.

Note 1—Additional performance tests specified in Table 4.5 are required relative changes that can occur to buildings.

Note 2—Additional performance tests may be required relative to the degree of health hazards as specified in Sections 6.1 and 6.2

SECTION 7: DECOMMISSIONING VAPOR INTRUSION MITIGATION AND STEWARDSHIP

Note—In certain instances, the source of hazardous soil gas can be found to have migrated away from a building or concentrations found to be depleted. This can occur either naturally or because of remediation and related efforts. In such circumstances, considerations can include discontinued operation of soil gas *mitigation* systems and ongoing stewardship.

7.1 Decommissioning Systems

Before permanent discontinued operation of soil gas *mitigation systems* and ongoing stewardship, requirements in Sections 7.1.1 through 7.1.4 shall be met.

Exception: These steps are not applicable to soil vapor extraction (SVE) systems unless the SVE system is also designed to function as a soil gas *mitigation system*.

7.1.1 *Step 1—Source remediation*

With the *mitigation* system(s) still operating, it shall be demonstrated that the applicable groundwater or soil sources have been remediated to the satisfaction of the *AHJ*.

7.1.2 *Step 2—Vapor evaluation*

With the *mitigation* system(s) still operating, measurements of the COCs shall be conducted to verify source remediation using procedures approved by the *AHJ*.

Note—As an example, procedures might entail concentration measurements of vapor within the headspace of sumps that contain groundwater and within ASD exhaust piping.

7.1.3 *Step 3—Checks for rebound*

Where demonstration of source remediation has been confirmed by measurements of vapor concentrations, the system can now be temporarily deactivated for evaluations to demonstrate if vapors rebound to unacceptable concentrations over time. The duration for continued sampling events, that may include accommodating seasonal evaluations, shall meeting the approval of the *AHJ*.

7.1.4 *Step 4— Decommissioning*

Discontinued operation of the soil gas *mitigation systems* and ongoing stewardship requires approval of the *AHJ*.

7.2 Property Owner Guidance

The property owner shall be notified in writing that the *mitigation system* is being decommissioned not less than 60 days in advance of permanently deactivating or removal of the *mitigation system* and cessation of OM&M procedures. The notice shall include the following or equivalent message:

> "Continued use and maintenance of the *mitigation system(s)* may be valuable for maintaining improved indoor air quality and protection from other soil gas hazards, such as *radon* gas."

7.2.1 A copy of the OM&M manual shall accompany the notification as updated to include historic data relative to initial purpose and demonstration of evidence used to determine that deactivation is warranted.

Normative Annex A

INDOOR AIR TESTING FOR COCs

A-1 Before Testing

A-1.1 *Prior Notification*

Because failure to comply with required conditions often occurs when residents are not properly informed about the necessary test conditions, procedures for notification shall comply with requirements in a) and b) of this Section A-1.1.

a) Information about test conditions required in Section A-4 shall be communicated to the person responsible for the building not less than 24 hours prior to deployment of air sampling devices.

b) Communications to clients or parties responsible for the property shall include essential elements required for compliance with closed-building protocols.

A-1.2 *Adverse VOC influences*

To minimize the influence on test results due to chemical vapors off-gassing from residual buildup within building materials, furniture, or from stored cleaning fluids or products, notifications and onsite review shall comply with requirements in a) and b) of this Section A-1.2.

a) Stored Chemicals
Efforts to reduce influences on test results, such as chemicals contained in household cleaning products and other stored chemicals shall be conducted, and documented.

b) After *Mitigation* or Alteration
Prior to evaluation of initial effectiveness after activation of a *mitigation system* fan or completion of other *mitigation* efforts, two conditions shall be addressed:

1. Valid test periods relative to existing indoor air concentrations begin no sooner than 24 hours after activation or completion of *mitigation* efforts; and
2. Valid test periods begin no sooner than 12 hours after initiating closed-building conditions.
Note—In absence of active mechanical air distribution, due to heating, ventilation, and air conditioning (HVAC) design or mild outdoor weather, closed-building conditions that extend to 24 hours or longer prior to sampling events may be advised.

A-2 Ground-Contact COC Test Locations

Indoor air testing procedures for *COCs* shall include targeting dwellings and nonresidential rooms that are occupied, or intended to be occupied, and that:

a) have floors or walls in contact with the ground, and

b) are closest to ground over untested ground-contact locations, to include the lowest level of the building over a crawl space, utility tunnel, parking garage or other non-habitable space that is in contact with ground.

A-2.1 *Ground-contact dwellings*

For ground-contact dwellings or living units, indoor air testing procedures for *COCs* shall include targeting the lowest level that serves or could serve as a living area, sleeping quarters, office, playroom or otherwise be occupied for residential use at some time in the future.

A-2.2 *Non-residential ground-contact locations*

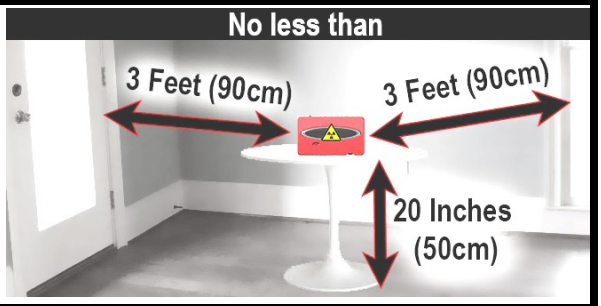
For non-residential ground-contact locations, indoor air testing procedures for *COCs* shall include targeting ground-contact rooms, offices, classrooms, and other general use areas that are occupied or intended to be occupied.

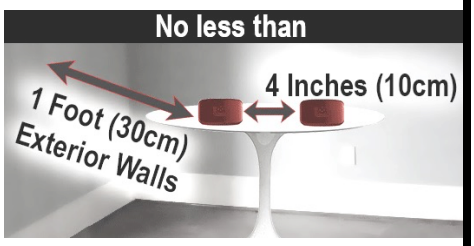
A-3 Choosing A Location Within a Room

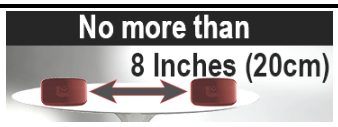
Air sampling devices and detectors for measuring *COCs* shall be placed in accordance with Table A-3.

Note—As overall guidance, place air sampling devices and detectors in the general breathing zone.

<table>
<tr><th>Table A-3</th><th colspan="2">Requirements for Test Locations Within a Room</th></tr>
<tr><td rowspan="4">Air sample collection devices shall be located NOT less than:</td><td colspan="2">▪ 3 feet (90 cm) from exterior doors and windows or other potential openings to the outdoors.</td></tr>
<tr><td colspan="2">▪ 20 inches (50 cm) above the floor.</td></tr>
<tr><td colspan="2">▪ 1 foot (30 cm) from the exterior wall of the building.
▪ 1 foot (30 cm) below the ceiling.
▪ 4 inches (10 cm) from other air sample collection devices and objects or surfaces that are above or to the side of the detector.</td></tr>
<tr><td colspan="2">Exception: Less than 4 inches (10 cm) is permitted for detectors that are not affected by nearby proximity to other objects. Confirm manufacturer or laboratory requirements or recommendations prior to exercising this exception.</td></tr>
<tr><td>Side-by-side samples</td><td colspan="2">Sample collection devices are to be not more than 8 inches (20 cm) from each other when seeking to use the average test result of two samples for QC checks and mitigation decisions.</td></tr>
<tr><td>Where not easily disturbed</td><td colspan="2">Informative Advisory—Select a position within the room where the devices are unlikely to be disturbed, moved, or have their performance altered during the measurement period.</td></tr>
<tr><td rowspan="4">Air sample collection devices shall NOT be located:</td><td colspan="2">▪ inside closets, cabinets, drawers, sumps, crawl spaces or nooks in the building foundation.</td></tr>
<tr><td colspan="2">▪ near heat sources, such as on appliances, radiators, fireplaces or in direct sunlight.</td></tr>
<tr><td colspan="2">▪ near drafts caused by fans or heating and air conditioning vents or within enclosed areas of high air velocity such as mechanical/furnace closets.</td></tr>
<tr><td colspan="2">▪ within enclosed areas that accumulate high humidity, such as bathrooms, laundry rooms and kitchens that are isolated by partitions and doors from adjoining less humid areas.
Exception: Where regularly occupied by workers for essential tasks, such as for cafeteria food preparation. Testing in such locations requires detector types that are virtually unaffected by high humidity which is to be confirmed by the manufacturer or laboratory prior to exercising this exception.</td></tr>
</table>







A-4 Test Conditions—Closed-building protocol

A-4.1 Closed-building conditions, much as they are for occupied conditions in heating seasons or summer cooling seasons, are required. Closed-building conditions compliant with Tables A-4: A, B, and C, and Sections A-4.2 and A-4.3 are required to be:

a) initiated 12 hours prior to the test for tests lasting less than 72 hours, and

b) maintained throughout the test period for tests lasting up to 90 days.

Table A-4: A ESSENTIAL CLOSED-BUILDING PROTOCOL REQUIREMENTS	
Windows	Keep closed on all levels of the building including areas not being tested
Exterior doors (except for momentary entry and exit)	
Heating and cooling systems	Set to normal occupied operating conditions with normal temperatures between 65˚and 80˚ F (18˚ - 27˚ C)
Systems that temporarily ventilate with outdoor air for seasonal comfort or energy savings	Set to the lowest seasonal ventilation
Bathroom fans	Operate normally
Exhausts Systems (that temporarily draw air from the building such as from laundries, workshops, community kitchens or for local control of fumes)	Avoid excessive operation
Fireplaces (that burn solid, liquid or gas fuels unless a primary/normal source of heat for the building)	Do not operate

Table A-4: B ADDITIONAL REQUIREMENTS FOR NEW CONSTRUCTION, RENOVATIONS AND REPAIRS	
All openings to the exterior (due to incomplete construction, structural defect, or disrepair)	These openings to the exterior shall be closed or sealed at least 12 hours prior to initiating the test
Heating/cooling systems active and set to a normal occupiable temperature	These items shall be completed or installed at least 12 hours prior to initiating the test
All windows and exterior doors installed with hardware and seals	
All insulation and exterior siding	
All wall and ceiling coverings to be completed including interior drywall or paneling but does not include decorative finishing of walls, floors, or ceilings	
All fireplaces and fireplace dampers installed	

Table A-4: C ADDITIONAL CLARIFICATION ON CLOSED BUILDING PROTOCOL REQUIREMENTS FOR SPECIFIC COMPONENTS	
Windows and Doors on all levels of the building including areas not being tested	
Broken windows or doors	Seal closed
Interior partition or stairway doors	Operate normally
Exterior doors into non-residential rooms	Keep closed (except for momentary entry and exit of individuals who customarily enter the building)
Garage doors and doors leading into a garage	Keep closed (except for momentary entry and exit).
Small Appliances	
Ceiling fans and portable fans	Do not blow fans directly towards testing devices
Window fans	Remove or seal shut and do not operate
Humidifiers and dehumidifiers	Operate normally
Crawl Spaces	
Passive crawl space vents	Set vents to the condition that prevails during the greatest amount of time each year
Crawl space humidity control systems	Operate normally
Mechanical Systems	
Passive vents for combustion air makeup	Leave open
Combustion appliance fans	Operate normally
Fans installed in attics to ventilate only attic air	
Window air conditioners	Operate in recirculation mode only
Evaporative cooling systems	Do not operate and do not cover

A-4.2 *HVAC ventilation*

A-4.1.1 Outside Air for Combustion Appliances

Openings to outside air designed to provide air needed for combustion appliances shall not be closed.

A-4.1.2 Ventilation with Outside Air

Where heating, ventilation, and air conditioning (HVAC) operation or design includes temporarily increasing outdoor air ventilation for seasonal comfort or energy savings, outside air inlet dampers shall be configured to provide only the minimum volume of outdoor air that is needed at all times of the year when the building or unique sector is significantly occupied.

Note—Further descriptions are provided in Annex D for Group 3 HVAC systems.

A-4.1.3 Temperature Control Via Air Volume

For variable air volume (VAV) systems that temper room temperatures using thermostats to vary the volume of heated or cooled air coming into rooms, thermostats shall be set to a normal occupied temperature in all portions of the building being tested that are served by the system.

Note—Further descriptions are provided in Annex D for Group 4 HVAC systems.

A-4.3 *Individual dwellings or rooms in a shared building*

When testing only one or several dwellings or rooms that are part of a shared building, such as an individual apartment, classroom or office, minimum requirements include closed-building conditions in accordance with this Section A-4 for dwellings and non-residential enclosed rooms:

a) immediately adjoining above and below the test location(s), and

b) on all floors directly below test location(s) that are 3 stories or less above grade.

A-5 Minimum Requirements for Efforts to Verify Test Conditions

A-5.1 To fulfill minimum requirements for verifying test conditions, all following steps are required:

a) Inform the person responsible for building operation of the required test conditions.

b) Post notification of an "Air Test in Progress" in conspicuous locations stating the required conditions of the test.

c) Request a signature on a noninterference agreement and note in the report if this document was not signed.

d) Conduct Visual Inspections.

Visual inspections of the dwelling that evaluate observed conditions and document deviations from protocol and temporary conditions that might affect the test result shall be conducted:

1. upon placement of air sampling devices to help ensure all closed-building conditions and other protocol requirements are met; and
2. upon retrieval of air sampling devices to help verify that:
    a. closed-building conditions and other protocol requirements are still being maintained;
    b. air sampler placement has not changed; and
    c. tamper seals, if employed, have not been broken.

A-5.2 *Surveillance not required*

It is not required to inspect for closed-building conditions during the 12-hour period prior to the test or between placement and retrieval of the detectors.

A-5.3 *Quality control of test conditions*

Test conditions, as specified in Table 3.3.3, shall be recorded, and retained in *OM&M* manual records. Additional quality control steps shall be permitted where deemed warranted by parties responsible for testing quality, such as extended periods between *mitigation* and initial post-*mitigation performance testing* or routine surveillance for compliance with test conditions.

Normative Annex B

AIR PRESSURE TESTING

B-1 PFE / Performance Test Conditions

Pressure measurements of indoor air relative to air within soils or, as applicable, air within adjoining indoor or outdoor air spaces are permitted for *performance testing ASD mitigation systems* and other *mitigation* methods that manipulate air pressure relationships to reduce the volume of soil gas entering a building.

B-1.1 *Locations*

A minimum of one differential pressure measurement shall be made at a location distant from the ASD suction point(s) with intent to evaluate if depressurization has been achieved or is being maintained within each targeted soil gas collection plenum.

B-2 Non-ASD

Performance testing *non-ASD mitigation* methods shall include air differential pressure measurements where required by national standards, OM&M plans or *AHJ*, for *mitigation* methods that rely on mechanical systems to manipulate air pressure to achieve *mitigation* goals.

B-3 Jobsite Logs

Jobsite logs for each pressure measurement event shall be retained in OM&M manual records that include:

a) The status of heating, cooling, or mixed HVAC operating conditions, at the time when conducting *PFE* or other air pressure *performance testing*;
Note—Differing HVAC operating conditions can alter and create false assumptions regarding PFE and other air pressure *performance testing* results.

b) Whether this testing was conducted, as is recommended:
   1. with all exterior windows and doors, including garage doors, closed; and
   2. with normal occupied indoor temperatures of between 65˚and 80˚ F (18˚ - 27˚ C);

c) The duration prior to this testing that closed-building conditions prevailed.
Note—Closed conditions for one or more hours is recommended prior to air pressure testing; and

d) Seasonal comparison data, as specified in Section 3.3.

Normative Annex C

WRITTEN OM&M MANUALS

C-1 Essential Content

The *OM&M* manual is to prominently include essential information specified in items a) through e) of this Section C-1:

a) The date of installation;

b) Maintenance and monitoring instructions, to include:

1. A description of system monitors and actions to take if system monitors indicate system degradation or failure; and
2. A recommendation to verify continued system effectiveness at regular intervals that comply with this standard;

c) Resources for credible health guidance at state, provincial, federal, or other authority; and

d) Contact information for service inquiries.

e) Identify soil gas concerns and guidance.

1. Should no *radon* testing reports be available for inclusion in historical information, the following or equivalent guidance shall be provided:

> "We have no recent test reports or otherwise reliable evidence that radon testing has been conducted. Note—Any building on any parcel of land can have a radon problem. Radon concentrations cannot be predicted based on state, local or neighborhood radon measurements. Testing indoor air for radon is the only way to know."

2. Should no testing reports relative to *COCs* be available for inclusion in historical information, the following or equivalent guidance shall be provided:

> "We have no recent test reports or otherwise reliable evidence that chemical vapor testing has been conducted. Note—Should there be reason for concern, contact your state health department for further information."

C-2 System Description

The *OM&M* manual is to include information regarding *mitigation systems* and methods as specified in items a) through e) of this Section C-2:

a) System components and sealed components labeled on a floor plan sketch or portrayed in narrative that describes system components and locations.

b) Basic operating principles;

c) Fan equipment model(s) and startup parameters, including system monitor pressure gauge readings and any control settings that existed at the time *mitigation* goals were achieved.

d) Adverse or extenuating circumstances
A description of important observations that have potential to adversely affect the *mitigation* system(s) or other building systems; and

e) Warranty/Guarantees
Information regarding warranties, guarantees and related conditions or limitations.

C-3 Stewardship Instructions

The *OM&M* manual is to provide stewardship guidance and instructions that include:

a) A general statement regarding stewardship obligations;

b) Instructions to update contact information on system labels when the party responsible for system maintenance and monitoring changes; and

c) Instructions that stewardship obligations require correction and repair of any conditions that are found to indicate component failure or inconsistencies in operating parameters.

C-4 Historical Information

The OM&M manual is to provide a summary of the pre-and post-*mitigation* investigation(s) and if available, pre-, and post-*mitigation* test data.

C-5 System Components

The *OM&M* manual is to provide detailed operating instructions and information on essential to maintain *mitigation* equipment and components, to include:

a) Manufacturer model numbers for fans and essential equipment;

b) Instructions on equipment and manufacturer instructions where applicable to operation and maintenance;

c) Locations of fans, fan monitors, electronic telemetry/monitoring equipment, permanent test ports, electrical disconnects and other components unique to the system;

d) Descriptions on how to interpret labels and annotations relative to control settings and other designed operating parameters for the equipment; and

e) A list of common maintenance and repair tasks associated with the system, such as:

1. Fan and fan monitor replacement or repair;
2. Duct pipe connections; and
3. Sealing and closure of openings between soil and indoor air.

C-6 Maintenance Inspection Checklists

OM&M manuals is to provide instructions regarding maintenance inspections, in accordance with requirements in a) and b) of this Section C-6.

a) Visual Operational Inspection Checklist
The OM&M manual is to define a list of items that are to be visually inspected on a frequent basis to verify continued operation of fans and other mechanical components, such as system monitors, controls, labels, vents, and filters.

b) Mechanical Inspection Checklist
The *OM&M* manual is to define a list of equipment to inspect when conducting mechanical performance inspections that include:

1. Performance indicators, labels, and fan operation;
2. Seals, straps, fasteners, fan boots, pipe connections, and any permanent PFE test ports;
3. Electrical components (including switch, GFCI or disconnect operation); and
4. Other related building systems, as applicable, such as sump pumps and combustion appliances.

INFORMATIVE ANNEX D

SEASONAL TESTING GUIDANCE

(As illustrated to account for most of the varied climate zones across the Northern Hemisphere)

Seasonal confirmation is required within the first-year low hazards are indicated by initial or post-*mitigation performance testing*. Seasonal conditions are defined in Section 3.4.3.

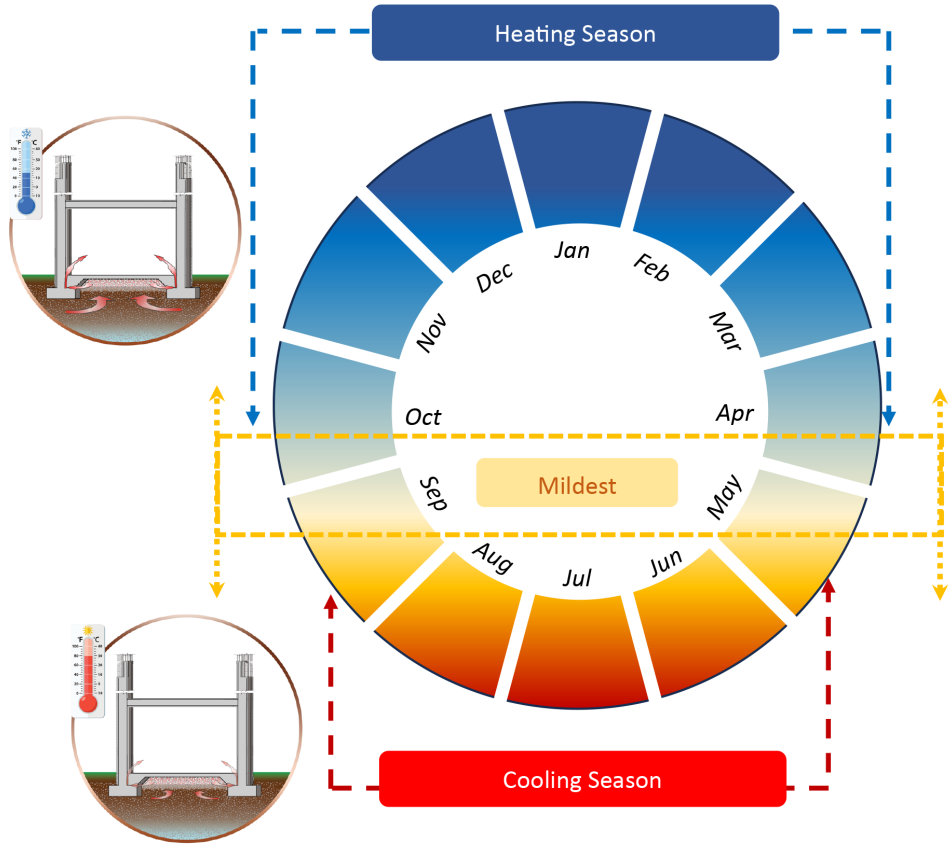
* Per Section 4.3 (Low Indoor Measurement), an additional indoor test is required if the initial tests have not been conducted under conditions that represent the predominant normal occupied building operating condition, as identified in Exhibit 3.4.

* Per Section 5 (Seasonal Confirmatory Characterization), provision 5.2.1 (Class 1 risk—*Continuous or chronic*) which is relative to most *radon* and vapor intrusion concerns requires:

    a. One indoor concentration or *pressure field extension (PFE)* test conducted under conditions that are representative of the predominant normal occupied building operating condition, as indicated in Exhibit 3.4, and

    b. Another test for indoor concentration or *PFE* conducted under the alternate seasonal condition of longest annual duration.

  Initial post-*mitigation* testing can be counted if representing a seasonal test condition required.



* Per Section 5 (Seasonal Confirmatory Characterization), in 5.2.2 (*Class 2 and 3 risk—Subchronic or Acute):*

a. Testing during an intermediate building operating condition under conditions that do not represent building the two most predominant building operation conditions, as identified in Exhibit 3.4.

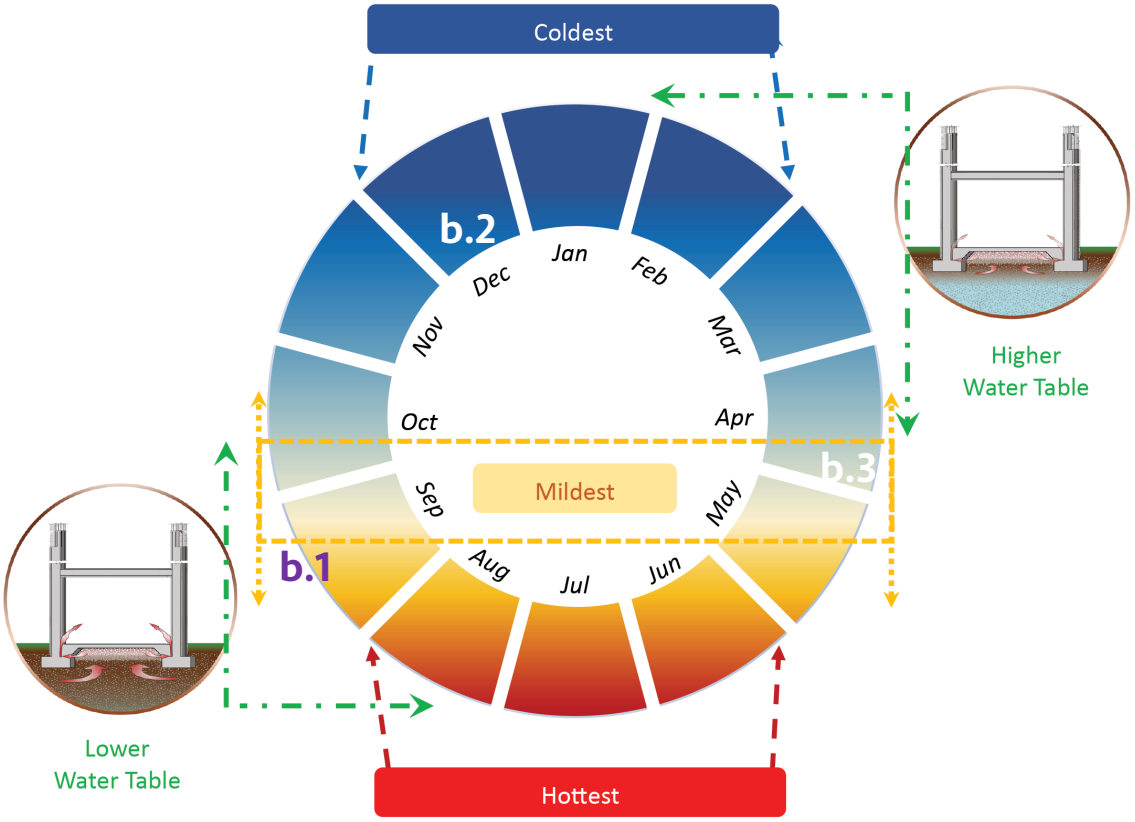
b. Testing to evaluate the effects of changing water tables and precipitation where they occur for prolonged periods of weeks or months:

1. when both heating season and lower *water tables* occur;
2. when both heating season and capped soil, due to snow or ice occurs; and
3. when high *water tables* occur that have the potential to impede system performance or transport *COCs* closer to the structure.

Exception: A specific condition where local seasonal weather conditions do not include the specific condition otherwise required to be evaluated in this Section 5.2.3.

Note 1—Additional testing to comply with **a.** is conducted under conditions that do not represent building the two most predominant building operation conditions.

Note 2—Tests required for **b.** are illustrated below for approximate times year in most climate zones.



INFORMATIVE ANNEX E

HVAC GROUP DESCRIPTIONS

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

Advisory—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 dwelling or unique area that does not provide seasonally variable outdoor air ventilation for added comfort or energy savings. • **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 dwelling or unique sector.	Test each unique sector or HVAC zone
Group 3: Variable Outdoor Air Ventilation HVAC systems that temporarily vary outdoor air ventilation for seasonal comfort or energy savings in: - individual dwellings; - multiple dwellings; or - the whole building. Such systems include those known as: Energy Economizer systems, Energy Recovery Ventilators (ERV) and Evaporative (swamp) cooling systems.	Set to provide only the minimum volume of outdoor air that is needed at all times of the year
Group 4: Variable Air Volume Distribution HVAC 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.	Set all thermostats and controls to occupied temperature conditions

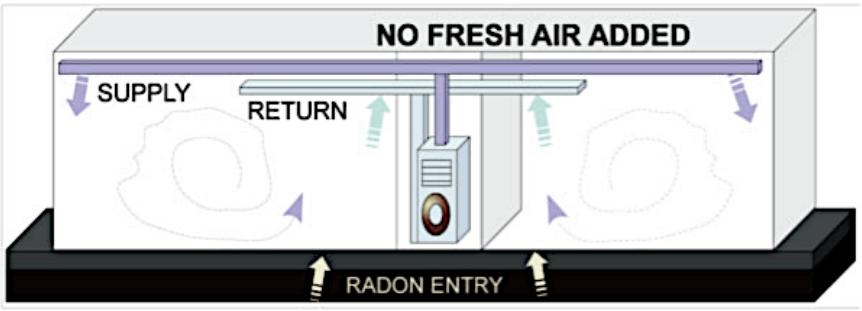
HVAC GROUP DESCRIPTIONS

Group 1: BASIC HEATING AND COOLING (HAC)

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

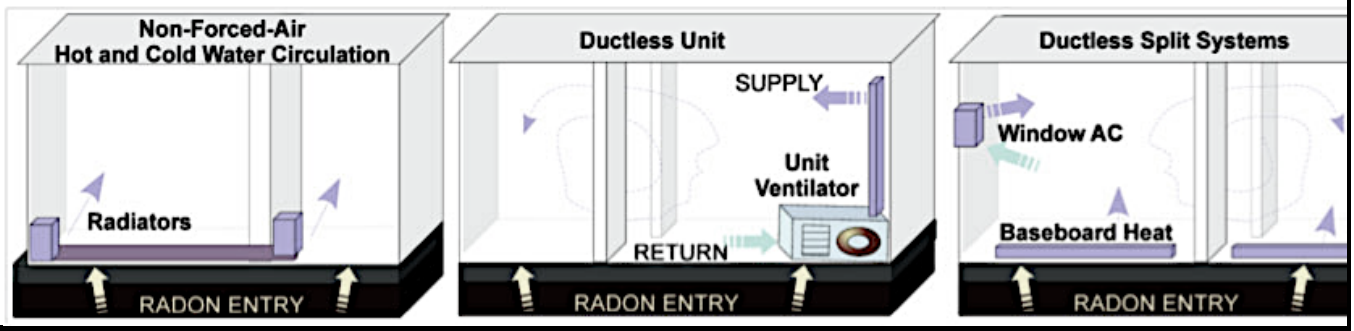
HAC Systems:
Many buildings have forced-air heating and air conditioning (HAC) systems.

Supply and return ducts distribute air around the building.



Ductless Systems:
Some rooms or dwellings do not have ducted forced-air distribution.

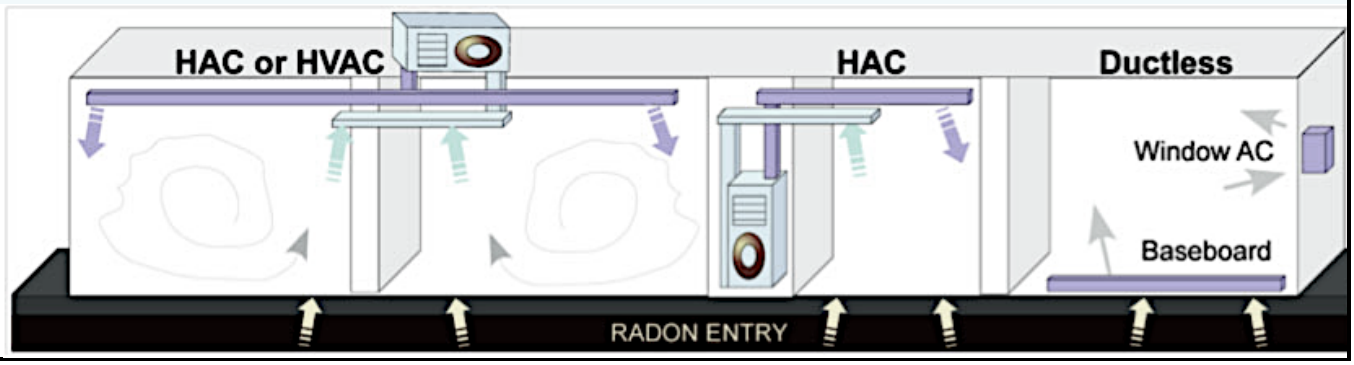
- Hot and Cold-Water Circulation (sometimes referred to as "radiator" systems).
- Window Air Conditioners.
- Wall or Baseboard Heating/Cooling Systems.
- Ductless Split Systems with one unit for cooling and another unit for heat (i.e., Window AC for cooling and Baseboard or Wall units for heat).



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 dwelling or common use area of a building.

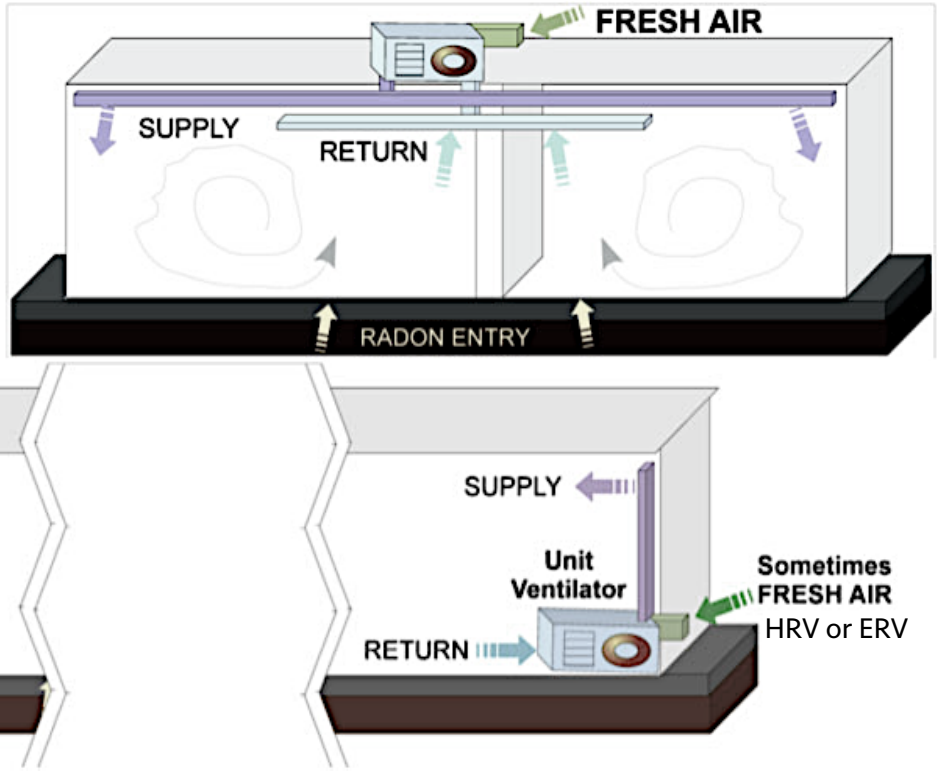
Radon and vapor concentrations can vary from room to room based upon variances in system operations.



Group 3: VARIABLE OUTDOOR AIR VENTILATION

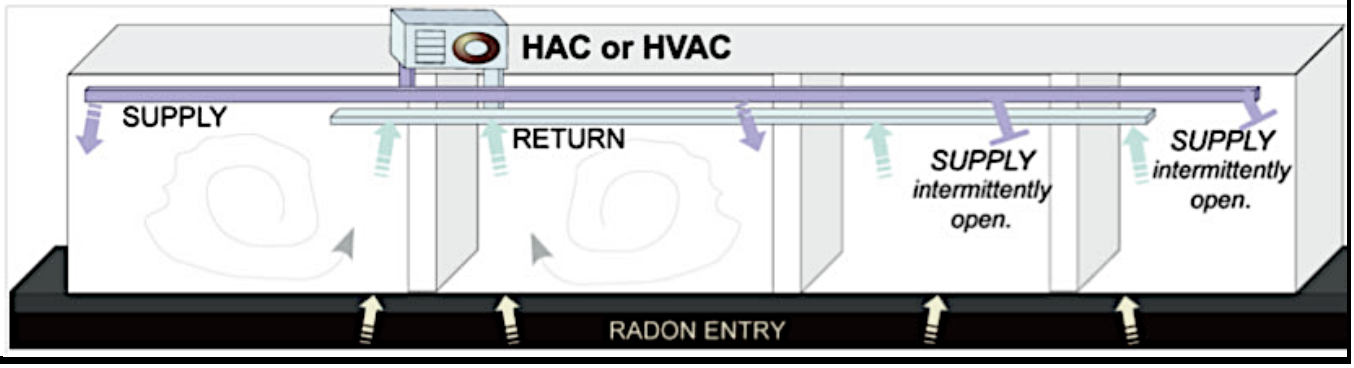
Variable Outdoor Air Ventilation systems are those that add outdoor air ventilation for seasonal comfort or energy savings. Such systems may service a whole building, multiple dwellings or a single dwelling or unit ventilator.

Concentrations of *radon* and chemical vapors can vary widely from test to test based the volume of outdoor air supplied to a dwelling or room at any given time.



Group 4: VARIABLE AIR DISTRIBUTION

Variable Air Distribution systems are those where airflow from a single air handler is distributed to multiple dwellings, rooms, or common use areas with independent controls within each area that open and close duct dampers. The normal operation of these systems can cause changes in distribution of *radon* and vapor or ventilation air and can also affect pressure relationships that can enhance or diminish the volumetric entry of soil gas containing *radon* and chemical vapors.



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Deep appreciation is expressed for contributions of time and wisdom provided by the following experts.

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