# Home Commercial Inspections

ENVIRONMENTAL TESTING • PROPERTY INPECTIONS

JamesJones@hcinspectors.com
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# RADON INSPECTION REPORT

**Job No. 102**

**Prepared For:**

**SUBMITTED TO:**

**Mr. Tyler Storey Scioto County CTC**

**951 Vern Riffe Drive**

**Lucasville, Ohio 45648**

**Prepared By:**

Mr. James Jones, Owner
Home and Commercial Inspections, LLC
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Dublin, Ohio 43065
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## 1.0 EXECUTIVE SUMMARY

Radon Inspection Report

February 15, 2024

**Sampling Location(s): Scioto County Career Technology Center**

Dear Mr.Tyler Storey,

This letter summarizes the finding of a short-term (48-96 hour) radon sampling test episode conducted at the 951 Vern Riffle Drive Lucasville Ohio 45648 for the Scioto County CTC listed above between January 24, 2024 - January 26, 2024. All radon samplers were sent to Accustar Labs (Ohio Approval # RL37) 2 Saber Way Ward Hill, MA 01835 on January 29,2024, and results were reported to Home Commercial Inspections LLC on February 12, 2024. The radon sampling episode was conducted by James Jones, Radon Tester RT943, \Mark Hearn Radon Tester RT1794 and Jennifer Jones Radon Tester RT1638 of Home Commercial Inspections LLC. No elevated radon considerations were noted or samples tested above the 4pCi/L action limit, based on the short-term radon results as reported by Accustar Labs (Ohio Approval # RL37) 2 Saber Way Ward Hill, MA 01835.

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EPA notes there is no safe level of radon, but no action is required for results under 4 pCi/L. If there are questions concerning the radon testing at the school facility, please initially contact my cell at 614-559-4622.

Respectfully submitted,

**James Jones, Ohio Radon License RT943**
**Home Commercial Inspections LLC**

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## 2.0 RADON ENVIRONMENTAL RISK

The U.S Environmental Protection Agency (EPA) and other major national and international scientific organizations have concluded that radon is a human carcinogen and poses a serious environmental health problem. The EPA recommends that schools take action to reduce the level of radon concentration if radon concentration levels are 4 pCi/L or higher.

The U.S Surgeon General has warned about the health risk from exposure to radon in indoor air. The surgeon general has urged Americans to test their homes because radon is the leading cause of lung cancer for non-smokers in the United States breathing in radon over prolonged periods can present a significant health risk. The US EPA has estimated that approximately 21,000 lung cancer-related deaths occur annually with an estimated 275 lung cancer deaths annually in Ohio.

The US EPA stated “Any exposure has some risk of causing lung cancer. The lower the radon risk level in your home, the lower your family’s risk of lung cancer.” The EPA has noted that depending on your geographic location the radon levels of air you breathe outside the home may be as high as 0.74 pCi./L. The national average of outside radon levels is 0.4 pCi/L and it has been estimated by The National Academy of Sciences that outdoor radon levels cause approximately 800 of the 21,000 radon induced lung cancer deaths in the US each year.

Radon Act 51 passed by Congress set the national outdoor level of radon gas (0.4pCi/L) as the target radon level for indoor radon levels. Unfortunately, two-thirds of all homes exceeded this level. The USEPA was tasked with setting practical guidelines and recommendations for the nation. The USEPA thereby set a practical level of 4pCi/L as an action level for radon.

## 3.0 RADON HEALTH EFFECTS

Radon is a known human carcinogen. The prolonged exposure to elevated radon concentrations does cause an increased risk of lung cancer. The precise magnitude of radon health risks is uncertain, and research continues regarding these health risks. The EPA has estimated that radon may cause nearly 14,000 lung cancer deaths in the United States each year. However, this number could range from nearly 7,000 to 30,000 deaths per year. The U.S. Surgeon general has warned that radon is the second-leading cause of lung cancer deaths. The individual risks from radon exposure have been attributed to three factors: the level of radon, the

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duration of radon exposure, and the individual smoking habits. The risk of death from lung cancer has been determined to be much higher for smokers than non-smokers.

The EPA has noted that the home is to be the most likely significant source of radon exposure. Additionally, the EPA has also noted that the second largest potential contributor to radon exposure is likely to be schools. The EPA has recommended that school buildings be tested for radon. In 1989 and 1990, the EPA conducted the School Protocol Development Study as a nationwide effort to further examine how best to conduct radon measurements in schools.

## 4.0 RADON DESCRIPTION

Radon is a gas, and the radon decay products are referred to as solid particles (progeny). The radon particles may become suspended in the air when they are formed. Some particles “plate out” (attach) to surfaces as aerosols, dust, and/or smoke particle in the air. The inhalation of the particles has attributed to lung tissue damage and may affect DNA.

Radon gas is an extremely toxic, chemically inert, odorless, colorless, and tasteless naturally-occurring radioactive element having the symbol Rn. Radon has the atomic number 86; an atomic weight of 222; a melting point of -71 degrees Celsius; a boiling point of -62 degrees; and 18 radioactive isotopes. It is derived from the radioactive decay of radium and is used in cancer treatment; as a tracer in leak detection; in radiology.

## 5.0 RADON CHARACTERISTICS

The concentrations of radon in a building are dependent on factors including the concentration of uranium and radium in the soil; the type of underlying geology; soil permeability; available migration pathways such as subsurface utilities; foundation openings; air temperature and pressure differentials and building ventilation.

Radon may migrate into a study area by either a pressure-driven transport or nopressure differentials. The subject buildings were likely built slab-on-grade. Radon may migrate through foundations by the availability of expansion joints and cracks in the foundation. Radon may also migrate into a building through basements, utility trenches, pipe runs, HVAC systems, and other building ventilation systems. Radon contributions from building materials off-gassing are not often the source of measurable radon.

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## 6.0 RADON TESTING ACTIVITY

The EPA has shown that radon concentration levels may vary from room to room in schools in the same building. It is also known that radon measurements for a particular room are not always precise indicators of radon measurements in adjacent rooms. The EPA requires that radon measurement teams measure radon in schools with initial radon measurements conducted in all frequently occupied rooms in contact with the soil or above a basement crawlspace.

The EPA requires a simultaneous initial test of all frequently occupied rooms including such rooms as offices, classrooms, a media entry area, a commons area, conference rooms, gymnasiums, auditoriums, common rooms/cafeteria, and break room. The EPA requires a minimum of one detector per every 2,000 square feet of open floor space or a portion of the room as required. The EPA has also noted that radon levels on upper floors are not likely to exceed the levels of lower rooms. The EPA has determined that testing the ground-level floors is sufficient for initial radon concentration determinations.

EPA recommends that initial measurements be performed by the utilization of short-term testers placed in the lowest section of the subject buildings and performed under closed-door conditions. An initial short-term test ensures that school students and workers may be informed quickly if radon measurements reveal elevated radon test levels. If the short-term measurement is greater than 4 picoCuries per liter (pCi/L) or 0.02 working levels (WL), a follow-up measurement is recommended. The purpose of the follow-up measurement is to determine whether radon mitigation is necessary for the measurement area.

## 7.0 RADON TEST RESULTS TABLE SUMMARY

Radon test units were supplied by a certified laboratory known As Accustar Labs (Ohio Approval # RL37) 2 Saber Way Ward Hill, MA 01835. The testers were placed within functional frequently occupied areas such as classrooms, offices, and a multi-purpose/cafeteria, between January 24, 2024 - January 26, 2024. All radon samplers were sent to Accustar Labs (Ohio Approval # RL37) 2 Saber Way Ward Hill, MA 01835 on January 29,2024, and results were reported to Home Commercial Inspections LLC on February 12, 2024. The radon sampling episode was conducted by James Jones, Radon Tester RT943, Mark Hearn Radon Tester RT1794 and Jennifer Jones Radon Tester RT1638 of Home Commercial Inspections LLC.

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## 8.0 RADON MEASUREMENT RISK ASSESSMENT

The U.S surgeon general has warned about the health risk from exposure to radon in indoor air. The surgeon general has urged Americans to test their homes because radon is the leading cause of lung cancer for non-smokers in the United States and breathing in radon over prolonged periods can present a significant health risk. The US EPA has estimated that approximately 21,000 lung cancer-related deaths occur annually with an estimated 275 lung cancer deaths annually in Ohio.

## 9.0 RADON LABORATORY ANALYSIS

The radon in test samplers was measured at the Pro-Lab Laboratory located at Accustar Labs (Ohio Approval # RL37) 2 Saber Way Ward Hill, MA 01835 using the liquid scintillation Method (EPA 402-R-92-004) The selected radon sampler devices utilized at the buildings are described as a passive activated charcoal adsorption devices (AC).

The short-term testers utilize activated carbon to absorb the radon gas in the air. The test unit has activated carbon with a perforation screen to filter out radon decay products.
The absorber is resealed by EIS and shipped for processing and evaluation. The selected passive radon tester devices do not uniformly adsorb radon during the testing episode and are not described as integrating devices.

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## 10.0 QUALITY ASSURANCE & CONTROL

Quality Assurance measurements were conducted during the initial testing episode. Minimum acceptable standards of precision and accuracy were maintained during the entire course of the radon testing period. The Quality Assurance protocol included the inclusion of side-by-side detectors (duplicates) and unexposed control detectors (Blanks).

The “blanks” are defined as tester measurements by analyzing unexposed (closed) radon detectors that accompany exposed detectors to the field. The school district may utilize blanks to assess any change in analysis caused by anything outside the immediate room conditions. Background levels may be due to leakage of radon into the tester, detector response to gamma radiation, or other causes.

The duplicates were placed as pairs of detectors deployed in the same location side by side during the identical testing periods. Duplicate placements were at least ten percent of the measurement locations. The duplicates were placed, shipped, and manifested with chains of custody to Accustar Labs (Ohio Approval #RL37) 2 Saber Way Ward Hill, MA 01835 for analysis in the same manner as the other devices so that processing at the laboratory could not distinguish the testers.

Spike samples are handled and spiked by the laboratory and results remain as internal tests and confidential per regulation. Spike samples are routinely conducted per the laboratory proficiency requirements.

An independent company, Bowser Morner located at 4514 Taylorsville Road (phone No. 937-236-8805) conducts routine controls for Accustar Labs (Ohio Approval #RL37) 2 Saber Way Ward Hill, MA 01835. Bowser Morner participated in spike testing using liquid scintillation charcoal devices (NRPP device Code # 7084).

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## 11.0 FINDINGS, OPINIONS, & CONCLUSIONS

In the opinion of Home Commercial Inspections additional short-term radon retesting is not required at the school generally satisfactory radon conditions in the functional areas as frequently occupied rooms and no additional short-term radon testing. The sample analytical position and result tables are listed in Appendix 1.0 of this report.

## 12.0 LIMITATIONS

This report was prepared in accordance with generally accepted ASTM standards of environmental practice at the time this investigation was performed. Evaluations of the conditions at the site for the purpose of this investigation are made from a limited number of observations and sample points and may be subjective in some cases. The client is solely responsible for providing any notices or disclosures to concerned public agencies or to the public.

Home Commercial Inspections LLC has prepared this report based on information collected from available analytical test results. The scope of this investigation is limited and did include a limited number of radon testers and no subsurface or sub-slab radon screening of soil and groundwater. No radon mitigation was performed on the subject property.

This report is not a substitution for a formal radon mitigation and/or radon mitigation effort. The findings and conclusions are not to be regarded as scientific certainties. Findings are based on professional judgment concerning independent laboratory data significance. This report is an expression of professional opinion and is not a warranty expressed or implied.

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## APPENDIXES

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# ATTACHMENTS

1..... FFE Plan Conector Adition
2..... Taylor
3..... T&I Building
4..... Reiser
5..... Schulte

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# APPENDIX 1.0

## RADON ANALYTICAL TEST RESULTS

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# Radon in Air

NELAC NY 11769
NRPP 103216 AL
NRSB ARL0017
Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
NRSB Device Code 12193

Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484355 | 5009269 | 01/26/2024 | 9:37 am | 01/29/2024 | 1:35 pm | Building Taylor Unit 122 Floor LL Room 124 | < 0.4 |
| 8484356 | 5009270 | 01/26/2024 | 9:32 am | 01/29/2024 | 1:03 pm | Building Taylor Unit 127 Floor LL Room 127 | < 0.4 |
| 8484357 | 5009271 | 01/26/2024 | 9:25 am | 01/29/2024 | 1:33 pm | Building Taylor Unit 103 Floor LL Room 103 | < 0.4 |
| 8484358 | 5009272 | 01/26/2024 | 9:04 am | 01/29/2024 | 1:28 pm | Building Taylor Unit 140 Floor LL Room 140 | 0.4 |
| 8484359 | 5009273 | 01/26/2024 | 9:04 am | 01/29/2024 | 1:23 pm | Bldg Taylor Unit 140 Flr LL Rm 140 Taylor Dup | 0.4 |
| 8484360 | 5009274 | 01/26/2024 | 9:05 am | 01/29/2024 | 1:25 pm | Building Taylor Unit 140 Floor LL Room 140 | < 0.4 |
| 8484361 | 5009275 | 01/26/2024 | 9:25 am | 01/29/2024 | 1:33 pm | Building Taylor Unit 103 Floor LL Room 103 | 0.4 |
| 8484362 | 5009276 | 01/26/2024 | 9:20 am | 01/29/2024 | 1:31 pm | Building Taylor Unit 102 Floor LL Room 102 | < 0.4 |
| 8484363 | 5009277 | 01/26/2024 | 8:57 am | 01/29/2024 | 1:29 pm | Building Taylor Unit 101 Floor LL Room 101 | < 0.4 |
| 8484364 | 5009278 | 01/26/2024 | 8:50 am | 01/29/2024 | 1:24 pm | Building Taylor Unit 100 Floor LL Room 100 | < 0.4 |
| 8484365 | 5009279 | 01/26/2024 | 10:20 am | 01/29/2024 | 1:47 pm | Building Taylor Unit 115 Floor LL Room 115 | < 0.4 |

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Report Reviewed By: _____ Report Approved By: _____

Shawn Price, Director of Laboratory Operations, AccuStar Labs

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Ohio Approval # RL37

EPA Method #402-R-92-004
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NRPP Device Code 8088
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Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

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| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484366 | 5009280 | 01/26/2024 | 10:21 am | 01/29/2024 | 1:47 pm | Bldg Taylor Unit 115 Flr LL Rm 115 Taylor Dup | 0.4 |
| 8484367 | 5009281 | 01/26/2024 | 10:02 am | 01/29/2024 | 1:46 pm | Building Taylor Unit 121 Floor LL Room 121 | < 0.4 |
| 8484368 | 5009282 | 01/26/2024 | 10:03 am | 01/29/2024 | 1:46 pm | Building Taylor Unit 121 Floor LL Room 121 | < 0.4 |
| 8484369 | 5009283 | 01/26/2024 | 9:57 am | 01/29/2024 | 1:37 pm | Building Taylor Unit 125 Floor LL Room 125 | < 0.4 |
| 8484370 | 5009284 | 01/26/2024 | 9:58 am | 01/29/2024 | 1:37 pm | Building Taylor Unit 125 Floor LL Room 125 | 0.4 |
| 8484371 | 5009285 | 01/26/2024 | 9:49 am | 01/29/2024 | 3:21 pm | Bldg Taylor Unit 138 A/B Floor LL Rm 138 A/B | < 0.4 |
| 8484372 | 5009286 | 01/26/2024 | 9:49 am | 01/29/2024 | 3:21 pm | Bldg Taylor Unit 138 A/B Floor LL Rm 138 A/B Dup | < 0.4 |
| 8484373 | 5009287 | 01/26/2024 | 9:46 am | 01/29/2024 | 1:39 pm | Bldg Taylor Unit 138 A/B Floor LL Rm 138 A/B | < 0.4 |
| 8484374 | 5009288 | 01/26/2024 | 9:36 am | 01/29/2024 | 1:35 pm | Building Taylor Unit 124 Floor LL Room 124 | 0.4 |
| 8484378 | 5009292 | 01/26/2024 | 10:52 am | 01/29/2024 | 2:00 pm | Building Taylor Unit 237 Floor UL Room 237 | < 0.4 |
| 8484379 | 5009293 | 01/26/2024 | 10:43 am | 01/29/2024 | 1:57 pm | Building Taylor Unit 243A Floor UL Room 243A | < 0.4 |

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# Radon in Air

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|---|---|---|---|---|---|---|---|
| 8484380 | 5009294 | 01/26/2024 | 10:35 am | 01/29/2024 | 1:50 pm | Building Taylor Unit 109 Floor LL Room 109 | 0.4 |
| 8484381 | 5009295 | 01/26/2024 | 10:36 am | 01/29/2024 | 1:50 pm | Building Taylor Unit 109 Floor LL Room 109 | < 0.4 |
| 8484382 | 5009296 | 01/26/2024 | 10:26 am | 01/29/2024 | 1:49 pm | Building Taylor Unit 113 Floor LL Room 113 | < 0.4 |
| 8484383 | 5009297 | 01/26/2024 | 10:26 am | 01/29/2024 | 1:49 pm | Building Taylor Unit 113 Floor LL Room 113 | < 0.4 |
| 8484384 | 5009298 | 01/26/2024 | 10:20 am | 01/29/2024 | 1:48 pm | Building Taylor Unit 115 Floor LL Room 115 | < 0.4 |

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|---|---|---|---|---|---|---|---|
| 8484375 | 5009289 | 01/26/2024 | 10:50 am | 01/29/2024 | 2:05 pm | Bldg New Addition Unit 814 Flr UL Rm 814 | 0.5 |
| 8484376 | 5009290 | 01/26/2024 | 10:54 am | 01/29/2024 | 2:03 pm | Bldg New Addition Unit 815 Flr UL Rm 815 | 0.4 |
| 8484377 | 5009291 | 01/26/2024 | 10:52 am | 01/29/2024 | 2:00 pm | Bldg New Addition Unit 816 Flr UL Rm 816 | 0.4 |
| 8484390 | 5009304 | 01/26/2024 | 11:10 am | 01/29/2024 | 3:55 pm | Bldg New Addition Unit 806 Flr UL Rm 806 | 0.4 |
| 8484391 | 5009305 | 01/26/2024 | 11:06 am | 01/29/2024 | 1:06 pm | Bldg New Addition Unit 807 Flr UL Rm 807 | 0.5 |
| 8484392 | 5009306 | 01/26/2024 | 11:06 am | 01/29/2024 | 1:06 pm | Bldg New Addition Unit 807 Flr UL Rm 807 Dup | 0.5 |
| 8484393 | 5009307 | 01/26/2024 | 11:03 am | 01/29/2024 | 2:04 pm | Bldg New Addition Unit 810 Flr UL Rm 810 | 0.4 |
| 8484394 | 5009308 | 01/26/2024 | 11:00 am | 01/29/2024 | 2:04 pm | Bldg New Addition Unit 809 Flr UL Rm 809 | < 0.4 |

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|---|---|---|---|---|---|---|---|
| 8484385 | 5009299 | 01/26/2024 | 11:29 am | 01/29/2024 | 2:20 pm | Bldg Schultz Lower Level Unit 339 Flr LL Rm 339 | < 0.4 |
| 8484386 | 5009300 | 01/26/2024 | 11:29 am | 01/29/2024 | 2:20 pm | Bldg Schultz Lower Level Unit 339 Flr LL Rm 339 | 0.4 |
| 8484387 | 5009301 | 01/26/2024 | 11:22 am | 01/29/2024 | 2:15 pm | Bldg Schultz First Unit 428A First Flr Unit 428A | 0.4 |
| 8484388 | 5009302 | 01/26/2024 | 11:20 am | 01/29/2024 | 2:16 pm | Bldg Schultz First Unit 437 First Flr Rm 437 | < 0.4 |
| 8484389 | 5009303 | 01/26/2024 | 11:16 am | 01/29/2024 | 2:12 pm | Bldg Schultz First Unit 404 First Flr Rm 404 | < 0.4 |
| 8484395 | 5009309 | 01/26/2024 | 12:02 pm | 01/29/2024 | 2:34 pm | Bldg Schultz Lwr Unit 325/326 Flr LL Rm 325/326 | < 0.4 |
| 8484396 | 5009310 | 01/26/2024 | 12:03 pm | 01/29/2024 | 2:34 pm | Bldg Schultz Lwr Unit 325/326 Flr LL Rm 325/326 D | 0.4 |
| 8484397 | 5009311 | 01/26/2024 | 12:05 pm | 01/29/2024 | 2:35 pm | Bldg Schultz Lwr Unit 325/326 Flr LL Rm 325/326 | 0.5 |
| 8484398 | 5009312 | 01/26/2024 | 11:59 am | 01/29/2024 | 2:36 pm | Bldg Schultz Lower Unit 307 Flr LL Rm 307 | < 0.4 |
| 8484399 | 5009313 | 01/26/2024 | 11:52 am | 01/29/2024 | 2:27 pm | Bldg Schultz Lower Level Unit 343 Flr LL Rm 343 | < 0.4 |
| 8484400 | 5009314 | 01/26/2024 | 11:59 am | 01/29/2024 | 2:36 pm | Bldg Schultz Lower Level Unit 307 Flr LL Rm 307 | < 0.4 |

**Comment:** AMENDED REPORT on 02/09/2024 to reflect a completed datasheet. Home & Commercial Inspections, LLC was emailed a copy of this report.

Distributed by: Home & Commercial Inspections, LLC

Date Received: 02/01/2024 Date Logged: 02/01/2024 Date Analyzed: 02/02/2024 Date Reported: 02/05/2024

Report Reviewed By: _____ Report Approved By: _____

Shawn Price, Director of Laboratory Operations, AccuStar Labs

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NELAC NY 11769
NRPP 103216 AL
NRSB ARL0017
Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
NRSB Device Code 12193

Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484401 | 5009315 | 01/26/2024 | 11:48 am | 01/29/2024 | 2:26 pm | Bldg Schultz Lower Level Unit 328 Flr LL Rm 328 | < 0.4 |
| 8484402 | 5009316 | 01/26/2024 | 11:40 am | 01/29/2024 | 2:23 pm | Bldg Schultz Lower Unit 330B Flr LL Rm 330B | < 0.4 |
| 8484403 | 5009317 | 01/26/2024 | 11:30 am | 01/29/2024 | 2:23 pm | Bldg Schultz Lower Unit 330B Flr LL Rm 330B Dup | < 0.4 |
| 8484404 | 5009318 | 01/26/2024 | 11:42 am | 01/29/2024 | 2:24 pm | Bldg Schultz Lower Unit 330A Flr LL Rm 330A | < 0.4 |
| 8484405 | 5009319 | 01/26/2024 | 12:00 pm | 01/29/2024 | 2:36 pm | Bldg Schultz Lower Level Unit 307 Flr LL Rm 307 | < 0.4 |
| 8484406 | 5009320 | 01/26/2024 | 12:00 pm | 01/29/2024 | 2:35 pm | Bldg Schultz Lower Level Unit 307 Flr LL Rm 307 | < 0.4 |
| 8484407 | 5009321 | 01/26/2024 | 12:11 pm | 01/29/2024 | 2:40 pm | Bldg Schultz Lower Unit 311 Flr LL Rm 311 | < 0.4 |
| 8484408 | 5009322 | 01/26/2024 | 12:12 pm | 01/29/2024 | 2:39 pm | Bldg Schultz Lower Unit 311 Flr LL Rm 311 Dup | < 0.4 |
| 8484409 | 5009323 | 01/26/2024 | 12:10 pm | 01/29/2024 | 2:40 pm | Bldg Schultz Lower Level Unit 311 Flr LL Rm 311 | < 0.4 |
| 8484410 | 5009324 | 01/26/2024 | 12:21 pm | 01/29/2024 | 2:41 pm | Bldg Schultz Lower Level Unit 323 Flr LL Rm 323 | < 0.4 |
| 8484411 | 5009325 | 01/26/2024 | 12:22 pm | 01/29/2024 | 2:43 pm | Bldg Schultz Lower Unit 320A Flr LL Rm 320A | < 0.4 |

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Professional Radon Laboratory Services Since 1984

# Radon in Air

NELAC NY 11769
NRPP 103216 AL
NRSB ARL0017
Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
NRSB Device Code 12193

Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484412 | 5009326 | 01/26/2024 | 12:23 pm | 01/29/2024 | 2:42 pm | Bldg Schultz Lower Unit 320A Flr LL Rm 320A Dup | < 0.4 |
| 8484413 | 5009327 | 01/26/2024 | 12:24 pm | 01/29/2024 | 2:43 pm | Bldg Schultz Lower Unit 320A Flr LL Rm 320A | < 0.4 |
| 8484414 | 5009328 | 01/26/2024 | 12:28 pm | 01/29/2024 | 2:45 pm | Bldg Schultz Lower Level Unit 324 Flr LL Rm 324 | < 0.4 |
| 8484424 | 5009338 | 01/26/2024 | 12:30 pm | 01/29/2024 | 2:45 pm | Bldg Schultz Lower Level Unit 324 Flr LL Rm 324 | < 0.4 |

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# Radon in Air

NELAC NY 11769
NRPP 103216 AL
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Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
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Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484415 | 5009329 | 01/26/2024 | 1:40 am | 01/29/2024 | 3:29 pm | Bldg T&I Bldg Unit 527 First Flr Rm 527 | 0.4 |
| 8484416 | 5009330 | 01/26/2024 | 1:33 am | 01/29/2024 | 3:34 pm | Bldg T&I Bldg Unit 511B First Flr Rm 511B | 0.5 |
| 8484417 | 5009331 | 01/26/2024 | 1:33 am | 01/29/2024 | 3:34 pm | Bldg T&I Bldg Unit 511B First Flr Rm 511B | < 0.4 |
| 8484418 | 5009332 | 01/26/2024 | 1:47 am | 01/29/2024 | 3:22 pm | Bldg T&I Bldg Unit 520 First Flr Rm 520 | 0.8 |
| 8484419 | 5009333 | 01/26/2024 | 1:46 am | 01/29/2024 | 3:21 pm | Bldg T&I Bldg Unit 520 First Flr Rm 520 | 0.5 |
| 8484420 | 5009334 | 01/26/2024 | 1:28 am | 01/29/2024 | 3:38 pm | Bldg T&I Bldg Unit 505C First Flr Rm 505C | 0.4 |
| 8484421 | 5009335 | 01/26/2024 | 1:27 am | 01/29/2024 | 3:38 pm | Bldg T&I Bldg Unit 505C First Flr Rm 505C | 0.5 |
| 8484422 | 5009336 | 01/26/2024 | 1:24 am | 01/29/2024 | 3:38 pm | Bldg T&I Bldg Unit 500A First Flr Rm 500A | 0.4 |
| 8484423 | 5009337 | 01/26/2024 | 1:45 am | 01/29/2024 | 3:22 pm | Bldg T&I Bldg Unit 520 First Flr Rm 520 | 0.7 |
| 8484425 | 5009339 | 01/26/2024 | 2:21 am | 01/29/2024 | 3:09 pm | Bldg T&I Bldg Unit 548 First Flr Rm 548 | 0.4 |
| 8484426 | 5009340 | 01/26/2024 | 2:18 am | 01/29/2024 | 3:00 pm | Bldg T&I Bldg Unit 557 First Flr Rm 557 | 0.6 |

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# Radon in Air

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NRSB ARL0017
Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
NRSB Device Code 12193

Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484427 | 5009341 | 01/26/2024 | 2:16 am | 01/29/2024 | 3:00 pm | Bldg T&I Bldg Unit 557 First Flr Rm 557 | < 0.4 |
| 8484428 | 5009342 | 01/26/2024 | 2:14 am | 01/29/2024 | 2:14 pm | Bldg T&I Bldg Unit 557 First Flr Rm 557 Dup | 0.4 |
| 8484429 | 5009343 | 01/26/2024 | 2:06 am | 01/29/2024 | 3:05 pm | Bldg T&I Bldg Unit 538 First Flr Rm 538 | 0.5 |
| 8484430 | 5009344 | 01/26/2024 | 2:05 am | 01/29/2024 | 3:05 pm | Bldg T&I Bldg Unit 538 First Flr Rm 538 | 0.5 |
| 8484431 | 5009345 | 01/26/2024 | 2:09 am | 01/29/2024 | 2:58 pm | Bldg T&I Bldg Unit 539 First Flr Rm 539 | 0.8 |
| 8484432 | 5009346 | 01/26/2024 | 1:56 am | 01/29/2024 | 3:17 pm | Bldg T&I Bldg Unit 532B First Flr Rm 532B | 0.4 |
| 8484433 | 5009347 | 01/26/2024 | 1:58 am | 01/29/2024 | 3:17 pm | Bldg T&I Bldg Unit 532B First Flr Rm 532B | < 0.4 |
| 8484434 | 5009348 | 01/26/2024 | 1:41 am | 01/29/2024 | 3:29 pm | Bldg T&I Bldg Unit 527 First Flr Rm 527 | 0.5 |
| 8484439 | 5009358 | 01/26/2024 | 2:22 am | 01/29/2024 | 3:09 pm | Bldg T&I Bldg Unit 548 First Flr Rm 548 | < 0.4 |

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# Radon in Air

NELAC NY 11769
NRPP 103216 AL
NRSB ARL0017
Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
NRSB Device Code 12193

Laboratory Report for:

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

Property Tested: Project # 20240126

Scioto Tech Initial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8484435 | 5009354 | 01/26/2024 | 2:37 am | 01/29/2024 | 3:44 pm | Bldg Reiser Bldg 701B First Flr Rm 701B | < 0.4 |
| 8484436 | 5009355 | 01/26/2024 | 2:36 am | 01/29/2024 | 3:45 pm | Bldg Reiser Bldg 701B First Flr Rm 701B | < 0.4 |
| 8484437 | 5009356 | 01/26/2024 | 2:33 am | 01/29/2024 | 3:43 pm | Bldg Reiser Bldg 700A First Flr Rm 700A | < 0.4 |
| 8484438 | 5009357 | 01/26/2024 | 2:32 am | 01/29/2024 | 3:43 pm | Bldg Reiser Bldg 700A First Flr Rm 700A | < 0.4 |

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# Radon in Air

NELAC NY 11769
NRPP 101193 AL
NRSB ARL0017
Ohio Approval # RL37

EPA Method #402-R-92-004
Liquid Scintillation
NRPP Device Code 8088
NRSB Device Code 12193

Laboratory Report for:

Scioto Tech Intial Radon Test
951 Vern Riffe Drive
Lucasville Ohio 45648 Scioto County

Property Tested: Project # 20240126

Scioto Tech Intial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Area Tested | Result pCi/L |
|---|---|---|---|
| 8486047 | 5009349 | Building Taylor Unit 160 Floor LL Room 160 Taylor | 51.5 |
| 8486048 | 5009360 | Building Taylor Unit 160 Floor LL Room 160 Taylor | 49.2 |
| 8486049 | 5009368 | Building Taylor Unit 160 Floor LL Room 160 Taylor | 48.2 |

Radon test results are above the EPA action level of 4 pCi/L. The EPA recommends that action be taken to reduce radon levels if the result is 4 pCi/L or higher in a livable area. If the property tested uses water from a private well, you may wish to consider testing for radon in water.

**Comment:** AMENDED REPORT for 5009349 and and and 5009360 and 5009368 on 02/14/2024 to reflect a completed datasheet. Home & Commercial Inspections, LLC was emailed a copy of this report.

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| | | | | | |
|---|---|---|---|---|---|
| Test Began: | 02/03/2024 8:29 am | Date Received: | 02/06/2024 | Date Analyzed: | 02/07/2024 |
| Test Ended: | 02/05/2024 8:29 am | Date Logged: | 02/06/2024 | Date Reported: | 02/07/2024 |

Test Exposure Duration: 48.0 Hours

Report Reviewed By: _____ Report Approved By: _____

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NRPP Device Code 8088
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Laboratory Report for:

Scioto Tech Intial Radon Test
951 Vern Riffe Drive
Lucasville Ohio 45648 Scioto County

Property Tested: Project # 20240126

Scioto Tech Intial Radon Test
951 Vern Riffe Drive
Lucasville OH 45648

| Log Number | Device Number | Test Exposure Duration: | | | | Area Tested | Result pCi/L |
|---|---|---|---|---|---|---|---|
| 8485313 | 5009363 | 01/26/2024 | 2:40 pm | 01/29/2024 | 2:45 pm | Field Blank | < 0.4 |
| 8485314 | 5009364 | 01/26/2024 | 2:38 pm | 01/29/2024 | 2:41 pm | Field Blank | < 0.4 |
| 8485315 | 5009365 | 01/26/2024 | 2:39 pm | 01/29/2024 | 2:41 pm | Field Blank | < 0.4 |
| 8485316 | 5009366 | 01/26/2024 | 2:40 pm | 01/29/2024 | 2:45 pm | Field Blank | < 0.4 |

**Comment:** AMENDED REPORT on 02/16/2024 to add the beginning and ending dates and times. Home & Commercial Inspections, LLC was emailed a copy of this report.

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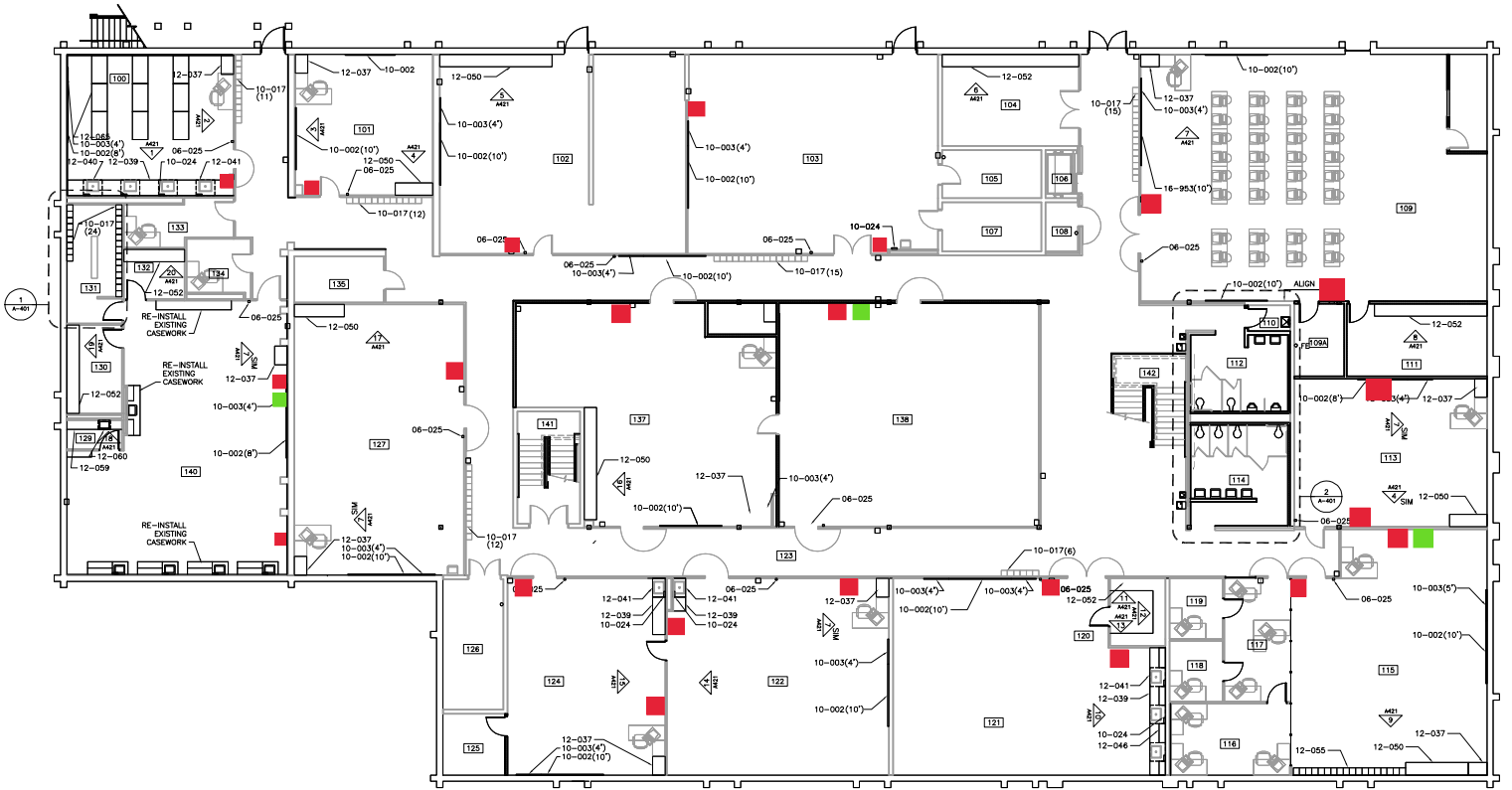
JamesJones@hcinspectors.com
800-241-0133, Ext. 3
HCInspectors.com

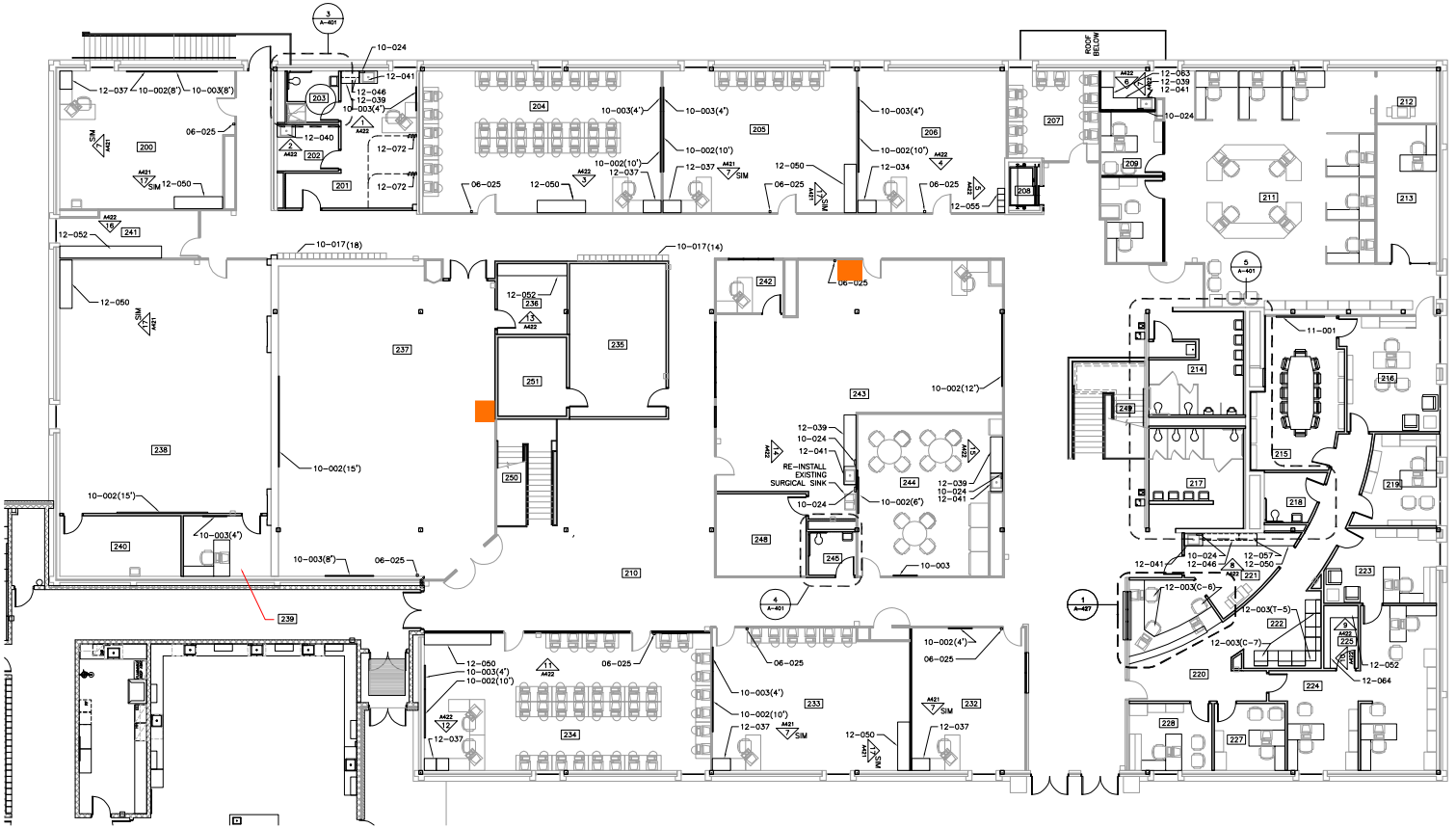
# APPENDIX 2.0

## SAMPLE LOCATION



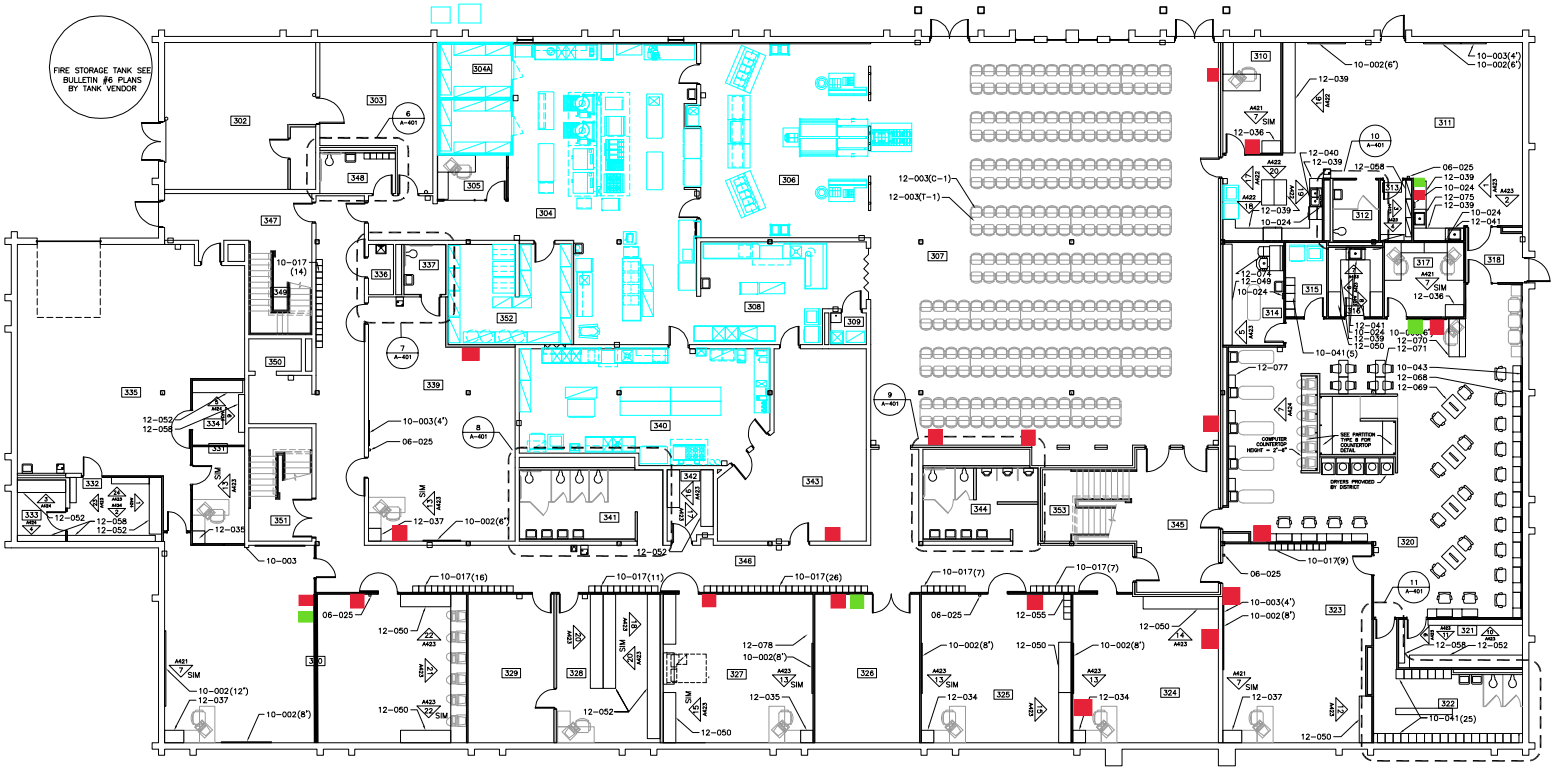
Green Duplicate Test Location
Red Radon Test Location
10% Upper Floor Test Location
Note: No Exterior Wall
Note: No Kitchens/Restroom
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom

TAYLOR BUILDING LOWER LEVEL FURNITURE PLAN



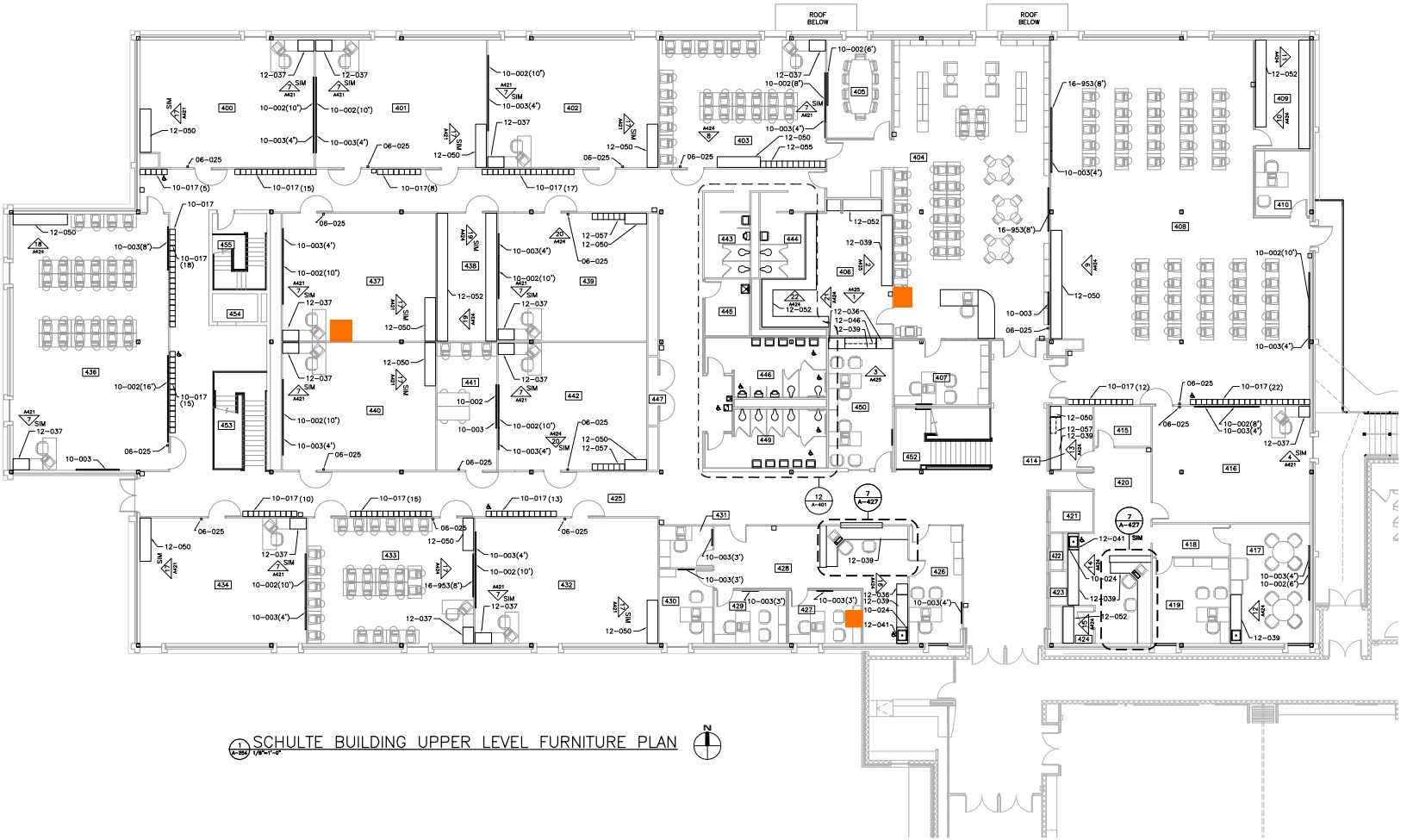

TAYLOR BUILDING UPPER LEVEL FURNITURE PLAN

Green Duplicate Test Location
Red Radon Test Location
10% Upper Floor Test Location
Note: No Exterior Wall
Note: No Kitchens/Restroom
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom



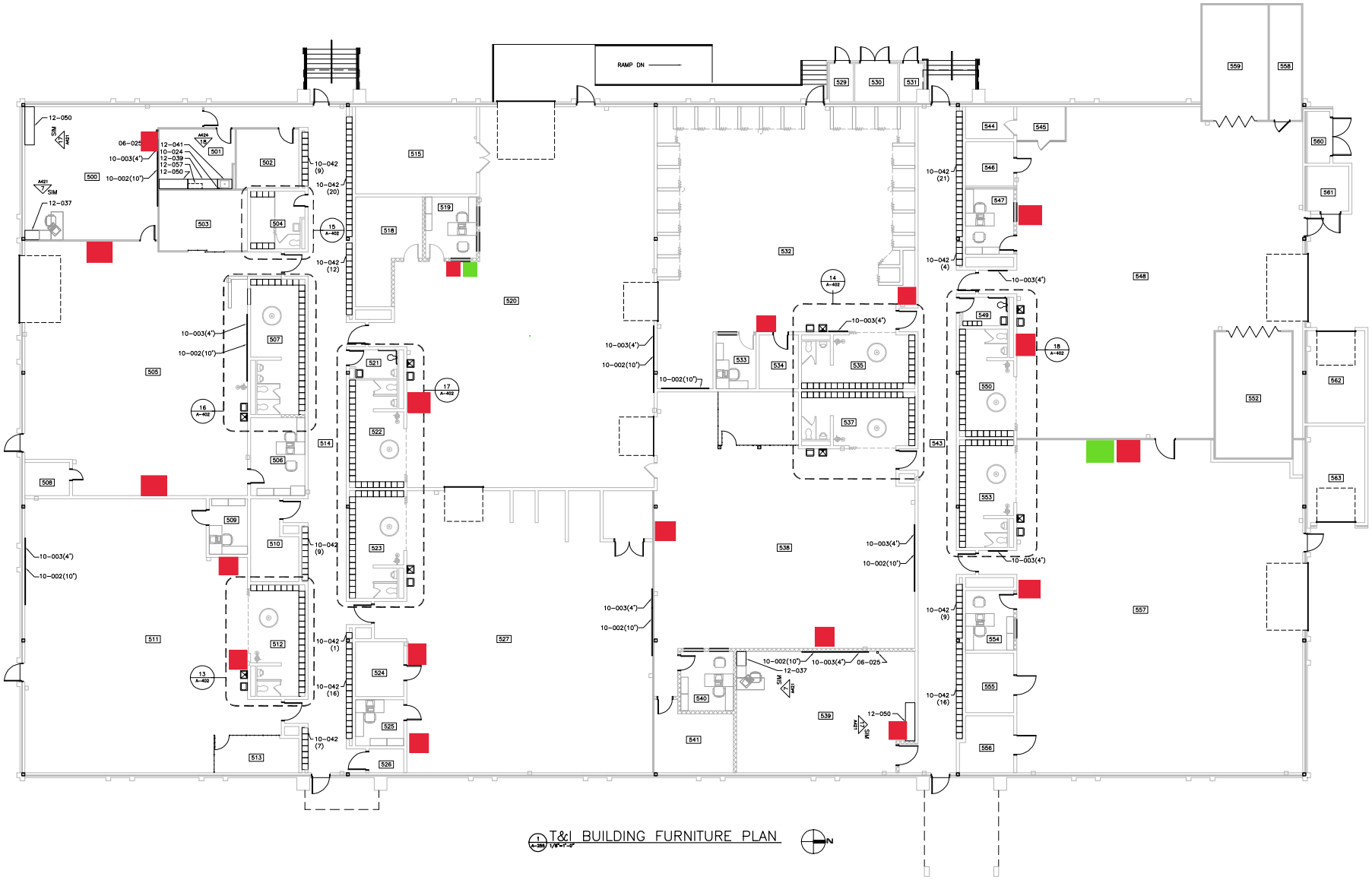

Green Duplicate Test Test Location
Red Radon Test
10% Upper Floor
Note: No Exterior Wall
Note: No Kitchens
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom

•



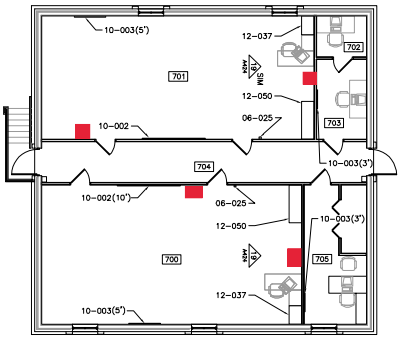

SCHULTE BUILDING UPPER LEVEL FURNITURE PLAN

Green Duplicate Test
Red Radon Test
10% Upper Floor
Note: No Exterior Wall
Note: No Kitchens
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom

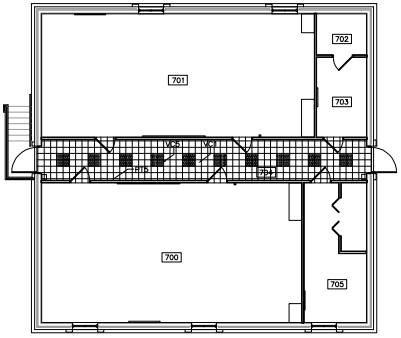



Green Duplicate Test Location
Red Radon Test Location
10% Upper Floor Test Location
Note: No Exterior Wall
Note: No Kitchens/Restrooms
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom

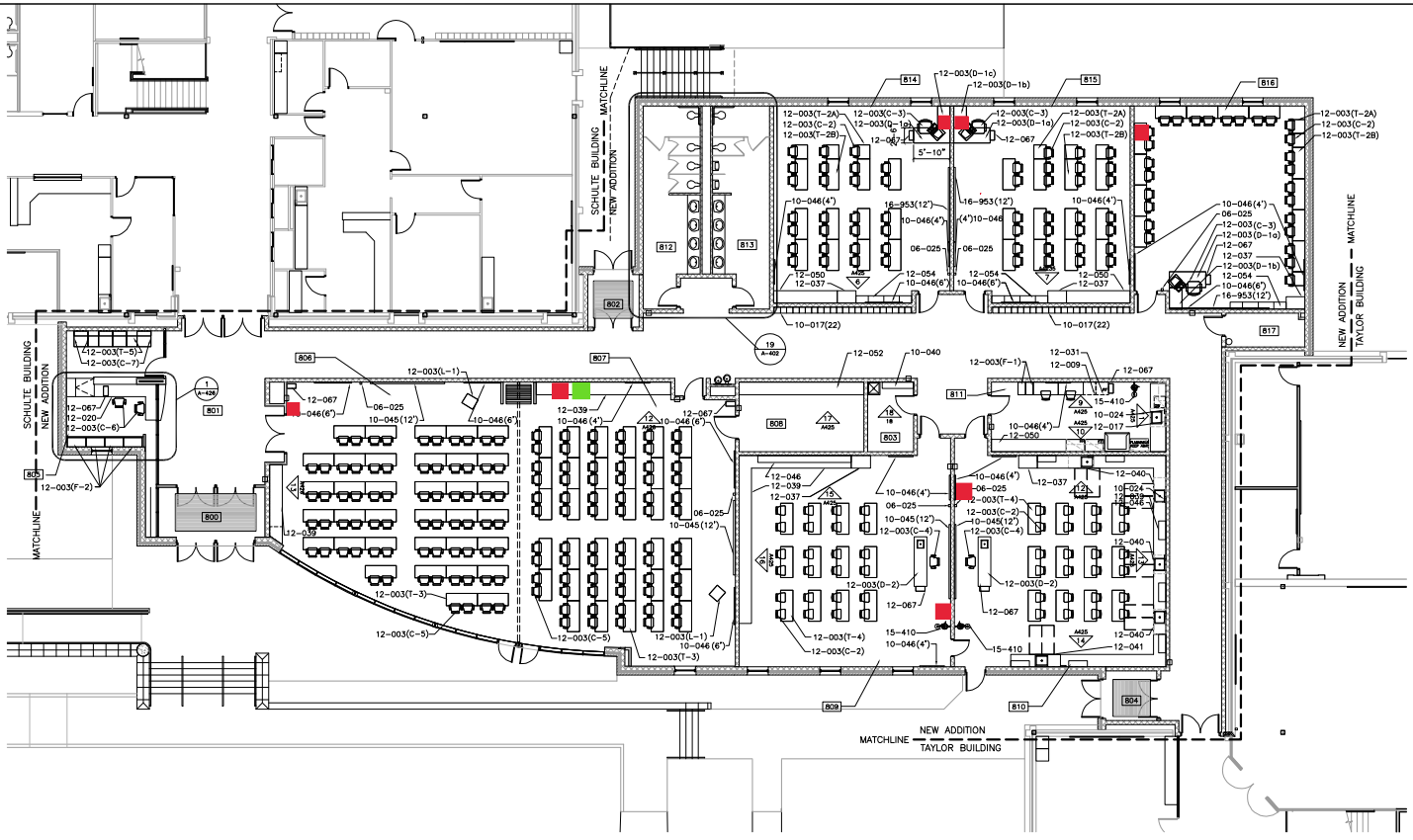
Green Duplicate Test Location
Red Radon Test Location
10% First Floor Test Location
Note: No Exterior Wall
Note: No Kitchens/Restroom
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom




1 A-206 REISER BUILDING FURNITURE PLAN 1/8"=1'-0" N




2 A-206 REISER BUILDING FLOOR FINISH PLAN 1/8"=1'-0" N




NEW ADDITION
FURNITURE FIXTURES AND EQUIPMENT PLAN

Green Duplicate Test Location
Red Radon Test Location
10% First Floor Test Location
Note: No Exterior Wall
Note: No Kitchens/Restroom
Note: No Storage Closet
Note: No Areas with Mechanical Ventilation
Note: No Restroom

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# APPENDIX 3.0

## RADON REGULATION

# Radon Testing in Schools

Ohio Department of Health

The Ohio Department of Health Indoor Radon Program


## What is radon?

Radon is:

- A naturally occurring gas that seeps into buildings from the surrounding soil.
- The second leading cause of lung cancer.
- The number one cause of lung cancer among non-smokers, according to Environmental Protection Agency (EPA) estimates.
- Responsible for about 21,000 lung cancer deaths every year. About 2,900 of these deaths occur among people who have never smoked.

## Do schools need to test for radon?

**Yes**, if the building has never been tested or past test results are unavailable, a radon test should be done. The building should be re-tested after any renovations to the building or HVAC system. In addition, re-testing should be done periodically, at least every 5 years. Retesting should be done in all buildings and in all ground contact rooms, regardless of prior results.

## Does the Ohio Department of Health (ODH) perform radon testing in schools?

**No,** ODH does not conduct radon testing in schools.

## Who can test for radon in schools?

- ODH licensed radon testers or mitigation specialists
- School personnel – The Ohio Administrative Code (O.A.C.) 3701-69-02 (B)(2) states, "An individual, business entity or government entity may perform radon testing on a building or real property that the individual, business entity or government entity owns or leases."
  If the school owns or leases the building, then school personnel may test the school without holding a radon tester or mitigation specialist license. If the decision is made to have school personnel perform radon testing, ODH strongly recommends the school personnel undergo training and that the testing be performed in the manner as outlined in the Ohio Administrative Code. However, ODH strongly recommends a licensed ODH radon tester or mitigation specialist conduct testing.

## When should radon testing in schools be conducted?

Schools need to be tested while the building is occupied and when the students are present. Testing should be conducted on weekdays when using a two- to five-day test. The US Environmental Protection Agency's *Radon Measurement in Schools* states, "Schools should schedule their testing during the coldest months of the year." Therefore, radon testing in schools needs to be conducted during the heating season, specifically between the months of October and March.

## Some schools and homes near us have reported finding no elevated radon levels. Do we still need to test for radon?

**Yes,** radon levels in buildings vary with local geology, building structure and heating, ventilation and air conditioning (HVAC) systems, schools in close proximity can exhibit dramatically different radon levels. The only way to know if the rooms in your school have elevated radon levels is to conduct radon testing.

The Ohio Department of Health • Indoor Radon Program • 614-728-0272 • Indoor.radon@odh.ohio.gov

Rev. 12-12-2018

*Note—ANSI/AARST MAMF and MALB consolidated into a single publication*

ANSI/AARST MA-MFLB 2023

An American National Standard

# Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial and Mixed-Use Buildings

# MA-MAMF 2023

## Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial and Multi-Use Buildings

### Scope Summary and Introduction

MA-MFLB consolidates ANSI/AARST MAMF (rev. 1/21) and ANSI/AARST MALB (rev. 1/21) into a single publication. This standard of practice specifies procedures and minimum requirements when measuring radon concentrations in shared structures, or portions of shared structures, used for residential, non-residential or mixed-use purposes[1] to determine if radon mitigation is necessary to protect current and future occupants. These protocols address low-rise and high-rise structures and procedures for testing whole buildings but also for testing only one or several individual rooms or dwellings within a shared building.

### Updates for 2023

Updates for 2023 include revised latitude in Section 6.2 (Quality Control for Number of Valid Tests). While recommended for immediate use, the effective date for compliance with this standard is **December 1st, 2023**.

### Purpose

Radon is the leading cause of lung cancer among nonsmokers and the second leading cause of lung cancer in the general population.[2] Radon in U.S. homes causes approximately 21,000 lung cancer deaths each year.[3] This risk is largely preventable. Most people receive their greatest exposure to radon in their home dwellings. Radon concentrations in ground-contact apartments have been found to be similar to those in low-rise residential buildings located in the same area.[4] Be it at home, work or school, an individual's exposure to radon gas combines over time to increase the risk of preventable lung cancer.

### Historical Perspective

In the 1950s, studies confirmed increased incidence of radon-induced lung cancer for workers in underground mines. In the 1980s, studies found that exposure to radon in homes can exceed exposures found for mine workers. This discovery resulted in the Indoor Radon Abatement Act (1988) that authorized U.S. state and federal activities to reduce citizen risk of lung cancer caused by indoor radon concentrations. Since 1988, the United States Environmental Protection Agency (USEPA) and the U.S. Surgeon General have recommended that all homes be tested for radon. 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.

In 1999, with publication of the BEIR VI[3] study, the National Academy of Science confirmed that any 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 concentrations found in residential buildings.[2]

### Normative References

| | |
|---|---|
| ANSI/AARST MS-QA | (Radon Measurement Systems Quality Assurance) |
| ANSI/AARST MAH | (Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes) *in regards to conducting radon decay product (RDP) measurements.* |
| 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) |

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[1] As point of reference, see the International Building Code (IBC) as published by the International Code Council.

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

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

[4] 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

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

| | |
|---|---|
| ANSI/AARST SGM-SF | (Soil Gas Mitigation in Existing Homes) |
| ANSI/AARST SGM-MFLB | (Soil Gas Mitigation in Existing Multifamily, School, Commercial and Mixed-Use Buildings) *Note—Previously published as ANSI/AARST RMS-MF and RMS-LB and now harmonized and consolidated into a single standard.* |
| ANSI/AARST CCAH | (Reducing Radon in New Construction of One & Two Family Dwellings and Townhouses) |
| ANSI/AARST CC-1000 | (Soil Gas Control Systems in New Construction of Multifamily, School, Commercial and Mixed-Use Buildings) |
| ANSI/AARST RRNC | (Rough-in of Radon Control Components in New Construction of 1 & 2 Family Dwellings and Townhouses) |

## Designation of the standard: MA-MFLB

For catalogue identification, "MA-MFLB" stands for Measurement of Air in Multifamily and Large Buildings.

## 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.

## Continuous Maintenance

This standard is under continuous maintenance by the AARST Consortium on National 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.

**User Tools**: User tools are posted online (www.standards.aarst.org/public-review), such as exhibit templates for field notices, inspection forms and, across time, interpretations, and approved addenda updates.

**AARST Consortium on National Standards**

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# MA-MFLB Table of Contents

# MA-MFLB 2023

# Protocol for Conducting Measurements of Radon and Radon Decay Products in Multifamily, School, Commercial and Mixed-Use Buildings

## 1.0 SCOPE

### 1.1 Scope and Purpose

This standard of practice specifies procedures and minimum requirements when measuring radon concentrations in shared structures, or portions of shared structures, used for residential, non-residential or mixed-use purposes to determine if radon mitigation is necessary to protect current and future occupants. These protocols address low-rise and high-rise structures and procedures for testing whole buildings but also for testing only one or several individual rooms or dwellings within a shared building.

1.1.1 *Multifamily and other residential occupancies*

The protocols in this standard of practice address residential occupancies that include:

a) Buildings having more than one attached dwelling or other occupied unit under the same ownership or designated maintenance or management authority;

b) Buildings or structures, or a portion thereof that are used, for example, as apartment houses, dormitories, military congregate residences, fraternities and sororities, non-transient boarding houses, hotels, convents, monasteries, motels, and live/work units; and

c) Multifamily structures that can include those with shared ownership or maintenance such as co-op units, townhouses, condominiums or vacation timeshare properties.

1.1.2 *Schools, commercial buildings and other non-residential occupancies* [5]

The protocols in this standard of practice also address non-residential occupancies that include:

a) Educational occupancies including for religious and educational purposes through the 12th grade and day care facilities (Group E);

b) Business occupancies including for offices, training and educational facilities to include universities, professional services or service-type transactions (Group B);

c) Assembly occupancies including for civic, social or religious functions (Group A);

d) Factory occupancies including for fabrication or manufacturing, repair or processing (Group F);

e) High-hazard occupancies (Group H);

f) Institutional occupancies including those where people are cared for or live in a supervised environment such as under restraint or security, detained in a penal institution, or for medical, surgical, psychiatric, nursing and custodial care or for childcare facility purposes (Group I); and

g) Mercantile occupancies including for the display and sale of merchandise, goods, wares or merchandise incidental to such purposes and accessible to the public (Group M).

### 1.2 Applicability

The terms "shall" and "required" indicate provisions herein that are mandatory for compliance with this standard. The terms "note", "informative", "should" and "recommended" indicate provisions that are considered to be helpful or good practice but that do not contain a mandatory requirement.

[5] As point of reference, see the International Building Code (IBC) as published by the International Code Council.

# 2.0 BEFORE YOU TEST

## 2.1 Which Buildings Should be Tested?

*Informative Advisory*
Any building on any parcel of land can have a radon problem. Testing is the only way to know. Radon concentrations cannot be predicted based on national, state or local radon survey maps, or neighborhood radon measurements.

## 2.2 When to Test?

2.2.1 *Where occupied both day and night*

Radon testing is permitted any time of year for locations that are significantly occupied both day and night.

*Informative Advisory*—Measurements are more likely to provide an accurate reflection of occupant exposure to radon hazards when conducted under conditions that most closely align to the normal building operating condition that prevails during the greatest amount of time each year.
See Normative Appendix A for information on how to determine when testing should occur.

2.2.2 *Where not occupied both day and night*

For buildings or portions of buildings that are non-residential and not significantly occupied both day and night, the measurements shall be conducted at a time that is representative of normal occupied building operating conditions, as defined in Section 2.7.2 (Building operating conditions).

**Exception:** It shall be permitted to test at any time of the year when the purpose of the testing demands timeliness, such as a business transaction or health concerns.

## 2.3 Test Devices

2.3.1 *Approved test devices required*

All test devices used for deciding if mitigation is warranted shall be devices that are listed by one of the following authorities:

a) As required by local jurisdictions that have a program for evaluating and approving devices; or

b) A national certification or listing program, such as the National Radon Proficiency Program (NRPP), the National Radon Safety Board (NRSB), or an equivalent program that verifies device compliance with the latest publication of ANSI/AARST MS-PC (Performance Specifications for Instrumentation Systems Designed to Measure Radon Gas in Air).

Note—Identification of two existing bodies that have a program for evaluating and listing devices that meet specified quality requirements is not an endorsement of either program.

2.3.2 *Device instructions and appropriateness*

Radon measurement devices shall be used in compliance with both this standard and instructions provided by the manufacturer.

Note—Section CG-3 in the attached Companion Guidance provides descriptions of test devices.

2.3.3 *Test device types (defined)*

When the following terms are used to describe radon test devices, the following definitions shall apply:

a) The term "Passive Device" refers to those that collect a time-weighted average and do not provide hourly readings.

b) The term "Continuous Monitor" refers to monitors that are capable of automatically recording a retrievable time series of numeric measurements of radon concentration averaged over time intervals of 1 hour or less and can be recalibrated periodically. 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.

2.3.4 *Radon Decay Products (RDP)*

The use of radon decay product (RDP) measurement devices shall comply with ANSI/AARST MAH (Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes).

## 2.4 Who Should Conduct the Testing?

To be considered qualified for conducting measurements in multifamily, the person(s) or team, regardless of business organizational structure, shall operate under a quality assurance (QA) program. The QA program shall include individuals who are qualified for their apportioned task and operations conducted under the responsible charge of a qualified measurement professional.

2.4.1 *Qualified measurement professionals*

For testing multifamily, school, commercial or mixed-use buildings, a "Qualified Measurement Professional" is defined as:

"An individual that has demonstrated a minimum degree of appropriate technical knowledge and skills both sufficient to place, retrieve and analyze (as applicable) radon detectors and to design, plan, and implement quality procedures when conducting radon measurements in multifamily buildings, schools and other non-residential or mixed-use buildings:

a) as established in certification requirements of a national program that is compliant with requirements in Normative Appendix D; and

b) as required by local statute, state licensure or certification programs that evaluate individuals for radon specific technical knowledge and skills."

2.4.2 *Testing project oversight*

A qualified measurement professional shall be physically present during all onsite 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 and retrieving detectors.

Individuals who are not qualified measurement professionals are permitted to assist in the placement and retrieval of detectors provided that their participation is approved by the qualified measurement professional and permitted by statute, state licensure or certification program. Participant names and qualifications or preparations shall be retained in quality control (QC) records and made available to the client upon request.

If noncertified individuals assist in detector placement and retrieval, the qualified measurement professional shall be responsible to either:

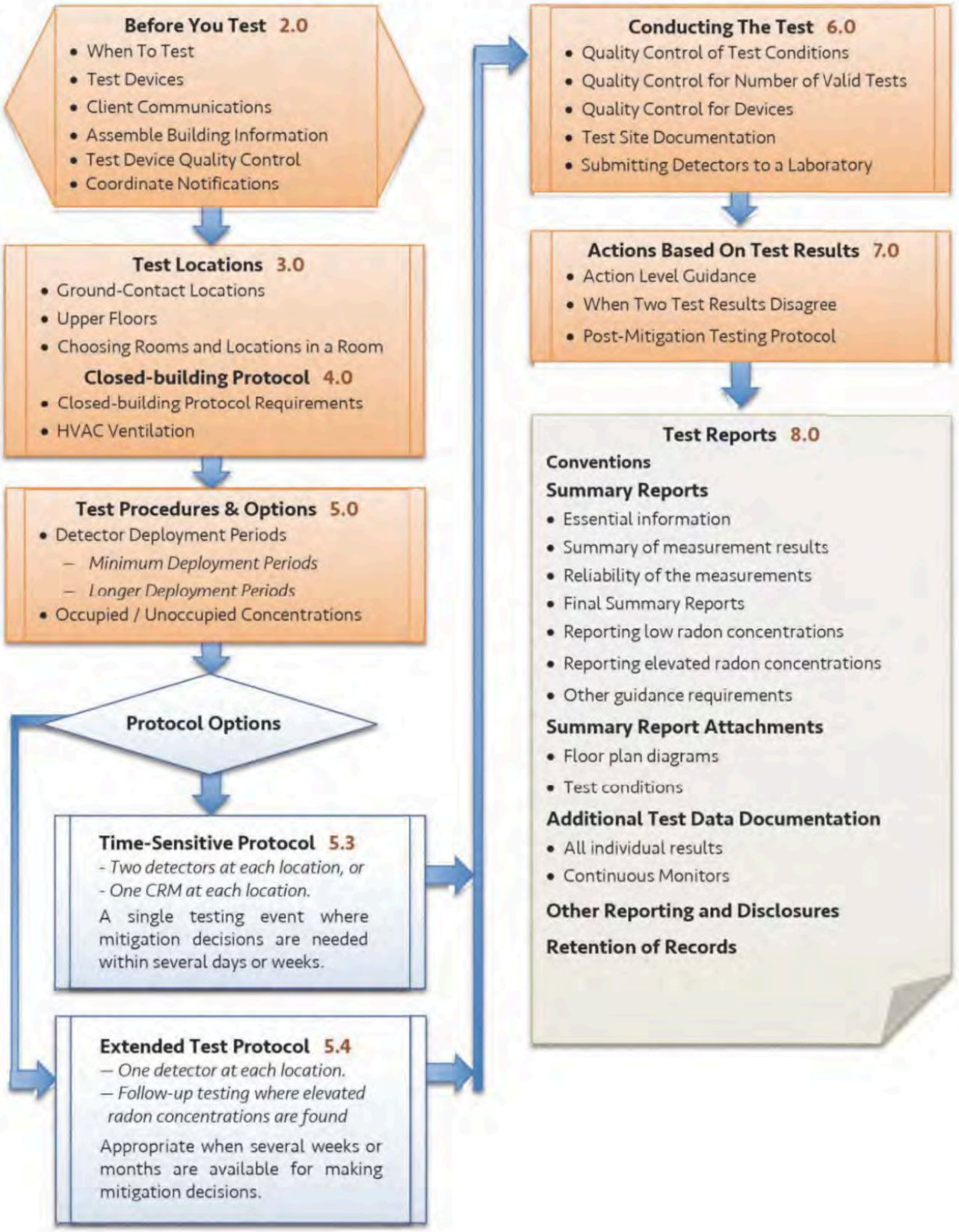
a) Create and present a written work plan specific to apportioned tasks and obtain evidence that the work plan is understood by all participants.

Note—Section CG-4 in the attached Companion Guidance provides guidance for work plan training; or

b) Verify that individuals have demonstrated, within the last 2 years, appropriate training and skills specific to detector placement and retrieval, such as completion of a training class approved by a national program that is compliant with requirements in Appendix D or state licensure or certification program where applicable.

## 2.5 Summary of Testing Procedures

**Flowchart of procedures embodied in this standard**



## 2.6 Client Communications

2.6.1 *Designing a plan for testing*

Prior to designing a testing plan, the person(s) responsible for quality procedures shall obtain or attempt to obtain information about the building(s) to identify test locations that comply with this standard.

2.6.2 *Client advisories prior to testing*

During initial interactions or in proposals, the client shall be informed in writing regarding;

a) Test plan options that comply with this standard;

b) Required quality control for closed building conditions;

c) The normal occupied building operating condition that prevails during the greatest amount of time each year for similar local buildings, in accordance with Appendix A; and

d) Requirements for a valid measurement at all test locations in each building and the possibility of delays and additional expense when test locations are not readily accessible or where requirements for closed-building conditions are not observed.

2.6.3 *Client authorizations*

Prior to testing, the client shall be requested in writing to provide confirmation regarding:

a) who is authorized by the client to receive test data and any limits the client requests or requires on disclosing test data or results, and

b) at which junctures during the process that the client requests or requires data to be provided.

Note—Exhibit 1 provides an example form for seeking to obtain client authorizations.

2.6.4 *Client commitments*

Prior to testing, the person(s) responsible for quality procedures shall obtain or attempt to obtain a signed statement from the client, or client's authorized agent, and facilitating staff members regarding:

a) Commitments to aid quality control of closed-building conditions.

b) A commitment from the onsite supervisor(s) to:

1. distribute notices prior to testing for both occupants and other staff members, and
2. provide timely access to all test locations.

c) A commitment from the HVAC or building operations supervisor(s) to ensure that building conditions required to achieve reliable radon tests are met. This commitment shall include:

1. providing information about HVAC systems when requested, and
2. affirmation prior to testing that HVAC system(s) have been reviewed and adjusted, as needed, where systems include automated or manual controls or dampers for:
   a. variable outdoor air ventilation, and
   b. variable air volume distribution (VAV) systems

Note 1—Exhibits 2, 3, 4 and 5 provide example forms for meeting these requirements.

Note 2— Exhibit 6 describes HVAC systems of concern that may be encountered.

## 2.7 Assemble Building Information

### 2.7.1 *Records*

A method to record and track activities for each test location shall be established prior to testing, such as creation or procurement of floor plan diagrams for recording and tracking details.

For tested areas, records shall be updated during test procedures:

a) to match current addresses,
b) the current use of non-residential rooms, and
c) building foundation types such as slab-on-grade, basement and crawl space foundations in the building being tested.

Note—Exhibit 7 provides an example of a floor plan diagram.

### 2.7.2 *Building operating conditions*

Planning and conducting measurements require identification of the normal occupied building operating condition that prevails during the greatest amount of time each year. The predominant building operating condition reported and used for testing procedures shall be based on climate examples in accordance with Appendix A.

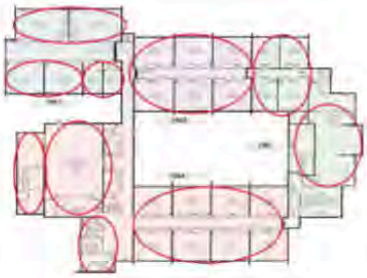
Planning and conducting measurements additionally require identification of conditions that temporarily inhibit clear characterization of radon hazards. These are conditions that do not exhibit regularity for at least intermittent periods during a test regarding:

a) Activity of heating or cooling system blowers, where applicable to the HVAC system, and
b) Negative air pressure in the lowest portions of the building relative to outside air.

### 2.7.3 *Unique sectors*

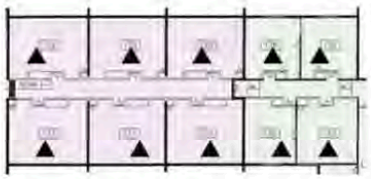
Each area served by a unique HVAC system shall be classified as a unique sector. When planning, or no later than when conducting measurements, actions are required to account for temporary conditions that can adversely affect reliability of the test result(s) where HVAC systems are designed with:

a) Variable outdoor air ventilation;
b) Variable air volume (VAV);
c) Return-air ducts laid in soil; and
d) HVAC setback for non-residential locations.



### 2.7.4 *Test devices needed*

The number of test devices for each test procedure shall include all planned test locations relative to the test procedure as specified in this standard and those additionally required for quality control.



## 2.8 Test Device Quality Control

Any person or team conducting radon or radon decay product measurements shall establish, maintain and follow a *quality assurance* plan that complies with ANSI/AARST MS-QA (Radon Measurement Systems Quality Assurance). Among other things, MS-QA requires a system to record and monitor the results of *quality control (QC)* check measurements and training qualifications of staff.

2.8.1 *Reporting QA checks*

All *quality control (QC)* check measurements for *duplicates*, *comparison checks*, *spikes* and *blanks* associated with a testing project shall be included in report documentation, as required in Section 8.4.

2.8.2 Onsite—*Duplicate and comparison checks*

For each detector configuration, *duplicate* measurements, or *comparison checks* associated with *continuous radon monitors (CRM)*, shall be:

a) Not less than 10% of all locations tested during each initial and *follow-up test procedure*, and

b) Distributed as widely as possible across all buildings being tested during the same testing event.

2.8.3 *Blanks required*

The local office(s) directly implementing the testing project(s) shall conduct *blank quality control check* measurements for *charcoal adsorption detectors (CAD)*, *alpha track detectors (ATD)*, and *electret ion chamber detectors (EIC)* in compliance with requirements of both a) and b) of this Section 2.8.3.

a) Project Start-up

For local office(s) directly implementing a testing project or projects that require 50 test locations or more during the same 60-day period, *blanks* shall conducted in accordance with Table 2.8.3.

| Table 2.8.3 **Project start-up** |
|---|
| For *CAD*, *ATD* and *EIC* detectors, no less than nine blanks that meet the following requirements are to be conducted prior to or in conjunction with initiating test deployments: |
| 1. Three *lab-transit blanks* (to look for unexpected exposures during shipping or handling) shall be returned to the laboratory immediately, or in conjunction with, beginning detector deployment. |
| 2. Three *office blanks* (to reveal any unexpected exposures during storage) shall remain where detectors are stored and be returned to the laboratory per normal procedure for the field detectors. |
| 3. Three *field blanks* (to reveal unexpected exposures onsite or from handling procedures) shall be deployed in the field and returned to the laboratory per normal procedure for the field detectors. |
| Standard practice of conducting not less than 5% blanks for all testing locations shall resume when the number of test locations exceeds 180 in accordance with Section 2.8.3 b. |

b) General Requirements (Blanks)

Project startup and throughout the testing project shall be subject to the following requirements:

1. The total number of blank measurements conducted and analyzed for each different detector configuration shall be not less than 5% of all testing locations where the detector configuration is deployed.
2. A portion of the required 5% *blanks* shall be field blanks with additional *blanks* dedicated to other evaluations, if and where deemed necessary, such as environments where test device inventories are stored (i.e., office blanks) and anomalies that might occur because of shipping (i.e., lab-transit blanks).
3. *Blank* measurement results associated with other *quality control* activities at the local office(s) implementing the testing project are acceptable to include for meeting testing project reporting requirements in Section 8.4.
4. For *CAD* and *ATD* detectors where storage locations have not been evaluated and monitored, *blank* measurements shall be conducted prior to deployment for detectors that have been

stored for more than 30-day durations. Alternatively, where storage locations are monitored under an ongoing program, monitoring records shall be made available upon request that verify inventories are stored in an environmentally controlled location that prevents unintended exposure to radon, high relative humidity and extreme temperatures beyond manufacturer's recommendations.

2.8.4 *Spiked measurements required*

For *CAD*, *ATD* and *EIC* measurement methods, requirements a) and b) of this Section 2.8.4 are required to provide evidence of continued accurate measurement system operation by comparing reported *spike* analyses results to a recognized reference authority for radon concentration.

a) The number of *spiked measurements* conducted and analyzed for each detector configuration associated with the testing project(s) shall be not less than 3% of *EIC* detectors and not less than 3% from each *lot* of *CAD* and *ATD* detectors placed into local inventories.

   Exception: For each detector configuration associated with the testing project(s), the maximum required is six *spikes* per month for both *EIC* detectors and from each lot of CAD and ATD detectors with no less than three *spikes* conducted each year; and

b) Spiked measurement results from *EIC* detectors and from each *lot* of *CAD* and *ATD* detectors associated with the testing project that are also associated with other quality control activities shall be acceptable to include for meeting test project reporting requirements in Section 8.4.

## 2.9 Coordinate Notifications

*Informative Advisory*—Failure to comply with required test conditions is most likely to occur when building staff and occupants are not properly informed about the necessary test conditions.

2.9.1 *Prior notification of facilitating staff*

Once a testing activity is confirmed, the property management team shall be instructed in writing to distribute notices of radon testing that inform and appropriately instruct individual facilitating staff members, such as authorized building supervisors, maintenance staff, teachers or office managers.

Notifications for facilitating staff shall comply with requirements in a) and b) of this Section 2.9.1.

a) Instructions shall be provided for distributing notices for both tested and non-tested units, and for posting of publicly viewable notices. The occupant notices provided shall include:
   1. Scheduled dates and times for test device placement and retrieval;
   2. Essential closed-building requirements portrayed in Table 4-A and that these conditions are required no later than 12 hours prior to the test and throughout the test period;
   3. Information on how to obtain federal or state radon health guidance; and
   4. Local contact information for inquiries, such as the authorized building supervisor.

   Note—Exhibits 3 and 4 provide examples of occupant notifications.

b) In addition to coordination of access, instructions shall be provided for duties required of facilitating staff, such as closing windows and adjustments to HVAC units or controls.

   Note—Exhibit 5 provides an example of written instructions for building operations staff.

2.9.2 *Prior notification of occupants*

The property management team shall be instructed and informed in writing to post notices of radon testing, as applicable, and distribute notices of radon testing no less than 24 hours prior to testing to all occupants in all buildings being tested.

## 3.0 TEST LOCATIONS

### 3.1 Ground-Contact Locations ▲

A measurement shall be conducted in all dwellings and all nonresidential rooms that are occupied, or intended to be occupied, 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.

3.1.1 *Ground-contact dwellings*

For each ground-contact dwelling or living unit, a measurement shall be conducted in 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.

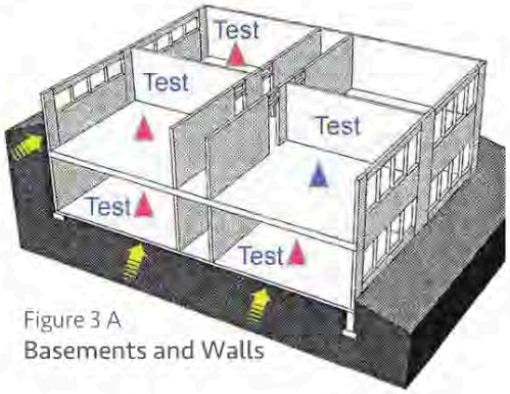


Figure 3 A
Basements and Walls

3.1.2 *Non-residential ground-contact locations*

For non-residential ground-contact locations, a measurement shall be conducted in all ground-contact rooms, offices, classrooms and other general use areas that are occupied or intended to be occupied.

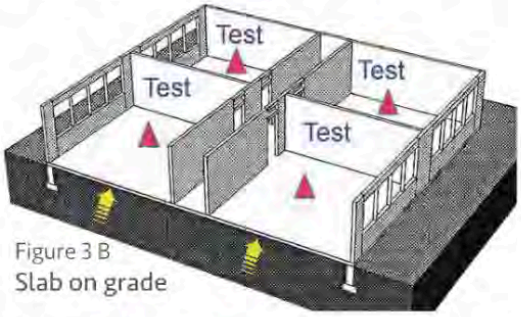


Figure 3 B
Slab on grade

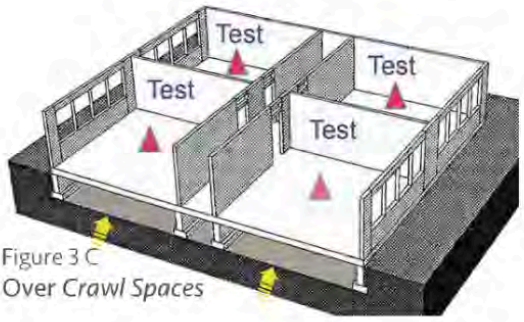


Figure 3 C
Over *Crawl Spaces*

### 3.2 Upper Floors ▲

On each upper floor, a measurement shall be conducted in at least one and not less than 10% of all dwellings and nonresidential rooms that are occupied or intended to be occupied. These measurements shall be in addition to tests performed in ground-contact locations and rooms or dwellings that adjoin immediately above untested ground-contact locations.

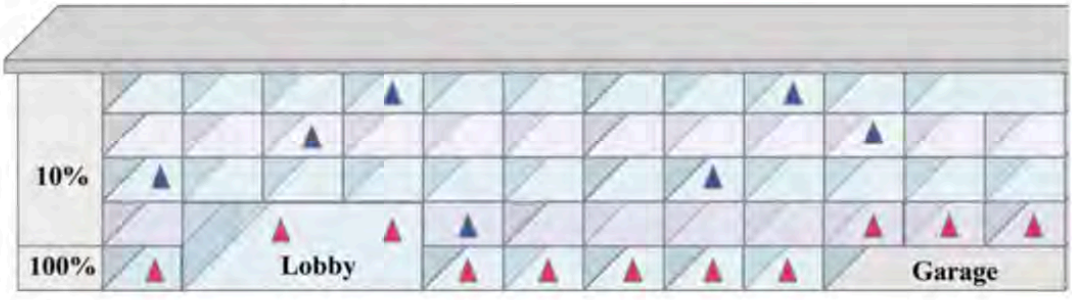
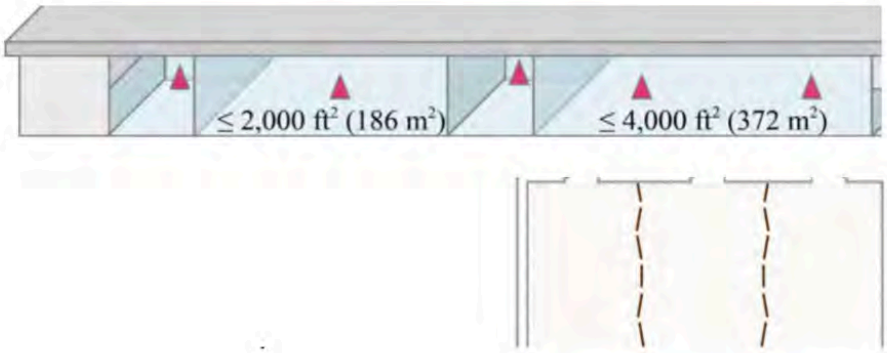


Figure 3 D
Upper floors

### 3.3 Locations Not to Test

Unless for investigative purposes, test locations shall not include hallways, closets and bathroom or shower areas unless they are open to other rooms that are occupied for other purposes.

Note—Table 3.8 provides additional requirements regarding rooms that are not to be tested.

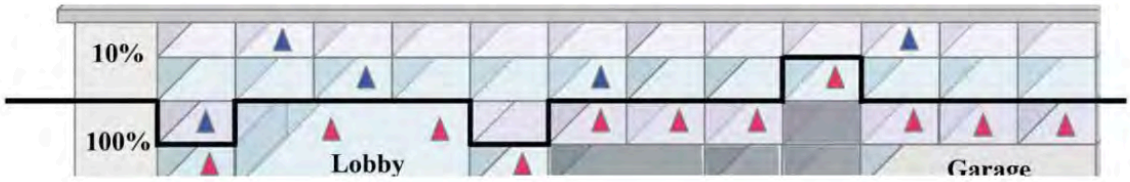


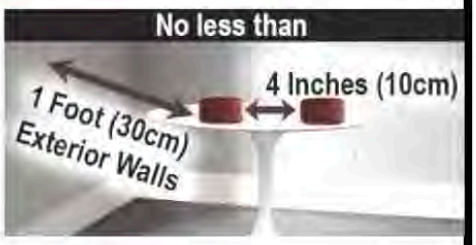
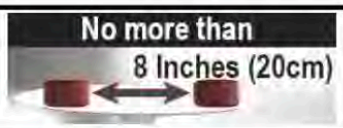

**Multi e HVAC Syste**

are served by the different HVAC syst

Ground ntact Locatio

Figure 3 H



| Table 3.8 | Requirements for Test Locations Within a Room |
|---|---|
| **Detectors shall be located NOT less than:** | ▪ 3 feet (90 cm) from exterior doors and windows or other potential openings to the outdoors.<br>▪ 20 inches (50 cm) above the floor.<br>  |
| | ▪ 1 foot (30 cm) from the exterior wall of the building.<br>▪ 1 foot (30 cm) below the ceiling.<br>▪ 4 inches (10 cm) from other test detectors and objects or surfaces that are above or to the side of the detector.<br>  <br>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. |
| **Side-by-side detectors** | Detectors are to be not more than 8 inches (20 cm) from each other when seeking to use the average test result of two side-by-side detectors for QC checks and mitigation decisions.<br>  |
| **Place detectors where not easily disturbed** | *Informative Advisory*—Select a position within the room where the detector(s) will not likely be disturbed, moved, or have their performance altered during the measurement period. |
| **Detectors shall NOT be located:** | ▪ inside closets, cabinets, drawers, sumps, crawl spaces or nooks in the building foundation. |
| | ▪ near heat sources, such as on appliances, radiators, fireplaces or in direct sunlight. |
| | ▪ near drafts caused by fans or heating and air conditioning vents or within enclosed areas of high air velocity such as mechanical/furnace closets. |
| | ▪ 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.<br>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. |
| | *Informative Advisory*—Avoid placing detectors on or near objects that may produce radiation such as natural stone, rock collections, granite counter tops, hearths and slate pool tables. |

## 4.0 TEST CONDITIONS REQUIRED

### 4.1 Closed-building protocol requirements

Closed-building conditions, as they are for occupied conditions in winter heating seasons or summer cooling seasons, in accordance with Tables 4-A, 4-B, 4-C and Section 4.2 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 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 |

### 4.2 HVAC Ventilation

4.2.1 *Outside air for combustion appliances*

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

4.2.2 *Ventilation with outside air*

Where 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 Exhibit 6 for Group 3 HVAC systems.

4.2.3 *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 Exhibit 6 for Group 4 HVAC systems.

4.3 Upper *Floor Rooms and Dwellings*

Note—Sections 6.1.3 adds specific required conditions when not testing adjoining rooms or dwellings.

| Table 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 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 |

# 5.0 TESTING PROCEDURES AND OPTIONS

## 5.1 Test Deployment Periods

5.1.1 *Test phase*

All measurement locations in each building shall be tested on the same days for:

a) All locations required in Section 3 within each building; and

b) All locations identified within each building for follow-up test procedures.

5.1.2 *Minimum deployment periods*

While deployment periods should optimally collect at least 48 hours of valid sampling time, tests shall be conducted continuously for durations that are:

a) not less than 46 hours under closed-building conditions that comply with Section 4; and

b) not less than the minimum exposure time recommended by the manufacturer of the device.

Note—For tests extended an additional day or more, it is best to terminate the test at a similar time of day as when the test was started to more evenly account for day-to-night fluctuations of radon entry.

5.1.3 *Non-residential deployment periods*

Where the building or portion of the building is not significantly occupied 24 hours a day, such as a school or office building, testing shall only be conducted, in accordance with Section 5.1.2, during portions of a week when the building is significantly occupied.

**Exception—**Where HVAC systems are not operated differently during nights, weekends and holidays compared to when occupied by most workers or students.

5.1.4 *Longer test periods*

When longer test periods are chosen with intent to more closely evaluate the annual average radon concentration before deciding if mitigation is warranted, the test period shall include heating season conditions that are not less than the percentage of year when heating systems are active.

**Exception:** Where heating season conditions are not the normal occupied building operating condition as defined in Normative Appendix A.

## 5.2 Evaluation of Occupied Versus Unoccupied Concentrations

For non-residential buildings or portions of a building that are not significantly occupied day and night most the year, an evaluation of occupied versus unoccupied radon concentrations is recommended and shall be permitted as an additional line of evidence relative to mitigation decisions. When conducting such evaluation, the test devices, procedures and reporting shall comply with Normative Appendix B.

5.2.1 *When to conduct the evaluation*

An evaluation of occupied versus unoccupied radon concentrations is permitted during initial testing, follow-up testing, post-mitigation testing, or in a series of sequential tests. An evaluation that simulates various building operating conditions is also permitted in accordance with Normative Appendix B-2.

5.2.2 *Where to conduct the evaluation*

*Informative advisories:* During initial testing, the evaluation is recommended for each unique sector at locations where airflow from HVAC systems is most representative of occupied rooms within the unique sector. For follow-up testing, the evaluation is recommended for at least the location of the highest radon concentration found during previous measurements within each unique sector.

## 5.3 The Time-Sensitive Testing Option

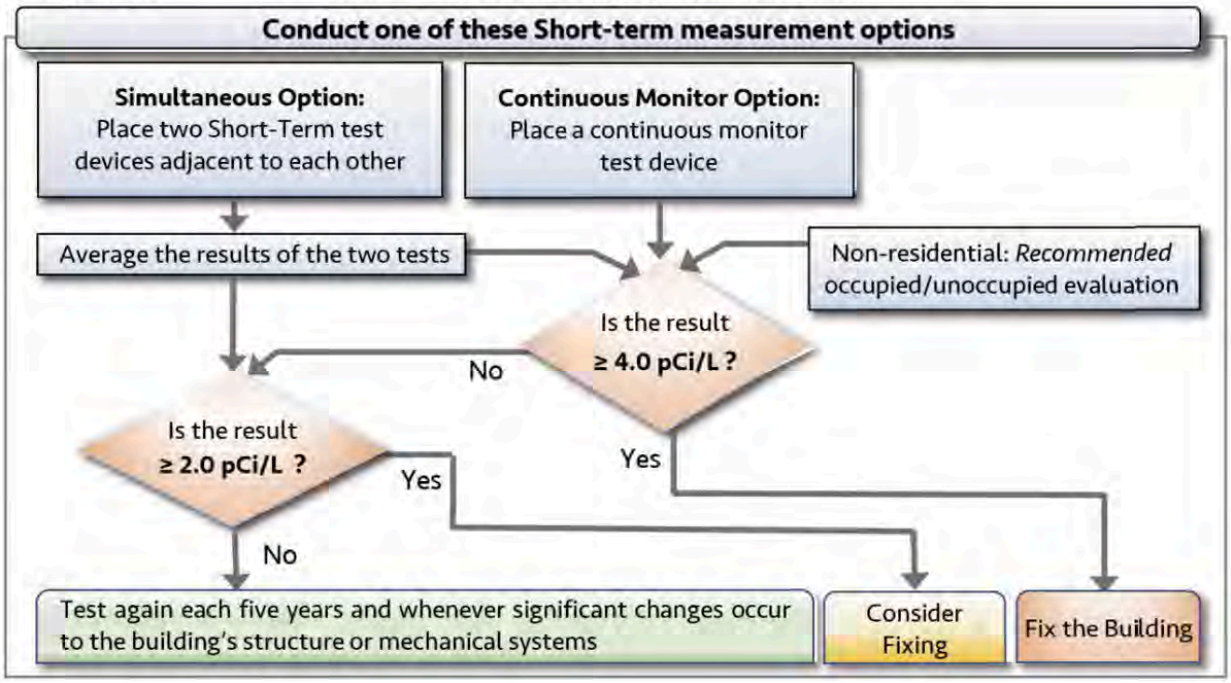
Note—This protocol builds upon protocols developed by EPA, relative to EPA's *"Home Buyer's and Seller's Guide to Radon."*

| Table 5.3 | | Time-Sensitive Testing Option—Required Procedure and Summary |
|---|---|---|
| **Step 1 Options** | *Simultaneous Testing Option* | Tests at each test location are conducted using two short-term test devices at the same time, 4 to 8 inches (10-20 cm) apart. |
| | *Continuous Monitor Option* | Tests at each test location are conducted using a monitor that records retrievable hourly measurements. |
| | | Evaluations of occupied versus unoccupied radon concentrations are additionally recommended for non-residential locations. |
| **Step 2** | | **Decisions to Fix the Building** |
| | | Mitigation decisions are to be based on the average result from a continuous monitor or the average of two test results conducted at the same time in the same location. [1, 2]<br><br>Fix the building<br>if test results meet or exceed the action level, e.g., 4 pCi/L. Consider fixing the building if results are greater than half the action level, e.g., between 2 and 4 pCi/L. |

[1] Where evaluations of occupied versus unoccupied concentrations have been conducted in accordance with Section 5.2, report recommendations shall account for radon exposures indicated by the evaluation.

[2] Section 7.2 provides requirements for when the test result from two short-term test devices disagree in terms of making a mitigation decision.

Figure 5.3 **Time-Sensitive Testing Option Flowchart**



## 5.4 The Extended Testing Option

Note—This protocol builds upon those developed by EPA, relative to EPA's *"A Citizen's Guide to Radon."*

| Table 5.4 | Extended Testing Option—Required Procedure and Summary | |
|---|---|---|
| **Step 1** | *Initial Test* | Testing at each location is conducted using a single short-term device. |
| | | Evaluations of occupied versus unoccupied radon concentrations are additionally recommended for non-residential locations. |
| **Step 2** | *Follow-up Test Options* | **Retest locations that meet or exceed the action level, e.g., 4 pCi/L. Follow-up testing requirements allow the following options:** [1,2] |
| | a) | A second test with a short-term device is conducted. Where a first test is twice the action level or greater, this confirmation test should be conducted without delay; or |
| | b) | Where a first test is less than twice the action level, testing can be conducted with a long-term test device for an extended period if the situation allows a closer evaluation of annual average to radon concentrations; or |
| | c) | Evaluation of occupied versus unoccupied radon concentrations for non-residential locations. |
| **Step 3** | **Decisions to Fix the Building** | |
| | Mitigation decisions are to be based on the average of the two test results from short-term devices or the results from long-term testing [3,4]<br>**Fix the building**<br>if test results meet or exceed the action level, e.g., 4 pCi/L. Consider fixing the building if results are greater than half the action level, e.g., between 2 and 4 pCi/L. | |

[1] Where follow-up testing is not completed within 12 months after completing Step 1, the testing procedure shall be restarted with Step 1, in accordance with either Section 5.3 or this Section 5.4.

[2] Note—While decisions to mitigate at any time are not prohibited, the second test aids confidence that decisions are not being made based on a faulty test device or unexpected conditions.

[3] Note—Section 7.2 provides requirements for when the test result from two short-term test devices disagree in terms of making a mitigation decision.

[4] Where evaluations of occupied versus unoccupied concentrations have been conducted in accordance with Section 5.2, report recommendations shall account for radon exposures indicated by the evaluation.

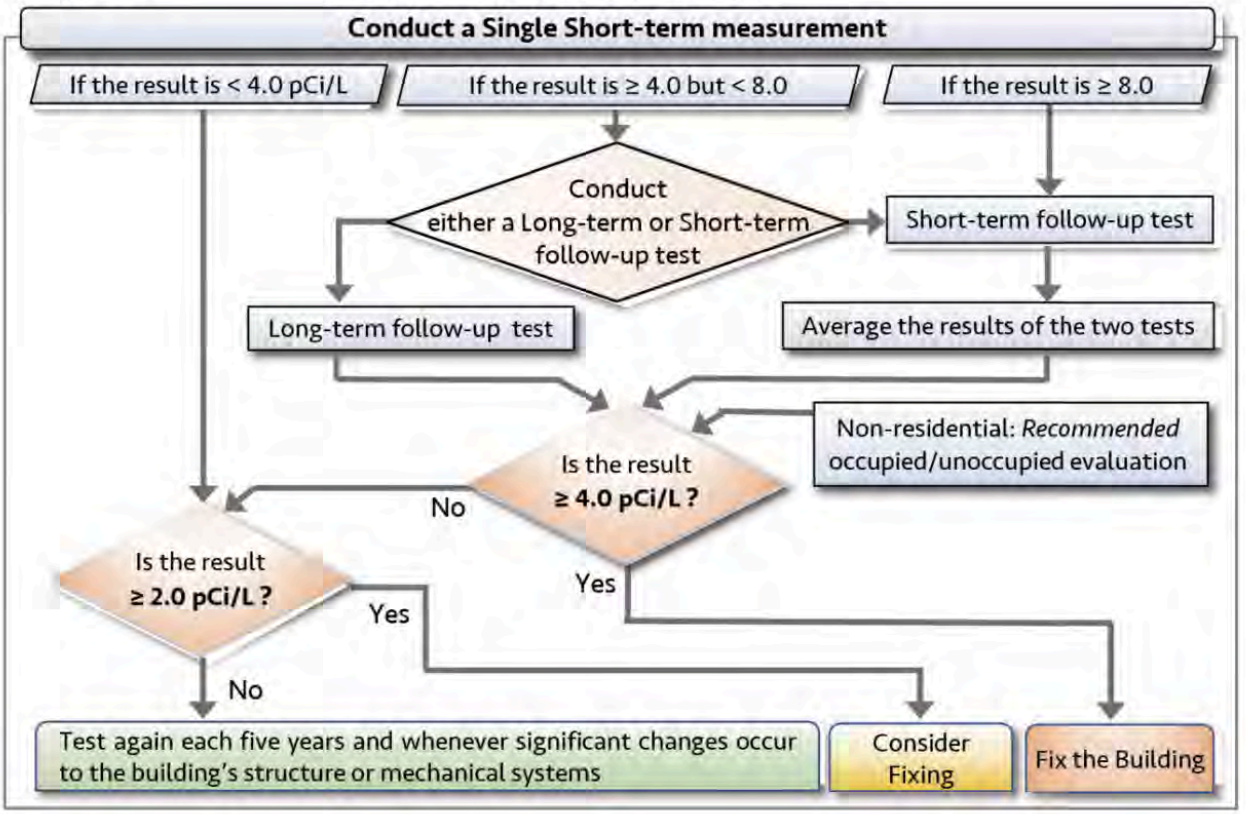
### 5.4.1 *Client Advisory required*

If choosing to use the Extended testing option in Table 5.4 under a time-sensitive situation, the client shall be informed in writing prior to conducting tests that:

a) Test results from Steps 1 and 2 of the Extended testing protocol are to be used for mitigation decisions, and

b) Time-sensitive situations will often not permit long test periods to more closely evaluate annual exposures to radon.

Figure 5.4 **Extended Testing Option Flowchart**




5.4.2 *Long-term test option*

Mitigation decisions are permitted to be based solely upon testing that is conducted with a long-term test device at each test location where the test period meets requirements in Section 5.1.4 to account for seasonal conditions and either:

a) the test location is a residential dwelling or living space, or

b) the test location is non-residential with HVAC systems that are not operated differently during nights and weekends compared to when occupied by most workers or students.

Note—Test periods employed for this purpose in the U.S. are commonly those greater than 90 days. Tests that are longer than 2-7 days can reduce the influence of short-lived temporary conditions on test results. However, regardless of test duration, any correlation between the test result and the annual average radon concentration depends upon building conditions during the test.

## 5.5 Testing A Single Room or Dwelling

Note—Section 6.1.3 adds additional required conditions when testing only individual rooms or dwellings.

## 5.6 New Construction

For buildings constructed with radon-resistant features, initial testing shall be conducted normally, such as required in accordance with either Section 5.3 (Time-Sensitive Testing Option) or Section 5.4 (Extended Testing Option).

## 5.7 Post-Mitigation Testing Protocols

Testing after mitigation efforts shall be conducted in accordance with Section 7.3 where effectiveness is judged based on one test event with one or more test devices at each location to be tested.

## 6.0 CONDUCTING THE TEST

### 6.1 Quality Control of Required Test Conditions

*Informative advisory*—Avoid testing during weather that is unusually severe for local weather if the test period is less than 72 hours. When this occurs during a test, retesting may be appropriate.

6.1.1 *Where closed-building conditions cannot be maintained*

Tests shall not be conducted if closed building conditions, as required in Section 4, cannot be maintained across the test period for tests lasting up to 90 days.

6.1.2 *Where closed-building conditions did not occur prior to the test*

Where closed-building conditions were not maintained for twelve hours prior to deployment, as required in Section 4, the radon testing shall be conducted with one of the following options:

a) The testing is postponed until at least 12 hours of closed-building conditions have been maintained prior to initiating the test; or

b) The test period is extends not less than 72 hours after closed-building conditions are initiated; or

c) The test period is extended, if testing with a continuous monitor. For this option, device features or other methods shall be employed to obtain an average test result that represents no less than 46 hours of contiguous data collected after 12 hours of closed building conditions were maintained.

6.1.3 *Individual dwellings or rooms*

When testing only one or several dwellings or rooms that are part of a shared building, such as when testing upper floors identified in Section 3.2 or an individual apartment, classroom or office, minimum requirements include closed-building conditions in accordance with Section 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.

6.1.4 *Failed closed conditions*

Where compliance with closed-building conditions in Section 4 did not occur for non-residential rooms, dwellings or untested ground-contact spaces, retest procedures shall include retesting those rooms or dwellings and any tested rooms or dwellings:

a) that immediately adjoin the side, above and below such locations, and

b) that share the same heating or cooling air ducts.

6.1.5 *Where closed conditions pose a health hazard*

If observing that closed-building conditions present a health hazard, the test shall not be conducted under conditions that place an occupant in harm's way.

Note—Hot weather is an example where closed building conditions can pose a health hazard in buildings that have no cooling systems. Safe conditions can violate requirements of this standard such as use of outdoor air ventilation, window fans or evaporative cooling systems.

6.1.6 *Fulfilling minimum requirements*

To fulfill minimum requirements for verifying test conditions, all the following steps, which are covered in greater detail elsewhere in this standard, are required:

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

b) Ensure that notifications of a "Radon Test in Progress" are posted in conspicuous locations.

Note—Exhibits 4 and 8 provide examples of public notices, door hangers and device placards;

c) Obtain or attempt to obtain a signed statement from the onsite supervisor or other facilitating staff member(s) regarding a commitment to aid in the quality control of closed-building conditions; and

d) Conduct visual inspections.
Visual inspections to evaluate observed conditions and document deviations from protocol or temporary conditions that might affect the reliability of the test result shall be conducted:

1. Upon detector placement to help ensure all closed-building conditions and other protocol requirements are met, and
2. Upon retrieval of detectors to help verify that closed-building conditions and other protocol requirements are still being maintained.

e) Surveillance not required
The measurement professional is not required to inspect for closed-building conditions during the 12-hour period before the start of the test or between placement and retrieval of the detectors.

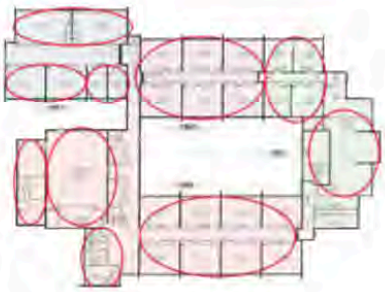
6.1.7 *Visual Inspections*

Where observations suggest reliability of the testing may be compromised, the observations shall be transmitted in a timely manner to person(s) responsible for quality control and recorded in testing records. To that end, the scope of visual inspections required in Section 6.1.6 d shall include requirements a), b), c) and d) of this Section 6.1.7.

a) Testing records shall include any observed deviations from basic closed-building requirements in Section 4.1; Tables 4-A, 4-B and 4-C; and Section 6.1.3 (Individual dwellings or rooms). Testing records shall also include where efforts to influence the outcome of the test are observed, to include tampering with devices or otherwise influencing test conditions.

b) Where, in accordance with Section 4.2, unique sectors of the building have been identified or found to be served by HVAC operation or designs that temporarily vary ventilation, requirements include:

1. Variable outdoor air ventilation
Testing records shall include a description of any observed outdoor air intakes that do not appear to be configured to provide the minimum volume of outdoor air ventilation needed at all times of the year when a building or unique sector is significantly occupied.
2. Variable air volume (VAV)
Testing records shall include a description of any observed thermostats or controls for variable air distribution (VAV) systems that are not set to a normal occupied temperature in portions of the building served by the system(s).



c) Return-air ducts laid in soil
Testing records shall include if return-air ducts are observed under slabs or otherwise surrounded by soil where this relates to:

1. Compliance with reporting requirements in Section 8.2.3 b Temporary conditions, or
2. Decisions on whether an evaluation of occupied versus unoccupied concentrations, in accordance with Section 5.2, may be warranted.

d) HVAC setback for non-residential locations
Testing records shall include if non-residential rooms are observed to be operating with HVAC setback temperatures when not significantly occupied that are outside of normal occupied temperatures of 65˚and 80˚ F (18˚ - 27˚ C) where this relates to:

1. Compliance with provisions in Section 5.1.3 (Non-residential deployment periods), or
2. Decisions on whether an evaluation of occupied versus unoccupied concentrations, in accordance with Section 5.2, may be warranted.

## 6.2 Quality Control for Number of Valid Tests

Unless it is decided at any juncture to proceed with mitigation, testing and follow-up testing shall continue until a valid test, compliant with all requirements of this standard, is achieved at all locations intended to be tested.

**Exception**: Allowances shall be permitted due to inaccessible locations or missing detectors upon retrieval, to the extent allowed by requirements in a), b) and c) of this Section 6.2.

These allowances shall be applicable individually for two distinctly different areas within each building: (1) the number of required ground-contact test locations, and (2) the number of tests required on upper floors.

a) Where all valid measurement results at the property are less than 4.0 pCi/L (150 Bq/m$^3$) and all valid measurement results in the building are less than 2.7 pCi/L (100 Bq/m$^3$), the number of missing valid tests shall not exceed the allowance in Table 6.2.1.[6]

**Table 6.2.1**

| Test Locations: | 3-5 | 6-10 | 9-11 | 12-16 | 15-20 | 18 or more |
|---|---|---|---|---|---|---|
| Allowance: | 1 | 2 | 3 | 4 | 5 | ≤ 33% |

b) Where any valid measurement at the property is 4.0 pCi/L (150 Bq/m$^3$) or more, or where any valid measurement result in a building is 2.7 pCi/L (100 Bq/m$^3$) or more, the number of missing valid tests for the property or for the building, respectively, shall not exceed the allowance in Table 6.2.2.[7]

**Table 6.2.2**

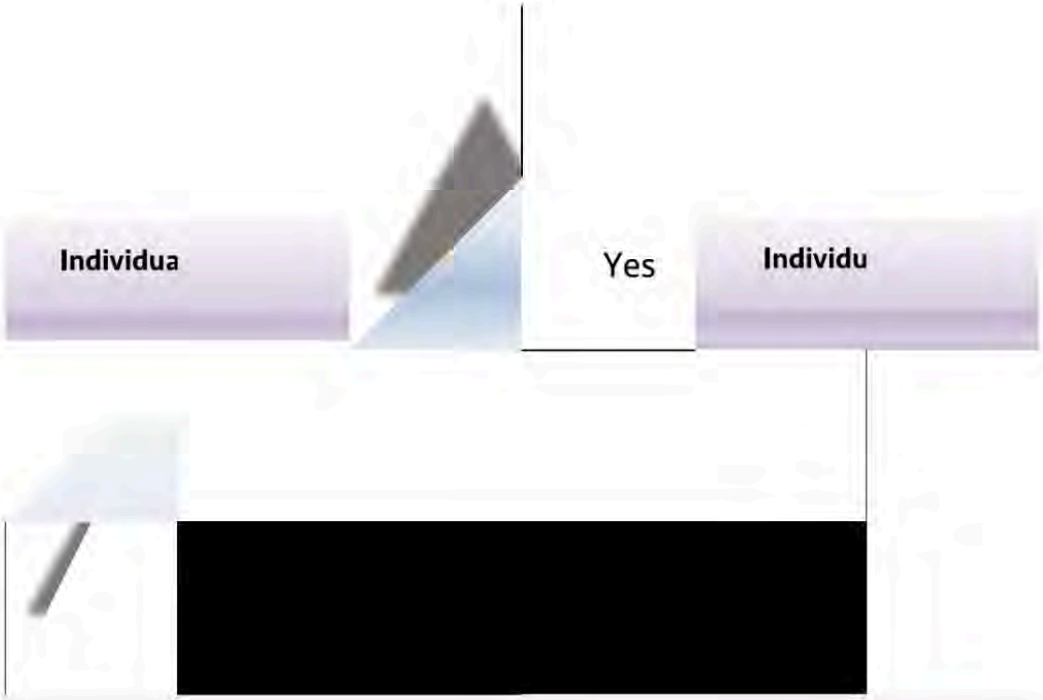
| Test Locations: | < 4 | 4-7 | 8-11 | 12-15 | 16-19 | 20 or more |
|---|---|---|---|---|---|---|
| Allowance: | 0 | 1 | 2 | 3 | 4 | ≤ 25% |

*Note—This allowance observes that the parcel of land where buildings reside has been shown to produce radon in soil sufficient to lead to elevated indoor radon concentrations.*

c) An allowance is not extended for two side-by-side ground-contact units or rooms that did not achieve a valid test, even though they were both intended to be tested.

[6] MIL-STD-105E, MILITARY STANDARD (1989): Sampling Procedures and Tables for Inspection by Attributes.

[7] Evaluating and Assessing Radon Testing in Housing with Multifamily Financing (EARTH).




25%, as calculated individuall

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search Staff, Oak Ridge National Laboratory. AARST Radon Reporter, March 2

## 6.3 Quality Control for Test Devices

Quality control check measurements deployed and retrieved shall include:

a) Duplicate measurements or comparison checks for all device types at not less than 10% of all locations being tested in accordance with Section 2.8.2; and

b) Field Blank measurements for *CAD*, *ATD* and *EIC* detectors, in accordance with Section 2.8.3.

## 6.4 Test Site Documentation

### 6.4.1 *Update testing records*

Floor plan diagrams or other records for tracking test locations shall be updated to achieve a record of:

a) Test locations, addresses, rooms and mechanical systems or conditions observed that were inadvertently omitted or different than found during initial efforts to assemble building information;

b) The nature of non-residential occupancies, such as locations occupied for educational, retail, food, beverage, or office purposes. This includes noting if significantly occupied hours of the day, portions of the week or months of the year are different than typically expected for such establishment; and

c) Building foundation types such as slab-on-grade, basement and crawl space foundations in the building being tested.

### 6.4.2 *Test device logs*

No later than in conjunction with retrieval of devices and detectors, site testing logs shall be completed to include:

a) Essential tracking details
   1. Test location identification or address with any location specific notes,
   2. Detector identification/serial numbers,
   3. The start and stop dates and times of the measurement period; and

b) Test reliability
   1. A record of conditions that are known or suspected to impact the reliability of the test at any location, and
   2. Annotation for each quality control check measurement to indicate its purpose.

## 6.5 Submitting Detectors to a Laboratory

Detectors shall be forwarded to the laboratory as soon as possible in accordance with laboratory requirements to ensure quality of analysis procedures. Information provided to the laboratory shall include:

a) The address of the property tested to include street address, city, state, and zip code.

b) Detector identification/serial numbers, and

c) The start and stop dates and times of the measurement period.

# 7.0 ACTIONS BASED ON TEST RESULTS

## 7.1 Action Level Guidance

Countries worldwide have adopted action levels for radon exposures. The action level observed should comply with the guidance of the country, state or local jurisdiction of authority where the test is being conducted.

U.S. Action Level. The following action level descriptions reflect guidance from the United States Environmental Protection Agency (EPA):

- 4 pCi/L or greater (≥ 150 Bq/m$^3$)
  Fix the building. The higher the radon concentration, the more quickly action should be taken to reduce the concentrations.
- Below 4 pCi/L (< 150 Bq/m$^3$)
  Consider fixing the building if test results indicate that radon concentrations are greater than half the action level, such as between 2 and 4 pCi/L (75 and 150 Bq/m$^3$).

  With observance that hazards from radon are virtually the same for radon concentrations that are near action level thresholds, it is noteworthy that the World Health Organization recommends limiting long-term exposures to less than 2.7 pCi/L (100 Bq/m$^3$).

  When measurement devices indicate concentrations lower than about 2.0 pCi/L (75 Bq/m$^3$), test data should normally be interpreted as being lower than the test device can accurately measure.

## 7.2 When Two Test Results Disagree

7.2.1 *Acceptable difference*

When two test devices were deployed to test the same testing location, the average of the two test results shall be reported as the value used for determining needs for mitigation if:

a) both test results are above the action level, or
b) both test results are below the action level.

7.2.2 *Where test results disagree on exceeding the action level*

When one test result is above the action level and the other test result is below the action level:

a) Acceptable Difference
   If the higher result is less than twice the lower result, the average of the test results shall be reported as the value used to determine if this location needs mitigation; and
b) Not Acceptable
   If the higher test result is more than twice the lower test result:
   1. For two collocated (side-by-side) tests conducted at the same time, a repeated collocated test for this location is required to obtain a valid measurement; and
   2. For two short-term detectors deployed at different times in the same location, obtaining confirmation on whether or not mitigation is warranted requires additional testing unless it is decided to proceed with mitigation.
      This degree of uncertainty requires a precautionary stance to include that the higher test result shall be regarded as correct for making mitigation decisions unless further testing indicates otherwise.

Test results to be regarded as a more accurate reflection of occupant exposure to radon hazards shall be those that most closely align to the predominant normal occupied building operating condition for the location tested, as defined in Section 2.7.2.

When conducting confirmation testing:

a. the testing shall be conducted under building conditions that are representative of the predominant normal occupied building operating condition, as defined in Section 2.7.2.
b. testing shall be initiated within 1 year after initial testing unless the evaluation is relative to older, historic test results; and
c. the evaluations shall be permitted based on data from short-term or long-term test devices or data from evaluations of occupied versus unoccupied radon concentrations.

## 7.3 Post-Mitigation Testing Protocol

The following procedures are required for determining if additional mitigation efforts are warranted.

### 7.3.1 *General procedures—Post-mitigation testing*

One or more short-term test devices shall be deployed at each test location to evaluate the effectiveness of the mitigation efforts. These measurements shall be conducted no sooner than 24 hours after activation of a mitigation system fan or completion of other mitigation efforts. In addition, closed-building conditions, in accordance with Section 4, shall be maintained 12 hours prior to and throughout the test period. Testing shall be either:

a) postponed until both conditions are met, or
b) extended if testing with a continuous monitor where device features or other methods shall be used to obtain an average reading that represents no less than 46 hours of contiguous data collected after both conditions are met.

### 7.3.2 *Clearance Testing*

Clearance testing to verify all portions of a building are below the action level shall comply with all requirements in a) and b) of this Section 7.3.2.

a) Test locations
   1. Test locations shall include all ground-contact dwellings and non-residential rooms, in accordance with Section 3, to include not less than 10% of the dwellings and non-residential rooms on each upper floor; and
   2. Where any active soil depressurization (ASD) system exhausts below the roof, a test shall also be conducted in the room(s) immediately adjoining the outside exhaust location.

b) Clearance testing—Failed locations

   Where clearance testing reveals a need for additional mitigation efforts, testing specific locations after additional mitigation efforts shall be sufficient for meeting clearance test requirements if the following requirements are met:

   1. Where the mitigation method is active soil depressurization (ASD) and the mitigated locations are served by individual HVAC systems described in Exhibit 6 for Group 1 (Basic Heating and Cooling): Testing shall include all locations where clearance testing revealed elevated radon concentrations.
   2. Where mitigation methods are based on passive mitigation efforts: Testing shall include all locations where clearance testing revealed elevated radon concentrations.

3. Where mitigation methods rely on HVAC mechanical systems to provide dilution or pressurization of indoor air, testing shall include:
    a. All locations required in Section 3 within each unique sector mitigated, and
    b. At least one measurement in each adjoining sector served by a different HVAC system.

7.3.3 *System Performance Testing*

Performance testing mitigation systems by testing only locations where elevated radon concentrations have been found shall not be reported as clearance testing verification that a building has been fixed. Performance testing mitigation systems shall be limited to evaluations of active systems prior to clearance testing or related to maintenance of active systems.

# MA-MFLB
# Companion Guidance

AARST CONSORTIUM

Advisory—The information contained in this guidance document is not part of this ANSI/AARST American National Standard (ANS) and does not contain requirements necessary for conformance to this standard. The information contained in this guidance document has not been processed in accordance with ANSI's requirements for an ANS. As such, this guidance document may contain material that has not been subjected to public review or a consensus process.

**CONTENTS**



# Informational Introduction to Radon

## A. Radon Facts

Radon is a naturally occurring radioactive gas that 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 world. 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, they release small bursts of radiation that can damage lung tissue and lead to lung cancer over the course of a lifetime. Studies by the U.S. Environmental Protection Agency (EPA) have found that radon concentrations in outdoor air average about 0.4 pCi/L (picocuries per liter) of air. However, radon 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, but EPA calculates that radon may cause 21,000 lung cancer deaths in the United States each year. The U.S. Surgeon General has warned that radon is the leading cause of lung cancer deaths in nonsmokers in the United States. 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 primarily 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.

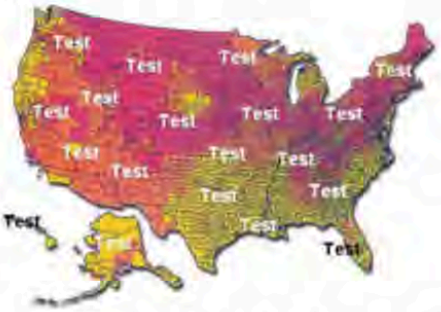
Risk increases as an individual is exposed to higher concentrations of radon over a longer period. Smoking combined with radon is an especially serious health risk. The risk of dying from lung cancer caused by radon is much greater for smokers than it is for nonsmokers.

## C. Radon Exposure

Because many people spend much of their time at home, the home is likely to be where the most significant radon exposure occurs. According to EPA, nearly one out of every 15 homes in the United States is estimated to have radon concentrations that exceed the EPA action level. For most people, the second largest exposure to radon is likely to be at their school or workplace.

Elevated concentrations of radon have been found in homes and other buildings in every U.S. state and similarly throughout the world. According to EPA studies, nearly one out of every five schools in the United States are estimated to have radon concentrations that exceed the EPA action level in at least one frequently occupied ground-contact room.

While elevated radon may be more common in some areas, any building can have a problem. It is recommended that ALL buildings be tested regardless of the area of the country and that maps should not be used to determine whether to test.




The concentration of radon in the air within a building should be reduced below the federally established radon action level or as established by the state or other local jurisdiction. Action levels, such as 4 pCi/L established in the United States, are based largely on the ability of current mitigation technologies to consistently reduce radon concentrations. Any radon exposure creates some risk; no concentration of radon is safe. Even radon concentrations below the action level pose some risk, and the risk of lung cancer can be reduced by further lowering indoor radon concentrations. Depending on the building characteristics, radon concentrations in some buildings can be reduced well below the action level. In others, reducing radon concentrations below the action level 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 may also enter buildings in well water. Radon from well water used in a building can off-gas and raise concentrations in the air within the building. For buildings or small communities that use well water, a test of the water

for radon should be considered, especially if the building is vacant or there is no water use when testing for radon in air. Radon in water testing is covered in a separate document and is beyond the scope of this testing protocol. More information on radon in drinking water is available at state radon offices, local drinking water safety programs or at federal water safety programs (e.g., EPA's Drinking Water Hotline (800) 426-4791

Sometimes building materials that contain uranium and radium can produce radon in sufficient amounts to result in elevated radon concentrations in the air. A radiation professional or local 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, building managers cannot know without testing if elevated concentrations of radon are present. The following factors determine why some buildings have elevated radon concentrations and others do not:

- **Source Strength:** The concentration of radon in the soil gas;
- **Gas Mobility:** The permeability of the soil or sub-surface geology under the building;
- **Structure and Construction** of a building; and,
- **Mechanical Systems:** The type, design, operation, and maintenance of the heating, ventilating, and air-conditioning system.

**Source strength:** The radon concentration in soil gas under structures can vary greatly from one building to the next. 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 room or portion of a building to have a radon concentration significantly higher than other nearby areas. 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 radon entry rate. For example, if the air pressure in the building is greater than the air pressure under the building's foundation, radon is less likely to 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 can have a radon problem even though building design and construction impact radon entry and ventilation once radon enters. Testing is the only way to know if elevated concentrations of radon are present.

**Heating, cooling and ventilation systems:**

Depending on their design and operation, HVAC systems can influence radon concentrations in buildings:

- Ventilation with outdoor air serves to dilute indoor radon concentrations; however, radon gas potency most often overwhelms the practical limits of increasing ventilation to adequately reduce occupant exposure.
- Poor ventilation provides less dilution of 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 needed to dilute indoor contaminants. An understanding of the design, operation and maintenance of a building's HVAC system and its influence on indoor air is helpful for managing radon problems and other indoor air quality problems in buildings. However, since HVAC systems are only one of many factors that affect radon concentrations in a building, their modifications are often not an effective stand-alone radon mitigation strategy.

## E. Contacts for Additional Information

**In the United States:**

- EPA website http://www.epa.gov/radon
- State radon offices: https://www.epa.gov/radon/epa-map-radon-zones-and-supplemental-information#datainfo
- Regional EPA offices: https://www.epa.gov/aboutepa/visiting-regional-office
- The National Radon Proficiency Program (NRPP): www.nrpp.info
- The National Radon Safety Board (NRSB) - Radon Proficiency Program: www.nrsb.org

**In Canada:**

- Health Canada https://www.canada.ca/en/health-canada/services/health-risks-safety/radiation/radon.html
- Canadian—National Radon Proficiency Program (C-NRPP): https://c-nrpp.ca/

## CG Section 2
## Guidance for Building Managers

### A. Introduction and Planning

The purpose of radon testing is to identify locations that have elevated radon concentrations and to determine if radon mitigation is necessary to protect the health of current and future occupants. -n 02

***Planning***

Planning to test a building for radon requires a basic understanding of the testing process and the steps that are necessary to ensure results are reliable. Radon testing requires careful planning and record-keeping. It requires determining appropriate test locations and handling large numbers of devices.

Use a trained professional who has demonstrated a minimum degree of appropriate technical knowledge and skills specific to design and implementation of the radon testing program.

If considering existing staff personnel, they should obtain national, and if applicable, local state certification or licensure prior to testing. Demonstration of personal proficiency by means of a license or certification is required by some jurisdictions.

***Preparation***

Poorly designed studies can lead to unnecessary expense, disruption and misinterpretation of data. Specifically, to plan for radon testing, you will need to:

- Become familiar with testing methods;
- Become familiar with building conditions required to conduct reliable radon tests;
- Gather building information pertinent to the design of a radon testing plan, including floor plan diagrams for ground-contact dwellings and non-residential rooms;
- Review logistics and estimate the number of detectors, including those for quality control (QC), when evaluating costs and competitive bids from companies providing radon testing services;
- Design, implement and document a plan to coordinate activities between staff and radon professionals;
- Investigate whether any previous tests have been conducted and collect any available test results; and
- Become familiar with radon reduction recommendations.

### B. Communication Plan

Develop a written communication plan for disseminating information throughout the process to all affected parties. Include senior staff, health and safety staff, appropriate communications staff, maintenance staff, and the radon measurement professional when developing the communication plan. This plan should be agreed to and signed by the responsible parties.

***Prior to the test:***

- Develop notices (with general information, instructions, and point of contact for inquiries) that can be made specific for each affected audience, including:
  - Facilitating staff
    These are people responsible for oversight of test devices and building conditions during the testing period such as building managers, maintenance managers, teachers, and other supervisors;
  - Occupants, which for non-residential occupancies may include students and workers; and
  - Guardians of occupants under supervised care that may include students
- Develop timetables and methods for distribution of notices.
- Specify the staff member responsible for onsite activities.

- Specify additional communication paths between senior staff, facilitating staff, maintenance staff and the professional radon service provider.
- Specify the procedure for internal distribution of radon test data including:
  - Who is designated to receive data or reports from the radon measurement professional.
  - What situations, if any, warrant reporting interim and incomplete test results prior to completion of all test phases. This should be decided prior to any situation where follow-up testing is a component of the chosen test strategy.
- Identify who is responsible for developing contingency plans for unexpected challenges during the testing.
- Identify who is granted permission to respond to public inquiries.
- Specify the procedure and mechanism for disclosing the radon test results and the person(s) allowed to discuss test results with occupants, parents or other parties.

***Pre-test notifications***

Distribute notices of radon testing at least two weeks in advance of beginning testing and again a few days before the test to appropriate staff and occupants. Poor communications prior to testing can lead to test disruption and unusable data, creating unnecessary expense and aggravation.

Note—Section 2.6 and Exhibits 2 through 5 provide details and sample notification forms.

***After the test – A Recommendation***

Full public disclosure of radon test results for large buildings is strongly recommended and, in some localities, required by law. Failure to disclose test results can deprive current and future occupants of information necessary to avoid risk, thereby increasing the culpability of building owners and managers.

**C. Selecting a Radon Measurement Professional**

The goal is to select a radon measurement professional who will provide reliable services and procedures. Use experienced professionals that have demonstrated a minimum degree of appropriate technical knowledge and skills both sufficient to place, retrieve and analyze (as applicable) radon detectors and to design, plan, and implement quality procedures when conducting radon measurements.

**Test devices:**

All equipment used for measuring radon must meet requirements of the local jurisdiction or be listed by a nationally recognized radon proficiency program if the jurisdiction has no device verification program.

**D. Role of a Facility's Personnel**

Because the facility's personnel frequently have knowledge of the building and the occupants, they can play a key role during the testing process, especially in planning and efficient use of professional services. By providing floor plan diagrams, when available, and timely access to rooms, the facility personnel can help the radon measurement professional to quickly plan the testing strategy and achieve reliable results.

It is strongly recommended that untrained personnel serve only in these support roles for trained and certified or licensed radon measurement professionals. Specific training that includes demonstration of proficiency in the use of detectors should be obtained prior to assisting a qualified radon measurement professional in placing and retrieving detectors.

**E. Documenting the Testing Program**

The building managers or owners should maintain a record of the testing program for future reference.

**F. When to Test**

While testing at any time can provide valuable information, confidence that elevated radon concentrations are not present is best achieved with tests conducted during periods that reasonably represent:

a) The normal occupied operating condition for the building or unique sector of the building.

b) Testing periods when the operating conditions are most likely to emphasize a clear characterization of a radon hazard.

Note—For most locations in the U.S., this would be during the heating season (e.g., winter). See Appendix A for more information.

## G. Retesting When Tests Have Indicated Low Radon Concentrations

Retesting the building at least every 5 years is recommended. Testing may be conducted more often to gain more information. Many factors can cause indoor radon concentrations in a building to change over time. These changes may produce variations in radon concentrations compared to previous tests.

It is recommended to test again when any of the following circumstances occur:

- ✓ A new addition is constructed, or significant renovation takes place;
- ✓ A ground contact area not previously tested is occupied or subsequent to taking occupancy of a building;
- ✓ Heating or cooling systems are significantly altered resulting in changes to air pressures or distribution;
- ✓ Ventilation is significantly altered by extensive weatherization, changes to mechanical systems or comparable procedures;
- ✓ Significant openings to soil occur due to:
  - — groundwater or slab surface water control systems (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
- ✓ An installed mitigation system is altered, modified or repaired.

## H. Mitigation

### *Timing*

How quickly to begin the mitigation process will depend on the initial radon concentration detected. Radon concentrations of more than twice the action level requires a more rapid response, e.g., more than 8 pCi/L (296 Bq/m$^3$).

### *The Need for Professional Mitigation Guidance*

Lowering radon concentrations requires special training, skills and experience. Persons qualified in varied disciplines with different skill sets are often needed. It is critical that persons, including radon professionals, be qualified for their apportioned task.

To successfully lower radon concentrations with confidence, the management team, contractor or contracting team needs to include individuals with experience in radon mitigation who have demonstrated a minimum degree of appropriate technical knowledge and skills specific to radon mitigation in the size of building being mitigated.

### Prior Design Diagnostics

Conditions in the entire building must be evaluated. Diagnostic procedures to evaluate air pressure relationships within and under a building are needed to identify the appropriate radon reduction technique and design.

## Results from the EARTH Study: Partial Testing of Multifamily Buildings Will Misrepresent Radon

"Evaluating and Assessing Radon Testing in Housing with Multifamily Financing" (EARTH) was a HUD-funded Healthy Homes Technical Study led by Health Research Inc. for the New York State Department of Health with assistance from the National Center for Healthy Housing. The primary aim of the study was to develop an evidence-based, statistically sound protocol for measurement professionals to correctly characterize a multifamily building's radon level that is sufficiently protective of occupant health without being unduly burdensome to transactions or property owners.

The below table presents the probability of missing a unit with a radon level above the EPA action level, based on the % of units sampled, according to the analysis of data for units in 276 multifamily buildings in the US. These data indicate, across building sizes, that to characterize radon levels correctly in multifamily buildings with up to 20 ground-contact units, i.e., achieve 95% confidence that no units in the building have radon ≥4 pCi/L, 100% testing is required. For the vast majority of multifamily building sizes, all ground-contact units in the buildings should be tested for radon.

**Average probability (%) of partial sampling missing a unit in a building* with≥4 pCi/L with various sampling percentages.**

| Number of ground contact units | Number of buildings | 10% sampled | 25% sampled | 50% sampled | 75% sampled | 90% sampled |
|---|---|---|---|---|---|---|
| 05-06 | 45 | 58 | 34 | 19 | 4.7 | 0.0† |
| 07-08 | 71 | 55 | 36 | 15 | 4.6 | 0.0† |
| 09-10 | 40 | 65 | 39 | 24 | 8.5 | 3.8 |
| 11-12 | 37 | 52 | 41 | 21 | 8.1 | 2.8 |
| 13-14 | 14 | 51 | 35 | 20 | 7.4 | 2.2 |
| 15-16 | 20 | 47 | 32 | 15 | 5.0 | 1.3 |
| 17-18 | 15 | 59 | 39 | 21 | 8.1 | 1.9 |
| 19-20 | 12 | 69 | 46 | 23 | 8.9 | 2.6 |
| 21-26 | 22 | 52 | 34 | 18 | 6.7 | 2.3 |
| All | 276 | 58% | 38% | 19% | 6.5% | 1.7% |

**Ground contact units only. Includes buildings with at least one unit ≥4 pCi/L.*

*†Note that for 90% sampling all units are tested for buildings with 9 or fewer units.*

*The work that provided the basis for this document was supported by funding under cooperative agreement # NYHHU0038-17 from the U.S. Department of Housing and Urban Development's Office of Lead Hazard Control and Healthy Homes. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this presentation. Such interpretations do not necessarily reflect the views of the Government.*

## DESCRIPTIONS OF TEST DEVICES

### Passive Device Measurement Systems

As used in this standard, "Passive devices" are measurement systems that collect a time-weighted average and do not provide hourly readings.

- *Charcoal adsorption detectors (CAD)*
  CAD detectors employ activated charcoal that adsorbs radon from the surrounding air. Exposure durations are typically limited to 2-7 days. After exposure, detectors must be sent to the laboratory without delay. Detectors are configured for either Gamma-ray Spectroscopy or Liquid Scintillation Spectroscopy analysis.
- *Alpha-track detectors (ATD)*
  ATD detectors utilize a piece of plastic inside a container. Alpha particles emitted from radon strike the plastic detector and create damaged "tracks" that are visible with a microscope. The track density is determined by the laboratory to achieve an average radon concentration for the time the detector is exposed.
- *Electret ion chamber detectors (EIC)*
  EIC detectors use a chamber made of, or lined with, an electrically conductive material with an electrically charged electret as the detecting mechanism. The decay of radon discharges voltage from the electret. The radon concentration is calculated by comparing the electret voltage measured before and after exposure.
- *Electronic integrating devices (EID)*
  An EID is an electronic measuring device is like a continuous monitor but is not recording a retrievable time series of 1-hour measurements. EID devices are categorized as passive devices because such devices do not provide the additional measurement data points needed for making mitigation decisions.

### Continuous Radon Monitors (CRM)

A CRM is an electronic device that is automatically recording a retrievable time series of numeric measurements of radon concentration averaged over time intervals of 1 hour or less. These additional data points can help to judge whether there was an unusual occurrence during the test that might invalidate the overall measurement.

## TERMINOLOGY ASSOCIATED QUALITY CONTROL (QC)

### Duplicate or Comparison Check Measurements

Duplicates or comparison check measurements are pairs of detectors or monitors deployed in the same location, side-by-side, approximately every tenth measurement (i.e., 10%). The purpose is to evaluate and track imprecision or agreement between detectors or monitors across time. Using calculations for relative percent difference (RPD):

- In an environment with a radon concentration ≥ 4 pCi/L, the goal for agreement is an RDP ≤14%. The warning limit is an RPD ≥ 28% and the control limit is an RPD ≥ 36%.
- Between 2 and 4 pCi/L, the goal for agreement is an RDP of ≤25%. The warning limit is an RPD ≥ 50% and the control limit is an RPD ≥ 67%.

### Calibration

Calibration means to adjust or determine or both, the response of an instrument or device relative to a series of conventionally true values. Ongoing annual calibration of each CRM is part of all quality assurance efforts.

### Blank Measurements

Blanks are CAD, ATD or EIC devices deployed for at least 5% of the number of measurements conducted to verify and document the absence of effects on the measurement resulting from sources other than the air being tested. Since blanks are not exposed (i.e., not left open to permit radon to enter the detector), their measurement value should be below the lower limit of detection.

### Spiked Measurements

Spikes are CAD, ATD or EIC detectors that have been exposed in an approved reference chamber to a known concentration of radon (i.e., "spiked" with radon). Spikes are conducted for at least 3% of the devices deployed for field measurements. Using spiked measurements helps to validate the accuracy of a laboratory analysis and/or detectors supplied by a laboratory.

See ANSI/AARST MS-QA, "Radon Measurement Systems Quality Assurance" for more detailed information.

## CG Section 4
## CHAIN OF CUSTODY

*For Support Staff under direct supervision of a Qualified Measurement Professional*

**Correlation of Tasks and Technical Skills Commonly Associated with Placing and Retrieving Detectors**

*Note—This informational table is not intended to stipulate what apportioned tasks are assigned to an individual and thereby not intended to stipulate what combination of instructions or training are appropriate for a specific assigned task.*

| Task | Instructions or Training associated with each task | QMP's Required Outcome |
|---|---|---|
| Identify test locations within a room | Sufficient to know where not to test and required distances away from floors; ceilings; exterior windows, doors, and walls; and other devices and objects. | - Devices deployed in compliance with Table 3.8 |
| Manage devices and documentation during placement and retrieval | Sufficient to document test locations, device serial numbers; start and stop dates and times; and where QC check devices were deployed.<br>Sufficient to update addresses and document occupancies, conditions and mechanical systems that are different than anticipated.<br>Sufficient to document and seek guidance if test reliability concerns are encountered.<br>Sufficient to use devices in compliance with manufacturer's instructions. | - 6.4.2: Documented details are recorded that are required for processing test result analysis and reports<br>- 6.4.1: Updated records and floor-plan diagrams<br>- 2.3.2: Devices used in compliance with manufacturer instructions |
| Identifying which dwellings and rooms are to be tested | Sufficient to understands which dwellings and rooms to test, compared to where not to test.<br>Sufficient to seek guidance and document locations that were designated to test but could not be tested or where a valid test could not be completed due to missing, lost and non-retrievable detectors | - 3.0: The required dwellings and rooms are tested<br>- 6.2: Locations intended to test but did not achieve a valid test are identified |
| Quality control of test conditions | Sufficient to inspect for and understand when closed-building conditions were not or cannot be maintained; and to seek guidance if unanticipated conditions are encountered.<br>Sufficient to ensure "radon test in progress" notices are posting in conspicuous locations.<br>Sufficient to identify unexpected HVAC conditions, which can include variable outdoor air ventilation, variable air volume systems and return air ducts under slabs. | - Tables 4-A, 4-B and 4-C and Section 6.1: Compliance with closed-building requirements<br>- 6.1.6: To include posting "Radon test in progress" notices |
| "QC" measurements | Sufficient to integrate duplicate and blank measurement detectors, where instructed. | - 6.3: QC measurements are conducted and reported |
| Temporary conditions and protocol deviations | Sufficient to understand, document or seek guidance on temporary conditions and deviations from protocol that may adversely affect test reliability | - 8.2.3 Report conditions that may adversely affect test reliability |

## CG Section 5
## CALCULATING AVERAGE BUILDING OPERATING CONDITIONS

The following methodology is intended to be simplistic yet reasonable for use.

1) **Know The Average Occupied Indoor Temperature: 74˚ F (23˚ C)**
Due to required comfort for occupants, the average indoor temperature is usually maintained with stability between 68˚ to 82˚ F (20˚ to 28˚ C). Use an average of about 74˚ F (23˚ C) during estimations unless known to be specifically different. HVAC systems are set to respond to needs for maintaining this comfort range during significantly occupied periods.

2) **Identify When the Building Is Significantly Occupied**

3) **Identify The Average Local Outdoor Temperatures During Significantly Occupied Months**
HVAC systems respond to changes in outdoor temperatures by activating heating, cooling and ventilation air handlers including certain designs that introduce outdoor air ventilation into a building.

4) **Identify Periods When Heating and Cooling Systems Activate**

| | |
|---|---|
| Heating Systems | In response to needs for indoor comfort:<br>Heating systems will often activate when outdoor temperatures drop to below about 65° F (18˚ C). |
| Cooling Systems | In response to needs for indoor comfort:<br>Cooling systems will normally be active when outdoor temperatures exceed about 75° F (28˚ C). |

**Examples of Heating and Cooling Activity**

24 Hour Averages

> 75˚F Cooling

66˚ - 75˚ F Intermittent

< 65˚F Heat

**24 Hour Temp Averages**

| ZONE | | Annual Avg | 9 mo School Avg | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Very Hot | Miami, FL | 76 | 74 | 82 | 79 | 74 | 69 | 68 | 69 | 72 | 75 | 79 | 82 | 83 | 83 |
| 2 Hot | New Orleans, LA | 69 | 64 | 79 | 70 | 61 | 55 | 52 | 55 | 62 | 69 | 76 | 81 | 82 | 82 |
| 3 Warm | Atlanta, GA | 62 | 56 | 73 | 63 | 53 | 45 | 43 | 46 | 53 | 62 | 70 | 77 | 79 | 79 |
| 4 Mixed | Phillidelpia, PA | 55 | 48 | 68 | 57 | 47 | 36 | 32 | 34 | 42 | 53 | 63 | 72 | 77 | 76 |
| 5 Cool | Chicago, IL | 49 | 42 | 65 | 53 | 40 | 27 | 22 | 26 | 37 | 49 | 59 | 69 | 74 | 72 |
| 6 Cold | Minneapolis, MN | 45 | 37 | 61 | 50 | 33 | 19 | 13 | 18 | 31 | 46 | 59 | 68 | 73 | 71 |
| 7-Very cold | Minot, ND | 39 | 30 | 56 | 45 | 26 | 14 | 6 | 11 | 21 | 41 | 53 | 61 | 68 | 67 |
| 8 SubArctic | Fairbanks, AK | 27 | 17 | 45 | 25 | 4 | -6 | -8 | -2 | 11 | 31 | 49 | 60 | 62 | 57 |
| 8 SubArctic | Cambridge Bay | 6 | -6 | 32 | 11 | -9 | -21 | -27 | -27 | -22 | -7 | 15 | 36 | 47 | 44 |

Daytime Only Averages

**Daytime Temp Averages**

| ZONE | | Annual Avg | 9 mo School Avg | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Very Hot | Miami, FL | 80 | 78 | 85 | 82 | 77 | 73 | 72 | 73 | 76 | 79 | 83 | 85 | 86 | 87 |
| 2 Hot | New Orleans, LA | 73 | 69 | 83 | 75 | 66 | 60 | 57 | 60 | 67 | 74 | 80 | 85 | 87 | 86 |
| 3 Warm | Atlanta, GA | 67 | 61 | 78 | 68 | 58 | 50 | 48 | 51 | 59 | 68 | 75 | 82 | 84 | 84 |
| 4 Mixed | Phillidelpia, PA | 59 | 52 | 73 | 62 | 51 | 40 | 36 | 38 | 47 | 58 | 68 | 77 | 82 | 81 |
| 5 Cool | Chicago, IL | 54 | 46 | 70 | 58 | 44 | 31 | 26 | 30 | 41 | 54 | 65 | 75 | 79 | 77 |
| 6 Cold | Minneapolis, MN | 50 | 41 | 66 | 55 | 37 | 23 | 17 | 23 | 35 | 51 | 64 | 73 | 78 | 76 |
| 7-Very cold | Minot, ND | 45 | 36 | 63 | 51 | 31 | 19 | 11 | 16 | 26 | 47 | 59 | 67 | 75 | 74 |
| 8 SubArctic | Fairbanks, AK | 32 | 21 | 50 | 29 | 8 | -3 | -4 | 3 | 18 | 37 | 55 | 65 | 67 | 62 |
| 8 SubArctic | Cambridge Bay | 9 | -3 | 33 | 14 | -6 | -18 | -24 | -24 | -18 | -2 | 19 | 39 | 51 | 46 |

## 5) Identify The Normal Average Occupied Operating Condition

A. **Calculate the Average Occupied Operating Condition**
The operational condition for the building or unique sector of the building that represents the greatest amount of significantly occupancy time.

B. **Clear Characterization**
Identify the operating conditions most likely to emphasize a clear characterization of a radon hazard. This is primarily time periods when the difference between indoor and outdoor temperatures cause:

a) Some degree of regularity for natural negative air pressure inside the building as compared to outside of the building (e.g., stack effect), and;

b) Some degree of regularity in the activity of heating or cooling system blowers.

This would not include time periods when the volume of outdoor air introduced into the building exceeds the minimum amounts required to maintain occupant health.

### EXAMPLE WORKSHEET

1) Identify the average occupied indoor temperature: ❑ 74˚ F (23˚ C) ❑ Other _____.

2) Identify the months per year that represent significant occupancy for each unique sector of the building.

❑ 12 months (as common for dwellings and most large buildings that house business occupancies).

❑ 9 months (as common for many school buildings).

❑ Other _____

Identify the hours of the day that represent significant occupancy for each unique sector of the building.

❑ 10-hour occupancies (e.g., Work or school day plus routine afternoon meetings, classes or sports).

❑ 24-hour occupancies (e.g., Dwellings and 24/7 services such as hospitals).

❑ Other _____

3) Identify the average outdoor temperatures during periods of significant occupancy.

| Annual | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ | ___ |

4) Calculate average HVAC activity during significantly occupancy periods

| HVAC Mode | Months in each operational mode | Total Months | Yearly % |
|---|---|---|---|
| Heating Active | ❑ Jan ❑ Feb ❑ Mar ❑ Apr ❑ May ❑ Jun ❑ Jul ❑ Aug ❑ Sep ❑ Oct ❑ Nov ❑ Dec | ___ | ___% |
| Cooling Active | ❑ Jan ❑ Feb ❑ Mar ❑ Apr ❑ May ❑ Jun ❑ Jul ❑ Aug ❑ Sep ❑ Oct ❑ Nov ❑ Dec | ___ | ___% |
| None (mixed) | ❑ Jan ❑ Feb ❑ Mar ❑ Apr ❑ May ❑ Jun ❑ Jul ❑ Aug ❑ Sep ❑ Oct ❑ Nov ❑ Dec | ___ | ___% |

### Example for Schools

Daytime Averages

> 75˚F Cooling

66˚ - 75˚F Intermittent

< 65˚F Heat

| Daytime Temp Averages ZONE | | Annual Avg | 9 mo School Avg | Sep | Oct | Nov | Dec | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 Very Hot | Miami, FL | 80 | 78 | 85 | 82 | 77 | 73 | 72 | 73 | 76 | 79 | 83 | 85 | 86 | 87 |
| 2 Hot | New Orleans, LA | 73 | 69 | 83 | 75 | 66 | 60 | 57 | 60 | 67 | 74 | 80 | 85 | 87 | 86 |
| 3 Warm | Atlanta, GA | 67 | 61 | 78 | 68 | 58 | 50 | 48 | 51 | 59 | 68 | 75 | 82 | 84 | 84 |
| 4 Mixed | Phillidelpia, PA | 59 | 52 | 73 | 62 | 51 | 40 | 36 | 38 | 47 | 58 | 68 | 77 | 82 | 81 |
| 5 Cool | Chicago, IL | 54 | 46 | 70 | 58 | 44 | 31 | 26 | 30 | 41 | 54 | 65 | 75 | 79 | 77 |
| 6 Cold | Minneapolis, MN | 50 | 41 | 66 | 55 | 37 | 23 | 17 | 23 | 35 | 51 | 64 | 73 | 78 | 76 |
| 7-Very cold | Minot, ND | 45 | 36 | 63 | 51 | 31 | 19 | 11 | 16 | 26 | 47 | 59 | 67 | 75 | 74 |
| 8 SubArctic | Fairbanks, AK | 32 | 21 | 50 | 29 | 8 | -3 | -4 | 3 | 18 | 37 | 55 | 65 | 67 | 62 |
| 8 SubArctic | Cambridge Bay | 9 | -3 | 33 | 14 | -6 | -18 | -24 | -24 | -18 | -2 | 19 | 39 | 51 | 46 |

# Home Commercial Inspections

ENVIRONMENTAL TESTING • PROPERTY INPECTIONS