Key Points

Short-Term Tests (2 days to 90 days)

- All exterior doors and windows need to be closed during the test.
  - People can go in and out but not leave doors and windows propped open.
  - No requirement regarding interior partition doors.
- If test is to be only 2-3 days in duration:
  - Closed house conditions must be started 12 hours before start of test.
  
  Note: Some devices allow you to deploy device and close windows on behalf of client, but first 12-hours is not used in calculating average.

If test is 4-days or longer:

- Doors and windows may be closed at time the test is initiated. Note they still need to be closed during test.
  
  Note: Any test 90-days or less in duration requires closed building conditions.
- Check for air handling systems that might impact measurement:
  - Evaporative (Swamp) coolers – OFF
  - Window fans – OFF
  - Whole house fans – OFF
  - Fireplaces – OFF
  - Forced air systems - ON as normal (note settings on report)
  - Combustion air and furnace make-up air – ON
  - Air-to-air heat exchangers – ON and noted on report
  - Legitimate mitigation systems - ON and noted on report
- Communication
  - Give clear instructions to occupant or real estate professional prior to starting the test
  - Leave instructions or notes at property

Long-Term Tests (91 days or longer)

- No special requirements for exterior doors and windows being closed
- Person operates building as they normally do.
**Key Points**

**Level of Home** (see previous section for more discussion)
- **Real Estate**
  - Lowest level of the home that could be occupied, regardless of if it is currently occupied or finished.
- **Non-Real Estate**:  
  - Lowest occupied level of the home.
  - Be careful! Indicate to client that future testing at time of sale could include a test in lower level.

**Room Selection**
- Choose a room that is frequently occupied (e.g., bedroom, family room)

**Location Criteria** *(know these very well!)*
- In a location where it will not be disturbed
- At least **20 inches above the floor**
  - It can be higher. In fact some devices hang from ceiling.
- At least **3 feet from an opening** in an exterior wall that could allow air in
  - It can be further from openings, like in the center of the room
- At least **12 inches from an exterior wall** where no openings exist
- Have **at least 4 inches of space** around it to allow radon or radon decay products in.
  - If you sit it on a bookshelf, keep it 4 inches or more from the back of the cabinet.
- Out of direct air drafts
  - Keep away from forced air ductwork, ceiling fans, etc.
- Not where direct sunlight could strike the device.
- Not in areas of high humidity
  - If house is occupied, do not place in bathrooms or kitchens.
- Not in areas where solvent vapors may be present

*Note: Check local regulations in your state. Some states require test devices in areas above crawl spaces in addition to lower levels of home.*
Step 1: Conduct Short-Term Test

- **If result is less than guidance** - Indicate EPA recommendation is not to recommend mitigation.
  - Point out that some risks exists at these lower exposures.
- **If result equal to or greater than guidance** - Recommend follow-up measurement

Step 2: Conduct Follow-up Measurement

- **If initial result is between 4.0 and 10** - recommend long-term test.
  - Base recommendations on result of long-term test.
  - Do not average long-term test result with result of initial short-term test.
- **If initial result is greater than 10** - recommend another short-term test
  - Same location as initial test (although addition locations could be included).
  - Average the result of the initial and follow-up short-term test and base recommendations on average.
  - Do not average results from different areas of the house to get a “whole house” average

*Note: The client may choose to mitigate without follow-up measurements or may choose not to mitigate regardless of the results. - Check State Protocols*

Note: AARST suggests long-term follow-up measurements should be recommended if initial short-term is greater than 8 (rather than 10 as suggested in EPA protocols)
Key Points
Continuous Monitors

- Commonly used for short-term measurements
  - Real Estate testing and building investigations
  - Several devices that either measure radon (CRM) or radon decay products (CW)
- Indicates hourly variations
  - Helps correlate changes in radon or radon decay product levels to weather and building condition changes.
  - Useful in detecting tampering
  - Some devices also measure:
    - Temperature of device (may indicate windows being opened)
    - Barometric pressure
    - If device has been moved during test
    - Read-out security measures.
- Must be set out for minimum of 48 hours.
  - If device is passive, the first four hours of data should be precluded from average.
    - Four-hour ramp-up time for device to come into equilibrium with room.
  - Closed house conditions required during test as well as 12 hours prior, if test is 2-3 days in duration
  - Some devices allow you to close windows and run test for 60 hours or more and preclude first 12 hours of data (includes time for instrument to come to equilibrium as well as house itself).
- Interpretation:
  - Based upon average of hourly measurements, rather than the highest measured.
  - If average is equal to or greater than guidance level, then mitigation is recommended.
    - Client may choose to do follow-up measurements.
- Other:
  - Only one device is needed provided it measures in hourly increments or less.
  - If device measures less frequently than hourly, a like measuring device (radon or radon decay products) must be placed beside it and the results averaged.
Real Estate Testing
Sequential Integrating Devices

- Provide integrated average for duration of measurement.
- Do not provide hourly measurements
- First one and then the other
  - No decision process as to if the second test should be conducted
  - Recommendation based upon average of two results.

Key Points
Sequential Integrating Devices

- Provide average for duration of measurement
- Do not provide hourly variations
- This method requires two passive measurement devices in sequence
- Integrating device examples:
  - Two activated charcoal devices, one after the other
  - Two electret ion chambers, one after the other
- Deploy under conditions of any short-term test.
  - If test is 2-3 days in duration, closed building conditions for 12-hours prior to and all during test.

Note: Some integrating devices can be optimally deployed for several days, thereby not requiring 12-hours closed building conditions prior to the start of the test—but still require closed conditions all during the test.

Step 1: Deploy the initial short-term test.

Step 2: Deploy second short-term device
- Note the decision to deploy the second device is independent of the initial reading. In fact you should not indicate to occupant what the result of the first test is in order to avoid the temptation of tampering with the second test.

Step 3: Average the results of the two tests and base recommendation on the average of the two tests.
- Provide both test results in your report.

Note: It is expected there will be a difference between the first and second measurement due to varying conditions.

This methodology is not frequently used due to the number of trips needed to execute the two tests as well as the delay it may cause in closing the transaction.
Real Estate Testing
Simultaneous Integrating Devices

- Provide integrated average for duration of measurement.
- Do not provide hourly measurements.
- Both placed at the same time.
  - Four-inches apart
  - Recommendation based upon average of two results.
  - Expectation that results will be similar
    - Allows you to perform QA/QC check
    - Relative percent Difference

Key Points
Simultaneous Integrating Devices

- Provide average for duration of measurement
- Do not provide hourly variations
- This method requires two passive measurement devices deployed at the same time
- Integrating device examples:
  - Two side-by-side activated charcoal devices
  - Two side-by-side electret ion chambers
  - Two side-by-side Radon Progeny Integrating Sampling Unit collectors.
- Deploy under conditions of any short-term test.
  - If test is 2-3 days in duration, closed building conditions for 12 hours prior to and all during test.
  - Place devices 4 inches apart (do not place in different rooms or levels of the building)

Note: Some integrating devices can be optimally deployed for several days, thereby not requiring 12-hours closed building conditions prior to the start of the test—but still require closed conditions all during the test.

Step 1: Deploy both devices at the same time.
Step 2: Conduct evaluation of agreement of results (See next section on how to determine agreement).
Step 3: If agreement between results is satisfactory, average the results of the two tests and base recommendation on their average. Provide both test results in your report.

This method is commonly used since it only requires two trips to the property and can be done within a minimum two-day period of time, depending upon how quickly one can analyze or obtain results from lab.
Relative Percent Difference:
• A percentage that is calculated to express the percent difference between the two measurements relative to their average.
• Take the difference between the two results and divide by their average and express it as a percentage.
  • Example: One result at 12 and the other at 9.
    \[ \text{RPD} = \frac{12 - 9}{\text{Average of 12 and 9}} \]
    \[ \text{RPD} = \frac{3}{10.5} = 0.29 \]
    To express as a percentage: 0.29 \times 100 = 29\%

Condition 1: Both above Guidance Level of 4.0pCi/L or 0.02 WL*
• Recommend mitigation regardless of agreement, since both are above guidance.
• If relative percent difference is greater than 36%, investigate the error on your own, but you need not retest the property.

Condition 2: Both Below Guidance Level of 4.0pCi/L or 0.02 WL*
• Do not recommend mitigation regardless of agreement, since both are below guidance.
• If relative percent difference is greater than 67%, investigate the error on your own, but you need not retest the property.

Condition 3: One Above and the Other Below Guidance Level of 4.0pCi/L or 0.02 WL*
• If one result is more than twice the value of the other, the test is to be repeated.

* EPA consumer publications after 2006 have suggested a recommendation of 0.016 WL rather than 0.020 WL.
Telephone Interview:
Real Estate Testing

Ralph Holmen
National Association of Realtors
Associate General Counsel

Measurement Device
Deployment & Interpretation of Results

Topic 3 - Audio 40-41

Reading Assignment:
Home Buyer’s & Seller’s Guide
Key Points
Avoiding or Detecting Test Interference

Avoiding Interference:
• Provide clear and concise instructions for occupant
• Do not use devices that provide a read-out to occupant.
• Use a homeowner agreement that could include cost consequences.
• Leave Instructions for Homeowner

Detecting Tampering:
• Detect unusual measurement swings with print-out from continuous monitor.
• Determine if device is moved by placing it in a specific orientation.
• Use devices that record barometric and weather conditions to identify unusual weather patterns that may account for abrupt changes that may not be due to tampering.
• Use devices that record room temperatures that may identify if windows were opened.
• Use specialty tamper tapes on exterior doors and windows to detect their being opened, as well as on device to determine if it has been moved or opened.
• Use time-integrating clocks on active devices that use a pump to determine if power was shut off.

Determining Tampering:
• Since radon is variable, fluctuations may be natural and not due to tampering.
• Requires additional data to suspect tampering.
• If suspected, provide information to client to allow them to resolve it with their agent.
Telephone Interview:
Radon & the Home Inspector

Steve Gladstone
Stonehollow, Incorporated
Immediate Past President ASHI