Radon Reduction Systems

- What Is Radon?
- Why Is Radon a Problem?
- Where Is Radon a Problem?
- How Do You Fix a Radon Problem?
- How Do You Inspect a Radon System?
Radon Gas

- Colorless
- Odorless
- Radioactive
- Present in the Soil Throughout US

Health Effects of Radon and Its Decay Products

Questions

Does radiation cause cancer?
What kind of radiation?
How does it affect the body?
Ionizing Radiation can deposit energy in nearby atoms and remove electrons in those atoms.

- **Alpha**
- **Beta**
- **Gamma**

**Alpha Radiation**
- Stopped by paper
- Stopped by dead skin

**Radon Decay**
- $^{222}\text{Rn}$
- $^{218}\text{Po}$ (3 min)
- $^{214}\text{Pb}$ (27 min)
- $^{214}\text{Bi}$ (20 min)
- $^{214}\text{Po}$ (0.0002 sec)
- $^{210}\text{Pb}$ (19 years)

**Alpha**
**Beta**
**Gamma**
Radon Lung Cancer Risk

Radon gas inhaled and exhaled before it decays

Actually Polonium/Bronchial Risk!

Radon decay products inhaled and stick to mucous where they decay

Lung Cancer Summary

- Radon and RDPs inhaled
- Radon exhaled
- RDPs stick to lung tissue
- $^{218}\text{Po}$ and $^{214}\text{Po}$ emit alpha particles
- Alpha particles strike lung cells, causing physical and/or chemical damage to DNA
U.S. Surgeon General
Health Advisory

"Indoor radon is the second-leading cause of lung cancer in the United States and breathing it over prolonged periods can present a significant health risk to families all over the county. It's important to know that this threat is completely preventable. Radon can be detected with a simple test and fixed through well-established venting techniques." (2005)

Radon and Other Health Hazards

Comparison of Radon to Other Causes of Death
What do the Colors Mean?

- **Zone 1** counties have a predicted average indoor radon screening level greater than 4 pCi/L (picocuries per liter) (red zones)
- **Zone 2** counties have a predicted average indoor radon screening level between 2 and 4 pCi/L (orange zones)
- **Zone 3** counties have a predicted average indoor radon screening level less than 2 pCi/L (yellow zones)
Slide 19

State Zone Maps by County

Zone 1
Essex
Middlesex
Worcester

Zone 2
Barnstable
Berkshire
Bristol
Dukes
Franklin
Hampden
Hampshire
Nantucket
Norfolk
Plymouth

Slide 20

Radon Sources;
Transport &
Entry

Slide 21

Radon Sources;
Soil Gas
(#1 Source)
Potential for Radon from Soil

Depends on:
- Radium content of soil
- Size of soil particles
- Porosity of soil
- Water content of soil particles
- Strength of forces moving soil gas through soil

Soil Gas Transport

Source, Pathway, Driving Force

Radon

Uranium
Slide 25

**Driving Force: Diffusion**

- Substance at higher concentration tends to move to area with lower concentration
- High radon concentration in soil moves to lower concentration in home
- Relatively low entry rate.

Slide 26

**Predominant Driving Force: Building Induced Soil Suction**

- Buildings create partial vacuums -- draw in soil gas
- Pressure differentials
- Convection

Slide 27

**Pressure Differentials**

1. "Stack effect"
2. Ventilation and exhaust systems
3. Weather conditions
The Stack Effect

Temperature-induced pressure differentials
- Hot air rises and leaks out the top of the house
- Make-up air drawn in, some from under slab
- Soil gas containing radon enters with make-up air

Thermal By-passes Enhance Stack Effect

Exhaust Ventilation

- Mechanical ventilation devices can lower pressure in the house, drawing in radon
  - Whole house fans
  - Kitchen exhaust
Slide 31

**Ventilation Can Pressurize Building**
- Buildings with very tight “skins”
- Mechanical fans that bring in outside air
- Pressure can increase and slow radon entry
- Most homes not this tight

Slide 32

**Ventilation: Open Windows**
- Vacuum may be reduced; radon entry reduced
- Radon diluted in the home
- Vacuum may be increased; radon entry increased

Slide 33

**Weather: Wind**
- High winds can cause
  - positive pressure in soil on windward side
  - overall negative pressure on building
Slide 34

Weather: Frost

- Caps soil
- Negative pressure field extended
- Easier for radon to be drawn into house than outside air
  (Asphalt aprons around buildings can have similar effect)

Slide 35

Weather: Rain

- Saturated soil prevents diffusion to outside air
- Extends pressure field generated by the house
- Heavy rains can raise water tables, forcing soil gases into building

Slide 36

Daily and Seasonal Variations

- Diurnal cycle
  - Typically higher at night
- Seasonal variations
  - Higher indoor concentrations during heating season, when suction placed on foundation at its greatest
Slide 37

Rate of Radon Entry Varies

- Concentrations can change rapidly in home
  - Temperature changes
  - Weather changes
  - Use of exhaust equipment
- Important to measure over at least a two-day period

Slide 38

Radon Entry Pathways

Slide 39

Natural Pathways

- Pores or openings in soil
  - Permeability of underlying soils
- Cracks and fissures
Slide 40

**Man-made Pathways**

- Excavation can make soil more permeable

Slide 41

**Water Drainage Systems**

- Sump holes may be connected to earth, gravel drainage, perimeter drain pipes, waterline, or variety of other transport paths
- Floor drains similarly connected

Slide 42

**Construction Slab Openings**

- Plumbing openings for drains, water lines
- Radon travels along trench and enters through slab opening
- Most hidden from sight
Joints in Slab Construction

- Joints extend completely around perimeter of slab
  - Cold Joints
  - Expansion Joints
  - Channel Drain
- Radon not stopped by sealing or other interior finishing

Foundation - Pier or Stilt

- Typically open to outside air
  - On hills, some sides may have restricted air movement
- Mobile homes often set on piers that can be skirted and insulated

Foundation - Crawl Space Enclosed over Earth Floor

- Large surface area over soil surface
  - Vacuum effect draws radon into home
  - Crawl space vents have little effect, especially in winter.
  - Floor insulation doesn’t prevent radon entry.

Soil around footing has been loosened and is more permeable.
Many openings permit radon entry:
- Cracks
- Penetrations
- Joints
  - Cold expansion & contraction

Joints may be hollow blocks or poured concrete.

“Monolithic Pours”
- Floor poured in one piece
- Common foundation type in warmer regions
- Radon can enter through cracks and penetrations.

Basement poured or block walls
- Blocks can be hollow - radon can enter through sides and top row
- Radon entry through cracks and penetrations in poured concrete
- Digging the basement cavity loosens the soil.
Slide 49

No pathway or driving force needed

- Jeff Miner 2012
- Radon At Tahoe

___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________
___________________________________

Slide 50

Radon Typically Higher in Lower Levels of Home

- If radon higher in upper floors versus lower floors, may indicate unusual entry mechanisms, sources, or ventilation patterns

- American Association of Radon Scientists and Technologies © 2013

- 11/15 to 11/24
- 12/24 to 1/2
- 1/17 to 1/29
- 2/17 to 2/20
- 3/1 to 3/6
- 3/13 to 3/19
- 3/28 to 4/2
- 4/23 to 4/30

Slide 51

Every Home Is Different

- Radon concentration in buildings affected by
  - Radon source strength
  - Pathways in the soil
  - Transport mechanisms
  - Building ventilation rate
  - Openings to the radon source

- NEXT: HOW DO WE MEASURE IT?
Introduction to Radon Measurement

Good Measurements Depend On
• Choosing the appropriate device for the job
• Following testing protocols
• Proper interpretation of measurement results
• Confidence in the quality of the measurement

Purpose of Test
• Short term measurements – check for elevated radon concentrations
• Follow-up measurements – confirm high radon concentrations
• Long-term measurements – confirm high radon concentrations or evaluate exposure
• Post-mitigation measurements – determine the effectiveness of remediation
Choice of Protocol

- Home Buyers and Sellers Guide
- Citizen's Guide
- AARST Protocols for Measurement in Homes

Some Preliminary Considerations

Units of Measure

- Radon gas – measured in pCi/L
  (pee-co-cure-ees per liter)
  – Reported to 1 decimal place (3.2)
Some Curie Facts

- Named after Madame Curie (Maria Sklodowska)

More Curie Facts

1 gram radium = 37 billion nuclear disintegrations/second = 1 Curie

Measurement: A Matter of Counting

- Alphas from radon and/or RDPs
- Alphas and betas from radon and RDPs
- Damage to film from alphas from radon & RDPs
- Gamma radiation from RDPs
- Ionization of air molecules by radon and RDPs
Sampling Considerations

Grab and Sniffing – isolated readings

- "Time Integrated" sampling - single average for time period
- Continuous sampling/monitoring – shows radon fluctuation

Time Integrated (Average)

- Two days to a year or more
- Passive integrating
  - Charcoal
  - Alpha track
  - Electret ion chambers
- Active integrating
  - Continuous radon monitors

Continuous Sampling

- Repeatedly sample over short periods of time
- Provide measurements of variation in the radon and/or RDP's
- Must integrate hourly or less to be used in real estate transactions
Grab Sampling

- Collect representative air sample over short period of time, typically few minutes
- Instantaneous measurement (snapshot of concentration at that particular point in time)
- Provide quick feedback
- Useful for diagnostics

Categories of Measurements

- Short Term
  - 2 to 90 days
- Long Term
  - 91 days or longer
- Grab Sampling or "Sniffing"
  - 1 - 30 minutes
  - grab is calculated after 4 hours, sniff is calculated immediately

Measurement Methods
Charcoal Canisters
Open Face Detectors  Diffusion barrier detectors
- used for 2-3 days  - used for 5-7 days

Charcoal Liquid Scintillation Device

Alpha Track Detectors
- Long Term Test
- Radon and radon decay products strike and damage plastic foil surface
- Foil etched, tracks counted at the lab
- Number of tracks correlated to radon concentration
**Measurement: A Matter of Counting**

- Alphas from radon and/or RDPs
- Alphas and betas from radon and RDPs
- Damage to film from alphas from radon and RDPs
- Gamma radiation from RDPs
- Ionization of air molecules by radon and RDPs

**Next:**

**Measurement Protocols In Depth**

**Radon Measurement Protocols**
Good Measurements Depend On

• Choosing the appropriate device for the job
• Following testing protocols
• Proper interpretation of measurement results
• Confidence in the quality of the measurement

General Protocol

Weather

Weather: Wind

• High winds can cause
  – positive pressure in soil on windward side
  – overall negative pressure on building
Slide 79

General Protocol

House Conditions

Slide 80

Ventilation: Open Windows

• Vacuum may be reduced; radon entry reduced
• Dilutes radon in the home
• Vacuum may be increased; radon entry increased

Summer

Ventilated
Open Windows - Closed Windows

Winter

Closed Windows

Slide 81

Closed House Conditions

• New Construction
  – All insulation
  – All windows
  – All exterior doors
  – All ceiling coverings
  – All interior trim & wall coverings
  – All exterior siding & weatherproofing
  – All heating/cooling functioning at normal temps
General Protocol
House Level

Which Level?

House Level Comparison

- Real Estate (Time Sensitive)
  - Lowest livable
- Citizen's Guide
  - Lowest lived-in
- AARST/ANSI
  - Recommend each structural level suitable for occupancy
General Protocol

Test Placement

Test Where?

More Than
• 20 inches off the floor
• 3 feet from outside walls
• NOT in crawlspace
• NOT in sump basin
• NOT in kitchen or bath
Post-Mitigation Measurements

- Determine success of mitigation
- Same location as pre-mitigation tests
- At least 48 hours duration
- Allow 24 hours of system operation prior to test
- Long term testing recommended
- Short term retest recommended every 2 years

Radon Mitigation

Mitigation Theory

Reduction Goal

- Better indoor air
- Below U.S. EPA Action Level—4.0 pCi/L
- U.S. EPA Recommendation—Consider fixing between 2 and 4 pCi/L
- World Health Organization 2009 Recommendation—2.7 pCi/L (100 Bq/m³)
- Many can be reduced below 1 pCi/L
- Most effective system with least energy penalty at reasonable cost
Slide 91

**Reduction Approaches**

- Inhibit radon from entering
  - Source
  - Transport mechanism
  - Pathways

Slide 92

**Source—Soil**

- Generally use control of transport mechanisms
- Rarely excavation

Slide 93

**Controlling Pathways**

- Sealing
  - Cracks
  - Holes
  - Crawlspace accesses
- Poor stand alone technique
**Control After Entry**

- Dilution/ventilation
  - Natural
  - Mechanical
    - Heat transfer device
      - HRV
      - ERV
      - AAHX
- Filtration
  - Questionable effectiveness

**Controlling Transport Mechanisms: Depressurization**

- Active Soil Depressurization (ASD)
  - Sub-slab depressurization (SSD, SSV, SSS)
  - Drain tile depressurization (DTD)
  - Sub-membrane depressurization (SMD)
- Block-wall depressurization (BWD)
- Combination

**ASD Theory**
Negative Pressure on the Soil

- Override house’s negative pressure
- Redirect and exhaust gases

ASD Sub-slab

ASD Sub-slab “Short Circuit”
Slide 100

American Association of Radon Scientists and Technologists © 2013

ASD Sub-slab “Short Circuit”

Ground level

Slab

Crushed rock

Plenum

Shallow footing

Slide 101

American Association of Radon Scientists and Technologists © 2013

ASD Sub-slab “Short Circuit”

Ground level

Slab

Crushed rock

Plenum

Tub

ASD Sub-slab “Short Circuit”

Ground level

Slab

Crushed rock

Plenum

Tub
Slide 106

**ASD—Drain Tile Depressurization**

- Ground level
- Slab
- Crushed rock
- Plenum

---

Slide 107

**ASD—Sub-membrane Depressurization**

- Crawl Space
- Plenum

---

Slide 108

**Radon Mitigation**

- Sealing
Slide 115

Radon Mitigation

Piping

Slide 116

Materials

• 3 or 4" PVC or ABS piping
  – Schedule 40
  – Foam core
• Compatible fittings
• Compatible cleaners and adhesives
  – All joints permanently sealed
  EXCEPT fan/piping and sump couplings

Slide 117

Pipe Routes

• Interior
• Exterior
**Pipe Route Considerations**
- Shortest distance
- Fewest elbows
- Least obtrusive
- Avoid hazards
- Don’t block other systems or components

**Avoid Other Hazards**
- Constricting or blocking exits
- Compromising building integrity
- Creating fire hazard
- Re-entrainment of radon gas
- Damaging equipment or systems

**Pipe Route Cautions**
- Noise
- Condensation
- Freezing
Slide 127

**Noise**
- Fan vibration
  - Flexible couplings to piping
  - Resilient mounting to structural member
  - Locate away from sensitive occupants
- Pipe resonance
  - Resilient mounting to structural member

Slide 128

**Noise (cont.)**
- Air flow
  - Higher the air flow resistance, the greater the noise
  - Use larger diameter pipe
- Elbows & T’s noisiest
  - Direct pipe route
  - Locate away from sensitive occupants

Slide 129

**Condensation**
- 100% relative humidity in piping
  - Slope horizontal pipes 1/8” per foot to enable drainage to suction point
Avoid Traps in Pipe

Sweating

- Sweating on exterior of pipe
  - Cool air inside pipe traversing warm humid environment
  - Insulate that section of pipe with insulation with external vapor barrier

Freezing

- Insulate piping running through attic in cold climates
- No rain caps or other restrictive devices on exhaust
Slide 133

Fire Rated Walls

Slide 134

Fire Rated Walls

• Restore fire rating
  – Fire collars

Slide 135

Install Fan

• Use flexible couplings
  – Ease of removal and replacement
  – Damper vibration
Install Fan: Exterior

- Vertical
- Upward
- Outside structure
- ≥ 12’ above roof

Exhaust Configuration

- Greater than 10 ft above ground level
- Greater than 10 ft from opening into conditioned space of building that it’s not 2 ft above
**Exhaust Location**

- Greater than 10 ft above ground level
- Greater than 10 ft from opening into conditioned space of building that it’s not 2 ft above
- Greater than 10 ft from opening into conditioned space of adjacent building

---

**Pipe Support Guidelines**

- Horizontal runs: every 4’
- Vertical runs
  - Above or below penetration of floor, ceiling, roof
  - Every 10’ on runs that do not penetrate floors, ceilings, or roofs

---

**Supporting Pipes**
Radon Mitigation

Fans

Fan Placement

- Install vertical
  - For drainage
- Outside the building
  - Rated for outdoor use
  - Or installed in weatherproof housing
- Inside the building
  - Outside of occupiable space
  - Above conditioned spaces

Fan Locations

Preferred Location for New Construction.
Choosing Fans
• Smallest fan that will do the job

<table>
<thead>
<tr>
<th>Foundation Area</th>
<th>RF1 Minimum Rating</th>
<th>RF2 Minimum Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less Than 1600 sq. feet</td>
<td>50 cfm @ 0.5 in. WC</td>
<td>75 cfm @ 1.0 in. WC</td>
</tr>
<tr>
<td>1600 to 2500 sq. feet</td>
<td>50 cfm @ 0.5 in. WC</td>
<td>75 cfm @ 1.0 in. WC</td>
</tr>
<tr>
<td>Greater than 2500 sq. feet</td>
<td>50 cfm @ 0.5 in. WC</td>
<td>75 cfm @ 1.0 in. WC</td>
</tr>
</tbody>
</table>

Radon fan to be sized by certified/licensed radon mitigator.

Additional guidelines/references for sizing ASD fans and piping can be found in Appendix C.

Exterior Wiring
• May be exterior plugs
  – Weatherproof & unattended rating

• Hardwired preferable

Fan Wiring
Slide 148

Fan Disconnect

Slide 149

System Monitor

- "Alarm" to alert homeowner
- Air flow or pressure indicator

Slide 150

Pressure Gauge

- Tube in piping reads pressure in "WC"
**Slide 151**

**U-Tube Manometer**
- Tube inserted in pipe
- Air flow past tube raises colored liquid in leg of tube
- Zero legs at installation

**Slide 152**

**Electronic Alarms**
- On unswitched circuit
- Automatic reset after power failure
- Battery operated needs low-battery warning

**Slide 153**

**Labels**
- Description label on system
- Legible with installer’s information
- Retest recommendation
- Additional labeling on all exposed pipe, membrane, circuit breakers
**Slide 157**

**Retrofit System - Existing Homes**

- EPA Radon Mitigation Standard (RMS)
- ASTM 2121
- AARST Radon Mitigation Standard
- Other State standards

**Slide 158**

**New Construction**

**IRC Appendix F**

**Slide 159**

**Other Standards & Guidance**

- “Building Radon Out” – USEPA guidance
System Installed?

Appendix A: Radon Mitigation System Inspection Checklist

1. System Name:

   - 1. Document Entry Date:
   - 2. System Descriptions:

   - 3. Number of Blowing Exit:
   - 4. Radon Retarder System:
   - 5. Radon Ventilation System:
   - 6. Radon Mitigation System:

2. Site Information:

   - 1. Site Address:
   - 2. Site Location:
   - 3. Site Description:

3. Inspections:

   - 1. Inspection Date:
   - 2. Inspectors:
   - 3. Inspection Results:

4. System Description:

   - 1. System Description:
   - 2. System Function:
   - 3. System Integrity:

5. System Installation:

   - 1. System Installation:
   - 2. System Maintenance:
   - 3. System Repair:

6. System Operation:

   - 1. System Operation:
   - 2. System Monitoring:
   - 3. System Compliance:

7. System Performance:

   - 1. System Performance:
   - 2. System Efficiency:
   - 3. System Reliability:

8. System Maintenance:

   - 1. System Maintenance:
   - 2. System Inspection:
   - 3. System Repair:

9. System Replacement:

   - 1. System Replacement:
   - 2. System Upgrade:
   - 3. System Disposal:

10. System Disposal:

    - 1. System Disposal:
    - 2. System Material:
    - 3. System Safety:

11. System Certification:

    - 1. System Certification:
    - 2. System Approval:
    - 3. System Compliance:

12. System Compliance:

    - 1. System Compliance:
    - 2. System Testing:
    - 3. System Inspection:

13. System Monitoring:

    - 1. System Monitoring:
    - 2. System Calibration:
    - 3. System Reporting:

14. System Maintenance:

    - 1. System Maintenance:
    - 2. System Inspection:
    - 3. System Repair:

15. System Replacement:

    - 1. System Replacement:
    - 2. System Upgrade:
    - 3. System Disposal:

16. System Disposal:

    - 1. System Disposal:
    - 2. System Material:
    - 3. System Safety:

17. System Certification:

    - 1. System Certification:
    - 2. System Approval:
    - 3. System Compliance:

18. System Compliance:

    - 1. System Compliance:
    - 2. System Testing:
    - 3. System Inspection:

19. System Monitoring:

    - 1. System Monitoring:
    - 2. System Calibration:
    - 3. System Reporting:

20. System Maintenance:

    - 1. System Maintenance:
    - 2. System Inspection:
    - 3. System Repair:

21. System Replacement:

    - 1. System Replacement:
    - 2. System Upgrade:
    - 3. System Disposal:

22. System Disposal:

    - 1. System Disposal:
    - 2. System Material:
    - 3. System Safety:

23. System Certification:

    - 1. System Certification:
    - 2. System Approval:
    - 3. System Compliance:

24. System Compliance:

    - 1. System Compliance:
    - 2. System Testing:
    - 3. System Inspection:

25. System Monitoring:

    - 1. System Monitoring:
    - 2. System Calibration:
    - 3. System Reporting:

26. System Maintenance:

    - 1. System Maintenance:
    - 2. System Inspection:
    - 3. System Repair:

27. System Replacement:

    - 1. System Replacement:
    - 2. System Upgrade:
    - 3. System Disposal:

28. System Disposal:

    - 1. System Disposal:
    - 2. System Material:
    - 3. System Safety:

29. System Certification:

    - 1. System Certification:
    - 2. System Approval:
    - 3. System Compliance:

30. System Compliance:

    - 1. System Compliance:
    - 2. System Testing:
    - 3. System Inspection:

31. System Monitoring:

    - 1. System Monitoring:
    - 2. System Calibration:
    - 3. System Reporting:

32. System Maintenance:

    - 1. System Maintenance:
    - 2. System Inspection:
    - 3. System Repair:

33. System Replacement:

    - 1. System Replacement:
    - 2. System Upgrade:
    - 3. System Disposal:

34. System Disposal:

    - 1. System Disposal:
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    - 1. System Certification:
    - 2. System Approval:
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36. System Compliance:

    - 1. System Compliance:
    - 2. System Testing:
    - 3. System Inspection:

37. System Monitoring:

    - 1. System Monitoring:
    - 2. System Calibration:
    - 3. System Reporting:

38. System Maintenance:

    - 1. System Maintenance:
    - 2. System Inspection:
    - 3. System Repair:

39. System Replacement:

    - 1. System Replacement:
    - 2. System Upgrade:
    - 3. System Disposal:

40. System Disposal:

    - 1. System Disposal:
    - 2. System Material:
    - 3. System Safety:

41. System Certification:

    - 1. System Certification:
    - 2. System Approval:
    - 3. System Compliance:
Radon Entry Points

7. Floor Sump (§404.1.1): Verify lid sealed on floor sump.
8. Floor Drains (§404.1.3): Verify radon resistant drains installed in any drain with exposure to the soil.

System Documentation

Notes 9, 10 & 18 are only required for an active radon mitigation system with fan installed.

   a. System Pressure (§1001.2): Record fan system start-up pressure.
   b. System Labeling (§1001.4): Verify system label on pipe.

Radon System Monitor

- Measures Fan Pressure
  NOT Radon.
- Pressure in Inches of Water Column ("WC")
11. Pipe Size (§501.1): Verify pipe is minimum 3 inch [7.6 cm] diameter PVC or ABS.
12. Pipe Labeling (§501.10): Verify pipe is labeled on each floor, if visible.

15. Electrical (§701.2): Verify junction box and disconnect for fan.

16. Fan Location (§901.8): Verify fan properly located outside occupiable space, attic, garage, etc.
17. Fan Clearance (§701.1): Verify an area of vertical height not less than 48 inches (122 cm) and a diameter of not less than 21 inches (53 cm) provided in the area where the radon fan is (or can be) installed.
18. Radon Fan (§901.3): Verify fan is installed and running.
Fan Installation
- Fan Location
- Adequate Clearance if Fan not Installed

Exhaust Location
19. Radon Discharge (§601): Verify pipe discharges upward outside the building, 1 foot (30 cm) above the surface, not less than 10 feet (3 m) horizontally, and 10 feet (3 m) above the ground, 2 feet (60 cm) above any operable door or window within 10 feet (3 m) in the building or any adjacent building and 2 feet (60 cm) above or 10 feet (3 m) away from mechanical air intake openings.

Radon Test
20. Test Kit (§801.1): Verify long-term radon-in-air test kits are provided for each dwelling.
21. Radon Test (§1101): Attach certified test result below NAL.
What Is Radon?

- Colorless, odorless, radioactive gas.
- From radioactive decay of radium.
- Present in the soil in many areas of US.

Why Is Radon A Problem?

- Exposure can cause lung cancer.
- 21,000 Americans die each year.
Where Is Radon A Problem?

- Any home can have elevated radon.
- EPA Zones 1 & 2 most likely.

How Do You Fix A Radon Problem?

- Active Soil Depressurization System
  - 99%+ Effective
  - Low Installation Cost
  - Low Operating Cost
  - Low Maintenance
  - NOT RECOMMENDED
    - Passive Systems
    - Sealing

How Do You Inspect a Radon System?

- Soil gas collection plenums
- Radon entry points
  - Sumps. Floor/wall joint. Block walls, etc
- Piping
  - Slope (no traps)
  - Support
How Do You Inspect a Radon System?

- System Monitor
  - Labeling
- Fan Location
  - Above or outside thermal envelope
- Exhaust Point
  - 2 feet above, 10 feet away

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