

NRSB CERTIFICATION EXAMS STUDY GUIDE

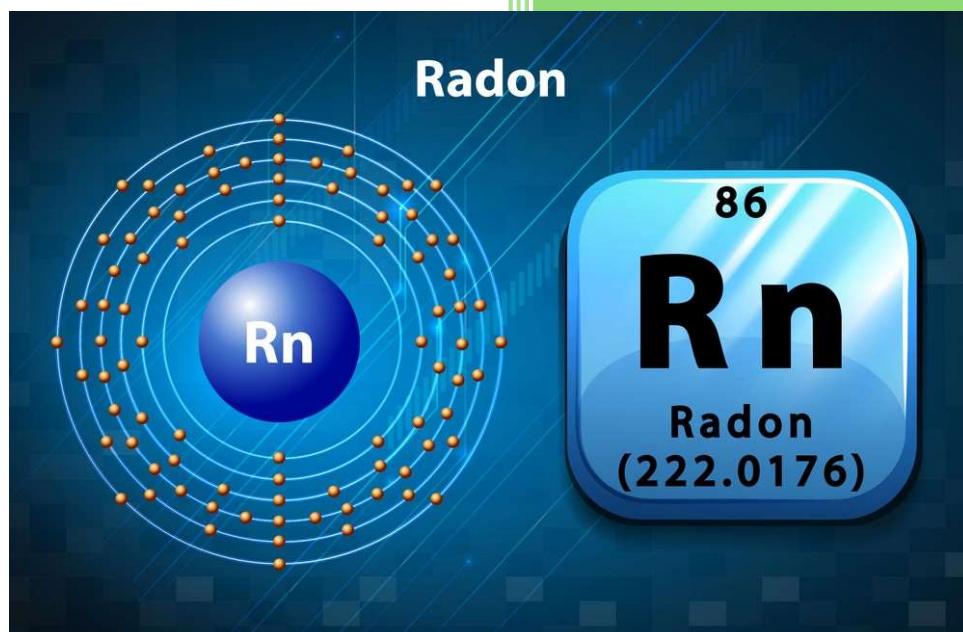


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Objective of Study Guide

The objective of this Study Guide is to provide consolidated information about the NRSB Certification Exams. This Study Guide provides a framework, information and suggested techniques to prepare for the NRSB Radon Professional Certification Exams.

We hope this will help support your success in becoming an NRSB-certified radon professional.

The NRSB Certification Exams

At the time that this study guide was written, the National Radon Safety Board offered 3 exams for individual certification: Radon Measurement Technician, Radon Measurement Specialist, and Radon Reduction (Mitigation) Specialist.

Radon Measurement Technician or RMT

Radon Measurement Technicians are people who have been trained and certified in the fundamentals of radon testing. This requires a basic understanding of radon and the health risks associated with it, as well as a thorough knowledge of measurement techniques and testing protocols.

RMT are qualified to place and retrieve measurement devices for the purpose of collecting radon data. This must be done in accordance with an active Quality Assurance Program (QAP) under the supervision of a certified Radon Measurement Specialist (RMS) or Accredited Radon Laboratory (ARL). A Radon Measurement Technician may oversee the QAP for self-provided measurement services only. A Radon Measurement Specialist must oversee the QAP for every other measurement service type, including laboratory and chamber services.

To qualify for NRSB certification as an RMT, the following requirements must be met:

- Sixteen hours minimum of classroom training on the nature of radon, radon entry in buildings, fundamental radon health risks, occupational health and safety, measurement devices and techniques, and current radon protocols;
- Successful passing of the NRSB RMT examination based upon this knowledge;
- Four hours of Continuing Education credits per certification renewal year;
- Adherence to the National Radon Safety Board code of ethics.

The RMT Exam

The RMT Exam:

- is a live-proctored exam
- consists of 75 multiple choice questions
- examinees are given 1.5 hours to complete the exam
- a score of 70% or better is required to pass the exam
- the list of formulae is in the “Tools” section of the exam window for reference

The RMT exam questions are grouped into 6 different subject areas, as follows:

RMT Subject Area	Total # of Questions
Problem Evaluation	5
Performance of Tests	36
Analysis of Measurements	8
Interpretation of Results	10
Report of Findings	16
Professional Standards of Conduct and Ethics	2

Yes, the total number of questions on this chart exceeds the total number of exam questions, since some of the questions posed cover more than one Subject Area.

The RMT Exam is made available on-line and can be scheduled 24 X 7 by the examinee on the NRSB website at: <https://nrsb.org/exams/digital-exam-information/>

The RMT Syllabus

The RMT Syllabus is the guideline given to our course-providers as they design the courses for both our initial education, as well as continuing education. The current RMT Syllabus is as follows:

I. Basic Concepts (9 questions)

- Radioactivity
- Radiation – alpha, beta, gamma
- Half-life
- Inert gas
- Uranium (mineral) > Radium (mineral) > Radon (gas) > Progeny (solids)
- Radon progeny
- Units: pCi/l, WL, Bq/m³, WLM
- Typical concentrations indoor/outdoor
- Action level
- Gas transport:
 - From soil: diffusion, permeation, mixing/dilution
 - From water: dissolution/aeration
- Sources: soil, rock, building materials, water
- Radon entry into house

II. Health Effects (9 questions)

- Gas > progeny > (attachment) > lungs > alpha radiation > lung cancer risk
- Dose-response model
- Evidence of radon link to lung cancer (miner studies)
- Residential studies
- Extrapolating mines to homes
- Radon-in-water > aeration > inhalation > lungs > known risk
- Radon-in-water > ingestion > stomach/intestines/bloodstream > risk (?)
- Synergistic effect with smoking

- Risk at EPA action level
- What level is “safe”?
- Comparative risks: auto accidents, drowning, other radiation exposures, etc.
- If you don’t know the answer refer client to EPA or State

III. Radon Test Methods (9 questions)

- Test purposes: screening, follow-up/confirm, diagnostic, post-mitigation, maintenance, research/other
- Duration: long term, short term, grab
- Strategy: passive, active
- Integrating vs. continuous
- Screening protocol goals
- Devices: passive/ active, short term/long term
- Passive: Short Term: AC, LS, ES
- Active: Short Term: CR, CW
- Passive: Long Term: AT, EL

IV. Test Placement and Conditions (19 questions)

- Variation: diurnal, seasonal, spatial, weather-related, occupant-related
- Placement: level, room, location, how many
- Minimum distances
- Closed House Conditions
- When required? When recommended?
- Requirements for Closed House Conditions
- Notifying occupants
- Interference/tampering: detecting, avoiding
- Test invalidation
- Data reported to lab with test kit
- EPA Protocol for real estate transactions
- Interpretation of results
- Measurement error /uncertainty
- Large buildings, schools
- Discussion
- (Recommended) Radon-in-water sampling

V. Mitigation (5 questions)

- Mitigation strategies: basics
- Radon from soil:
- Soil depressurization: greatly reduces radon entry into house
- Ventilation: dilutes radon that has entered the house
- Other: sealing – usually doesn’t work by itself
- Radon from water:
- Aeration
- GAC filtration
- Comparative performance and costs
- Difficult situations
- Don’t offer mitigation strategies, let mitigators determine strategies

- All houses can be fixed – cost is the issue
- Radon resistant new construction
- Post-mitigation testing, system monitoring, and maintenance

VI. Relation with Client (9 questions)

- Dialogue with client
- Risk communication
- Confidentiality
- Interpretation of results for client
- Based on radon test results, what should be done next?
- Do nothing, retest, or call mitigator(s)
- If unusually high radon concentrations, urge client to call EPA or state for advice
- What follow-up is required?
- Real estate transaction
- Re-test when?
- Who pays for mitigation?
- Negotiation and escrow possibilities
- Discussion

VII. Relation with Laboratory (5 questions)

- Choosing lab
- Levels of service
- Division of responsibilities
- Quality assurance responsibilities
- Blanks, duplicates, spikes, calibrations
- Quality assurance plan

VIII. Role of Government (5 questions)

- Federal: EPA
- States: unregulated and regulated
- Regional review of state laws
- Real estate disclosure laws
- Radon outreach programs
- EPA Publications:
- Citizen's Guide to Radon
- Consumer's Guide to Radon Reduction
- Home Buyers and Sellers Guide to Radon

IX. Tester's Health and Safety, Professional Conduct, and Ethics (3 questions)

- Testing in houses with known high radon concentrations
- Professional Conduct
- Ethics

X. Additional Courses, Continuing Education, and Credentials (2 questions)

- Advanced measurement methods
- Analytical services and quality assurance

- Radon in water
- Radon mitigation standards; and inspecting mitigation systems
- Video courses
- AARST programs
- NRSB Certification
- Other Certification Programs

Sources for the RMT Exam Questions

The documents listed below provide all of the information on which the questions on the NRSB RMT Exam are based. It is anticipated that this list will be updated from time to time and be posted at www.nrsb.org.

1. Current ANSI/AARST Standards: <https://standards.aarst.org/>
 - a. ANSI/AARST MAH: Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes
2. A Citizen's Guide to Radon: The guide to Protecting Yourself and Your Family from Radon ([EPA 402-K-12/002, December 2016](#))
3. Consumer's Guide to Radon Reduction: How to Fix Your Home ([EPA 402-K-10/005, December 2016](#))
4. Home Buyer's and Seller's Guide to Radon ([EPA 402-K-13/002, September 2013](#))
5. Standard Practice for Installing Radon Mitigation Systems in Existing Low-Rise Residential Buildings ([ASTM E-2121-13](#))
6. Radon Reduction Techniques for Detached Houses Technical Guidance (Second Edition) ([EPA/625/5-87/019, Revised January 1988](#))
7. Radon Reduction Techniques for Existing Detached Houses Technical Guidance (Third Edition) for Active Soil Depressurization Systems ([EPA/625/R-93/011, October 1993](#))
8. Final Report Reducing Radon in Structures (EPA Contract Number 68-D-90170, Work Assignment 2-46, December 1992)
9. Technical Support Document for the 1992 Citizens Guide to Radon ([EPA 400-R-92-011, May 1992](#))
10. Indoor Radon and Radon Decay Product Measurements Device Protocols (EPA 402-R-92-004, July 1992)
11. Protocols for Radon and Radon Decay Product Measurements in Homes ([EPA Document Number 402-R-93-003, June 1993](#))
12. Radon Measurement in Schools Revised Edition ([EPA 402-R-92-014 July 1993](#))

Radon Measurement Specialist or RMS

Certification by the National Radon Safety Board as a Radon Measurement Specialist requires demonstration of knowledge which goes significantly beyond that required of a Technician. In addition to basic training in the rudiments of radon measurements, the certified RMS must demonstrate a basic knowledge of radiation physics, an understanding of risk assessment, the

epidemiological evidence of radon health risks, and the differences between various devices and techniques for measuring radon and radon decay products. The NRSB certified Radon Measurement Specialist must also understand the importance of radiation safety and be capable of designing and implementing a quality assurance program.

In addition to placing and retrieving devices, Radon Measurement Specialists are qualified to read and analyze — rather than simply report — radon measurements in a manner that is consistent with current knowledge. They are also qualified to create and implement Quality Action Plans (QAPs) and Quality Control Plans (QCs). Lastly, they are also qualified to create and maintain Worker Protection Plans (WPPs).

To qualify for NRSB certification as an RMS, the following requirements must be met:

- Sixteen hours of NRSB-approved classroom training on the nature of radon, radon entry in buildings, fundamental radon health risks, occupational health and safety, measurement devices and techniques, and current radon protocols;
- Successful passing of the NRSB RMS knowledge-based exam;
- Eight hours of NRSB-approved continuing education per certification year;
- Adherence to the National Radon Safety Board code of ethics.

The RMS Exam

The RMS Exam:

- is a live-proctored exam
- consists of 100 multiple choice questions
- examinees are given 2 hours to complete the exam
- a score of 70% or better is required to pass the exam
- the list of formulae is in the “Tools” section of the exam window for reference

The RMS exam questions are grouped into 6 different subject areas, as follows:

RMS Subject Area	Total # of Questions
Problem Evaluation	6
Performance of Tests	30
Analysis of Measurements	33
Interpretation of Results	11
Report of Findings	17
Professional Standards of Conduct and Ethics	3

Yes, the total number of questions on this chart exceeds the total number of exam questions, since some of the questions posed cover more than one Subject Area.

The RMS Exam is made available on-line and can be scheduled 24 X 7 by the examinee on the NRSB website at: <https://nrsb.org/exams/digital-exam-information/>

The RMS Syllabus

The RMS Syllabus is the guideline given to our course-providers as they design the courses for both our initial education, as well as continuing education. The current RMS Syllabus is as follows:

I. Basic Concepts Radiation and Radon Sources (15 questions)

- Radioactivity
- Radiation – alpha, beta, gamma
- Half-life
- Inert gas
- Uranium (mineral) > Radium (mineral) > Radon (gas) > Progeny (solids)
- Radon progeny
- Units: pCi, dpm, dps, ER, pCi/l, WL, Bq/m³, WLM
- Typical concentrations indoor/outdoor
- Action level
- Gas transport:
 - From soil: diffusion, permeation, mixing/dilution
 - From water: dissolution/aeration
 - Sources: soil, rock, building materials, water
- Radon entry into house – Mechanisms

II. Health Effects (7 questions)

- Gas > progeny > (attachment) > lungs > alpha radiation > lung cancer risk
- Dose-response model
- Evidence of radon link to lung cancer (miner studies)
- Residential studies
- Extrapolating mines to homes
- Radon-in-water > aeration > inhalation > lungs > known risk
- Radon-in-water > ingestion > stomach/intestines/bloodstream > risk(?)
- Synergistic effect with smoking
- Risk at EPA action level
- What level is “safe”?
- Comparative risks: auto accidents, drowning, other radiation exposures, etc.
- If you don’t know the answer refer client to EPA or State

III. Radon Test Methods (25 questions)

- Test purposes: screening, follow-up/confirm, diagnostic, post-mitigation, maintenance, research/other
- Duration: long term, short term, grab
- Strategy: passive, active
- Integrating vs. continuous
- Screening protocol goals
- Devices: passive/ active, short term/long term
- Passive: Short Term: AC, LS, ES
- Active: Short Term: CR, CW
- Passive: Long Term: AT, EL
- Instrument Accuracy at 4.0pCi/L

IV. Test Placement, Protocols and Conditions (26 questions)

- Variation: diurnal, seasonal, spatial, weather-related, occupant-related
- Placement: level, room, location, how many
- Minimum distances
- Closed House Conditions
- When required? When recommended?
- Requirements for Closed House Conditions
- Notifying occupants
- Interference/tampering: detecting, avoiding
- Test invalidation
- Data reported to lab with test kit
- EPA Protocol for real estate transactions
- Interpretation of results
- Measurement error /uncertainty
- Large buildings, schools
- Discussion
- (Recommended) Radon-in-water sampling

V. Mitigation (5 questions)

- Mitigation strategies: basics
- Radon from soil:
- Building investigation
- Soil depressurization: greatly reduces radon entry into house
- Soil pressurization
- Ventilation: dilutes radon that has entered the house
- Other: sealing – usually doesn't work by itself
- Radon from water:
- Aeration
- GAC filtration
- Advantages & Disadvantages
- Comparative performance and costs
- Difficult situations
- Don't offer mitigation strategies, let mitigators determine strategies
- All houses can be fixed – cost is the issue
- Radon resistant new construction – How it works
- Post-mitigation testing, system monitoring, and maintenance

VI. Relation with Client (4 questions)

- Dialogue with client
- Risk communication
- Confidentiality
- Interpretation of results for client
- Based on radon test results, what should be done next?
- Do nothing, retest, or call mitigator(s)
- If unusually high radon concentrations, urge client to call EPA or state for advice
- What follow-up is required?

- Real estate transaction
- Re-test when?
- Who pays for mitigation?
- Negotiation and escrow possibilities
- Discussion

VII. Relation with Laboratory (9 questions)

- Choosing lab
- Levels of service
- Division of responsibilities
- Quality assurance responsibilities
- Blanks, duplicates, spikes, calibrations
- Quality assurance plan
- Control Charts

VIII. Role of Government (4 questions)

- Federal: EPA
- States: unregulated and regulated
- Regional review of state laws
- Real estate disclosure laws
- Radon outreach programs
- EPA Publications:
 - Citizen's Guide to Radon
 - Consumer's Guide to Radon Reduction
 - Home Buyers and Sellers Guide to Radon

IX. Tester's Health and Safety, Professional Conduct, and Ethics (3 questions)

- Testing in houses with known high radon concentrations
- Calculate occupational exposures (WLM)
- Professional Conduct
- Ethics – Conflict of Interest

X. Additional Courses, Continuing Education, and Credentials (2 questions)

- Advanced measurement methods
- Analytical services and quality assurance
- Radon in water
- Radon mitigation standards; and inspecting mitigation systems
- Video courses
- Seminar participation
- AARST programs
- NRSB Certification
- Other Certification Programs

Sources for the RMS Exam Questions

The documents listed below provide all of the information on which the questions on the NRSB RMS Exam are based. It is anticipated that this list will be updated from time to time and be posted at www.nrsb.org.

1. Current ANSI/AARST Standards: <https://standards.aarst.org/>
 - a. ANSI/AARST MAH: Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes
 - b. ANSI/AARST MS-QA: Radon Measurement Systems Quality Assurance
2. A Citizen's Guide to Radon: The guide to Protecting Yourself and Your Family from Radon ([EPA 402-K-12/002, December 2016](#))
3. Consumer's Guide to Radon Reduction: How to Fix Your Home ([EPA 402-K-10/005, December 2016](#))
4. Home Buyer's and Seller's Guide to Radon ([EPA 402-K-13/002, September 2013](#))
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7. Radon Reduction Techniques for Existing Detached Houses Technical Guidance (Third Edition) for Active Soil Depressurization Systems ([EPA/625/R-93/011, October 1993](#))
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11. Protocols for Radon and Radon Decay Product Measurements in Homes ([EPA Document Number 402-R-93-003, June 1993](#))
12. Radon Measurement in Schools Revised Edition ([EPA 402-R-92-014 July 1993](#))

Radon Reduction (Mitigation) Specialist or RRS

The NRSB requirements for certification as a Radon Mitigation Specialist (RRS) are essentially the same as those established by the Environmental Protection Agency Radon Proficiency Program for radon mitigators. To be certified a candidate must have a working knowledge of radon measurement techniques and health risks and must demonstrate a broad knowledge in all aspects of residential radon mitigation.

This includes the ability to evaluate the quality of radon measurements, assess alternative mitigation strategies, and properly design and install effective control systems.

To qualify for NRSB certification as an RRS, the following requirements must be met:

- Twenty-four hours of NRSB- approved mitigation training, including not less than eight hours of hands-on experience;
- Sixteen hours of NRSB-approved measurement training;
- Successful passing of the NRSB RRS knowledge-based exam;
- Eight hours of NRSB-approved continuing education per certification year;
- Adherence to the National Radon Safety Board Code of Ethics.

The RRS Exam

The RRS Exam:

- is a live-proctored exam
- consists of 125 multiple choice questions
- examinees are given 2.5 hours to complete the exam
- a score of 70% or better is required to pass the exam
- the list of formulae is in the “Tools” section of the exam window for reference

The RRS exam questions are grouped into 6 different subject areas, as follows:

RRS Subject Area	Total # of Questions
Problem Evaluation	25
Problem Diagnosis	20
Selection of Mitigation Strategy	41
Implementation of Mitigation Strategy	16
Evaluation of Mitigation Systems	26
Professional Standards of Conduct and Ethics	2

The RRS Exam is made available on-line and can be scheduled 24 X 7 by the examinee on the NRSB website at: <https://nrsb.org/exams/digital-exam-information/>

The RRS Syllabus

The RRS Syllabus is the guideline given to our course-providers as they design the courses for both our initial education, as well as continuing education. The current RRS Syllabus is as follows:

I. Radon Source and Behavior Fundamentals (20%)

- Sources of Radon
- Radon from soil vs individual rocks/boulders
- Pathways through the soil
- Forces that create pressure differences between home interior and soil
- Common Radon Entry Points
- Building ventilation rate and relationship to radon measurement

II. Mitigation Theory and Design (10%)

- Active Soil Depressurization (ASD) - Umbrella term for single direction depressurization system focused on removing soil gasses from outside the building envelope

- Sub-Slab Depressurization (SSD)
- Drain Tile Depressurization (Interior or Exterior) (DTD)
- Crawl Space Depressurization (CSD)
- Sub-Membrane Depressurization (SMD)
- Block Wall Depressurization (BWD)
- Stem Wall Depressurization (SWD)
- When and how to use combinations of the above systems

III. Dilution by Ventilation Systems (5%)

- Energy Recovery Ventilators (ERVs)
- Heat Recovery Ventilators (HRVs)
- How to calculate appropriate cubic feet / minute of ventilation per household size
- Best practices for installing these units
- How to seal ducts
- How to plan out locations of interior and exterior vents and how to properly screen exterior vents
- How to balance systems
- Maintenance needed and client communication specific to these units

IV. ASD Installation Process: (30%)

- Walk-through to assess sources of negative pressure
- Sealing of radon entry points (most appropriate to perform before pressure field testing)
- How to create sealable covers for sewer clean-out traps
- Building investigation
- Pre-mitigation testing either with grab sampler, or setting out passive devices
- Identification of ideal “exit point” for systems with suction from interior
- Pressure Field Extension Testing (diagnostically with shop vac vs. confirmatory testing with fully excavated suction pit and radon fan)
- Suction pit excavation process and best practices
- Examining substrate composition and porosity
 - When and where do drill multiple test holes to find porosity
- How to determine how many suction points will be needed and where would provide the most benefit
- Using micromanometers and/or smoke to ensure that the entire structure is under negative pressure
- Communication between block walls and floor
- Managing water entry into piping - pitching pipe, when to add bypasses, ways to configure bypasses
- What to do when finished interior space occupies all of the area between desired suction points
- Balancing system pressure between multiple suction points
- DTD systems - how to properly seal sump lids; how to properly connection suction piping to sump lids
- How to read fan performance charts
- How to match the correct fan for a given system type and foundational size

- How to confirm that the installed fan performs as needed to guarantee reduction
- Measuring whether systems create backdrafts or not
- How to approach setting up electrical connections for systems
 - Low voltage unit options
 - When in doubt, follow local code
 - Ensuring that fans are connected to GFCI protected outlets or circuits

V. Crawl Depressurization Additional Considerations (10%):

- Approach options taking into account if the crawl space is ventilated or not, already has a membrane, or has cement rat slab & whether or not and how the first floor is insulated.
- Methods for installing membranes over dirt crawl spaces and where to route piping
- How to seal membrane seams
- How to properly affix membranes to conventional or varied fieldstone walls
- How to seal around pipe penetrations into membrane or the home's support columns
- Health and Safety best practices specifically for crawl space work
- When and where to use closed cell spray foam

VI. Troubleshooting non or underperforming systems (10%)

- What to do if system has not performed as expected
 - How to select areas for diagnostic survey
 - How to determine if upgrading the fan to a more powerful model will help or not
- For non-functioning systems
 - Is it an electrical issue, or an issue with the fan itself?
- Is pipe obstructed with water or other debris?
- Is the system losing pressure anywhere?
- Are all pipe connections glued properly
- Was the suction pit dug out sufficiently
- Is the system reaching all areas of the foundation - including sub-grade walls, or multiple slabs?

VII. Mitigation Systems for Radon from water (5%):

- May be limited by state to only licensed plumbers
- Aeration
- GAC filtration
- Advantages & Disadvantages
- Comparative performance and costs
- All houses can be fixed – cost is the issue
- Radon resistant new construction – How it works
- Post-mitigation testing, system monitoring, and maintenance

VIII. Relation with Client (10%)

- Client communication: Mitigator decides the technical method required to achieve the performance guarantee, When possible, collaborate with client providing options if multiple locations can be used
- Risk communication of what could go wrong during installation and how that would be handled
- Confidentiality
- Going through the post-mitigation testing process
- How to offer testing services, when appropriate, while acknowledging a conflict of interest
- Interpretation of results for client
- Based on radon test results, what should be done next?
- Do nothing, retest, or amend system
- Real estate transaction special considerations
- Re-test when?
- Who pays for mitigation if prior test shows level above, or below 4.0?
- Negotiation and escrow possibilities

Sources for the RRS Exam Questions

The documents listed below provide all of the information on which the questions on the NRSB RRS Exam are based. It is anticipated that this list will be updated from time to time and be posted at www.nrsb.org.

1. Current ANSI/AARST Standards: <https://standards.aarst.org/>
 - a. ANSI/AARST MAH: Protocol for Conducting Measurements of Radon and Radon Decay Products in Homes
 - b. ANSI/AARST MS-QA: Radon Measurement Systems Quality Assurance
 - c. ANSI/AARST SGM-SF: Soil Gas Mitigation Standards for Existing Homes
2. A Citizen's Guide to Radon: The guide to Protecting Yourself and Your Family from Radon ([EPA 402-K-12/002, December 2016](#))
3. Consumer's Guide to Radon Reduction: How to Fix Your Home ([EPA 402-K-10/005, December 2016](#))
4. Home Buyer's and Seller's Guide to Radon ([EPA 402-K-13/002, September 2013](#))
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11. Protocols for Radon and Radon Decay Product Measurements in Homes ([EPA Document Number 402-R-93-003, June 1993](#))
12. Radon Measurement in Schools Revised Edition ([EPA 402-R-92-014 July 1993](#))

Tools Available to the Examinee

Formula Sheet

The information below are the formulae that are accessible within the exam screens under the “Tools” option:

Formula Tool for Radon Professionals

Radon =	$\frac{WL}{ER} \times 100$
ER =	$\frac{WL}{Radon} \times 100$
WL =	$\frac{Radon \times ER}{100}$
WLM =	$\frac{WL \times (\text{hours of exposure})}{170}$
Accuracy (Bias) =	$\frac{\text{Test Device} - \text{Reference}}{\text{Reference}}$
Precision or RPD of Duplicates =	$\frac{\text{AbsVal}(\text{Test1} - \text{Test2})}{\text{Average of Test1 \& Test2}}$
Convert pCi/l to Becquerel =	$\text{Bq/l} \times 27.03$

NRSB Initial Course-Providers Materials

All of the NRSB Initial Course-Providers provide every student with either a study guide to their course and/or continued access to the class(es) you have completed. We also recommend that you use these tools as you continue to prepare for your exam.