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# Washington TRU Solutions

N42.50 - Performance Specifications for Instrumentation Systems Designed to Measure Radon Progeny in Air

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# Introduction

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- Why do we have standards?
- Who uses standards?
- Who writes standards?
- What authority exists within a standard?
- How do standards relate to regulations and requirements?
- When is a standard used?
- What is the 42.50 ANSI standard on radon progeny?
- Why are there so many standards in air monitoring?
- Why doesn't somebody just combine them into a single user friendly standard rather than leaving them piecemeal in multiple standards?

# Why do we have standards?

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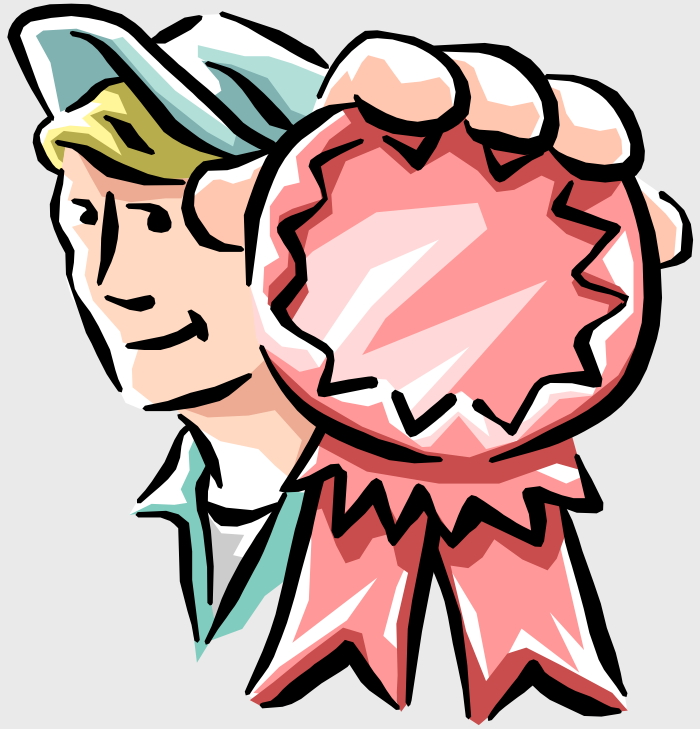
- Quality
  - Reproducibility and Consistency
  - Common understanding
  - Minimum performance specifications
- Safety related parameters
  - Insures minimum safety specifications
  - Insures expert guidance is available



# Who uses standards?

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- Manufacturers
  - Design engineering
  - Testing and validation
- End users
  - System must be user friendly
  - The safe way to do things should be the simplest
- Maintenance
- General Public

# What authority exists within a standard?

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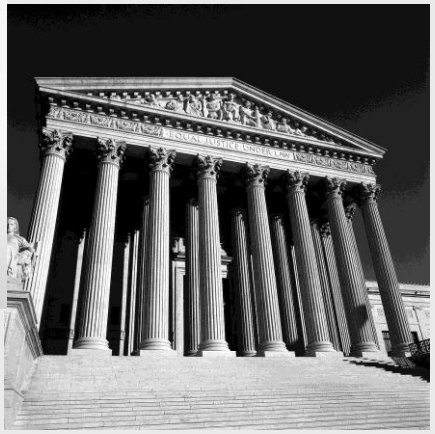
- Due diligence, best practices
- State Regulations
- Standards determine minimum specifications for system performance
  - These generally directly relate to worker or public safety
- Minimum procurement requirements



# How do standards relate to regulations and requirements?

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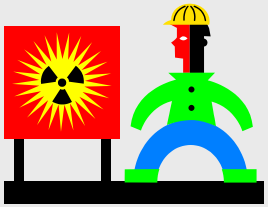
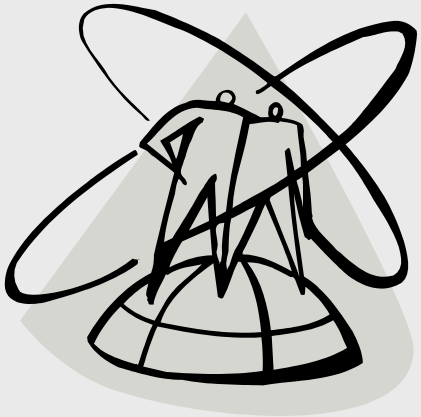
- Occasionally, a national standard will be uniquely called out in a Federal Regulation
  - 10CFR830 Nuclear Facility Safety (criticality safety standards)
- Contractual requirements for management and operating contractors often call out specific standards
- Standards can drive manufacturing specifications





# When is a standard used?

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- Process implementation
  - Facility operations
    - Calibration, maintenance and operating equipment as intended
  - System or component manufacture
  - Testing and evaluation
    - Type testing, operational tests, functional tests
  - Documentation
  - Peer review
  - Lifecycle issues

# Lifecycle can be a continual process

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| Name of test or requirement | Purpose of test or requirement | Test frequency | Units to be tested | Specifications to be tested | Responsibility |
|---|---|---|---|---|---|
| **evaluation** | To define mission and measurement objectives and identify candidate technologies | Prior to initiation of the development process, and continuously throughout the life cycle | Conceptual or by analogy with existing missions and technologies | Definition of the specifications that will be evaluated in the subsequent life-cycle phase | Responsible officials with input from research, development, manufacturing and user professionals |
| **Development tests** | To aid in the development of a prototype that is likely to meet certain specifications | As needed | Individual components and assemblies | As selected by the manufacturer or requested by the purchaser/user | The manufacturer |
| **Prototype tests** | To demonstrate that the design of the instrument is likely to meet certain specifications | As needed prior to the start of production | One or more prototype units | As selected by the manufacturer or requested by the purchaser/user | Generally the manufacturer; occasionally the purchaser/user or designer |
| **Type tests** | To demonstrate that the design of the instrument as manufactured meets certain specifications | A minimum of one prior to full production | One or more initial production units | All specifications from the relevant standards or as agreed upon by the manufacturer and purchaser/user | Generally the manufacturer; occasionally the purchaser/user or designer |
| **Production control tests** | To control production, avoid defects and confirm instrument compliance with select specifications | Depending on the acceptable failure rate agreed upon between manufacturer and purchaser/user | As determined by the manufacturer or as agreed upon by the manufacturer and purchaser/user | As selected by the manufacturer or requested by the purchaser/user | Manufacturer |
| **Training** | To ensure proper execution of all tests and requirements | Prior to and periodically during the life cycle | Life cycle participants | As appropriate for the instrument and its use | All life cycle participants |
| **Acceptance tests** | To demonstrate compliance with selected specifications | After the units are received and prior to their initial use | As agreed upon between manufacturer and purchaser/user | As selected by the purchaser/user | Purchaser/user |
| **Initial calibration** | To establish a traceable calibration relevant to expected conditions of use | Prior to initial use in operations | Each unit | Selected instrument parameters and response sufficient for metrology of the measurand | Designated calibration staff (can be users or appropriate vendors) |
| **Operational tests** | To provide indications that the instrument is operational | Before each use and possibly during use | Each unit | Primary functions required for correct unit operability | User |
| **Functional tests** | To provide indications that the instrument is calibrated | More frequently than re-calibration requirements | Each unit | As appropriate for the instrument being tested (e.g.. alarms) | User or calibration staff |
| **Operational experience** | To provide indications that instrument continues to meet mission requirements | Continually in general but in great detail with control charts and performance data | Each unit | User selected responses, can be as basic as ease of use or procedural improvements | Both user and designated oversight experts of the users organization |
| **Maintenance and calibration** | To provide preventative maintenance, make necessary repairs and reestablish a traceable calibration | At a frequency (e.g., annually) based on the design and reliability history of the instrumentation | Each unit | As per manufacturer recommendation or based on operational experience | Designated maintenance and calibration staff or appropriate vendor |
| **Periodic performance tests** | To verify that the instrument continues to meet relevant specifications | As appropriate based on experience and anticipated modes of failure | A representative number of units | Selected specifications from the type test | As arranged by the purchaser |

# What is the 42.50 ANSI standard on radon progeny?

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- 1 SCOPE
- 2 OVERVIEW
- 3 NORMATIVE REFERENCES
- 4 DEFINITIONS & ACRONYMS
- 5 UNITS & CONVERSIONS
- 6 CLASSIFICATION OF INSTRUMENT SYSTEMS
- 7 PERFORMANCE AND TESTING
  - 7.1 Attached and Unattached fraction
  - 7.2 Radiation Response to Radon Progeny
  - 7.3 Sampling System Design
  - 7.4 Electronic Criteria
  - 7.5 Interfering Responses

# Quick content overview

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- 7.6 Mechanical Criteria
- 7.7 Environmental Criteria
- 7.8 Calibration and Maintenance

- 8 CLASS SPECIFIC PERFORMANCE & TESTING CRITERIA
  - 8.1 Grab Sampling Instruments
  - 8.2 Continuously Sampling Instruments
  - 8.3 Integrating Sampling Instruments

- 9 DOCUMENTATION
  - 9.1 Type test report
  - 9.2 Certificate
  - 9.3 Manuals and Procedures
  - 9.4 Records

# Content overview continued

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- 10 BIBLIOGRAPHY
- 11 ANNEXES
  - 11.1 Radon and Radon Progeny Equilibrium
  - 11.2 Aerosol Sampling Considerations
  - 11.3 Filter Selection
  - 11.4 Radon Decay Chain
  - 11.5 Life Cycle Approach to Instrument Tests and Test Requirements
  - 11.6 Radiation Response – Radon Progeny as Interfering Radionuclides

# Scope of N42.50

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- This standard specifies minimum performance requirements and performance testing requirements for instruments designed to measure radon progeny in air.
- This can take place with radon progeny either as the primary quantitative measurement or as an interferent.
- In as much as the health effects of exposure to radon progeny, and hence regulatory control, are quantified relative to the ultimate dose delivered by the complete decay of all the radon progeny in the monitored air, the principle measurand of interest may be the potential alpha energy concentration (PAEC), expressed in either units of Working Level or $J \cdot m^{-3}$.
- This standard addresses the needs of users, manufacturers, and regulators concerned with radon progeny measurements.

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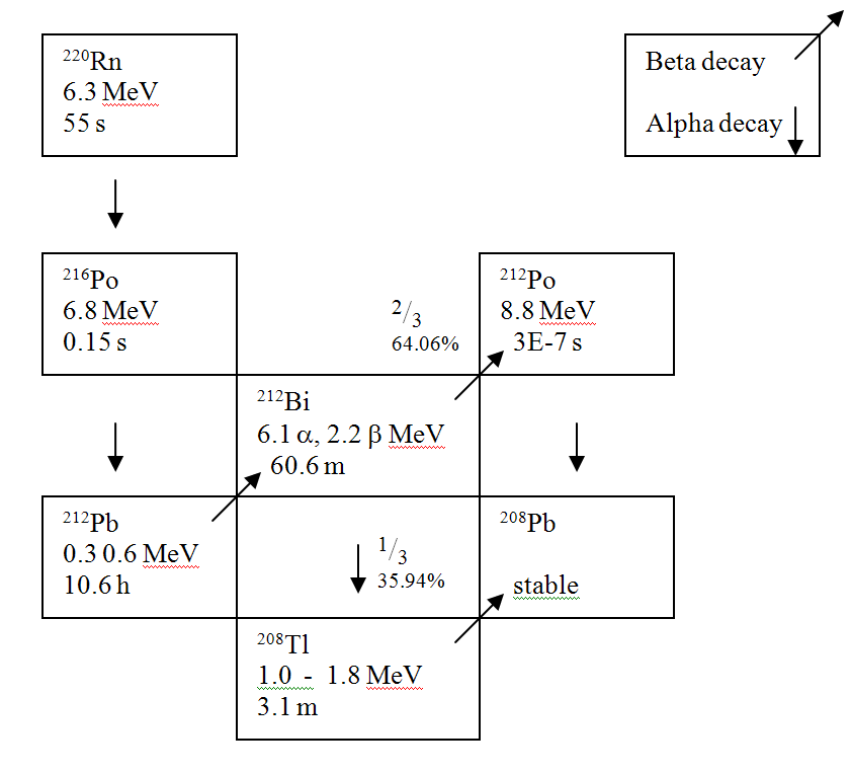
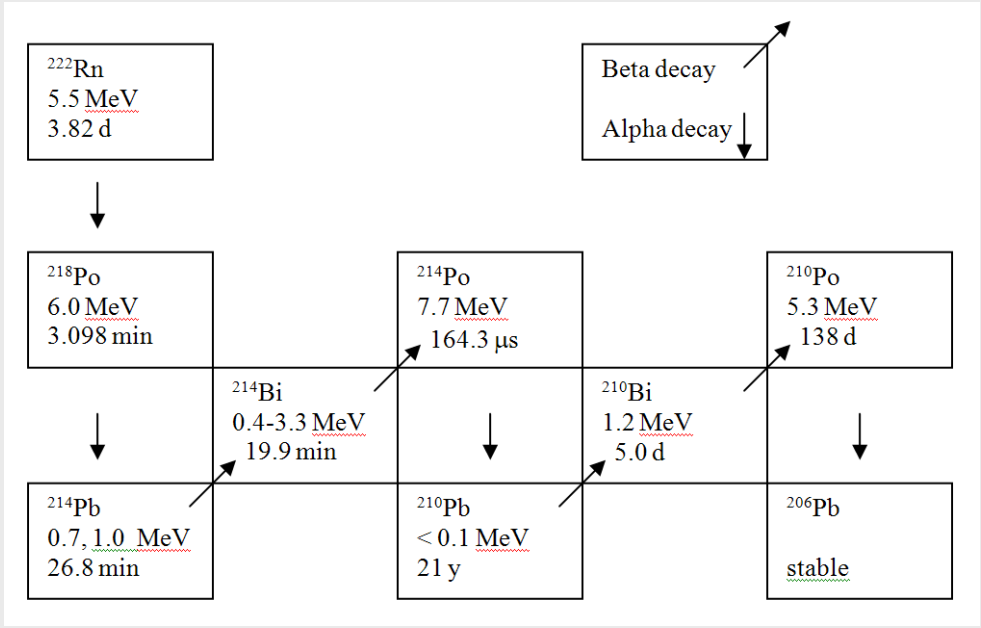
# Basic Radium Decay Chains

## Rn-220
## (Thoron, Th-232 progeny)




## Rn-222
## (Radon, U-238 progeny)



# Radon Masking is a Common Concern

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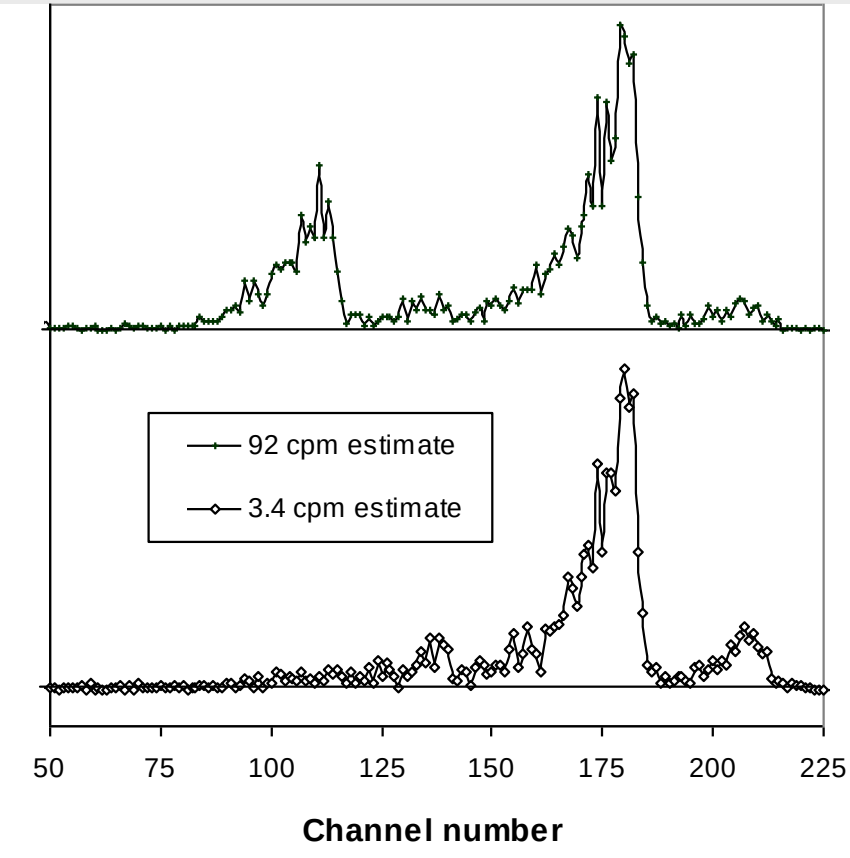


- Spectra acquired from used PAS filters having a small TRU count rate contribution present due to a source being placed behind the filter (Figure 1).
- The upper spectra had a total accumulation time of 3.5 minutes whereas the lower spectrum had a 16 minute accumulation time.
- No amplitude normalization was used, intensity similarities reflect radon progeny activity on the filters.

# Meteorological Dependencies

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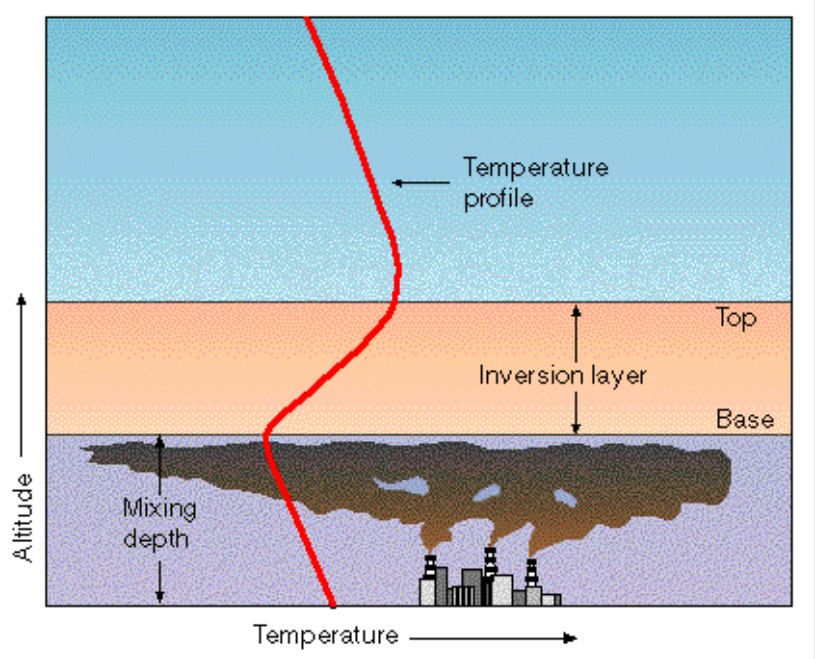
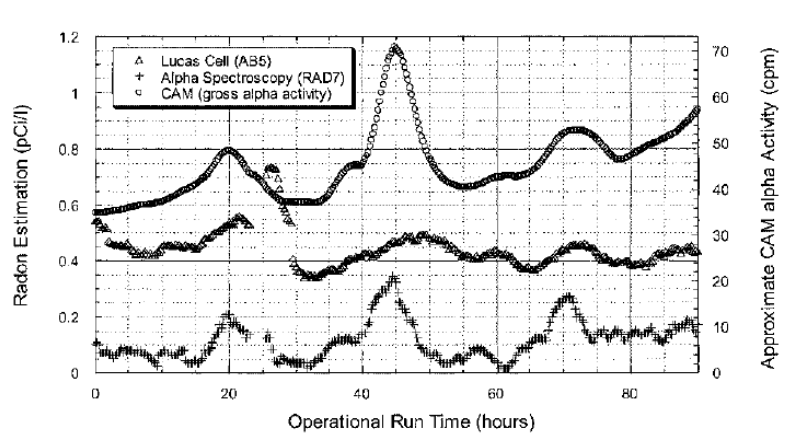
- Radon typically is more concentrated in the mornings due to temperature inversions.
  - The inversion prevents mixing with upper atmosphere air which would dilute surface concentrations
  - This gives rise to diurnal variations
- When windy conditions are present, thoron to radon ratios tend to be higher.
- Humidity and dust loading effect unattached fraction



# Why are there so many standards in air monitoring?

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- ANSI 42.17B -1989, *Performance Specifications for Health Physics Instrumentation- Occupational Airborne Radioactivity Monitoring Instrumentation*
- ANSI N42.18-2004, *Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents*
- ANSI N323C *Radiation Protection Instrumentation Test and Calibration – Air Monitoring Instruments*
- ANSI N42.30-2002*Performance Specification for Tritium Monitors*

# Why doesn't somebody just combine them into a single user friendly standard?

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Writing committee established and work already begun!

| | | |
|---|---|---|
| Murray E Moore | LANL | Aerosols and TRU (lead) |
| Roger Schanzenbach | So Cal | Iodine (lead) |
| David Schafer | LANL | ? |
| Brian Asamoto | General Atomics | Nobles (lead), General Req. (lead) |
| Jim Rolph | WRPS | ? |
| Dennis Hadlock | SRNL | Tritium (lead) |
| Andy Lasko | Fluke Biomed | General Req. |
| Lisa Spinelli | Millipore | General Req. |
| Hsiao-Lan Chang | Millipore | ? |
| Morgan Cox | NIST/DHS | General Req., Norm Ref (lead) |
| Tom Voss | LANL | Tritium |

# ANSI N42.5X - Instrumentation and systems for monitoring airborne radioactivity

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- This standard is intended to encompass monitoring airborne radioactivity including transuranics, noble gases, iodines and tritium in the workplace, in effluent and in the environment. This standard includes initial design, manufacture, minimum performance, performance testing, calibration and maintenance requirements. This standard covers both monitoring and sampling followed by retrospective analysis.
- The purpose of this standard is to supersede ANSI N42.17B, ANSI N42.18, ANSI N42.30 and ANSI N323C. The initial design was based on the IEC 60761 series. The intended users would be government and commercial facilities which manage radionuclides

# Conclusion

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- ANSI 42.50 writing committee came to consensus on the standard and all comments and sections have been completed and addressed
- ANSI 42.50 has been send to N42 as an initial submission
- As of this writing (3/25/10) no response has been obtained on this standard
- Condensation of the multiple air monitoring standards will kick off at the Air Monitors Users Group meeting at Palace Station (right here) on May 2-6, 2010
- Further questions regarding standards can be directed to the session chair Morgan Cox