## Proposed Changes and additions to MS-PC

Dear reviewers,

The following series of definitions are the result of work to begin harmonization and improvements to both:

- ANSI/AARST MS-PC *Performance Specifications for Instrumentation Systems Designed to Measure Radon Gas in Air*, and
- ANSI/AARST MS-QA *Radon Measurement Systems Quality Assurance*.

The initial phase of this work entails updates and harmonization for MS-PC.

Access to read these standards is publicly available for free at https://standards.aarst.org

### REQUESTED PROCESS AND FORM FOR
### FORMAL PUBLIC REVIEW COMMENTS

*Submittals (MS Word preferred) may be attached by email to StandardsAssist@gmail.com or submitted in paper form by fax to (913) 780-2090*

*1) Do not submit marked-up or highlighted copies of the entire document.*

*2) If a new provision is proposed, text of the proposed provision must be submitted in writing.  If modification of a provision is proposed, the proposed text must be submitted utilizing the strikeout/underline format.*

*3) For substantiating statements: Be brief. Provide abstract of lengthy substantiation. (If appropriate, full text may be enclosed for project committee reference.)*

### REQUESTED FORMAT

Title of Public Review Draft:  **MS-PC Proposed Updates 01-2020**

- **Name:**                                             Affiliation:
- **Clause or Subclause**:
- **Comment/Recommendation**:
- **Substantiating Statements**:
- [____] Check here if your comment is supportive in nature and does not require substantive changes in the current proposal in order to resolve your comment.
*Repeat the five bullet items above for each comment.*

| MS-PC 2015 | MS-QA 2019 |
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| ~~**Continuous Radon Monitor (CRM) –** an electronic device that~~ ~~(1) is capable of providing reviewable, numeric measurements of radon concentration averaged over time intervals of 1 hour or less,~~ ~~(2) has a minimum detectable concentration (MDC) of no greater than 148 Bq/m³ (4 pCi/L) for a 1-hour measurement, and~~ ~~(3) has a calibration factor of at least 2 counts per hour per 37 Bq/m³ (0.054 counts per hour [cph] per Bq/m³ or 2 cph per pCi/L).~~ | ✳ Public review for updating MS-PC **Continuous Radon Monitor (CRM):** An electronic device that (1) is capable of automatically recording <u>a retrievable time series of</u> numeric measurements of radon concentration averaged over time intervals of 1 hour or less; (2) has a *minimum detectable concentration* (MDC) of no greater than 148 Bq/m³ (4 pCi/L) for a 1-hour measurement; and (3) has a *calibration* factor of at least 2 counts per hour per 37 Bq/m³ (0.054 counts per hour [cph] per Bq/m³ or 2 cph per pCi/L). |

~~**Equilibrating Device** – a detector that functions by adsorbing and/or desorbing radon from or to the ambient air until an equilibrium is established between the quantity of adsorbed radon and the radon concentration in the ambient air.~~

~~**6.3    Equilibrating Methods**~~

~~This class of device employs a material such as activated charcoal that adsorbs radon from the air until a state of equilibrium is reached between the quantity of adsorbed radon and the concentration of radon in the surrounding air.  Once equilibrium is established, radon may exchange between the charcoal and the air. Some of the adsorbed radon may be replaced by moisture from the air and, thus, the quantity of adsorbed radon may decrease after equilibrium is established.  If the concentration of radon in the surrounding air decreases once equilibrium has been established, then radon will desorb from the charcoal to maintain the state of equilibrium.   Moisture in the air competes with adsorption sites on the charcoal; therefore, less radon is adsorbed when the air contains more moisture (higher relative humidity).   Also, less radon is adsorbed at higher temperatures. Therefore, devices using adsorption of radon by activated carbon are subject to effects of moisture and temperature. Device providers may need to take such effects into consideration to meet the requirements of the standard.  This class of device can provide a good representation of the average radon concentration during the exposure period as long as there are no large changes in the radon concentration during the exposure. Depending on the design of the device, its response may be significantly influenced by the radon concentration in the air during the last 12 hours or so of the exposure period.  Because of the half-life of radon and the time it takes for equilibrium to be established between the adsorbed radon and the radon concentration in the air, this class of device is typically limited to exposure durations from 2 to 7 days.   Calibration of an equilibrating device is accomplished through exposures of representative sets of devices in a STAR for various time periods and~~

**6.3 Charcoal Adsorption Device (CAD) Methods:**

This class of device employs a material such as activated charcoal that adsorbs radon from the air. The amount of radon adsorbed depends on the design of the device, the type of material ~~charcoal~~, the exposure time and the radon concentration, temperature and relative humidity in the surrounding air.  This class of device can provide an accurate representation of the average radon concentration during the exposure period if there are no large changes in radon concentration or the environment (e.g., temperature, humidity) during the exposure.  Because of the half-life of radon and the time it takes for radon to adsorb, they are typically limited to exposure durations from 2 to 7 days. *Calibration* of a charcoal adsorption system is accomplished through exposures of representative sets of devices in a *STAR* for various time periods and different values of temperature and humidity.

Lower Limit of Detection (LLD$_{CT}$), Counting Technology Methods – the smallest net count rate at which there is 95% confidence that a signal above background is detected. For the purpose of this standard, and for devices that rely on counting technology, the following equation is used (Currie, 1968):

LLD$_{CT}$ = [2.71/t$_s$ + 3.29(R$_b$/t$_b$ + R$_b$/t$_s$)$^{1⁄2}$]

where LLD$_{CT}$ = Lower Limit of Detection (cpm) for counting technology methods

t$_s$ = Sample counting time (min)

R$_b$ = Background or blank count rate (cpm)

t$_b$ = Background or blank counting time (min)

For continuous radon monitors, the sample counting time is the time spent making a radon measurement, and the background count rate and counting time are determined when measuring an atmosphere free of radon, such as nitrogen or aged air. For charcoal devices, the sample counting time is the time spent counting the sample in the laboratory. The blank count rate and blank counting time are determined from counting a blank sample in the laboratory. For alpha-track detectors, the parameters are defined as follows:

t$_s$ = Area of sample scanned (mm²)

R$_b$ = Blank sample track density (tracks/mm²)

t$_b$ = Area of blank sample scanned (mm²)

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★ Public review for updating MS-PC

**Use this in both standards:**

**Lower Limit of Detection, Counting Technology (LLD$_{CT}$) Methods (CRM, ATD and CAD):** The smallest net count rate at which there is 95% confidence that a signal above background is detected (true positive). The *blank* count rate and *blank* counting time are determined by counting a *blank* sample in the laboratory. For this standard, and for devices that rely on independent event counting technology, this equation by Currie (1968) is used.

$$LLD_{CT} = 2.71/t_s + 3.29(R_b/t_b + R_b/t_s)^{1⁄2}$$

(2)

where LLD$_{CT}$ = *Lower Limit of Detection* (cpm) for counting technology methods

t$_s$ = Sample counting time (min), or for ATDs, the area of sample scanned (mm²)

R$_b$ = Background or *blank* count rate (cpm), or for ATDs, the *blank* sample track density (tracks/mm²)

t$_b$ = Background or *blank* counting time (min), or for ATDs, the area of *blank* sample scanned (mm²)

Note—The LLD for ATD counting systems can use the same formula by using the areas of the plastic counted for *blanks* and field exposed detectors as surrogates for the background and sample counting times. For CRMs, the sample counting time is the time spent making a radon measurement; the background count rate and counting time are determined when measuring an atmosphere free of radon, such as nitrogen or aged air. For CADs, the sample counting time is the time spent counting the sample in the laboratory.

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| ~~Lower Limit of Detection, Noncounting Technology Methods (LLD~~<sub>NCT</sub>~~) – the smallest measure at which there is a specified degree of confidence that a signal above background is detected. For consistency with the LLD~~<sub>CT</sub>~~ for radioactive decay counting methods, a value of k=3.29, or 3.3, is used for purposes of this standard. This results in an LLD above which there is at least a 95% confidence that the measured value is not due to background. This LLD~~<sub>NCT</sub>~~ value is calculated by the following equation:~~ <br><br> ~~$LLD_{NCT} = m_B + ks_B$~~ <br> ~~where $m_B$ is the mean of the blank measures, $s_B$ is the standard deviation of the blank measures, and $k$ is a numerical factor chosen according to the confidence desired (IUPAC Compendium of Chemical Terminology, 2013; ISO 11843).~~ | <span style="color:red">✶ Public review for updating MS-PC</span><br><span style="color:red">✶ **Use this in both standards:**</span><br>**Lower Limit of Detection, Non-Counting Technology (LLD<sub>NCT</sub>) Methods:** The EIC method does not count detected radioactive decay events, but the LLD for such methods is calculated to provide the same assurance: the smallest signal at which there is 95% confidence that a signal above background is detected (true positive). EIC methods use the difference between the two voltage measurements (final subtracted from initial with the uncertainty in each voltage determination being independent of both the concentration and one another). Therefore, the combined variance is given by the sum of the variances in both the initial and final voltage, which follows the traditional root-sum-of-the-squares of sample standard deviations of both measurements. Assuming that both voltage determinations have equal variances, and using the square of sample standard deviation as the variance, results in the combined standard uncertainty in the net voltage of: <br><br> Uncertainty in net voltage loss = $\sqrt{s_{vi}^2 + s_{vf}^2}$ <br> (3) <br><br> If both voltage determinations are assumed to have equal variances ($s_v^2$), then the uncertainty in net voltage loss given by the combined uncertainty of the two analyses is given by $\sqrt{2} * s_v$ <br> If the mean background voltage loss $m_b$ is zero, as there should be zero voltage loss in EICs stored with the sensitive plastic prevented from discharge using a "keeper cap," this reduces to: <br><br> $LLD_{NCT} = 3.29*\sqrt{2} * s_v$ or the familiar (4) <br> $LLD_{NCT} = 4.65 * s_v$ (5) |
| <span style="color:red">✶ Add "Batch" to MS-PC definitions</span> | <span style="color:red">✶ Public review for updating MS-PC</span><br>**Batch:** The set of material that is considered to be homogenous regarding characteristics that determine the calibration relationship. For example, activated carbon is prepared and sold in batches, which are then used by laboratories to construct devices with that carbon; a single plastic melt is sold to laboratories who manufacture many ATDs from that batch. |

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| ✰ Add "Blanks" to MS-PC definitions | ✰ Public review for updating MS-PC<br>**Blanks:** A type of quality control (QC) check that quantifies detector response due to factors other than the measurement itself. Blanks are devices deployed to measure effects on the measurement result from anything other than the environment tested, i.e., effects caused during storage, shipping, handling and transport. The purpose of blanks for in-control operations is to verify and document the lack of influence of factors encountered outside the measured environment; their records are necessary to support data validity. |
| ✰ Add "Blind" to MS-PC definitions | ✰ Public review for updating MS-PC<br>**Blind:** A type of performance test of the analytical capability of a method in which a sample is not identified as a performance test to the analyst. |
| ✰ Add "Calibration" to MS-PC definitions | ✰ Public review for updating MS-PC<br>**Calibration:** To adjust or determine or both, the response or reading of an instrument or device relative to a series of conventionally true values (U.S. DOE 2011). |
| ✰ Add "Performance Test" to MS-PC definitions | ✰ Public review for updating MS-PC<br>**Performance Test:** A Performance Test, or blind performance test, is a blind spike in which the radon concentration reported by the device user or laboratory is compared by an independent party, such as a chamber or proficiency program, to the established chamber concentration in which the device was exposed. Performance Test criteria historically includes an absolute IRE of no more than 25%. Independent verification is a demonstration of quality that is valuable to third parties such as certification bodies (State or private) and consumers. |