

NOT ALL SPECIFICATIONS ARE EQUAL!

CRM ERROR SPECIFICATIONS

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Continuous Radon Monitor (CRM) performance evaluations by NRPP and NRSB follow stringent guidance for performance evaluation and test procedures. However, there is no guidance on how manufacturers specify and market CRM performance, which can lead to confusion and misinterpretation.

What are typical performance specifications?

- **Typical Error** - the "mean error" or "the most likely error" to be observed when performing repeated tests. This error is less meaningful when comparing CRM monitors only among each other, and not against a NIST (National Institute of Standards & Technology) traceable source.
- **Coefficient of Variations** or **COV** (also referred to as **Uncertainty** or **Precision**) (ANSI MS-PC 2015) – the standard deviation (SD) of a set of measurements from the arithmetic mean of those measurements. An Uncertainty of 1 SD, 2 SDs, and 3 SDs would cover ~68%, ~95%, and ~99.7% of data respectively.
- **Accuracy** (ISO 5725-1) – the closeness of measurement to the true value. Accuracy includes all errors and is the maximum percent error measured against the true value.

Per a requirement set by the US EPA in the 1990s and later adopted by the NRPP and NRSB, Sun Nuclear has traditionally used **Accuracy** to specify CRM performance.

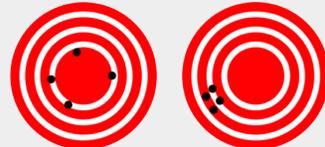
We are often asked why Sun Nuclear CRMs specify a 25% error (i.e., Accuracy) while other CRM manufacturers often specify less than a 10% error. Such error comparisons are problematic and are rooted in the ambiguous definition and use of the term "error".

To illustrate this, the figure above shows a 2007 US EPA evaluation of (5) Model 1028 radon monitors against a NIST traceable radon concentration. The blue bars represent

Sun Nuclear is the **ONLY** major CRM manufacturer that specifies Accuracy. Most other manufacturers do not specify an error limit but only provide a sensitivity value, which on its own does not limit the error that a measurement may exhibit. When an error specification is provided, it is typically limited to an Uncertainty specification.

Accuracy vs Uncertainty

The figure below illustrates measurements with similar Accuracy; small Mean Error but high Uncertainty (left), and small Uncertainty but large Mean Error (right).



the quantity of discrete 1028 measured data points organized by the percent difference from the NIST source. The red line is the statistical best-fit distribution for these measurements.

This figure demonstrates three ways to define error for the same set of data, with drastically different answers. Based on the EPA evaluation shown above, Sun Nuclear's 1028 monitor performance for a typical 48-hour test can be described as follows:

- **Typical Error – 3%.** This means the most common error to be measured is 3% from actual against the NIST source.
- **COV / Uncertainty / Precision – +/- 8%.** This means that at 1 SD, ~68% of the 1028 measurements are within 8% of the mean value.
- **Accuracy – specified to be +/- 25%.** This means Sun Nuclear specifies that the maximum deviation of any one measurement among all measurements collected is 25% or less from actual.

In summary, when comparing CRM performance or "error" among CRM manufacturers, terminology and definition can vary considerably. Don't hesitate to ask questions to ensure you understand the percent error published for your device.

For additional information, please contact Sun Nuclear by phone, +1-321-259-6862 (ext. 2230), or by email radon@sunnuclear.com with the subject line "tech talk".