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RSSI AT-101 MINIMUM DETECTABLE EXPOSURE

A common specification for alpha track radon detectors is the lowest concentration that can be reliably measured for a specified testing period, frequently 90 days. This concentration is frequently, and erroneously, referred to as a limit of detection, L_d , or as the minimum detectable activity, MDA, which is used in measuring the activity of a sample and more suitable when measuring radon with a device that captures radon for later analysis. The limit of detection, L_d , is a statistical term used when discrete objects or events are counted. When counting alpha tracks, which are discrete objects, L_d is the minimum track count necessary to be certain of detecting tracks above the detector background. L_d is calculated from the analyzed area, T , and the background track density, R_b .

$$L_d = \frac{k^2}{T} + 2k \left[2 \frac{R_b}{T} \right]^{1/2} \quad (1)$$

where :

L_d = the limit of detection in tracks/mm²,

k = the one-sided confidence factor ,

T = the counted area for background and sample foils in mm², and

R_b = the background track density in tracks/mm²

When k is 1.65, a true track count, L_d , will be detected 95% of the time. L_d is a practical detection limit with a 95% probability of the track count being detecting. For the AT-101, T is 124 mm² and a typical $R_b = 0.27$ tracks/mm², yielding $L_d = 0.24$ tracks/mm².

Alpha track detectors effectively integrate concentration over time. The integrand is the exposure to radon expressed in Bq-days/m³, calculated as the product of the track density and an exposure conversion factor, ECF. The average concentration, in Bq/m³, is calculated by dividing the exposure by the exposure period, in days. The minimum detectable exposure, MDE, in Becquerel-days per cubic meter (Bq-days/m³) or as Bq/m³ for a specified exposure period in days that can be detected on a routine basis, is calculated by multiplying L_d by the ECF.

The ECF for the AT-101 is 733 Bq-days m⁻³/tracks mm⁻², yielding an exposure of 174 Bq-days/m³ or 2 Bq/m³ for a 90 day exposure. Measured concentrations below 4 Bq/m³ are reported as 4 Bq/m³. Calculated concentrations where the track count is below the L_d are reported as <4 Bq/m³ or as <174 Bq-days/m³ divided by the exposure period, whichever is greater.

(1) NBS SPECIAL PUBLICATION 456, Measurements for the Safe Use Of Radiation