Test report RTM2300/EQF33xx

Summary

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1. Motivation

The aim of this test was to evaluate the measurement performance of the RTM2300 and EQF33xx device types under variable measurement conditions. Both device types use an identical measurement chamber to measure the Radon activity concentration. The test fully incorporates the test specified in ANSI/AARST MS-PC 2022, which is currently the only globally binding type approval for Radon monitors. This test primarily focuses on conditions such as those encountered during indoor air measurements. As the scope of application for the RTM2300 and EQF33xx devices is significantly wider, the tests are extended accordingly. This includes the requirements of DIN 61577 insofar as they are relevant to the device type under investigation.

The tests were carried out in the calibration laboratory of SARAD GmbH, which is accredited by DAkkS under number D-K-21847-01-00 in accordance with DIN/EN/ISO/IEC 17025.

Five RTM2300 devices and one EQF3320 device were available for the test:

Type	RTM2300	RTM2300	RTM2300	RTM2300	RTM2300	EQF3320
S/N	413	414	421	423	424	429

Note on the calculation of radon concentration by the RTM2300 and EQF33xx instruments

The radon activity concentration is determined by the instruments on the basis of the count rates of short-lived radon decay products in radioactive equilibrium. The calculation is carried out for the entire measurement range using the following formula:

$$C_{Rn} = R \cdot S$$

C_{Rn} Activity concentration
S Sensitivity (instrument constant determined during calibration)
R Count rate of radon decay products

No correction algorithms are applied.

Responsible for conducting the experiments: Christian Bartzsch and Veikko Oeser
Responsible for analysing the measurement data: Veikko Oeser

2. Summary of the test results

Calibration constant (sensitivity)

The deviation between the lowest and highest sensitivity of the six instruments was less than 6%. This is due to the individual statistical variation of the instruments during calibration, as well as manufacturing tolerances of the measuring chamber. It can be concluded that the inter-unit variation of the measuring chamber is very low and that the manufacturing process is well controlled.

Linearity and reproducibility

For all Radon concentration values in the range from 300Bq/m³ to approximately 50,000Bq/m³, the devices showed an extremely small deviation from one another. This applies equally to the deviation from the reference value. It should be emphasised here that this deviation includes the calibration errors and the counting statistics of the three different reference instruments. The largest individual deviation from the reference measurement was 2.8%, with the majority of values lying below 2%. No linearity deviations were detected within the tested measurement range.

Effect of Temperature and Humidity

The test results show a very minor influence of ambient temperature and humidity. For the temperature range up to 30°C and up to 95% relative humidity, the deviation is less than ±2.5%. For the operating range above these values (up to 40°C/99% rH, in accordance with the operating limits specified in the data sheet), the deviation is between 0 and -5%. One single deviation of -7.1% observed on RTM414 at 35°C and 93% rH is probably to be a statistical outlier, as this deviation could not be reproduced during the test in the temperature chamber.

Intrinsic background

The test revealed a background level of less than 0.5 Bq/m³. It cannot be definitively determined whether this represents the actual intrinsic background, influenced by detector effects, or is attributable to traces of Radon in the gas flow. The higher individual reading for the RTM423 instrument is due to the uncertainty in the counting statistics for the Thoron decay products (a high number of Bi-212 pulses and a low number of Po-212 pulses). If this value is excluded, the average Po-218 pulse count is 8 pulses, which accurately reflects the radioactive equilibrium with Po-214 and suggests the presence of trace amounts of Radon.

Influence of ambient gamma radiation

As expected, no influence of ambient gamma radiation could be detected, as this merely increases the number of conversion electrons, whose energy lies well below the emission energy of the Radon decay products.

Effect of Radon daughter product concentration

No significant correlation between Radon measurements and the concentration of Radon daughter products could be established. The minimal influence of 3.5%, calculated from the measurement data on daughter product exposure for the entire range of the equilibrium factor F, is very likely attributable to the statistical uncertainty of the measured values.

Performance at low Radon concentrations

A long-term experiment using a highly sensitive dual-filter monitor as a reference demonstrated excellent linearity and accuracy of the RTM devices, even for activity concentrations below 100Bq/m³.

Response time

The tests demonstrated that the T90 response time is less than 15 minutes. The measured values show that approximately 95 per cent of the final value is reached after a period of 15 minutes.

Radon – Thoron (Rn-220) Interference

The cross-interference of one Radon isotope (Rn-222 and Rn-220) on the measurement of the other isotope is significantly less than 1%, as demonstrated by exposure in pure Radon and Thoron atmospheres as well as in a mixed atmosphere. Even immediately after 25 hours of Thoron exposure (23kBq/m³), a Radon concentration approximately 30 times lower (800Bq/m³) could be reliably measured.

Note: The full test report can be requested from SARAD.