GT·Analytic
Gschnaller-Tessadri Forschungs-, Entwicklungs- und Handels KG
Innstrasse 38a • 6020 Innsbruck • Austria

☎ +43 (0)512 290201 • ✉ office@gt-analytic.at • 💻 www.Radon.at

Ramon 2.2

Radon-Monitor

Applications – Measurement Modes - Technology - Quality

1) Application of the Ramon 2.2:

The Ramon2.2 Radon monitor is a unique device and it can be best described as an automatic, electronic Radon dosimeter. Electronic Radon measuring equipment usually is quite expensive and other such instruments require special PC-software and skilled operators. The Ramon 2.2 Radon monitor though, allows anyone to measure Radon gas and reliably monitor indoor Radon levels in a very easy way.

The Ramon 2.2 Radon monitor is also the most economic and suitable device for the continuous monitoring of Radon levels in homes (e.g. for permanent control after Radon mitigation). Due to its great performance it is even in use by professional Radon services, state institutes and Universities in several countries.

It is very simple to make Radon measurements with the Ramon 2.2 as the measurement automatically starts by connecting the Radon monitor to mains supply and since the results are directly indicated on its display. Only care should be taken that the Ramon 2.2 are not placed in the near vicinity of windows or in areas with high humidity (like bathrooms). Since some electronic equipment that generate strong electromagnetic fields may interfere with the Ramon 2.2 (e.g. wireless phones and cell phones) such devices shall not be operated in the near vicinity of the Radon monitors (see also section 5 of this brochure).

A general rule for Radon measurements says that the longer a Radon measurement lasts the more reliable will be the information that can be obtained about the Radon situation in the measured location. We therefore recommend that Radon measurements that are made with Ramon 2.2 Radon monitors should also last a minimum of two weeks per room. We further recommend to regularly note down the measurement results for the specific measurement locations (e.g. once every week) since such records may be very useful at later times.

The Ramon 2.2 has a non-volatile memory and when the instrument is disconnected from power and re-connected again the former measurement results are not deleted. It is thus very important to reset the memory of the Ramon 2.2 to zero each time that the Radon monitor is moved to a different location and when a new measurement is started.

The non-volatile memory though has another big advantage and it allows operating the Ramon 2.2 units only during selected periods by means of automatic timers.

For example: When Radon measurements are made in schools or at workplaces, it may be very useful to obtain specific information about the Radon levels to which the children, staff or employees are exposed only during their working times.

So far, regular "passive" Radon dosimeters that continuously measure Radon levels 24 hours/day and 7 days/week are widely used for measurements in schools and at workplaces. Nevertheless, it is also known that the presence of persons in a room or building can have a significant influence on indoor Radon levels due to aeration habits and other factors. Continuous measurements with passive dosimeters therefore may lead to results for Radon concentrations that are significantly different from those to which people are really exposed during their working hours.

The application of Ramon 2.2 Radon monitors with automatic timers though, is a very smart and efficient option for such particular measurements and tasks.

But also for other users such measurements with Ramon 2.2 units and automatic timers provide interesting and helpful applications. By this method it is possible for example, to specifically determine those Radon concentrations that occur in a bedroom at night times and to which someone is exposed during sleep. Especially in cases where Radon concentrations exceed the recommended levels this type of time-limited, periodic measurements can provide valuable information for subsequent and efficient Radon remediation.

2) The measurement modes and results indicated by the Ramon 2.2:

In order to correctly interpret measurement results obtained with a Ramon 2.2 Radon monitor it is very important to understand that the instruments always indicate averages of Radon concentrations that were detected during specific periods but not the momentary Radon levels.

The Ramon 2.2 feature two measurement modes that give results for the averages of Radon levels on a long-term and on a short-term basis. The Radon monitor collects data in measurement cycles of one hour and the results for newly calculated averages of Radon levels are therefore automatically updated once every hour.
Both measurement modes work in parallel and the user can change between the readings of the two modes by shortly pushing the menu button.

When the long-term reading is selected, the Radon monitor indicates the average Radon level over the entire measurement period since the last reset of the memory.

For example: If a Radon measurement was made for a period of six weeks the long-term reading on the display will indicate the average of the Radon levels that the Ramon 2.2 Radon monitor was exposed to during the entire six weeks.

Results of long-term readings are applicable for the evaluation of an investigated room or building in reference to recommendations for safe Radon levels as issued by radiological protection authorities. Nevertheless, it is important to realize that official recommendations always refer to the one-year averages of indoor Radon levels. For correct evaluations of buildings and rooms it is thus necessary that measurements with Ramon 2.2 Radon monitors are made for sufficiently long periods.

In some countries like Austria, national norms exist that define such details. Especially for professional users of Ramon 2.2 Radon monitors it is therefore recommended to conduct Radon measurements in compliance with the applicable national norms or regulations. Ramon 2.2 Radon monitors, of course, are most suitable for this task.

When the short-term reading this selected, the Ramon 2.2 Radon monitor indicates the average of the Radon levels that the instrument detected in the last 7 days. Since the Radon monitor updates the results once every hour the short-term mode can be understood as a moving time-window of 168 hours (seven days), that is shifted by one hour after each completed one-hour measurement cycle.

Here is a short example of the two measurement modes and of their results:

In this example a measurement was started on July 15, 08:00 pm and the results are read on September 8, 01:00 pm.

The long term reading indicates the total average of the Radon levels for the period: July 15, 08:00 pm - September 8, 01:00 pm.
The short term reading of the Ramon 2.2 though, indicates the average of the Radon levels for the past 168 hours and thus for the period from September 1, 01:00 pm to September 8, 01:00 pm.

If the user reads the results one hour later the long term result indicates the average of the Radon levels that were detected from July 15, 08:00 pm to September 8, 02:00 pm whereas the short term reading gives the average value for the period from September 1, 02:00 pm - September 8, 02:00 pm.

The short-term reading of the Radon monitor intends to notify the user about natural or man-made changes in the Radon levels within only a few days. For this reason, the short-term measurement mode is very useful for the evaluation of Radon reduction measures.
For example, if too high Radon levels are found in a home the homeowner can try to reduce the Radon levels by aerating the rooms more frequently or by installing a Radon sump. The short-term readings of the Ramon 2.2 will tell if this method for Radon reduction is successful and sufficient.

In the first week of a measurement both, the long-term and short-term measurement mode will indicate the same results. After more than one week of continuous measurement the results of the long-term readings will start differing from the short-term readings if Radon levels significantly vary after this first week.

3) The principle of measurement of the Ramon 2.2 Radon monitors:

The Ramon 2.2 Radon monitor was designed in such a way that it specifically detects alpha particles from Radon decay. The devices are not sensitive to other types of ionizing radiation such as gamma- and beta- radiation.

The Radon detector is equipped with a special silicon semiconductor sensor detecting only alpha particles that directly hit the surface of the sensor. The sensor is surrounded by a light-proof plastic housing (also called "metering cell"). Radon gas from ambient air diffuses into the metering cell through small openings that are covered by a filter keeping dust and other (radioactive) particles outside. It also prevents Radon decay products that are present in the ambient air from getting inside the metering cell.
When Radon atoms have got inside the metering cell some of them will undergo radioactive decay by emitting alpha particles. If the alpha particles hit the sensor these events will be counted. Unfortunately, the probability is very low that alpha particles from direct Radon decay will be detected since the surface of the sensor is small and the rate of decaying Radon atoms inside the metering cell usually is also very low.

But, an additional phenomenon can be observed with Radon decay and this is used for a more efficient detection of Radon with the Ramon 2.2 Radon monitors:

When a Radon atom decays it is transformed into an isotope called Polonium-218. At the very moment of its synthesis the Polonium-218 particle is ionized, bearing a positive electric charge. Since the walls of the metering cell are also positively charged whereas the sensor is earthed the Polonium-218 particles that are formed inside the metering cell are repelled from the walls of the metering cell and they are forced to deposit on the surface of the sensor.
Polonium-218 has a very short half-live of only 3 minutes and it also decays by emitting alpha particles. The probability that these alpha particles are detected by the sensor is much higher since the Polonium-218 particles were directly deposited on its surface.

In fact, the Ramon 2.2 Radon monitor is a Polonium detector but since each decay of a Polonium atom is the result of a preceding decay of a Radon atom, it is possible to use this principle for Radon measurements. After thorough calibration of the Radon monitor the number of alpha counts that are registered by the sensor within a certain time can be expressed as result for the airborne Radon concentration.

4) The quality of the Ramon 2.2 Radon monitors:

A very important method for the evaluation of the quality of measurements of our Ramon 2.2 Radon monitors is the periodic participation at official and independent validation tests for Radon measuring equipment that are organized by accredited institutions.

As by January 1, 2011 we have very successfully participated at six validation tests for Radon detectors, two of which were made by the Austrian National Institute of Metrology (BEV) in Vienna (2005 and 2009), three were done in Switzerland by the accredited "Paul Scherrer Institute" (2005, 2006 and 2010) and finally one validation test was organized by the National Radiation Protection Institute of the Czech Republic in the year 2010.

Due to the successful participation at these validation tests, the Ramon 2.2 comply with the general requirements for the competence of calibration and testing laboratories according to DIN EN ISO/IEC 17025.

These tests are intended to generally evaluate the quality of a Radon measurement system and only small numbers of samples of Ramon 2.2 Radon monitors are tested each time. In recent validation tests not only Ramon 2.2 units have participated that were submitted by GT-Analytic but also Ramon 2.2 instruments that were sent to the tests by our customers. The Ramon 2.2 units from our customers also achieved very good results that are consistent with those of our own instruments.

In order to assure the high quality of the Radon monitors that we supply to our customers we accomplish thorough internal quality tests and calibrations. Before delivery of the Ramon 2.2 Radon monitors to our customers all units are submitted to internal quality tests, part of which is also the calibration of each individual Radon monitor. The entire quality management procedures last about two weeks.

After a first test lasting 7 days the results of the Ramon 2.2 Radon monitors are compared to those obtained with an officially calibrated reference instrument in order to determine the measurement accuracies of the individual Ramon 2.2 units.
We use an "AlphaGuard" Radon detector as reference instrument as these very precise professional Radon detectors are also applied by most Radon calibration laboratories and metrological institutes in Europe for the same purpose.

According to the first test results the calibration factor of each individual Ramon 2.2 Radon monitor is adjusted and the units are thereafter tested again for one week in order to verify the correct calibration. If necessary, the calibration factors are corrected by a final adjustment and in few cases Radon monitors are tested again.

Our quality management safeguards the compliance of each single Ramon 2.2 Radon monitors with our high quality standards. We are keeping records of all quality test results and therefore, each Radon monitor that was sold to a customer can be traced back to the internal quality test results by its serial number.

In compliance with our quality standards only Ramon 2.2 Radon monitors are supplied to our customers and resellers which had measurement errors of less than ± 5% in our final quality tests. These deviations are thus in the range of the inevitable statistical uncertainty.

In this respect it is also worth knowing that according to international standards for Radon measuring equipment, measurement uncertainties of up to ± 20% are tolerated and devices with measurement uncertainties of less than ± 10% are considered good, or even very good.

For professional users it may be of particular interest to know the measurement uncertainties for results that were obtained with Ramon 2.2 Radon monitors. For this purpose we supply a free Excel calculator on our web pages by means of which the specific measurement uncertainties (formerly also referred to as "measurement errors") can easily be determined for any Ramon 2.2 measurement result.

The Excel calculator can be downloaded from our web pages for free and the user only needs to insert the length of the measurement period and the long-term average Radon concentration that is indicated by the Ramon 2.2 Radon monitor.
We further believe that a conservative calculation of measurement uncertainties is reasonable and therefore all other parameters that were set in the calculator are "worst case" figures.

Regarding the aspect of quality we finally want to point out that the calibration of the reference instrument that we use in our quality tests can be traced back to the Austrian national Radon standard and to the European primary Radon Standard of the PTB in Braunschweig, Germany.

Therefore, the traceability of the calibration is also maintained for each Ramon 2.2 unit and it can be traced back to the European primary Radon standard of the PTB-Braunschweig!

5) Interference with strong electromagnetic fields causing "Error 3" messages:

It sometimes may occur that during a measurement the display of a Ramon 2.2 permanently indicates "Err3" which is the "error-3" message. This message is triggered by strong electromagnetic fields like those emitted by cell phones and wireless phones.
Care should thus be taken that mobile phones are not operated in a distance of less than 2 meters from a Ramon 2.2 unit. Also other electronic equipment may cause electromagnetic noise that can disturb the Radon monitors and although this is very rare, if such disturbances are observed the Ramon 2.2 unit needs to be moved away from such devices.

In other very rare cases, the electronics of the Ramon 2.2 can also be disturbed by strong "noise" signals from the 230V AC mains system by which the Ramon 2.2 unit is powered. Such electric "noise" can be caused by certain machines (mostly old electric motors) that are also connected to the same mains system.

Unfortunately, the sensitivity of the Ramon 2.2 units to electromagnetic noise can not be completely avoided or shielded due to the very particular amplification system of the devices. Therefore, this issue was solved through a special software program of the Radon monitors.

When an "error-3" occurs the "Err3" message will permanently be displayed by the Radon monitor and it can not be deleted by means of the menu button. In order to delete the "Err3" message the Ramon 2.2 needs to be disconnected from power and reconnected again after a few seconds. The display will show the regular measurement results and the menu button works again.

As described in section 2) the Ramon 2.2 Radon monitors collects impulses from Radon decay in 1-hour intervals and after each hour the measurement results are automatically updated. When an "error-3" occurs the measurement results of the specific hour in which the "Err3" message was caused are automatically deleted from the memory of the Radon monitor. By this method it can be avoided that noise signals are recorded and misleadingly counted as Radon impulses as this would lead to erroneous results. Nevertheless, after the hour in which the "error-3" had occurred the Radon monitor automatically continues the regular measurement even when the "Err3" message is still displayed by the Ramon 2.2. Therefore, even when the user discovers an "Err3" message at a much later time this is not a real problem since the Ramon 2.2 will have continued the regular measurement. Finally, the missing data of the deleted one-hour measurement cycle is not a problem either since it has no significant influence on the accuracy of the measurement results that are the averages of the Radon levels calculated for a much longer measurement period.

Thank you very much for your interest in our Ramon 2.2 Radon monitors and for any additional questions about the product please, don't hesitate to contact us:

GT-Analytic KG, Innstrasse 38a, 6020 Innsbruck, Austria
Tel.: +43-512-290201, Fax: +43-512-291816,
email: office@Radon.at; URL: www.Radon.at