The Rn_{50} test of radon at negative pressure

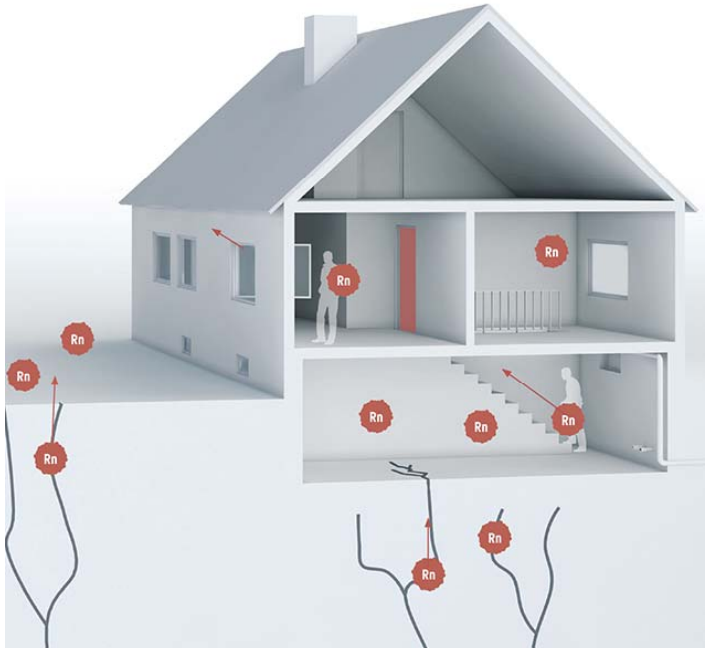
Use of the BlowerDoor system for measuring radon concentration in buildings

Radon – what is it?

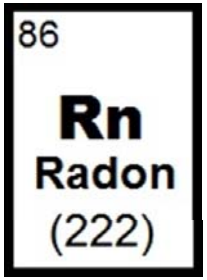
Radon is an odorless radioactive noble gas produced by the regular decay of naturally occurring uranium in the soil.

Radon mainly comes from the soil, but can also be found in building materials. Radon does not pose a problem outside because it immediately mixes with the ambient air and the concentration drops to a safe level. In buildings, on the other hand, very high concentrations of radon can occur.

If a harmful radon gas concentration is inhaled over a longer period of time, the risk of developing lung cancer increases. Radon is the second most common cause of lung cancer after tobacco.



Source: Bundesamt für Strahlenschutz



Is there a limit?

Radon was classified as a carcinogen by the World Health Organization WHO at the end of the 1980s and a guideline value of 100 Becquerel per cubic metre of air was recommended.

In Germany, there was a draft law on radon protection in 2005, which was blocked by the federal states at the time.

In 2013, the European Union set a uniform reference value of 300 becquerels per cubic metre. This EU directive had to be implemented by the member states by the end of 2018.

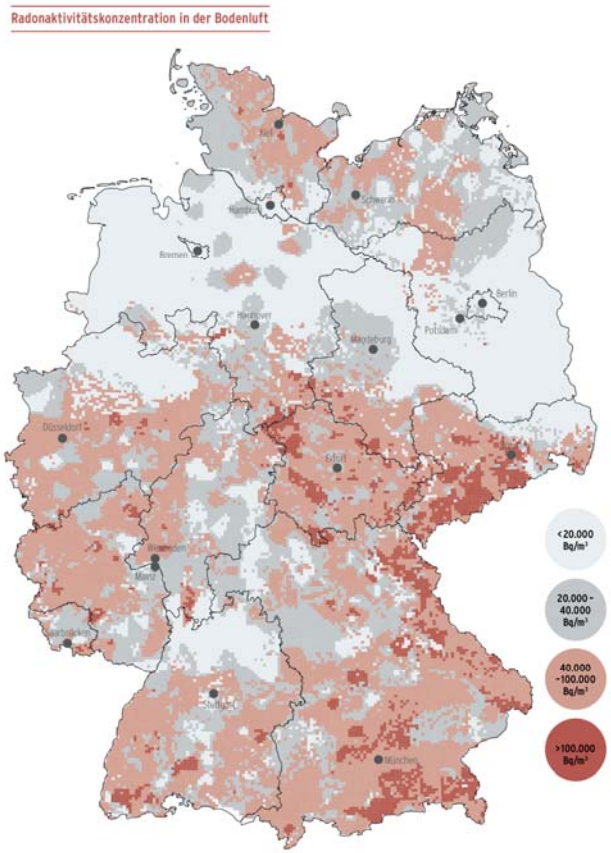
In Germany, the above-mentioned EU limit value for radon concentrations at workplaces has been in place for the first time since this year, but there are also many other structural requirements for protection against radon. These new requirements will become a major challenge for planners from 2020 at the latest!

Risks and the passive measurement method

There is the so-called radon map of the Federal Office for Radiation Protection (BfS), which is supposed to show the most endangered places in Germany. Due to the many influencing factors, however, this map says nothing about the actual radon concentration in a specific building. To make a reliable statement about the radon concentration, it is necessary to conduct a radon measurement.

The simplest measuring method is passive measurement with so-called nuclear track dosimeters.

These small plastic cups are placed in living rooms and sent to a laboratory for analysis after 3 to 12 months.



Source: Bundesamt für Strahlenschutz

Active measurement of radon concentration

In addition to passive detectors, active electronic measuring devices can also be used for long-term measurements. Such active measuring devices often display a measured value within a few minutes.

However, these snapshots should only be used with caution, as no statements can be made about the long-term radon concentration in the building. Reliable statements on radon concentration can only be made by long-term measurements of at least three months or better one year.

If you want to check the building in a short period of time, e.g. before acceptance or purchase of a property, then there has been no reliable measurement method so far.

Relatively new is the Rn_{50} test with support from a BlowerDoor measurement system, which will be explained in more detail below.

Active electronic measuring device

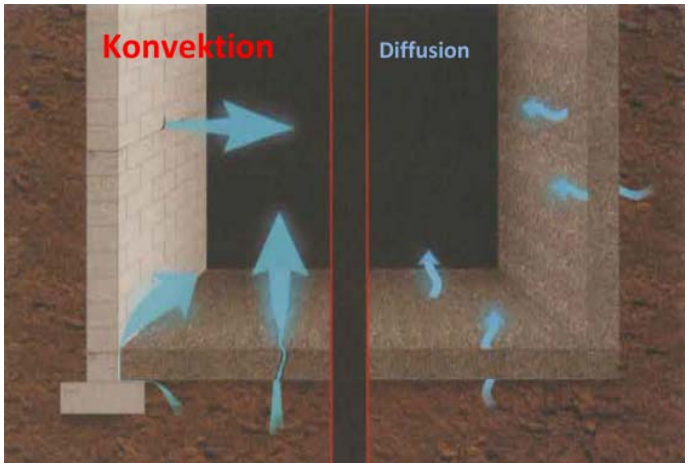
Source: Radonshop.com

The Rn_{50} test at negative pressure

Radon is introduced into the building mainly by convection through existing cracks, joints, penetrations, etc. The main cause of this is the formation of a large number of radon particles. The diffusion of or through building materials plays only a minor role.

Consequently, a BlowerDoor measuring system can be used to create a negative pressure situation that increases the flow of radon over the existing leaks.

This after-flow via existing leaks can already be used, for example, for so-called "radon sniffing". The individual leaks are examined with a very sensitive active radon measuring device and radon entry points are located, which can then be professionally sealed.



Convective penetration of radon-containing soil air through leaks (left) and diffusion of radon through components (right)

Source: Radon-Handbuch (BfS 2011)

Photo: Dr. Th. Haumann

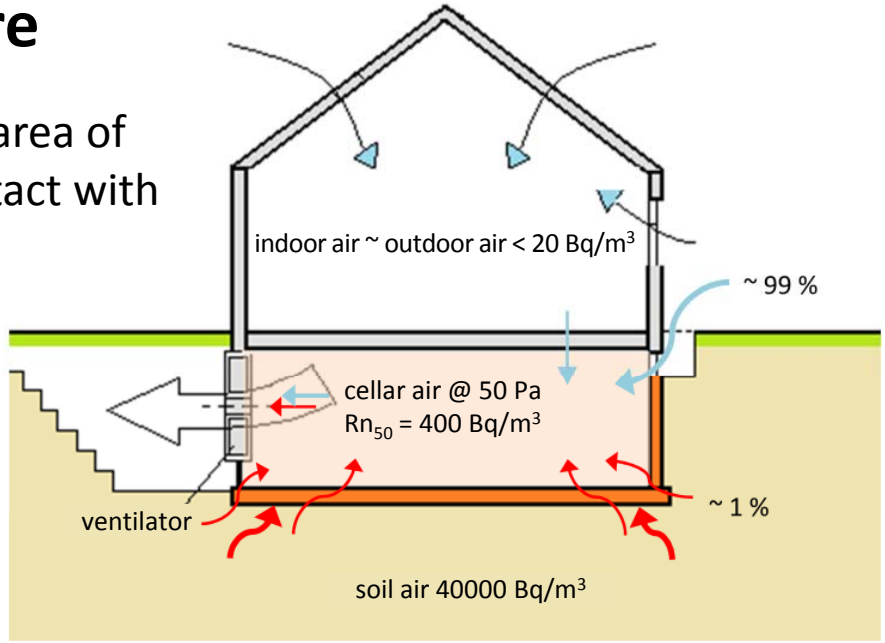
The Rn_{50} test at negative pressure

The measurement should be carried out in an area of the building that has the greatest possible contact with the ground.

Therefore a cellar is recommended. If there is no cellar, the ground floor or the whole building is measured.

With the BlowerDoor measuring system a negative pressure of 50 Pascal is built up in the building part. The exhaust air is examined with a suitable radon measuring device.

Depending on the tightness of the building, a constant radon concentration results after a relatively short time for further evaluation.



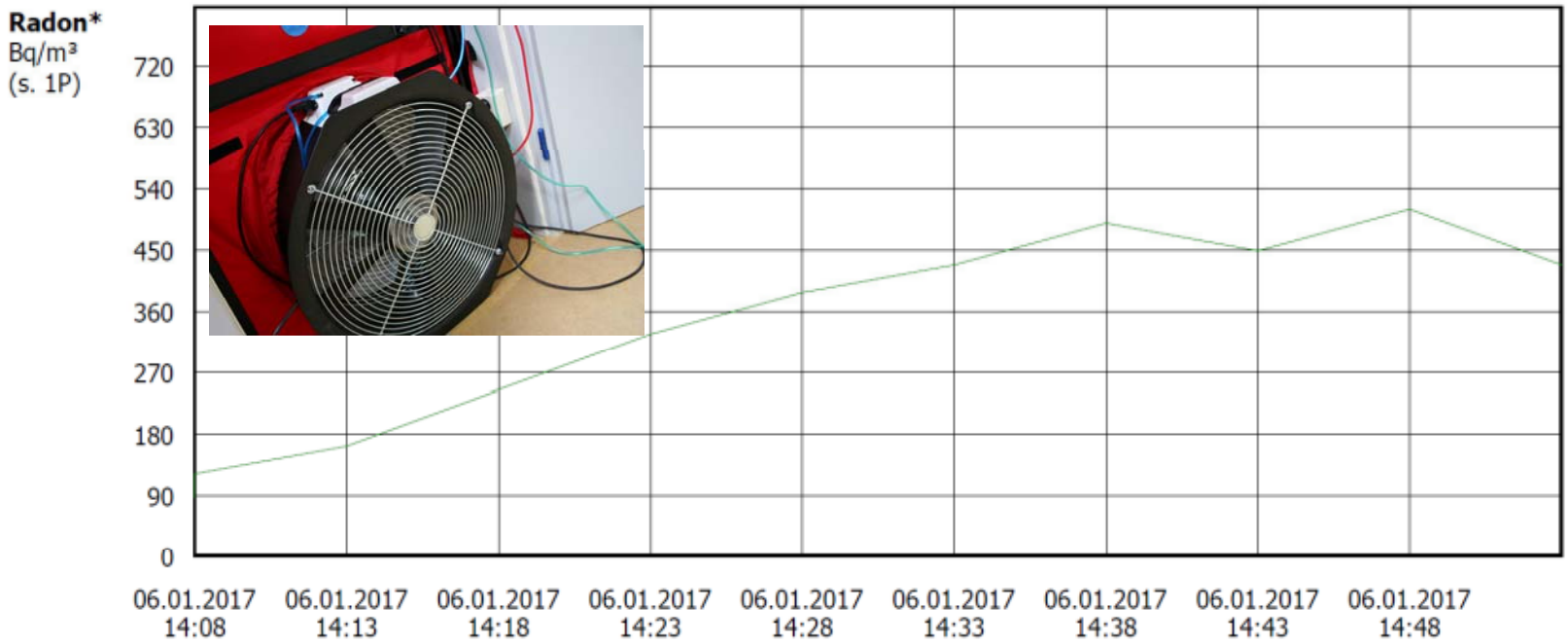
Source: Dr. Th. Haumann

Radon measuring device *RTM 1688-2* of the manufacturer *Sarad , Dresden, Germany*

The Rn_{50}test at negative pressure

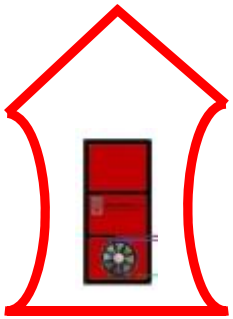
Here the course of a measured radon concentration at negative pressure is shown. This Rn_{50} test was carried out by Dr. Thomas Haumann, whereby this building had a high air exchange rate of n50 = 3.8 h-1. The tightness of the building is decisive for the required duration of the Rn50 test.

Increase in radon concentration during measurement at negative pressure (dP = 50 Pa)

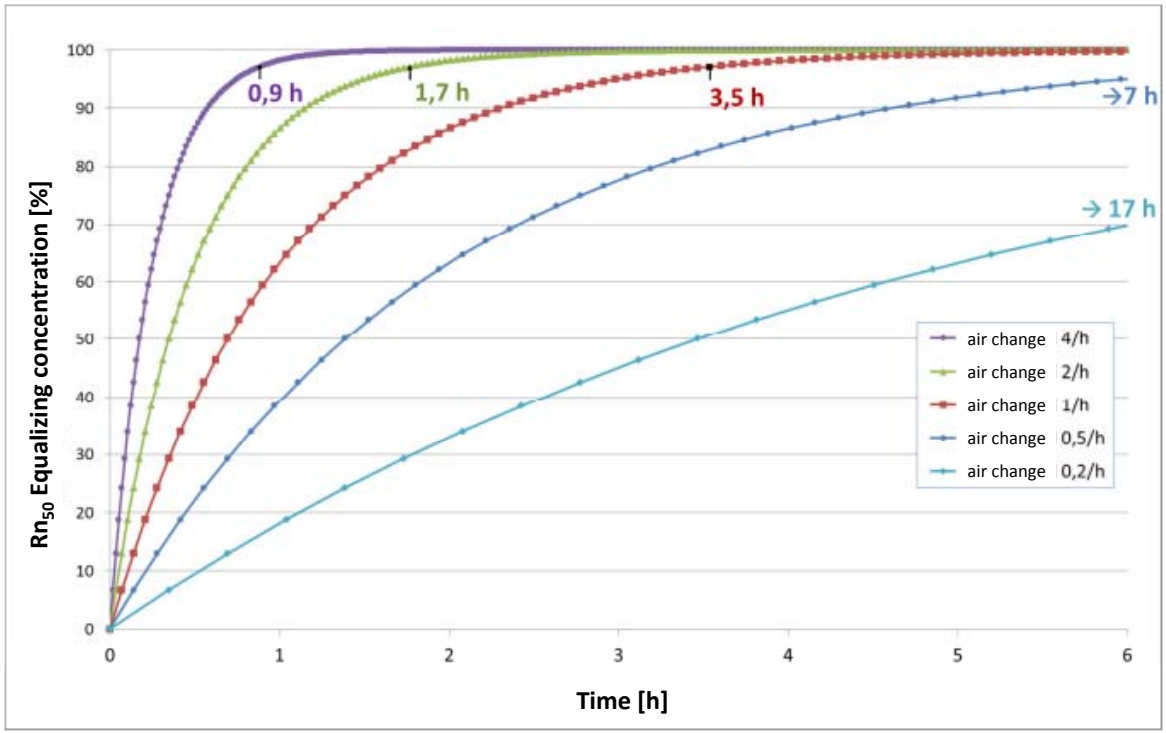


Time required for Rn_{50} test and air tightness

Dr. Haumann's graph shows the relationship between the determined air exchange rate and the measurement duration in order to achieve a meaningful equilibrium concentration.



Time to equilibrium concentration (97% max.) at constant source strength



The measurement at 50 Pascal differential pressure offers a clear time advantage.

From the measured radon entry rate at 50 Pascal negative pressure, the expected radon concentration in the annual average can now be calculated.

Source: Dr. Th. Haumann

Literature and Links

- COUNCIL DIRECTIVE 2013/59/EURATOM of 5 December 2013
- Bundesamt für Strahlenschutz (Federal Office for Radiation Protection, BfS in Germany): Radon Handbuch Deutschland, 2011
- Collignan, B., Powaga, E.: Procedure for the characterization of radon potential in existing dwellings and to assess the annual average indoor radon concentration, 2014
- Froňka, A., Moučka, L.: Blower Door Method in Radon Diagnostics, 2004
- Maringer; F.J. et al.: Ein robustes und schnelles Verfahren zur Abschätzung der langzeitlich mittleren Radonkonzentration in einem Gebäude (erweiterte BlowerDoor-Methode), 1998

Links:

- Bundesamt für Strahlenschutz (Federal Office for Radiation Protection, BfS in Germany): http://www.bfs.de/EN/topics/ion/environment/radon_node.html