

Radon probe R4000



Application:

The probe R4000 measures the volume activity of radon in air to restrict its concentration in buildings.

This is a RS485 ModBus probe which can work independently or work as slave of the E4000 air quality probe to be integrated in the intelligent management of the Low-Energy Buildings (LEB).

The RT2012 regulations, requires airtightness for LEB buildings therefore internal air renewal can only be performed by HVAC. Airtightness can increase the concentration of the radon in a significant manner.

The earth-air heat exchangers (Canadian wells) represent an additional source of radon entry into the LEB.

For most individuals **Radon is a main source of the natural background exposure** (59 %) and represents about 40 % of radiation exposure from all radiation sources (natural + medical + others). Radon is an invisible, odorless, radioactive gas, result of the disintegration of radium (Ra-226), which is a decay product of uranium (U-238), naturally occurring in the Earth crust. The radon can be released to soil pores, migrate to the ground surface and accumulate in buildings. Radon and its short-lived progenies Polonium (Po-218), and (Po-214) settled in the respiratory tract give rise to high doses to lung tissue from alpha particle radiation which they emit. This can effect in lung cancer.

- In France, about 3000 cases of lung cancer death per year (12 % of deceases by lung cancer noticed) are attributed to the domestic radon exposure [1].

The **concentration of radon** in air is measured in units of Becquerel's per cubic meter [Bq/m^3]. One Becquerel (Bq) corresponds to one disintegration per second.

Radon:

- 43 % of the individual houses are exposed to radon concentration $\geq 100 \text{ Bq}/\text{m}^3$ and 10.8 % to radon level $\geq 300 \text{ Bq}/\text{m}^3$
- Respectively 21.5 % and 2.8 % for the collective accommodation [2].

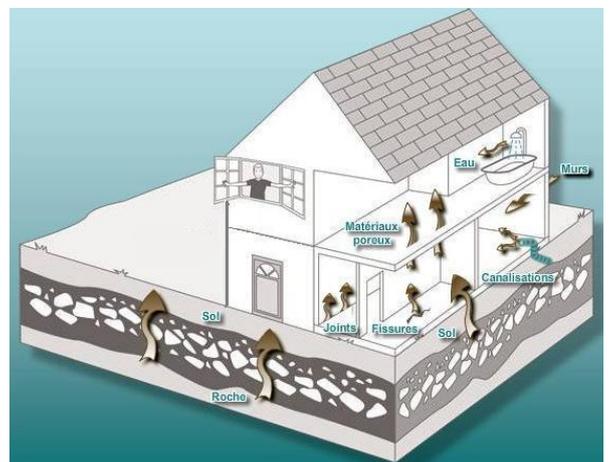


Fig 1. Transfer of radon from the soil to a building.

Regulations:

- 31 French departments are the object of regulations concerning the implementation of corrective actions to reduce the radon exposition in public places [3] :

Radon concentration [Bq/m ³]	Risk of lung cancer (+, ++, +++)
<100	small
100-400	+, corrective actions
400-1000	++, corrective actions
>1000	+++, corrective actions

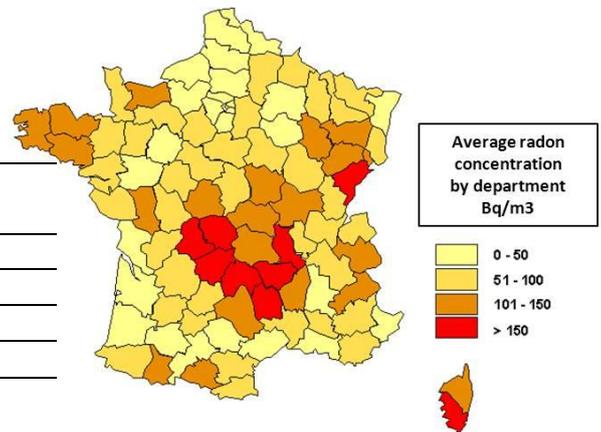


Fig. Average radon concentration in French departments [2].

- The 2011-2015 action plan [1] envisages the implementation of the regulations concerning radon management in new residential buildings.

Recommandations:

- The radon level of 300 Bq/m³ should be considered as a first stage of the management of radon problem, with a long-term objective to lower this level to 100 Bq/m³ [4].

The indoor concentration of the radon depends on the natural activity of the soil, on building materials, on the type of building (living space, Canadian well), habits of life (heating, aeration) and weather forecast. It is common to find up to 10 times different radon concentration in 2 neighboring identical buildings.

The radon concentration, in the same place, can vary by factor from 10 to 100 according to the period of the year and the hour of the day. To follow the temporal evolution of the volume activity of radon, the method of measurement must be adapted to the dynamics of phenomenon.

- To optimize the detector response-time and sensibility, the R4000 Radon probe uses a solid state sensor to measure the activity of the decay products of the radon. Applied alpha spectrometry technique allows categorizing descendants with short half period between (Po-218, Po-214) and long half period (Po-210). Thanks to short time of radon concentration measurement, strategy of an adapted to the dynamics of possible changes of concentration of the radon in buildings can be rapidly applied.

The R4000 probe:

- **continuous measurement of the radon concentration** and in case of the overtaking of regulation level, different strategies of radon **remediation** are implemented, as:
 - Mechanical exchange of air,
 - Overpressurization of the building,
 - Bypassing the entrance from the air of the Canadian well. In fact the radon can seep through by Canadian well and notably by the sump.The application of these strategies of remediation allows bringing down the average concentration of radon, to acquire a quality of the air guaranteeing comfort and health on long term.
- If the probe R4000 is connected to the E4000air quality probe, the measurements and the commands for the remediation can be send by KNX or LON, even by radio or standard EnOcean.
- The R4000 probe can also be connected to the network via RS485 ModBus and can have 10 selectable addresses.

References:

- [1] ASN *Le plan national d'actions 2011-2015 pour la gestion du risque lié au radon*, 2011.
- [2] IRSN Report *Bilan de l'état radiologique de l'environnement français en 2009*, 2009.
- [3] *Arrêté du 22 juillet 2004 relatif aux modalités de gestion du risque lié au radon dans les lieux ouverts au public.* (J.O. n° 185 du 11 août 2004, page 14359, texte n° 25)
- [4] HCSP 17/03/2010 sur les projets de décret et d'arrêtés relatifs à la protection des personnes contre le risque lié au radon dans les bâtiments, 2010.