

# ***Soil Gas Measurements***

***Short instruction for the use of the Soil Gas Probe in  
combination with the radon monitor AlphaGUARD***

**08/2001**

---

# In cooperation with Geophysik GGD Leipzig, Dr. H. Schubert

## Contents

<b>1. Measurements.....</b>	<b>2</b>
1.1. Preparation of the measurement .....	2
1.2. Execution of measurement .....	2
<b>Annex - Example of a form for recording measurements.....</b>	<b>8</b>

## 1. Measurements

### 1.1. Preparation of the measurement

For executing determinations of the radon concentration in soil gas the equipment is required resp. recommended:

- AlphaGUARD PQ2000PRO
- AlphaPUMP
- STITZ-Soil Gas Probe consisting of
  - exterior tube with hammering head (possibly 2-fold)
  - interior probe with adapter for tube connection
  - diverse sealing rings for the probe tip
- Tube connections between probe ↔ pump ↔ AlphaGUARD including filter cartridge against progeny products and water break-in
- Heavy plastic hammer
- Rivets DIN 660 - 6x10 to lock-up the exterior probe during hammering
- Stopwatch
- Measurement protocols
- Fast-lock couplings to close up the measurement device during measurement
- Three-way tap
- Air bag with approx. 1 liter capacity (swimming-aid for kids recommended)
- Diverse tools
  - (spanner to loosen the hammering head resp. for turning up the probe, needles to clean the probe)
- Vessel for the transport of the measurement units between the measurement points and usable as storage for the unit at the point of measurement
- If possible measurement set-up for the determination of the soil humidity after tearing the probe

Additionally required is the respective equipment for establishing, marking and measuring at the points of measurement. Normally there are wood-pegs or nails, metric measure, escape rods, angle mirrors resp. complete equipment for terrestrial or satellite-based land survey works (GPS).

### 1.2. Execution of measurement

Geophysik GGD Leipzig has developed a measurement technology based on the experience with the measurement of radon concentration around several thousand

measurement points. This field-proven measurement technology can be structured with the following technological steps for measurements in the field:

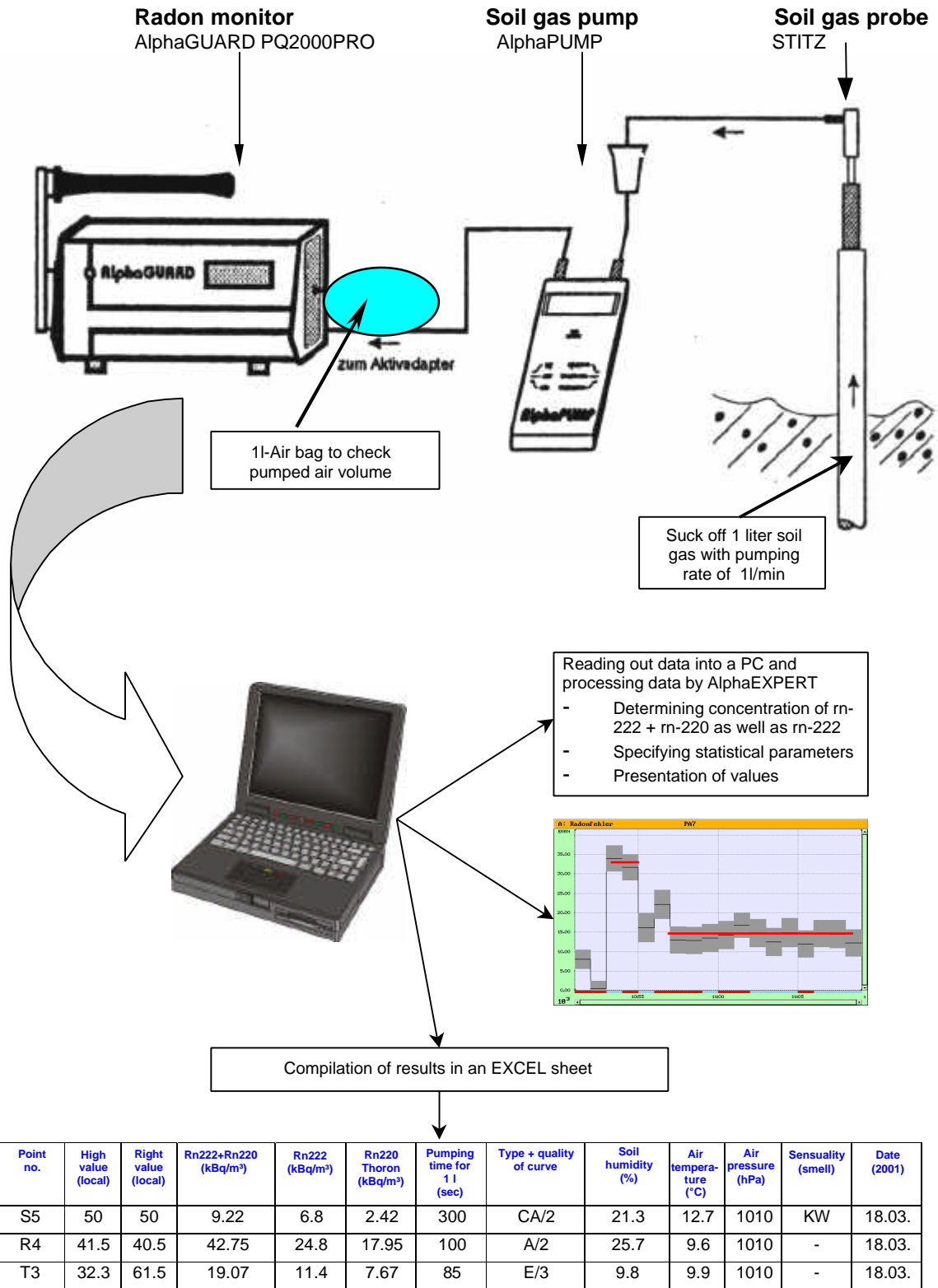
- Hammer in the soil gas exterior probe (locked with a rivet at the tip) into the ground down to  $\geq 70$  cm depth with the aid of a heavy plastic hammer.
- Tear the soil gas exterior probe for ca. 5 cm and press the closing rivet through by bringing in the interior probe.
- Set the AlphaGUARD to flow-mode - 1 min (cycle = 1 min F)
- Set AlphaPUMP to a performance of 1 Liter / min
- Connect AlphaGUARD with the pump and rinse the measurement system while the unit is switched on with exterior air for 1 ... 2 min. without using the interior probe.
- Connect the AlphaGUARD – AlphaPUMP set-up to the interior probe and take out 1 Liter soil gas with a performance of AlphaPUMP at 1 l/min
- Control der quantity of gas and time via the filling process of a 1 liter balloon at the air outlet nozzle of the AlphaGUARD
- Measure the pumping time via stopwatch; duration of normal-permeable soils 70...180s, with tight soils this only makes sense up to 5 min. duration.
- Separate AlphaGUARD and probe and close up AlphaGUARD on two sides with quick-lock couplings resp. a 3-way tap.
- With pumping times of  $< 3$  min insert a waiting time of 3..5 min such that Rn220 (Thoron) can decay
- With pumping times  $> 3$ min the waiting time can be skipped because Rn 220 has decayed during pumping time; with pumping times starting 6...7 min a new measurement point is recommended because of the low permeability there is very high risk that exterior air is drawn in.
- Measurement of the concentration of Rn222 in AlphaGUARD in 1-min cycle via a duration of 10...15 min
- Draw the probe during waiting time and determine the soil humidity at the bottom of the probe hole
- Do control readings of the indicated individual values in 1 min intervals; these values still represent Rn220 + Rn222 and can regularly not be used as measurement values
- Automatic saving of the one minute values of the radon/thoron concentration registered at the point, plus the data of exterior temperature, air pressure, air humidity and measurement time determined in the same cycle.
- Reporting of number of measurement, number of measurement in AlphaGUARD, time at start and end of measurement at the point, pumping time for 1 Liter soil gas, indicated mean value of Rn (+Thoron) - concentration in  $\text{Bq/m}^3$  as well as remarks to the particularities at the point of measurement.

After a training period of a few hours regarding the above described technology a performance of 3...4 measurement points per hour can be reached by a technician depending on the distance of measurement points. It should become a routine to repeat about 5...10 % of the measurement points and protocol the results as a measure for the quality of the investigation.

---

With the measurement it should be noted that the memory of AlphaGUARD has a capacity of 32 measurement points, the data of the first measurement points will then be overwritten. In projects with a larger number of measurement points it will be necessary to read out the instrument with AlphaEXPERT at the end of each measurement day.

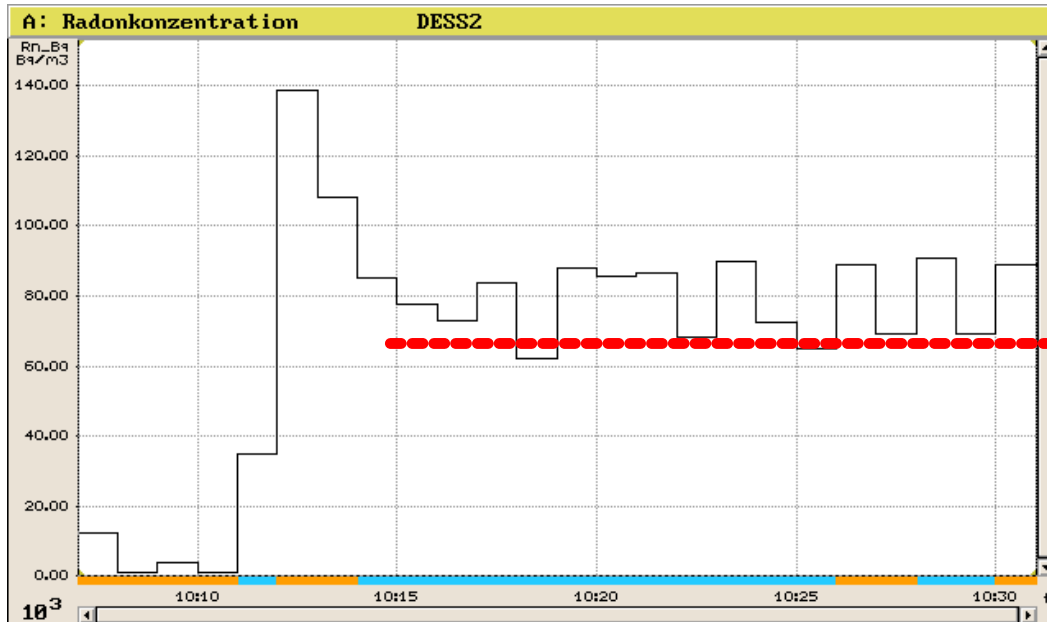
If in a several days lasting measurement program large areas with a high concentration of measurement points are covered, then there should be repeat measurements for the determination of the development at least three times a day at a firmly installed basic probe within the measurement area. In case of significant changes in the radon concentration as a consequence of extremely changing meteorological conditions appear respective corrections of the measurement values are required, and such a homogenous level for the complete area should be assured.



Schematic description of steps for determining radon concentration in soil gas

### 3 Analysis of measurements

After reading the dvd – files from AlphaGUARD into a PC by using the AlphaEXPERT program a visual control of the results at the respective measurement points should be done.



Similar to the above example most of the measurement series will start with very low measurement values as a consequence of flushing with exterior air. After the chamber has been filled in the above example at 10:10 hrs with soil gas and the instrument has been tightened from all sides the measurement of the activity in the soil gas can start. After about 2 min there is in the above example of about 140 kBq/m<sup>3</sup> the first value to start with which is made up of the activities of Rn222 (Radon) and Rn220 (Thoron). Following the low half life of Rn220 (Thoron) of about 55 s this part disappears within the cause of the following 3...4 min and the measuring series shows for the Rn222-contents varying values. By setting markers AlphaEXPERT allows to determine the extreme- and mean values of different time slots. As a result of the above example the following values could be reported:

concentration Rn222 + Rn220	139 kBq/m <sup>3</sup>
concentration Rn222 (Radon)	80 kBq/m <sup>3</sup>
concentration Rn220 (Thoron)	59 kBq/m <sup>3</sup> (Difference 139 - 80 kBq/m <sup>3</sup> )

Together with further data the results gained by this can be combined in a MS EXCEL-sheet in the following form and be used as an input for suitable following programs for the presentation of the results:

Right-value (m)	High value (m)	Point No.	Rn222+220 (kBq/m <sup>3</sup> )	Rn222 (kBq/m <sup>3</sup> )	Rn220 (kBq/m <sup>3</sup> )	Pumping time (s)	Humidity (%)	Date	Particularity
35.5	40.0	C40	139	80	59	85	15	12-10	1
20.2	15.0	B15	125	75	50	95	22	12-10	8
10.8	10.0	A10	95	63	32	70	18	12-10	4



**2. Annex - Example of a form for recording measurements**

Name of company:

Name of Object:

**Determination of radon concentration in soil gas**

**Object:**

Date:

Observer:

Air volume: 1 liter

Weather:

Equipment: AlphaGUARD AlphaPUMP

Pumping rate: 1 liter / min

Point-no.	Number of measurement	Begin/end	Pumping period	Mean (Rn222+Rn20) in kBqm3	Humidity	Notes

Characteristics of investigated area: