

# Radon measurements in Finnish workplaces during measurement seasons 2005-2010

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## **Abstract.**

In Finland the action level for radon concentration in inhaled air is 400 Bq/m<sup>3</sup> in workplace, where people are working regularly (1 600 hours per year). The radon concentration means the annual mean of radon concentration during working time. The mean concentration may be higher than 400 Bq/m<sup>3</sup>, if the work is not regular. However, in schools, in day-care centres and in other public rooms radon concentration must be below the action level. In this study we have results of 6 440 radon measurements. The responsible party, i.e. employers, ordered them between November 3, 2005 and April 22, 2010. Passive alpha track detectors of STUK were used for these mainly two month measurements. Private companies ordered 61%, municipalities ordered 32%, and the government 7% of the radon measurements. It was possible to classify 5 454 measurements by the type of measuring place. The average of radon concentrations for all measurements was 230 Bq/m<sup>3</sup>, and the median was 78 Bq/m<sup>3</sup>. The radon concentration of 400 Bq/m<sup>3</sup> was exceeded in 792 measuring points (12%), and the concentration of 1 000 Bq/m<sup>3</sup> was exceeded in 254 measuring points (4%), respectively.

***KEYWORDS: radon, indoor air, workplaces***

## **INTRODUCTION**

In Finland the action level for radon concentration in inhaled air is 400 Bq/m<sup>3</sup> for workplaces, where people are working regularly (1 600 hours per year). The radon concentration means the annual mean of radon concentration during working time. The mean concentration may be higher than 400 Bq/m<sup>3</sup>, if the work is not regular. However, in schools, in day care centres and in other public rooms radon concentration must be below the action level. There is Regulatory Guide on radiation safety in practices causing exposure to natural radiation (ST 12.1 Regulatory Guide).

Employers should measure the radon concentration, if workplace is situated in a region where over 10 per cent of the annual mean values exceed 400 Bq/m<sup>3</sup>. STUK issues a list of municipalities where radon measurements shall be made. In January 2011 there are 61 municipalities on the list, earlier it was 88. The main reason for this is consolidation of municipalities.

## **Results of alpha track measurements and discussion**

Passive alpha track detectors of STUK were used for these mainly two month measurements (Reisbacka, H. 2011). In this study we have results of 6 440 radon measurements. Private companies ordered 61%, municipalities ordered 32%, and the government 7% of the radon measurements. There were on an average five detectors included in one order. It was possible to classify 5 454 measurements by the type of measuring place. The customer has specified the measuring place. The average of radon concentrations for all measurements was 230 Bq/m<sup>3</sup>, and the median was 78 Bq/m<sup>3</sup>. The radon concentration of 400 Bq/m<sup>3</sup> was exceeded in 792 measuring points (12%), and the concentration of 1 000 Bq/m<sup>3</sup> was exceeded in 254 measuring points (4%), respectively. A national day care centre survey was carried out during spring 2006, and it was focused on new buildings.

367 day care buildings were measured with two radon detectors and the average radon concentration was 52 Bq/m<sup>3</sup>, substantially lower than in old day care buildings (Valmari, T. et al. 2007). Results of these measurements are not included in this study.

Results of public places are shown in Tables 1 and 2.

Table 1. Statistics of radon measurements, public buildings

Measuring place	Number of radon measurements	Average Bq/m <sup>3</sup>	Median Bq/m <sup>3</sup>
School	563	180	80
Day care centre	340	160	70
Day club for children	21	170	130
Public room	897	170	60

Table 2. Exceedings and maximum of radon concentration, public buildings

Measuring place	Percentage > 400 Bq/m <sup>3</sup>	Percentage > 1000 Bq/m <sup>3</sup>	Maximum Bq/m <sup>3</sup>
School	11	2	5 800
Day care centre	8	2	2 720
Day club for children	14	-	570
Public room	8	3	8 300

Highest radon concentrations we have in district heating tunnels, which are situated in bedrock and mainly in metropolitan area. Results classified by measuring place is shown in Tables 3 and 4.

Table 3. Statistics of radon measurements, classified by type of work place

Measuring place	Number of radon measurements	Average Bq/m <sup>3</sup>	Median Bq/m <sup>3</sup>
Service or instrument room	547	470	160
Industrial premises	673	170	70
Office	1 627	180	70
Restroom for workers	259	190	90
Storage room	330	310	120
Underground tunnel	197	950	500

Table 4. Exceedings and maximum of radon concentration, classified by type of work place

Measuring place	Percentage > 400 Bq/m <sup>3</sup>	Percentage > 1000 Bq/m <sup>3</sup>	Maximum Bq/m <sup>3</sup>
Service or instrument room	21	8	11 160
Industrial premises	8	2	6 120
Office	9	3	7 010
Restroom for workers	7	3	5 360
Storage room	25	6	3 390
Underground tunnel	58	27	11 940

If we compare data from measuring seasons 2005-2010 with the data from measuring seasons 2005–2007, bigger data gives smaller average radon concentration in other workplaces, except in underground tunnels and in storage rooms (Reisbacka H. 2008).

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