



## GRAETZ News:

The current situation in Japan shows the future necessity to extend the detection of radioactively contaminated products on the one hand and on the other hand to increase the measures for the personal radiation protection with regard to the detection of  $\alpha$ -,  $\beta$ - and  $\gamma$ -radiation (= ionizing radiation).

Frequently, we are faced with the following questions:

- I.) What is the meaning of activity / dose / dose rate / contamination?
- II.) When is ionizing radiation hazardous for humans? Limit values?
- III.) Which portable measuring devices are available and for which task are they used?
- IV.) Recommended preventive measures

The following explanations shall answer these questions.

### I.) Activity / Dose / Dose Rate / Contamination?

It has to be distinguished:

- **Activity**  
no information about the influence on the human body  
unit of activity: Becquerel [Bq], 1 Bq = one decay per second
- **Dose**  
influence of a certain quantity of radiation on material (e. g. the human body)  
measurement unit: Sievert [Sv], measurand: ambient dose equivalent
- **Dose Rate**  
dose per time unit  
measurement unit: Sievert per hour [Sv/h], measurand: ambient dose equivalent rate
- **Contamination**  
contamination of surfaces with hazardous radioactive material,  
measurement unit: counts per second [cps], Becquerel [Bq], [Bq/cm<sup>2</sup>]

Another frequently asked question is „Is it possible to convert measured dose rate values in Bq?”. That's not simply done without knowing a lot of various boundary conditions.



### II. When is ionizing radiation hazardous for humans? Limit values?

The following table<sup>1)</sup> shows some exemplarily chosen radiation exposures:

Kind of exposure	Dose in Sv
dental radiogram	~ 10 $\mu$ Sv
flight Frankfurt-New York	~ 30 $\mu$ Sv
mammogram	~ 500 $\mu$ Sv
limit value for persons professionally exposed to radiation	~ 20 mSv
maximum life dose for persons professionally exposed to radiation	~ 400 mSv
lethal dose	~ 4 Sv

The German legislation prescribes e. g. the following admissible dose values for fire brigades when exposed to radiation:

Operation	Max. radiation dose
operation for protecting things and objects	15 mSv per action
operations for protecting people and for limitation of damage	100 mSv per action and year
operations for rescuing people	250 mSv per action and life of the rescuer
Training and instruction purposes of the task force	1 mSv per year

To your information:

- The average dose accumulated in the course of several years should not exceed 20 mSv per year.
- The keep-off area begins at a dose rate of 25  $\mu$ Sv/h.

By the above shown figures the potential danger of radioactivity can be realistically estimated.

<sup>1)</sup> Source: Prof. Dr. Claus Grupen, Introduction to Radiation Protection, 4th edition



How to measure contamination and background radiation:

- According to the measuring position (geographical position) the natural background radiation varies between a few nSv/h and some hundred nSv/h. Depending on the kind, the volume and the material of the used detector values between approx. 15 counts per minute and approx. 6000 counts per minute for high sensitive detectors are measured.

In order to verify whether there is a contamination, the background radiation has to be determined at first. The German Fire Brigades legislation defines: contamination is existing when the measured count rate is three times exceeding the determined background count.

- The European Community determined a limit value of 600 Bq/kg for the cross-border traffic of foods. This limit value is valid for all foods in Germany. For milk and baby food this value is even limited to 370 Bq/kg. For comparison: acc. to the German Radiation Protection Regulation the approval value for the radio nuclide Co-60 e. g. is 0,1 Bq/g, i. e. 1000 Bq/kg.
- Since March 19, 2011<sup>\*)</sup> the valid contamination value for surface contaminations of aircrafts in Germany is 1 Kilobecquerel per square centimeter. This value corresponds to a local gamma dose rate of 5 Mikrosievert per hour measured at a distance of one meter from the surface of the aircraft.
- When a contamination has been determined, the responsible authorities have to be informed.

### III. Portable measuring instruments / measuring purpose

#### a) Personal dosimeters:

*Example:* PTB-approved personal dosimeter **ED150** for the personal radiation protection.

#### b) Dose rate meters:

*Example:* PTB-approved dose rate meters **GammaTwin** or **X5C plus** (possibility to connect external probes for extending the measuring range up to 10 Sv/h). Both devices are suitable for the personal radiation protection. When combining the **X5C plus** with the probe **ABG170** respectively **18526 D** it is also suitable for the inspection of incoming goods. It is recommended to measure over a period of some minutes.

First: background count has to be determined as reference value. Second: contamination check has to be effected. Contaminated material will result in considerably higher measuring values than the determined background radiation. Acc. to the German Fire Brigades Regulation a triple background count means contamination as already described above.

By using the probe **ABG170** it is even possible to effect food controls. For such measurements a flat basin is needed having a depth of approx. 2 – 3 cm and a surface size like the detector surface. Determine the background count as reference value at first, then effect contamination control. If this measurement technique is not sufficient for the required application, it is recommended to use a special measuring station for food control which is able to effect nuclide specific measurements by a spectrometer.

#### c) Contamination measuring instruments

*Example:* Combination **X5C plus** with probe **18526 D** respectively **ABG170** and probe cable or contamination monitor **CoMo170** for detecting surface contaminations of incoming goods and as described above also suitable for food controls.

### IV. Recommended preventive measures

For the protection against contamination and incorporation of radioactivity it is necessary to wear protective clothes.

- protective suit, mask, gloves for single-use and an overcoat for shoes
- carry measuring instruments for the personal radiation protection
- limit radiation from the outside and contamination to a minimum
- spreading of contamination and incorporation have absolutely to be avoided
- if possible, keep distance to the source of danger
- time-limited duration of stay in the hazard area
- if possible, use of shieldings
- food, drinking, smoking are forbidden; for longer missions attend a location with a low radiation exposure; take care that hands are thoroughly cleaned before!
- Contamination control when mission has ended

Please note: this list is not complete!

<sup>\*)</sup> Source: Federal Bulletin No. 45, decree for radiation protection precaution regarding radioactively contaminated aircrafts

For more than 60 years your partner for radiation protection!

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