DANISH HEALTH AUTHORITY
Radiation Protection

December 2018

Dose monitoring using whole body personal dosimeters

Whole body dosimetry

The Personal Dosimetry Laboratory at the Danish Health Authority, Radiation Protection (SIS) offers dose monitoring of radiation exposed workers using personal dosimeters, also called whole body personal dosimeters.

The whole body personal dosimeter

The dosimeter can measure radiation doses caused by ionising radiation (X-rays, gamma and beta radiation). Doses are determined by the dose equivalents $H_p(10)$ and $H_p(0,07)$, which are used as measures of effective dose and skin dose, respectively. Doses are expressed in mSv (millisievert). The whole body personal dosimeter consists of a metal card containing radiation sensitive thermoluminescent material. The metal card is wrapped in a special foil and a plastic holder in which the card is to be placed during use (see figure 1). The holder contains different filters that make it possible to measure the doses received by the wearer.

Figure 1. Plastic holder and dosimeter card (the whole body personal dosimeter).

Registering for dose monitoring

You can register for dose monitoring by filling in the web form 'Create dosimetry service agreement' on our website. The general terms and conditions can also be found on the website.

Once your company is registered, the registration/deregistration of workers for dose monitoring as well as changes to the data can be done via the web form 'Submit changes regarding dose monitoring'.

Using the whole body personal dosimeter

The whole body personal dosimeter should be worn close to the body in a location where it is exposed to the highest possible radiation; this will typically be at chest or belt level.

We regularly dispatch new dosimeters to dose monitored workers, who must replace the dosimeters card in the holder by themselves. The dosimeter card has an imprinted date interval for the intended measurement period. Dosimeter cards must be returned as soon as possible after the end of the measurement period.

Results of dose monitoring

All received dosimeter cards are read out using equipment calibrated by the accredited SIS Standard Dosimetry Laboratory. Radiation doses are then sent in a result list to the company where the dose monitored worker is employed. The doses are also registered in the Danish Health Authority's Register for Personal Dosimetry, SRP. If there is reason to suspect that a dosimeter wearer has been exposed to a large dose, the dosimeter must be read out urgently for the result to be made available within 24 hours of its receipt in the laboratory.

Quality assurance

The Personal Dosimetry Laboratory is accredited for measurement of $H_p(10)$ and $H_p(0,07)$ using whole body personal dosimeters in accordance with the standard DS/EN ISO/IEC 17025:2017. This means that quality assured procedures are followed and the laboratory is regularly inspected by the national accreditation body, DANAK. The laboratory also participates in international intercomparisons.

Additional information

You can find further information regarding the Danish Health Authority's dose monitoring programme and web forms on our website www.sis.dk. If you need additional information, please do not hesitate to contact us. On the next page you can read more about the technical details of the whole-body personal dosimeter.

Technical specifications and reported dose

Technical specifications

The dosimeter card is of the type Harshaw TLD™ and contains thermoluminescent elements encapsulated in Teflon, which are used for measuring $H_p(10)$ and $H_p(0,07)$. The elements are made of the material ^{7}LiF (Mg, Cu, P). Some cards contain an additional element of the type ^{6}LiF (Mg, Cu, P) that can detect the presence of neutron radiation, but not the dose from neutrons.

The whole body personal dosimeter is tested in accordance with the standard DS/EN 62387:2016 for measuring $H_p(10)$ and $H_p(0,07)$ in the dose interval [0,1 mSv ↔ 1 Sv] and the angular interval [-60° ↔ +60°] for photon exposure in the energy interval [16 keV ↔ 1,3 MeV] and for beta particle exposure in the energy interval [0,7 MeV ↔ 2,3 MeV] (E_{max}).

figure 2 shows the personal dosimeter response for the two dose equivalents $H_p(10)$ and $H_p(0,07)$ as a function of photon energy. The response is given as the measured value of the dose equivalent divided by its 'true' value. The ideal ratio is 1 (one).

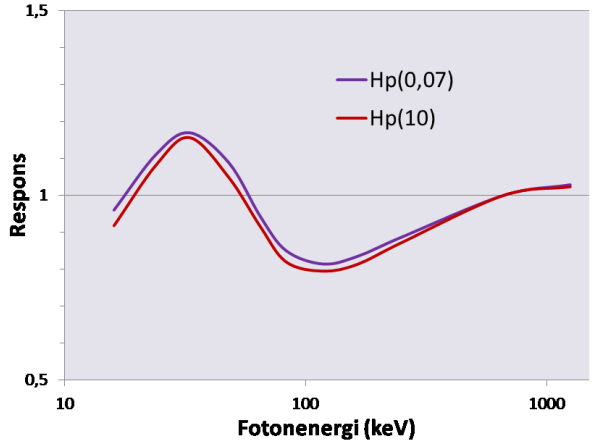

Figure 2. Response for dose equivalents Hp(10) and Hp(0,07) as function of photon energy.

Reported dose and uncertainty

When reporting personal doses, the uncertainty is not considered, i.e. only the measured dose is reported. The measured dose is also used when deciding whether the statutory dose limits have been exceeded.

However, there will always be an uncertainty in the measured personal dose. The uncertainty is mainly due to the fact that the energy and angular distributions of the radiation are unknown. For doses less than 1 mSv, the variation in background radiation will also contribute significantly to the uncertainty.

The uncertainty is estimated in accordance with *Guide to the Expression of Uncertainty in Measurement* (GUM). For a dose of 0,1 mSv, the uncertainty on the measurement of $H_p(10)$ for a measurement period of 1 month or 3 months will be approx. 50% and 100% (95% confidence), respectively. For doses greater than 1 mSv, the uncertainty is approx. 25% (95% confidence) regardless of the length of the measurement period. The uncertainty in measuring $H_p(0,07)$ is comparable with the uncertainty in measuring $H_p(10)$.

The uncertainty is within the criteria set by international standards[1,2]. Participation in regular international intercomparisons has shown good compliance.

When reporting dose where the above guidelines are not followed or applicable, this will be stated in the measurement report together with the reported dose.

Lower measuring limit

The uncertainty in $H_p(10)$ measurement determines how low doses can be measured. The variation in background radiation is the main reason for this. This means that the lower measurement limit (decision limit) for $H_p(10)$ and $H_p(0,07)$ when using a personal dosimeter for 1 or 3 months are 0,04 and 0,07 mSv, respectively. Doses less than the lower measuring limit of are reported on the result list as 0,0 mSv.

[1] European Commission, Radiation Protection No 160, Technical Recommendation for Monitoring Individuals Occupationally Exposed to External Radiation.

[2] ISO 14146:2018, Radiation protection - Criteria and performance limits for the periodic evaluation of dosimetry services