Public Health England

Neutron Dosemeter

The Personal Dosimetry Service of Public Health England provides neutron dosimetry based on poly-allyl diglycol carbonate (PADC, also called CR-39). The dosemeter is designed to measure doses from neutrons to the whole body and to the skin in terms of the radiation quantities $H_p(10)$ and $H_p(0.07)$ as required by the Health & Safety Executive (HSE).

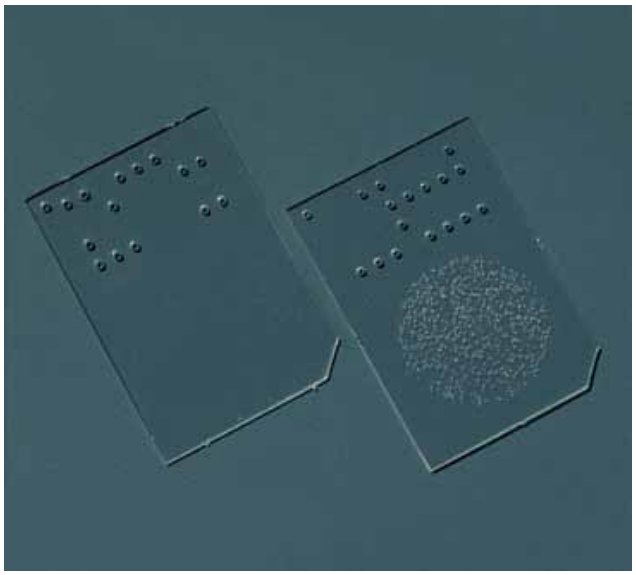
The PHE neutron dosimetry service is approved by the HSE under Regulation 36 of the Ionising Radiations Regulations 2017.

The dosemeter is a passive device for the detection of thermal, epithermal and fast neutrons. It is insensitive to other radiations (gamma, X- and beta), is relatively unaffected by environmental factors such as heat and humidity, and has a very low radon sensitivity. It comes in a neat, lightweight green nylon holder and offers high sensitivity. The response is acceptable over an extended neutron energy range, covering thermal and epithermal neutrons and fast neutrons above an energy threshold of approximately 144 keV. The dosemeter is labelled with the wearer's name or a serial number and also bears the company's code number, the expiry date and an optional personal identifier (eg department name or a works number) for each employee.

The dosemeter utilises the ability of PADC to record the tracks of charged particles as damage to its polymeric structure. These charged particles are mostly protons, produced by interactions between the neutrons and nuclei of the PADC or the holder. Chemical etching and subsequent electrochemical etching of the damage track can then develop it into a pit with a diameter in the range 20–200 μm, thereby enabling an automated scanner to assess the number of such tracks. The PADC plastic before and after the etching process is shown below.

Neutrons from about 144 keV upwards are detected by direct collisions with nuclei in the dosemeter/holder assembly, whilst the detection of thermal neutrons utilises capture interactions with nitrogen nuclei in the nylon holder. Hence, the detector is able to detect neutrons over a very wide energy range.

PADC dosemeter



PADC plastic, before and after processing

The neutron dosemeter service is just one of the approved dosimetry services offered by Public Health England and can be linked to our dose record keeping service via an automated system. The processing laboratory is based at our premises in Leeds. For further information or to place an order please contact us on the numbers below.

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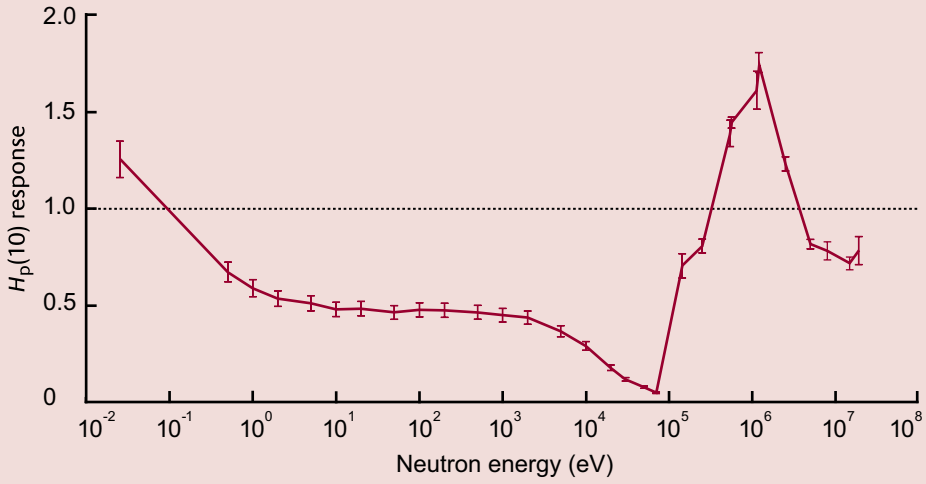
https://www.phe-protectionservices.org.uk/pds

Technical Specification

Material	Poly-allyl diglycol carbonate
Dose range	0.2 mSv to 200 mSv
Change interval	Standard periods of 1, 2 or 3 months Periods of 2, 4, 8 or 13 weeks also available
Energy range	Thermal, epithermal and fast neutrons from 144 keV to 15 MeV

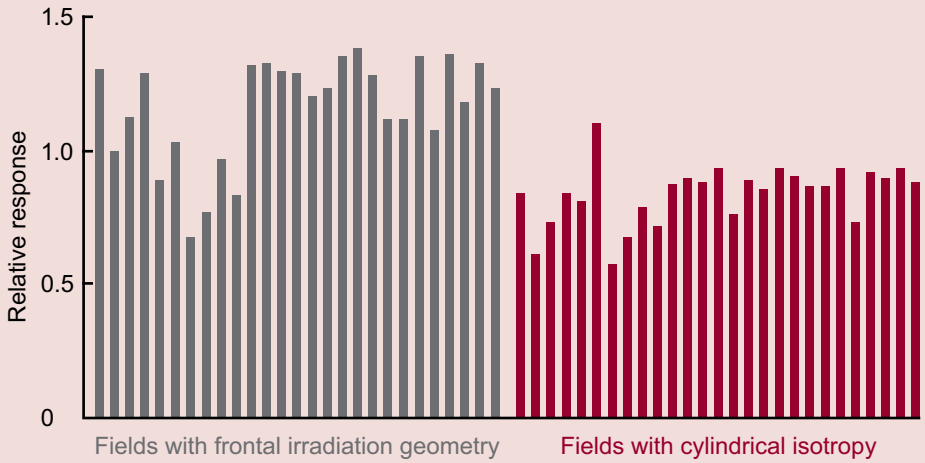
Energy response

The variation of response with neutron energy for normal incidence is given below, normalised to the response to americium–beryllium sources



Energy dependence of response for normal incidence

In practical workplace fields, the variation in response is less marked



Calculated response in a range of workplace fields

Measurement uncertainties

The neutron dosemeter is subject to measurement uncertainties which comply with the recommendations given in European Commission report *Radiation Protection 160: Technical Recommendations for Monitoring Individuals Occupationally Exposed to External Radiation.*

In HSE performance tests, the overall relative standard deviation and overall bias are typically 10% (allowed values: 20% and 25%, respectively).

Special Features

Immunity to other radiations

The neutron measurement capability of the dosemeter is not affected by the presence of significant amounts of X-, gamma or beta radiation.

Life span

The fading of tracks formed in the PADC plastic is low and the dosemeter is relatively unaffected by heat and humidity. Issue periods of up to 13 weeks can be offered, thus keeping the cost of monitoring low.

Energy range

The dosemeter is able to detect neutrons over a very wide energy range, including thermal energies, with good efficiency.

Physical record

The PADC plastic forms a physical record of the dose received by the wearer. The etched plastic is stored by PHE for at least five years and may be accessed by the customer.

March 2018