



Active Personal Dosimeters (APDs) can be a powerful tool in optimizing occupational radiation doses from interventional procedures

How much do you know about Active Personal Dosimeters (APDs) in interventional radiology /cardiology?

What is an APD?

An Active Personal Dosimeter (APD) is an electronic device for instant and continuous display of radiation dose and dose rate received by the person who wears it:

- for monitoring worker's exposure on a daily basis
- for optimization and education purposes
- for monitoring worker's exposure during a new task or new technique
- for alerting the worker when a threshold is exceeded

How to wear and use?

When not used as official dosimeter, APDs should be worn above the lead apron at chest height. Clear guidance and instruction should be provided to the worker (i.e. orientation of the dosimeter).

APDs should include an alarm to indicate that the measured value is above a given threshold. The alarm should preferably be visual (or vibrating) rather than audible.

Requirements

When used in interventional radiation fields (typically pulsed fields), APDs have to comply with additional tests as described in the recent IEC/TS 63050 standard.

APDs can be approved as a dosimeter for regulatory compliance once the national criteria required have been fulfilled.

[IEC TS 63050:2019, Radiation protection instrumentation - Dosimeters for pulsed fields of ionizing radiation]

Features

The APD must be of suitable design for use as a dosimeter of record, including software security, protection from data manipulation and against electromagnetic disturbances.

Software to manage APDs is a useful tool (in particular, it allows traceability of the wearer's dose) and should be considered when purchasing dosimeters.

Calibration

APDs should be periodically calibrated (according to local regulation) or verified in terms of $H_p(10)$ in a calibration laboratory.

The conditions of calibration should be as close as possible as those of use or, when the energy response for the conditions of normal use is known, calibration can be accepted at another energy (like Cs-137 for instance).

[Vanhavere F, Carinou E, Gualdrini G, et al. 2012. ORAMED: Optimization of Radiation Protection of Medical Staff. EURADOS Report 2012-02, ISSN 2226-8057, ISBN 978-3-943701-01-2. Braunschweig]

Can APDs be used in parallel with passive dosimeters?

Yes, but the results may differ significantly (energy and angular dependance, position...).

A detailed interpretation of the results should be carried out by a qualified Radiation Protection Expert (RPE). If the APD does not comply with the pulsed field standard, the dosimeter may indicate incorrect values, in most cases lower, than that measured with a passive dosimeter.

[O'Connor U., Carinou E., Clairand I., Ciraj-Bjelac O. et al. Recommendations for the use of active personal dosimeters (APDs) in interventional workplaces in hospitals. Phys. Med. 87, 131-135 (2021)]

Typical fields in interventional procedures

Pulse duration	1 ms to 20 ms
Pulse frequency	1 s ⁻¹ to 30 s ⁻¹
Personal dose equivalent rate integrated over the pulse in the direct beam (on patient table)	2 Sv.h ⁻¹ to 300 Sv.h ⁻¹
Personal dose equivalent rate in the scattered beam (operator - above the lead apron)	5.10-3 Sv.h ⁻¹ to 10 Sv.h ⁻¹
Average energy range of scattered spectra	20 keV to 100 keV

! There is risk of APDs resetting the dose to zero, and of battery failing mid-procedure, along with the potential for human error manually transcribing data.

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Individual Monitoring

