

THE LB 6411 NEUTRON DOSE RATE PROBE

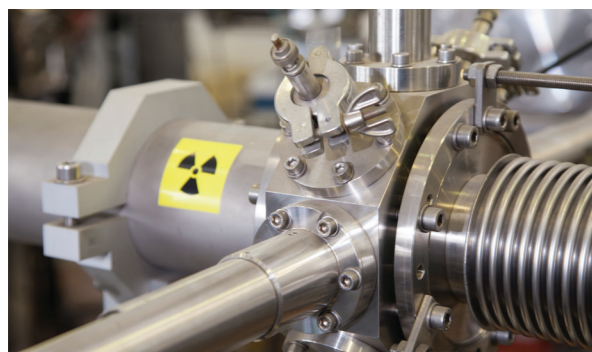
Sensitive and flexible
Neutron Dose Rate Monitoring



BERTHOLD

NEUTRON DOSE RATE MONITORING

High flexibility. Best-in-class sensitivity.



Designed for high-sensitivity

The LB 6411 Neutron Dose Rate Probe was designed for the measurement of the ambient equivalent dose of neutrons. It consists of a polyethylene (PE) moderator sphere with a composite ³He recoil proton counter tube at its center. The system can be operated with the easy-to-use universal monitor (UMo II) LB 134 or as stationary system with our data logger LB 115.

The probe is characterized by an extremely high sensitivity of approx. 3 pulses per nSv, more than 5-times better vs. detectors with conventional design. This was achieved by the relatively large detector volume and a special gas filling of the proton counter tube. Thus, additional recoil protons are produced in the counting gas, resulting in enhanced sensitivity.



Figure 1: Different versions of the LB 6411. A: Mobile measuring system setup connected to the LB 134 Umo II Universal Monitor. B: LB 6411-Pb version for high energy applications

LB 6411 benefits at a glance

- ▣ **Best-in-class sensitivity:** 3 counts per nSv in the energy range of 1 to 10 MeV
- ▣ **Fast results:** Short measuring times in weak neutron fields
- ▣ **Outstanding flexibility:** can be used both, as a portable and as a stationary measuring device
- ▣ **High data integrity:** calibrated to the ambient equivalent dose $H^*(10)$ for neutrons recommended by the ICRP 60 and ICRU 39
- ▣ **Wide range of applications:** special version available for high energy applications at several hundred MeV or more, e.g. to be used for neutron dose rate monitoring at high-energy accelerators

Application flexibility

The probe can be used both, as a portable measuring device and as a stationary monitor. The principal applications are reactors and the nuclear fuel cycle in the nuclear sector, accelerators in research and the use of neutron sources in the industrial sector.

The LB 6411-Pb is a special version available for high energy applications with several hundred MeV or more. This special version has an outer layer of 10 mm lead. The response to high-energy neutrons is improved by using spallation neutrons generated in the lead.

DESIGNED TO DELIVER RELIABLE RESULTS

Benefit from specific design features

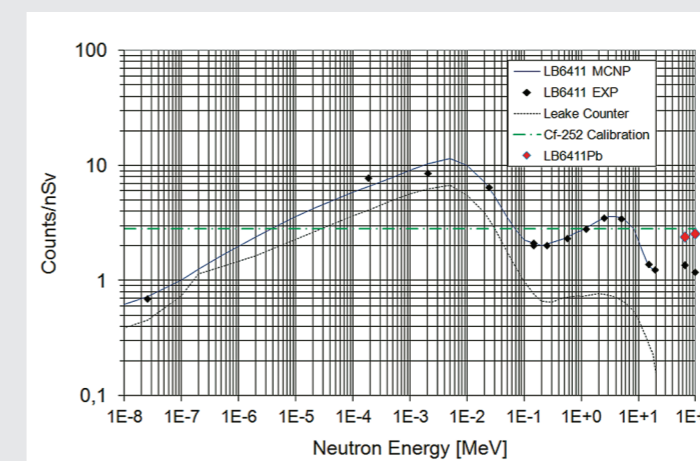


Figure 2: Responsiveness of the LB 6411 to ambient equivalent dose $H^*(10)$ for neutrons according to ICRP 60

Excellent energy dependent behaviour

The LB 6411 neutron probe is characterized by a wide measuring range and high sensitivity. The geometry of the moderator arrangement, the counter tube sensitivity and the materials used are selected so that the count rate is proportional to the equivalent dose rate. This applies approximately independently of the respective neutron spectrum.

The energy-dependent behaviour of the arrangement was optimised by introducing neutron absorbers into the moderator and by using a special combined ³He recoil proton counter tube.

Very low directional dependency

The LB 6411 operates virtually independent of the radiation direction. This is made possible by the optimized spherical geometry of the moderator and counter tube. In the energy range between 1 MeV and 20 MeV, it results in a directional deviation of less than $\pm 10\%$ from the preferred direction over the entire angular range. In the lower hemisphere the directional dependence remains below 10% even at low neutron energies.



Figure 3: Neutron measurement during CASTOR transport

TECHNICAL SPECIFICATIONS

Neutron Monitoring Specifications (LB 6411)	Measured quantity	Ambient dose equivalent H*(10) rate for neutrons in Sv/h according to ICRP 60
	Measuring range	30 nSv/h to 100 mSv/h
	Neutron energy range	Thermal to 20 MeV
	Calibration	Relative to an unmoderated ²⁵² Cf spectrum
	Fluence Response	1.09 cm ² for unmoderated ²⁵² Cf spectrum
	H*(10) response	2.83 counts per nSv or 0.79 cps per μSv/h
	Calibration factor	1.27 μSv/h per cps
	Energy dependency	± 30% between 50 keV and 10 MeV
	γ-sensitivity	< 30 μSv/h in 10 mSv/h, ¹³⁷ Cs gamma-field
	Temperature range	-10 °C to 50 °C
	Weight	9.2 kg
Counter Tube (LB 6410)	External dimensions	Ø 40 mm x 100 mm
	Counter tube housing	stainless steel 1 mm thickness
	Active length	approx. 40 mm
	Active volume	approx. 45 cm ³
	Counting gas	³ Helium/Methane
	Operating voltage	2650 Volt
	Detection efficiency for Thermal neutrons	approx. 90%
	Background	< 0.02 cps
	Dead time	5 μs
Moderator	External diameter	250 mm
	Material	Low pressure polyethylene with 2 % carbon additive
	Density	0.95 g/cm ³
	Weight	9.2 kg
Ordering Infos	82042	LB 6411 Neutron Ambient Dose Equivalent Probe
	58886	LB 6411-1 Neutron Ambient Dose Equivalent Probe with reduced counting gas filling pressure
	47152	LB 6411-Pb Neutron Ambient Dose Equivalent Probe with 10 mm lead
	64039	LB 6411-D Neutron Ambient Dose Equivalent Probe with differential data output
	64040	LB 6411-1D Neutron Ambient Dose Equivalent Probe with reduced gas pressure & differential data output
	24960	Wall mounting support distance holder for LB 6411
	55589	Storage and trolley case for LB 6411 with universal monitor (UMo II) LB 134

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