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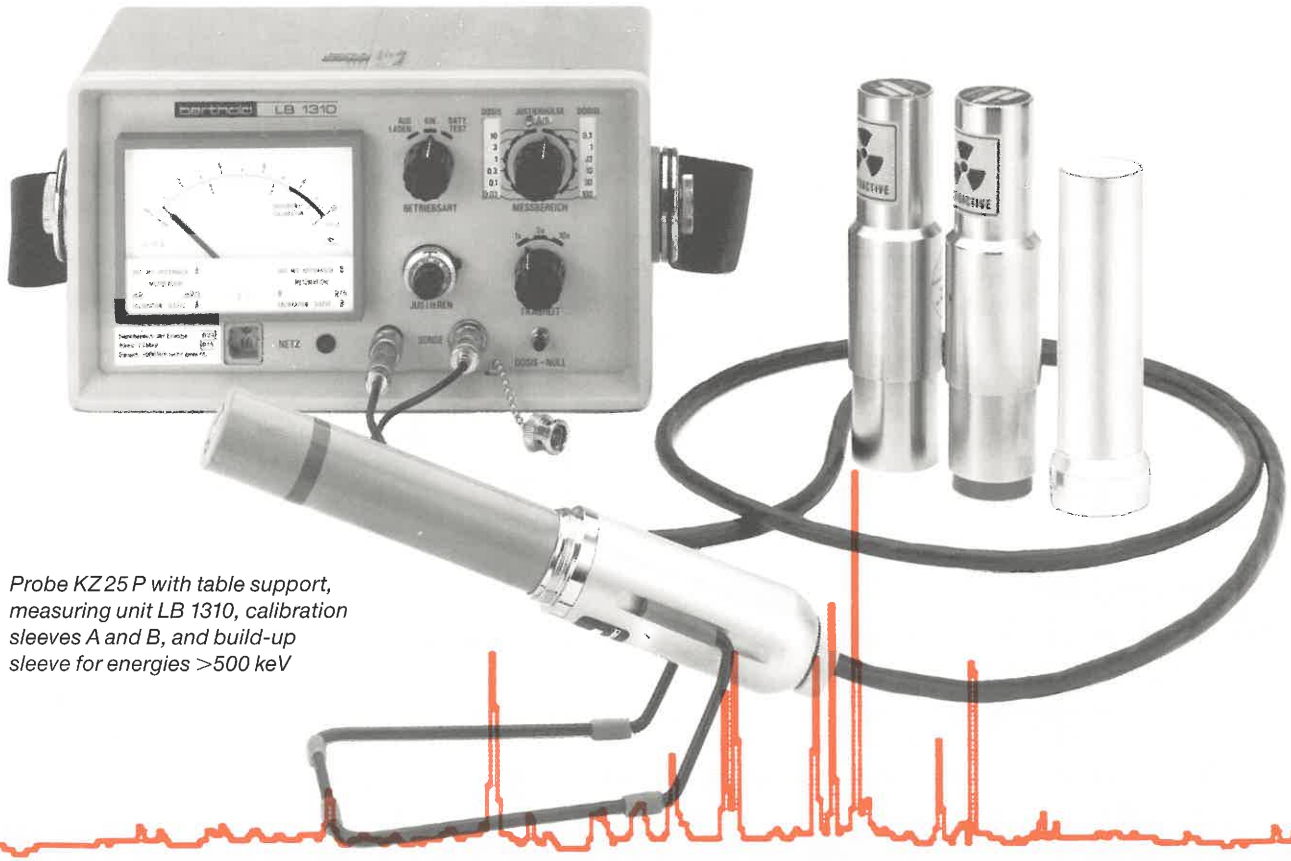
Radiation Protection Dose Ratemeter TOL/E

Ionization Chamber with Gas Amplification

Type-tested and approved by the German National Office of Standards (PTB)
Energy Range from 8 keV up

Short Description:
The TOL/E is a **portable universal device for measurements** of the **dose rate** as well as that of the integrated **dose.** It has both an extremely low energy dependence and a very wide measuring range (dose rate practically from background count rate up to 30 Svh^{-1}, dose up to 3 Sv). An air-equivalent ionization chamber with variable gas amplification serves as **detector**.
The chamber is connected by cable (standard model 2 m) to the LB 1310 measurement and indicator device.
The instrument can be operated **by connection to mains** as well as **independently** through a built-in rechargeable battery.

Dose rate measurement of beta-radiation is valid for 0.5 mm pre-filtering, i. e. corresponding to measurements at about 0.5 mm below the surface of the skin.



Probe KZ 25 P with table support, measuring unit LB 1310, calibration sleeves A and B, and build-up sleeve for energies >500 keV

Radiation Protection Dose Ratemeter TOL/E

Air-equivalent Plastic Probe KZ 25 P

The device operates with an ionization chamber with variable gas amplification. The **plastic measuring chamber,** due to its wall material and gas contents, is the equivalent of an "air-walled chamber". In contrast to most ionization chambers, the ionization current caused by the radiation being measured is appreciably amplified within the probe itself. Thus the gas amplification factor can be adjusted to great extent by the choice of operating voltage.

Through this method, the high sensitivity of a counter tube is combined with the wave-length-independence and saturation proofness of an air-walled ionization chamber. In the range between 16 kV filtered X-radiation (half value layer 0.12 mm A) and gamma radiation from ^{60}Co and radium, measurement error caused by energy dependence is less than ±10 %. (For Cu-Kα-radiation the instrument indicates 30 % too low).

Moreover, through the principle of current measurement instead of the single-pulse amplification which is usual with counter devices, **overload effects are avoided;** however high the dose rate, the indicator needle does not fall back but remains at the upper end of the scale.

The exact **correction factors** for different radiation qualities **determined by the PTB** (Physikalisch Technische Bundesanstalt) are shown in below table. In order to establish the necessary conditions of secondary electron equilibrium it may become requisite to use a wall enforcing cover out of plastic (perspex) round the probe when measuring radiation energies above c. 500 keV, with a wall thickness corresponding to the maximal range of the secondary electrons of the respective energy.

Measuring Ranges

The device has 6 linear basic measuring ranges. They extend from 3 $\mu Sv h^{-1}$ to $10^3 \mu Sv h^{-1}$ (dose rate measurement) or from 0.3 μSv to 10^2 μSv (dose measurement). Calibration for this range results from a single adjustment of the high voltage on a helipot through the use of Calibration Sleeve A. Recalibration through the use of Calibration Sleeve B results in the aforementioned ranges in $mSv h^{-1}$ or in mSv. An extension to still higher ranges can be obtained by sliding the coarse range switch to position II (ionization chamber, range without gas amplification). At the same time, the range scale is automatically changed and the high voltage brought up to 200 volts. This puts the potentiometer "Calibration" out of operation; calibration is not necessary under these operating conditions, when the ionization chamber is functioning without gas amplification. The measuring ranges now extend from 0.1 $Sv h^{-1}$ to 30 $Sv h^{-1}$ (dose rate measurement) or from 0.01 Sv to 3 Sv (dose integration).

Doserate measurement limits.

The limit for linearity of doserate measurements (indicated value 10% low) is given by a current output of 10^{-7} A. In the $\mu Sv h^{-1}$ ranges, this corresponds to 10 $mSv h^{-1}$, in the $mSv h^{-1}$ ranges to 10 $Sv h^{-1}$. For pulsed radiation, the limit is lower than that for continuous radiation by the ratio of pulse distance to pulse duration. The same considerations apply for dose measurements.

Calibration Factors

Calibration factors K of plastic probe KZ 25 P with different radiation qualities (Out of PTB test-sheet, journal-no.: 6.42-18/74)

Tube voltage (kV) resp. Radio Isotope	Effective Energy (keV)	Correction Factor K
^{60}Co	1300	1,08*)
^{137}Cs	662	1,16
380	305	1,10
250	198	1,09
150	113	1,03
80	55	1,06
40	33	0,98
25	20	0,94
12	10	1,15

Own examinations resulted further correction factors:

Cu Kα	8,0	1,4
Fe Kα	6,4	2,5
Linear accelerator	9000	1,05*)

*) with wall enforcing cover

Standard Accessories

1 genuine leather case
1 LB 1310 device
1 special mains cable
1 plastic probe with special cable (2 m) and plug, with stand
1 calibration sleeve A (μSv range)

Special Accessories

1 calibration sleeve B (contains 4 MBq ^{90}Sr, therefore in some countries subject to authorization) (mSv-range)
8 m extension cable
1 table stand for secure positioning of probe

A special high-frequency-shielded model of the device is also available for delivery under the specification "TOL/E-HF".

Technical Data

Measuring ranges:

Dose rate	Dose
3 $\mu Sv h^{-1}$	0,3 μSv
10 $\mu Sv h^{-1}$	1 μSv
30 $\mu Sv h^{-1}$	3 μSv
100 $\mu Sv h^{-1}$	10 μSv
300 $\mu Sv h^{-1}$	30 μSv
1000 $\mu Sv h^{-1}$	100 μSv

Recalibration with **Calibration Sleeve B** results in the aforementioned **ranges in $mSv h^{-1}$ or mSv.**

Switching over to "ionization chamber without gas amplification" results in the following **ranges:**

Dose rate	Dose
0.1 $Sv h^{-1}$	0.01 Sv
0.3 $Sv h^{-1}$	0.03 Sv
1 $Sv h^{-1}$	0.1 Sv
3 $Sv h^{-1}$	0.3 Sv
10 $Sv h^{-1}$	1 Sv
30 $Sv h^{-1}$	3 Sv

Input: $10^{-15}\Omega$, 33 pA to 100 nA

Output: High voltage 100 to 2000 volts

Time constants for dose rate measure ments: 1,3 and 10 s

Time constants for dose measurements: (Self-discharging of the integration condenser): $>10^5$s, corresponds to > 28 hours

Energy dependence:
<10 % from 10 keV gamma radiation or filtered X-radiation from 16 kV up to gamma radiation from radium and ^{60}Co (secondary electron equilibrium presupposed)

Dimensions:
Height 140 mm, width 245 mm, depth 135 mm

Weight: About 4 kg

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Radiation Measuring Instruments for Industry, Science and Medicine

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