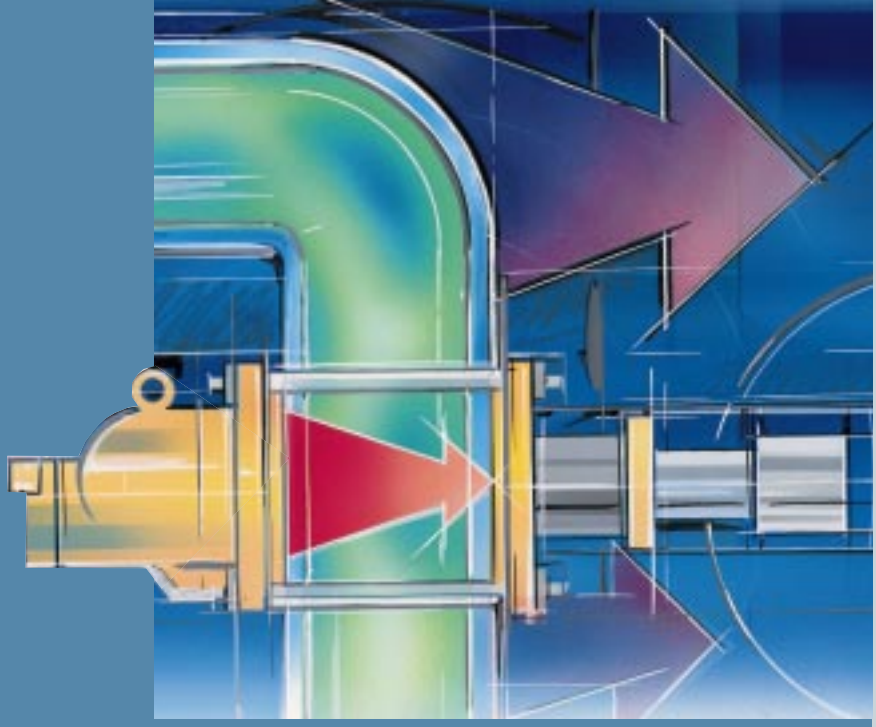


CONTACTLESS MEASUREMENT

Density Gauge
LB 444

BERTHOLD TECHNOLOGIES

Determining density and concentration using the LB 444

ARRANGEMENT FOR 45° IRRADIATION

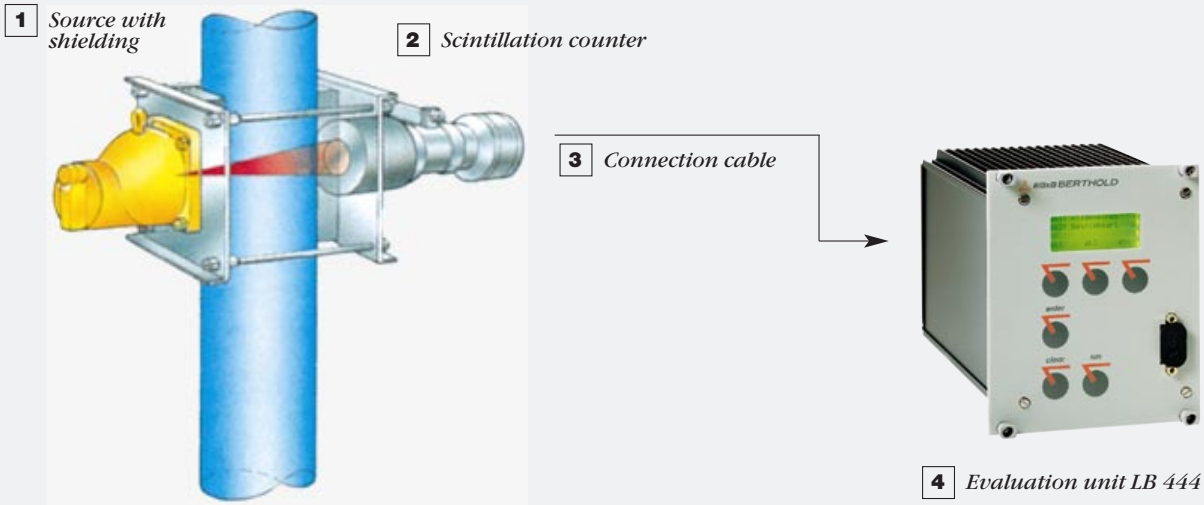
The measuring system LB 444 is used for contactless, continuous measurement of **liquids or bulk materials** in pipes and vessels. It can easily be installed on existing pipelines without downtime. It works reliably and is unaffected by colour, temperature, pressure or chemical properties of the product to be measured.

Applications

- **Concentration measurements of acids, alkalis, saline solutions and suspensions.**
- **Crystallisation and polymerisation monitoring.**
- **Measurement of the solid matter content in slurry, in flue gas desulphurisation suspensions, in aluminium production and in mining.**
- **Determination of the bulk density in washing powder and clinker.**

Measuring principle The gamma radiation emitted by a source is attenuated when it passes through matter. The extent to which it is attenuated depends on the measuring path and on the density of the product. Given a constant distance in the measuring path, radiation absorption is a function of the density of the material being measured.

Measuring arrangement The figure below shows a typical schematic arrangement of a complete measuring system. It consists of the source with shielding **1** , a scintillation counter **2** and the connection cable **3** from the detector to the LB 444 evaluation unit **4** .Installation can be carried out without pipeline modification or production downtime. Both the shielding and the detector can be mounted on the outside of the pipe using various clamping device (90°, 45°, 30° irradiation angle).



If the diameter of the pipe is large enough to provide sufficient absorption, the measurement can be arranged at an angle of 90° to the pipe axis. In the case of smaller pipe diameters, the measuring system can be fitted at an angle of 30° or 45° in order to achieve a sufficient measuring effect. For more precise measurements with small pipe diameters, an s- or u-shaped measuring path is used. The radiometric measuring method affords a high level of operational safety and requires virtually no maintenance, even under extreme environmental conditions.

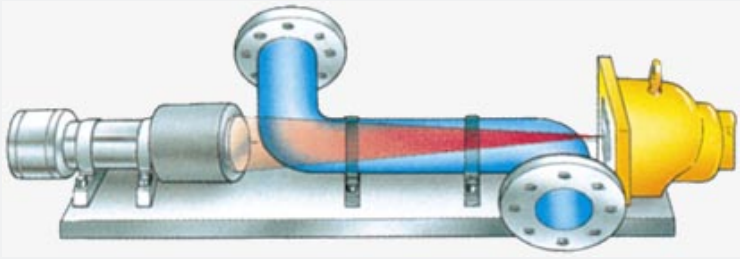


ILLUSTRATION OF
S-SHAPED MEASURING PATH

Evaluation unit The LB 444 evaluation unit incorporates state of the art technology with a 32 Bit processor for high computing speed and precision in even the most simple operation. ■ Compact design in 19“ module 3 HE; 21 TE ■ Installation in a wall housing or up to 4 units in a 19“ rack ■ Illuminated 4 line LCD Display ■ User guidance via soft keys with multilingual dialogue ■ 6 membrane keys for easy operation ■ Continuous self-monitoring of the measuring process ■ Storage of all calibration data in a Flash-memory ■ Up to four calibration curves can be stored for different products and accessed externally.

Radiation sources and shielding All radioactive sources ”used” for industrial applications are encapsulated in stainless steel, so that radioactive substance is kept separate and isolated from the material being measured. In most cases, a ^{137}Cs radiation source is used, although ^{60}Co and ^{241}Am sources can also be used for special measuring purposes. The shielding container consists of a cast-iron or stainless-steel casing filled with lead and a lockable exit channel for the useful beam. Special shieldings are available for measurements in vessels.

Detector A scintillation counter with an NaI crystal is used as a detector. Photoflashes are produced in the crystal by means of radiation. The number of flashes is proportional to the intensity of the radiation field. The crystal is optically linked to a photo multiplier which, together with the electronics, converts the photoflashes into electrical impulses. By way of comparison with other detectors, e.g. ionisation chambers, the advantages are obvious: high sensitivity as regards gamma radiation, therefore low source activity, temperature stability and practically unlimited service life. The compact shape of the crystal allows the latter to be shielded easily against fluctuations in ambient radiation which could influence the measurement. The signals are transmitted to the evaluation unit via a two-wire technique using ASK modulation in order to ensure resistance to interference.

Contactless, on-line measurement

DENSITY MEASUREMENT OF SLURRY

Calibration A user-friendly calibration program makes correct operation easier. Special product characteristics and the conditions at the measuring site are automatically taken into consideration. During start-up, a single calibration point is sufficient. For very precise calibration, up to 10 measurement points can be used. Should temperature fluctuations occur, the temperature compensation sets the unit of measurement with regard to a reference temperature. The contactless radiometric measuring method demonstrates high long-term stability and therefore is almost maintenance-free.

Engineering data

To prepare our quotation the following technical data are necessary:

- **density range**
- **product temperature range**
- **for suspensions: solid matter density, liquid density, min./max. density**
- **for liquids: measuring range in kg/m^3, min./max.**
- **concentration, chemical formula, if possible**
- **required accuracy**
- **external diameter of the pipe, wall and material thickness, lining (if any)**
- **reference to possible gas bubbles at the measuring point.**

Technical Data
Density Gauge LB 444

Evaluation unit LB 444	
Design	19“ module 3 HE, 21 TE protection class IP 20
Weight	approx. 2 kg
Power supply	115 V AC ± 10 % 230 V AC ± 10 % 18 - 32 V DC
Power consumption	approx. 30 VA (AC), 30 W (DC)
Temperature range	operating temperature: 0 ... +50 °C (273 ... 323 K) no condensation storage temperature: - 40 ... +70 °C (233 ... 343 K) no condensation
Arrangements	in a panel in a 19“ rack 21 HE, 84 TE (max. 4 units) wall mounted cabinet (max. 2 units), IP 65
CPU	32 bit computer data storage in FLASH-Memory
Inputs	
Detector connection	[EEx iB] IIB
Temperature signal	Pt 100 connected at the detector, [EEx ib] IIC T6 measuring range: - 20 ... +200°C (253 ... 473 K) or input for temperature signal 0/4...20 mA, isolated, impedance 50 Ω
Digital inputs	DI1/DI2: for external selection of calibration curve DI3: for external start/stop of the measurement
Outputs	
Current output	0/4 - 20 mA, isolated, max. 500 Ω
Digital outputs	DO1: relay for collective failure message DO2: relay for threshold DO3: relay for threshold max. load: 230 V AC, 100 mA
Display	LCD-display with 4 x 20 characters, illuminated, data input via membrane keys, user guided dialog with softkeys, dialog: several languages, data protection by user-selectable password.
Interfaces	RS 232 and RS 485
Program	Time constant 0.5 - 9999 s with automatic reduction of 1/10 of the value in case of rapid changes of measuring value. Automatic decay compensation for ^{137}Cs, ^{60}Co, ^{241}Am, ^{244}Cm, ^{90}Sr and ^{85}Kr.
Detectors	
Scintillation counter	with crystal NaI (Tl) long-term stability: ± 0,1 % stainless steel housing cable entry: PG 7 for cable outside diameter 4 .. 6.5 mm weight: approx. 18 kg

designation	crystal size	protection class
LB 4441-1	40/35	EEx de IIC T6 / EEx de [ib] IIC T6 / IP 65
LB 4442-1	50/50	EEx de IIC T6 / EEx de [ib] IIC T6 / IP 65
LB 5441-1	40/35	IP 65
LB 5442-1	50/50	IP 65
LB 5480-1	44/5	IP 65

Temperature range	operating temperature : - 30 ... +50 °C (243 ... 323 K) Water cooling for higher temperatures is available. Monitoring of detector temperature and alarm in case of exceeding the max. temperature. storage temperature : - 30 ... +70°C (243 ... 343 K)
Connection cable	LiYCY

cross-section in mm²	max. cable length in m
1	750
1.5	1000
2.5	1800

Source and shielding see separate brochure.

Design modifications may occur without notice.

We have subsidiaries and representatives worldwide. For further details please contact our headquarters in Germany.

BERTHOLD TECHNOLOGIES

CERTIFIED DIN EN ISO 9001 QUALITY SYSTEM REG. NO 10 051-03

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