

Contactless Measurements

In Line Density Measurement



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BERTHOLD
TECHNOLOGIES

The In Line Density Meter

The Compelling Advantages

- Noncontact, continuous measurement without contact with medium being measured.
- Minimum radiation exposure (dose rate $\leq 1 \mu\text{ Sv/h}$ (0.1 mrem/h) at 10 cm (4") distance from surface).
- ^{241}Am radiation source in ultrasafe capsule with long half-life (433 years).
- Complete stainless steel construction of measuring section.
- Simple installation in existing pipelines.
- High statistical accuracy and longterm stability by use of highly sensitive scintillation counter with patented drift compensation.
- Application in food industry.
- Calibration and measurement output directly in measured variables (g/cm^3 , %, $^{\circ}\text{Bx}$, $^{\circ}\text{Be}$, g/l).
- Very simple calibration by microprocessor controlled amplifier.

Some Examples for Application

Sugar industry

For measurement of thin and thick juice and milk of lime.

Milk Industry

Concentration measurements on whole milk, skim milk, and whey for control of evaporators.

Beverage Industry

For monitoring mixing of concentrate and water.

Power Plants

Concentration measurements of lime and limestone gas desulfurizing systems (scrubbers) in flue.

Starch Production

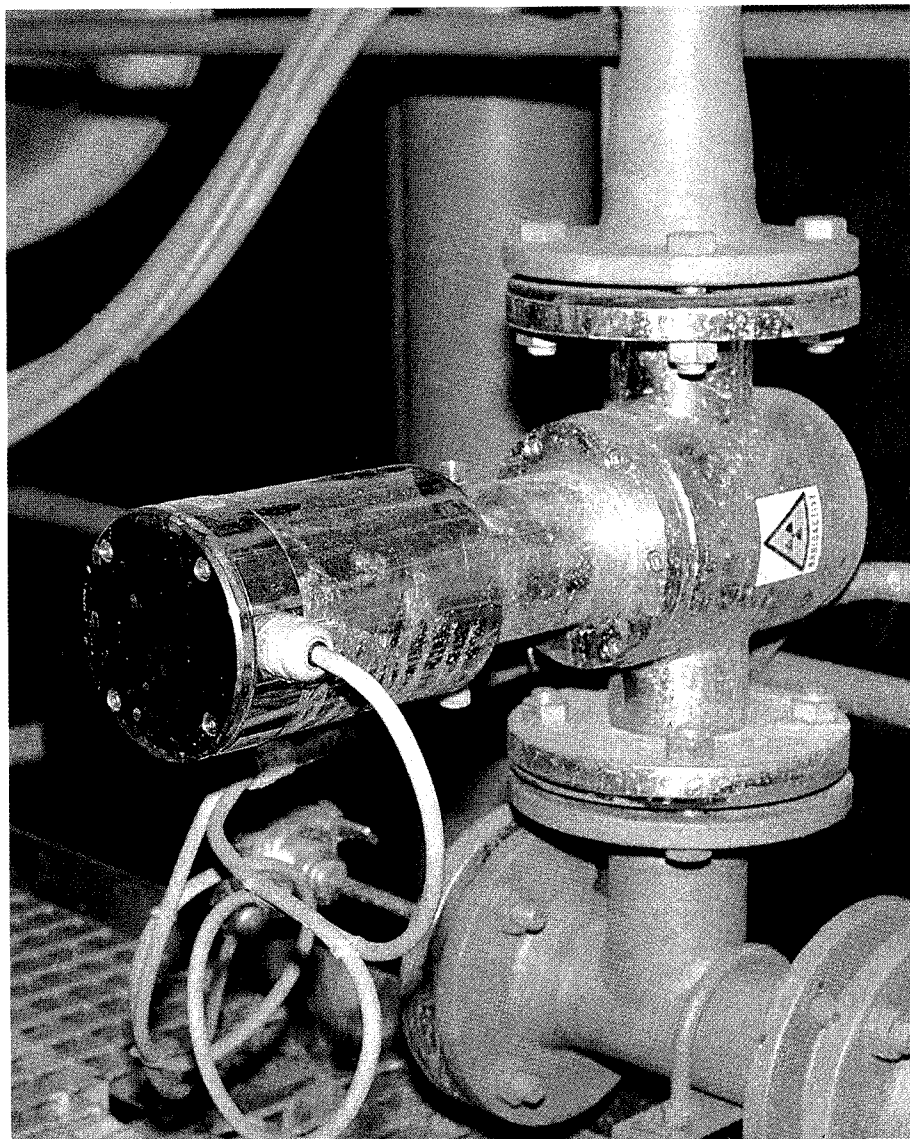
Measurement of starch suspensions.

Chemical Industry

Measurement of acids, alkalis, suspensions, concentration of anti-freezing compounds, bulk density determination in washing powder.

Textile Industry

Measurement of foaming of dyeing liquor.



Density measurement in a flue gas desulfurizing facility.

Photo by permission of Neckarwerke and KRC Co.

With the LB 379 Measuring Section

The Principle of Measurement

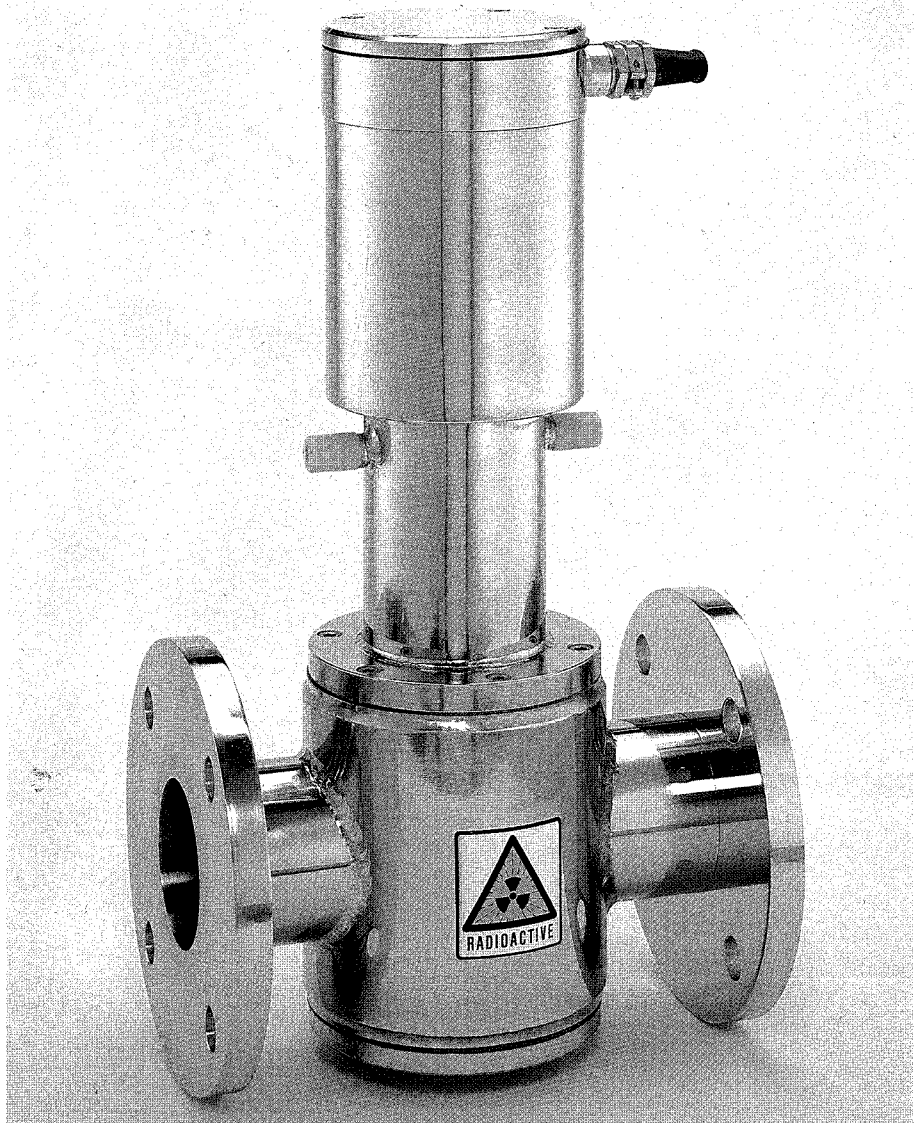
The density measurement is based on the absorption method. The radiation emitted by an ^{241}Am radiation source is attenuated by the product being measured. A detector measures residual incoming radiation and delivers an output signal dependent on radiation intensity. The microprocessor unit transforms the detector signal into a current signal. The ^{241}Am radiation offers several advantages when used in chemical production:

- The radiation attenuation depends on the atomic number of the absorber. If the concentration of a material with high atomic number in a liquid, (e.g., HCl , H_2SO_4 , CaO , etc. in water) must be determined, very high measurement accuracies can be attained thereby.

Some examples:

$\text{H}_2\text{O}-\text{HCl}$	$\pm 0.022\%$ HCl
$\text{H}_2\text{O}-\text{H}_2\text{SO}_4$	$\pm 0.038\%$ H_2SO_4
$\text{H}_2\text{O}-\text{Ca}(\text{OH})_2$	$\pm 0.017\%$ $\text{Ca}(\text{OH})_2$
$\text{H}_2\text{O}-\text{TiO}_2$	$\pm 0.014\%$ TiO_2
$\text{NaH}_2\text{O}-\text{NaOH}$	$\pm 0.033\%$ NaOH
Low-fat milk	$\pm 0.075\%$ TS
Starch suspension	$\pm 0.085\%$ TS
Sugar solution	$\pm 0.095\%$ TS

- Chemical reactions in which materials with high atomic number are deposited can be monitored. This is possible even when no density change, or only a minimal change occurs.



Radiation Protection

The measuring system has been tested by the Physikalisch-Technische Bundesanstalt (PTB), German Federal Standards Laboratory, and by the Austrian Study Commission for Atomic Energy as well as by the US Nuclear Regulatory Commission. The USNRC has registered the gauge for General Licence distribution. A design approval was granted in the above named countries meaning that the operating company does not require the usual handling licence. The radiation level 10 cm (4") from the surface is only $1\ \mu\text{Sv/h}$ (0.1 mrem/h). Therefore, the in line density meter can be installed in the vicinity of the work place.

The Transducer

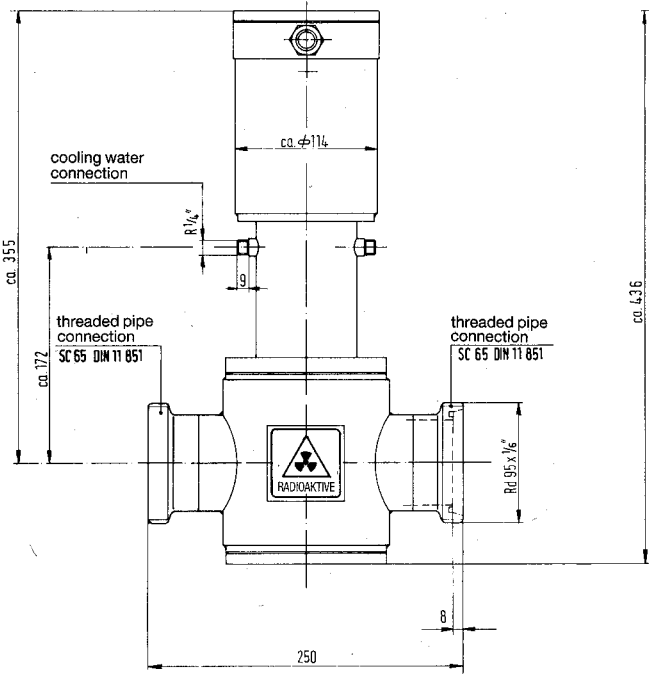
The internal pipe section is completely smooth on the inside and is resistant to corrosion and abrasion from most products. On request, a rubber or teflon lining can be installed. Also, with the contactless measurement, no failures occur from fowling of electrodes, prisms, or other sensors. The measuring unit can therefore be installed for products with high viscosity and high solids content.

For food industry applications the measuring unit can be „integrated“ in the normal cleaning cycle without any problem. Due to the stainless steel construction of the measuring section and its compact design, it can easily be integrated into existing facilities.

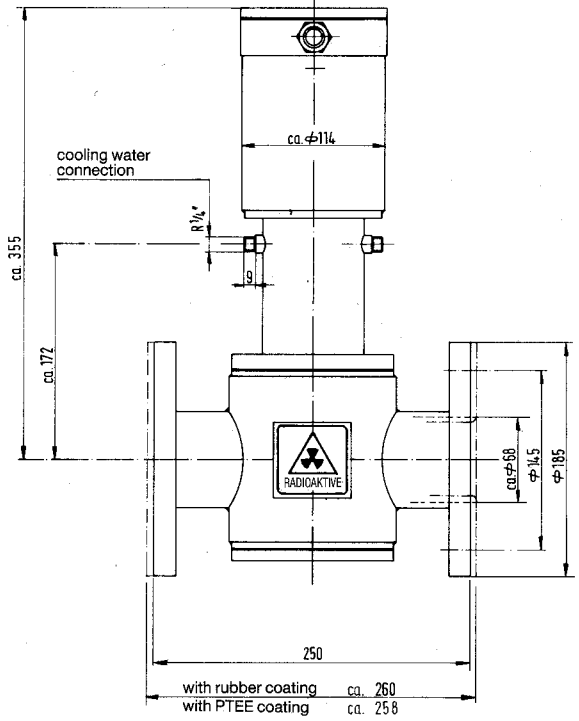
The electronics of the detector are equipped with drift compensation. This provides high long-term stability assuring that the measuring unit will deliver reliable measuring results even under adverse installation conditions.

The measuring signal is transmitted digitally. This transmission method is protected against interference and permits signal transmission over long distances. Thus, the evaluation unit can be installed without any problem in a remote location.

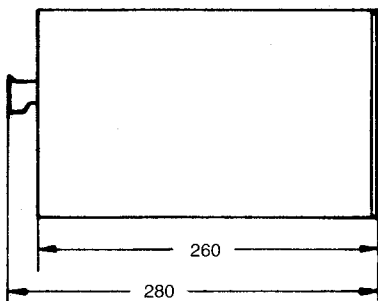
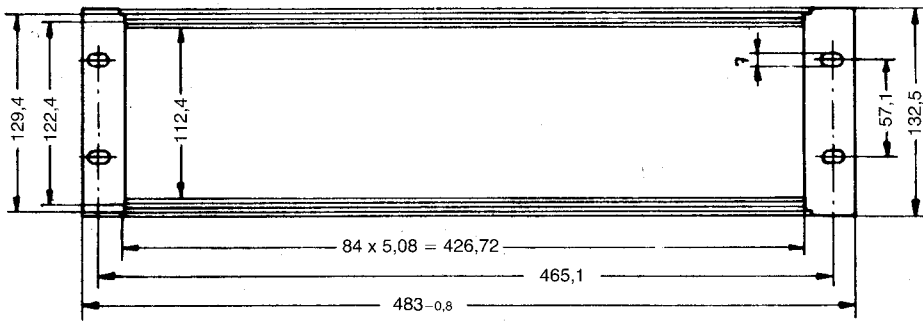
Scale Drawings



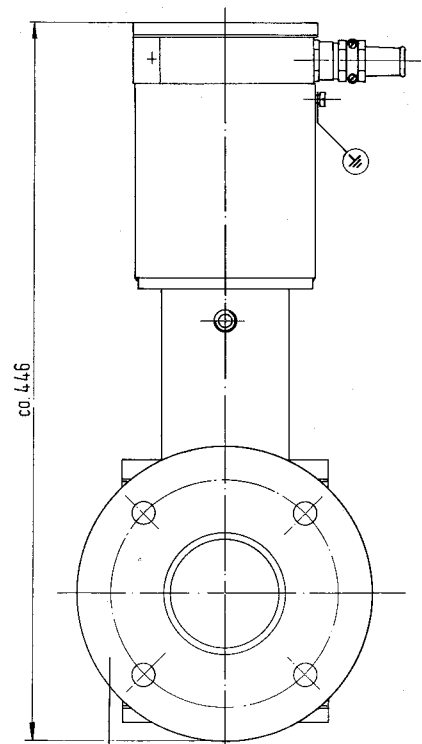
Density measuring system with threaded pipe connection („milk pipe screw connection“)



Flanged density measuring system



19" frame



	B65/76,1	DIN 2576
Flange		ND 10
or	2 1/2"	150/lbs Sq inch.

LB 386-1 C

An Evaluation Unit with Many Advantages

Versatile

- Storage for 3 different products:
 - calibration data
 - temperature compensation
 - range of current outputs
- Selection of data sets via keyboard or external switch
- Two isolated current outputs per channel 0/4 - 20 mA
Output 1 for density or concentration
Output 2 either for density/concentration or product temperature
The ranges for both current outputs are freely selectable
- Input for temperature signal:
Pt 100 or 0/4 - 20 mA
- Test function for detector signal and current outputs
- Calibration possible with only one measuring point
For highly accurate measurements one may use up to 10 calibration points. Thus one gets an exact linearization of the output signal even with "difficult" products, such as NaOH or H₂SO₄

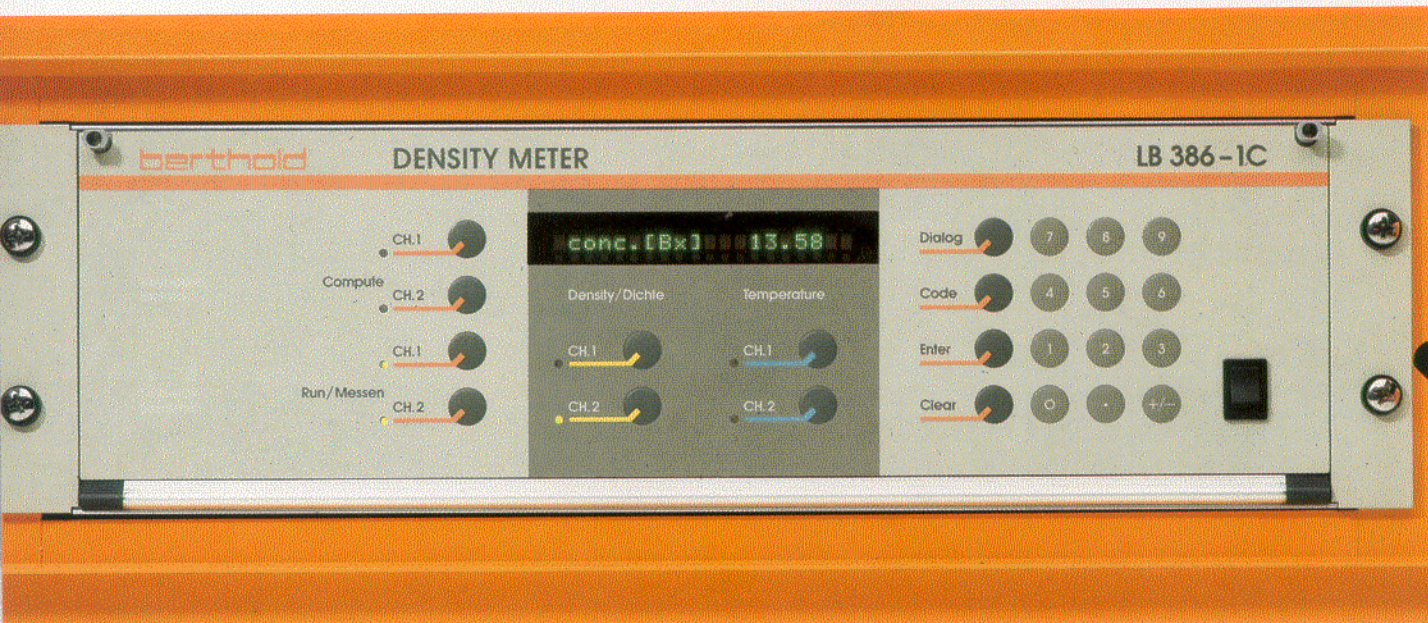
Reliable

- Storage of all calibration data in EE-Prom

- Detector failure alarm
- Check of the evaluation unit by means of a "watch-dog"
- Alarm via relay output
- Interference due to external sources of radiation can be suppressed, e.g. during non-destructive testing
- The measurement can be stopped via external contact at which point the last measured value will be held, e.g. during empty pipe condition.
- Operating via foil-keypad. To protect the system against unauthorized data manipulation, the keyboard can be locked by entering a password.

Data Outputs

- Printout via printer interface (RS 232 or line current) for
 - a) calibration data
 - b) product temperature
 - c) average value of density or concentrationThe measured value averaged over the interval time (freely selectable between 1 - 1440 min.) is printed out.
- RS 232 interface for data transfer to a master computer



In Line Density Measurement Facility

Technical Data

LB 379 Measuring System

Approval No.: BW/19/78 (applies to Germany and Austria only)
US licence No: NR-D-101-B

Detector Sz6-G5 44/5:	Scintillation counter with NaI (TI) crystal 44/5. With drift compensation circuit.
Explosion protection:	EEx de II cT6, PTB No. 81/1049
Temperature range:	- 20 °C to + 50 °C (-4 to + 122 °F) (253 to 323 K). Standard water cooling for higher temperatures
Source:	Radioactive nuclide: ²⁴¹ Am Activity: 1110 to 3700 MBq (30 to 100 mCi) In ultrasafe (special form) design
Measuring tube:	ND 65, NP 10 (2½" 150 lb./sq. in), stainless steel 1.4571 or 1.4401 (316), material 1.4301 (304) for pipes with linings

Connections:	Flanges according to the following specifications are available: DIN 2576, or ANSI B 16.5, 150 lb./sq. in, or threaded connection pipe SC 65 in accordance with DIN 11851. Measuring path with rubber or PTFE coating available on request (only with flanged design).
Product temperature:	Measuring tube without lining: -190 °C to +260 °C (-310° to 500° F; 80 to 560 K); measuring tube with rubber coating: -30 to +80 °C (-22 to 176° F; 243 to 353 K); measuring tube with PTFE coating: -190 °C to +260 °C (-310 to 500° F; 80 to 560 K)
Housing:	Stainless steel 1.4301 (304)
Protection class:	IP 65 (NEMA 4)
Weight:	Approx. 18 kg (40 lb.)
Connecting cable:	7-core, shielded, 7 x 1.5 mm ² , max. cable length between detector and evaluation unit 500 m (1,500')

Evaluation Unit LB 386-1 C

Assembly:	19" Rack, 3 HE, 84 BE, protection type IP 20, weight approx. 6 kg
Power supply:	250/220/125/110/24 V, + 10-15%, 47-64 Hz 24 V = (18-36 V)
Power consumption:	at 250/220/125/110/24 V ~: 55 VA at 24 V =: 30 W
Temperature range:	0-50 °C (273 to 323 K) no condensation
Storage of all parameters:	for up to 3 different products
Inputs:	
Analog inputs:	Temperature compensation with Pt 100 in 4-wire network Measuring range: -200 to 400 °C (73 to 673 K), Inputs for temperature signal 0/4-20 mA, Temperature range freely selectable between -99 and +999° C (174 to 1277 K)
Digital inputs:	a) Input for external start/stop of measurement b) Input for external range switching of the current output or c) External selection of the product parameters.

Outputs:	
Analog outputs:	0/4-20 mA isolated max. 500 Ω per channel: a) 1 x density or concentration b) 1 x temperature signal or 2nd range for density or concentration
Threshold outputs:	2 open collector outputs per channel for max. and min. values, 24 V/0.1 A
Collective failure message:	Open collector 24 V/0.2 A
Option:	
Relay outputs for all open collector outputs:	Switching capacity: 30 V, 80 W with resistive load, 250 V, 2000 VA Type: single changer
Printer Interface:	RS 232, 75 to 9600 Bd and line current 75 to 9600 Bd
Computer interface:	RS 232, 9600 Bd
Display:	20 characters, alphanumeric display in g/cm ³ , g/l, %, °Be, °Bx (selected by DIP-switches) Data input via keyboard with dialog, German, English or French (selectable); data manipulation possible only after password entry
Time constant:	5-9999 s with automatic reduction to 1/10 of this value in case of sudden density changes
Automatic decay compensation:	for ¹³⁷ Cs, ⁶⁰ Co, ²⁴¹ Am and ²⁴⁴ Cm, selectable for each channel
Weight	approx. 6 kg

Design modification may occur without notice.

Shieldings see special brochure.

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

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