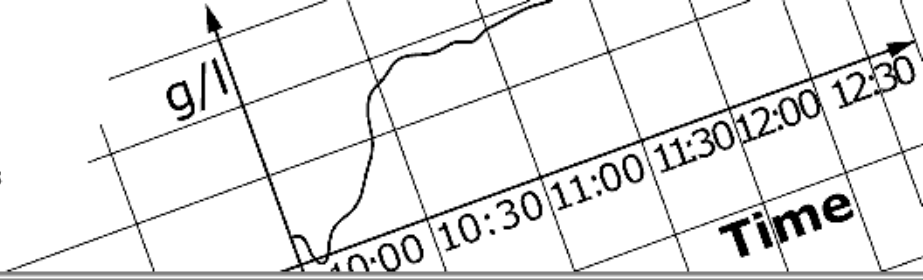
BERTHOLD TECHNOLOGIES

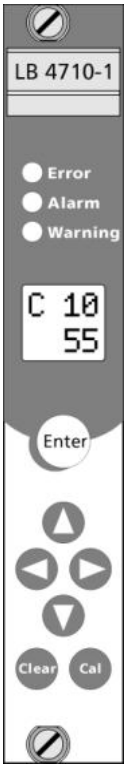


Process Control

detect and identify

Limit Switch
Mini-Switch LB 471

Hardware Manual



User's Guide

ID No. 39505 BA2

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Soft. Version: 1.12 or higher

Chapter 1. General Information

1.1 Use and Function

The limit switch system LB 471 Mini Switch has been designed for monitoring and detection of levels in containers and pipelines.
Licensed as an "overflow protection device for containers storing liquids that are hazardous to waters" in accordance with the Water Resources Act, the system may also be used as overflow protection device.
Beyond this scope, each application is considered as not being in compliance with the law and may result in severe personal injury or property damage.
BERTHOLD TECHNOLOGIES does not assume any liability for this kind of injuries or damage.

1.2 Target Group

This user's guide has been written for operating, assembly and service personnel.

Qualification

The system may only be assembled, serviced and maintained by authorized and trained persons. Any modification of the settings may only be carried out by persons who are familiar with the function of the system. Persons working with ionizing radiation must be familiar with the rules of radiation protection and adequate work techniques.

Training

Personnel have to be specially trained and informed about possible hazards. Detailed knowledge of this user's guide and careful observation of the instructions contained therein is an essential prerequisite.
Each staff member has to know the major rule of the "ALARA principle" (as low as reasonably achievable).
BERTHOLD TECHNOLOGIES is offering appropriate training courses.
Depending on the participant's professional qualifications, two kinds of training can be chosen:

1.3 Radiation Protection Courses

- Special course in radiation protection

  (Duration: 2 days)
  This course is needed if the participant has not yet received any radiation protection training. A successfully completed course has a validity of 5 years.

- Refreshing course in radiation protection

  (Duration: 1 day)
  All persons who have already successfully completed the special course may refresh their special knowledge with this course (Radiation Protection Ordinance of August 1, 2001).
  A successfully refreshing course has a validity of 5 years.

1.4 Definitions

Automatic — Some parameters can either be set to the automatic or manual mode. In the automatic mode the value is calculated using a formula. Enter -1 to enable the automatic mode. The inverted C in the top row indicates whether a parameter has been set to automatic.

EVU — **Ev**aluation **U**nit

Edit — Change value

Edit mode — In this mode, a value can be changed. Not every parameter can be changed since some parameters are only used as display values. Editable Parameters can be set to the edit mode with the "Enter" button. In the edit mode the cursor positioned over a digit is flashing.

GM detector — Detector with **G**eiger-**M**üller counter tube

NaI detector — NaI = sodium iodine crystal = scintillator
Scintillation detectors are very sensitive to Gamma radiation.
See pages 40 and 121.

Super-Sens detector — Detector which is highly sensitive to Gamma radiation with large-volume plastic scintillator 150x150mm
See pages 43 and 125.

Limit value — Count rate or percentage value upon reaching the measurement level

HV	Detector high voltage
Cassette	Case (7 TE) into which the evaluation unit LB 4710 is installed, so it can be used in any 19" rack
Empty	Level below limit value.
Empty count rate	Count rate with empty container
Manual	Some parameters can either be set to the automatic or manual mode. For the manual mode you have to enter a fixed value in the respective parameters.
Nuclide / Isotope	Type of radiation source: Cobalt-60 (Co-60) or Cesium-137 (Cs-137) for level measurements.
Zero count rate	Count rate caused by natural environmental radiation.
Parameters	A value stored under a certain code.
Timeout	Time after which an automatic reset is performed.
Full	Level below limit value.
Full count rate	Count rate with full container.
Count rate	Value of counts relative to one second.
cps	Count rate unit: **C**ounts **p**er **s**econd.
Read in count rate	A process that is started by the user in order to determine the average value of the count rate at the respective level. This count rate is needed to calibrate the measurement. The count rate is averaged over a certain time (standard 60 s) to exclude statistical and process-immanent fluctuations.
Factory setting	All parameters have been preset by the manufacturer using standard values. In most cases this simplifies calibration of the instrument significantly. Despite factory setting, calibration **always** has to be performed.
mSv	Dose rate unit Millisievert

MBq Mega-Becquerel
This unit indicates the source activity. Each Bq corresponds to one decay per second..
1 MBq = one million decays

mCi Milli-Curie
This unit is also used for the activity of a source. However, this unit has been replaced by the unit MBq (1mCi = 37 MBq)

1.5 Safekeeping of the User's Guide

Note!

This user's guide always has to be available at a fixed place. The personnel have to be informed about this place. Any time the device is used by another operator and whenever there is a change in ownership of the device, the user's guide has to be given to the new operator or owner.

Chapter 2. Safety

2.1 Safety Concept

The state-of-the-art system is designed in accordance with accepted safety rules to ensure the greatest possible on-the-job safety. To rule out health hazards when handling radioactive substances, limit values stating the highest acceptable radiation exposure of the operating personnel have been defined on an international level. These limits have to be observed when designing shieldings and planning the configuration of the measuring system at the measurement point.

2.2 Symbols and Pictograms

The following symbols identify safety instructions in this user's guide:

Danger!

Possible danger for life and health hazard

Caution!

Possible hazard
Minor personal injuries

Warning!

Possible hazard
Property damages

Note!

Tips for application and useful information

The safety instructions are supplemented by explanatory pictograms, for example:

2.3 Radiological Safety Officer

To ensure proper handling and the observance of the statutory requirements the operating company has to appoint a radiological safety officer who is in charge of all radiation protection issues in connection with the measuring system.
The radiological safety officer has to:

- monitor working with the radiometric measuring system
- draw up a plan for the organization of radiation protection
- monitor compliance with the regulations of the Radiation Protection Ordinance
- issue directives and carry out training and instruction of the employees
- get on-site information on the situation and takes appropriate actions immediately if operation problems have occurred
- cooperates with the work's council or the personnel office and qualified personnel for on-the-job safety, advises and informs them on important radiation protection issues.

2.4 Duty of Notification

Caution!

Radioactivity!
In case of suspected damage to the shielding, the radiological safety officer has to be informed immediately. Further steps can be taken in consultation with BERTHOLD TECHNOLOGIES.

2.5 Radiation Protection Areas

Radiation protection areas define the boundaries around a radiation source. The maximum dose rate defines the limit. We distinguish three radiation protection areas:

2.5.1 Exclusion Areas

Exclusion areas are areas in which the local dose rate may be exceed 3 Millisievert (mSv) per hour. These areas have to be protected such that nobody has unchecked access to these areas – not even with single body parts. Actually, these areas can occur only in the active beam in the direct vicinity of the shielding.

Caution!

Radioactivity!
The radiation protection directives have to be observed.
Exclusion areas have to be protected such that nobody has unchecked access to these areas – not even with single body parts. This has to be ensured through constructive measures, for example by protective covers.

2.5.2 Controlled Areas

Controlled areas are areas in which persons in one calendar year may receive an effective dose of more than 6 mSv if they stay in this area 40 hours a week and 50 weeks per calendar year. Based on this, the calculated maximum dose rate is 3 µSv/h. These areas should be planned such that accessibility is virtually not possible or that the required safety fences can be installed easily. **If controlled areas are accessible they have to be secured**. Moreover, they have to be identified clearly and permanently by a radiation danger sign and the comment "Controlled Area". Persons may access controlled areas only to carry out maintenance work for the operations going on inside this area (§ 37). Body doses have to be calculated or personal doses have to be measured. The authorities may permit exceptions from the demarcation and identification duty, provided individuals or the general population are not endangered. **Higher limit values are admissible if reliable information is provided that the person affected stays within the controlled area for a shorter period of time.**

Caution!

Radioactivity!
The radiation protection directives have to be observed.
Controlled areas outside the shielding have to be identified and secured if they are accessible.

2.5.3 Monitoring Areas

Monitoring areas are operation areas which do not belong to the controlled area. In these areas, a person may receive an effective dose of more than 1 mSv in one calendar year.

The monitoring area starts at the controlled area. It is an area in which persons staying permanently in this area may be exposed to a radiation level of more than 1 mSv in one calendar year. For a stay of 40 hours per week and 50 weeks per year the area is between the dose rate limit values of 3 µSv/h and 0.5 µSv/h. It has to be ensured that persons are not exposed to a dose exceeding 1 mSv per year, taking into account the actual time they stay in this area. This means that no permanent work place may be set up in this area.

2.6 Safety Installations

2.6.1 Source Shieldings

Caution!

Radioactivity!
The shielding with the source installed may be taken into operation by specially licensed persons who have been trained on handling radioactive materials only after consultation and coordination with the radiological safety officer.
The radiation exit channel must only be opened by authorized persons after consultation with the radiological safety officer.
Modification of or tampering with the shielding construction are prohibited.

Source

Co-60 or Cs-137 point sources ❹ are used for the system. They are tightly welded into a sturdy stainless steel capsule, so that the radioactive substance cannot escape and contamination is prevented. The capsule with the source ❹ is fixed on a holder ❺ and installed into the shielding.

Shielding

The shielding consists of a lead cylinder with radiation exit channel ❸, surrounded by a steel jacket. The locking core ❷ is fixed to a lever ❻. The padlock ❼ secures the open / closed position and protects the source against unauthorized removal.

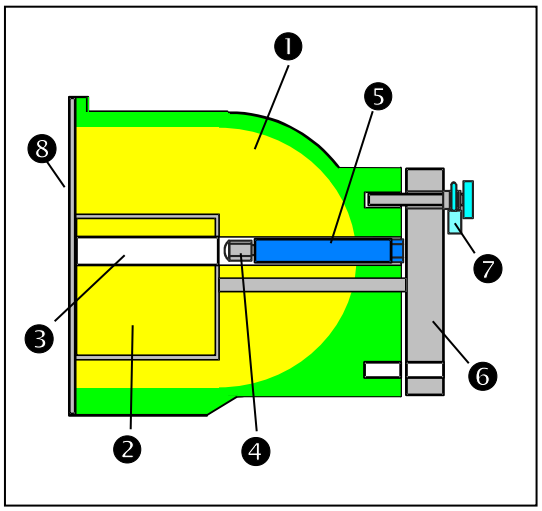


Figure 1: Point source shielding radiation channel open Sectional drawing

❶ Shielding
❷ Locking core
❸ Radiation channel
❹ Point sources
❺ Source holder
❻ Lever
❼ Padlock
❽ Cover plate front

When turning the lever ❻, the locking core is rotated as well and the radiation exit channel is opened towards the detector. The arrow on the lever ❽ is pointing towards "OPEN".

Figure 2: Shielding - view of lock

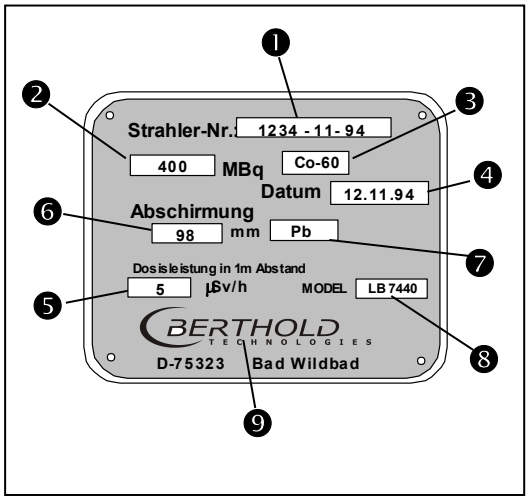
❻ Lever with arrow
❼ Padlock
❾ Cover plate rear

The radiation exit channel has to be closed during transport, assembly and while carrying out work on the container.
The arrow on the lever is then pointing to "CLOSED".
The lever or the locking core is secured by a padlock ❼ in the "OPEN" and in the "CLOSED" position.
Shielding, radiation type, isotope and activity have to be selected for each measuring configuration such that the internationally permissible dose rate limits will not be exceeded.

Type label

The source and shielding version is documented in the supplied technical source documentation and on the type label on the shielding.

Figure 3: Type label on shielding



❶ Source number
❷ Activity
❸ Isotope
❹ Source manufacturing date
❺ Dose rate in 1m distance
❻ Effective shielding thickness
❼ Shielding material
❽ Type of shielding
❾ Shielding manufacturer