

## LQtest 2.8 Special Device for detection of explosive and flammable liquids inside sealed vessels

### *Portable security device PPB 2.8*

Developed and constructed specially for security services and other law-enforcement authorities.

LQtest™ is a handheld device for contactless detection of flammable and explosive liquids inside sealed vessels (bottle screening).



### **Purpose of LQtest 2.8 special**

The device can be used by safety and security services and other law enforcement authorities in crowded places, on transport, in enhanced security installations. The device allows the user, without having to open a container, to distinguish substances such as gasoline, incendiary mixtures, acetone, nitroglycerine, various



alcohols, ethers and other dangerous liquids from water, nonalcoholic and alcoholic drinks, dairy products, cosmetics, etc.

### Principle of LQtest 2.8 special

LQtest 2.8 special uses quasistatic electrical tomography to estimate the spatial distribution of the electric properties of a medium and determine the characteristics of liquid. Electrical properties of the liquid (permittivity and conductivity) allow to unambiguously define its flammability.

In addition to this method, special software has been developed. This software uses a linear artificial neural network to identify the liquids according to the test results. Since the imaginary part of complex permittivity is in proportional linearity with conductivity, the device defines as safe every liquid with high values of permittivity and/or conductivity, which is characteristic for beverages and other domestically used liquids.

One more neural network descriptor implemented in this device is used to define the presence of testable object in front of the device's sensor.

The latest version of software allows testing more than 800 different liquids, the parameters of which are used as a database to compare with the measured values.



### Key features of LQtest 2.8 special

- Time required to make one inspection — 0.5 s
- Minimum amount of liquid — 50 ml
- Container wall thickness — up to 0.8 cm
- Allowed wall materials — any non-metallic (glass, plastic, paper, ceramics, etc.)
- Indication — Light and sound
- Weight — 170 g
- Dimensions — 207x70x30 mm
- Power supply — 2 AA-type batteries
- Library of tested liquids — more than 800 liquids
- Average battery life — 100 hrs

## How to use LQtest 2.8 Special

Press the device sensor to the vessel wall. The level of liquid in the vessel must cover the sensor from top to bottom (figure 1a). Under improper placement of the device (figure 1b) the test results will be incorrect, even if there is no interrupted glowing of yellow indicator.

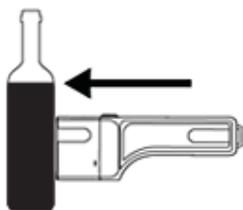


Figure 1a

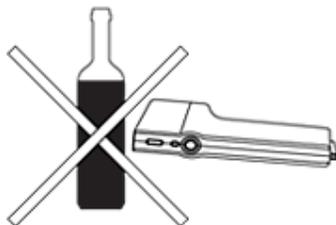


Figure 1b



Figure 1c

In case of incorrect device placement against the vessel wall or excessive irregularity of the vessel wall you will observe interrupted glowing of yellow indicator (figure 1b).

Try to avoid surfaces of the vessels covered with any labels, some of which may have metal foil layer (conductive layer) and thus prevent from correct detection. Also upon inspecting cardboard containers keep in mind that some boxes have internal foil layers which render them inaccessible for testing.

In case liquid level is not high enough to cover the whole sensor, tilt the vessel to cover enough of the vessel wall with the liquid (figure 1c).

If a plastic bottle does not have a sufficiently flat and even surface area, slightly deform the bottle wall to achieve a tighter contact with the sensor.

## Technology implemented

The device uses the method of quasistatic electrical tomography. This method allows to estimate spatial distribution of electric properties of a medium and to determine characteristics of a liquid regardless of the container size. The electrical properties of the liquid (permittivity and conductivity) allow determining its flammability unambiguously, which is illustrated by the examples in the following table:

Liquid	Permittivity	Conductivity, S/m
Water, soft drinks	81	0.01 - 1
Ethanol	25	$10^{-5}$
Acetone	21	$10^{-5}$
Nitroglycerine	19	

Ether	4,3	
Petrol, diesel oil	2	$10^{-10}$
Methyl nitrate	24	
Nitromethane	39	

The device is totally electronic and does not contain sources of ionizing or microwave radiation and other potentially dangerous parts. The simplified diagram of the instrument is shown in the following figure. The sensor of the system is linear array of electrodes. One of the electrodes creates alternating electric field in the medium, and other electrodes measure this field perturbed by the object under investigation.

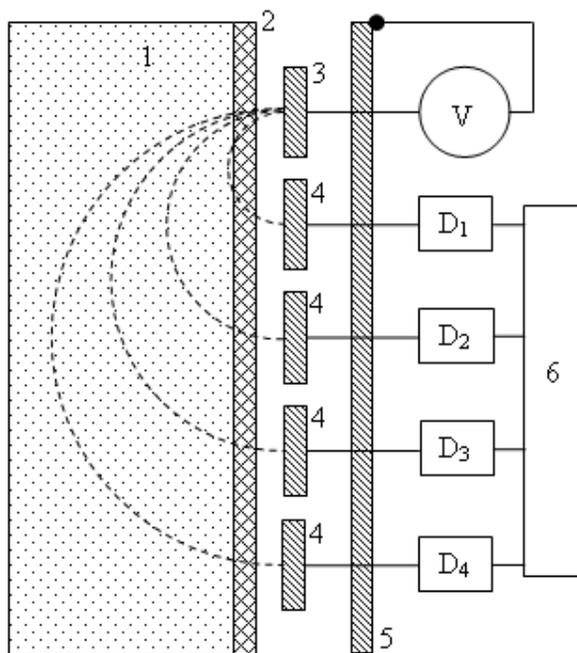


Figure 2

Simplified diagram of the measuring system:

- 1— liquid under investigation;
- 2 — vessel wall;
- 3 — active electrode connected to an alternating current source (V);
- 4 — sensing electrodes connected to the measuring electronics (D1-D4);
- 5 — earthed electrode (shield);
- 6 — free-space electric field lines connecting transmitter and receivers and defining corresponding sensitivity



zones;

7 — specialized computing unit and indicator.

Using of the multi-electrode electric field measurements allow to separately estimate electrical properties of the vessel wall and the liquid by solving a so-called inverse problem for electric field. This provides very high detecting capability of the device: practically total absence of misses of dangerous objects and false alarms. An independent laboratory has tested 15 random-chosen LQtest devices on 70 different liquids and revealed a total number of incorrect results – 2%

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