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BSI Standards Publication

Leak detection systems

Part 1: General Principles

bsi.

National foreword

This British Standard is the UK implementation of EN 13160-1:2016. It supersedes BS EN 13160-1:2003 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PVE/393/2, Leak detection devices.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Leak detection systems - Part 1: General Principles

Systèmes de détection de fuites - Partie 1: Principes généraux

Leckanzeigesysteme - Teil 1: Allgemeine Grundsätze

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Contents

European foreword

This document (EN 13160-1:2016) has been prepared by Technical Committee CEN/TC 393 “Equipment for storage tanks and for service stations”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2017, and conflicting national standards shall be withdrawn at the latest by January 2017.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 13160-1:2003.

According to edition 2003 the following fundamental changes are given:

— new definitions for the Class IV C added;

— requirements concerning electromagnetic compatibility added;

— requirements for the different classes shifted to the part of the appropriate class.

This European Standard *Leak detection systems* consists of 7 parts:

— *Part 1: General principles*

— *Part 2: Requirements and test/assessment methods for pressure and vacuum kits*

— *Part 3: Requirements and test/assessment methods for liquid systems for tanks*

— *Part 4: Requirements and test/assessment methods for sensor based leak detection systems*

— *Part 5: Requirements and test/assessment methods for in-tank gauge systems and pressurized pipework systems*

— *Part 6: Sensors in monitoring wells*

— *Part 7: Requirements and test/assessment methods for interstitial spaces, leak detection linings and leak detection jackets*

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

1 Scope

This European Standard specifies the general principles for leak detection systems for use with double-skin, single-skin, underground or above ground tanks and pipework designed for water polluting fluids.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 60079-0, *Explosive atmospheres — Part 0: Equipment — General requirements (IEC 60079-0)*

EN 60079-26, *Explosive atmospheres — Part 26: Equipment with equipment protection level (EPL) Ga (IEC 600079-26)*

EN 60950-1, *Information technology equipment — Safety — Part 1: General requirements (IEC 60950-1)*

EN 61000-6-1, *Electromagnetic compatibility (EMC) — Part 6-1: Generic standards — Immunity for residential, commercial and light-industrial environments (IEC 61000-6-1)*

EN 61000-6-2, *Electromagnetic compatibility (EMC) — Part 6-2: Generic standards — Immunity for industrial environments (IEC 61000-6-2)*

EN 61000-6-3, *Electromagnetic compatibility (EMC) — Part 6-3: Generic standards — Emission standard for residential, commercial and light-industrial environments (IEC 61000-6-3)*

EN 61000-6-4, *Electromagnetic compatibility (EMC) — Part 6-4: Generic standards — Emission standard for industrial environments (IEC 61000-6-4)*

EN 61010-1, *Safety requirements for electrical equipment for measurement, control and laboratory use — Part 1: General requirements (IEC 61010-1)*

EN 61340-4-1, *Electrostatics — Part 4-1: Standard test methods for specific applications — Electrical resistance of floor coverings and installed floors (IEC 61340-4-1)*

EN ISO 80079-36:2016, *Explosive atmospheres — Part 36: Non-electrical equipment for explosive atmospheres — Basic method and requirements (ISO 80079-36:2016)*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
atmospheric pressure conditions
pressures ranging from 0,08 MPa (0,8 bar) to 0,11 MPa (1,1 bar)

3.2
working pressure
maximum pressure which is generated by a pressure/vacuum generator in the interstitial space under normal operating conditions

3.3
operating pressure
fluid pressure occurring during specified operating conditions

3.4
leak detection system
includes all equipment required to indicate a leak

Note 1 to entry: Main components could include the interstitial space, leak protecting linings, leak protecting jacket, leak indicating device, leak detector, system pipework, leak detecting media, monitoring wells or sensors.

3.5
interstitial space
space between the walls of double-skin systems. It provides the passage for fluids which may enter the interstitial space

3.6
double-skin tank
tank constructed with an inner and outer wall with an interstitial space where the maximum filling level of the tank does not exceed the height of the interstitial space

3.7
single-skin tank
tank constructed with a single wall

3.8
leak detection lining
internal layer which solely or in conjunction with the tank wall produces a suitable interstitial space

3.9
leak detection jacket
external layer which solely or in conjunction with an intermediate material and the tank wall produces a suitable interstitial space

3.10
intermediate layer
material used to separate the inner and outer surfaces, it ensures the creation of an interstitial space

3.11
double-skin pipework
pipework constructed with an inner and outer wall with an interstitial space

3.12
single-skin pipework
pipework constructed with a single wall

3.13
vacuum leak detector
detects a leak using air as the leak detection medium, an alarm is triggered by a rise in pressure in the interstitial space in the event of a leak

3.14
pressure leak detector
detects a leak using air or inert gas as the leak detection medium; an alarm is triggered by a drop in pressure within the interstitial space in the event of a leak

3.15
leak detector using liquid
detects a leak using liquid as a leak detection medium; any leak in the interstitial space is indicated by a drop of the leak detection liquid level

3.16
liquid sensor
device which will detect liquid

3.17
vapour sensor
device which will detect gas and vapour

3.18
leak indicating device
indicates the operational and the alarm status of any connected sensors or leak detectors

3.19
tank gauge leak detection system
a tank gauge system measures the volume of liquid stored in a tank, a loss can be indicated where the volume of liquid drawn from the tanks is monitored independently from the gauge and reconciled with changes in the stored volume, a loss can also be indicated by analysis of the changes in "static" liquid volume during periods when no additions to, or depletions, from the tank are taking place

3.19.1
static leak detection
where a tank integrity test is carried out by the gauge whilst no additions to or depletions from the tank contents are being made

3.19.2
dynamic leak or loss detection
where the tank contents gauge forms part of an integrated detection system and is used to detect a leak or loss during normal operation where additions to or depletion from the tank contents may be made, a loss can be detected in tanks and pipeworks, connected with the tank, which may indicate a leak

3.19.3
statistical quiet period leak detection
where the gauge system collects data during intervals (which are shorter than required for static leak detection) between dispensing and delivery operations, the data are then analysed to determine if a loss has occurred, which may indicate a leak

3.19.4
tank integrity test
test which is capable of detecting a leakage rate in accordance with a given test procedure, the test takes into account the thermal expansion of the liquid being stored, evaporative losses and the effects of any other variables including groundwater level

3.20
monitoring wells
wells installed into the ground around a storage system, positioned to ensure that any liquid or vapour from a leakage from the system will reach one of them

Note 1 to entry: The monitoring well is used to ensure that the leakage can be detected visually or by sensors.

3.21
leakage containment
system, which is designed that leakage from a primary system can be detected and contained

3.22
frost protected area
area where the temperature will not go below 0 °C

3.23
liquid stop device
valve used to prevent the passage of liquid beyond a fixed point in a connecting line

4 Classes of leak detection systems

For the purpose of this standard the following classes apply in order of protection for the level of safety or environmental protection required:

Class I: Systems of this class will detect a leak above as well as below the liquid level in a double-skin system. They are inherently safe and will detect a leak before any liquid can enter the environment (i.e. pressure or vacuum systems).

Class II: Systems of this class will detect a leak above as well as below the liquid level in a double-skin system with the possibility of the leak detection liquid leaking into the environment (i.e. liquid monitoring system).

Class III: Systems of this class will detect a leak below the liquid level in a tank or in a pipework system. These systems are based on liquid and/or vapour sensors located in leakage containment or interstitial space. A possibility exists of product entering the environment.

Class IV: Systems of this class will detect, to specific levels of probability, specified rates of change of tank contents (i.e. leakages into or out of the tank). A strong possibility exists that product will enter the environment in the event of a leak.

Class IV A: Dynamic leak detection systems will by reconciliation also indicate leaks in the connected pipework.

Class IV B: Static tank gauge leak detection systems or statistical quiet period leak detection systems will only indicate leaks in a tank.

Class IV C: Pressure line leak detection system which will detect a leak in pressurized pipework, only when no product is being dispensed.

Class V: Systems of this class may detect liquid loss in tanks or pipework below the liquid level. Product will enter the environment before the leak is detected (i.e. sensors of class III in monitoring wells).

For examples for the different classes see Annex A.

5 Requirements

5.1 General

Leak detection systems shall trigger the alarm in the event of a leak or in the event of malfunctions of the leak detection system. All leak detection systems shall indicate every leak by a visual and audible alarm.

In the event of a power interruption, the leak detection system shall be designed to resume normal operation on the restoration of the power supply.

Leak detection systems shall be designed for operation under atmospheric conditions according to 3.1.

The components of a leak detection system shall be suitable to operate in the following temperature ranges:

— Type 1: — −20 °C to +60 °C;

— Type 2: — 0 °C to +40 °C;

— Type 3: — −40 °C to +40 °C.

Leak detection systems and/or their components intended for installation in a potentially explosive atmosphere shall be explosion protected. If there exists the possibility of an explosive atmosphere being present within the leak detection system and/or its components these shall be explosion protected.

The leak detection systems shall be designed for installation in such a way to prevent accidental disconnection of the equipment's power supply. Plug and socket connections or switches are only permitted if their interruption triggers off an alarm.

For a leak detection system using liquid the interstitial space shall be equipped with a test nozzle above the liquid level in the inner tank.

The leak detection system shall be capable of being tested or capable of simulating a leak condition. Disconnections of any sensor or transducer or a short circuit in connecting cables shall result in an alarm condition. All indications and sounders shall be capable of being tested.

The leak detection systems shall be designed so that correct operation can be verified.

The leak detection systems shall be used and maintained in accordance with the manufacturer's instruction.

If a leak detector serves more than one tank or pipework equipment is required which shows or allows to test in an event of an alarm which tank or pipework leaks.

5.2 Avoidance or reduction of ignition sources

All electrical and non-electrical equipment and components, intended for use in potentially explosive atmospheres, shall be designed and constructed according to good engineering practice and in conformity with the required categories for group II equipment to ensure avoidance of any ignition source. To classify the category of the equipment it shall be subjected to an ignition hazard assessment in accordance with 5.2 of EN ISO 80079-36:2016.

Device categories for explosion-proof parts of the leak detection systems see Annex B.

Where regulations require, the leak protecting lining used in a conductive tank shall be conductive with a surface resistance of less than 1×10^9 Ω in order to dissipate any electrostatic charges if the stored product has a flash point of < 55 °C.

This requirement shall be tested according to EN 61340-4-1.

Where the leak protecting lining has a greater surface resistance than 1×10^9 Ω an object shall be inserted in the stored product which is capable of dissipating the electrostatic charges loads, either

1) a steel plate with a surface of $(0{,}04 \times V_t)$ in m^2 in which V_t is the volume in m^3 of the tank or

2) steel filling, dipping and/or suction pipes which have a total surface as indicated above.

In both cases the object inserted in the stored product shall have provision for earthing with a resistance less than 1000 Ω.

5.3 Safety and electromagnetic requirements

All electrical equipment of the leak detection system or its parts not in relation with hazardous areas shall comply with EN 61010-1 or EN 60950-1.

All electrical equipment of the leak detection system or its parts in relation with hazardous areas shall be in compliance with an appropriate mode of protection according to the EN 60079-0 or EN 60079-26.

All non-electrical equipment of the leak detection system or its parts to be installed into hazardous locations shall be in compliance with an appropriate mode of protection according to EN ISO 80079-36.

Leak detection systems shall be in compliance with the EN 61000-6-1 and the EN 61000-6-3 or the EN 61000-6-2 and the EN 61000-6-4 in the field of the electromagnetic compatibility.

5.4 Leak indicating device

The operating condition shall be clearly indicated.

The visual alarm shall be clearly indicated.

It shall be impossible to switch off the visual alarm while the system is powered on and an alarm condition exists.

The audible alarm shall be suitable for continuous operation and shall be designed for muting.

All leak indicating devices shall be designed for connecting an additional alarm. The output parameter shall be stated.

All indicators shall be equipped with a device for testing the operating condition of the alarm.

5.5 Inspection of equipment

The user shall ensure before use of the equipment that

— the electrical equipment and the leak detection system shall be suitable for its application when installed in or connected with a hazardous area;

— the equipment shall be installed in accordance with the manufacturer's instructions;

— the installing staff shall be trained and qualified for mounting, starting up and functional testing of the leak detection systems;

— after setting up a functional test shall be carried out by the qualified person including a test protocol according to manufacturer’s regulations.

The user shall ensure that an annual function test is carried out by a qualified person according to manufacturer’s recommendations.

The interval of the function test can be extended if permanent online monitoring is used which shall fulfil the following requirements:

— Permanent and active monitoring of the power supply via daily data transmission, minimum the operating data (e.g. pressure / vacuum of the system).

— Where applicable the tightness of the system including a warning when the values are below the threshold.

— Identification of necessary maintenance e.g. of pumps, dry filters.

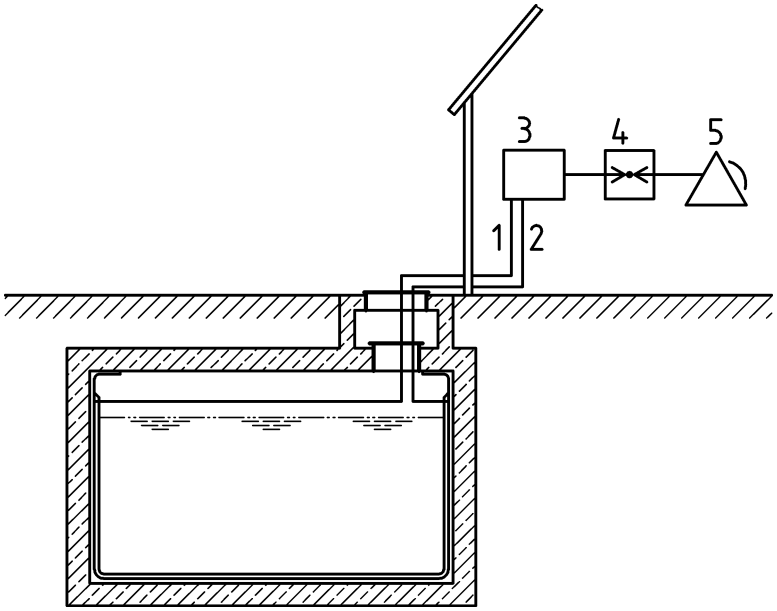
— Significant changes or manipulation within the system shall be identified and shall result in a warning.

— In case of an alarm immediate information (e.g. SMS, e-mail) shall be transmitted. Multiple sending is required as long as the problem is not fixed.

Annex A
(informative)

Examples of leak detection systems

A.1 Leak detection systems – class I



Key

1 Pressure line

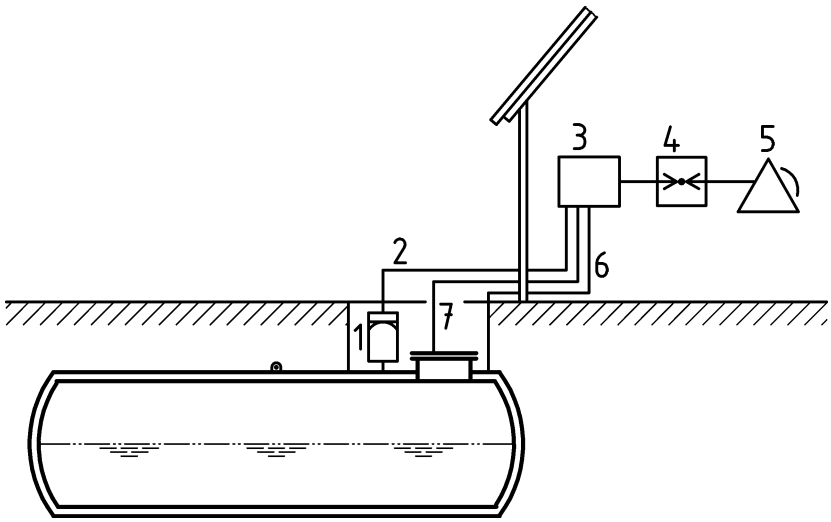
2 Measuring line

3 Leak detector

4 Measuring device for pressure

5 Alarm device (visual and audible)

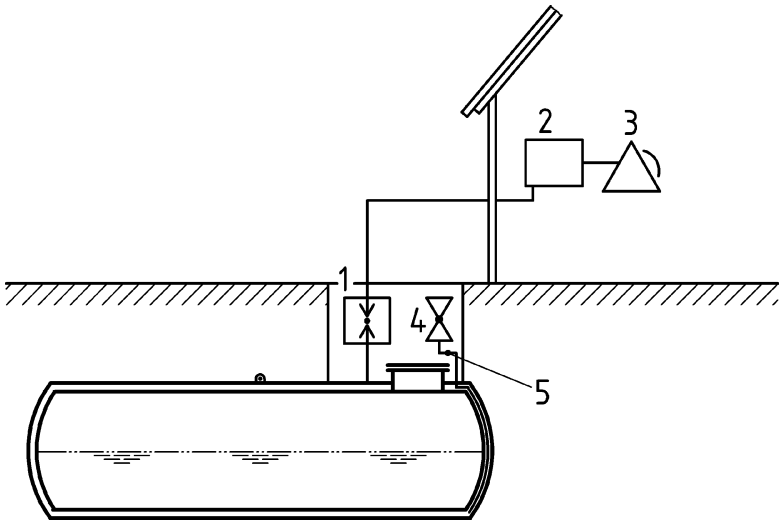
Figure A.1 — Leak detection system for pressure with integrated pressure generator for tanks with rigid leak protecting lining



Key

1 Liquid stop device
2 Suction line
3 Leak detector
4 Measuring device for pressure
5 Alarm device (visual and audible)
6 Measuring line
7 Exhausting line

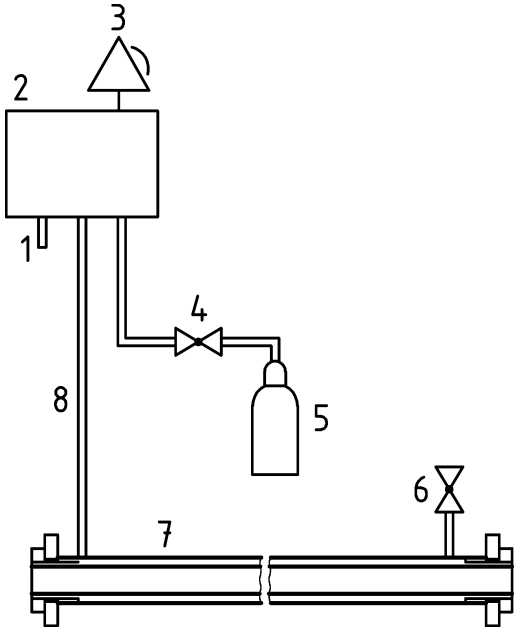
Figure A.2 — Leak detection system for vacuum with integrated vacuum generator for tanks



Key

1 Measuring device for pressure
2 Leak detector
3 Alarm device (visual and audible)
4 Test valve
5 Suction line down to the lowest point of the interstitial space

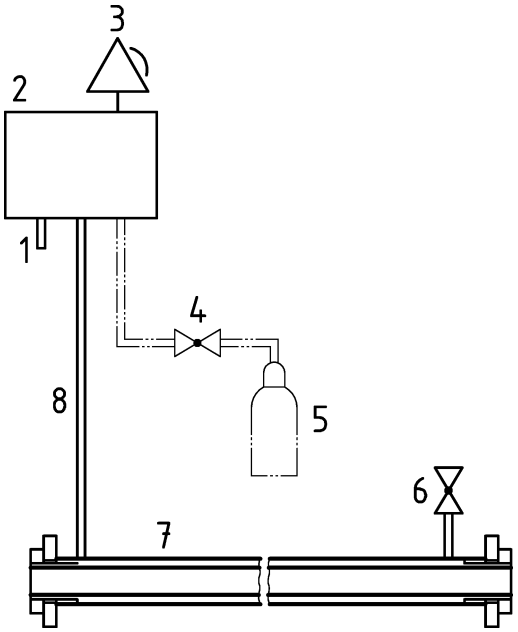
Figure A.3 — Leak detection system for vacuum without integrated vacuum generator for tanks



Key

1 Test coupling
2 Pressure leak detector
3 Alarm device (visual and audible)
4 Pressure reducer
5 Nitrogen bottle
6 Test valve
7 Double-skin pipework
8 Pressure/measuring line

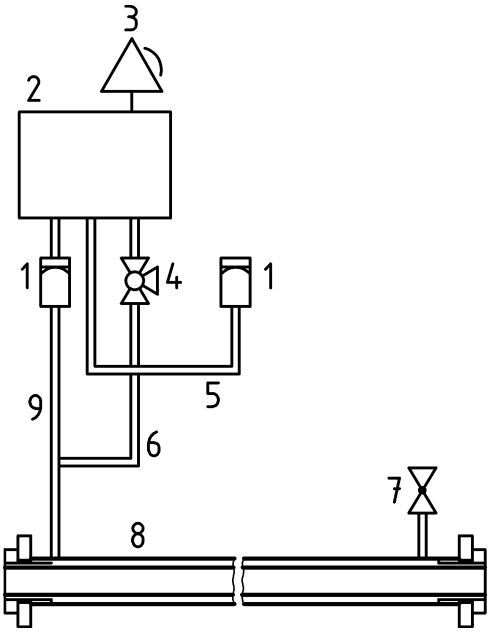
Figure A.4 — Leak detection system for pressure with integrated pressure generator for pipework



Key

1 Test coupling
2 Pressure leak detector
3 Alarm device (visual and audible)
4 Pressure reducer
5 Nitrogen bottle
(remove after first filling)
6 Test valve
7 Double-skin pipework
8 Pressure/measuring line

Figure A.5 — Leak detection system for pressure without integrated pressure generator for pipework

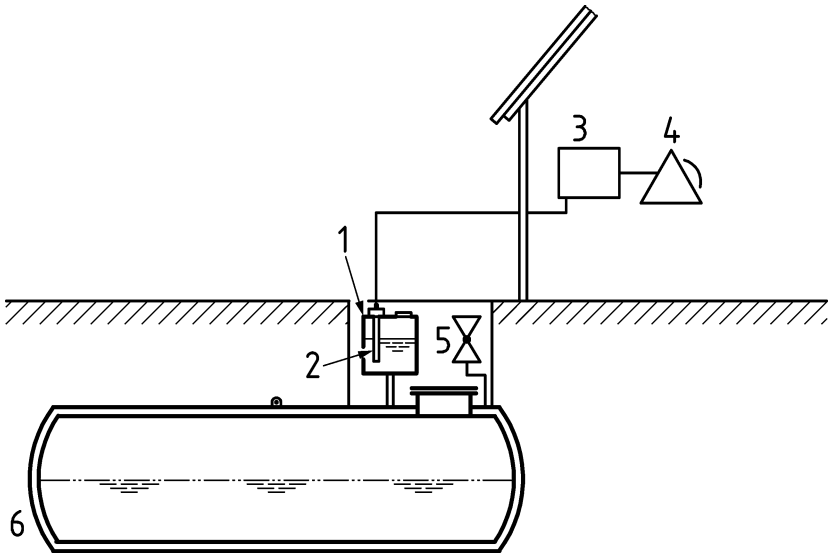


Key

1 Liquid stop device
2 Vacuum leak detector
3 Alarm device (visual and audible)
4 Three way valve
5 Exhausting line
6 Measuring line
7 Test valve
8 Double-skin pipework
9 Suction line

Figure A.6 — Leak detection system for vacuum with integrated vacuum generator for pipework

A.2 Leak detection systems – class II



Key

1 Leak detection liquid reservoir

2 Liquid sensor

3 Evaluation device

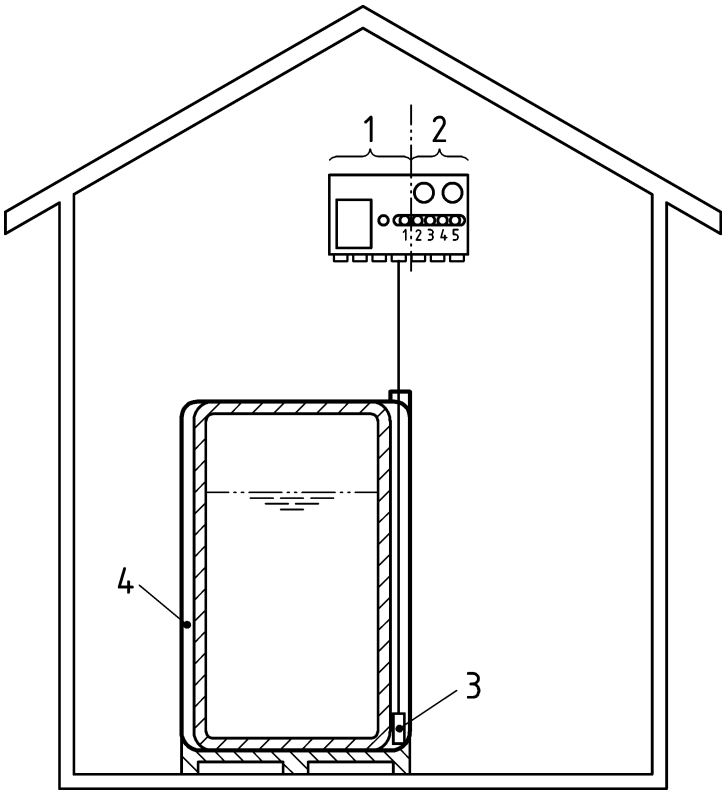
4 Alarm device (visual and audible)

5 Test valve

6 Interstitial space with leak detection liquid

Figure A.7 — Leak detection system using liquid for tanks

A.3 Leak detection systems – class III



Key

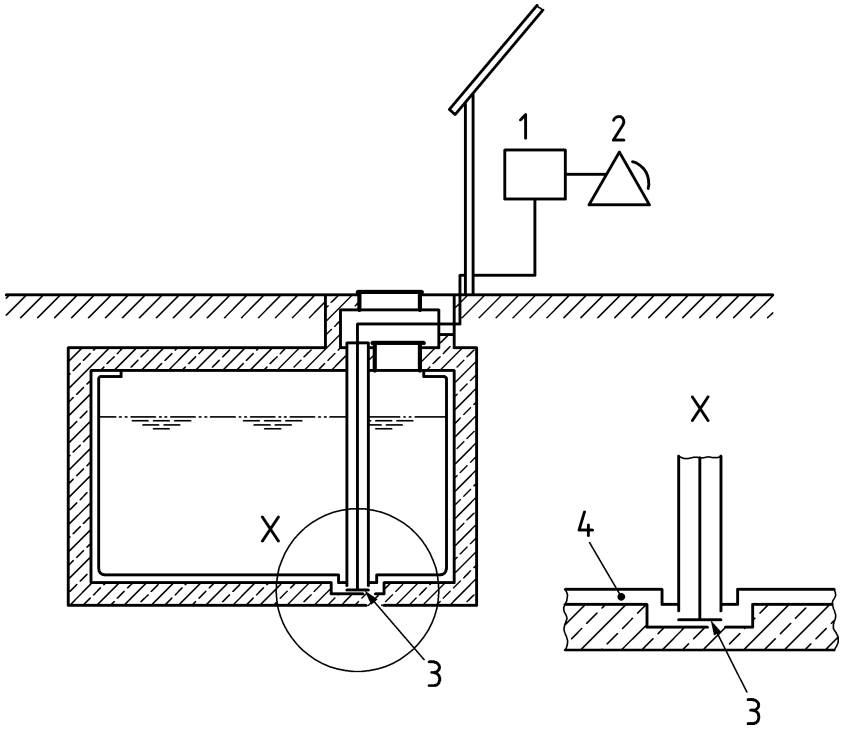
1 Evaluation device

2 Alarm device (visual and audible)

3 Sensor

4 Leakage containment

Figure A.8 — Sensor based leak detection system for use in a leakage containment of an aboveground tank



Key

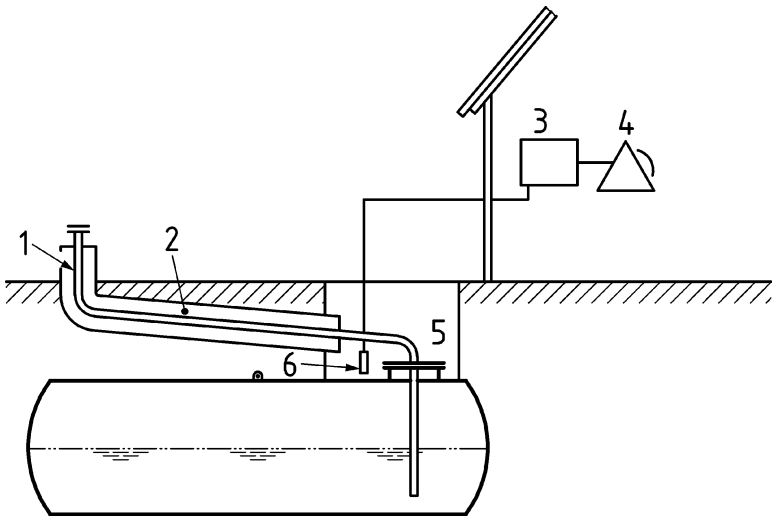
1 Evaluation device

2 Alarm device (visual and audible)

3 Sensor

4 Interstitial space

Figure A.9 — Sensor based leak detection system for use in an interstitial space of an underground tank



Key

1 Filling line

2 Protecting pipe

3 Evaluation device

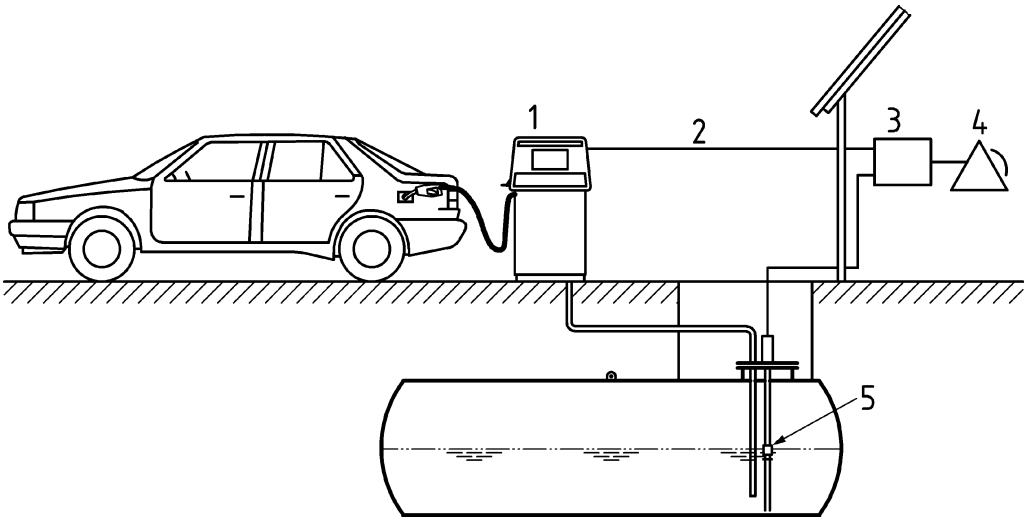
4 Alarm device (visual and audible)

5 Leakage containment

6 Sensor

Figure A.10 — Sensor based leak detection system for use in leakage containment for pipework and chambers

A.4 Leak detection systems – class IV



Key

1 Indicator for dispensed volume

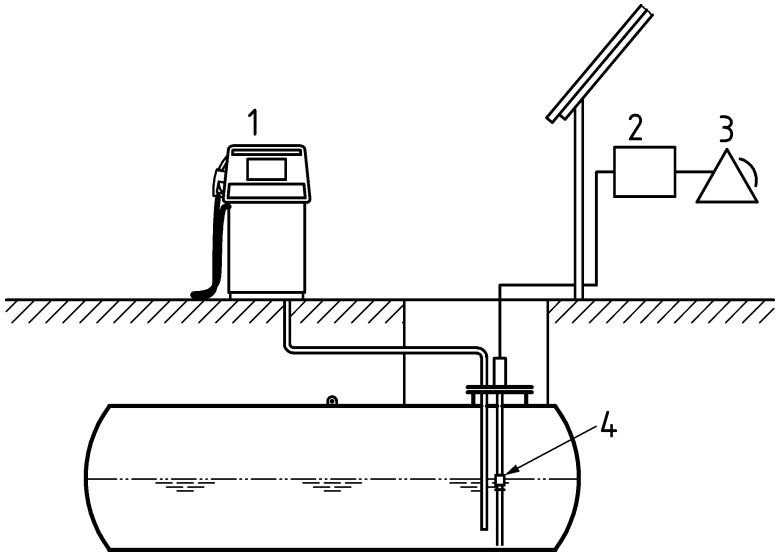
2 Data line

3 Tank gauge processor

4 Alarm device (visual and audible)

5 Tank gauge

Figure A.11 — Tank gauge leak detection system – Category A



Key

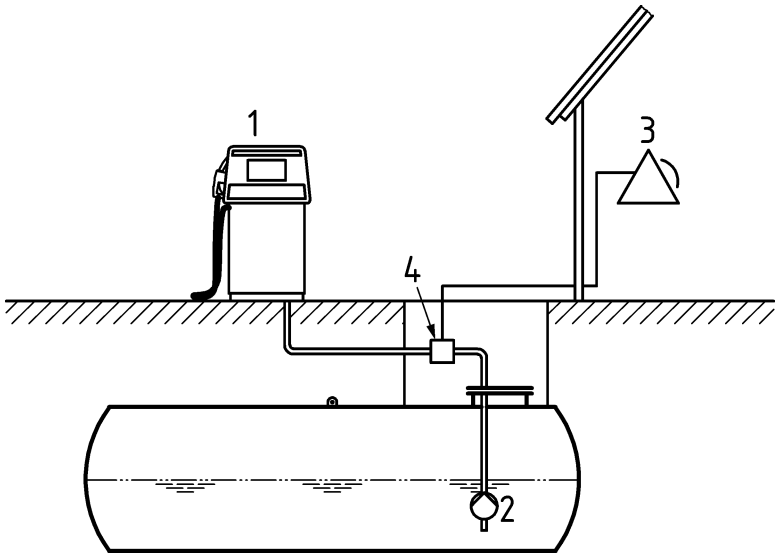
1 Indicator for dispensed volume

2 Tank gauge processor

3 Alarm device (visual and audible)

4 Tank gauge

Figure A.12 — Tank gauge leak detection system – Category B



Key

1 Indicator for dispensed volume

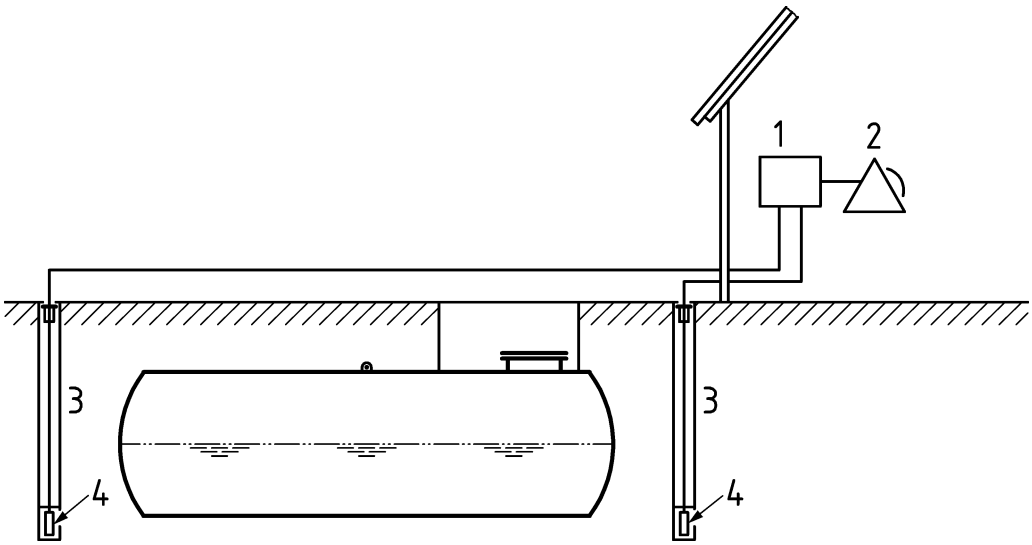
2 Submersible pump

3 Alarm device (visual and audible)

4 Pressure line leak detector

Figure A.13 — Pressure line leak detection system – Category C

A.5 Leak detection systems – class V



Key

1 Leak indicating device

2 Alarm device (visual and audible)

3 Monitoring well, perforated class V

4 Sensor of leak detection system class III

Figure A.14 — Sensors in monitoring wells

Annex B
(informative)

Equipment categories for explosion-proof parts of the leak detection systems

Leak detection systems or their components can be installed in different hazardous areas (zones) or also in non-hazardous areas. EN 1127-1 specifies methods for the identification of hazardous situations leading to explosion and the design and construction measures appropriate for the required safety. The definition of zones and categories and the relation between categories and zones are detailed in this standard. It is the responsibility of the user to choose the suitable category of the equipment for installation in a particular zone.

If the stored product is a liquid with a flash point below 55 °C, equipment installed in certain locations will conform to one of the categories of equipment defined in EN 1127-1. Table B.1 shows the equipment categories which typically will be used in certain areas of the system. However, these categories can be varied where prevailing regulations or other constraints apply.

NOTE 1 For equipment outside the interstitial space reduced requirements could apply, see Table B.1.

NOTE 2 If the interstitial space and/or components of the leak detection system are not chemically resistant to any liquids with which they can come into contact, there can be a risk of the generation of an explosive atmosphere.

Regardless of these proposals the requirements arising from the potentially explosive atmospheres at the place of installation should apply.

Table B.1 — Equipment categories

<table>
<tr><th colspan="4">Definition of system areas</th><th>Equipment category</th></tr>
<tr><td colspan="4">Inner part of the tank</td><td>1</td></tr>
<tr><td colspan="4">Monitoring well</td><td>2</td></tr>
<tr><td rowspan="6">Interstitial space</td><td rowspan="3">inner wall with permeation by the stored product</td><td colspan="2">monitoring medium air</td><td>1</td></tr>
<tr><td rowspan="2">monitoring medium inert gas</td><td>with secured recharging facility</td><td>no requirements</td></tr>
<tr><td>without secured recharging facility</td><td>2 or 3</td></tr>
<tr><td rowspan="3">inner wall without permeation by the stored product</td><td rowspan="3">monitoring medium air</td><td>vacuum</td><td>1 or 2</td></tr>
<tr><td>pressure without secured recharging facility</td><td>2</td></tr>
<tr><td>Pressure with secured recharging facility</td><td>3</td></tr>
<tr><td rowspan="2">monitoring medium inert gas</td><td>with secured recharging facility</td><td>no requirements</td></tr>
<tr><td>without secured recharging facility</td><td>no requirements</td></tr>
</table>

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[1] EN 1127-1, *Explosive atmospheres — Explosion prevention and protection — Part 1: Basic concepts and methodology*

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