DuoSeries Detectors

LB 4700

Operating Manual

56926BA2 Rev.04 08/2023
Embedded Software as of Version 12.00.00

BERTHOLD

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Table of Contents

1 General Information

1.1 Applicable Documents

This manual contains the following documents:

- Safety Manual / Explosion Protection Manual, Id. No. 56926BA26
- Informations sur la sécurité, Id. No. 56925BA59
- Technical Information, Id. No. 56926TI2

Additional documents are available for the InlineSENS Measuring Path that are not included in these operating manual:

- Operating Manual Id. No. 56926-5BA2
- Technical Information, Id. No. 56926-5TI

1.2 Conformity

The company **Berthold Technologies GmbH & Co. KG** hereby declares in its sole responsibility that the design of this product in the distributed form complies with relevant EU directives stated in the original declaration of conformity.

This statement shall become void in the case of unauthorised changes or improper use.

For the original declaration of conformity, please refer to the technical information and safety manual / explosion protection manual.

1.3 Approvals and certificates

For approvals and certificates, please refer to the safety manual / explosion protection manual.

1.4 Symbols Used on the Device

Observe the operating manual

Please observe the instructions in this operating manual.

Electrostatic discharge

Please note the handling instructions. Electrostatically endangered components. Please observe the instructions in this operating manual.

	Protective earth connection
	At this position, connect the protective earth conductor (PE).
	Equipotential bonding connection
	At this position, connect the equipotential bonding conductor.
	No domestic waste
	The electric product must not be disposed of in domestic waste.

1.5 About this Operating Manual

The product is handed over to you by the manufacturer BERTHOLD TECHNOLOGIES GmbH & Co. KG (hereinafter referred to as Berthold) in a complete and functionally reliable condition.

This operating manual illustrates how to:

- set up/install the product
- establish the connections to the power supply
- perform measurements
- apply software settings
- install accessories
- carry out maintenance on the product
- fix errors
- disassemble the product
- dispose of the product

Read these instructions thoroughly and completely before working with the product. We have tried to compile all information for safe and proper operation for you.

However, should questions arise which are not answered in this operating manual, please contact Berthold.

Store the instructions where they are accessible for all users at all times.

Validity of the Operating Manual

The operating manual is valid from the delivery of the Berthold product to the user until its disposal. Version and release date of this operating manual can be found in the bottom of each page. Modification service is not performed by the manufacturer Berthold.

The manufacturer reserves the right to make changes to this operating manual at any time without stating reasons.

NOTICE

The current revision of this operating manual replaces all previous versions.

Target Group

This operating manual is directed at qualified specialist personnel who are familiar with handling electrical and electronic assemblies as well as with communication and measuring techniques.

Specialist personnel refers to those who can assess the work assigned to them and recognise possible dangers through their specialist training, knowledge and experience as well as knowledge of the relevant regulations.

Storage Place

This operating manual as well as all product-related documentation relevant to the respective application must be accessible at all times near the device.

Copyright

1.5.1 Structure of the Operating Manual

This operating manual has been divided into chapters. The order of the chapters should help you to quickly and properly familiarise yourself with the operation.

Representation

Identifier	Meaning	Example
Quotation mark	Field in the software interface	"Calibrating"
Vertical line	Path specification	Settings | Selection
Pointed brackets	Keys and buttons	<Update>
Round brackets	Image reference	Connect the plug (Fig. 1, item 1)

In the software description, the term "clicking" is used if a process is to be activated. This also refers to the pressing of a button (key) or an area on the touch display if a mouse is not used for controlling.

Symbols Used

NOTICE

If this information is not observed, deterioration in the operation and/or property damage may occur.

IMPORTANT

Sections marked with this symbol point out important information on the product or on handling the product.

Tip

Provides tips on application and other useful information.

General warning symbol

Warning symbol electrical shock

Warning symbol Danger of crushing

Warning symbol heavy loads

	Warning symbol suspended load
	Warning symbol explosion hazard
	Wear protective helmet
	Wear safety shoes

1.5.2 Structure of Warnings

Signal Word

Source and consequence
Explanation, if required

- ▶ Prevention

In case of emergency

- **Warning symbols:** (warning triangle) draws attention to the hazard.
- **Signal word:** indicates the severity of danger.
- **Source:** specifies the type or source of danger.
- **Consequence:** describes the consequences of non-compliance.
- **Prevention:** states how one can avoid the hazard.
- **In case of emergency:** specifies which actions are required in the event of the occurrence of risk.

In this manual, warning instructions before instructions for action refer to risks of injury or damage to property. The hazard-prevention measures described must be observed.

DANGER

Indicates an **imminent**, major hazard, which will certainly result in serious injuries or even death if the hazard is not avoided.

WARNING

Indicates a **potential** hazard, which can result in serious injuries or even death if the hazard is not avoided.

CAUTION

Refers to a **potentially dangerous** situation, which can result in medium or minor physical injuries or damages to property, if it is not avoided.

2 Safety

When operating in areas with danger of explosion, observe the specific safety notes and installation instructions in the safety manual / explosion protection manual, see 1.1 Applicable Documents.

2.1 Dangers and safety measures

- Read these instructions and all applicable documents thoroughly and completely before working with the product.
- Store the instructions where they are accessible for all users at all times.

2.2 Proper Use

The detectors are used along with an appropriate evaluation unit of Berthold and an appropriate radiation source to measure the radiation intensity as part of a radiometric measurement.

The following constitutes proper use

- Strictly adhering to the instructions and procedural sequences and perform no unauthorised third party actions that endanger your safety and the functional efficiency of the detectors!
- Observing the provided safety instructions!
- Carrying out the prescribed maintenance measures or having them carried out for you!

Improper Use

- Failing to observe the specified safety instructions and instructions for the operation, maintenance and disposal in the manual.
- Any non-compliance with the present manual for the supplied products.
- Applying conditions and requirements which do not conform to those stated in the technical documents, data sheets, operation and assembly instructions and other specific guidelines of the manufacturer.
- Using the product in a damaged or corroded condition.
- Restructuring or changing the system components.
- Repairs of detectors that are used in hazardous areas by persons who are not authorised by Berthold Technologies GmbH & Co. KG.
- Using the product with
  - open or not properly closed cover
  - improperly closed entries,
  - insufficiently tightened or damaged screw connections i.e. cable glands, adapters or blind plugs[1].

[1] blanking elements acc. to IEC 60079

- Operation without the safety precautions provided by the manufacturer.
- Manipulation or avoidance of existing safety equipment.

Berthold shall only accept liability for/guarantee the conformity of the device to its published specifications.

If the product is used in a way which is not described in the present manual, the device's protection is compromised and the warranty claim becomes invalid.

2.3 Qualification of the Personnel

NOTICE

A minimum requirement for all work on or with the product would be employees with general knowledge who are instructed by an expert or authorised person.

At different parts in this operating manual, reference is made to groups of people with certain qualifications who can be entrusted with different tasks during installation, operation and maintenance.

These three groups of people are:

- Employees with General Knowledge
- Experts
- Authorised Persons.

Employees with General Knowledge

NOTICE

Employees with general knowledge must always be guided by an expert at the very least. When dealing with radioactive substances, a radiation safety officer must also be consulted.

Employees with general knowledge are e.g. technicians or welders, who can undertake different tasks during the transportation, assembly and installation of the product under the guidance of an authorised person. This can also refer to construction site personnel. The persons in question must have experience in handling the product.

Experts

Experts are persons who have sufficient knowledge in the required area due to their specialist training and who are familiar with the relevant national health and safety regulations, accident prevention regulations, guidelines and recognised technical rules.

Expert personnel must be capable of safely assessing the results of their work and they must be familiar with the content of this operating manual.

Authorised Persons

Authorised persons are those who are either designated for the corresponding task due to legal regulations or those who have been authorised by Berthold for particular tasks. When dealing with radioactive materials, a radiation safety officer must also be consulted.

2.4 Operator's Obligations

The operator of the product must regularly train his personnel in the following topics:

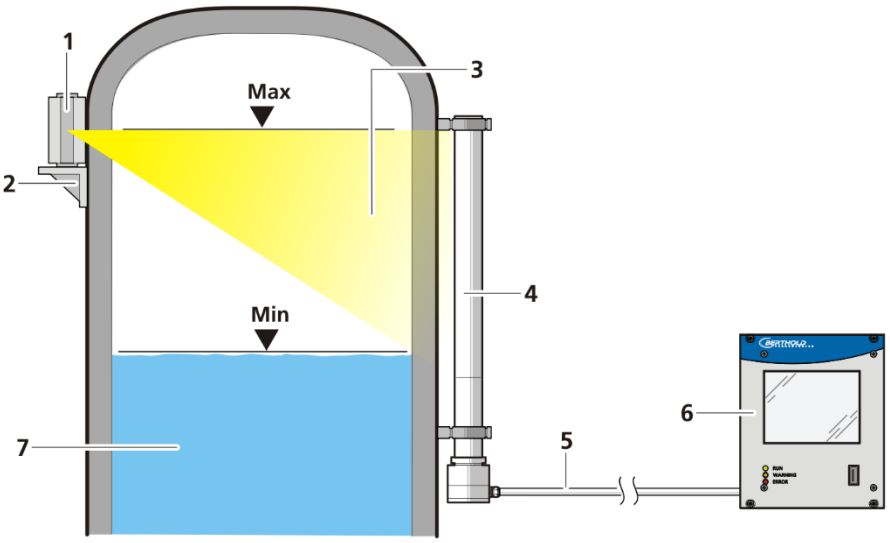
- Observation and use of the operating manual and the legal provisions.
- Intended operation of the product.
- Observation of the plant security instructions and the operating instructions of the operator.
- Regular monitoring/maintenance of the product.

3 System Description

3.1 Measuring Principle

The detectors of the DuoSeries are used in industrial measuring systems for measuring the level, density or mass flow in different installation situations. In addition to the detectors of DuoSeries, additional system components such as transmitters, radioactive sources and shieldings are required for a complete measuring system. Usage of these system components is not subject of this operating manual. Please refer to the individual manuals of the respective system components.

The detectors of the DuoSeries supply measurement signals for further processing and visualisation of LB 47x or LB 44x transmitters. Each detector is connected to either an LB 47x/44x transmitter or a 47x slave module.



1 Point source shield
2 Mounting socket
3 Radiation beam
4 Rod detector (UniSENS)
5 Measurement line to master EVU
6 Master EVU
7 Product

Fig. 1 Exemplary measuring arrangement

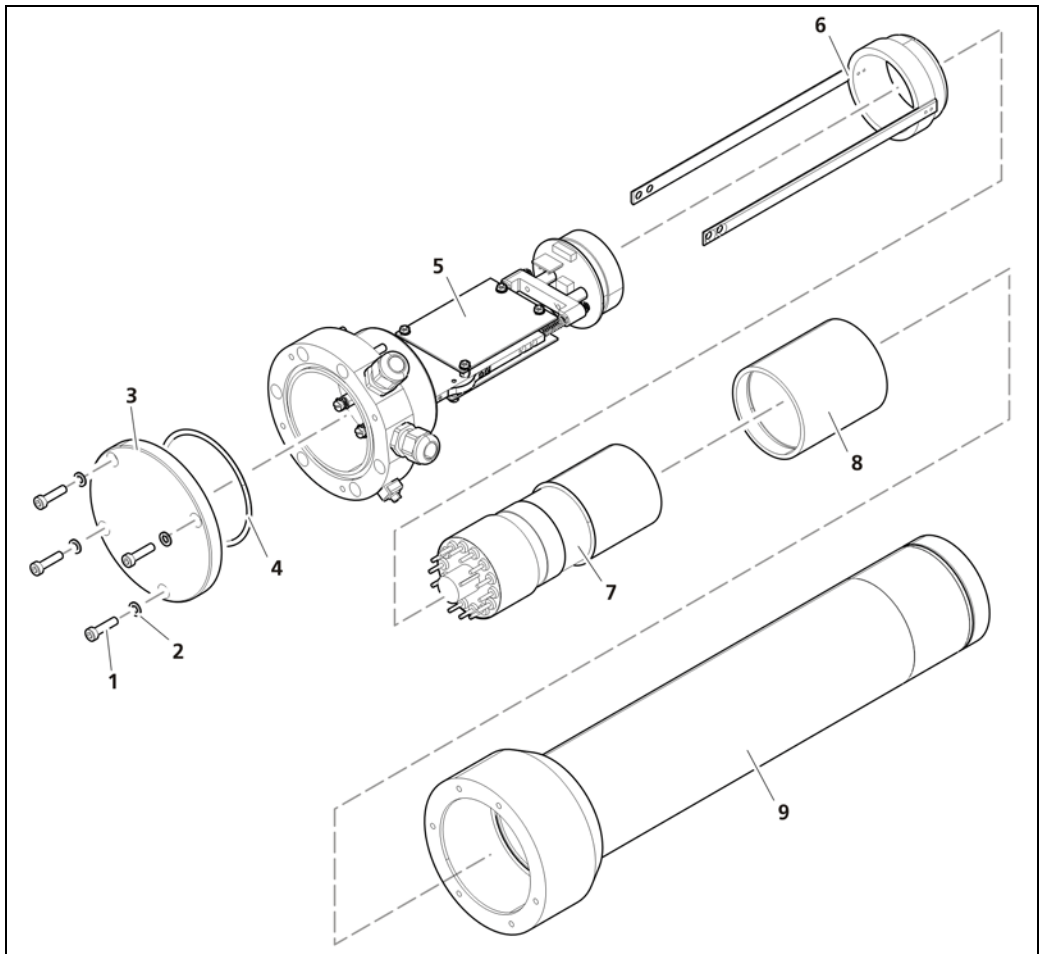
3.2 Storage

Keep devices in a dry (no condensation), dark (no direct sunlight), clean and lockable room. Stay within the temperature range for storage.

3.3 System Components

3.3.1 Overview ATEX/IECEx variant

The detectors consist of the following components.



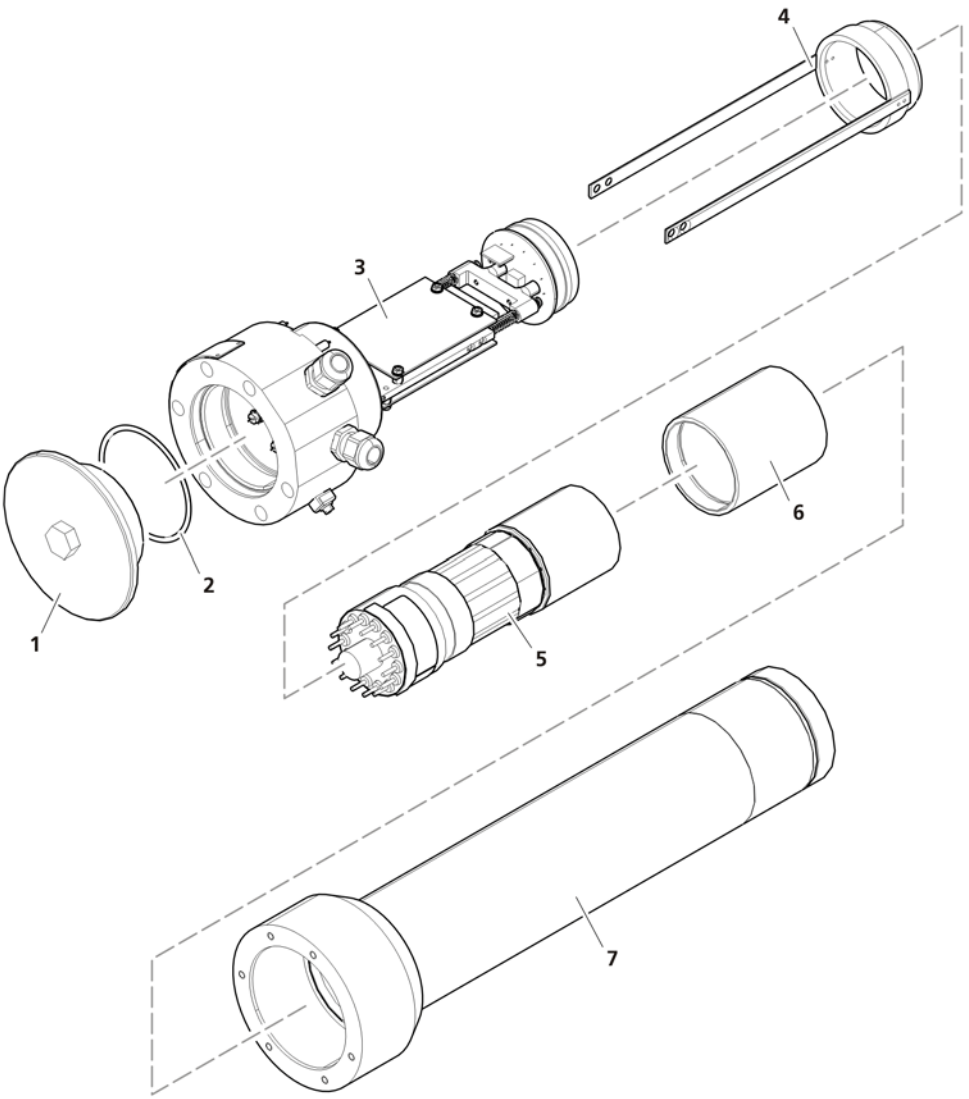
1	Screws cover	6	Photomultiplier holder
2	spring washers	7	photomultiplier
3	Cover	8	scintillator
4	Sealing	9	Stainless steel housing (housing tube)
5	Socket unit with detector electronics		

Fig. 2 View of DuoSeries detector (ATEX / IECEx variant) CrystalSENS point detector

Not visible on the view are the optional water cooling system and collimator.

3.3.2 Overview XP variant (Class/Division)

The detectors XP variant (Class/Division) consist of the following components.

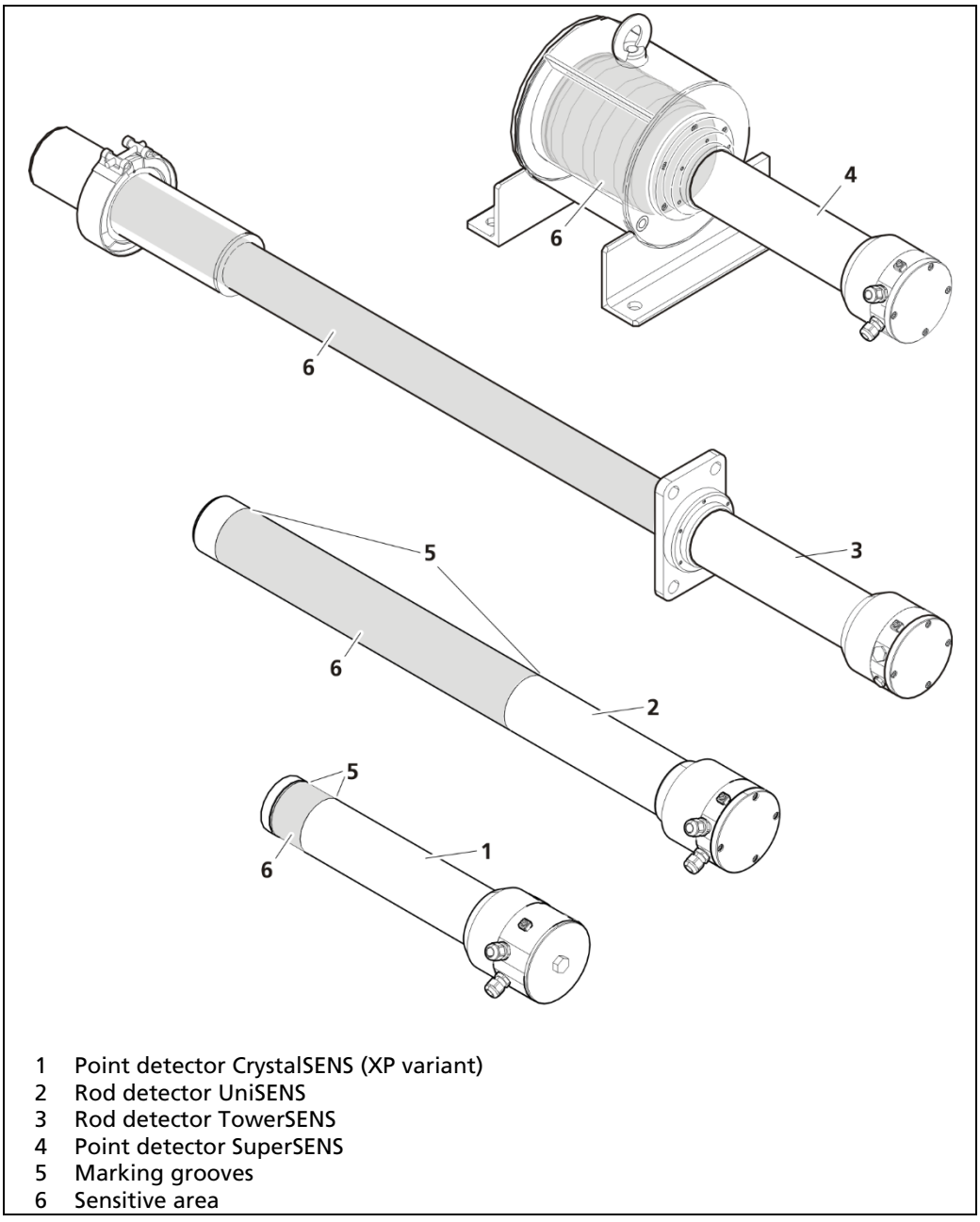


1 Screw lid
2 Sealing
3 Base unit with detector electronics
4 Photomultiplier holder
5 Photomultiplier
6 Scintillator
7 Stainless steel housing (housing tube)

Fig. 3 View of the DuoSeries detector XP variant (Class / Division) CrystalSENS point detector

Not visible on the view are the optional water cooling system and collimator.

3.3.3 Rod and point detector



1 Point detector CrystalSENS (XP variant)
2 Rod detector UniSENS
3 Rod detector TowerSENS
4 Point detector SuperSENS
5 Marking grooves
6 Sensitive area

Fig. 4 View of the DuoSeries detectors

3.3.4 Scintillator

The DuoSeries detectors differ in their external dimensions and the scintillators used. Point detectors (CrystalSENS) are equipped either with a 50/50, 40/35 or 25/25 (diameter x length) sodium iodide (NaI) scintillator or a 50/60 polymer scintillator. Polymer scintillators are used in the rod detectors. Rod detectors (UniSENS) are available with sensitive lengths of 500 mm, 750 mm, 1000 mm, 1250 mm, 1500 mm and 2000 mm, TowerSENS detectors with lengths of 3 to 8 m in 1 m components. The size of the scintillator determines the size of the sensitive area (the area that is used for the measurement and which is sensitive to gamma radiation). Marking grooves (Fig. 3) on the detector housing mark size and position of the sensitive area.

3.3.5 Software

The DuoSeries detectors are distributed with software already installed.

For the revision level (version) of the software, refer to the submenu of the evaluation unit software (Device settings | Setup | Sensors | [NAME DETECTOR] | Detector Service | Device information) or the PC software (see chap. 6.4.2).

The software as of version 12.00.00 is described in this operating manual. A software update is performed with the detector service modem (see chap. 8.2).

Change Log

Software Version LB 4700	Release Date	Display in LB 4710-1 Systems	Significant changes
12.06.09	12/2015	1.13	▪ Error message on LB 44x eliminated after restart ▪ Faults are reported to LB 44x with 1V HV
12.06.10	02/2016	1.14	RID possible with LB 44x
12.06.11	03/2017	1.15	HV error is now detected on LB 471
12.06.12	08/2019	1.16	More detector codes
12.06.14	07/2022	1.17	Detector codes for TowerSENS

3.3.6 Accessories and Options

For accessories and options for the DuoSeries detectors, see chapter 9 in these instructions.

4 Installation

4.1 Safety Notes

The applicable national regulations of the country of use have to be observed! Repair and maintenance on the devices may only be performed by experts (see chapter 2.3). In case of doubt, the complete device must be returned to Berthold for repair.

⚠ WARNING

Danger of injury by falling loads

- Never stand underneath a lifted or suspended load, keep at a safe distance.
- Exclusively use the provided lifting eyes (at SuperSENS detectors) for attaching the sling gear.
- Only use tested sling gear components appropriate for the transport weight.
- Observe the marking for the centre of gravity on the outer packaging, if applicable.
- The bearing capacity of the vessel walls or the brackets must be suitable for installation of the detector.
- Wear head protection and safety shoes.

⚠ WARNING

Danger to life by explosion

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the safety manual / explosion protection manual, see 1.1 Applicable Documents.

⚠ CAUTION

Danger of injury caused by heavy and bulky system components

- Heavy and bulky system components should only be handled using aids and by at least 2 persons.
- Observe the guidelines for safe handling of heavy loads.
- Ensure stability and use the provided fixing possibilities.

IMPORTANT

The applicable national regulations of the country of use have to be observed!

4.2 General Notes

NOTICE

The detectors of the DuoSeries contain a photomultiplier with glass enclosure and possibly a fragile scintillation crystal. Proceed carefully with the detectors in order to prevent breakage or chipping of the photomultiplier or scintillator.

- Transport the detector and components in the original packaging and protect the parts from vibrations.
- During installation, also observe the instructions in the safety manual / explosion protection manual, see 1.1 Applicable Documents.

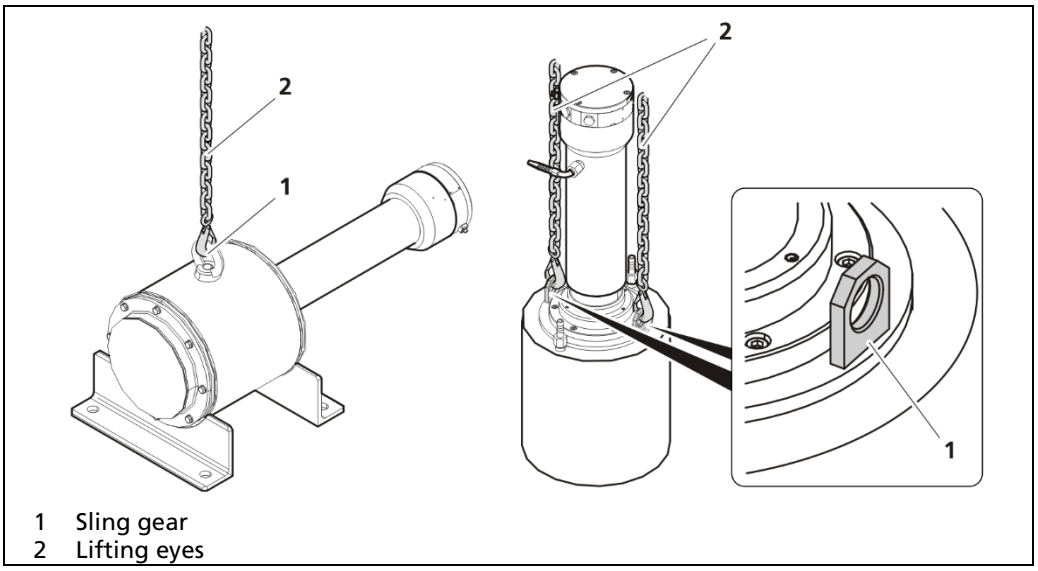
NOTICE

- Only clamping devices approved by Berthold should be used to install the device.
- The device may only be operated if permanently installed.

Free space must be foreseen at the installation site for:

- Freedom of motion for delivery of the detector
- The electrical installation of the detector.
- Servicing and repair work, to install and dismantle parts.

Transport



1 Sling gear
2 Lifting eyes

Fig. 5 Transport notes for SuperSENS Detectors

Since the SuperSENS variant detectors weigh ≥ 50 kg, they must be attached with sling gear (Fig. 5, item 1) using both lifting eyes (Fig. 5, item 2).

4.3 Unpacking / Scope of Delivery

The product will be delivered completely configured according to the purchase order. Check your delivery for completeness and damage according to your order. Please report missing, defective or incorrect parts immediately.

4.4 Detector Protection

NOTICE

Risk of damage!

The detector may be damaged due to strong mechanical stress, heavy ibrations and high temperatures.

- Please note the data in the "Technical Information" document.

Cooling

The ambient temperature must not exceed the values specified in the technical data. If temperatures exceeding 50° C are expected, you have to use a detector with water cooling system (see 9.1 Water Cooling System). Prevent heat transfer from the detector holder to the detector by using a suitable heat-neutralizing suspension.

Sun Protection

For open-air installation, a weather protection cover that provides protection against direct sunlight and associated heat should also be installed over the detector.

Avoidance of strong Mechanical Stress

When selecting the installation site, keep in mind that the detector should not be affected by strong mechanical stress or heavy vibrations, in order not to restrict its service life. If the measuring system is used in a heavy-duty environment, the detector and the shielding should be provided with an additional protective cover.

Precautions against strong Vibrations

Excessive vibrations or shocks on the detector shorten the service life. Mount the detector on a vibration-free support; you may also dampen possibly occurring vibrations or shocks using appropriate vibration absorbers.

Magnetic Fields

The detector is provided with an internal shielding that protects the photomultiplier against magnetic fields. Nevertheless, strong magnetic fields in close proximity to the detector may impair its function. Installation in close proximity should therefore be avoided.

Cleaning

Take care not to damage the cable glands and the type plates during cleaning. The detector may be cleaned with water or gasoline. Grinding, filing or chipping away at deposits with the hammer is not permitted.

4.5 Application-specific Assembly

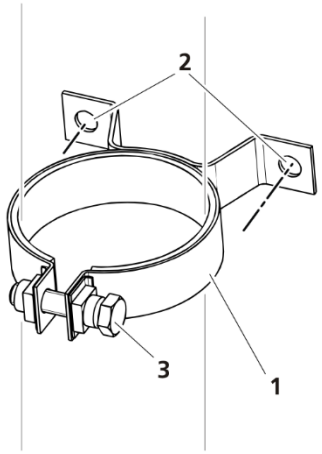
Application-specific specifications for installation are described in the following chapters.Information on installing rod detectors (UniSENS and TowerSENS) and point detectors (CrystalSENS and SuperSENS) can be found in chapters 4.6 and 4.7.

4.5.1 Installation of Mounting Clamps

Mounting clamps are used to fasten the detectors. These clamps are installed on a mounting base, cross beams or similar which are to be provided by the operator. A robust stainless steel holder is optionally available for detectors with and without water cooling system. For more details, please refer to document “technical information”. If mounted on a vessel, the information in chapters 4.5.2 and 4.5.3 must be observed.

These mounting clamps are suitable for point and rod detectors.

Mounting Clamps Type 1



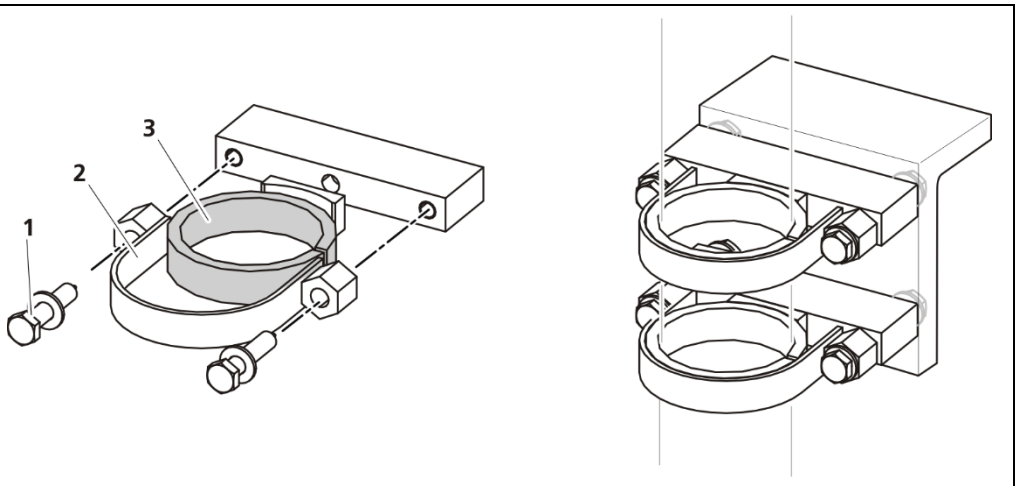
1 Hex Mounting clamp
2 Holes for mounting material
3 Hex screw M10

Fig. 6 Mounting clamp type 1

1. Unscrew the fastening screw on top of the mounting clamp.
2. Slide the clamp from over the detector housing.
3. Tighten the screw sufficiently so that the mounting clamp cannot slip on the detector.

   ▶ The assembly is complete

Mounting Clamps Type 2 and Detector Holder



1 Screw M10 incl. washer
2 Top part
3 Spacer ring

Fig. 7 U-clamp and detector holder stainless steel

1. Unscrew the two screws on the side of the mounting clamp.
2. Take off the top part of the mounting clamp.
3. If necessary, remove the spacer ring if a detector with water cooling system is to be installed.
4. Place the detector in the bottom part of the mounting clamp
5. Refit the top part and tighten the screws until the mounting clamp can no longer slip on the detector.

   ▶ The assembly is complete.

4.5.2 Installation on a Vessel

For mounting the detector on the vessel, the mounting clamps must first be mounted on the detector (see chap.4.5.1). Examples are shown in Fig. 8 and Fig. 9. Appropriate mounting fixtures (e.g. mounting brackets, platforms, etc.) are to be provided by the operator. The dimensions of the detector and the mounting clamps (see Appendix) should be observed. The orientation of the system components (radiator/shielding and detector) to each other and to the measuring range is described in detail in the operating manual of the corresponding transmitter.

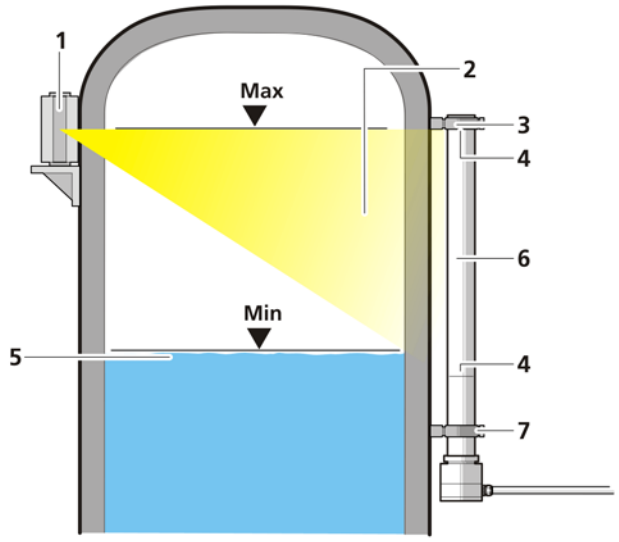
The cable bushing and cable inlet should be positioned so that no water can flow along on the cable into the bushing.

IMPORTANT

The distance from the middle of the detector to the vessel surface or surface of heat insulation should be approx. 100 mm.

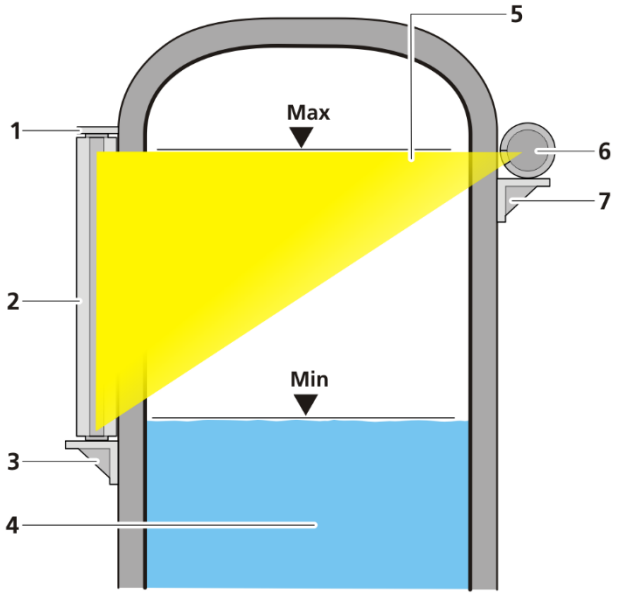
Tip

Care should be taken during mounting to avoid as far as possible heat transfer from the vessel via the clamps to the detector.



1 Point source with shielding
2 Radiation beam
3 Upper mounting clamp
4 Marking groove on the detector
5 Level
6 Rod detector
7 Lower mounting clamp

Fig. 8 Fastening of Rod Detector



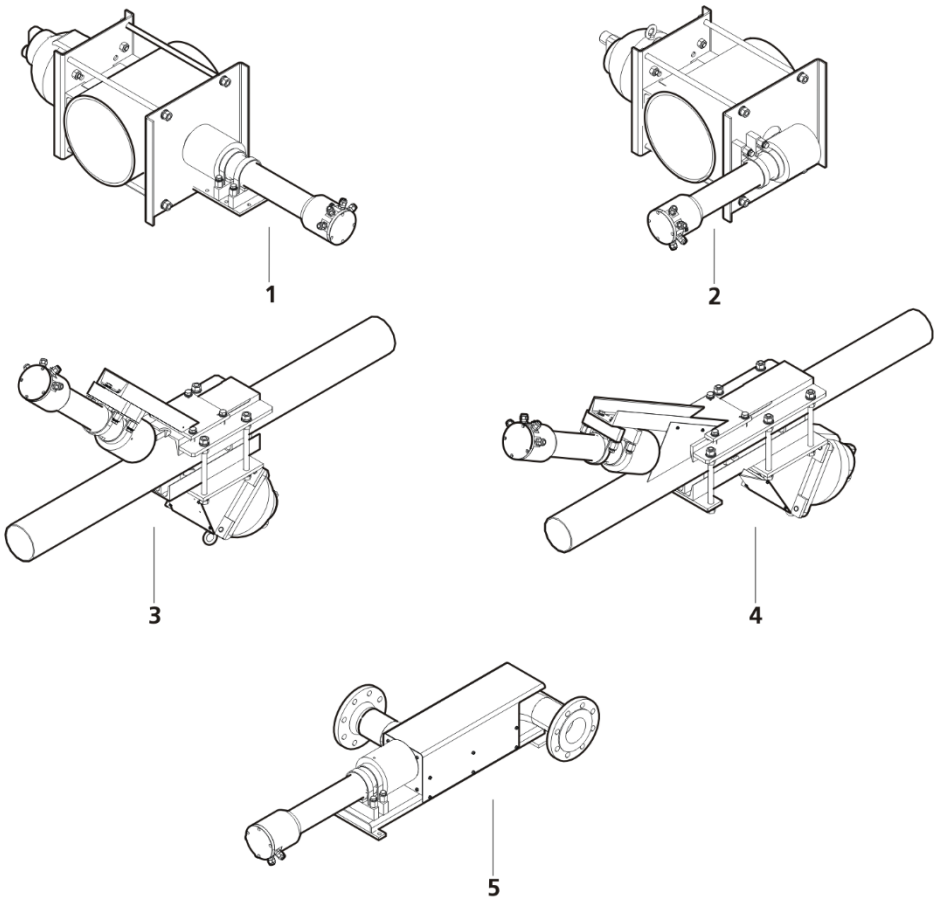
1 Holder
2 Rod source shielding
3 Mounting base
4 Level
5 Radiation beam
6 Point detector
7 Mounting base

Fig. 9 Fastening of Point Detector

4.5.3 Installation on a Pipeline

There are clamping devices for different pipe diameters and irradiation angles for installing a detector on a pipeline. Some examples are shown in Fig. 10. For the detailed description of the clamping devices and the associated dimension drawings, refer to the operating manual of the corresponding transmitter.

The various types of clamping devices already include mounting clamps. To mount the detector, please follow the instructions in chapter 4.5.



1 Clamping device for a radiation angle of 90° and vertical detector mounting
2 Clamping device for a radiation angle of 90° and parallel detector mounting
3 Clamping device for a radiation angle of 45°
4 Clamping device for a radiation angle of 30°
5 S-shaped density measuring path

Fig. 10 Overview - Pipeline Installation

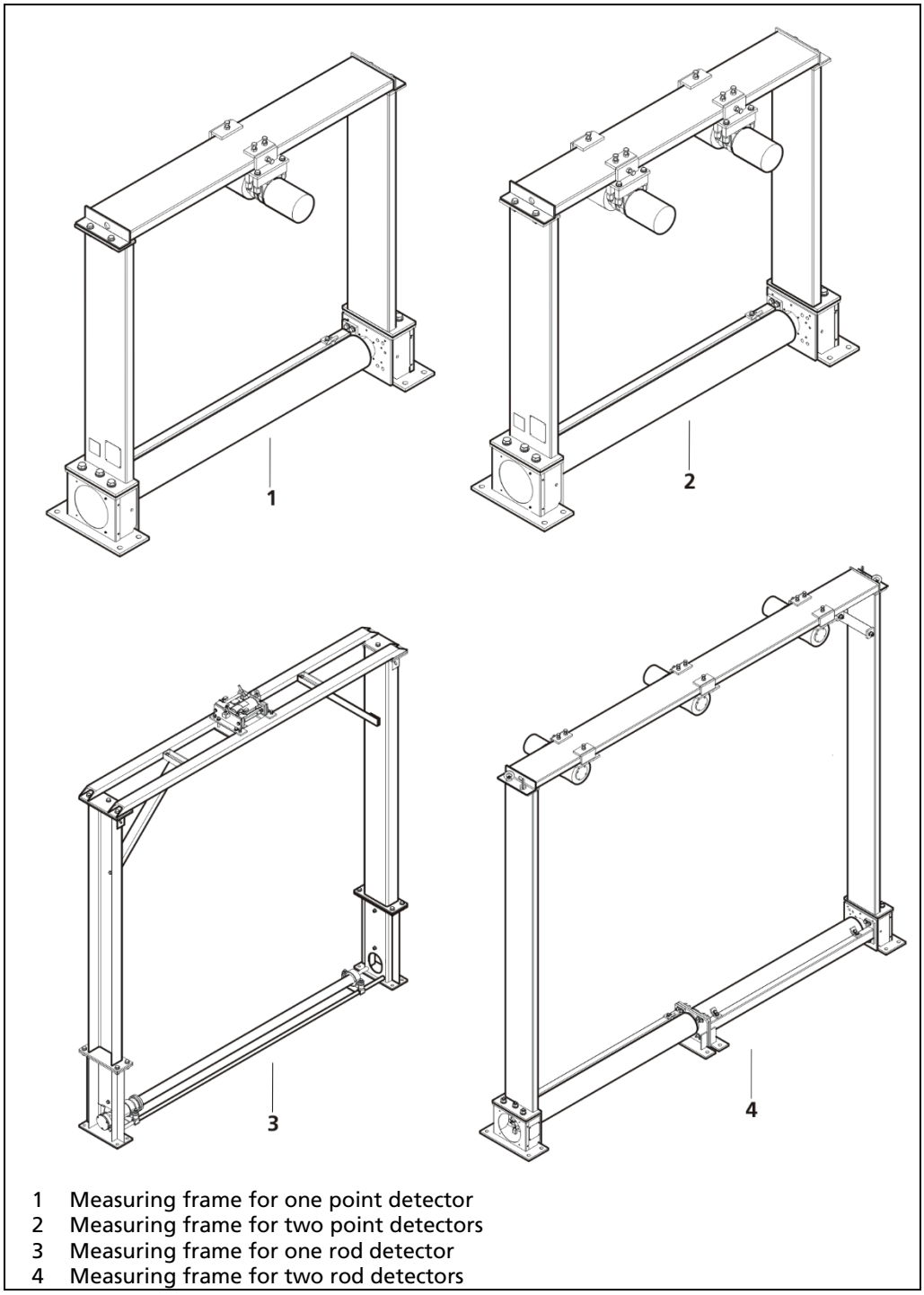
IMPORTANT

On thick-walled pipelines, the SuperSENS detector can be installed directly on the pipe.

4.5.4 Installation on a Conveyor Belt

Various measuring frames are available for the installation of detectors on conveyor belts. Some examples are shown in Fig. 11. For the detailed description of the measuring frame and the associated dimension drawings, refer to the operating manual of the corresponding transmitter.

The measuring frames already have mounting clamps. To mount the detector, please follow the instructions from 4.5.

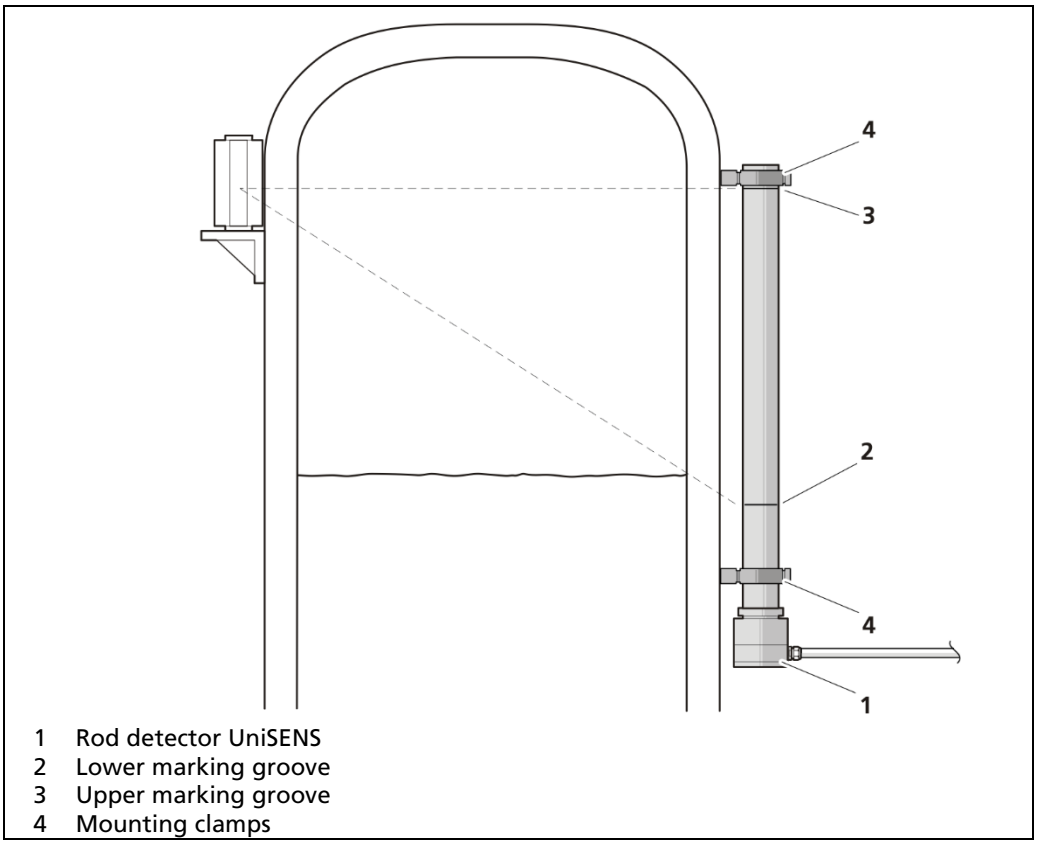


1 Measuring frame for one point detector
2 Measuring frame for two point detectors
3 Measuring frame for one rod detector
4 Measuring frame for two rod detectors

Fig. 11 Overview Mounting on Conveyor Belt

4.6 Installation Rod Detectors on a Vessel

4.6.1 Mounting of the UniSENS Rod Detector



1 Rod detector UniSENS
2 Lower marking groove
3 Upper marking groove
4 Mounting clamps

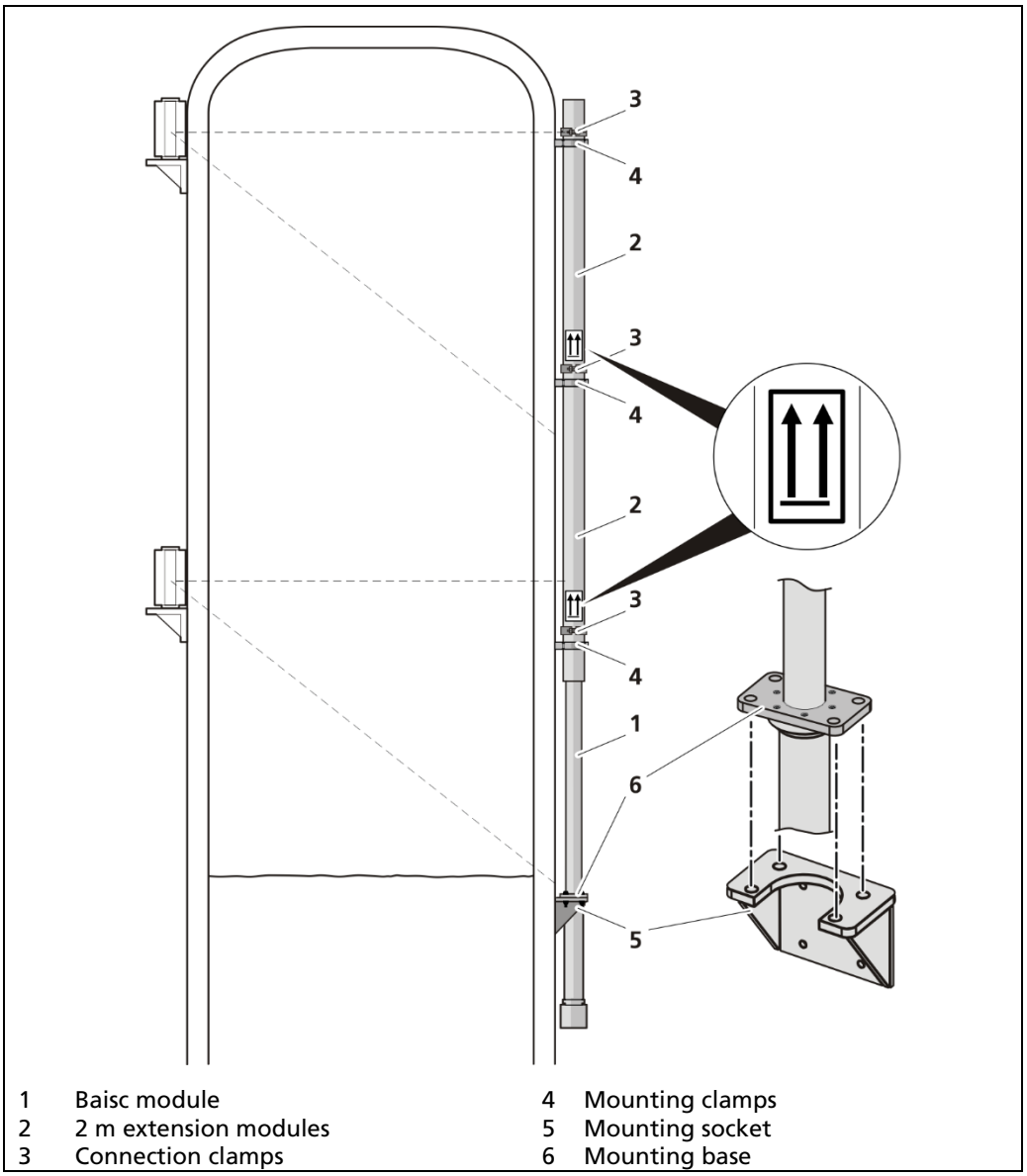
Fig. 12 Assembly rod detector UniSENS (exemplary arrangement with point source)

The rod detector is mounted usually vertically on the outside of the vessel. The top point of the effective detector length is marked by a marking groove. The rod detector is mounted outside the marking grooves, with one fixing clamp each at the top and at the bottom.

The distance from the center of the detector to the surface of the vessel or the surface of a thermal insulation is about 100 mm. The clamps have to be arranged so that no heat is transferred to the detector.

An overview of the clamp positions can be found in the "Technical Information" document in chapter 4.1 Clamping Positions for UniSENS Rod Detectors. The installation of the water cooling is described in chapter 9.1.

4.6.2 Mounting the TowerSENS Rod Detector



1	Baisc module	4	Mounting clamps
2	2 m extension modules	5	Mounting socket
3	Connection clamps	6	Mounting base

Fig. 13 TowerSENS detector arrangement with 6 m measurement range (exemplary)

Detector lengths of more than 2 m can be realized with the TowerSENS detector. There is also a 1 meter version of the extension module, so that all lengths up to 8 m can be installed. TowerSENS arrangements are available with and without water cooling.

The TowerSENS detector can be installed with the electronic housing on top. For performance reasons, however, it is recommend to install the electronic housing facing down, shown in Fig. 13.

A sticker is attached to the adapted extension modules, which indicates in which direction the extension module is to be installed in the TowerSENS setup. Regardless of regular or reverse mounting, the directional arrows shown must point upward (away from the ground), thus the preferred orientation of the extension modules is considered.

The clamping locations and mounting base location are shown in Fig. 14. Information on water cooling is described in chapter 9.1.

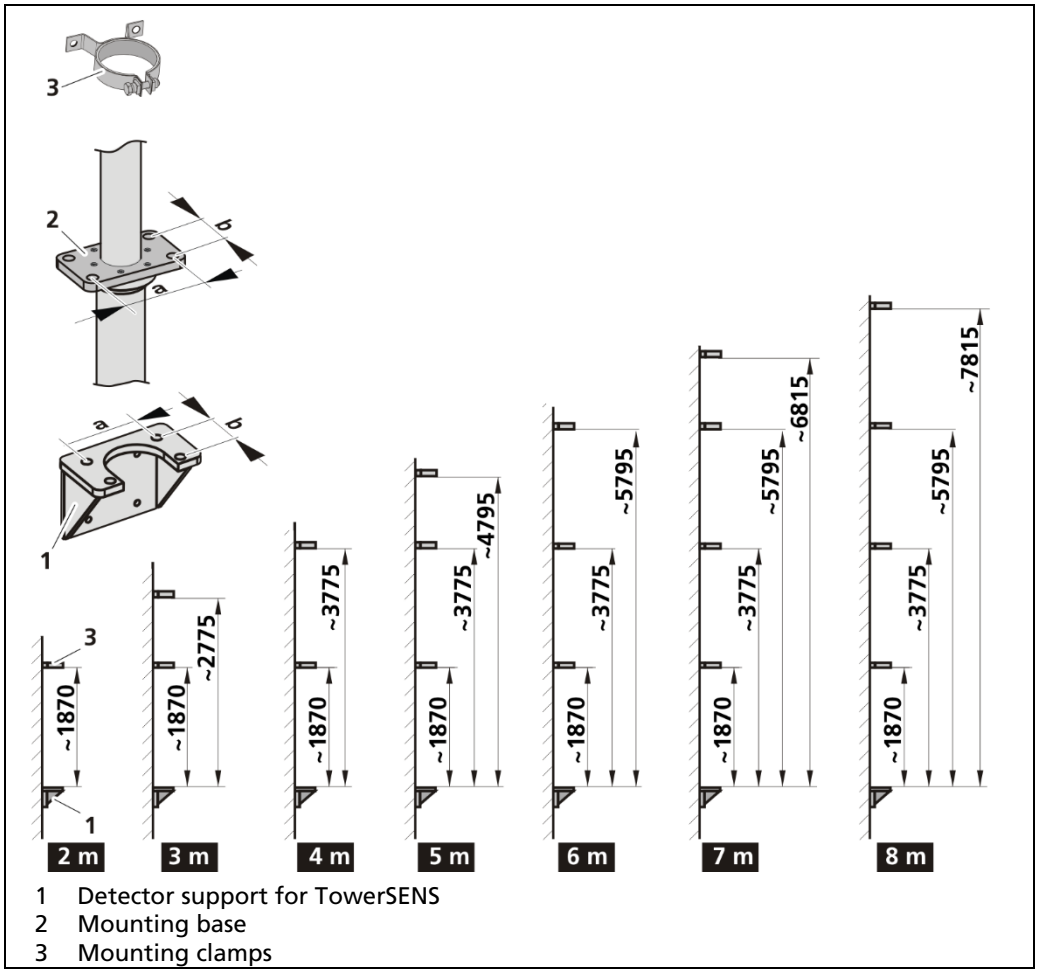
Mounting Steps

TowerSENS detectors must be assembled and mounted at the final assembly location (vessel), as the components are shipped separately packaged. A TowerSENS system usually consists of:

- 1x base module (2 m) incl. 1x connection clamp and 1x end cap
- 1x extension module (1 m or 2 m) incl. 1x connection clamp and 1x centering sleeve

The clamp positions and the position of the mounting socket are shown in Fig. 14 and in the document Technical Information, chapter 6. Information for water cooling systems can be found in chapter 9.1.

With the detector lengths of 3 m, 5 m and 7 m, the 1 m extension module must be installed at the end so that the distances between the fastening clamps match as shown in in Fig. 14.



1 Detector support for TowerSENS
2 Mounting base
3 Mounting clamps

Fig. 14 Distances of mounting clamps

1. Manufacture a detector support matching the mounting base of the TowerSENS detector according to specified dimensions (see measurements in the document “Technical Information”) and mount detector support on the vessel.
2. Use the correct mounting brackets. Note the Information for detector with or without water cooling in the document “Technical Information”. Fasten the mounting clamps for the TowerSENS detector on the vessel in the specified distances. Pay attention to the correct diameter of the clamps (detectors with

or without water cooling). The operator is responsible for selecting the connection elements, locking elements and tightening torque.

3. Make sure that clamps and detector support properly aligned with respect to each other.

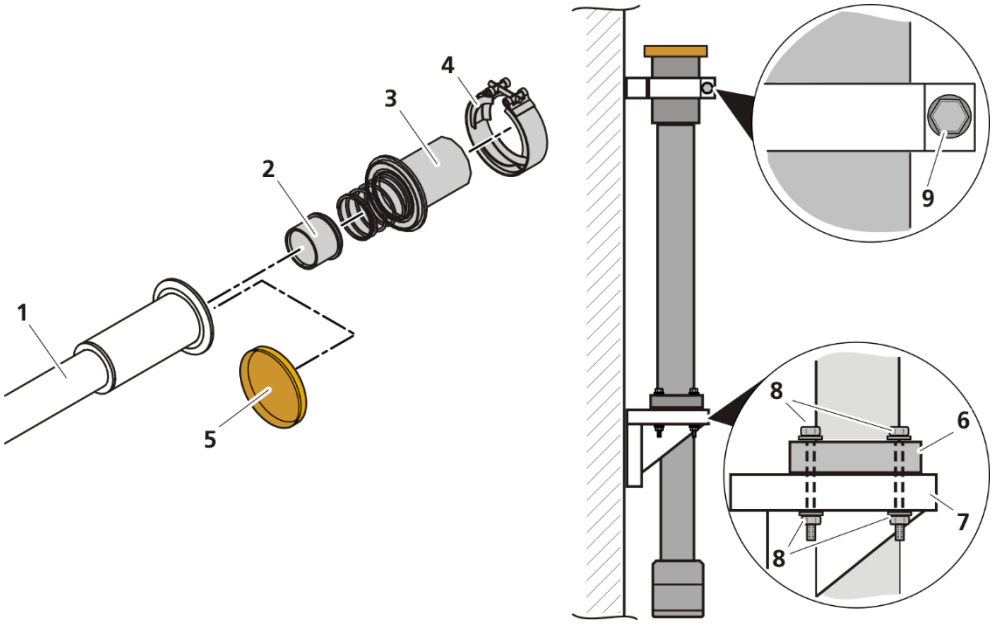
NOTICE

Risk of damage!

The detector components are sensitive and must be handled with extreme care.

- Protect the module ends from moisture and dirt.
- Remove the protective caps just before putting them on.
- Do not connect the detector to the mains until the installation is complete.
- Carry out the first measurements or calibrations no earlier than three hours after completing the installation.

Install Basic Module



1	Basic module	6	Mounting base
2	Cylindrical block	7	Detector support for TowerSENS
3	Closure cap with spring	8	Screw connections
4	Connection clamp	9	Screw mounting clamp
5	Yellow plastic cover		

Fig. 15 Install basic module

4. Remove the closure cap (Fig. 15, item 3) with spring and cylindrical block (Fig. 15, item 2) from basic module (Fig. 15, item 1):
Press slightly from top against the closure cap (Fig. 15, item 3) while opening the connection clamp (Fig. 15, item 4).

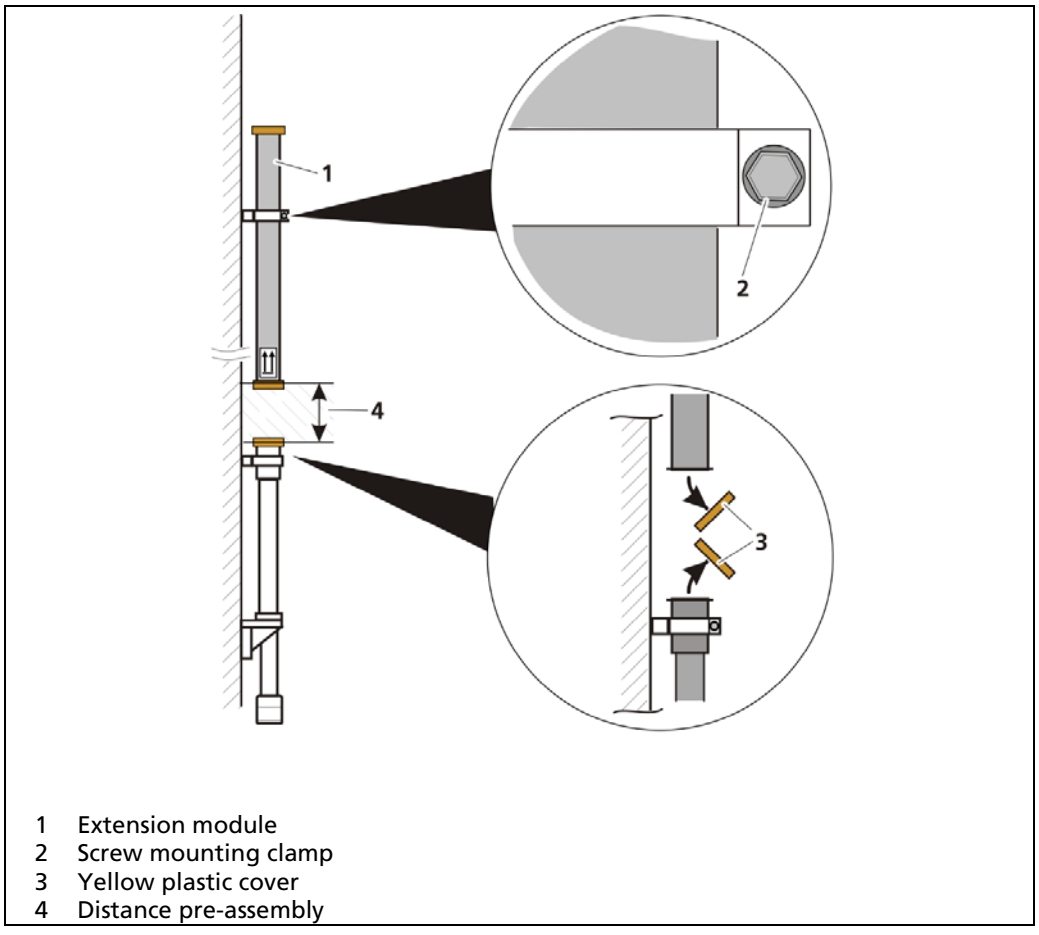
NOTICE

- In some cases the protection foil (mirror foil) keeps sticking at the plastic cylinder of the closure cap. In such cases remove it and apply it on the silicon pad from the basic module, in order to protect the surface of the silicon pad.
- **Do not remove any of the silicon pads from any of the modules!** After the entire TowerSENS detector is installed, no protection foils (mirror foil) may remain between the extension modules and between extension module and the basic module.
- Protect the module end faces from dirt and moisture!

5. Place the yellow plastic cover (Fig. 15, item 5) on the top of the basic module.
6. Position the basic module with the mounting base (Fig. 15, item 6) on the detector support (Fig. 15, item 7) and fasten them tightly together with 4 screws (Fig. 15, item 8).
7. Secure the upper end of the base module by tightening the screw (Fig. 15, item 9) on the pre-assembled fastening clamp.

Install Extension Module

It is recommended to have two people assemble the extension module.



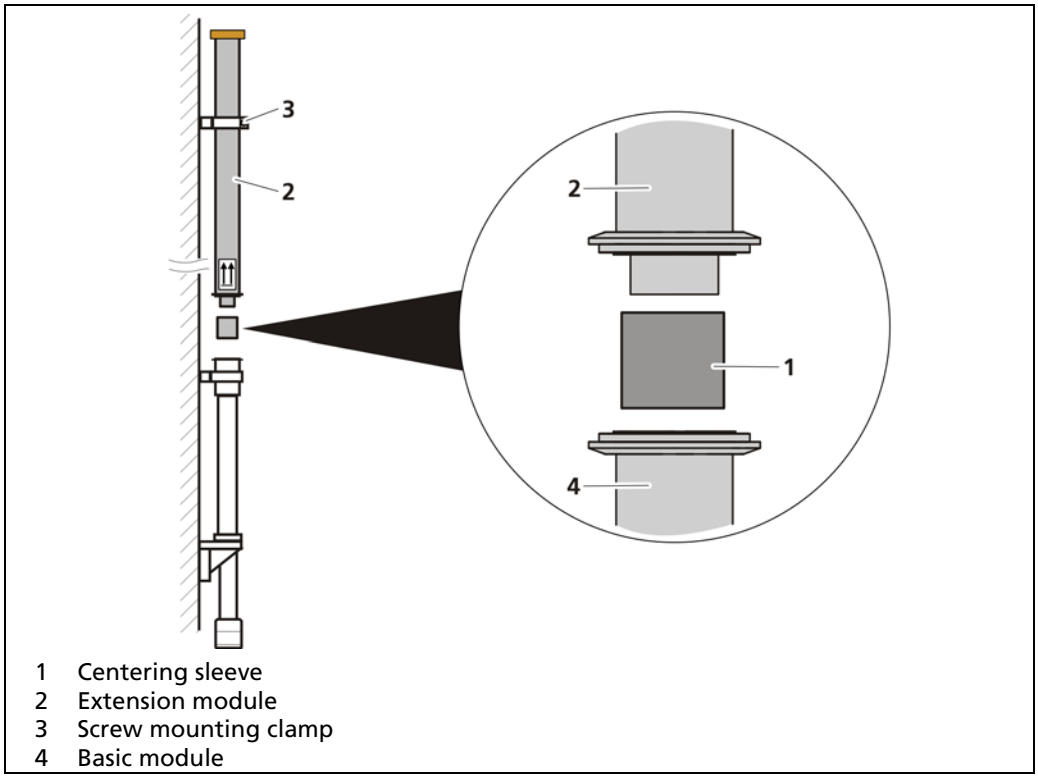
1 Extension module
2 Screw mounting clamp
3 Yellow plastic cover
4 Distance pre-assembly

Fig. 16 Install extension module

8. Position the extension module (Fig. 16, item 1) on the basic module and secure it with respective mounting clamp (screw) (Fig. 20, item 2).
9. Slightly open the mounting clamp (Fig. 16, item 2), move the extension module up by approximately 20 cm (Fig. 16, item 4) and secure it in this position by fastening the mounting clamp again (Fig. 16, item 2).

10. Remove the yellow plastic cover (Fig. 16, item 3) from the basic module and the bottom extension module. **Protect the module end faces from dirt and moisture!**

Recommended Intermediate Step: Check of fit with protection foil



1 Centering sleeve
2 Extension module
3 Screw mounting clamp
4 Basic module

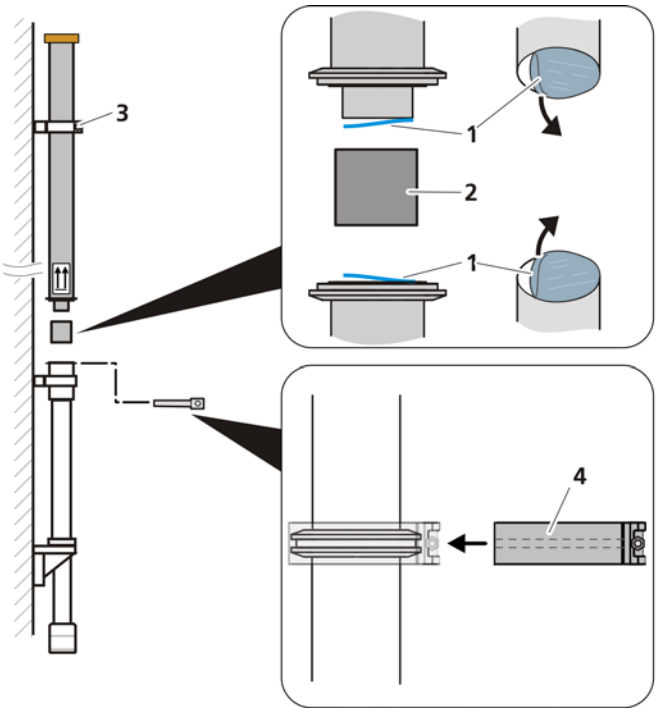
Fig. 17 Check accuracy of fit

11. **Do not** remove protection foil yet.
12. Place centering sleeve (Fig. 17, item 1) in basic module.
13. Slightly open the mounting clamp (Fig. 17, item 3) of the extension module (Fig. 17, item 2) and lower it carefully into the centering sleeve of the basic module.

    ▶ If this procedure is possible without difficulties, continue with the assembly step "Connecting Modules".

14. Move up the extension module and secure it by closing its mounting clamp (Fig. 17, item 3).
15. Remove centering sleeve (Fig. 17, item 1) again.

Connecting Modules

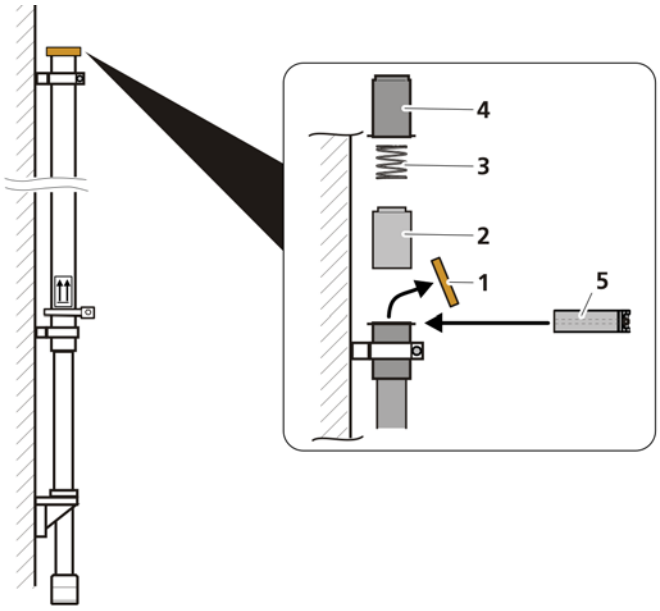


1 Protection foils
2 Centering sleeve
3 Mounting clamp
4 Connection clamp

Fig. 18 Connecting modules

16. Remove the protection foil (Fig. 18, item 1) from basic module and extension bottom side. **Attention**: **Don't remove the silicon pad from the basic module**.
17. Insert the centering sleeve (Fig. 18, item 2) into the basic module.
18. Slightly open the mounting clamp (Fig. 18, item 3) of the extension module and lower it carefully into the centering sleeve of the basic module.
19. Securely join both modules by closing the connection clamp (Fig. 18, item 4) with a wrench size 13.
    - When no gap is visible between the two modules, fastening the clamp by another 2 to 3 turns is sufficient. **Attention: Do not overtighten the screw.**
20. Close the mounting clamp (Fig. 18, item 3) again.
    - The modules are correctly connected.

Install last Extension Module



1 Yellow protective plastic cover
2 Cylindrical block
3 Spring
4 Closure cap
5 Connection clamp

Fig. 19 Install last extension module

21. Remove the yellow protective plastic cover (Fig. 19, item 1) from the end of the last extension module. **Attention: The protection foil (mirror foil) must remain at the silicon pad and the closure cap.**
22. Place cylindrical block (Fig. 19, item 2) and spring (Fig. 19, item 3) onto the end face of the extension module.
23. On top, place the metal closure cap (Fig. 19, item 4) onto the spring.
24. Press the metal closure cap onto the extension module and join them with a connection clamp (Fig. 19, item 5).
25. Close the connection clamp with a wrench 13: When no gap is visible, fasten the clamp by another 2-3 turns.

    ▶ As soon as no gap can be seen, fastening the clamp by another 2-3 turns is sufficient. **Attention: Do not overtighten the screw.**

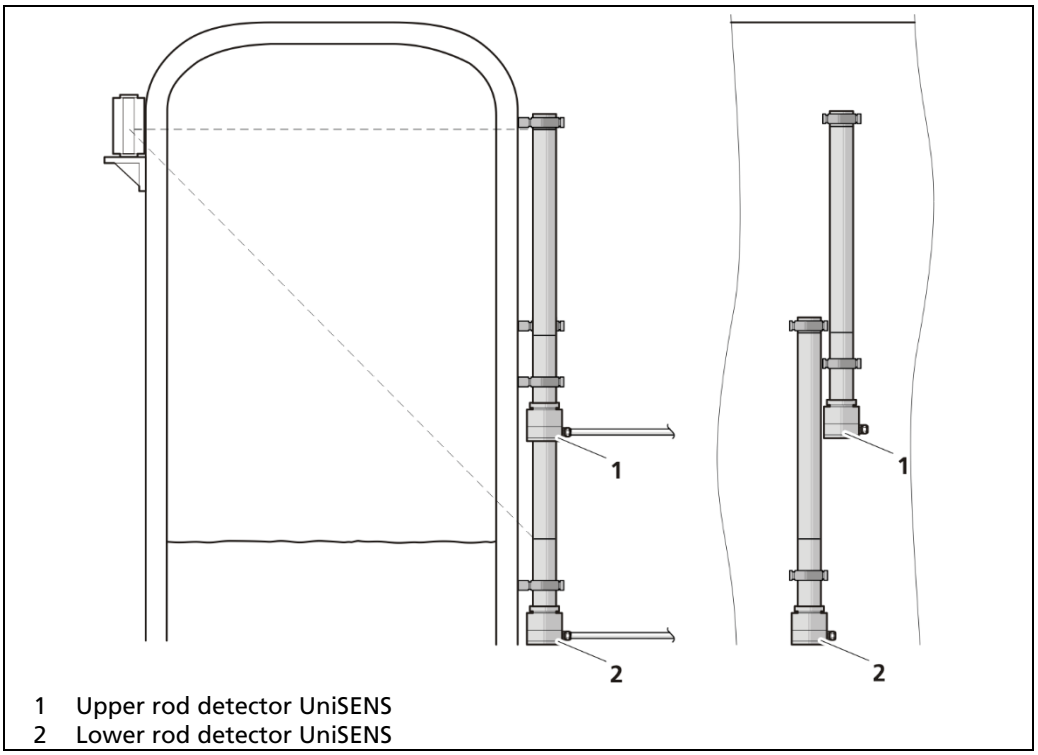
    ▶ Note the Information for water cooling systems in chapter 9.1.

    ▶ The TowerSENS detector is installed correctly and the electrical installation can be carried out.

IMPORTANT

After the installation, wait at least 3 hours before powering the detector. Read the chapter 6 Operation for pre-setting and calibration the measurement.

4.6.3 Multi-Detector Arrangement



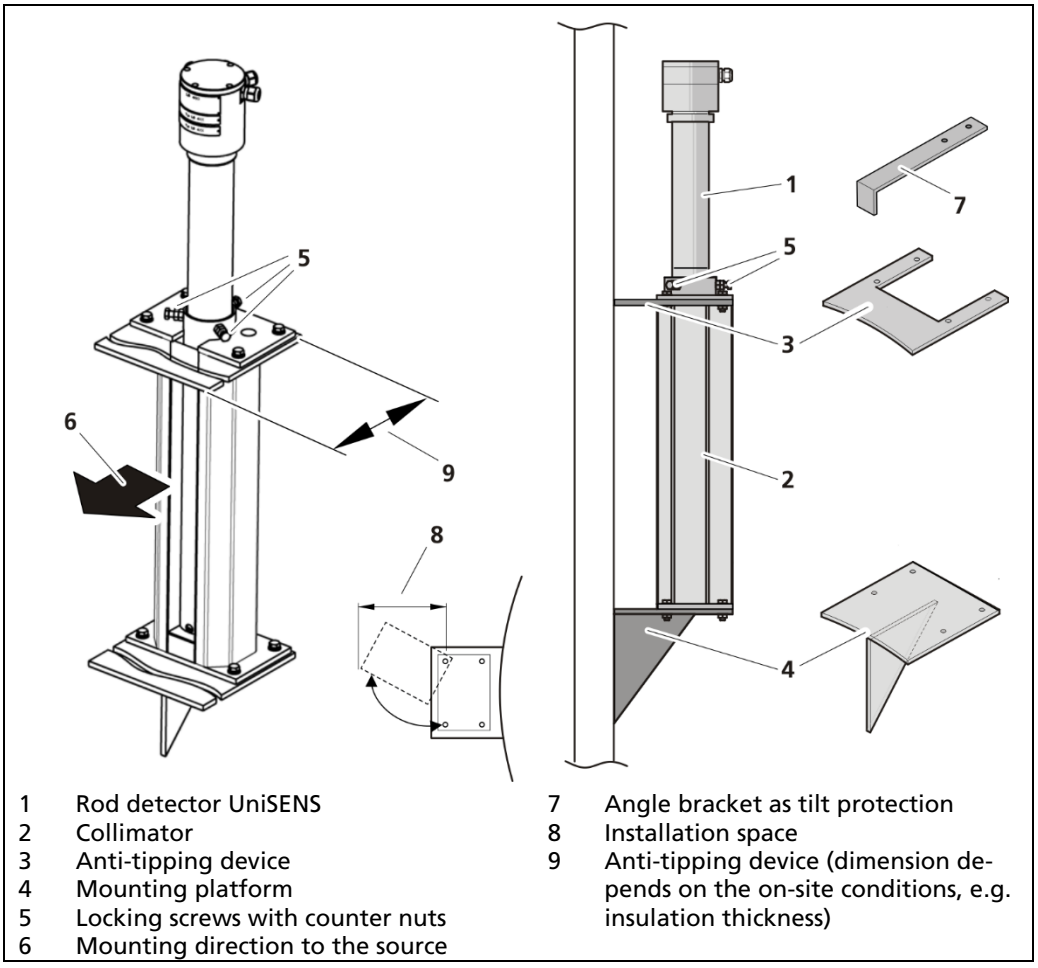
1 Upper rod detector UniSENS
2 Lower rod detector UniSENS

Fig. 20 Multi-detector arrangement (exemplary)

Several detectors are necessary for measurement ranges of more than 2 m for UniSENS detectors, or more than 8 m for TowerSENS detectors. The detectors are arranged such that the sensitive areas of the detector overlap seamlessly. The detectors are offset on the side. The sensitive areas are marked by grooves.

An overview of the clamp positions at multi-detector arrangements can be found in the "Technical Information" document in chapter 4.1 Clamping Positions for UniSENS Rod Detectors. In the case of TowerSENS detectors, the clamping locations and mounting base location are shown in Fig. 14.

4.6.4 Assembly of the detector shield for UniSENS detectors



1	Rod detector UniSENS	7	Angle bracket as tilt protection
2	Collimator	8	Installation space
3	Anti-tipping device	9	Anti-tipping device (dimension depends on the on-site conditions, e.g. insulation thickness)
4	Mounting platform		
5	Locking screws with counter nuts		
6	Mounting direction to the source		

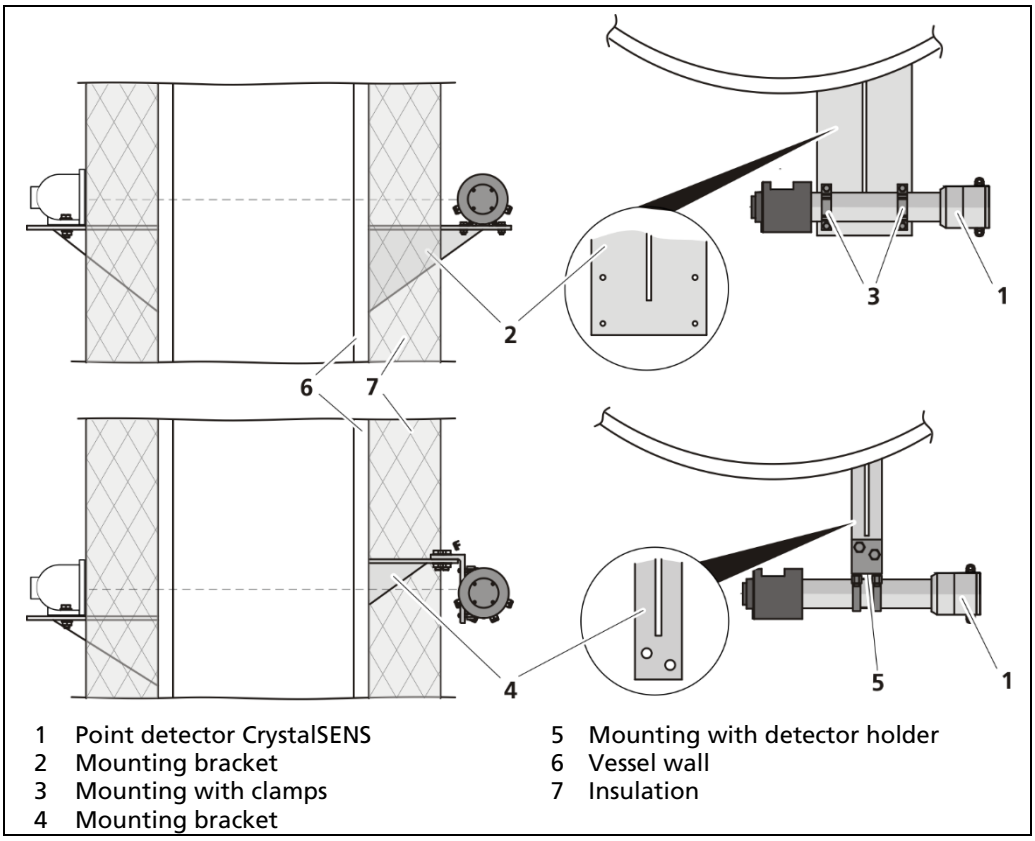
Fig. 21 Assembly rod detector UniSENS with collimator

Due to the weight of the collimator, a mounting foot has to be used which will carry the detector with collimator. In addition, an anti-tipping device has to be installed by customer at the upper flange (Bracket e.g. welded to the vessel or a special support). Alternative to the stabilizer against tilting, you can use a one-sided mounted angle bracket as a stabilizer too.

For installation or deinstallation, space for swiveling the collimator is recommended.

4.7 Installation Point Detectors on a Vessel

4.7.1 Mounting oif the CrystalSENS Point Detector



1 Point detector CrystalSENS
2 Mounting bracket
3 Mounting with clamps
4 Mounting bracket
5 Mounting with detector holder
6 Vessel wall
7 Insulation

Fig. 22 Mounting of point detector

With Point Source

The combination of CrystalSENS and point source is typically used to measure the limit level. The detector is aligned on the same height relative to the source.

With Rod Source

The size of the measurement range for continuous level measurement is defined by the radiation field received by the detector; this radiation field has to be taken into account during installation of detector and shielding. The installation situation is illustrated in the project drawings, sketches and descriptions.

IMPORTANT

When installing the CrystalSENS, please pay attention to the correct alignment relative to the source. The lateral opening (beam window) in the collimator releases the sensitive area of the detector and must be directed at the source.

The CrystalSENS is installed on the container using a bracket that is provided by the customer. The distance to the surface of the vessel or the surface of a thermal insulation should be about 100 mm. Clamps or an installation kit are used for installation of the detector on a bracket.

If the bracket cannot be mounted on the container, then it has to be mounted on a support in the vicinity. The technical drawings for CrystalSENS and its accessories can be found in the document "Technical Information". Information on water cooling can be found in chapter 9.1.

4.7.2 Mounting of the SuperSENS Point Detector

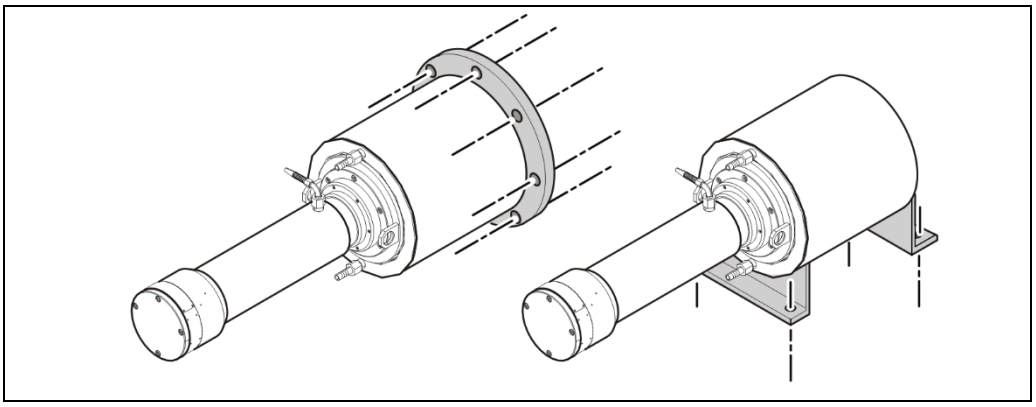


Fig. 23 Mounting of SuperSENS detector

SuperSENS detectors are installed on both thick-walled pipes and large vessels. The installation is carried out according to project-specific specifications. Information on water cooling can be found in chapter 9.1

5 Electric Installation

5.1 General Instructions

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Connect only devices onto the product that comply with the applicable safety standards.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

5.2 Initial Start-up

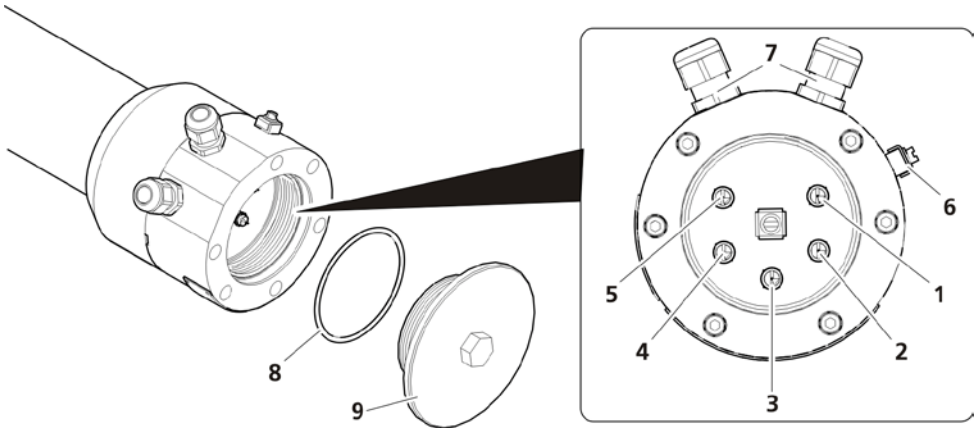
WARNING

Danger to life by explosion

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the safety manual / explosion protection manual.

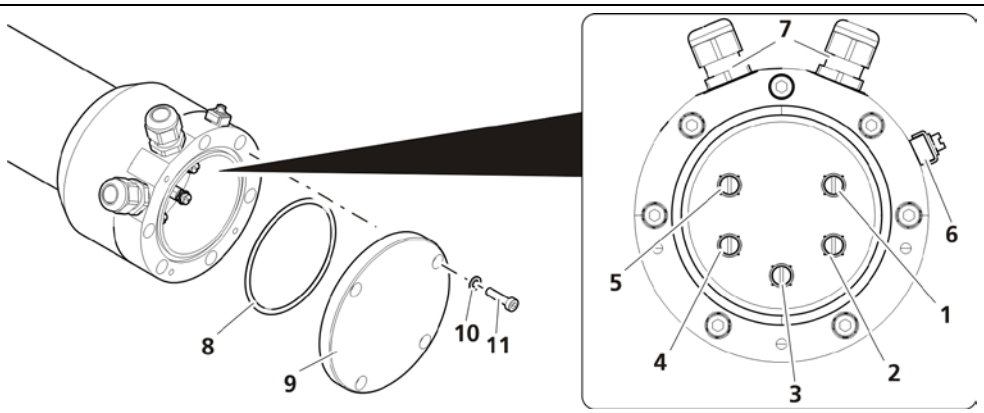
1. Make sure that the detector was mounted as described in chapter 4.
2. Loosen the screws on the cover and open the cover.
3. Connect the cable which connects the detector to the evaluation unit to terminals 1 and 2 in the terminal compartment. Also observe the operating manual for the evaluation unit LB 47x. The screws for fixing the conductors must be tightened with a torque of 1.2 Nm at the stud-type bushings.
4. Optional: Connect the connection cable of a Pt100 resistance thermometer (for measuring the medium temperature) to terminals 3 and 4 in the terminal compartment with a torque of 1.2 Nm.
5. If a shielded cable is used, connect the shield on terminal 5 on the terminal compartment. Make sure that the shield is sufficiently isolated from contact with other current-carrying conductors.
6. Connect the detector to a local equipotential bonding.
7. Attach the O-ring to the groove on the face of the socket.
8. Attach the lid. For all threads fat must be used, OKS 217 is recommended. To ensure the sealing function, the grease must be thickly applied to NPT threads.
   - The cover screws (cylinder head screws ISO 4762 - M5x16-A2-70) for the ATEX / IECEx variant must be underlaid with self-locking lock washers (NL5 SS from Nordlock®) and tightened with a torque of 4 Nm.
   - The screw cap of the NEC / CEC version must be tightened on the hexagon (spanner size SW 19) with a torque of 15 Nm.
9. Unused entries must be closed with the plugs listed (1/2 "NPT fitting) A tightening torque of 20 Nm is recommended.

- The electrical installation is complete.



1 Signal and supply circuit +
2 Signal and supply circuit -
3 Pt100 +
4 Pt100 -
5 Potential equalization
6 Potential equalization
7 Cable glands
8 Sealing
9 Screw cap

Fig. 24 Terminal compartment XP variant (Class / Division)



1 Signal and supply circuit +
2 Signal and supply circuit -
3 Pt100 +
4 Pt100 -
5 Potential equalization
6 Potential equalization
7 Cable glands
8 Sealing
9 Cover
10 Spring washers
11 Screws cover

Fig. 25 Terminal compartment ATEX/IECEx variant

5.3 Reuse of Detectors

NOTICE

If a detector was previously used, then please observe the following: Detectors that were used in non-explosive areas may no longer be used in an explosive area.

NOTICE

If an intrinsically safe detector was previously used, then please observe the following:
If intrinsically safe signals were connected to non-intrinsically safe circuits, these may no longer be connected to intrinsically safe circuits.

6 Operation

6.1 Operating Concept

For operation, different user interfaces are available

1. Evaluation unit LB 47x
2. Evaluation unit LB 44x
3. PC software (via detector service modem)

The detector internal diagnostic functions and data are not available when operating the detector with the transmitters LB 471 and LB 44x.

The operation and parameterisation is described solely by the example of the PC software. For information on the operation of the detector with the transmitters LB 47x and LB 44x, please refer to the respective operating manual of the transmitters.

6.2 PC Software

The following system requirements have to be met:

System requirements	Menu language: English Windows XP or higher 512 MB RAM 1 gigahertz processor USB port
Connections	USB port 2-pin FSK interface to the detector

1 Power connection
2 Terminal strip
3 USB port
4 2-pin FSK connector

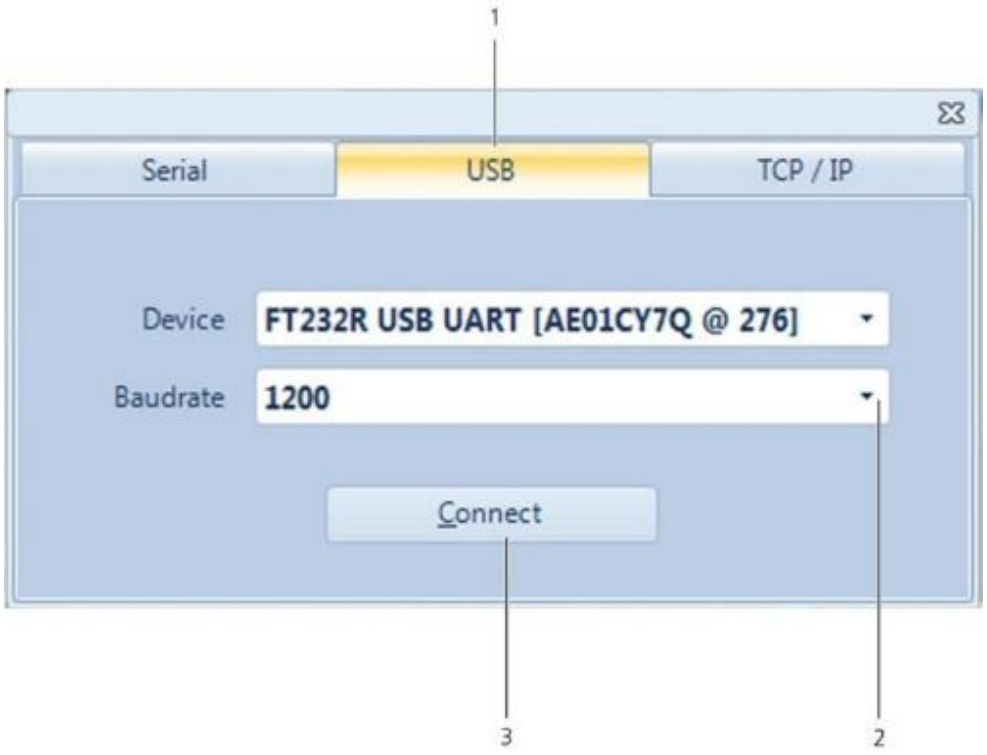
Fig. 26 Detector Service Modem

NOTICE

If the detector service modem is used on intrinsically safe detectors, the detector service modem with intrinsically safe FSK interface must be used.

1. Install the driver by running the driver file **"BertholdRS485.exe"** before connecting the detector service modem.
2. Execute the installation file "Setup.exe" in order to install the operating software **"LB 4700 PC"**.
   - ▶ Access to the detector is possible with the operating software **"LB 4700 PC"**.
3. Connect the detector to the 2-pin FSK connector of the detector service modem (Fig. 28 item 4).
4. Connect the detector service modem via the supplied USB cable (Fig. 28 item 3) to an available USB port on your PC.
5. Connect the detector service modem via the supplied power adapter to the power supply.

6. Start the program "LB-4700 PC PC-Software.exe".
   ▶ The program opens.
7. Click on the tab <USB> (Fig. 29, item 1).
8. In the selection menu (Fig. 29, item 2), select a baud rate of **1200**.
9. Click on <Connect> (Fig. 29, item 3).
   ▶ Die Startseite des Programms LB-4700 PC öffnet sich.



1 USB tab
2 Selection of baud rate
3 Connect button

Fig. 27 Connection Window, Operating Software "LB-4700 PC"

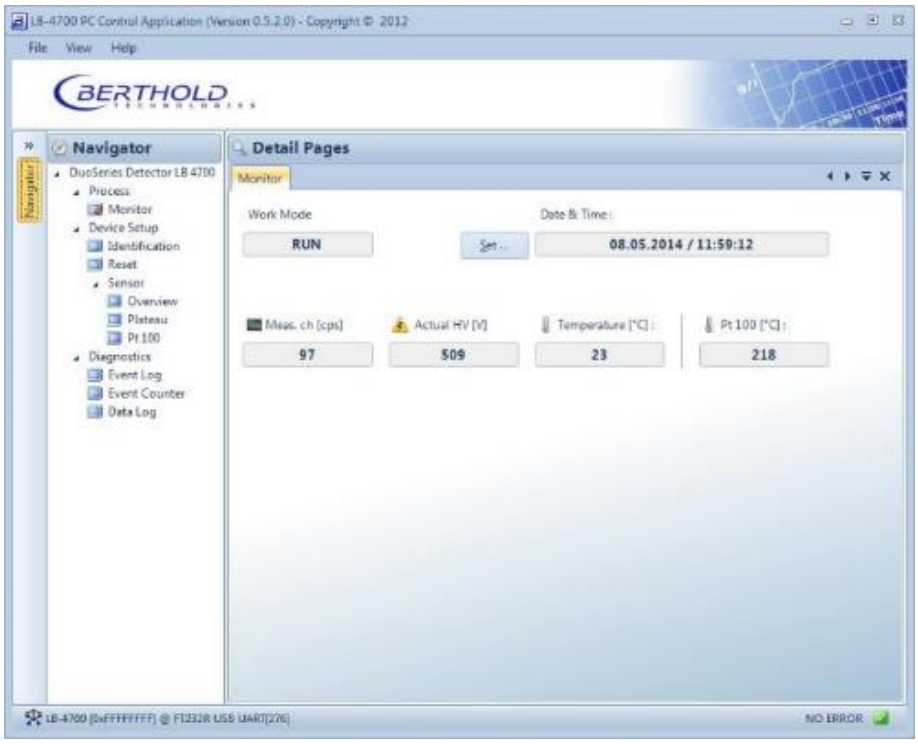


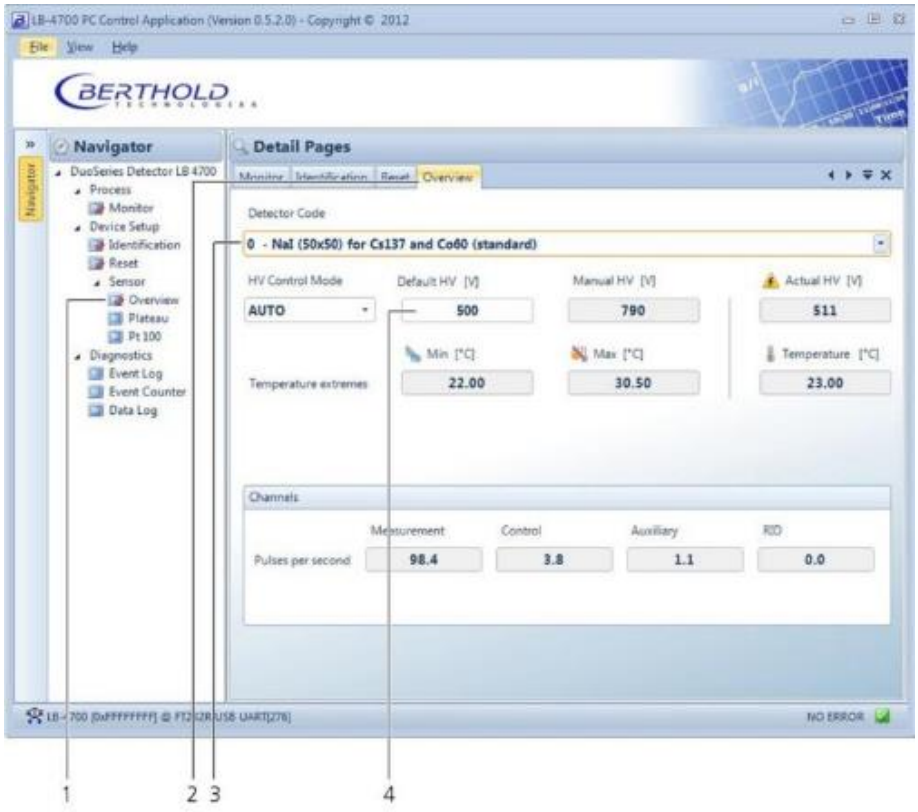
Fig. 28 Home Page, Operating Software "LB-4700 PC"

10. In order to return to the start screen from another menu, click on the tab <Monitor>.

6.3 Operating the PC Software

The following figures show the structural design of the PC software screen and the control options.

- Navigator with tree structure
- Input fields, buttons, and selection lists
- Tabs



1 Navigator
2 Tab
3 Selection List
4 Input field

Fig. 29 User Interface of the PC Software

1. Navigate in the navigator with a double click on the corresponding submenu (Fig. 31, item 1).
2. Once opened submenus remain open and can be viewed by clicking on the appropriate tab. (Fig. 31, item 2).
3. Open selection lists by clicking on the arrow button on the right side of the list field (Fig. 31, item 3).
4. Click in the input field to enter the desired values (Fig. 31, item 4). A red outline indicates the clicked box.

6.4 The PC Software Menu

The schematic structure of the detector menu of the PC software is displayed in Fig. 32.

- The Process menu gives you an overview of the most important measurement data and the system status. In addition, you can also adjust the detector's internal date and time.
- In the Device Setup menu, you can read and set all system and measurement parameters, as well as perform the plateau recording.
- The Diagnostics menu provides information about the event history and data log.

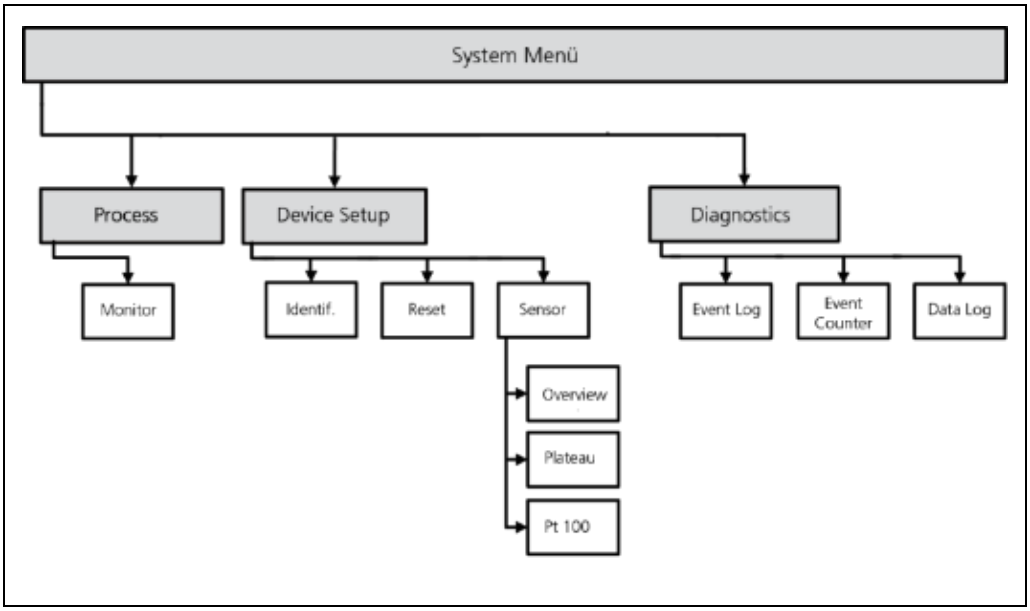
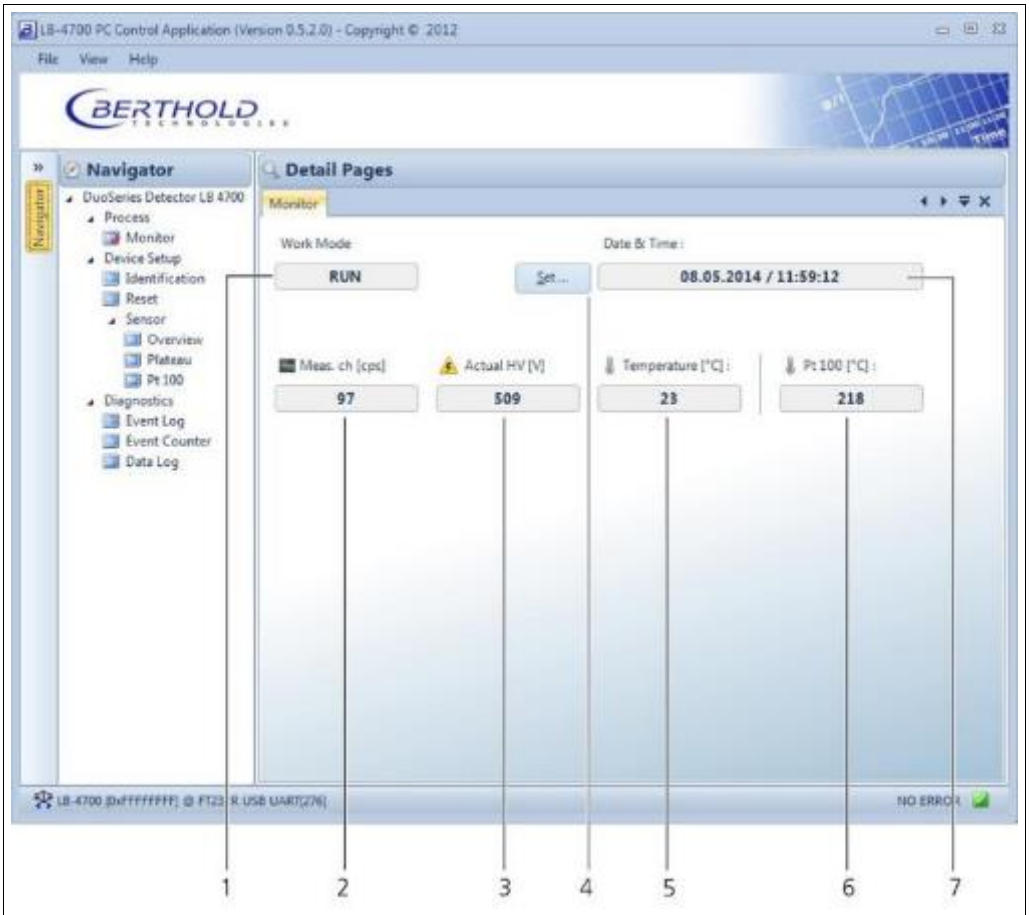


Fig. 30 System Menu, LB-4700 PC PC-Software

6.4.1 Monitor

The most important measurement data and the system status (work mode) are displayed in an overview in this submenu. In addition, you can set the date and time. Date and time are used to date events and log data.



1 Work Mode Display (System Status)
2 Meas. Display Ch [cps] (count rate in the measuring channel)
3 Actual HV Display (current high voltage)
4 Date and Time Setting
5 Temperature Display
6 Pt 100 [°C] Display
7 Date and Time Display

Fig. 31 Process | Monitor

Set Date and Time

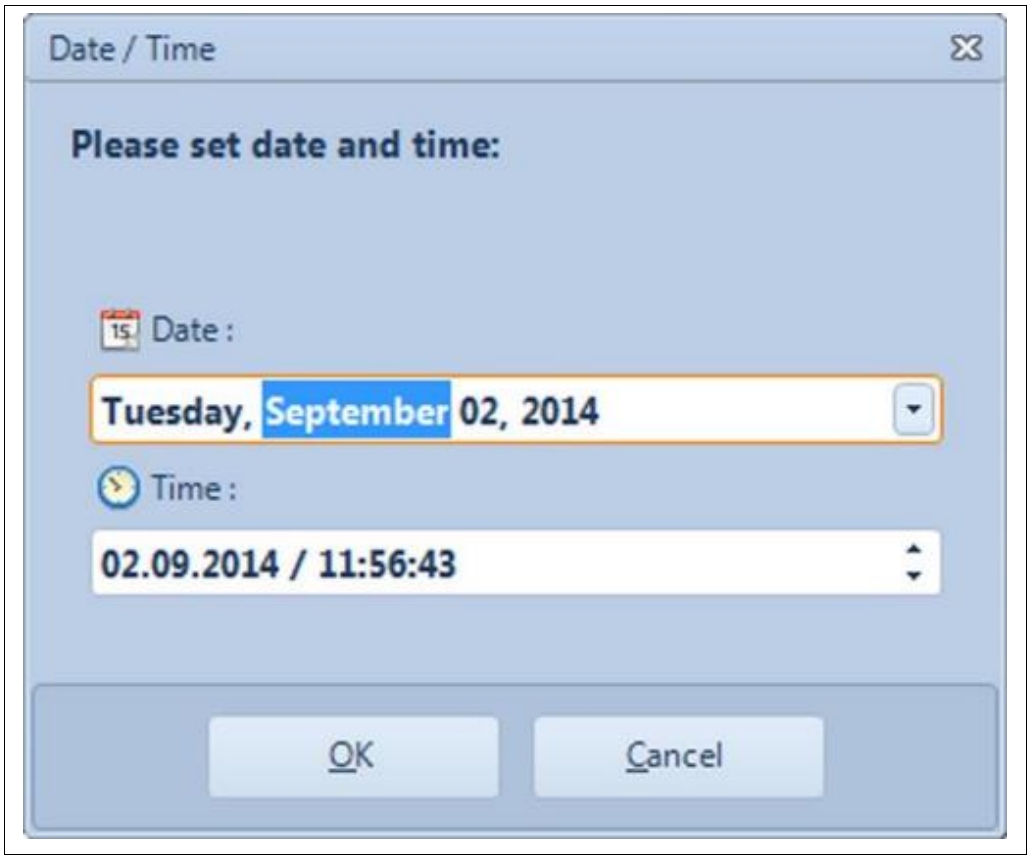


Fig. 32 Window to Set the Date/Time

1. Click on the button <Set ...>. (Fig. 33, item 4), to make changes to the date and time.
   - A window opens.
2. Make the changes.
3. Confirm with <OK>.

6.4.2 Identification

This submenu shows you an overview of the software version of the detector and the PC program as well as the device ID.

Open the Identification submenu in the menu group Device Setup of the navigator by double-clicking on <Identification> (Fig. 35).

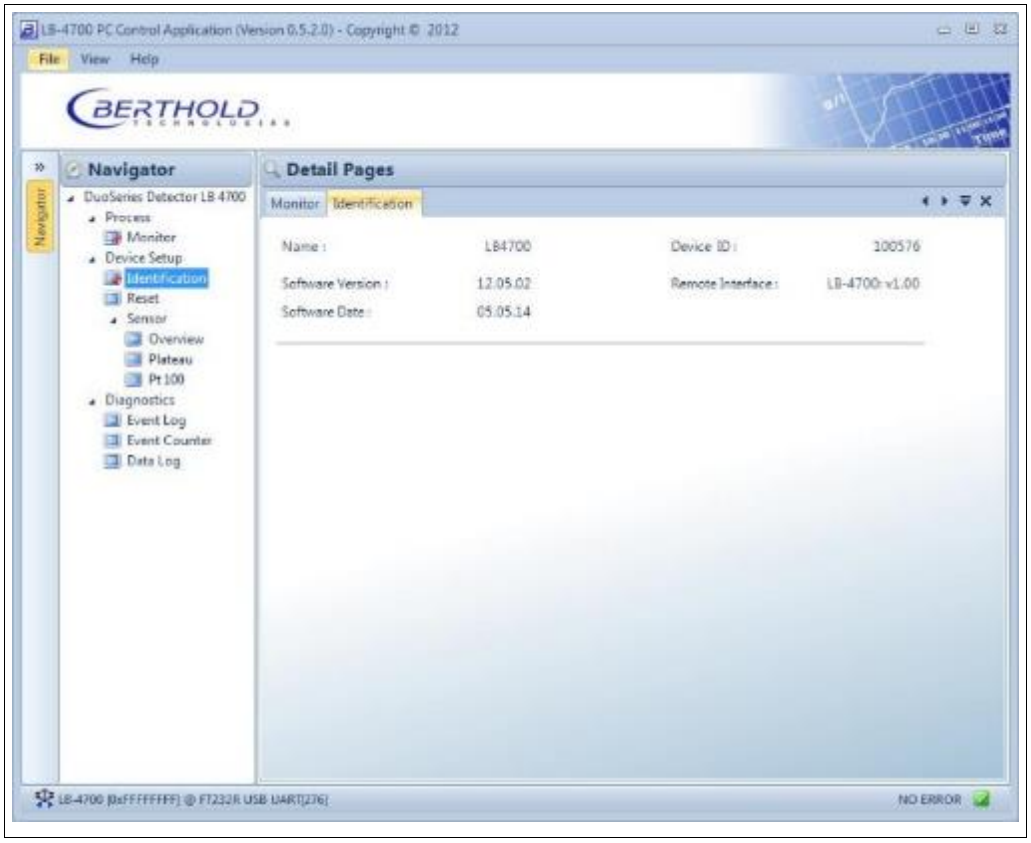
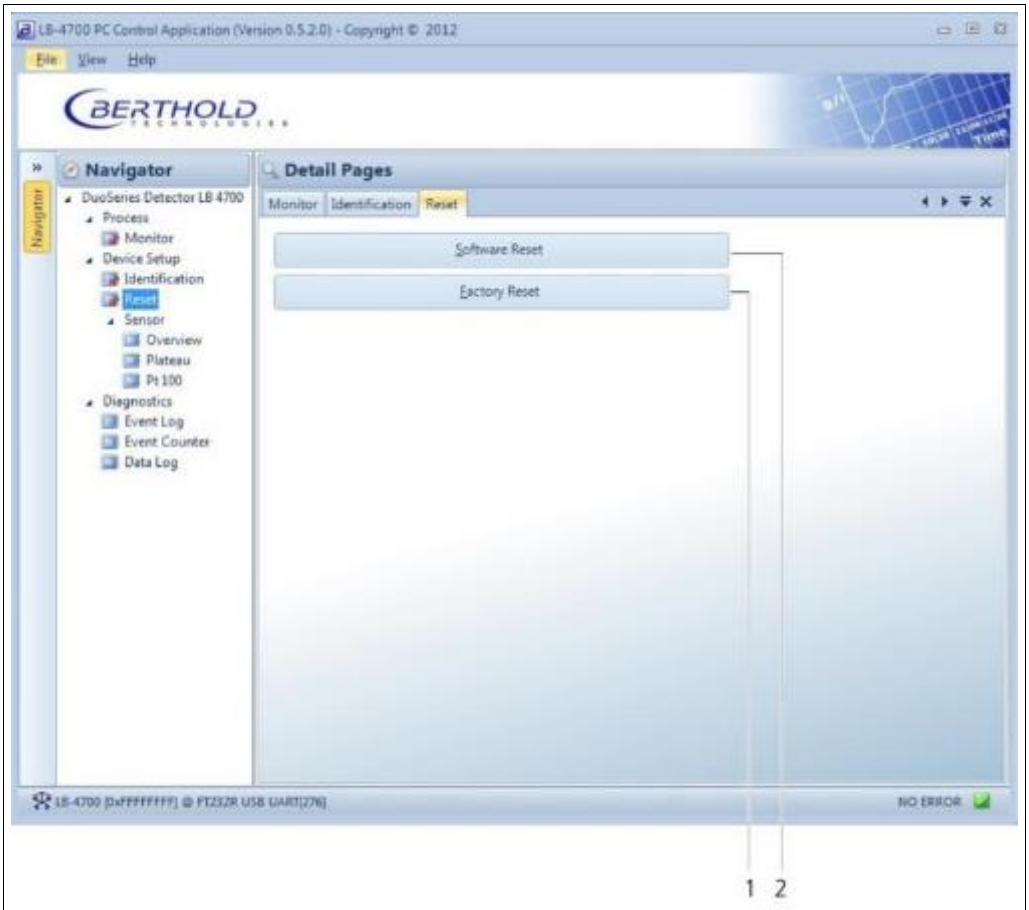


Fig. 33 Device Setup | Identification

6.4.3 Reset

In this submenu, you can restart the detector or reset it to the factory settings.

- Open the Reset submenu in the menu group Device Setup of the navigator by double-clicking on <Reset>.



1 Button <Software Reset> performs a restart of the detector.
2 Button <Factory-Reset> resets the detector to the factory settings and performs a restart.

Fig. 34 Device Setup | Reset

Perform Reset and Factory Reset

NOTICE

During the restart, the detector is not ready for measurement!

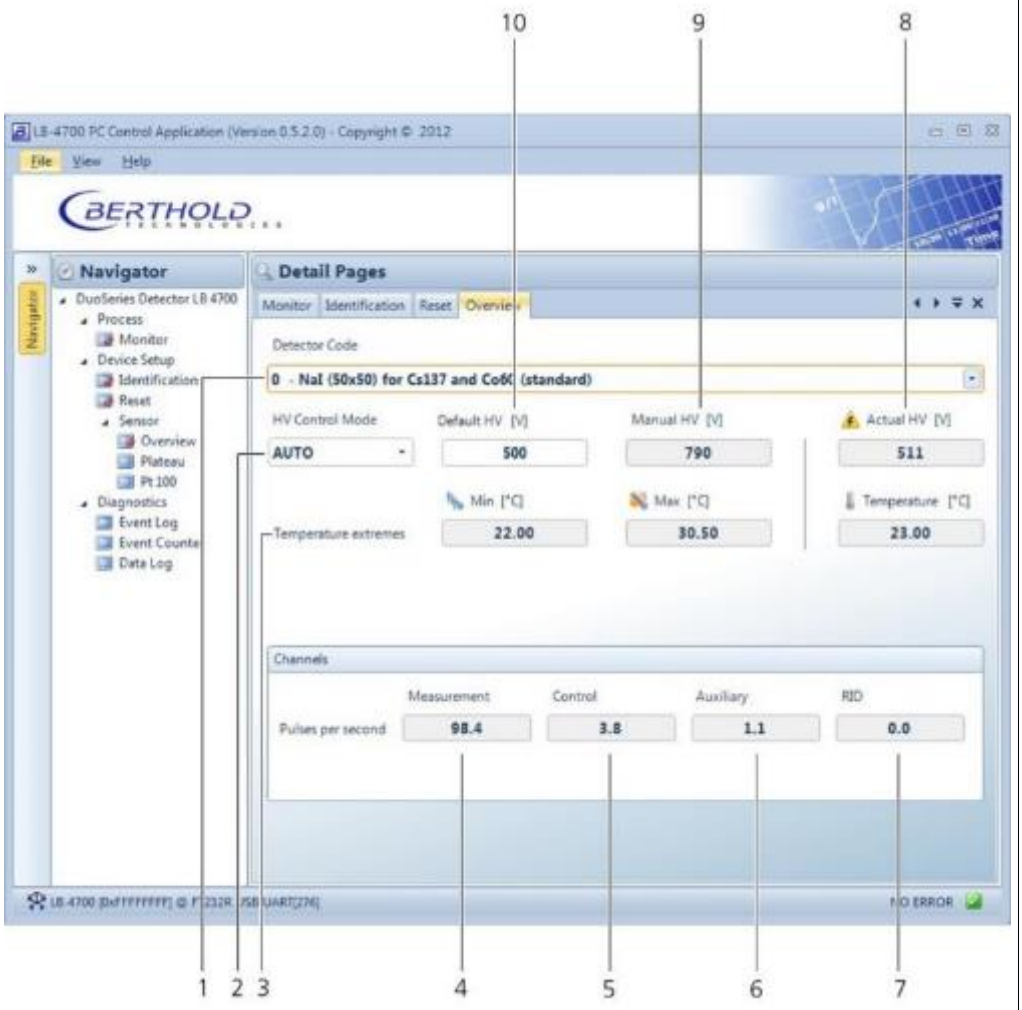
All settings made, such as plateau recordings and event logs, are lost when the detector is reset to factory settings.

Fig. 35 Warning message

1. Click on the desired Reset Button in the Reset submenu of the menu group Device Setup .
   - A warning message appears.
2. Confirm the warning message by clicking on <OK>.
   - During the restart, the PC-program loses the connection to the detector for a few seconds. The connection is automatically restored after the restart. After restart, the detector is ready to measure again.

6.4.4 Overview

Open the submenu Overview in the menu group Device Setup | Sensor of the navigator by double-clicking on <Overview> (Fig. 38). You can select the detector code and set preferences for high voltage control here.



1 Detector code selection
2 High-voltage mode selection Manual/Auto
3 Temperature values display
4 Display count rate in the measuring channel
5 Display count rate in the control channel
6 Display count rate in the auxiliary channel
7 Display count rate in the RID channel
8 Display current high voltage
9 Manual high voltage
10 Default HV (starting value of the high voltage control)

Fig. 36 Device Setup | Sensor | Overview

Setting the Detector Code

Internal device parameters are adjusted to suit the used scintillator size by setting the detector code. The correct detector code is set at the factory and a change is not normally required. A table with the detector codes to be used is found below:

Detector code	Scintillator type and size
0	CrystalSENS NaI (50x50 / 40x35 / 25x25)
2	CrystalSENS NaI (44x5) Am-241 (Soft Vers. ≥12.06.12)
3	CrystalSENS NaI (44x5) Cm-244, 0 ... 60°C, high stability (Soft Vers. ≥12.06.12)
4	CrystalSENS NaI (44x5) Cm-244, -40 ... 60°C (Soft Vers. ≥12.06.12)
6	CrystalSENS Polymer (50x60) [valid for LB 44x and LB 47x]
7	CrystalSENS NaI (125x50) K2O/KCL, 0 ... 60°C, high stability (Soft Vers. ≥12.06.12)
8	CrystalSENS NaI (50x50 / 40x35 / 25x25) low background (Soft Vers. ≥12.06.12)
9	CrystalSENS NaI (125x50) K2O/KCL, -40 ... 60°C (Soft Vers. ≥12.06.12)
52	CrystalSENS Polymer (50x60) [valid for LB 47x]
10	UniSENS Polymer (1500 and 2000 mm)
13	UniSENS Polymer (1000 and 1250 mm)
22	UniSENS Polymer (500 and 750 mm)
23	SuperSENS Polymer (150x150) (Soft Vers. ≥12.06.12)
32	TowerSENS Polymer 2000 mm (Soft Vers. ≥12.06.14)
33	TowerSENS Polymer 3000 mm (Soft Vers. ≥12.06.14)
34	TowerSENS Polymer 4000 mm (Soft Vers. ≥12.06.14)
35	TowerSENS Polymer 5000 mm (Soft Vers. ≥12.06.14)
36	TowerSENS Polymer 6000 mm (Soft Vers. ≥12.06.14)
37	TowerSENS Polymer 7000 mm (Soft Vers. ≥12.06.14)
38	TowerSENS Polymer 8000 mm (Soft Vers. ≥12.06.14)

NOTICE

An incorrect setting may have a negative impact on the long-term stability of the device or may lead to other forms of malfunction.

Setting the Detector Code (continued)

Click on the arrow button (Fig. 38, item 1) in order to set the desired detector code.

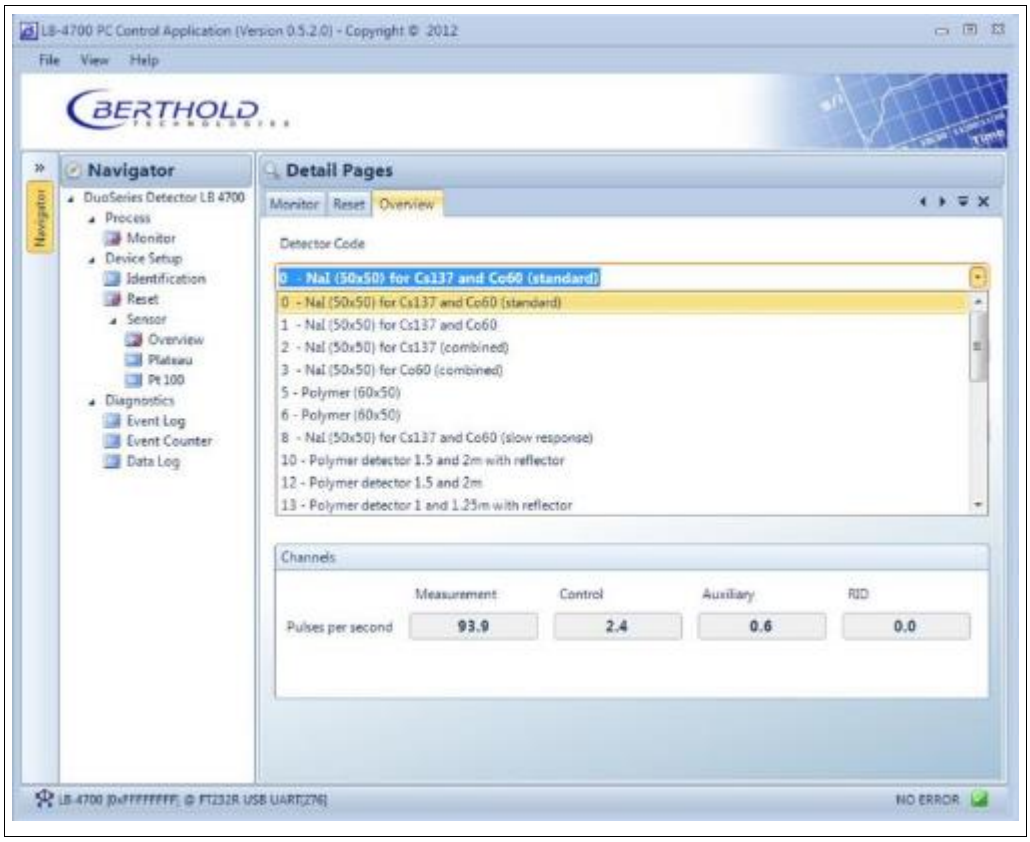


Fig. 37 Device Setup | Sensor | Overview | Detector Code

Setting the High Voltage Control

Click on the selection arrow (Fig. 38, item 2) in order to set the desired HV mode (auto or manual).

AUTO	The optimum high-voltage supply of the photomultiplier is automatically determined and set by the device
MANUAL	The high voltage is maintained at a fixed, user-entered value (manual HV, Fig. 38, item 9).

Click in the input field "Default HV" (Fig. 38, item 10) in order to enter the desired starting value for the high voltage control.

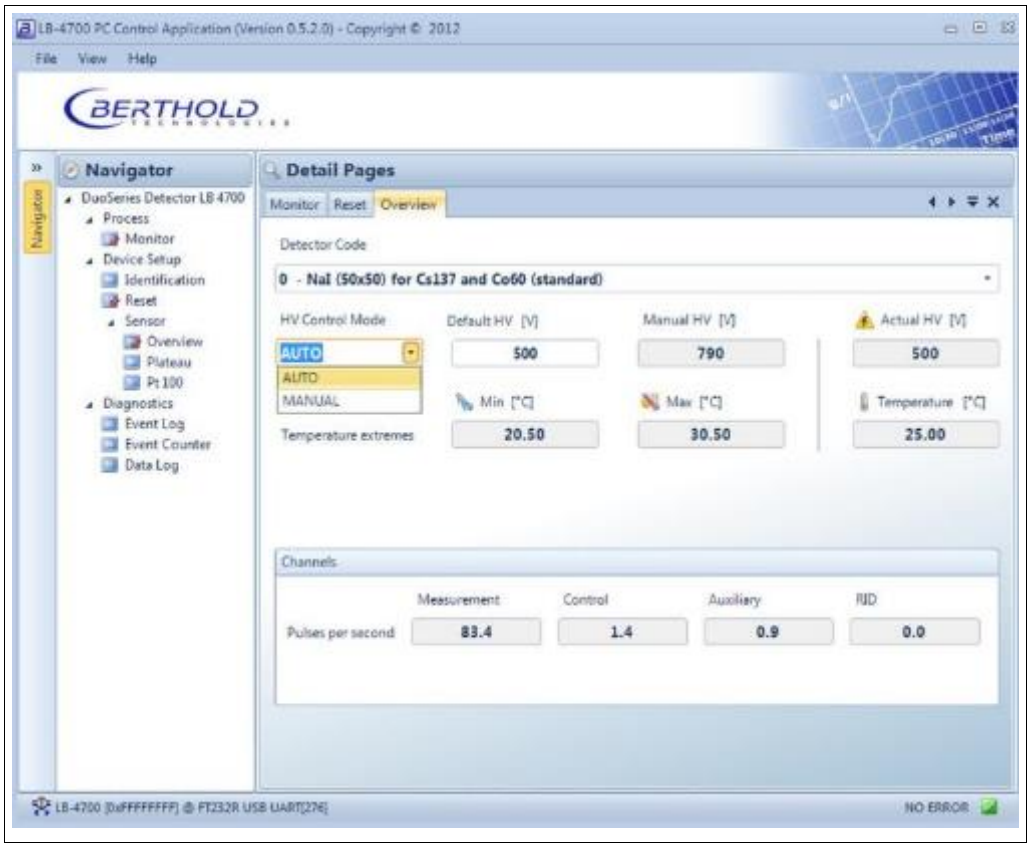


Fig. 38 Device Setup | Sensor | Overview | HV Control Mode

NOTICE

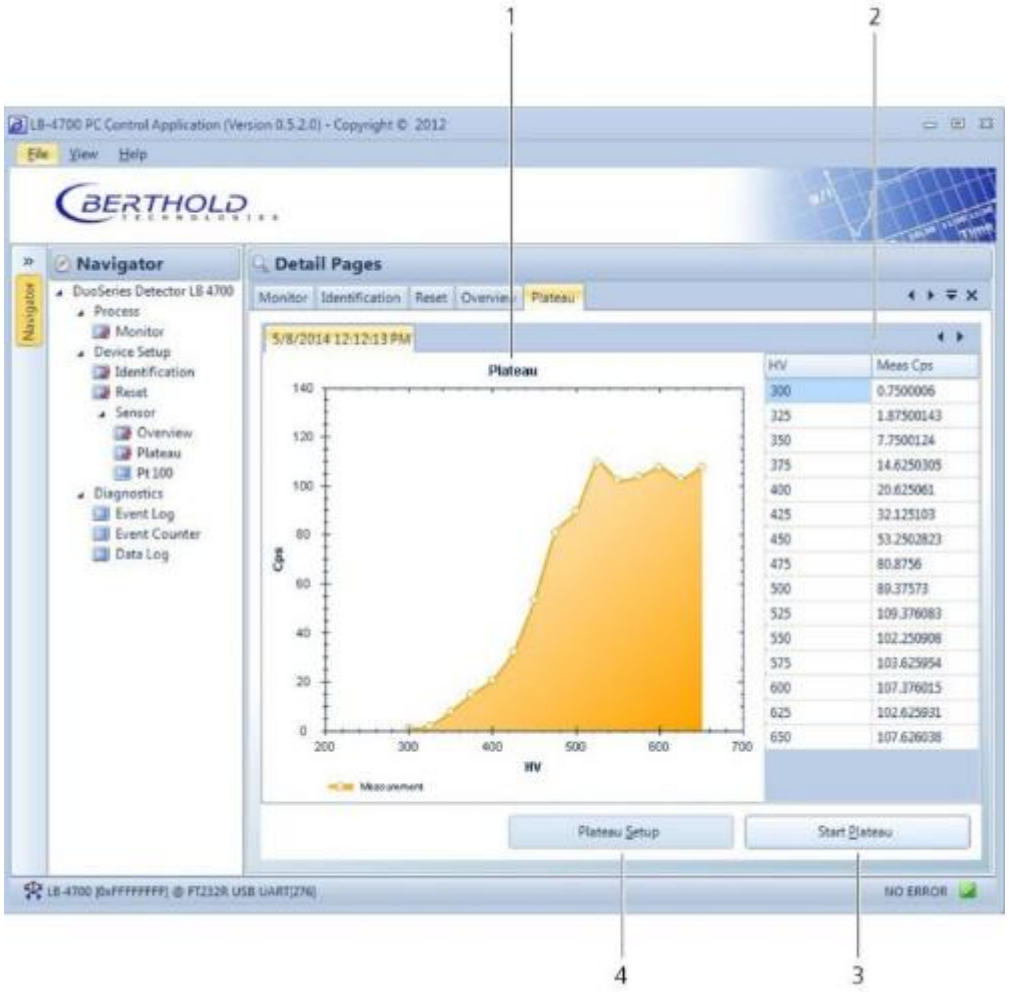
Default HV is preset by BERTHOLD. A subsequent change is not usually necessary. The default value HV = 0 may only be set for testing purposes. An incorrect setting may cause malfunction.

6.4.5 Plateau

Open the submenu Plateau in the menu group Device Setup | Sensor of the navigator by double-clicking on <Plateau> (Fig. 41).

Here you can read the saved plateau curve on the detector, set the parameters for plateau recording, and perform the plateau recording by clicking on <Start Plateau> .

The plateau curve is used for diagnostic purposes and must not be recorded during normal operation.



1 Display of the plateau curve
2 Display of the high-voltage values and the corresponding measured values of the count rate.
3 Button Start Plateau
4 Button Plateau Setup

Fig. 39 Device Setup | Sensor | Plateau

Setting the Parameters for the Plateau Recording

Click on <Plateau Setup> (Fig. 41, item4), in order to set the parameters.

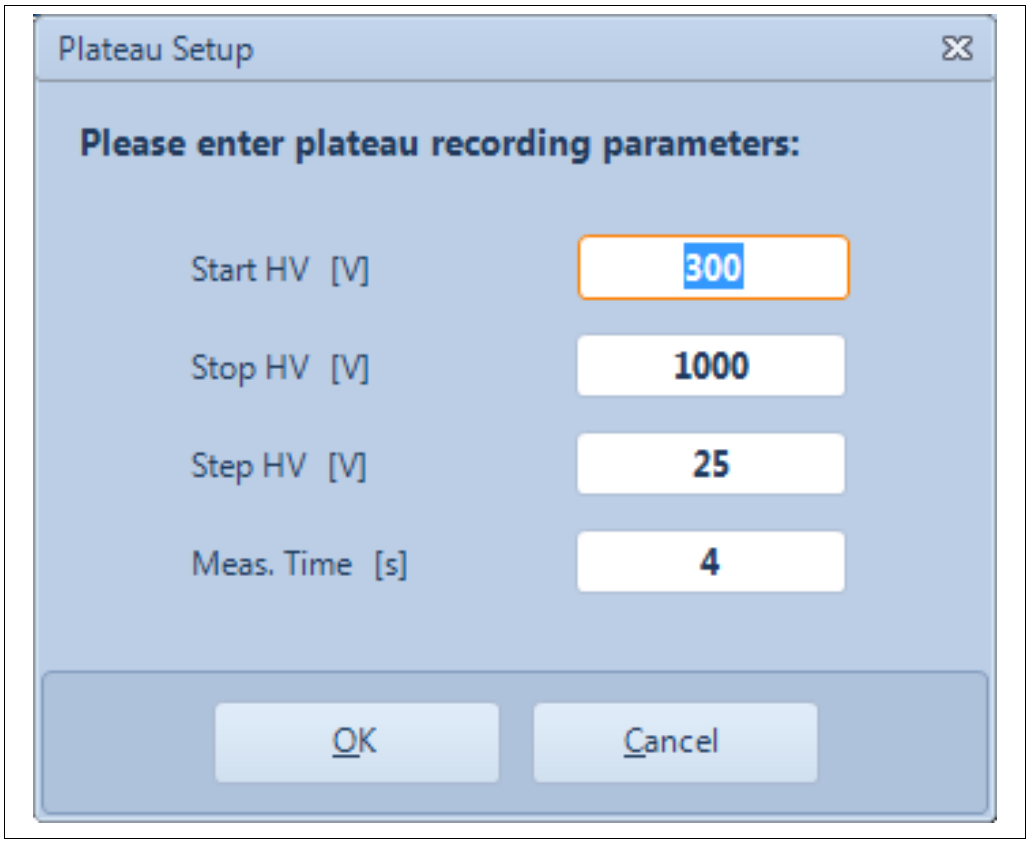


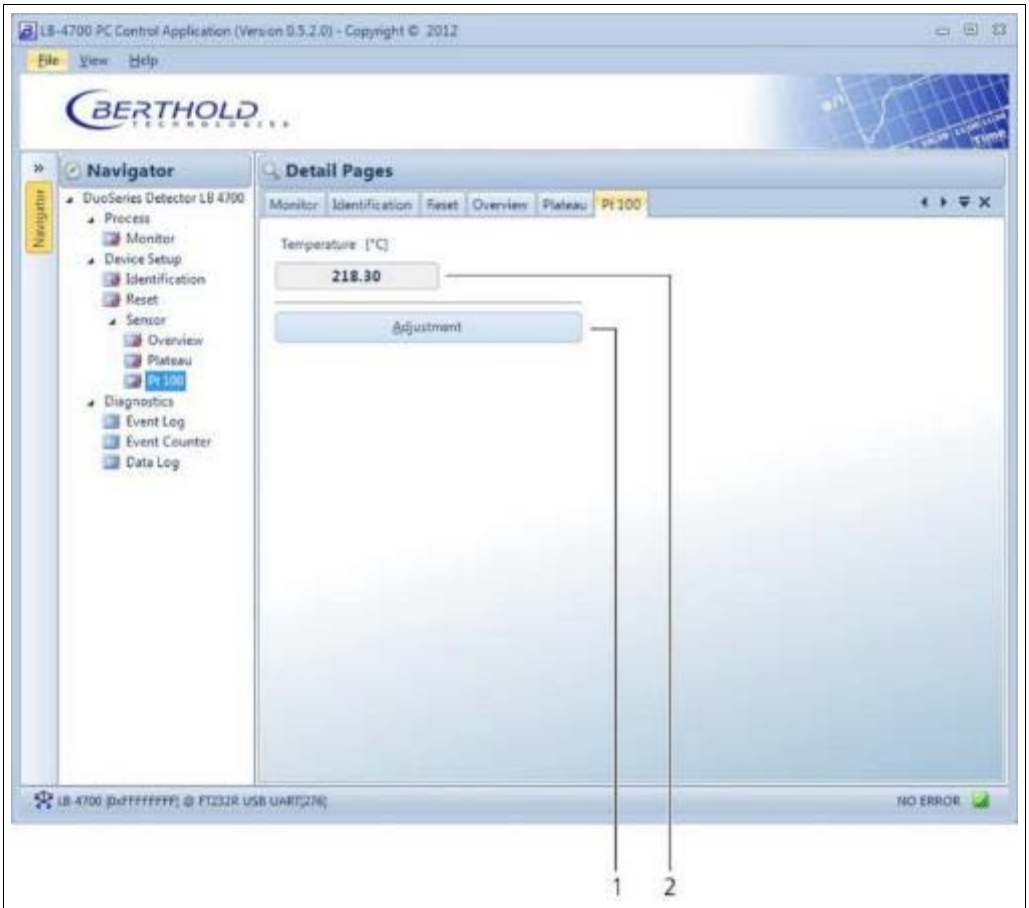
Fig. 40 Settings Dialogue Window for "Plateau Setup"

Start HV	Start value of the high voltage for a plateau measurement
Stop HV	End value of the high voltage for a plateau measurement
Step HV	Step size between two points during plateau measurement
Meas. Time	Measurement time for each plateau measurement point

6.4.6 Pt 100

Open the submenu Pt 100 in the menu group Device Setup | Sensor of the navigator by double-clicking on <Pt 100>. (Fig. 43).

The current temperature of the thermometer is displayed for the associated Pt 100 thermometer in this submenu. You can also calibrate the temperature measurement.



1 Adjustment button
2 Temperature display

Fig. 41 Device Setup | Sensor | Pt 100

Calibrate Pt 100 Temperature Measurement

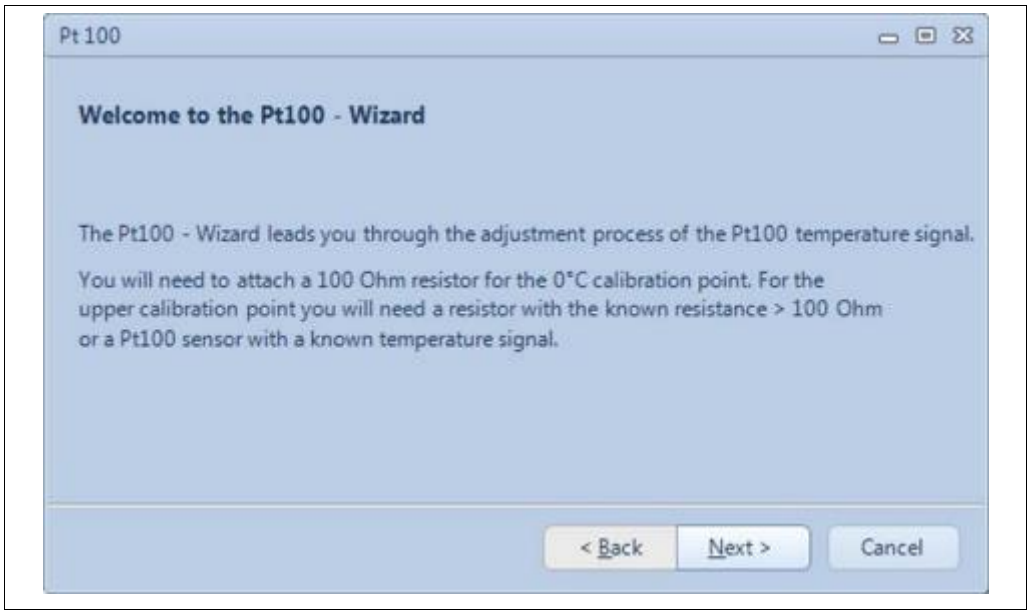


Fig. 42 Start Window of the Pt100 Wizard

1. Click on the button <Adjustment> (Fig. 43, item 1) in order to calibrate the Pt 100 temperature measurement.
   - ▶ A window opens. The Pt100 wizard guides you through the calibration process.
2. Connect a resistance of 100 ohms at terminals 3 and 4 in the terminal compartment of the detector.
3. Click on <Accept> in order to calibrate the 0 °C point.
   - ▶ The product temperature should now be displayed at about 0 °C.

Fig. 43 Step 1 of the Pt100 Wizard

4. Click on <Next> in order to proceed to the next step.
5. Connect a defined resistance (> 100 ohms) to terminals 3 and 4 in the terminal

compartment of the detector and enter the corresponding temperature value under "Real Temperature". Alternatively, you can also use a Pt 100 sensor with a known temperature signal. In this case, enter the known Pt 100 temperature.

6. Click on <Accept>.
   - The measured product temperature should now roughly match the entered value.

7. Click on <Next>, in order to proceed to the next step.

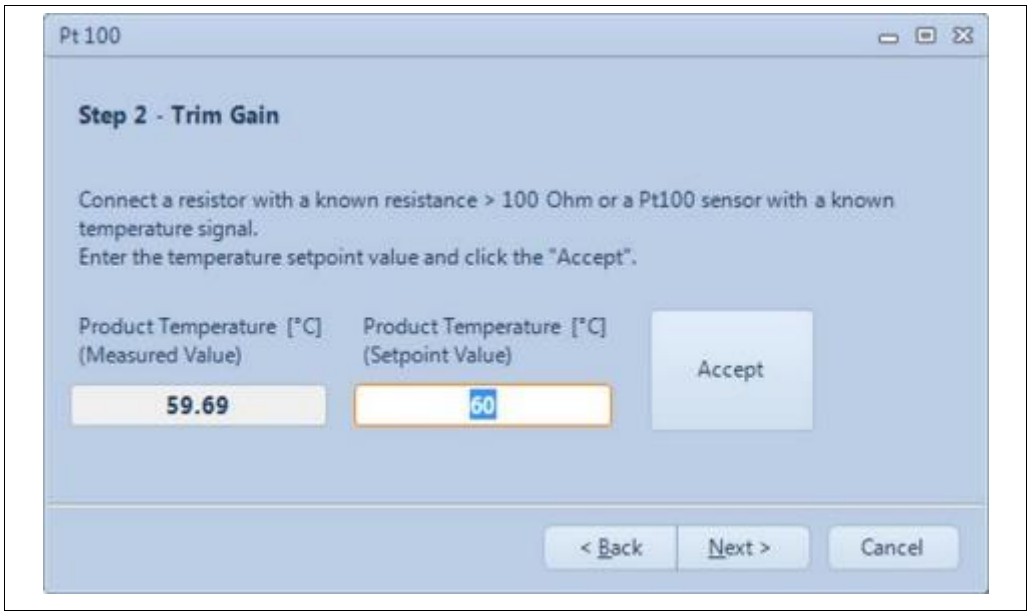


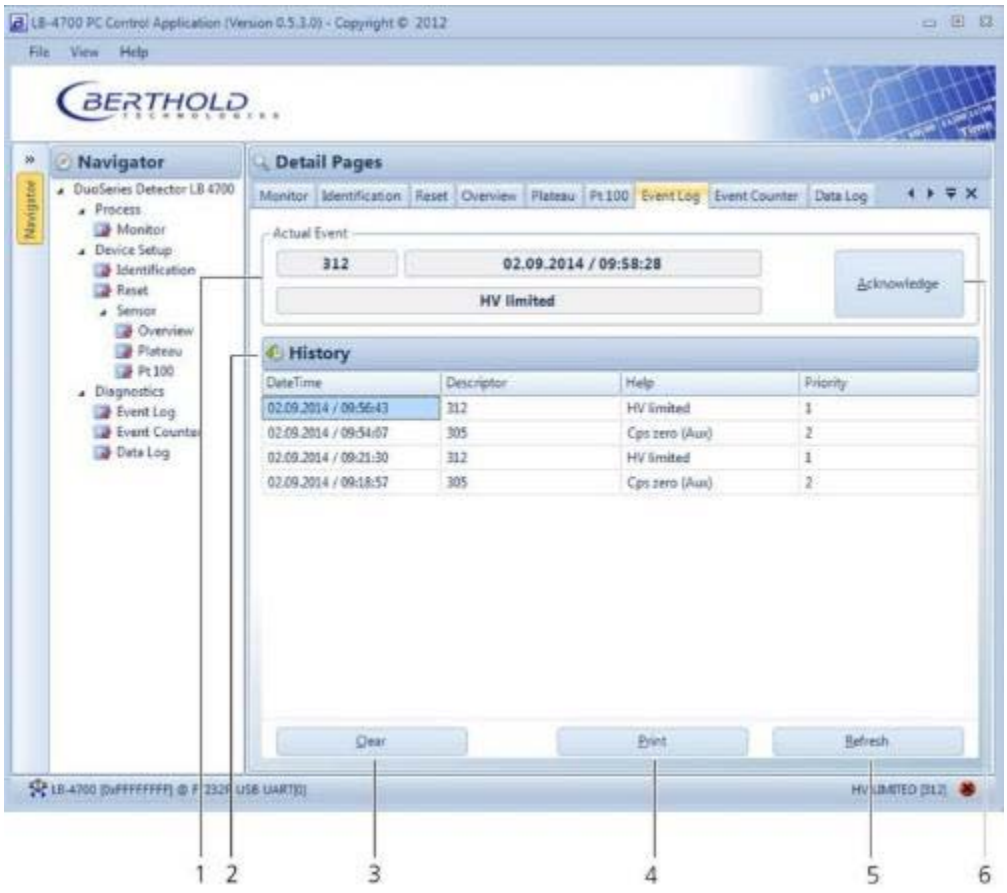
Fig. 44 Step 2 of the Pt100 Wizard

8. Click on <Finish> in order to complete the process or, if necessary, end the process with <Cancel> in order to cancel the calibration.

Fig. 45 Last Step of the Pt100 Wizard

6.4.7 Event Log

Open the submenu Event Log in the menu group Device Setup | Diagnostics of the navigator by double-clicking on <Event Log> (Fig. 48). The submenu "Event Log" logs the last 25 events that have occurred with date, time and description.



1 Display of the current event
2 List of events occurred
3 Clear button (clears the event list)
4 Print button (creates a printable PDF)
5 Refresh button (reloads the current event list from the detector)
6 Acknowledge button (acknowledges the currently pending events)

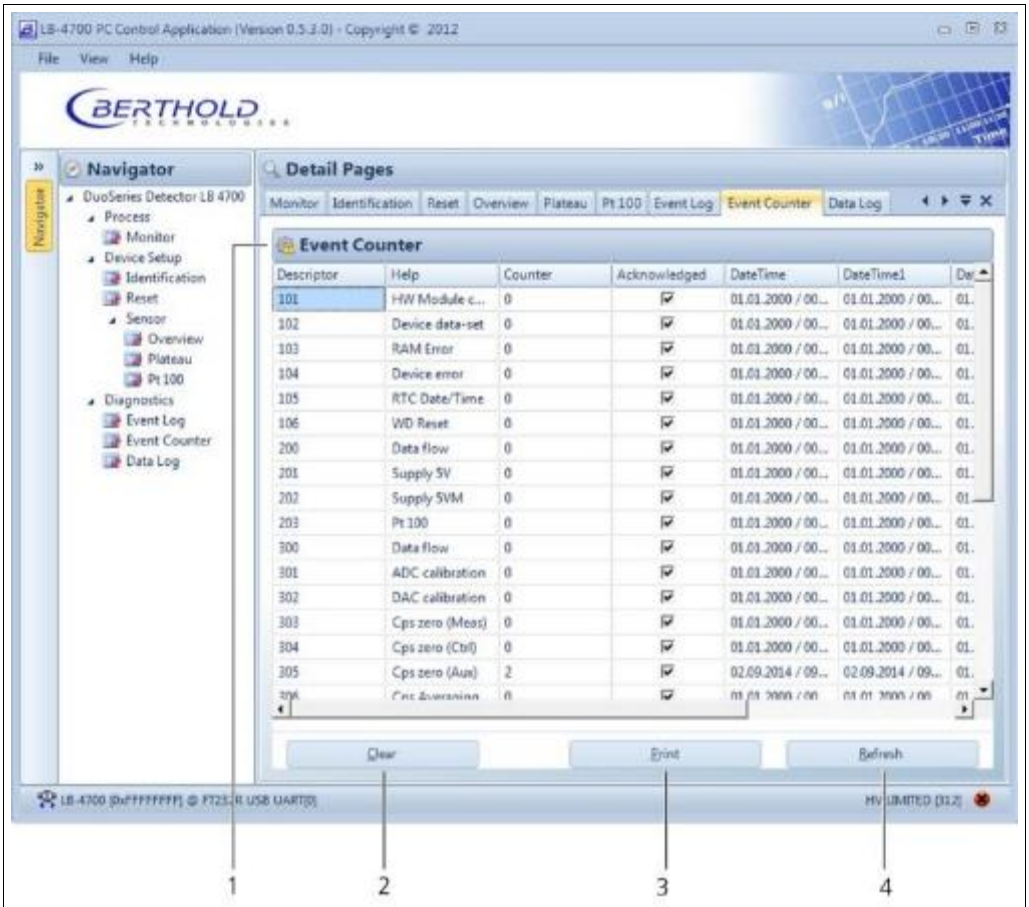
Fig. 46 Diagnostics | Event Log

1. If you want to clear the event list, click <Clear> (Fig. 48, item 3).
2. In order to print the event list, click <Print> (Fig. 48, item 4).
   - ▶ This will open the "Print Preview" window.
   - ▶ Printing the event list using the dialogue window "Print Preview" generates a PDF.
3. Click <Refresh> (Fig. 48, item 5), in order to load the list of events from the detector.
4. Click <Acknowledge> (Fig. 48, item 6), when an event requires an acknowledgement.

6.4.8 Event Counter

Open the submenu Event Counter in the menu group Device Setup | Diagnostics of the navigator by double-clicking on <Event Counter>. (Fig. 49).

This submenu displays, sorted by groups, for each event, the counter of how often the event occurred, and the time stamp of the last five events.



1 List of all events that have occurred
2 Clear button (clears the event list)
3 Print button (creates a printable PDF)
4 Refresh button (reloads the current event list from the detector)

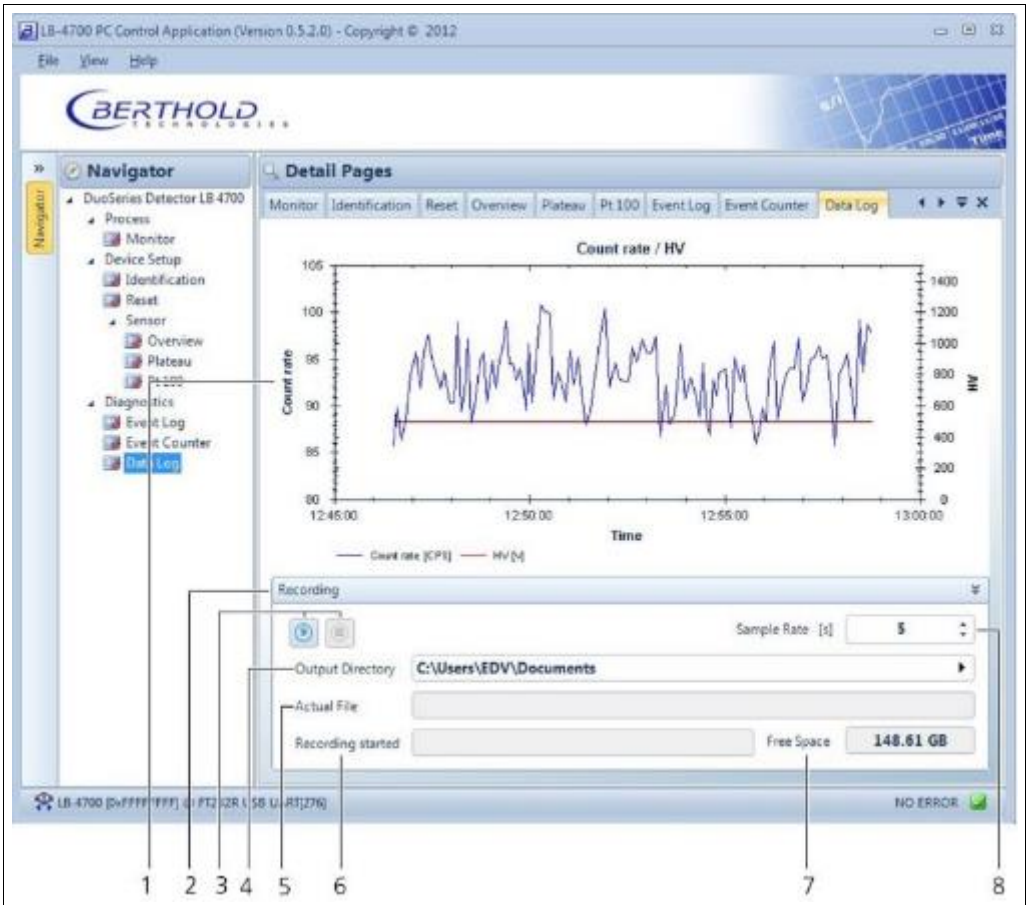
Fig. 47 Diagnostics | Event Counter

1. If you want to clear the event list, click <Clear> (Fig. 49, item 2).
2. In order to print the event list, click <Print> (Fig. 49, item 3).
   - This will open the "Print Preview" window. Printing the event list via the "Print Preview" generates a PDF.
3. Click <Refresh> (Fig. 49, item 4) in order to load the list of events from the detector.

6.4.9 Data Log

Open the submenu Data Log in the menu group Device Setup | Diagnostics of the navigator by double-clicking on <Data Log> (Fig. 50). The current count rate and high voltage of the detector are shown graphically in this .

In addition, you can output the recorded chart values as a text file (.txt) and save on the connected PC.



1 Graphical representation of the count rate and high voltage curve
2 Display and control panel "Recording"
3 Buttons to start recording and stop recording
4 Select output directory (output location of the log file)
5 Display actual file (name of the current log file)
6 Display recording started (date/time for the start of recording)
7 Display Free Space (free hard disk space on the connected PC)
8 Selection keys Sample Rate (log interval of the data logs)

Fig. 48 Diagnostics | Data Log

1. To zoom, hold down the left mouse button in the chart box and highlight the area to be zoomed.
2. Right-click in the chart box to open a window with the following settings:
   - Copy: Copies the current chart view to the clipboard of PC
   - Save Image as: Saves the current chart view on the PC
   - Page Setup: Page settings for printing function.
   - Print: Prints the current chart view.
   - Show Point Values: Enables/disables the display of measurement points on the chart when they are highlighted with the cursor.
   - Un-Zoom: Undoes the last zoom operation.

- Undo all Zoom/Pan: Sets the zoom back to the start value.
- Set Scale to Default: Adjusts the axis scaling to the fluctuation of the measured values.

3. In order to start the recording of log data on the PC, click on Recording | <Record-Start> (Fig. 50, item 4).
4. In order to stop the recording, click on <Record-Stop> (Fig. 50, item 3).
5. Click on the selection arrows or click in the field <Sample Rate> (Fig. 50, item 8) in order to select or enter the log interval.

7 Troubleshooting

7.1 System Events

A list of all possible device event messages with troubleshooting options is provided below. Event messages are automatically hidden if the cause of the event is no longer present. Exceptions are marked in the list. In this case, the event, as described in chapter 6.4.7, must be manually acknowledged.

System events can lead to the following system statuses:

- Shutdown
- Failure
- Out of Specification
- Function Check

Shutdown (Namur107: F)

A critical error has occurred. The detector will shut down to prevent damage. The measurement is stopped.

Failure (Namur107: F)

A serious error has occurred and the accuracy of the measurement results is not ensured. The measurement is continued.

If the detector is operated with an LB 44x/LB 471 transmitter, then the count rate is set to 0 by the system status "Failure" in order to signal the system status. In this case, the measurement is interrupted.

Out of Specification (Namur107: S)

The detector, one of its components or the environmental conditions are not within the normal specifications. The measurement is continued.

Function Check (Namur107: C)

Indicates that entries are made at the detector or a function check/simulation is being performed.

Code	Text	Description	Namur107	Correction
System				
D101	HW module corrupted	Corrupt hardware electronics module	F	Restart the device. If the event occurs frequently, contact Berthold.
D102	Device data-set	Permanent memory error, no parameter set was found.	F	Perform a factory reset and/or restart the device. If the event occurs frequently, contact Berthold.
D103	RAM error	Error in RAM.	F	Restart the device. If the event occurs frequently, contact Berthold.
D104	Device error	System error	F	If the event occurs frequently, contact Berthold.
D105	RTC date/time	Error in the real-time clock.	F	Reset the date and time. Restart the device. The event must be confirmed manually.
D106	WD Reset	The watchdog has triggered a restart of the device.	S	If the event occurs frequently, contact Berthold. Verify whether massive electromagnetic disturbances have triggered the event.
Main Board				
D200	Data flow	Error during execution of the software	F	Restart the device. If the event occurs frequently, contact Berthold.
D201	Supply 5.0V	Hardware error	F	Contact Berthold. The hardware is defective and, if necessary, must be checked and replaced.
D202	Supply -5.0V	Hardware error	F	Contact Berthold. The hardware is defective and, if necessary, must be checked and replaced.
D203	Pt100 Temperature	Error when reading the Pt100 input. The last valid temperature value is kept.	F	Restart the device. If the event occurs frequently, contact Berthold. The event must be confirmed manually.
Detector				
D300	Data flow	Error during execution of the software.	F	Restart the device. If the event occurs frequently, contact Berthold.
D301	ADC calibration	Hardware error	S	Restart the device. If the event occurs frequently, contact Berthold. The event must be confirmed manually.
D302	DAC calibration	Hardware error	S	Restart the device. If the event occurs frequently, contact Berthold. The event must be confirmed manually.

Code	Text	Description	Namur107	Correction
D303	Cps Zero (Meas)	No count rate in the measuring channel.	F	The photomultiplier may be defective. Check the photomultiplier or contact Berthold.
D304	Cps Zero (Ctrl)	No count rate in the control channel.	S	The photomultiplier may be defective. Check the photomultiplier or contact Berthold.
D305	Cps Zero (Aux)	No count rate in the auxiliary channel.	S	The photomultiplier may be defective. Check the photomultiplier or contact Berthold.
D306	Cps averaging	The count rate fluctuates more than permissible.	F	If the event occurs frequently, contact Berthold.
D307	Threshold (Meas)	The voltage of the measuring channel deviates from the admissible set value.	F	Restart the device. If the event occurs frequently, contact Berthold.
D308	Threshold (Ctrl)	The voltage of the control channel deviates from the admissible set value.	S	Restart the device. If the event occurs frequently, contact Berthold.
D309	Threshold (Aux)	The voltage of the auxiliary channel deviates more than allowed from the control value.	S	Restart the device. If the event occurs frequently, contact Berthold.
D310	Threshold (RID)	The voltage of the RID channel deviates from the admissible set value.	S	Restart the device. If the event occurs frequently, contact Berthold.
D311	HV voltage - PMT	An error in the high-voltage supply of the photomultiplier was detected.	F	Check detector electronics and photomultiplier. If necessary, contact Berthold.
D312	HV limited	The current high voltage deviates from the average high voltage by more than 20%.	F	Check detector electronics and photomultiplier. If necessary, contact Berthold.
D313	Lower Avg. HV limit	The average HV is more than 20% lower than the Default-HV.	F	Check Default HV for plausibility and change if necessary. Check detector electronics and photomultiplier. If necessary, contact Berthold.

Code	Text	Description	Namur107	Correction
D314	Upper Avg. HV limit	The average HV exceeds the Default-HV by more than 40%.	S	Check Default HV for plausibility and change if necessary. Check detector electronics and photomultiplier. If necessary, contact Berthold.
D315	Temperature sensor	The temperature sensor of the detector is defective.	S	Contact Berthold. The hardware is defective and, if necessary, must be checked and replaced.
D316	Temperature warning	The internal detector temperature is close to the upper or lower limit of the permissible operating temperature.	S	If the detector is too hot: Install/check water cooling system. If the detector is too cold: Install/check heating.
D317	Temperature alarm	The internal detector temperature has exceeded the upper limit of the permissible operating temperature or dropped below the lower.	F	Proper function of the device can no longer be guaranteed. It is recommended to have the device checked by Berthold Technologies, even if it still seems to work properly.
D318	Detector malfunction	An error in the state machine of the detector has occurred	F	Restart the device. If the event occurs frequently, contact Berthold.
D319	Plateau Recording	Indicates that plateau recording is running.	C	No action is required. The detector returns automatically to measurement mode after plateau recording is finished.
D320	HV too high	The actual HV has reached the upper HV limit (HV > 1287V, bzw. HV > 1300V - 1%)	F	Contact BERTHOLD. Detector must be checked and replaced if necessary.
D321	HV too low	The actual HV has reached the lower HV limit (HV < 303V, bzw. HV < 300V + 1%)	F	Contact BERTHOLD. Detector must be checked and replaced if necessary.

8 Maintenance and Repair

8.1 Safety Instructions

⚠ WARNING

Danger to life by explosion

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the Safety Manual / Explosion Protection Manual.

NOTICE

The applicable national regulations of the respective country of use have to be observed!

Maintenance work on the detectors may only be performed by qualified personnel. For detectors that will be used in explosion hazardous areas, repairs should only be performed by the service of Berthold Technologies GmbH & Co. KG. Improper repairs may lead to the loss of explosion protection.

NOTICE

Repairs to electronic circuits on the boards of a DuoSeries detector may only be performed by the manufacturer.

The relevant safety regulations should be observed when working on electrical components. Particularly observe the safety instructions in the chapter of 2 this operating manual. Disconnect the detector from the power supply.

IMPORTANT

To achieve optimum measuring accuracy, we recommend recalibrating the measuring system after a repair (not after changing the housing).

For devices that are *NOT* used in hazardous areas, the following parts may be replaced at your own risk and loss of any currently existing warranty against Berthold Technologies GmbH & Co. KG:

- the complete electronics system of the detector
- the scintillator
- the multiplier (photomultiplier)
- the multiplier/scintillator combination
- the detector housing

Berthold recommends that detectors are only repaired by the Service of Berthold Technologies GmbH & Co. KG or by persons authorised to do so by Berthold Technologies GmbH & Co. KG.

Only original spare parts from Berthold may be used.

Perform a visual inspection and a test of the terminal compartment after repair, maintenance or servicing. To do this, use the check lists in Safety Manual / Explosion Protection Manual.

8.2 Software Update

The following chapter describes the process of a software update of the device with the Detector Service Modem.

⚠ WARNING

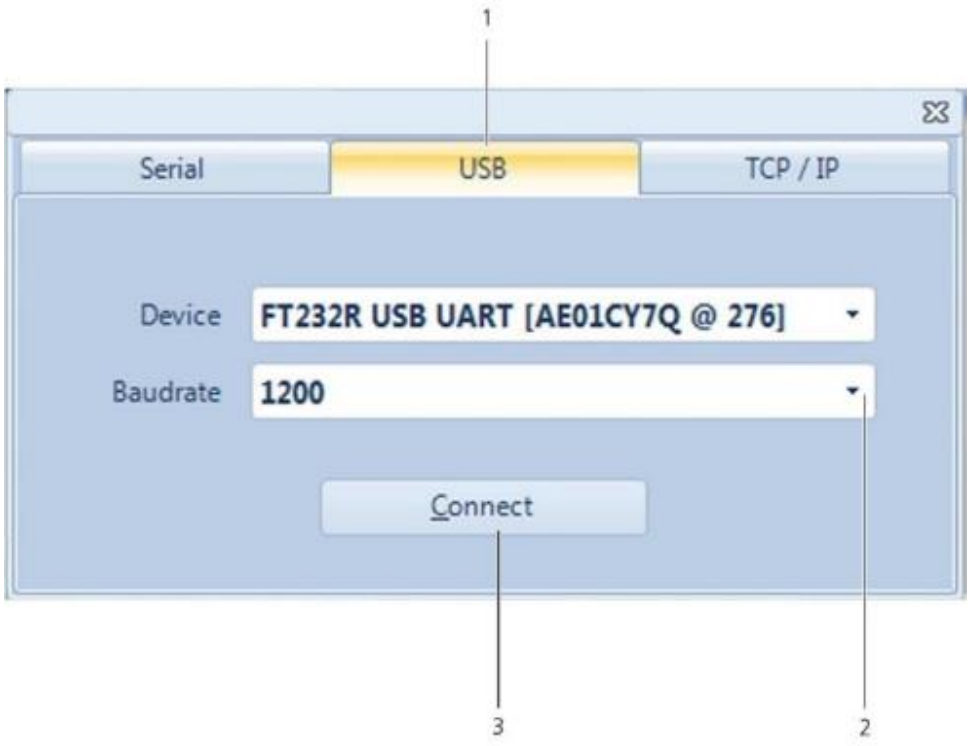
Danger to life by explosion

- If the detector service modem is to be used on intrinsically safe detectors, the intrinsically safe version of the modem should be used.

NOTICE

For software updates, Flash Loader version 2.1.0 or higher is required.

1. Install the drivers by executing the driver file. "BertholdRS485.exe" before connecting the detector service modem.
2. Run the installation file "Setup.exe" to install the service program "FLASH Loader". The software of the detector can be updated with the service program "FLASH Loader".
3. Connect the detector to the 2-pin FSK interface of the "detector service modem" (Fig. 28, item 4).
4. Connect the "detector service modem" via the supplied USB cable (Fig. 28, item 2) to an available USB port on your PC.
5. Connect the detector service modem via the supplied AC adapter to the power supply (Fig. 28, item 1).
6. Start the program **"FlashLoader.exe"**
7. The program opens.
8. Click on the tab <USB> (Fig. 51, item 1).
9. Select a baud rate of 1200 in the selection menu (Fig. 51, item 2).
10. Click on <Connect> (Fig. 51, item 3).



1 USB tab
2 Selection of baud rate
3 Connect button

Fig. 49 Connection Window "Flash Loader"

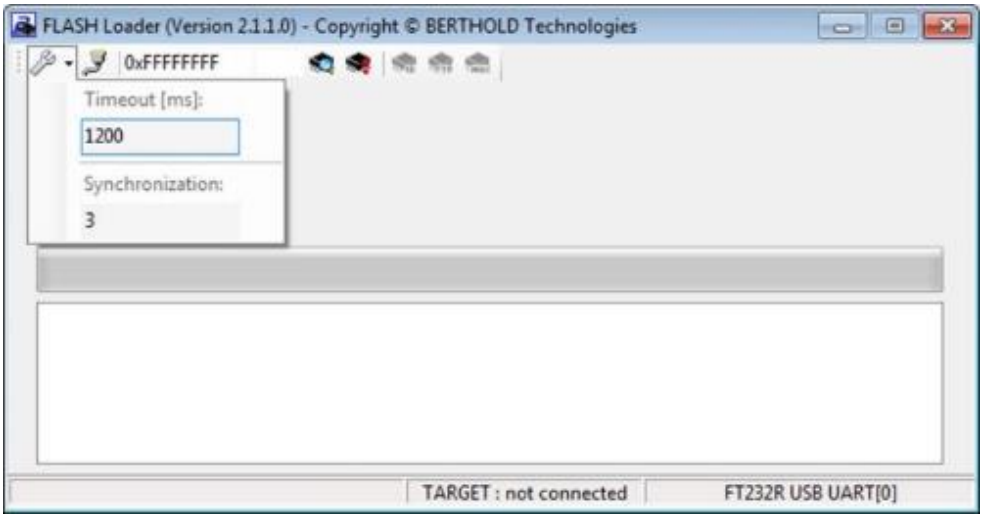
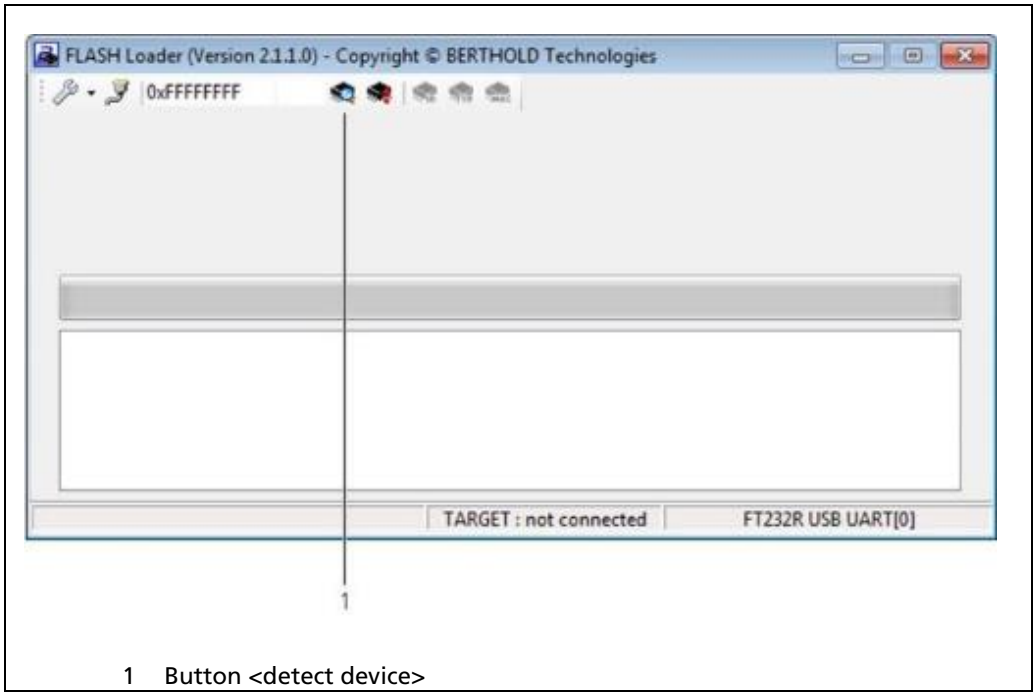


Fig. 50 Flash Loader Main Screen

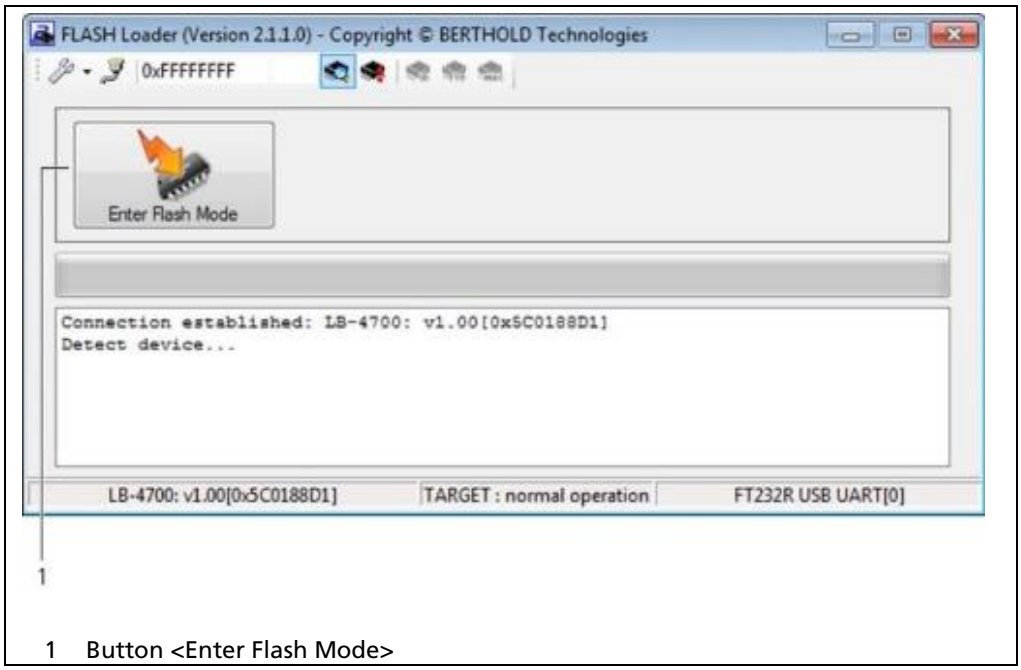
11. In the menu "Settings", set the value "Timeout" to 1200 and the value "Synchronisation" to 3.



1 Button <detect device>

Fig. 51 Flash Loader Main Screen

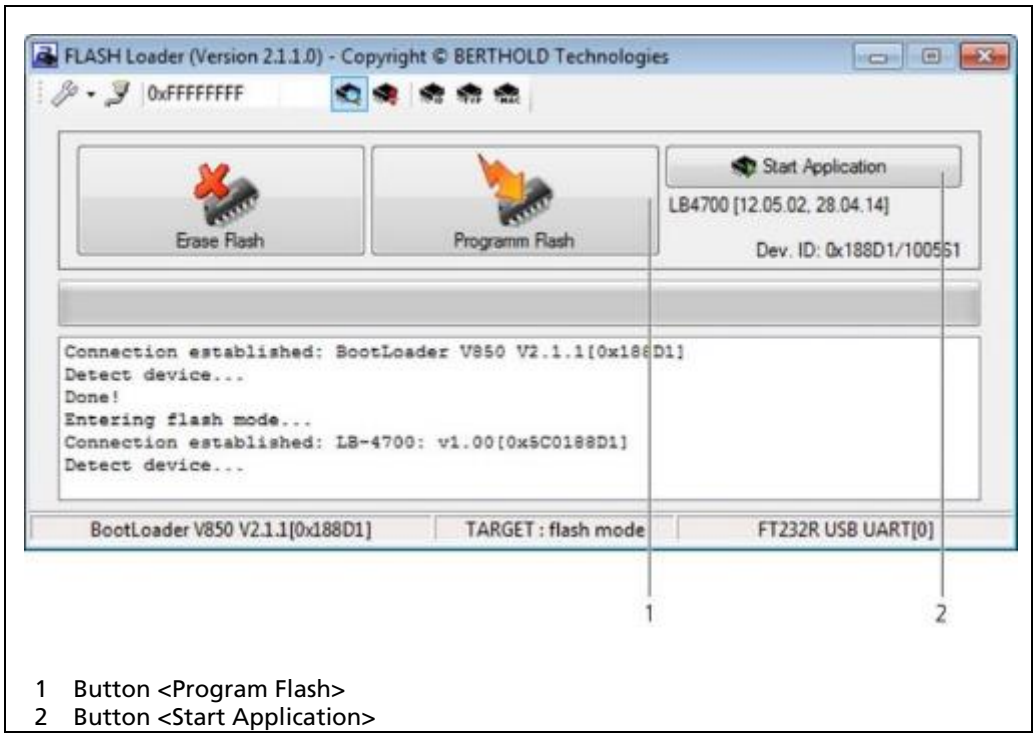
12. Click on the button <detect device> (Fig. 53, item1).
    - o The program establishes a connection to the detector.



1 Button <Enter Flash Mode>

Fig. 52 Flash Loader Connection

1. Click on the button <Enter Flash Mode> (Fig. 54, item 1).



1 Button <Program Flash>
2 Button <Start Application>

Fig. 53 Flash Loader “Program Flash” Page

13. Click on the button <Program Flash> (Fig. 55, item 1).
    - ▶ A dialogue window is opened.
14. Select the corresponding file for the software update
    - ▶ The detector is programmed with the respective software.

NOTICE

Make sure that the detector is only programmed with compatible software.

15. Click on the button <Start Application> (Fig. 54Fig. 55, item 2) after the programming has ended.

NOTICE

Reset the detector to the factory default settings if the first or second digit of the software version has changed. Make a note of the settings before the factory reset and enter them again after the reset is completed.

8.3 Visual Inspection of Scintillator and Photomultiplier

⚠ DANGER

Danger to life from electric shock!

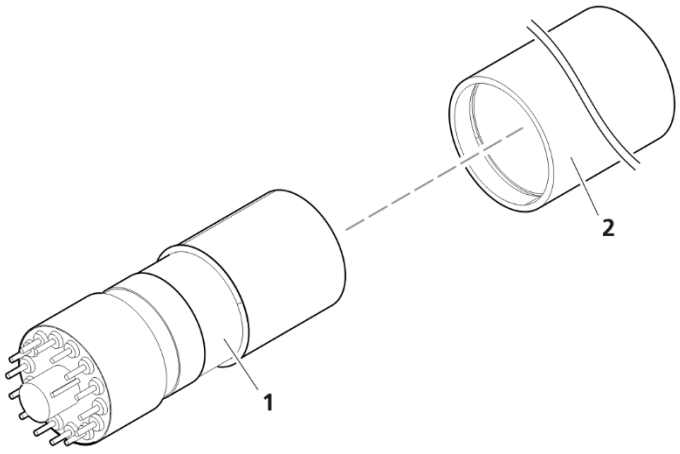
- The installation may only be carried out by persons authorized by Berthold.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energised.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

Errors on the scintillator and/or photomultiplier manifest themselves by a too small or too steep plateau (see chapter 6.4.5). Such errors can often already be recognized in a visual inspection. To do so, the scintillator and the photomultiplier must be disassembled.

The scintillator has to be crystal clear on the inside and neither have any cracks nor dull spots. A clear yellow to brown discolouration indicates a thermal overload and requires replacing the scintillator.

The window of the photomultiplier has a deposited film as a photocathode. This layer causes the window to have a slightly brownish or smoked glass colour. If this layer is no longer present or is stained, the cathode is damaged (e.g. through overheating, broken glass or light). In this case, the multiplier has to be replaced.



1 Photomultiplier (PMT)
2 Scintillator

Fig. 54 Representation of the Scintillator and the Photomultiplier

8.4 Replacing the Entire Detector

To replace the detector, proceed as follows:

1. Document all software parameters of the installed detector
2. Take the old detector out of operation as described in chapter “Decommissioning”.
3. Install the new detector as described in chapter “Installation”.
4. Perform the electrical installation as described in chapter “Electric Installation”.
5. Transfer the software parameters of the old detector to the new one.

NOTICE

If the detector has been previously used, please note that detectors that were used in non-hazardous areas must no longer be used in a hazardous area!

Intrinsically safe detectors whose intrinsically safe signals were connected to non-intrinsically safe circuits must not be connected to intrinsically safe circuits.

8.5 Replacing the Electronics Module

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by persons authorized by Berthold.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energised.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

⚠ WARNING

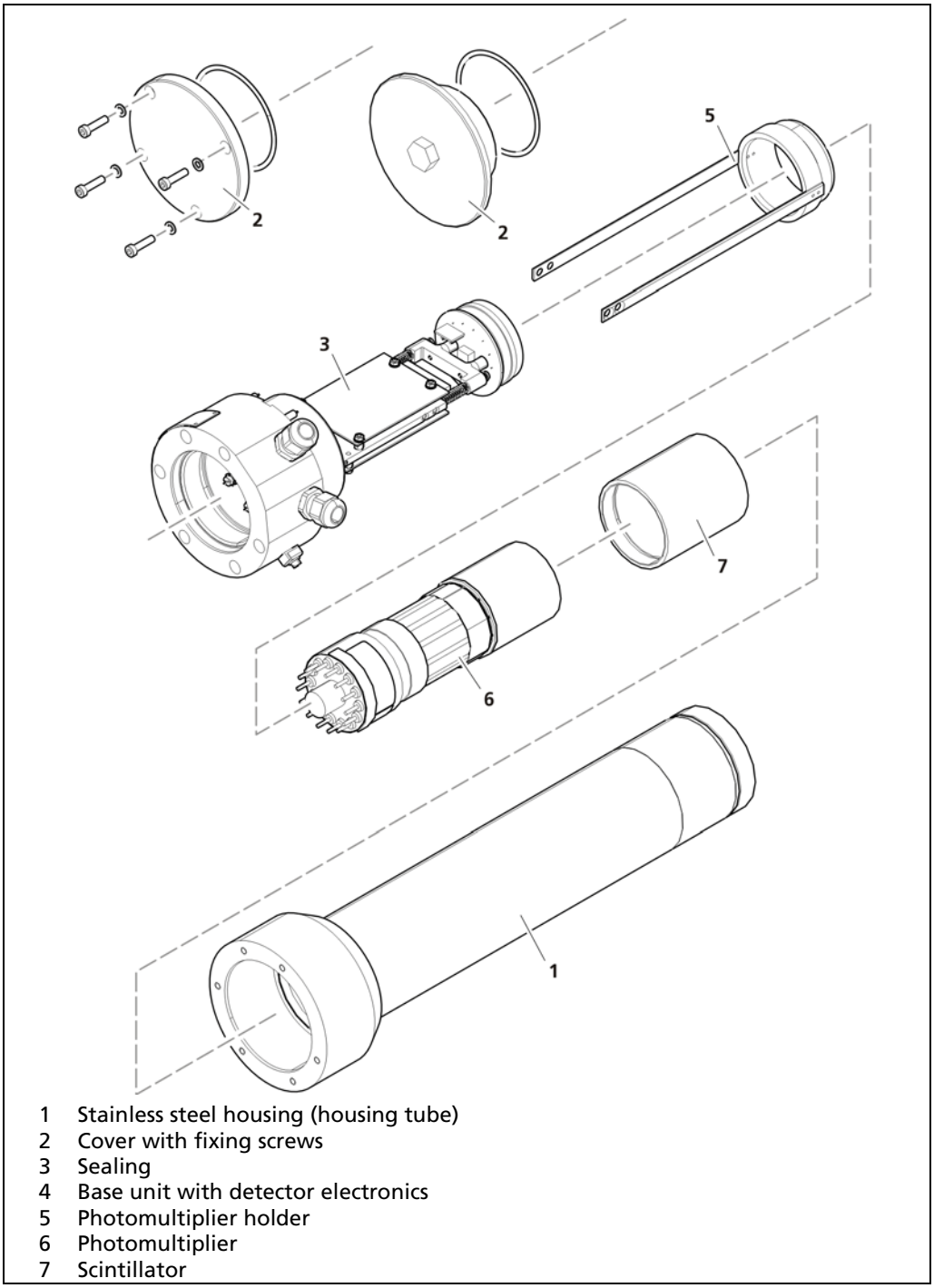
Danger to life by explosion!

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the safety manual / explosion protection manual.

NOTICE

The removal and installation of parts of the DuoSeries detector must be performed in clean workshop environment.

8.5.1 Disassembling the Electronics Module



1 Stainless steel housing (housing tube)
2 Cover with fixing screws
3 Sealing
4 Base unit with detector electronics
5 Photomultiplier holder
6 Photomultiplier
7 Scintillator

Fig. 55 Removing Detector Electronics

1. Document all software parameters of the installed detector
2. Disconnect the detector from the power supply and de-energise it and any potentially connected peripherals.
3. Loosen the four screws of the housing cover and remove the cover (Fig. 57, item 2).
4. Loosen the six screws that hold the detector housing to the socket.
5. Carefully pull out the electronics module and the scintillator/multiplier combination on the socket.

6. Remove the holder (Fig. 57, item7) with the scintillator/multiplier combination of the electronics by loosening the four Phillips screws on the side of the holder.
7. Pull the scintillator/multiplier combination out of the connection socket.
8. Now, the complete electronics module can be replaced.

8.5.2 Installing the Electronics Module

To assemble the electronics module, proceed in reverse order.

1. Replace the O-ring which seals the housing.
2. Make sure that no humidity or metal chippings are inside the terminal compartment.
3. Carefully insert the electronics module on the socket with the scintillator/multiplier combination forward back into the housing.
4. Fasten the socket again on the detector housing. Tighten the screws alternating and equally on both sides.
5. Check and replace, if necessary, the O-ring that seals the terminal compartment.
6. Carefully close the terminal compartment with the lid. To do this, fit the housing cover onto the housing and tighten the Allen bolts with the specified torque: depending on the model M5 with 4 Nm (standard values).

If you have installed a new electronics module:

- Remove the adhesive label with the Dev. ID and attach the supplied new adhesive label.
- Reconnect the supply voltage to the detector.
- Now set the software parameters based on the list that you noted at the beginning.

8.6 Replacing the Scintillator

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by persons authorized by Berthold.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energised.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

WARNING

Danger to life by explosion!

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the safety manual.

8.6.1 Disassembling the Scintillator

The multiplier should not be subject to bright light during the following working steps.

1. Remove the electronics module through the action steps 1 - 7 as described in the chapter 8.5.1.
2. Point detectors: Carefully screw off the scintillator from the photomultiplier. Rod detectors: Remove the scintillator carefully from photomultiplier.
3. Clean the optical contact surfaces with a soft cloth from silicon oil residues.

8.6.2 Installing the Scintillator

1. Before assembly, apply a drop pure silicon oil (BERTHOLD ID no. 18844) between the scintillator and the multiplier and slightly distribute it by rubbing to ensure a good optical connection between the two components.
2. Reassemble the scintillator and the multiplier and install the holder by retightening the 4 Phillips screws.

8.7 Replacing the Scintillator/Multiplier Combination

⚠ DANGER

Danger to life from electric shock!

- The installation may only be carried out by persons authorized by Berthold.
- Please adhere to the relevant safety regulations.
- Installation/maintenance may only be carried out if the device has been de-energised.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

WARNING

Danger to life by explosion!

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the safety manual.

1. Remove the electronics module through the action steps 1 - 7 as described in the chapter 8.5.1.
2. Insert the new crystal/multiplier combination in the socket. Please observe the coding lug.
3. Insert the electronics module again, see chapter 8.5.1.
4. Check the measuring function. Should there be discrepancies, perform a new calibration (see operating instructions of the associated evaluator device).

9 Accessories

Available accessories are listed in the "Technical Information" document, see chapter 15 Parts Overview.

9.1 Water Cooling System

To protect the scintillators against overly high temperatures, a water cooling system is optionally available. A water cooling system must be used if the detector temperature may exceed +60 °C. In this respect, ambient temperature, sun light, radiant heat of hot components and the transition of heat from installation fixtures should be considered. With water cooling, the detectors can be operated at a maximum ambient temperature of 100 °C. For the minimum cooling water requirement, please refer to the document “Technical Information”.

NOTICE

When operating in areas with danger of explosion, observe the specific ambient temperature limits, which are specified in the safety manual and in the document technical information.

NOTICE

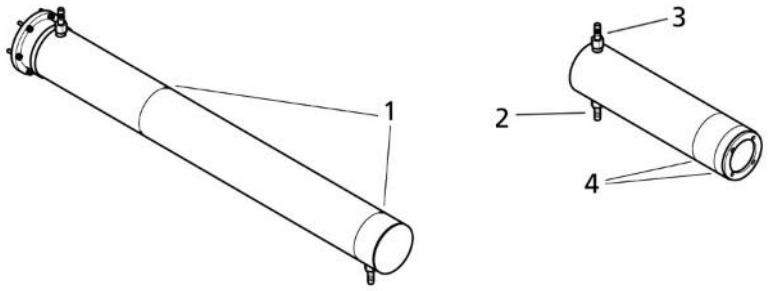
If water remains in the water cooling systems at ambient temperatures below the frost point, the cooling water system can be damaged.

- ▶ If there is a risk of frost, empty the water cooling system.

If there is a risk that the maximum operating temperature is exceeded, the cooling water circuit must remain in operation even if the detector is switched off.

NOTICE

A failure of the cooling water system or an insufficient flow can overheat the detector and thereby cause damage. For cooling, exclusively use water of drinking water quality.



1 Marking grooves on the water cooling system of the rod detector
2 Water supply
3 Water discharge
4 Marking grooves on the water cooling system of the point detector

Fig. 56 Water Cooling System Point Detector/Rod Detector

The cooling water cycle has to remain in operation even when the detector is turned off, if the maximum operating temperature is likely to be exceeded.

NOTICE

Risk of overheating!

A failure of the water cooling or insufficient flow can overheat and thus destroy the detector.

The maximum ambient temperatures are listed in the technical data (see document “Technical Information).

In addition:

- To prevent freezing, the water cooling system must be drained.
- Polluted cooling water may clog the water cooling system, which may result in the detector getting overheated and destroyed. It is therefore essential to use clean cooling water.
- The water pressure in the cooling jacket must not exceed 6 bar.

UniSENS: Water Cooling Installation

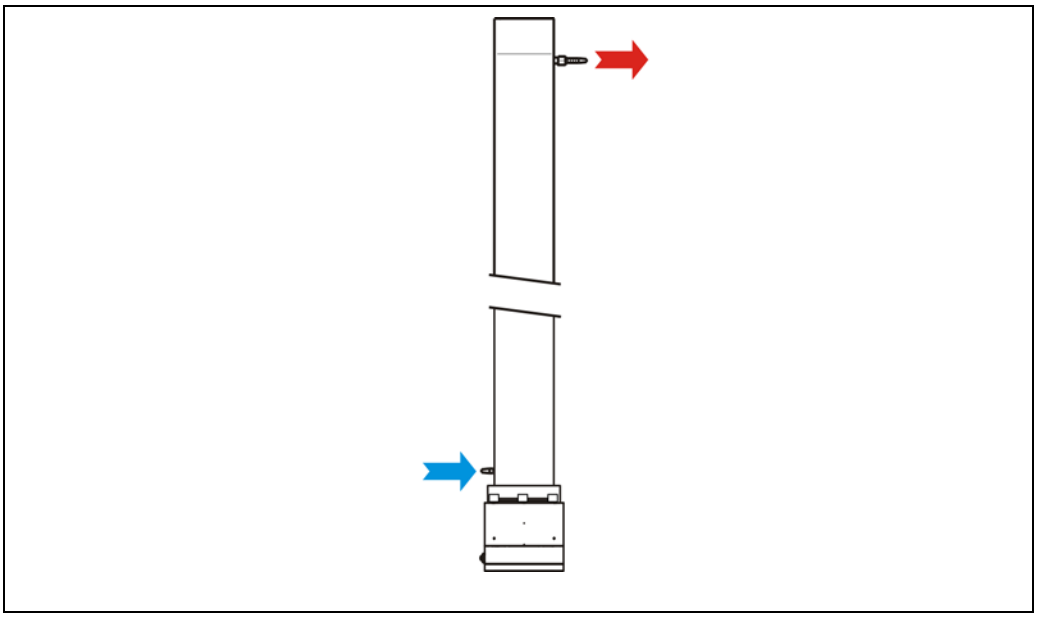
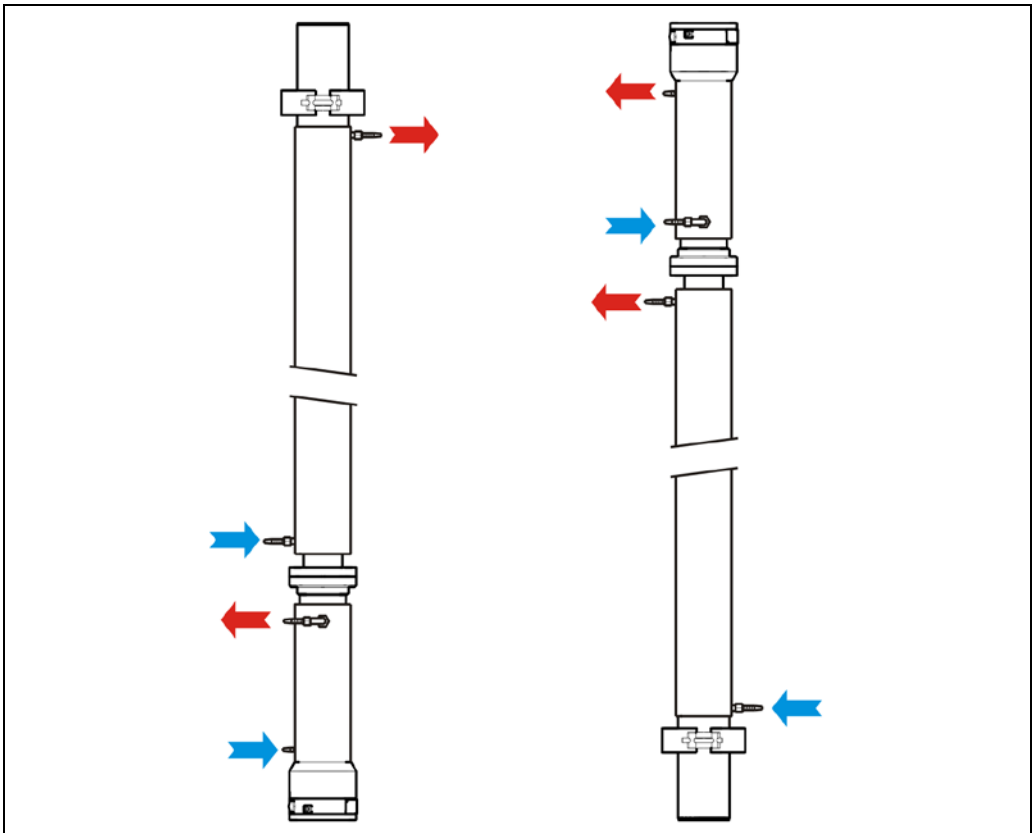


Fig. 57 Water Cooling Installation

In order to fill the entire water cooling jacket, incoming water must enter from the bottom.

TowerSENS: Installation with Water Cooling

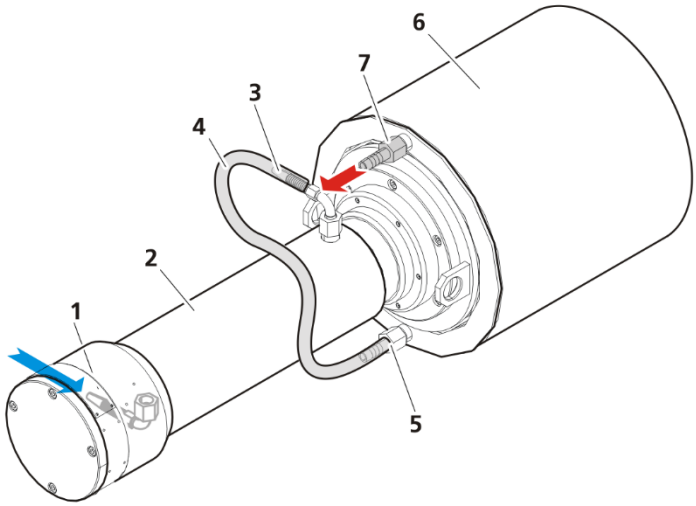


1 Installation connection head below (regular installation)
2 Installation connection head above

Fig. 58 Installation with water cooling

Water is always supplied from the bottom to prevent air pockets that can drastically reduce the cooling effect. Therefore, the detector has to be aligned so that the water exits at the highest point.

SuperSENS: Water Cooling Installation



1	Water inlet electronics part	5	Water inlet detector head/collimator
2	Water cooling electronics part	6	Water cooling detector head/collimator
3	Water outlet electronics part	7	Water outlet electronics part
4	Hose connection		

Fig. 59 Water Cooling Installation

With the SuperSENS detector, the water can flow through a hose connection from the outlet of the electronics part to the inlet of the detector head/collimator.

Water Cooling in Ex-areas

The information in the Safety Manual regarding the ambient temperature for explosion protection also apply to the operation of a water cooling on detectors that are used in hazardous areas.

Detector Temperature Monitoring

The detector includes an internal temperature measurement which can be used to trigger a pre-alarm if higher temperatures are measured. The temperature switching point can be adjusted. The alarm can be picked up at the digital output. If you operate the water cooling so that the temperature at the detector remains below 40° C, you could switch off the detector on exceeding a temperature limit of e.g. 50° C prematurely to protect the detector against over-temperature.

Cooling Water Curves

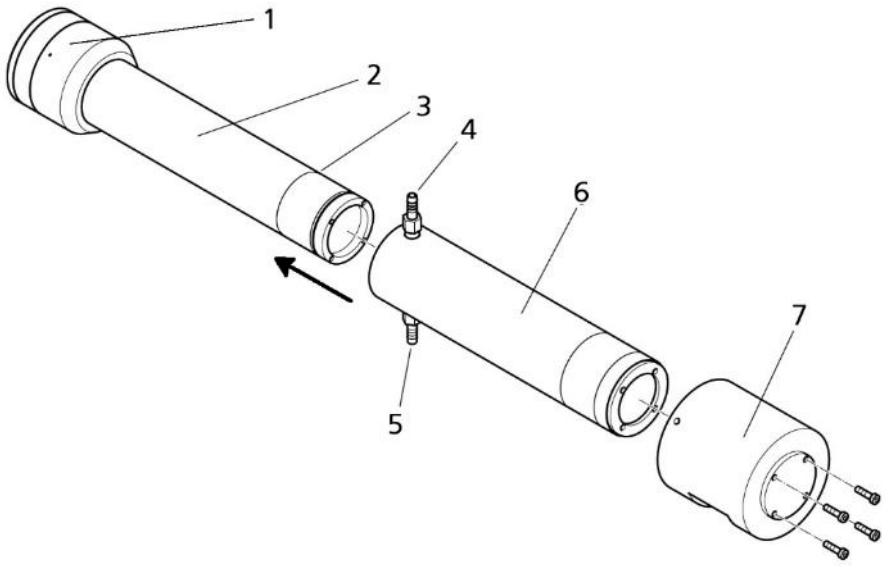
The required amount of cooling water is dependent on the possible heat transmission, the cooling water temperature and the detector type. You find the cooling water curves and further information in the document “Technical Information” in chapter 13 Cooling Water Demand.

9.1.1 Installation and Connection of the Water Cooling System

If the detector is equipped with a water cooling system, the cooling water nozzles must be aligned so that the water lines can be connected freely.

IMPORTANT

Observe the information on water cooling and mounting direction of the respective detectors in chapter 4 Installation.



1 Terminal compartment
2 Point detector
3 Marking groove
4 Water discharge
5 Water supply
6 Water cooling system
7 Collimator

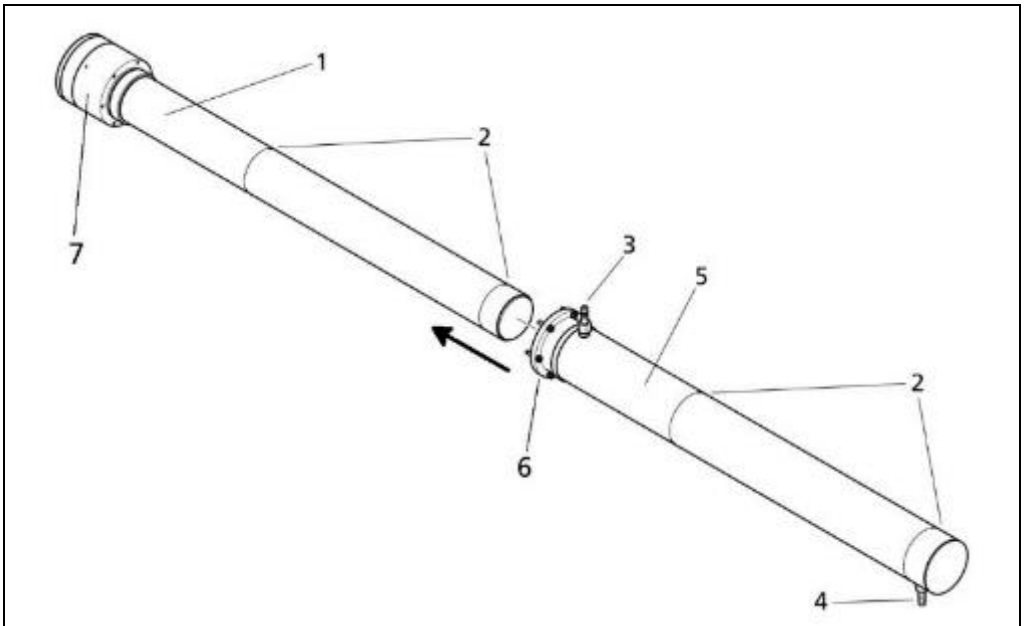
Fig. 60 Point Detector with Water Cooling System

1. Slide the water cooling system (Fig. 59, item 6) with the connection nozzles pointing forward towards the terminal compartment.
2. Attach the water cooling system with the provided screws at the pipe of the detector.

Make sure that the water lines do not run in front of the radiation window. So that no air pockets form in the cooling water, the detectors must be mounted as follows:

If the detector is mounted horizontally, the bottom connector (Fig. 59, item 5) must be used as a water supply.

If the detector is mounted vertically, the terminal compartment must be oriented upward, so that the connections are located at the upper end of the water cooling system.



1 Rod detector
2 Marker grooves
3 Water discharge
4 Water supply
5 Water cooling system
6 Connection flange
7 Connection chamber

Fig. 61 Rod Detector with Water Cooling System

1. Slide the water cooling system (Fig. 60, item 5) with the connecting flange (Fig. 60, item 6) in the direction of the connection chamber
2. Fasten the water cooling system on the detector socket with the enclosed screws.

Depending on the detector assembly, (horizontally or vertically, terminal compartment on top or at the bottom) the respective lower cooling water connection should be used as a feed, so that no air pockets form in the cooling water.

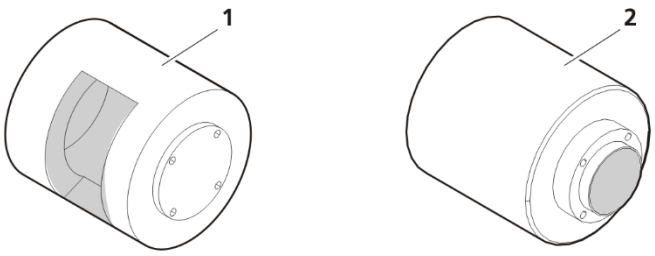
9.2 Conversion Kit for Extended Temperature Range

If DuoSeries detectors are operated in the extended temperature range of -40°C to + 100°C (with additional water cooling), a conversion kit is required per detector. The conversion kit includes metal cable glands, which are certified for operation in the extended temperature range.

NOTICE

When operating in areas with danger of explosion, observe the specific ambient temperature limits, which are specified in the safety manual / explosion protection manual, and in the technical information.

9.3 Collimator



1 Radiation window radial
2 Radiation window axial

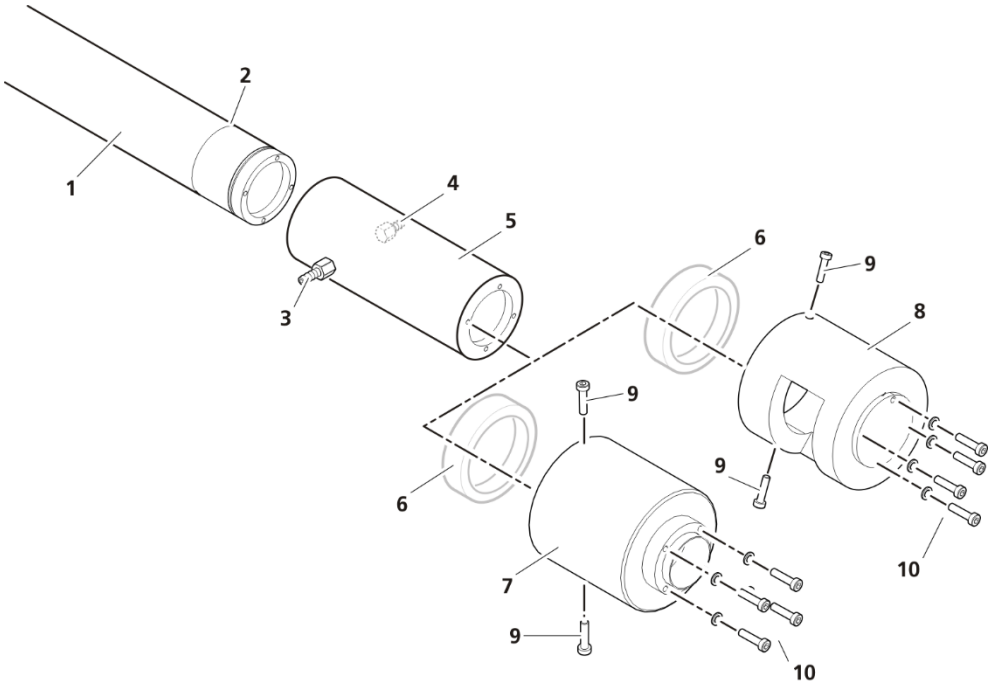
Fig. 62 CrystalSENS collimators (for lateral and frontal irradiation)

The optional lead collimator for the point detector protects against interfering background radiation and ensures higher reliability and accuracy. The collimator is available with a radial (irradiation from the side) or axial (irradiation from the front) radiation window.

NOTICE

For collimators with frontal irradiation and perpendicular detector mounting, the collimator must be aligned upwards. If the collimator is aligned downwards, there is a risk of incorrect readings due accumulation of water.

9.3.1 Collimator Assembly with Water Cooling System

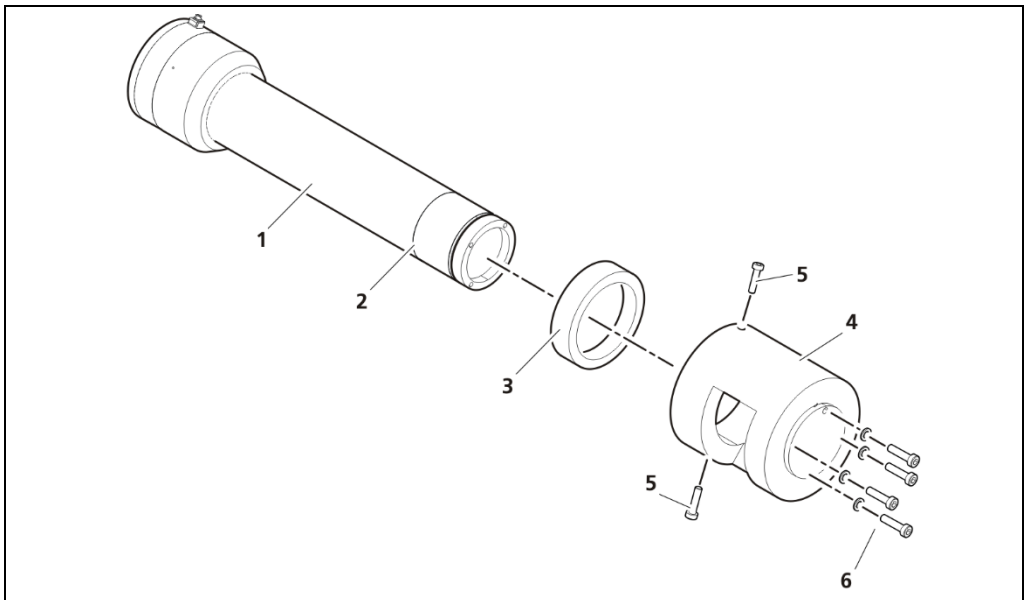


1	Detector	7	Collimator with frontal irradiation
2	Marking groove	8	Collimator with side irradiation
3	Water discharge	9	lateral screws
4	Water supply	10	frontal screws
5	Cooling jacket		
6	Spacer ring		

Fig. 63 Assembly Collimator with Water Cooling

1. Remove if installed the spacer ring from the collimator by unscrewing the screws on the side. The spacer ring is no longer required.
2. For fixing collimator with water cooling must be used longer screws.
   3 mm -> 5 mm.
3. Slide the collimator over the water cooling system so that the radiation window is positioned in the direction of the source. To do so, position the collimator and the cooling water system so that the pattern of their fastening holes matches the one of the detector. Make sure that the position of the connection nozzles does not obstruct later installation of the water supply.

9.3.2 Collimator Assembly without Water Cooling System



1 Detector
2 Marking groove
3 Spacer ring
4 Collimator
5 Lateral screws
6 Frontal screws

Fig. 64 Assembly Collimator without water cooling

The spacer ring must be inserted and screwed at the side. The collimator is screwed to the detector with the front screws.

Slide the collimator over the detector housing so that the radiation window is positioned in the direction of the source. To do so, position the collimator so that the pattern of its fastening holes matches the one of the detector.

10 Decommissioning

⚠ DANGER

Danger to life from electric shock!

- The decommissioning may only be carried out by a qualified electrician.
- Please adhere to the relevant safety regulations.
- Only open the device when free of voltage.

In case of an electric shock, carry out first aid measures and immediately call an emergency service.

⚠ WARNING

Danger of injury by falling loads

- Never stand underneath a lifted or suspended load, keep at a safe distance.
- Exclusively use the provided lifting eyes (SuperSENS detectors, shields and collimators) for attaching the sling gear.
- Only use tested sling gear components appropriate for the transport weight.
- Observe the marking for the centre of gravity on the outer packaging, if applicable.
- Wear head protection and safety shoes.

⚠ WARNING

Danger to life by explosion

- If the detector is located in a potentially explosive atmosphere, it is essential to observe the corresponding instructions and safety instructions in the safety manual / explosion protection manual.

⚠ CAUTION

Danger of injury caused by heavy and bulky system components

- Heavy and bulky system components should only be handled using aids and by at least 2 persons.
- Observe the guidelines for safe handling of heavy loads.
- Ensure stability and use the provided fixing possibilities.

Follow this sequence for decommissioning:

1. Remove all cables from the detector.
2. Remove the detector with/without water cooling system out of its holder.
3. Remove the detector from the water cooling system if necessary.

10.1 Disposal

⚠ CAUTION

Toxic!

The product contains electronic components containing toxic substances that are harmful to health.

- The device is to be disposed of according to applicable legal regulations by a specialised waste management company.

If the product has been used, you can dispose of it through a waste management company in accordance with the statutory provisions.

Modifications due to technical advancement reserved.

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LB 4700-..-IB (ATEX / IECEx / UKCA / NEC / CEC)
LB 4700-..-FA (NEC / CEC)

Safety Manual / Explosion Protection Manual

56926BA26 Rev.08 03/2023

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Table of Contents

(bg) Инструкции за безопасност за употреба в потенциално експлозивни райони. Това ръководство за безопасност е и на разположение на официалните езици на Европейския съюз.

(cs) Bezpečnostní pokyny pro použití v oblastech, kde hrozí nebezpečí výbuchu. Tato příručka s bezpečnostními pokyny je k dispozici i v úředních jazycích Evrospké unie.

(da) Skkerhedsvejledning til brug i eksplosionsfarlige omgivelser. Denne sikkerhedsmanual findes på alle officielle sprog i det Europæiske fælleskab.

(de) Sicherheitshinweise für den Einsatz in explosionsgefährdeten Bereichen. Dieses Sicherheitshandbuch ist auch in den Amtssprachen der europäischen Gemeinschaft erhältlich.

(el) Υποδείξεις ασφάλειας για χρήση σε περιοχές με κίνδυνο έκρηξης. Αυτό το εγχειρίδιο ασφάλειας διατίθεται επίσης στις επίσημες γλώσσες της Ευρωπαϊκής Ένωσης.

(en) Safety instructions for use in potentially explosive areas. This safety manual is available also in the official languages of the European Community.

(et) Ohutusjuhised kasutamiseks plahvatusohtlikes piirkondades. Käesolev ohutuskäsiraamat on saadaval ka Euroopa Ühenduse ametlikes keeltes.

(fi) Räjähdysvaarallisilla alueilla käyttöä koskevat turvallisuusohjeet. Tämä turvaohjekirja on saatavilla myös Euroopan yhteisön virallisilla kielillä.

(fr) Consignes de sécurité relatives à une utilisation en zones explosives. Le présent manuel de sécurité est également disponible dans les langues officielles de la communauté européenne.

(ga) Treoracha sábháilteachta le haghaidh úsáide i limistéir inphléasctha Tá an lámhleabhar sábháilteachta seo ar fáil i dteangacha oifigiúla an Aontais Eorpaigh, chomh maith.

(hu) Biztonsági utasítások robbanásveszélyes területeken történő alkalmazáshoz. Ez a biztonsági kézikönyv az Európai Közösség hivatalos nyelvein is rendelkezésre áll.

(it) Istruzioni per l'impiego in ambienti a rischio di deflagrazione. Il presente manuale contiene le disposizioni di sicurezza ed è disponibile in tutte le lingue ufficiali della comunità europea.

(lt) Saugumo nurodymai naudojimui potencialiai sprogiose zonose. Šį saugumo vadovą taip pat galima gauti Europos Bendrijos oficialiomis kalbomis.

(lv) Drošības noteikumi piemērošanai jomās, kas saistītas ar sprādzienbīstamību. Šī drošības noteikumu rokasgrāmata ir pieejama arī citās Eiropas Kopienas oficiālajās valodās.

(mt) Istruzzjonijiet dwar is-sigurtà li għandhom jintużaw f'żoni potenzjalment splussivi. Dan il-manwal tas-sigurtà huwa disponibbli wkoll fl-ilsna uffiċjali kollha tal-Komunità Ewropea.

(nl) Veiligheidsinstructies voor de inzet in gebieden met gevaar voor explosies Dit veiligheidshandboek is ook in officiële talen in de Europese Gemeenschap verkrijgbaar

(pl) Przepisy bezpieczeństwa dotyczące użytkowania na obszarach zagrożonych wybuchem. Niniejsza instrukcja bezpieczeństwa dostępna jest również w językach urzędowych Unii Europejskiej.

(pt) Indicações de Segurança para a utilização em áreas potencialmente explosivas. Este Guia de Segurança também está disponível nas línguas oficiais da Comunidade Europeia.

(ro) Instructiuni de siguranţă pentru utilizarea în zone periculoase. Acest manual de siguranţă este de asemenea disponibil în limbile oficiale ale Comunităţii Europene.

(sk) Bezpečnostné pokyny pri použití vo výbušnom prostredí. Táto bezpečnostná príručka je k dispozícii aj v úradných jazykoch Európskej únie.

(sl) Varnostna navodila za uporabo v eksplozijsko ogroženih območjih. Ta varnostni priročnik je na voljo tudi v uradnih jezikih Evropske unije.

(sp) Instrucciones de seguridad para el uso en áreas explosibles. El presente manual de seguridad está disponible también en las lenguas oficiales de la Comunidad Europea.

(sv) Säkerhetshänvisningar till användning i områden som är utsatt för exlposionsfara. Denna handbok finns även tillgänglig i alla officiella språk av den europäiska gemenskapen.

ID. No. 56926BA26
Rev. No.: 08 03/2023

1 Declaration of Conformity

BERTHOLD

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info@bertho d.com
www.berthold.com

EU-Declaration of Conformity (original) File No.: CE20027-6

We, hereby declare under our sole responsibility that the design of the fo lowing products / systems / units brought into circulation by us comply with the relevant harmonized rules of the EU.

This declaration loses its validity should modifications or unsuitable and improper use take place without our authorisation.

Description: ***detector for radiometrical measurement system in hazardous environments***

Typ: ***LB 4700-xx-ee-xx-xx-xxx***

|e = all letters except O (Zero)
x = all letters

	directive	applied standards	
EMC	2014/30/EU	EN 61326-1	2013
RoHS	2011/65/EG	EN 50581	2012
ATEX	2014/34/EU EPS 13 ATEX 1 547 X	EN 60079-0	2018
		EN 60079-1	2014
		EN 60079-7	2015
		EN 60079-11	2012
	notified body: 0102 PTB Braunschweig, Germany	EN 60079-31	2014

This declaration is issued by the manufacturer

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22, D-75323 Bad Wildbad, Germany

released by

Dr. J. Briggmann

Head of R&D
Bad Wildbad, 23rd of May, 2019

Registergericht / Court of Registration: Stuttgart HRA 330991
Persönlich haftende Gesellschafterin / Fully liable Associates: Berthold Technologies Verwaltungs-GmbH
Registergericht / Court of Registration: Stuttgart HRB 331520
Geschäftsführung / Management: Andreas Dobratz
USt.-Id-Nr. / VAT Reg. No.: DE813050511
Deutsche Steuernummer / German Tax No.: 49038/08038
WEEE-Reg. No.: DE99468690

Bankverbindungen / Bank Details	IBAN	BLZ	Konto / Account	Swift BIC
Sparkasse Pforzheim-Calw	DE37	6665 0085	0008 0450 03	PZHSDE66
Volksbank Pforzheim	DE85	6669 0000	0000 9570 04	VBPFDE66
Commerzbank Pforzheim	DE05	6668 0013	0651 1120 00	DRESDEFF666

detect and identify

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www.berthold.com

UK Declaration of Conformity

File No.: UK20027-01

We hereby declare, under our sole responsibility, that the design of the following detector placed on the market by us complies with the relevant U.K. legislation for UKCA-marking.

Unauthorized modifications or unintended use of the product make the declaration invalid.

Product name: ***detector for radiometrical measurement system in hazardous environments***

Type / model: ***LB 4700-xx-ee-xx-xx-xxx***

e = all letters except 0 (Zero) or Z
x = all letters

Regulation		applied standards
Equipment and Protective System Intended for Use in Potentially Explosive Atmospheres Regulations 2016	SI 2016/1107	EN IEC 60079-0:2018 EN 60079-1:2014 EN IEC 60079-7:2015/A1:2018 EN 60079-11:2012 EN 60079-31:2014
Electromagnetic Compatibility Regulations 2016	SI 2016/1091	EN 61326-1:2013
The Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012	SI 2012/3032	

approved body /number	measure	certificate
Element Materials Technology / 0891	type examination production control	EMA21UKEX0049X

This declaration is issued by the manufacturer.

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22, D-75323 Bad Wildbad, Germany

released by

Dr. Jürgen Briggmann

Head of R&D
Bad Wildbad, 15th of March 2023

Registergericht / Court of Registration: Stuttgart HRA 330991
Persönlich haftende Gesellschafterin / Fully liable Associates: Berthold Technologies Verwaltungs-GmbH
Registergericht / Court of Registration: Stuttgart HRB 331520
Geschäftsführung / Management: Thomas Bogner
USt.-Id-Nr. / VAT Reg. No.: DE813050511
Deutsche Steuernummer / German Tax No.: 49038/08038
WEEE-Reg. No.: DE99468690

Sparkasse Pforzheim-Calw	DE37	6665 0085	0008 0450 03	PZHSDE66XXX
Volksbank pur eG	DE37	6619 0000	0029 1282 51	GENODE61KA
Commerzbank Pforzheim	DE05	6668 0013	0651 1120 00	DRESDEFFXXX

Transforming science into solutions

2 General Instructions

This safety manual provides operating instructions in accordance with directive 2014/34/EU and explosion protection standards named in the declaration of conformity, the National Electrical Code (NEC: ANSI/NFPA 70) and the Canadian Electrical Code (CEC) and the regulations for Great Britain arising from the UKCA approval.

National responsible authorities can claim additional requests.

Observe the safety manual unconditionally to avoid personal injury and property damage and to ensure safe operation.

3 Proper Use

The detectors are used along with an appropriate evaluation unit of Berthold Technologies GmbH & Co. KG and an appropriate radiation source to measure the radiation intensity as part of a radiometric measurement.

The following constitutes proper use:

- Strictly adhering to the instructions and procedural sequences and perform no unauthorised third-party actions that endanger your safety and the functional efficiency of the detectors!
- Observing the provided safety instructions!
- Carrying out the prescribed maintenance measures or having them carried out for you!

3.1 Improper Use

- Failing to observe the specified safety instructions and instructions for the operation, maintenance and disposal in the manual.
- Any non-compliance with the present manual for the supplied products.
- Applying conditions and requirements which do not conform to those stated in the technical documents, data sheets, operation and assembly instructions and other specific guidelines of the manufacturer.
- Using the product in a damaged or corroded condition.
- Restructuring or changing the system components.
- Repairs of detectors that are used in hazardous areas by persons who are not authorised by Berthold Technologies GmbH & Co. KG.
- Using the product with
    - open or not properly closed cover
    - improperly closed entries,
    - insufficiently tightened or damaged screw connections i.e. cable glands, adapters or blind plugs[1].
- Operation without the safety precautions provided by the manufacturer.
- Manipulation or avoidance of existing safety equipment.

Berthold Technologies GmbH & Co. KG shall only accept liability for/guarantee the conformity of the device to its published specifications.

If the product is used in a way which is not described in the present manual, the device's protection is compromised and the warranty claim becomes invalid.

[1] blanking elements acc. to IEC 60079

4 Qualification of the Personnel

NOTICE

A minimum requirement for all work on or with the product would be employees with general knowledge who are instructed by an expert or authorised person.

At different parts in this manual, reference is made to personnel with certain qualifications who can be entrusted with different tasks during installation, usage and maintenance.

These three groups of people are:

- Employees with General Knowledge
- Experts
- Authorised Persons

Employees with General Knowledge

NOTICE

Employees with general knowledge must always be guided by an expert at the very least. When dealing with radioactive substances, a radiation safety officer must also be consulted.

Employees with general knowledge are e.g. technicians or welders who can undertake different tasks during the transportation, assembly and installation of the product under the guidance of an authorised person. This can also refer to construction site personnel. The persons in question must have experience in handling the product.

Experts

Experts are persons who have sufficient knowledge in the required area due to their specialist training and who are familiar with the relevant national health and safety regulations, accident prevention regulations, guidelines and recognised technical rules.

Expert personnel must be capable of safely assessing the results of their work and they must be familiar with the content of this manual.

Authorised Persons

Authorised persons are those who are either designated for the corresponding task due to legal regulations or those who have been authorised by Berthold Technologies GmbH & Co. KG for particular tasks. When dealing with radioactive materials, a radiation safety officer must also be consulted.

5 Operator's Obligations

The operator of the product must regularly train his personnel in the following topics:

- Observation and use of the manual and the legal provisions.
- Intended operation of the product.
- Observation of the plant security instructions and the operating instructions of the operator.

6 Safety Instructions

Safety Instructions for Installation and Operation Staff

NOTICE

Assembly, installation, commissioning, operation and maintenance may only be carried out by authorised and properly trained personnel!

Before assembly/commissioning:

- Read safety manual
- Read operating instructions
- Train assembly and operating personnel sufficiently
- Make sure that the contents of the safety manual and the operating manual are fully understood by the personnel.

If in doubt, please contact the manufacturer.

NOTICE

Repair of explosion-proof components

Spare parts may only be fitted by the service of Berthold Technologies GmbH & Co. KG or by persons authorised by Berthold. If this is not possible, you must replace the entire detector or send it in for repair to the manufacturer.

Specific Condition of Use: The flamepath joints are not intended to be repaired.

⚠ WARNING

Danger to life by explosion!

- Repair of variants (LB 4700-1x-Ix) with intrinsically safe circuits.
- Substitution of components may impair intrinsic safety.

Explosion protection and temperature limits

Explosion Protection and Environmental Conditions	
Certificates[1)]	ATEX: EPS 13 ATEX 1 547 X IECEx: IECEx EPS 13.0008X IECEx: EMA21UKEX0049X NEC / CEC (CSA): 70131654 (HazLoc) 70165124 (OrdLoc)
Degree of protection	IP66 / IP67 according to IEC 60529[2)] Type 4X
Air pressure	80 kPa (0.8 bar) to 110 kPa (1.1 bar) Oxygen content of the air, usually: 21% (Vi/V)

1) see chapter with certificates
2) IP68 max. depth 1 m and 35 min duration.

⚠WARNING

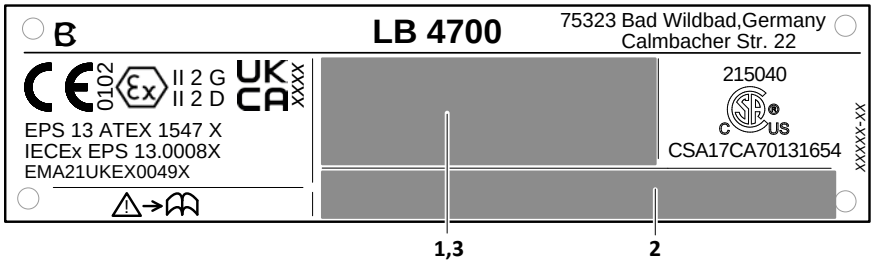
Danger to life by explosion!

- Strictly maintain the permissible ambient temperature (T_a).
- Make sure that the maximum permissible surface temperature is not exceeded.
- The versions of the InlineSENS LB 4700 5x-1x and LB 4700 5x-Ix are not approved for the use of media with explosive substances in the pipe.
- In case of non-intrinsically safe installation and in explosive atmosphere, deenergize and wait 2 minutes!

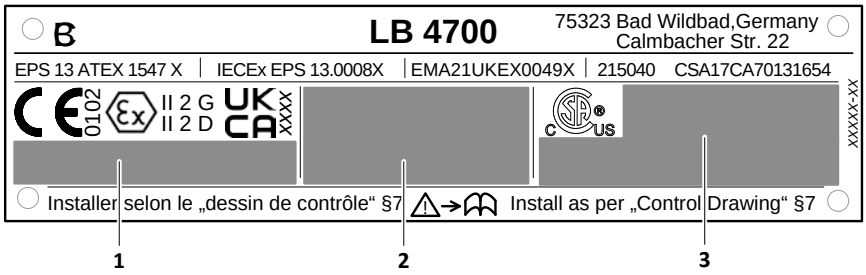
6.1 Marking

Nameplate

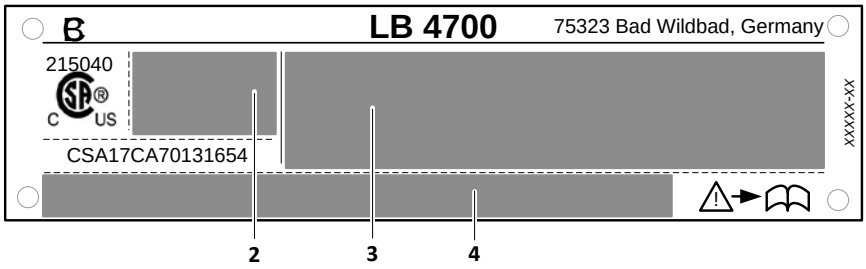
LB 4700-xx-1B-xx-xx-xxx



LB 4700-xx-IC-xx-xx-xxx



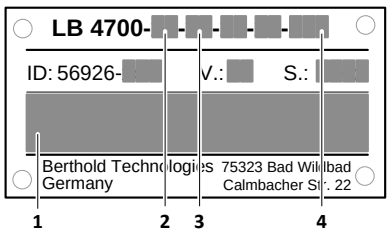
LB 4700-xx-FA-xx-xx-xxx



xxxx next to the UKCA marking is replaced by the number of the UK approved body, if required by UK legislation).

1	Marking for type of protection for ATEX / IECEx based approvals
2	Ambient temperature range for safe operation in an explosive atmosphere (depending on the temperature class) and other ratings
3	Marking for type of protection for NEC / CEC
4	Additional installation instructions / Warnings

Typeplate



1	other information, including functional temperature range
2	Variants
3	Certification
4	Openings

6.2 Overview of explosion protection concepts

Zones: Not Intrinsically Safe

Variants / Certification	CrystalSENS: LB 4700-1x-1x UniSENS: LB 4700-2x-1x	SuperSENS: LB 4700-3x-1x TowerSENS_ LB 4700-4x-1x InlineSENS[3]: LB 4700-5x-1x
Signal Circuits	**Not intrinsically Safe**	
Explosion Protection Concept of the Compartments		
All Compartments	Ex "t" (dust protection)	
Electronics Compartment (Housing)	Ex "d" (flameproof enclosure)	
Terminal Compartment	Ex "e" (increased safety)	
Ambient Temperature		
T_a min.	-40 °C	
CE 0102 Ex UKCA		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T1-T5 ($T_a \leq$ +80 °C) / 85°C	T1-T6 ($T_a \leq$ +60 °C) / 80 °C
	T6 ($T_a \leq$ +75 °C) / 80 °C	
II 2 G (Zone 1)	Ex db eb IIC T1-T6 Gb	
II 2 D (Zone 21)	Ex tb IIIC T85 °C Db	Ex tb IIIC T80 °C Db
NEC		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T1-T6 ($T_a \leq$ +75 °C) / 80°C	T1-T6 ($T_a \leq$ +56 °C) / 80 °C
Class I, Zone 1	AEx db eb IIC T1-T6 Gb	
Zone 21	AEx tb IIIC T85 °C Db	AEx tb IIIC T80 °C Db
CEC		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T1-T6 ($T_a \leq$ +75 °C) / 80°C	T1-T6 ($T_a \leq$ +56 °C) / 80 °C
Class I, Zone 1	Ex db eb IIC T1-T6 Gb	
Zone 21	Ex tb IIIC T85 °C Db	Ex tb IIIC T80 °C Db
Protection Principle	**Ex "d"/"e"/"t"**	

1) Temperature Class: Equipment Temperature Class and Installation Temperature Class.

2) Higher temperatures possible, see nameplate.

3) Must not be used for highly charge-generating processes in Zone 21 installations.

Zones: Intrinsic Safety

Variants	CrystalSENS: LB 4700-1x-Ix UniSENS:LB 4700-2x-Ix	SuperSENS: LB 4700-3x-Ix TowerSENS: LB 4700-4x-Ix InlineSENS[3]: LB 4700-5x-Ix
Signal Circuits	**intrinsically safe**	
Explosion Protection Concept of the Compartments		
All Compartments	Ex "t" (dust protection)	
Electronics Compartment (Housing)	Ex "d" (flameproof enclosure)	
Terminal Compartment	Ex "i" (intrinsic safety)	
Ambient Temperature		
T_a min.	-40 °C	
CE 0102 Ex UKCA		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T1-T5 (T_a <= +80 °C) / 85 °C	T1-T6 (T_a ≤ +60 °C) / 80 °C
	T6 (T_a <= +75 °C) / 80 °C	
II 2 G (Zone 1)	Ex db [ib] IIC T1-T6 Gb	
II 2 D (Zone 21)	Ex tb [ib] IIIC T85 °C Db	
NEC		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T1-T6 (T_a ≤ +75 °C) / 80 °C	T1-T6 (T_a ≤ +56 °C) / 80 °C
Class I, Zone 1	AEx db ib IIC T1-T6 Gb	
Zone 21	AEx tb ib IIIC T85 °C Db	AEx tb ib IIIC T80 °C Db
CEC		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T1-T6 (T_a ≤ +75 °C) / 80 °C	T1-T6 (T_a ≤ +56 °C) / 80 °C
Class I, Zone 1	Ex db ib IIC T1-T6 Gb	
Zone 21	Ex tb ib IIIC T85 °C Db	Ex tb ib IIIC T80 °C Db
Protection Principle	**Ex "d"/"i"/"t"**	

1) Temperature Class: Equipment Temperature Class and Installation Temperature Class.

2) Higher temperatures possible, see nameplate.

3) Must not be used for highly charge-generating processes in Zone 21 installations.

Class, Divisions: "DIP"/"XP"

Variants	CrystalSENS: LB 4700-1x-Fx UniSENS: LB 4700-2x-Fx	Super-SENS: LB 4700-3x-Fx Super-SENS: LB 4700-4x-Fx
Signal Circuits	**Not Intrinsically Safe**	
Explosion Protection Concept of the Compartments		
All Compartments	DIP (Dust Ignition Proof) XP (Explosion Proof)	
Ambient Temperature		
Temperature class[1] (T_a max.[2]) / max. surface temperature	T6 ($T_a \leq$ +75 °C) / 80 °C	T6 ($T_a \leq$ +56 °C) / 80 °C
NEC – Class I, Division 1&2		
Groups	A, B, C, D	
T_a min.	-50 °C	-40 °C
NEC – Class II/III, Division 1&2		
Groups	E, F, G	
T_a min.	-40 °C	
CEC – Class I, Division 1&2		
Class I, Division 1&2	B, C, D	
T_a min.	-50 °C	-40 °C
CEC – Class II/III, Division 1&2		
Groups	E, F, G	
T_a min.	-40 °C	
Protection Principle	**"DIP"/"XP"**	

1) Temperature Class: Equipment Temperature Class and Installation Temperature Class.
2) Higher temperatures possible, see nameplate.

NOTICE

Please note that the detector can be damaged in case of failure of the water-cooling system at an ambient temperature greater than 60 °C.

Electric parameters for the supply

Terminal 1+, 2–	Supply and signal circuit (FSK)
max. input voltage U_N	16.8 V
max. input power P_{max}	5 W

Electrical safety parameters for the associated equipment

Terminal 1+, 2–	Supply and signal circuit (FSK) Rectangular characteristic curve
Gas group	**IIC**
max. input voltage U_i	17.64 V
max. input current I_i	81 mA
max. input power P_i	1.4 W
max. internal inductance L_i	2.7 µH
max. internal capacitance C_i	2.42 nF

Signal output (terminal 3, 4)	Thermometer circuit (PT100) linear characteristic curve
max. output voltage U_o	16.8 V
max. output current I_o	33.3 mA
max. output power P_o	139 mW
Maximum concurrently permissible external values of jointly acting reactance (C_i, L_i already considered)	**IIC**
L_o	15 mH
C_o	0.19 µF

IMPORTANT

The above ranges for ambient temperature (T_a) only apply to free-standing mounted detectors. If the detector is not free-standing, this can lead to an additional increase in surface temperature (e.g. by reflection of heat). In this case, the ambient temperature (T_a) must be accordingly reduced in order to make sure that the maximum surface temperature is not exceeded.

IMPORTANT

See chapter 7 for the “Control Drawing” and details on the explosion concept.

6.3 Installation

- Observe the installation and safety instructions of the operating manual.
- Install in accordance with manufacturer's specifications and the relevant standards and rules.
- Do not operate the device outside of its electrical, thermal and mechanical parameters.
- Professionally install the housing cover and the screw connections (cable glands, adapters and blind plugs[2]) to maintain the degree of protection of the housing.
- Unused entries must always be sealed with a blind plug[3].
- Also observe the installation instructions for the screw connections in this safety manual.
- The O-ring between the housing cover and socket must be inserted for sealing the terminal compartment (hereafter referred as terminal compartment) in the groove on the front surface of the socket.
- The cover screws (cylinder screw ISO 4762 - M5x16-A2-70) of the LB 4700-xx-1x / LB 4700-xx-Ix must be underlaid with self-locking lock washers (NL5 SS of Nord-lock®) and tightened with a torque of 4 Nm.
- The screw cap of the LB 4700-xx-Fx must be tightened on the hexagon (size SW 19) with a torque of 15 Nm.
- The 1/2"NPT fitting must be tightened to a torque of 20 Nm.
- Grease must be used on all threadings, OKS 217 is recommended.
- Unused entries must be closed with listed stopping plugs. A tightening torque of 20 Nm is recommended.
- Before the installation of an intrinsically safe circuit, verification of intrinsically safe circuits must be provided (see IEC 60079-14).
- The detector must be connected to an equipotential bonding system.
- The intrinsically safe circuit is connected to the probe on the PA.
- Sufficient insulation of >500 V between signal / power supply circuit (FSK) and thermometer circuit (PT100) must be ensured.
- The intrinsically safe circuit is galvanically separated with an insulation >1.5 kV in the evaluation unit.
- When using a screen, make sure:
  - Connect the screen on the detector side.
  - Insulation between screen, line and evaluation unit > 500 V respectively.
  - DO NOT connect the screen on the evaluation side.
- The temperature of the entry / branching point can exceed 60 °C, select cable entries that are suitable for the expected temperature.
- Use suitable connecting cable for the ambient conditions.
- Connecting cables (conductors and insulation) must be suitable for a continuous service temperature ≥ T_a +15 K.

[2] [3] blanking elements acc. to IEC 60079

- Before the use of connection cables, they have to be checked for the possibility of gas migration (especially if changes of the ambient and/or operating conditions can occur).
- Connected lines must be strain-relieved.
- Conductor must be placed in an U-shape around the screw of the saddle clamp.
- Do **not** disassemble the detector housing (Fig. 6, Pos. 1) from the socket (Fig. 6, Pos. 2) by opening the Torx screws in the terminal compartment.
- The detectors are to be used exclusively for fixed location installation.
- Devices that were used in "non-hazardous conditions" must not be used in hazardous areas.
- The plan for the control of the terminal compartment (check list on page 32) should be completed before commissioning and after each opening of the terminal compartment.
- Devices with intrinsically safe circuits may no longer be connected to intrinsically safe circuits if they were not previously used in an intrinsically safe manner.

6.4 Terminal Compartment

Screw Connections

NOTICE

If it cannot be excluded that the cable gland might have suffered damage (e.g. by a mechanical shock), then the cable gland and in particular the threads should be checked for damage and replaced if necessary.

- Non-metallic screw connections may only be used for the temperature range of -20 °C ≤ T_a ≤ +60 °C.
- For ambient temperatures of -20 °C ≤ T_a ≤ +60 °C, only such screw connections should be permitted that at least technically meet the standard level listed on the cover page of LB 4700 EC-type examination certificate. For outside of this temperature range, only use screw connections that are approved by Berthold Technologies GmbH & Co. KG.
- Screw connections must have at least degree of protection IP66 / IP68.
- Only use screw connections that are suitable for the cable type (armoured, non-armoured, ...) and the cable cross section.
- When using adapters for thread adjustment (e.g. thread reduction), only one adapter may be used in any entry.
- Only replace screw connections with those of the same type.

Connecting Terminals

- Permissible max. conductor cross section: 2.5 mm² (AWG 21 - 14 flexible or rigid).
- Both fine stranded conductors and rigid conductors are allowed.
- Lay the connecting cables in the terminal compartment so that
  - no dirt and humidity gets into the terminal compartment.
  - the conductors are not damaged when the cable insulation is removed.
  - the distances between bare conductors comply with the clearance and creepage distances.
  - the conductors are placed U-shape around the screw of the connection terminal.
  - clamped conductors in the connection terminals meet a pull-out test according to IEC 60947-1 for 1 minute:
    - 30 N pull-out force for 0.5 mm² cross section and
    - 50 N pull-out force for 2.5 mm² cross section
- The connection of superfine stranded conductors of class 6, according to IEC 60228, is not permitted.
- If the bushing loosens while opening/closing the connecting terminal of the bushing, the device must be returned for repair.

6.5 Operation

Further operation is not allowed if:

- the detector is damaged.
- threads on the housing are corroded.
- the housing of the detector is heavily corroded.
- sealing plugs are badly corroded or damaged.
- cable glands are corroded or damaged.
- adapters are heavily corroded or damaged.
- seals are damaged and/or have a visible ageing effect or movement.

Protection principle Ex-d/-e/-t / XP

- Do not open the terminal compartment while there is voltage
- If an explosive atmosphere is present: Waiting time before opening the electronics compartment after turning off the supply: 2 minutes.

Protection principle Ex-d/-i/-t

- The housing cover may be opened for a short time for repair and maintenance purposes.

7 Control drawing

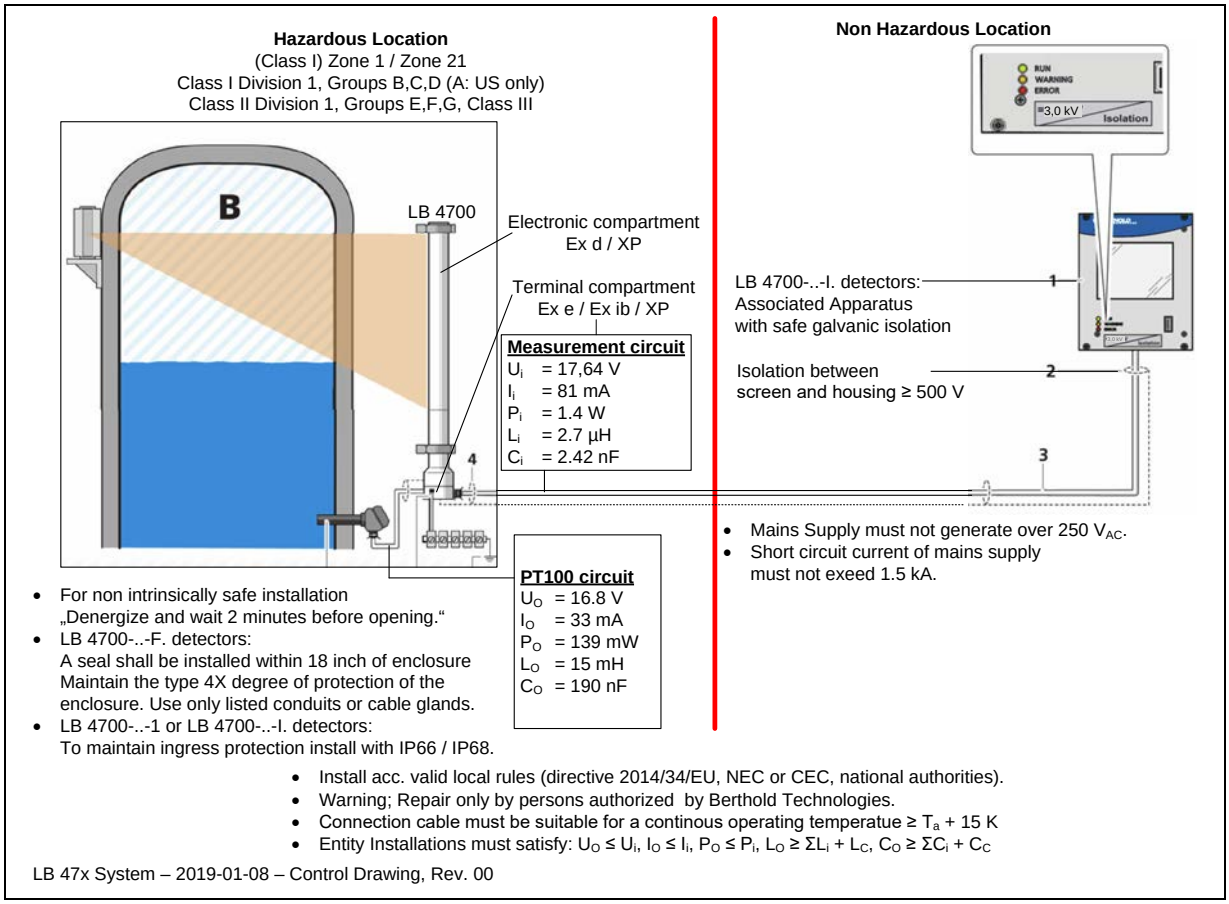
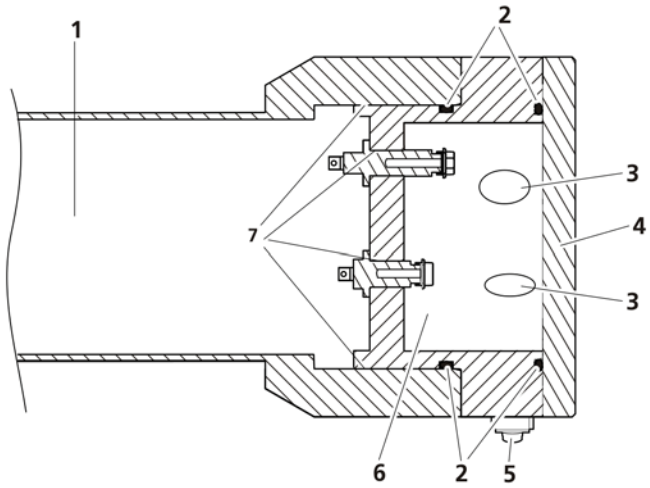


Fig. 1 Control Drawing

8 Explosion Protection Design

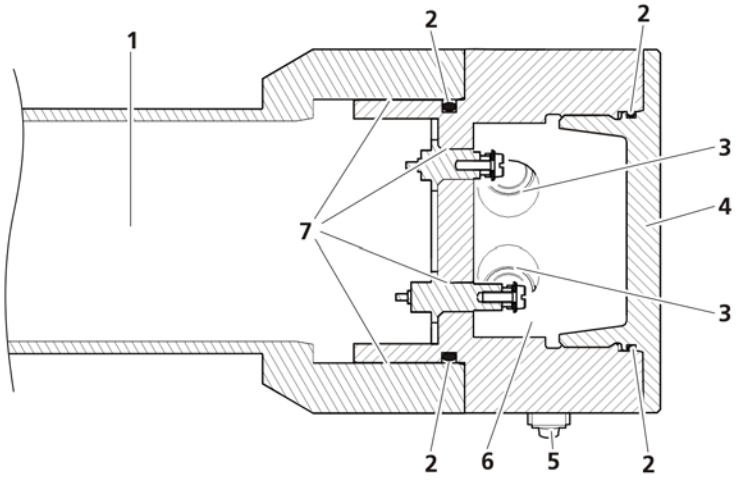
The electronics are located in compartment (item 1), which is enclosed by the housing and the base (socket) in the protection type "d" (Ex-d).

The cables are led into the terminal compartment through the entries (Pos.3) using approved cable glands, either in protection type "e" (Ex-e) or "i" (Ex-i). The conductors are connected directly to approved feed through connectors of the protection type Ex-d.



1	Electronics compartment Ex-d	5	Equipotential bonding
2	O-ring (silicone)	6	Terminal compartment Ex-e or Ex-i
3	Entry	7	Ignition gap
4	Housing cover		

Fig. 2 Explosion Protection Design LB 4700-xx-1x / LB 4700-xx-Ix



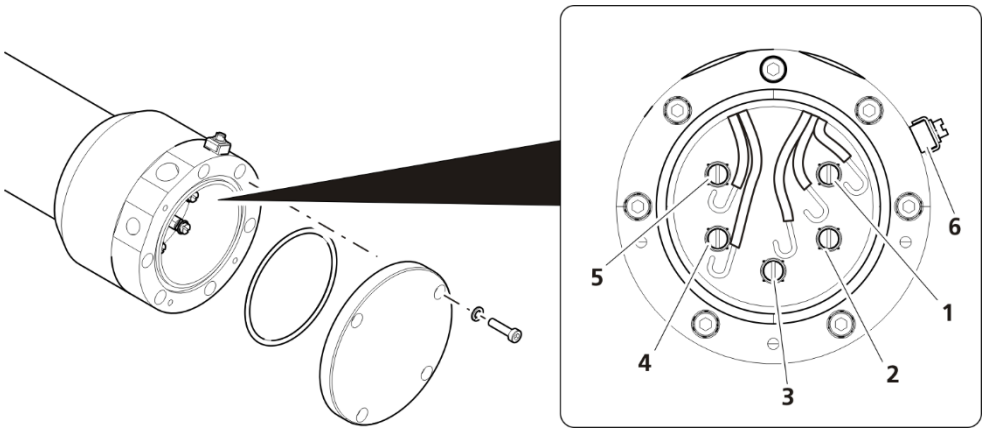
1	Electronics compartment Ex-d	5	Equipotential bonding
2	O-ring (silicone)	6	Terminal compartment Ex-e or Ex-i
3	Entry	7	Ignition gap
4	Housing cover		

Fig. 3 Explosion Protection Design LB 4700-xx-Fx

8.1 Terminal Compartment

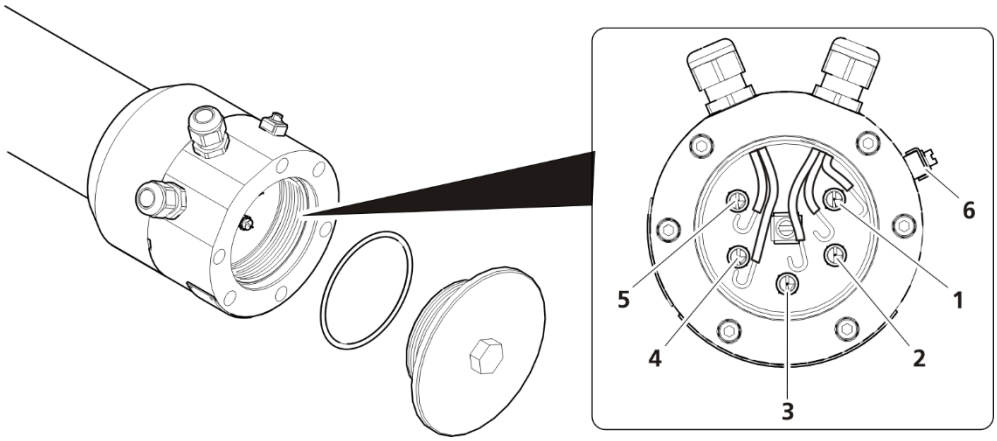
IMPORTANT

Observe the specifications in the chapter during assembly and electrical installation in chapter 6.3 Installation.



1	Signal and power supply circuit +	4	Pt100 -
2	Signal and power supply circuit -	5	Equipotential bonding
3	Pt100 +	6	Equipotential bonding

Fig. 4 Terminal Compartment LB 4700-xx-1x / LB 4700-xx-Ix



1	Signal and power supply circuit +	4	Pt100 -
2	Signal and power supply circuit -	5	Equipotential bonding
3	Pt100 +	6	Equipotential bonding

Fig. 5 Terminal Compartment LB 4700-xx-Fx

8.2 Cable Entries into the Terminal Compartment

The cable glands may only be used for connection of permanently laid lines.

IMPORTANT

If cable glands or cables that were not tested by Berthold Technologies GmbH & Co. KG are used, the torques for fixing may need to be redefined.

The specified torques in the table of the attached manuals are guidelines for the cable glands listed in the table, but essentially depend on the cable used. The pressure screw and the fitting body must be tightened so that the IP protection is securely guaranteed.

Only metallic cable glands may be used outside the temperature range -20 °C ≤ T_a ≤ +60 °C.

Note the torques, cross sections and protective types of screw connections in the table of the attached manuals.

The following table shows the installed threading for the cable entry:

Detector Variant	Threaded Entries into Enclosure
LB 4700-xx-xx-xx-xx-xx0	M12x1.5, M16x1.5 (radial)
LB 4700-xx-xx-xx-xx-xx1	2x 1/2" NPT (radial)
LB 4700-xx-xx-xx-xx-xx2	M16x1.5 (axial)
LB 4700-xx-xx-xx-xx-xx3	M20x1.5 (axial)
LB 4700-xx-xx-xx-xx-xx4	M25x1.5 (axial)
LB 4700-xx-xx-xx-xx-xx5	M32x1.5 (axial)
LB 4700-xx-xx-xx-xx-xx6	1/2" NPT (axial)

8.3 Stopping (Blanking) Plugs

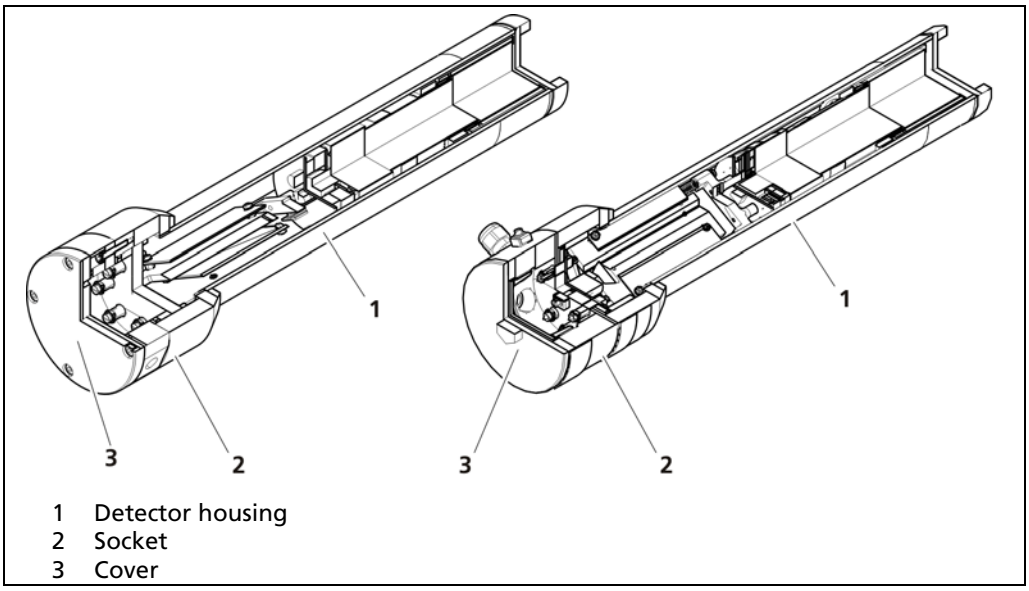
Material	Size	ID No.	Ex Code / Type of Protection	Wrench Size	Torque
Stainless steel	M12 x 1.5	68462	approved with the detector	16 mm (outer hexagon)	6 Nm silicone
	M16 x 1.5	68463		20 mm (outer hexagon)	8 Nm silicone

- Grease must be used on all threadings, OKS 217 is recommended. To ensure the sealing function, the grease must be thickly applied to NPT threads.
- Unused entries must be closed with listed stopping plugs with an appropriate protection (at least IP66 / IP68 or type 4X).
- For 1/2" NPT threading, a tightening torque of 20 Nm is recommended.

9 Maintenance and Visual Inspection

NOTICE

For detectors that are used in areas of explosion risk, the six screws that connect the detector housing with the socket may only be opened by the service of Berthold Technologies GmbH & Co. KG or by persons authorised by Berthold.



1 Detector housing
2 Socket
3 Cover

Fig. 6 Detector Housing with Socket and cover

IMPORTANT

During commissioning, maintenance or repair, always use the check lists in chapter 10 and 11, in order to document the accuracy and completeness of your work.

Visual Inspection

Regularly perform a visual inspection at least once every three years. We recommend to use the checklist from chapter 10. Initiate immediate appropriate measures if you discover damage during visual inspection. If necessary, immediately disconnect the detector from the power supply.

When determining the intervals for the visual inspection, the following conditions are to be considered:

- ambient conditions (temperature, humidity, corrosive atmosphere, shock and vibration).
- operating conditions (utilization, incorrect operation).
- major changes in the whole system (e.g. changes in the classification of explosion protection zones).

Seals

If the cover or the housing is opened, the corresponding seals should be examined and replaced if necessary.

NOTICE

Do not install other seals. If seals need to be replaced, contact Berthold for replacement, otherwise the approval for Explosions Protection is void.

Cleaning

Make sure that the cable glands and the name plates are not damaged during cleaning. Cleaning measures that may cause damage, such as grinding, filing, etc., are not permitted.

10 Plan for Visual Inspection of the Detector

IMPORTANT

If you answer any of these questions with "No", you must make a note of the measures you have taken to remedy this deficiency in the last column. Before you take the detector into operation, make sure to verify the correctness of the measures with your explosion protection officer again.

Date:..... Name:.....	Yes	No	Measures
General examination			
Is the housing free from corrosion, dents, cracks, holes and deformation?			
Is the cover of the detector mounted firmly?			
Are the safety-relevant temperatures (ambient temperature and temperature classes) met according to chapter 6?			
Are the outer terminals of the equipotential bonding intact?			
Is the surface of the detector free from contact with other, non-alloy steel parts?			
Are the connected cables mounted strain-relieved?			
Is a circuit break installed?			
Is the circuit break easily accessible by maintenance personnel?			

Examination of the screw connections (cable glands, adapters, sealing plugs)			
	Yes	No	Measures
Are the screw connections suitable for the environmental conditions?			
For the normal ambient temperature range between -20 °C and +60 °C, do the screw connections used technically correspond to at least the specified standards of the cover page of the EC-type examination certificate, and are screw connections used which are approved by Berthold Technologies GmbH & Co. KG for use on the detector?			
Is the permissible temperature range of the screw connections suitable for the temperatures involved?			
Are the screw connections for the required degree of protection (min. IP65) suitable?			
Are the screw connections corrosion free?			
Is no more than one adapter (reducer or extension piece) used?			
Is the total length of the cable gland plus possibly used adapter less than 10 cm?			
Are the cable diameters of the cable used within the specified range for cable glands?			
Are the connecting cables suitable for the environmental conditions?			
Are the connecting cables suitable for a temperature which is 15 °C above the maximum ambient temperature?			
Are the screw connections undamaged?			
Are you confident about the sealing of the screw connections?			
Are the cables firmly fixed in the cable glands?			
Are the screw connections tight?			
Are all unused entries closed?			
Are the screw connections suitable for the required explosion group?			

11 Plan for the Control of the Connection

IMPORTANT

If you answer any of these questions with "No", you must make a note of the measures you have taken to remedy this deficiency in the last column. Before you take the detector into operation, make sure to verify the correctness of the measures with your explosion protection officer again.

Date:..... Name:.....	Yes	No	Measures
Examination in the terminal compartment			
Is the interior (terminal compartment) in good condition?			
Is the interior dry, clean and free of debris?			
Are the clamped conductors firmly seated?			
Are the terminals in good condition?			
Is the interior free from corrosion?			
Is the insulation free of damage or creepage paths?			
Is the mechanical attachment of the components intact?			
Is the detector properly installed according to EN 60079-14?			
For fine wired strands: Are all the wires from the terminals covered and clamped? The connection of superfine stranded lead of class 6, according to IEC 60228, is not permitted.			
Is the equipotential bonding properly connected?			
Is the screen properly isolated electrically (e.g. with shrink tubing)?			

Checking Sealing			
Is the sealing for the cover in the terminal compartment undamaged and free of cracks and subsidence?			

12 ATEX Certificate

BUREAU VERITAS

EU - Type Examination Certificate

(1)

(2) Equipment and protective systems intended for use in potentially explosive atmospheres – **Directive 2014/34/EU**

(3) EU - Type Examination Certificate Number

EPS 13 ATEX 1 547 X **Revision 6**

(4) Equipment: Scintillation measuring unit Type LB 4700

(5) Manufacturer: Berthold Technologies GmbH & Co. KG

(6) Address: Calmbacher Str. 22, 75323 Bad Wildbad, Germany

(7) This equipment and any acceptable variation thereto are specified in the annex to this certificate and the documentation therein referred to.

(8) Bureau Veritas Consumer Products Services Germany GmbH, notified body No. 2004 in accordance with Article 21 given in the Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014, certifies that this equipment has been found to comply with the essential health and safety requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II of the Directive. The examination and test results are recorded in the confidential documentation under the reference number 12TH0493

(9) Compliance with the essential health and safety requirements has been assured by compliance with:

EN IEC 60079-0:2018 **EN 60079-1:2014** **EN 60079-31:2014**

EN 60079-7:2015/A1:2018 **EN 60079-11:2012**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the annex to this certificate.

(11) This EU - Type Examination Certificate relates only to the design and examination of the specified equipment in accordance with Directive 2014/34/EU. Further requirements of this Directive apply to the manufacture of this equipment and its placing on the market. Those requirements are not covered by this certificate.

(12) The marking of the equipment shall include the following:

II 2G Ex db eb IIC T1-T6 Gb
II 2D Ex tb IIIC T80°C / T85°C Db
II 2G Ex db [ib] IIB / IIC T1-T6 Gb
II 2D Ex tb [ib] IIIC T85°C Db

Certification department of explosion protection

Hamburg, 2020-11-20

H. Schaffer

Page 1 of 3

Certificates without signature and seal are void. This certificate is allowed to be distributed only if not modified. Extracts or modifications must be authorized by Bureau Veritas Consumer Products Services Germany GmbH. EPS 13 ATEX 1 547 X, Revision 6.

BUREAU VERITAS
Consumer Products Services Germany GmbH
Oehleckerring 40, D-22419 Hamburg
Phone: +49 40 74041-0
cps-hamburg@bureauveritas.com
www.bureauveritas.de/cps

(13) **Annex**

(14) **EU - Type Examination Certificate EPS 13 ATEX 1 547 X** **Revision 6**

(15) Description of equipment:

The scintillation measuring unit of the LB 4700 series is part of a measuring system for monitoring industrial processes. It is used for continuously measuring the level in tanks or bins that contain liquid, granular, viscous or encrustation-forming media, and/or measuring conveyor belt charges and the density of liquids, suspensions, slurries and bulk solids. It is also used for continuously measuring level, weight per unit area, ash, sulphur, hydrogen and other specific application. The measuring principle is based on the absorption of gamma rays. The radiation source does not form part of the measuring unit and is therefore not included in the above type approval either. The field of application is the installation in zone 1 or 2 (dust: 21 or 22, resp.). The unit consists of a scintillation detector with the required analyzing electronics, which is housed in flameproof enclosure with connection terminal in increases safety room. The enclosure can be provided with a water-cooling system to be able to cool the electronics system.

Additional options with glass feed through separate enclosure: SuperSENS: LB 4700-3x-.., TowerSENS: LB 4700-4x-.., InlineSENS: LB 4700-5x-..

Electrical data:

U_{max} = 16.8 V
P_{max} = 5.0 W

For devices Type LB 4700 - xx - 1B with xx = 11-16,1A,1B, 2A to 2L. 31, 32, 41 to 44

Intrinsic safe type (ib), electrical ratings:

For devices Type LB 4700 – xx - IC with xx = 11-16,1A,1B, 2A to 2L. 31, 32, 41 to 44

Power supply (FSK)
IIB: Ui = 17.64 V, Ii = 118 mA, Pi = 2.0 W, Li = 2.7 µH, Ci = 2.42 nF
IIC: Ui = 17.64 V, Ii = 81 mA, Pi = 1.4 W, Li = 2.7 µH, Ci = 2.42 nF

Pt100 circuit
IIB and IIC: Uo = 16.8 V, Io = 33 mA, Po = 139 mW, Li = 2.7 µH, Ci = 2.42 nF
Highest permissible values for outer reactances:

combined	IIB					IIC				
Lo [mH]	5.000	1.000	0.500	0.100	0.010	5.000	1.000	0.500	0.100	0.010
Co [µF]	1.600	2.000	2.000	2.100	2.290	0.290	0.320	0.320	0.340	0.390

BUREAU VERITAS
Consumer Products Services Germany GmbH
Oehleckerring 40, D-22419 Hamburg
Phone: +49 40 74041-0
cps-hamburg@bureauveritas.com
www.bureauveritas.de/cps

(16) Reference number: 12TH0493

(17) Special conditions for safe use:

Only certified components defined by manufacturer can be used.

Repair of flameproof joints is not allowed according to table values of IEC 60079-1.

The ambient temperature range is given by the following table:

Ambient temperature range	Temperature class
-40 °C ≤ Ta ≤ +75 °C	T6 / T80 °C
-40 °C ≤ Ta ≤ +80 °C	T1-T5 / T85 °C
-20 °C ≤ Ta ≤ +60 °C	T1-T6 / T80 °C when using non metallic cable glands

For dust Ex applications high electrostatic charge generating processes shall be excluded.

(18) Essential health and safety requirements:

Met by compliance with standards.

Certification department of explosion protection

Hamburg, 2020-11-20

H. Schaffer

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Consumer Products Services Germany GmbH
Oehleckerring 40, D-22419 Hamburg
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www.bureauveritas.de/cps

13 IECEx Certificate

IECEx Certificate of Conformity

INTERNATIONAL ELECTROTECHNICAL COMMISSION
IEC Certification System for Explosive Atmospheres
for rules and details of the IECEx Scheme visit www.iecex.com

Certificate No.:	**IECEx EPS 13.0008X**	Page 1 of 4	Certificate history:
Status:	**Current**	Issue No: 7	Issue 6 (2020-11-20) Issue 5 (2018-11-13) Issue 4 (2018-09-13) Issue 3 (2015-10-09) Issue 2 (2015-03-16) Issue 1 (2014-04-03) Issue 0 (2013-06-04)
Date of Issue:	2021-11-16		
Applicant:	**Berthold Technologies GmbH & Co. KG** Calmbacher Str. 22 75323 Bad Wildbad **Germany**		
Equipment:	**Scintillation measuring unit LB 4700**		
Optional accessory:	SuperSENS: LB 4700-3x-.., TowerSENS: LB 4700-4x-.., InlineSENS: LB 4700-5x-.		
Type of Protection:	**"db", "ib", "tb", "eb"**		
Marking:	Ex db eb IIC T1-T6 Gb Ex tb IIIC T80 °C / T85 °C Db or Ex db [ib] IIB / IIC T1-T6 Gb Ex tb [ib] IIIC T85 °C Db		

Approved for issue on behalf of the IECEx Certification Body: **Ulrich Feike**

Position: **Certification Manager**

Signature: (for printed version)

Date: 2021-11-16

1. This certificate and schedule may only be reproduced in full.
2. This certificate is not transferable and remains the property of the issuing body.
3. The Status and authenticity of this certificate may be verified by visiting www.iecex.com or use of this QR Code.

Certificate issued by:

Bureau Veritas Consumer Products Services Germany GmbH
Businesspark A96
86842 Türkheim
Germany

IECEx Certificate of Conformity

Certificate No.: **IECEx EPS 13.0008X** Page 2 of 4

Date of issue: 2021-11-16 Issue No: 7

Manufacturer: **Berthold Technologies GmbH & Co. KG**
Calmbacher Str. 22
75323 Bad Wildbad
Germany

Additional manufacturing locations:

This certificate is issued as verification that a sample(s), representative of production, was assessed and tested and found to comply with the IEC Standard list below and that the manufacturer's quality system, relating to the Ex products covered by this certificate, was assessed and found to comply with the IECEx Quality system requirements.This certificate is granted subject to the conditions as set out in IECEx Scheme Rules, IECEx 02 and Operational Documents as amended

STANDARDS :
The equipment and any acceptable variations to it specified in the schedule of this certificate and the identified documents, was found to comply with the following standards

IEC 60079-0:2017 Explosive atmospheres - Part 0: Equipment - General requirements
Edition:7.0

IEC 60079-1:2014-06 Explosive atmospheres - Part 1: Equipment protection by flameproof enclosures "d"
Edition:7.0

IEC 60079-11:2011 Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "i"
Edition:6.0

IEC 60079-31:2013 Explosive atmospheres - Part 31: Equipment dust ignition protection by enclosure "t"
Edition:2

IEC 60079-7:2017 Explosive atmospheres - Part 7: Equipment protection by increased safety "e"
Edition:5.1

This Certificate **does not** indicate compliance with safety and performance requirements other than those expressly included in the Standards listed above.

TEST & ASSESSMENT REPORTS:
A sample(s) of the equipment listed has successfully met the examination and test requirements as recorded in:

Test Report:

DE/EPS/ExTR13.0009/06

Quality Assessment Report:

DE/PTB/QAR06.0011/06

IECEx Certificate of Conformity

Certificate No.: **IECEx EPS 13.0008X** Page 3 of 4

Date of issue: 2021-11-16 Issue No: 7

EQUIPMENT:
Equipment and systems covered by this Certificate are as follows:

The LB 4700 Series is a scintillation measuring unit for measuring of filling level, charging and density of different materials. The enclosure is constructed with an Ex-e connection space and electronics are fitted in Ex-d room. Water cooling can be provided for cooling of electronics. Optional glass window module can be fitted.

Ex-d/e electrical ratings:

U_N =15V

P = 5W

Intrinsic safe type (ib), electrical ratings:

Power supply (FSK)
IIB : Ui = 17.64 V, Ii = 118 mA, Pi = 2.0 W, Li = 2.7 µH, Ci = 2.42 nF
IIC : Ui = 17.64 V, Ii = 81 mA, Pi = 1.4 W, Li = 2.7 µH, Ci = 2.42 nF

Pt100 circuit:
IIB and IIC: Uo = 16.8 V, Io = 33 mA, Po = 139 mW, Li = 2.7 µH, Ci = 2.42 nF

Lo = 30mH

Co = 390nF

These are maximum values for only inductance or capacitance circuit. For combined values clause 10.1.5.2 of IEC 60079-11 must be considered

SPECIFIC CONDITIONS OF USE: YES as shown below:
Only certified components defined by manufacturer can be used.

Repair of flameproof joints is not allowed according to values of table 3 of IEC 60079-1.

Ambient temperature range:

-40 °C ≤ Ta ≤+75 °C (T6 / T80°C)

-40 °C ≤ Ta ≤+80 °C (T1-T5 / T85 °C)

-40 °C ≤ Ta ≤+65 °C (T1-T5 / T85 °C) (for glass window variant C1/C4)

-20 °C ≤ Ta ≤+60 °C (T1-T6 resp. T80 °C (when using the non-metallic cable glands)

For dust Ex applications high electrostatic charge generating processes shall be excluded.

IECEx Certificate of Conformity

Certificate No.: **IECEx EPS 13.0008X** Page 4 of 4

Date of issue: 2021-11-16 Issue No: 7

DETAILS OF CERTIFICATE CHANGES (for issues 1 and above)
Rev. 7: Addition of alternative cementing materials for glass window.

14 UKCA Certificate

element

UNITED KINGDOM CONFORMITY ASSESSMENT

1

UK TYPE EXAMINATION CERTIFICATE

2 **Product or Protective System Intended for use in Potentially Explosive Atmospheres SI 2016:1107 (as amended) – Schedule 3A, Part 1**

3 Type Examination Certificate No.: **EMA21UKEX0049X**

4 Product: **Scintillation measuring unit Type LB 4700**

5 Manufacturer: **Berthold Technologies GmbH & Co. KG**

6 Address: **Calmbacher Strasse 22, 75323 Bad Wildbad, Germany**

7 This product and any acceptable variation thereto is specified in the schedule to this certificate and the documents therein referred to.

8 Element Materials Technology, Approved Body number 0891, in accordance with Regulation 42 of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 2016, SI 2016:1107 (as amended), certifies that this product has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of products intended for use in potentially explosive atmospheres given in Schedule 1 of the Regulations.

The examination and test results are recorded in the confidential report **12TH0493**.

9 Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 60079-0:2018 **EN 60079-1:2014** **EN 60079-7:2015/A1:2018**

EN 60079-11:2012 **EN 60079-31:2014**

Except in respect of those requirements listed at section 18 of the schedule.

10 If the sign "X" is placed after the certificate number, it indicates that the product is subject to specific conditions of use specified in the schedule to this certificate.

11 This TYPE EXAMINATION CERTIFICATE relates only to the design and construction of the specified product. Further requirements of the Regulations apply to the manufacturing process and supply of this product. These are not covered by this certificate.

12 The marking of this product shall include the following:

II 2G Ex db eb IIC T1-T6 Gb **II 2G Ex db [ib] IIB / IIC T1-T6 Gb**

II 2D Ex tb IIIC T80 °C / T85 °C Db **II 2D Ex tb [ib] IIIC T85 °C Db**

Ta see section 17.

This certificate and its schedules may only be reproduced in its entirety and without change. This certificate is issued in accordance with the Element Materials Technology Ex Certification Scheme.

S P Winsor, Certification Manager

Issue date: 2023-03-24 Page 1 of 5 CSF341 4.0

Unit 1, Pendle Place, Skelmersdale, West Lancashire, WN8 9PN, United Kingdom
Element Materials Technology Warwick Ltd
Company Reg No. 02536659

UKAS PRODUCT CERTIFICATION 0178

13 SCHEDULE TO UK TYPE EXAMINATION CERTIFICATE

14 CERTIFICATE NUMBER EMA21UKEX0049X

15 Description of Product

The scintillation measuring unit of the LB 4700 series is part of a measuring system for monitoring industrial processes. It is used for continuously measuring the level in tanks or bins that contain liquid, granular, viscous or encrustation-forming media, and/or measuring conveyor belt charges and the density of liquids, suspensions, slurries and bulk solids. It is also used for continuously measuring level, weight per unit area, ash, sulphur, hydrogen and other specific application. The measuring principle is based on the absorption of gamma rays. The radiation source does not form part of the measuring unit and is therefore not included in the above type approval either. The field of application is the installation in zone 1 or 2 (dust: 21 or 22, resp.). The unit consists of a scintillation detector with the required analyzing electronics, which is housed in flameproof enclosure with connection terminal in increases safety room. The enclosure can be provided with a water-cooling system to be able to cool the electronics system.

Additional options with glass feed through separate enclosure: SuperSENS: LB 4700-3x-.., TowerSENS: LB 4700-4x-.., InlineSENS: LB 4700-5x-..

Electrical data:

U_{max} = 16.8 V
P_{max} = 5.0 W

For devices Type LB 4700 - xx - 1B with xx = 11-16,1A,1 B, 2A to 2L. 31, 32, 41 to 44
Intrinsic safe type (ib), electrical ratings:
For devices Type LB 4700 — xx - IC with xx = 11-16,1A,1 B, 2A to 2L. 31, 32, 41 to 44

Power supply (FSK)
IIB: Ui = 17.64 V, Ii = 118 mA, Pi = 2.0 W, Li = 2.7 µH, Ci = 2.42 nF
IIC: Ui = 17.64 V, Ii = 81 mA, Pi = 1.4 W, Li = 2.7 µH, Ci = 2.42 nF

Pt100 circuit
IIB and IIC: Uo = 16.8 V, Io = 33 mA, Po = 139 mW, Li = 2.7 µH, Ci = 2.42 nF
Highest permissible values for outer reactance's:

combined		IIB					IIC				
Lo	[mH]	5.000	1.000	0.500	0.100	0.010	5.000	1.000	0.500	0.100	0.010
Co	[pF]	1.600	2.000	2.000	2.100	2.290	0.290	0.320	0.320	0.340	0.390

16 Test report No. (associated with this certificate issue): None

17 Specific Conditions of Use

1. Only certified components defined by manufacturer can be used.
2. Repair of flameproof joints is not allowed according to table values of IEC 60079-1.
3. The ambient temperature range is given by the following table:

Ambient temperature range	Temperature class
-40 °C ≤ Ta ≤ +75 °C	T6 / T80 °C
-40 °C ≤ Ta ≤ +80 °C	T1-T5 / T85 °C
-20 °C ≤ Ta ≤ +60 °C	T1-T6 / T80 °C when using non metallic cable glands

4. For dust Ex applications high electrostatic charge generating processes shall be excluded.

SCHEDULE TO UK TYPE EXAMINATION CERTIFICATE

CERTIFICATE NUMBER EMA21UKEX0049X

Attention is drawn to the operating and installation instructions which may contain useful information in relation to conditions of use.

18 Essential Health and Safety Requirements (Regulations Schedule 1)

In addition to the Essential Health and Safety Requirements covered by the standards listed at item 9, all other requirements are demonstrated in the relevant test reports.

The test reports were considered to satisfy the requirements of Schedule 1 with the exception of Essential Health and Safety Requirements 5 and 6, which were separately satisfied by the content of the label drawings and the instructions.

19 Drawings and Documents

The list of controlled technical documentation is given in Appendix A to this schedule.

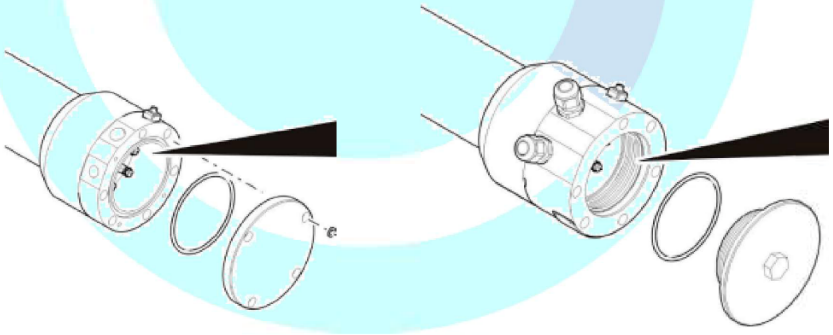
20 Routine Tests

None.

21 Specific Conditions for Manufacture

None.

22 Photographs



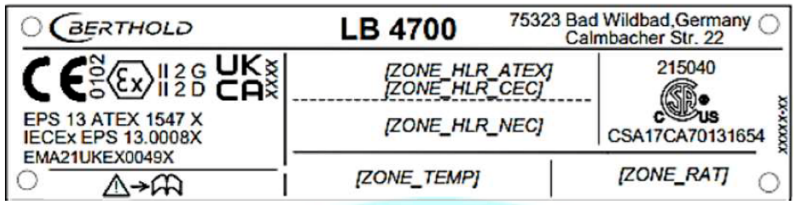
LB 4700-xx-1x

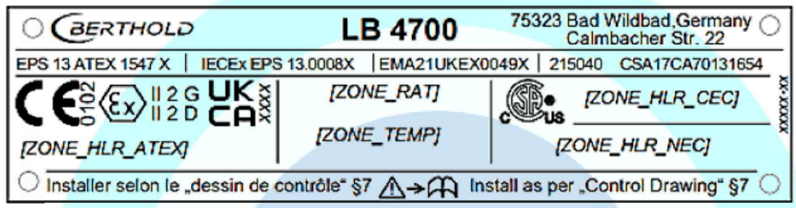
LB 4700-xx-Fx

SCHEDULE TO UK TYPE EXAMINATION CERTIFICATE

CERTIFICATE NUMBER EMA21UKEX0049X

23 Details of Markings





Details of [TYPE], [ZONE_HLR_ATEX], [ZONE_TEMP], [ZONE_RAT] are controlled in drawing 56926GZ4

24 Certificate History

Original certificate 2022-03-24 First issue.

This certificate is a consolidated certificate and reflects the latest status of the certification, including all variations and amendments.

25 Notes to UKCA marking

In respect of UKCA Marking, Element Materials Technology accepts no responsibility for the compliance of the product against all applicable Regulations in all applications.

26 Notes to this certificate

Element Materials Technology certification reference: TRA-054560-00 i2 (GU-BERQ-0002).

Throughout this certificate, the date format yyyy-mm-dd (year-month-day) is used.

Approved Body 0891 is the designation for Element Materials Technology Warwick Ltd.

SCHEDULE TO UK TYPE EXAMINATION CERTIFICATE

CERTIFICATE NUMBER EMA21UKEX0049X

27 **Conditions for the validity of this certificate**

This certificate remains valid for so long as:

(i) The equipment listed in section 4 is manufactured in accordance with the documents listed in Appendix A of this certificate.

(ii) The standards listed in section 9 of this certificate continue to satisfy the Essential Health and Safety Requirements of Schedule 1 of the Regulations SI 2016:1107 (as amended by SI 2019:696) and the generally acknowledged state of the art (e.g. as determined by the publishers of those standards).

APPENDIX A - TECHNICAL DOCUMENTS

Title:	Drawing No.:	Rev. Level:	Date:
Element list of scheduled drawings for this certificate	Scheduled drawings list for EMA21UKEX0049X	1	2023-03-22

15 NEC/CEC HazLoc Certificate

CSA GROUP™

Certificate of Compliance

Certificate: 70131654 **Master Contract:** 215040

Project: 80164511 **Date Issued:** July 21, 2023

Issued To: **Berthold Technologies GMBH & CO KG**
Calmbacher Str 22
Bad Wildbad, Baden-Württemberg, 75323
Germany

Attention: Juergen Betzelt

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US or with adjacent indicator 'US' for US only or without either indicator for Canada only.

C US

Issued by: Jayaraj Balaraman

PRODUCTS
CLASS 2258 02 - PROCESS CONTROL EQUIPMENT For Hazardous Locations
CLASS 2258 82 - PROCESS CONTROL EQUIPMENT For Hazardous Locations - Certified to US Standards

Ex db eb IIC T1-T6 Gb
Class I, Zone 1 AEx db eb IIC T1-T6 Gb
Ex tb IIIC T80 °C / T85 °C Db
Zone 21 AEx tb IIIC T80 °C / T85 °C Db

Scintillation measuring unit, model LB 4700-aa-1c-d0-fg-hij
Ratings: U_n =16.8 Vdc, P_{max} - 5 W
Enclosure Type 4X; IP66/IP68 (1m/35min)

Variant	Type	Ambient temperature range
A1, B1	LB 4700-1a-1c-d0-fg-hij LB 4700-2a-1c-d0-fg-hij	–40 °C ≤ *Ta* ≤ +75 °C (T1-T6 / T85 °C)
C1	LB 4700-3a-1c-d0-fg-hij LB 4700-4a-1c-d0-fg-hij	–40 °C ≤ *Ta* ≤ +65 °C (T1-T6 / T80 °C)

DQD 507 Rev. 2019-04-30 Page 1

Certificate: 70131654
Project: 80164511

Master Contract: 215040
Date Issued: July 21, 2023

Class I, Division 1, Group B,C,D T1-T6 (Canada)
Class I, Division 1, Group A,B,C,D T1-T6 (USA)
Class II, Division 1, Group E, F, G
Class III, Division 1

Scintillation measuring unit, model LB 4700-aa-Fc-d0-fg-hij
Ratings : U_n =16.8 Vdc, P_{max} – 5 W
Enclosure Type 4X; IP66/IP68 (1m/35min)

Variant	Type	Ambient temperature range
A4, B4	LB 4700-1a-Fc-d0-fg-hij LB 4700-2a-Fc-d0-fg-hij	–50 °C ≤ *Ta* ≤ +75 °C (T1-T6 / T85 °C)
C4	LB 4700-3a-Fc-d0-fg-hij LB 4700-4a-Fc-d0-fg-hij	–40 °C ≤ *Ta* ≤ +65 °C (T1-T6 / T80 °C)

Where Model Code:
aa= Model and scintillator length (first character = 1 for CrystalSENS – variant Bx, 2 for UniSENS – variant Ax, 3 for Super-Sens – variant Cx, 4 for Tower-Sens – variant Cx; second character = length of scintillator with options: 50/50mm, 40/35mm, 25/25mm, 50/60mm, 150/150mm, 500mm, 750mm, 1000mm, 1250mm, 1500mm, and 2000mm & odd numbers are without water cooling and even numbers are with water cooling)
b= Certification type (1 = Hazloc Zones; Ex-d/e/t, F = Hazloc Divisions; XP/DIP)
c= wild card – can be any alphanumeric; not critical to CSA certification
d= signal/supply (8=FSK)
f= wild card – can be any alpha numeric not critical to CSA certification
g= Housing Material (1 = 1.4301 Standard stainless steel; 3 = 316L stainless steel)
h= Temperature Range for accessories not covered by CSA certification
i= wild card – can be any alphanumeric; not critical to CSA certification
j= Entries/Openings (0 = M12x1.5; M16x1.5; radial, 1 = 2x1/2" NPT; radial, 2 = M16x1.5; axial, 3 = M20x1.5; axial, 4 = M25x1.5; axial, 5 = M32x1.5; axial, 6 = 1/2" NPT; radial)

Where Variants:
1st Character = type of housing of electronic compartment: Ax (CrystalSENS detectors), Bx (UniSENS detectors), or Cx (Super-Sens/Tower-Sens detectors)
2nd Character = type of housing of the terminal compartment: x1 (detectors with terminal compartment in type of protection increased safety; Ex e) or x4 (detectors with terminal compartment in type of protection flameproof or explosionproof; Ex d or XP)

Conditions of Acceptability:
- Equipment is only to be installed by manufacturer trained or authorized personnel.
- Equipment is to be fixed by either U-bolt, strap or similar fixing method. The stability is subject to acceptance by the local Authority Having Jurisdiction (AHJ).
- If at any time, there is a conflict between the system safety provisions and any relevant local (national or regional) requirements, the local requirements always take precedence.

DQD 507 Rev. 2019-04-30 Page 2

Certificate: 70131654
Project: 80164511

Master Contract: 215040
Date Issued: July 21, 2023

- This equipment may only be powered by a power supply unit with a limited energy electric circuit in accordance with CAN/CSA C22.2 No. 61010-1-12 and ANSI/UL 61010-1, or Class 2 as defined in the Canadian Electrical Code C22.1, Section 16-200 and/or National Electrical Code (NFPA 70), article 725.121.
- Approved or recognized cable glands or conduit fittings, rated 4X or better, shall only be used in the equipment to maintain the Enclosure Type Rating 4X.
- Cable glands or conduit fittings rated IP66/68 shall be used in the equipment to maintain Degree of Protection IP66/68 of the enclosure.
- The Scintillation measuring unit, Variant C4 shall be connected to an extension module or end cap, which protects the window from mechanical impacts and thermal shocks.

Class 2258 04 – PROCESS CONTROL EQUIPMENT – Intrinsically Safe Entity – For Hazardous Locations
Class 2258 84 – PROCESS CONTROL EQUIPMENT – Intrinsically Safe Entity – For Hazardous Locations – Certified to US Standards

Ex db ib IIC T1-T6 Gb
Class I, Zone 1 AEx db ib IIC T1-T6 Gb
Ex tb ib IIIC T80 °C / T85 °C Db
Zone 21 AEx tb ib IIIC T80 °C / T85 °C Db

Scintillation measuring unit, model LB 4700-aa-Ic-d0-fg-hij
Intrinsically Safe, when installed per drawing 56926BA26
Enclosure Type 4X; IP66/IP68 (1m/35min)

Variant	Type	Ambient temperature range
A1, B1	LB 4700-1a-Ic-d0-fg-hij LB 4700-aa-Ic-d0-fg-hij	–40 °C ≤ *T*a ≤ +75 °C (T1-T6 / T85 °C)
C1	LB 4700-aa-Ic-d0-fg-hij LB 4700-aa-Ic-d0-fg-hij	–40 °C ≤ *T*a ≤ +65 °C (T1-T6 / T80 °C)

Ratings for associated intrinsically safe models, supplied by an intrinsically safe source:

Terminals (number and designation)	Electrical data
1 Signal and power supply circuit + (FSK) 2 Signal and power supply circuit - (FSK)	For group IIC and IIIC Ui = 17.64 V Ii = 81 mA Pi = 1.4 W Internal inductance and capacitance Ci = 2.42 nF Li = 2.7 µH
3 Pt100 + 4 Pt100 -	For group IIC and IIIC Uo = 16.8 V Io = 33 mA Po = 139 mW

DQD 507 Rev. 2019-04-30 Page 3

Certificate: 70131654
Project: 80164511

Master Contract: 215040
Date Issued: July 21, 2023

Terminals (number and designation)	Electrical data
	Maximum permissible external inductance and capacitance for circuits containing both (mixed circuits): Lo = 15 mH Co = 190 nF
5 Equipotential bonding 6 Equipotential bonding	Equipotential bonding

Where:
aa= Model and scintillator length (first character = 1 for CrystalSENS – variant Bx, 2 for UniSENS – variant Ax, 3 for Super-Sens – variant Cx, 4 for Tower-Sens – variant Cx; second character = length of scintillator with options: 50/50mm, 40/35mm, 25/25mm, 50/60mm, 150/150mm, 500mm, 750mm, 1000mm, 1250mm, 1500mm, and 2000mm & odd numbers are without water cooling and even numbers are with water cooling)
b= Certification type (I = Hazloc Zones; Ex-d/i/t)
c= wild card – can be any alphanumeric, not critical to CSA certification
d= signal/supply (8=FSK)
f= wild card – can be any alpha numeric not critical to CSA certification
g= Housing Material (1 = 1.4301 Standard stainless steel; 3 = 316L stainless steel);
h= Temperature Range for accessories not covered by CSA certification;
i= wild card – can be any alphanumeric, not critical to CSA certification
j= Entries/Openings (0 = M12x1.5; M16x1.5; radial, 1 = 2x1/2" NPT; radial, 2 = M16x1.5; axial, 3 = M20x1.5; axial, 4 = M25x1.5; axial, 5 = M32x1.5; axial, 6 = 1/2" NPT; radial)

Where Variants:
1st Character = type of housing of electronic compartment: Ax (CrystalSENS detectors), Bx (UniSENS detectors), or Cx (Super-Sens/Tower-Sens detectors)
2nd Character = type of housing of the terminal compartment: x1 (detectors with terminal compartment in type of protection intrinsically safe; Ex i)

Conditions of Acceptability:

- Equipment is only to be installed by manufacturer trained or authorized personnel.
- Equipment is to be fixed by either U-bolt, strap or similar fixing method. The stability is subject to acceptance by the local Authority Having Jurisdiction (AHJ).
- If at any time, there is a conflict between the system safety provisions and any relevant local (national or regional) requirements, the local requirements always take precedence.
- This equipment may only be powered by a power supply unit with a limited energy electric circuit in accordance with CAN/CSA C22.2 No. 61010-1-12 and ANSI/UL 61010-1, or Class 2 as defined in the Canadian Electrical Code C22.1, Section 16-200 and/or National Electrical Code (NFPA 70), article 725.121.
- Approved or recognized cable glands or conduit fittings, rated 4X or better, shall only be used in the equipment to maintain the Enclosure Type Rating 4X.
- Cable glands or conduit fittings rated IP66/68 shall be used in the equipment to maintain Degree of Protection IP66/68 of the enclosure.
- The Scintillation measuring unit, Variant C4 shall be connected to an extension module or end cap, which protects the window from mechanical impacts and thermal shocks.

Certificate: 70131654
Project: 80164511

Master Contract: 215040
Date Issued: July 21, 2023

APPLICABLE REQUIREMENTS

CAN/CSA-C22.2 No. 60079-0:15 Ed. 3	Explosive Atmospheres - Part 0: Equipment - General requirements
CAN/CSA-C22.2 No. 60079-1:16 Ed. 3	Explosive Atmospheres – Part 1: Equipment protection by flameproof enclosures "d"
CAN/CSA-C22.2 No. 60079-7:12 Ed. 1	Explosive Atmospheres – Part 7: Equipment protection by increased safety "e"
CAN/CSA-C22.2 No. 60079-11:14 Ed. 2	Explosive Atmospheres – Part 11: Equipment protection by intrinsic safety "i"
CAN/CSA-C22.2 No. 60079-31:15 Ed. 2	Explosive Atmospheres – Part 31: Equipment dust ignition protection by enclosure "t"
CSA C22.2 No. 25:17 (R2022)	Enclosures for Use in Class II Groups E, F, and G Hazardous Locations
CSA C22.2 No. 30-M1986 (R2012)	Explosion-proof enclosures for use in class I hazardous locations
CAN/CSA-C22.2 No. 61010-1-12 + UPD1:2015+UPD2:2016	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
CSA C22.2 No. 94.2-15, 2nd Edition	Enclosures for Electrical Equipment, Environmental Considerations
ANSI/UL 60079-0-2013 Sixth Edition (R2017)	Explosive Atmospheres - Part 0: Equipment - General requirements
ANSI/UL 60079-1-2015 Seventh Edition	Explosive Atmospheres – Part 1: Equipment protection by flameproof enclosures "d"
ANSI/UL 60079-7-2008 Fourth Edition	Explosive Atmospheres – Part 7: Equipment protection by increased safety "e"
ANSI/UL 60079-11-2014 Sixth Edition	Explosive Atmospheres – Part 11: Equipment protection by intrinsic safety "i"
ANSI/UL 60079-31-2015 Second Edition	Explosive Atmospheres – Part 31: Equipment dust ignition protection by enclosure "t"
ANSI/UL 61010-1-2012 Third Edition	Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
ANSI/UL 50E-15, Second Edition	Enclosures for Electrical Equipment, Environmental Considerations
FM 3600 - 2011	Electrical Equipment for Use in Hazardous (Classified) Locations, General Requirements
FM 3615 - 2006	Explosionproof Electrical Equipment - General Requirements
FM 3616 - 2011	Dust-Ignitionproof Electrical Equipment General Requirements

DQD 507 Rev. 2019-04-30 Page 5

Certificate: 70131654
Project: 80164511

Master Contract: 215040
Date Issued: July 21, 2023

MARKINGS

The manufacturer is required to apply the following markings:

- Products shall be marked with the markings specified by the particular product standard.
- Products certified for Canada shall have all Caution and Warning markings in both English and French.

Additional bilingual markings not covered by the product standard(s) may be required by the Authorities Having Jurisdiction. It is the responsibility of the manufacturer to provide and apply these additional markings, where applicable, in accordance with the requirements of those authorities.

The products listed are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US (indicating that products have been manufactured to the requirements of both Canadian and U.S. Standards) or with adjacent indicator 'US' for US only or without either indicator for Canada only.

Markings are on stainless steel nameplates at the enclosure body and the warnings appear at the cover. The following marking details appear:

- Manufacturer's name: "Berthold Technologies GMBH & CO KG", or CSA Master Contract Number "215040", adjacent to the CSA Mark in lieu of manufacturer's name.
- The CSA Mark, with or without the "C" and "US" indicators, as shown on the Certificate of Conformity.
- Certificate reference "CSA 17CA70131654"
- Model designation: As specified in the PRODUCTS section, above.
- Manufacturing date, or serial number, traceable to year and month of manufacture.
- Electrical ratings: As specified in the PRODUCTS section, above. Note: Intrinsically Safe Entity Parameters can be located in the instruction manual/control drawing.
- Hazardous Location designation: As specified in the PRODUCTS section, above. The word "Class" may be abbreviated "CL", the word "Division" may be abbreviated "DIV", and the word "Groups" may be abbreviated "GRP" or "GP".
- Method of Protection markings (Ex – markings): As specified in the PRODUCTS section, above. The word "Class" may be abbreviated "CL", the word "Zone" may be abbreviated "ZN".
- Ambient temperature: As specified in the PRODUCTS section, above. The maximum ambient temperature of the equipment is reduced to +56 °C when the version with window glass(Cx) is cemented using 3M Scotch-WeldTM DP 105 for zone applications.
- Enclosure Rating: "Type 4X"
- Ingress Protection: "IP66 / IP68 (1 m / 35 min)"
- The words "Use wire rated ≥ Ta + 15K", or equivalent.
- ISO 3864 Symbol B.3.1 ⚠ or ISO 7000 symbol 0434 ⚠ (triangle with exclamation point).

The following warnings shall be applied in English and French at the cover:

- WARNING: In case of non-intrinsically safe installation and in explosive atmosphere, de-energize and wait 2 minutes!
  AVERTISSEMENT: Dans une installation à sécurité intrinsèque et presence d'une atmosphère explosives, après mise hors tension attendre 2 minutes!

DQD 507 Rev. 2019-04-30 Page 6

Certificate: 70131654
Project: 80164511

Master Contract: 215040
Date Issued: July 21, 2023

- See safety manual for further information
  Voir le manuel de sècurité pour plus de reseignetments!

The equipment with intrinsically safe marking "ib" shall additional be marked with the following:

- Install per "Control Drawing §7"
  Installer selon le "dessin de contrôle §7"
  (marking in both languages must be located adjacent to the manual icon)

The Class I, Division 1 enclosure shall additional be marked with the following:

- A seal shall be installed within 18 inches of the enclosure.
  Un scellement doit êntre installé à moins de 18 pouces du boîter.

INSTALLATION MANUAL AND DOCUMENTATION

An installation manual, data sheet, or other documentation shall be supplied with each unit, containing the following minimum information:

The following warnings shall be applied in English and French in the safety manual:

- WARNING: THE TEMPERATURE OF THE ENTRY / BRANCHING POINT CAN EXCEED 60°C, SELECT CABLE ENTRIES THAT ARE SUITABLE FOR THE EXPECTED TEMPERATURES
  ATTENTION: LA TEMPERATURE D'ENTRÉE / POINT DE BRANCHEMENT PEUT DÉPASSER 60 °C, SELECTIONNER LES ENTRÉES DE CÂBLE ADAPTEES AUX TEMPERATURES ATTENDUES

- WARNING: REPAIR OF FLAMEPROOF JOINTS IS NOT ALLOWED
  ATTENTION: LES JOINTS ANTIDÉFLAGRANTS NE SONT PAS DESTINÉS À ÊTRE RÉPARÉS

- WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY
  ATTENTION: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE

Notes:

Products certified under Class C225802, C225882, C225804, C225884 have been certified under CSA's ISO/IEC 17065 accreditation with the Standards Council of Canada (SCC).
www.scc.ca

SCC Accredited CB-P/S OCPS Accredité CCN

DQD 507 Rev. 2019-04-30 Page 7

16 NEC/CEC OrdLoc Certificate

CSA Group

Certificate of Compliance

Certificate: 70161752 **Master Contract:** 215040

Project: 70165124 **Date Issued:** 2018-11-02

Issued to: **Berthold Technologies GmbH & Co. KG**
Calmbacher Str. 22,
75323 Bad Wildbad
GERMANY

Attention: **Juergen Betzelt**

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators 'C' and 'US' for Canada and US (indicating that products have been manufactured to the requirements of both Canadian and US Standards) or with adjacent indicator 'US' for US only or without either indicator for Canada only

C US

Issued by: R. Rosales

CLASS 2252 06 - PROCESS CONTROL EQUIPMENT
CLASS 2252 86 - PROCESS CONTROL EQUIPMENT (Certified to U.S. Standards)

Scintillation measuring device, Model LB 4700 Series. Rated 16.8Vdc, 5.0W.

Notes:

1. The above model is permanently connected, Pollution Degree 2, Measurement Category II.
2. Mode of operation: Continuous
3. Environmental Conditions: Normal: 5 to 40 C, 2000 m max, 80% to temperatures up to 31 °C decreasing linearly to 50% rH at 40 °C; and Extended: -20 °C to +60 °C (standard), -50 °C to +60 °C (metallic cable glands) and -50 °C to +100 °C (with water cooling).
4. Rated IP66 / IP68, Enclosure Type Rating 4X
5. Indoor and outdoor use
6. Weighing 9 to 27kg, depending on the configuration.

DQD 507 Rev. 2016-02-18 Reaffirmed 2018-04-09 Page 1

Certificate: 70161752 **Master Contract:** 215040

Project: 70165124 **Date Issued:** 2018-11-02

CONDITIONS OF ACCEPTABILITY

(1) Equipment is only to be installed by manufacturer trained personnel.
(2) Equipment is to be fixed by either U-bolt, strap or similar fixing method, which the stability is to be considered at end application.
(3) If at any time, there is a conflict between the system safety provisions and any relevant local (national or regional) requirements, the local requirements always take precedence.
(4) Any other accessory/ies to be used with the equipment has to be checked and complied with the relevant standard (i.e., radiation, etc).
(5) The equipment shall be supplied from Limited Energy Circuit, NEC Class 2, LPS or Limited Power Source only.
(6) This assessment covers the basic safety of the equipment only. It does not cover reliable function, performance, or other properties of the equipment not related to safety.
(7) Approved or recognized cable glands rated 4X or better shall only be used in the equipment to maintain the Enclosure Type Rating 4X.
(8) Cable glands rated IP66/68 shall only be used in the equipment to maintain Degree of Protection IP66/68 of the enclosure.

APPLICABLE REQUIREMENTS

CAN/CSA-C22.2 No. 61010-1-12 3rd Edition (Update 1 & 2, April 2016)	- Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use, Part 1: General Requirements
UL Std. No. 61010-1, 3rd Edition (Rev up to April 2016)	- Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements
UL Std. No. 50E, 2nd Edition (October 2015)	- Enclosures for Electrical Equipment, Environmental Considerations
CSA C22.2 No. 94.2-15, 2nd Edition (October 2015)	- Enclosures for Electrical Equipment, Environmental Considerations

MARKINGS

The manufacturer is required to apply the following markings:

- Products shall be marked with the markings specified by the particular product standard.
- Products certified for Canada shall have all Caution and Warning markings in both English and French.

Additional bilingual markings not covered by the product standard(s) may be required by the Authorities Having Jurisdiction. It is the responsibility of the manufacturer to provide and apply these additional markings, where applicable, in accordance with the requirements of those authorities.

CSA Group

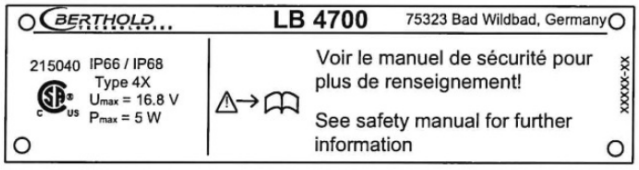
Certificate: 70161752 **Master Contract:** 215040

Project: 70165124 **Date Issued:** 2018-11-02

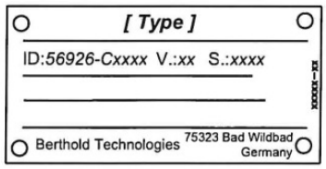
The following markings appear on the product:

1. Submittor's identification (company name and/or file number and/or registered tradename);
2. Marking on the unit that indicates the manufacturing location if the equipment is manufactured at more than one factory location;
3. Model designation;
4. Electrical rating;
5. Date of manufacture: Month and year of manufacture or date code. If a serial number is used instead of date of manufacture, a record of serial numbers shall be kept traceable to date of manufacture. (Not related to date of sale).

Copy of the Marking:



Type Plate



Font Size>=1.5mm

Mark	Symbol	Reference	Title
X		ISO 7000-0434A	Caution

Marking Method: The above markings are made via engraving or laser.

Modifications due to technical advancement reserved.

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Rev.-No.: 08, 03/2023

BERTHOLD TECHNOLOGIES GmbH & Co. KG

Calmbacher Str. 22
75323 Bad Wildbad
Germany
www.Berthold.com

Id.-No. 56926BA26

Unité d'évaluation
DuoSeries
LB 47x

Détecteurs
DuoSeries
LB 4700

Informations sur la sécurité

56925BA59 Rev.05 08/2023

BERTHOLD

1 A propos de ce manuel d’utilisation

1.8 Avertissement

Les avertissements sont identifiés comme suit :

Signalement

Source et conséquence
Explication si requise
▶ Prévention
En cas de danger

- **Symboles d’alerte :** (triangle d’alerte) attire l’attention sur le risque.
- **Signalement :** Indique la sévérité du danger.
- **Source :** Précise le type ou la source de danger.
- **Conséquence :** Décrit les conséquences d’un non respect.
- **Prévention :** Précise comment le risque peut être écarté.
- **En cas de danger :** Précise quelles actions sont requises en cas d’occurrence du risque

1.8.1 Symboles employés dans le manuel d’utilisation

Dans ce manuel, les avertissements indiqués avant les instructions d’utilisation se réfèrent aux risques de blessures ou de dégâts matériels. Les mesures de prévention de danger décrites doivent être respectées.

DANGER

Indique un danger majeur imminent, qui entraînera certainement des blessures sérieuses ou la mort s’il n’est pas évité.

AVERTISSEMENT

Indique un danger potentiel qui peut entraîner des blessures sérieuses ou la mort s’il n’est pas évité.

PRUDENCE

Se réfère à une situation potentiellement dangereuse qui peut entraîner des blessures physiques mineures ou graves, ou des dégâts matériels si elle n’est pas évitée.

RECOMMANDATION

Si cette information n'est pas appliquée, un dysfonctionnement et/ou un dégât matériel peuvent apparaître.

IMPORTANT

Les sections identifiées avec ce symbole signalent des informations importantes du produit ou de son fonctionnement.

Tip

Fournit des conseils sur l'application ou d'autres informations utiles.

1.8.2 Symboles utilisés sur l'appareil

Lire le manuel d'utilisation

Veuillez suivre les instructions dans ce manuel d'utilisation.

Décharge électrostatique

Veuillez noter les instructions de manipulation. Composants sensibles aux décharges électrostatiques. Veuillez suivre les instructions de ce manuel d'utilisation.

Connexion de mise à la terre

Raccorder le conducteur de mise à la terre à cet endroit.

Raccordement equipotentiel

Raccorder le conducteur d'équipotentialité à cet endroit

Tension continue

L'appareil fonctionne en tension continue et ne doit être raccordé qu'à une source de tension continue.

Tension alternative

L'appareil fonctionne en tension alternative et ne doit être raccordé qu'à une source de tension alternative.

Déchet non domestique

Cet appareil électrique ne doit pas être éliminé avec les déchets domestiques

1.9 Conformité

La société Berthold déclare par la présente, sous son entière responsabilité, que la conception de ce produit mis sur le marché par Berthold est conforme aux directives EU indiquées dans la déclaration de conformité originale.

Cette disposition devient nulle en cas de modifications non autorisées par Berthold ou dans le cas d'une utilisation impropre.

Pour la déclaration de conformité originale, se «Technical information».

2 Sécurité

2.1 Dangers et mesures de sécurité

- Lire ces instructions entièrement et avec attention avant d'utiliser l'appareil.
- Stocker ces instructions dans un endroit accessible à tous les utilisateurs en permanence.

2.2 Utilisation appropriée

Ce qui suit constitue une utilisation appropriée :

- Se conformer strictement aux instructions et séquences d'utilisation mentionnées. Ne pas procéder à des pratiques différentes non autorisées qui pourraient engager votre sécurité et la fiabilité fonctionnelle de l'EVU !
- Suivre les instructions de sécurité mentionnées !
- Effectuer les opérations de maintenance prescrites ou les faire réaliser pour vous !
- Utiliser uniquement les accessoires et pièces de rechange Berthold.

Utilisation inappropriée à éviter:

- Ne pas suivre les instructions de sécurité et les instructions pour l'utilisation, la maintenance et la mise au déchet indiquées dans le manuel.
- Un non respect quelconque avec le présent manuel d'utilisation pour le produit délivré.
- Appliquer des dispositions et conditions non conformes à celles mentionnées dans les documents techniques, feuilles de spécifications, manuels d'utilisation et instructions de montage, ou tout autre document spécifique du constructeur.
- Utiliser l'appareil si des éléments sont endommagés ou corrodés. Ceci s'applique aussi aux joints et aux câbles.
- Modification ou changement des éléments du système.
- L'appareil ne doit pas être installé en atmosphère explosive et de ce fait, ne peut pas être utilisé dans une telle atmosphère. Il n'est pas antidéflagrant.
- Utilisation...
  - où les éléments sous tension sont accessibles.
  - dans un boîtier mural avec presse-étoupes insuffisamment étanches et/ou non adaptés pour le passage des câbles.
- Utilisation sans les précautions de sécurité recommandées par le constructeur.
- Manoeuvre inappropriée ou oubli des équipements de sécurité présents.

Berthold assume la responsabilité de la garantie seulement dans le cadre de ses spécifications publiées.

Si le produit est utilisé dans des conditions autres que celles décrites dans le présent manuel, la sécurité du produit est compromise et la garantie devient nulle.

RECOMMANDATION

L'appareil n'est pas conforme à IEC 61508 « Sureté de fonctionnement des systèmes comportant des composants électriques, électroniques ou électroniques programmables »

2.3 Qualification du personnel

RECOMMANDATION

Le minimum requis pour intervenir sur nos appareils ou pour les utiliser est un personnel avec des connaissances générales complétées par une formation d'un expert ou d'une personne autorisée.

A plusieurs endroits dans ce manuel d'utilisation, il est fait références à des groupes de personnes avec des qualifications particulières et à qui différentes tâches peuvent être confiées pendant l'installation, l'utilisation et la maintenance.

Les trois groupes de personnes sont :

- Employés avec des connaissances générales
- Experts
- Personnes autorisées

Employés avec connaissances générales

RECOMMANDATION

Les employés avec des connaissances générales doivent être guidés par un expert pour le moins. Lors de la mise en œuvre de matières radioactives, la personne compétente en radioprotection doit être consultée.

Les employés avec connaissances générales sont, par exemple, des techniciens, des soudeurs, qui vont assurer différentes tâches lors du transport, de l'assemblage et de l'installation de l'appareil sous l'encadrement d'une personne autorisée. Il peut s'agir aussi de personnel de montage du site. Les personnes concernées doivent posséder une expérience dans la manipulation du produit.

Experts

Les experts sont des personnes avec des compétences suffisantes dans le domaine requis, dues à leur formation spécialisée et qui sont familiers avec les lois nationales relatives à la santé et la sécurité, les règlements concernant la prévention des accidents, et les usages techniques applicables.

Le personnel expert doit être capable de déterminer et d'évaluer le résultat de ses tâches et doit être très familier avec le contenu de ce manuel d'utilisation.

Personnes autorisées

Les personnes autorisées sont celles désignées pour les tâches correspondantes dans le cadre de dispositions réglementaires, ou celles dûment autorisées par Berthold pour des tâches particulières. Lors de la mise en œuvre de matières radioactives, la personne compétente en radioprotection doit être consultée.

2.4 Les obligations de l'opérateur

L’opérateur de ces appareils doit régulièrement former son personnel sur les sujets suivants :

- Connaissance et utilisation **du manuel d’utilisation et des clauses légales**.
- Utilisation prévue de l’appareil.
- Respect des instructions de sécurité du site et des conditions d’utilisation de l’opérateur.
- Gestion régulière de la maintenance du produit.

Sous réserve de modifications dans le cadre du progrès technique.

langue: Français
Imprimé en Allemagne
08/2023
Rev.-Nr.: 05

BERTHOLD TECHNOLOGIES GmbH & Co. KG

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Id.-Nr. 56925BA59

DuoSeries Detectors
LB 4700

Technical Information

56926TI2 Rev.03 08/2023
Embedded Software as of Version 12.00.00

BERTHOLD

Table of Contents

1. Information on 2-Wire Technology

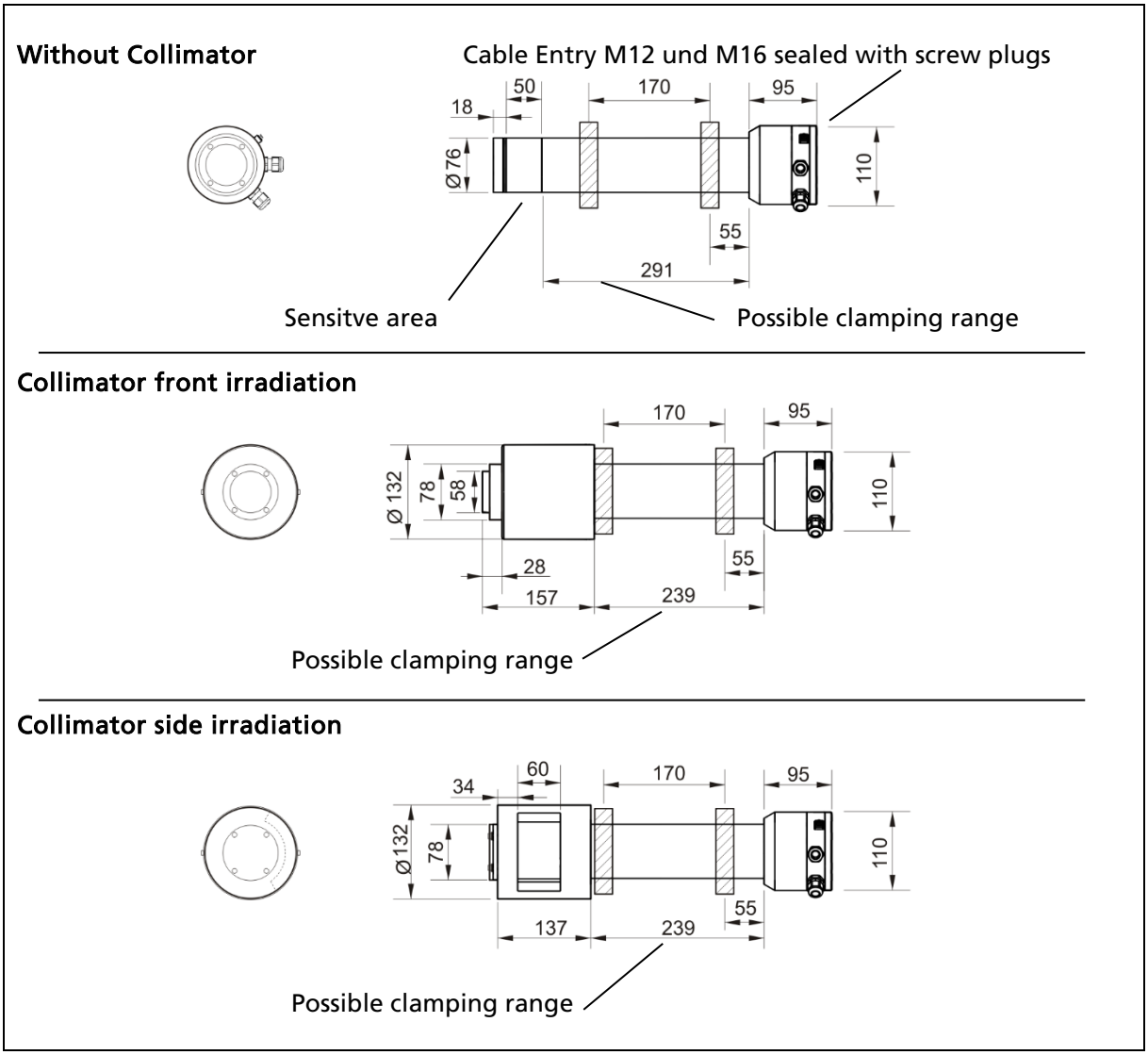
The DuoSeries/DuoXPERT measuring system consists of a scintillation detector – CrystalSENS point detector, UniSENS rod detector, SuperSENS detector or TowerSENS detector – and a sophisticated evaluation unit (DuoXPERT) for display and operation.

The evaluation unit is a state-of-the-art control unit with robust 3.5" TFT touch panel, powerful Dual Core CPU and diverse operator interfaces. Advanced self-diagnostics and monitoring features ensure a safe function of the system. Furthermore the data logging functionality allows operators to analyze their processes in depth, e.g. develop trends, track process changes etc.

Sophisticated Measuring System in 2-Wire Technology

- Unique: Radiometric system with intrinsically safe power supply (Full Ex-i)
- Real 2-wire technology, only 2 wires in the field
- Advanced self diagnostics and monitoring features
- Easy to use touch screen panel for local display and operation
- Integrated gas density compensation feature
- Direct replacement of predecessor model LB 440
- Interfaces with all 2-wire detectors LB 44xx, LB 54xx and LB 47xx

2. CrystalSENS LB-4700-1x

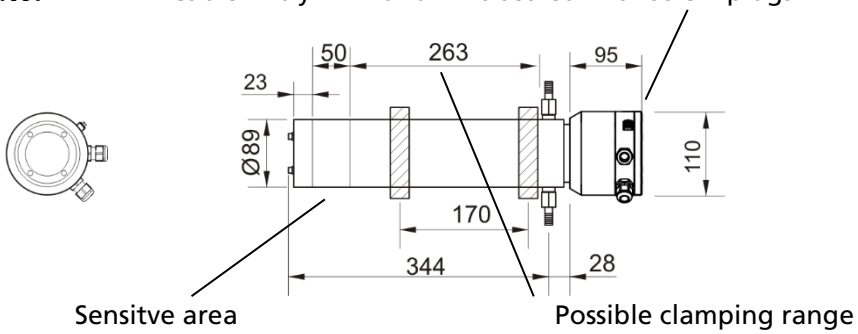


TI-Fig. 1 Dimensions CrystalSENS LB-4700-1x without water cooling (Dimensions in mm)

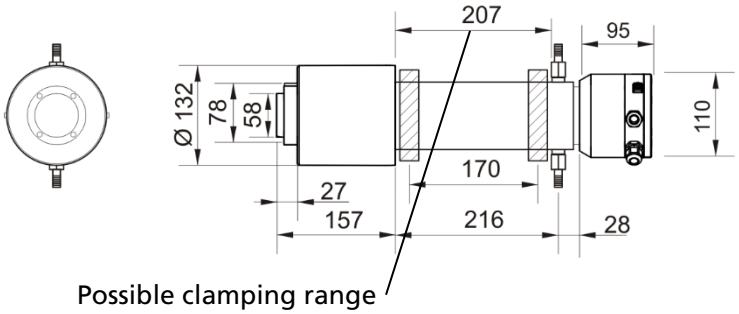
Water cooling	Collimator	Total Length (approx.)	Weight (approx.)
---	---	452 mm	9.4 kg
	Front irradiation	491 mm	21.1 kg
	Side irradiation	471 mm	19.2 kg

Without Collimator

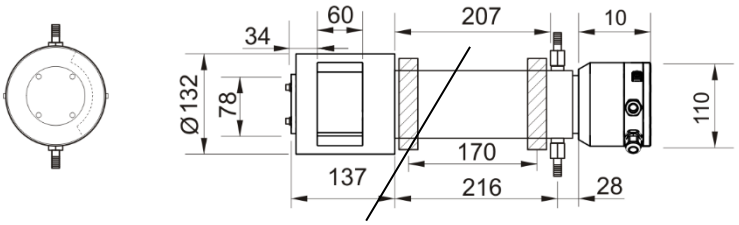
Cable Entry M12 und M16 sealed with screw plugs



Collimator front irradiation



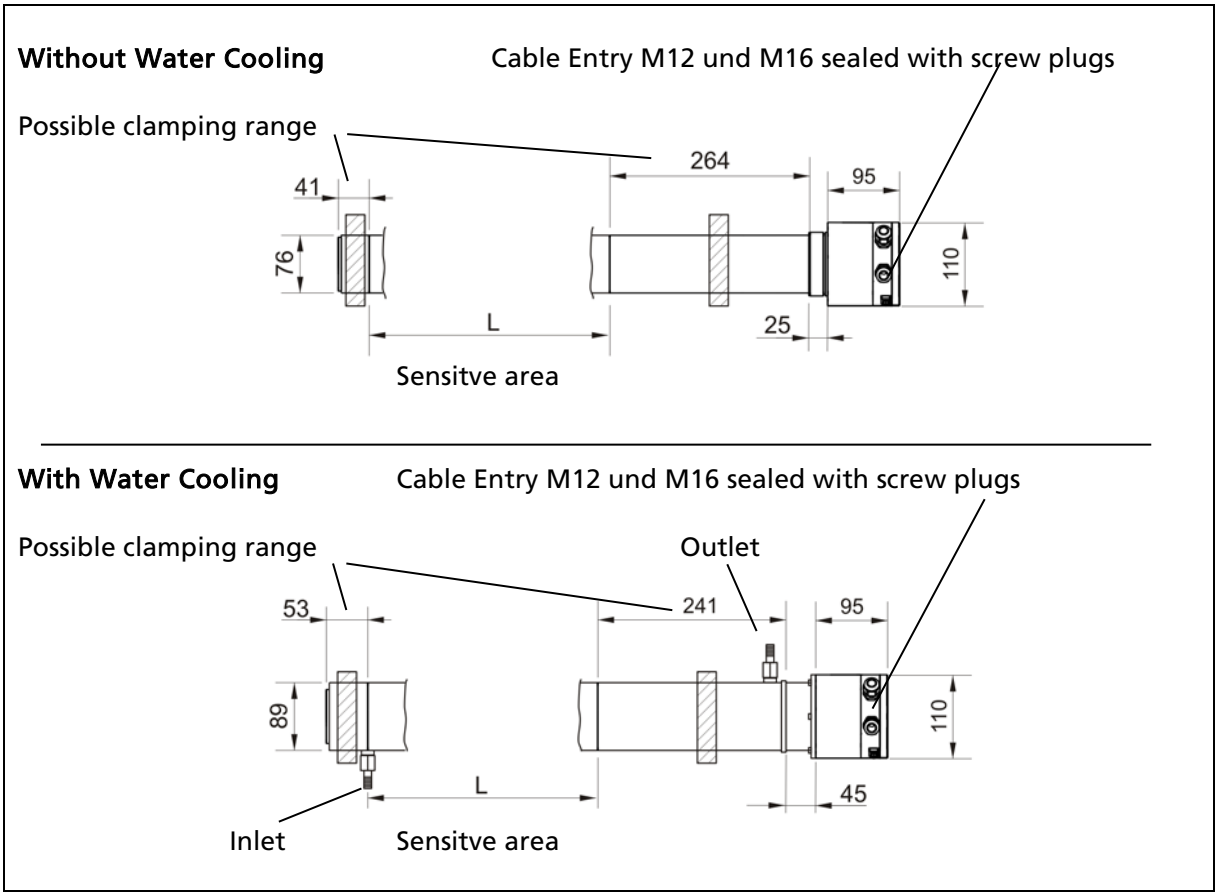
Collimator side irradiation



TI-Fig. 2 Dimensions CrystalSENS LB-4700-1x with water cooling (Dimensions in mm)

Water cooling	Collimator	Total Length (approx.)	Weight (approx.)
✓	---	467 mm	12.3 kg
	Front irradiation	496 mm	23.0 kg
	Side irradiation	475 mm	21.7 kg

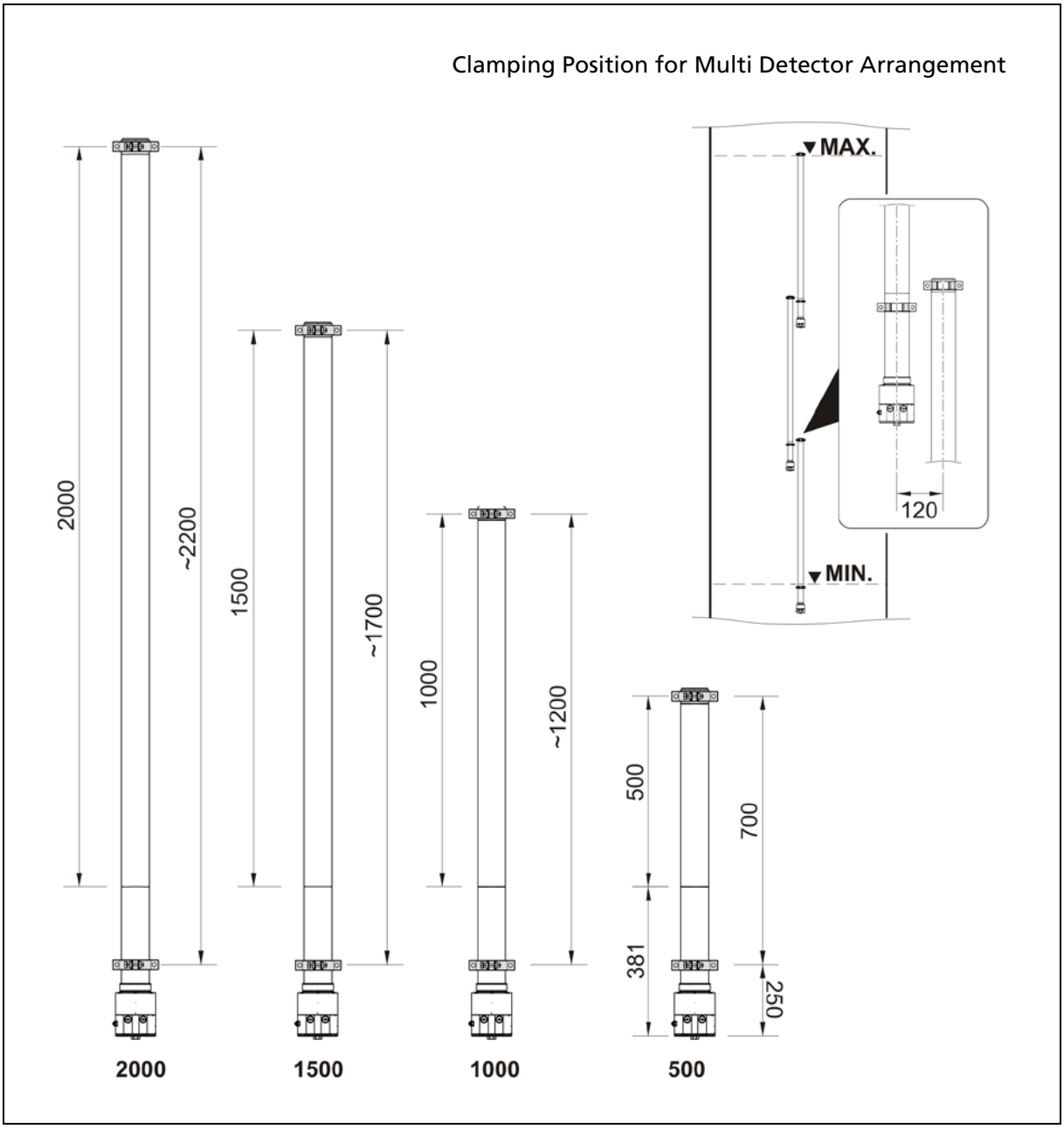
3. UniSENS LB 4700-2x



TI-Fig. 3 Dimensions UniSENS LB-4700-2x (Dimensions in mm)

L (sensitive area)	Water cooling	Total Length (approx.)	Weight (approx.)
500 mm	-	925 mm	13.7 kg
	✓	934 mm	19.5 kg
750 mm	-	1175 mm	15 kg
	✓	1184 mm	23 kg
1000 mm	-	1425 mm	16.8 kg
	✓	1434 mm	26.3 kg
1250 mm	-	1675 mm	19.3 kg
	✓	1684 mm	31.5 kg
1500 mm	-	1925 mm	22.7 kg
	✓	1934 mm	35.7 kg
2000 mm	-	2425 mm	26.5 kg
	✓	2434 mm	42.8 kg

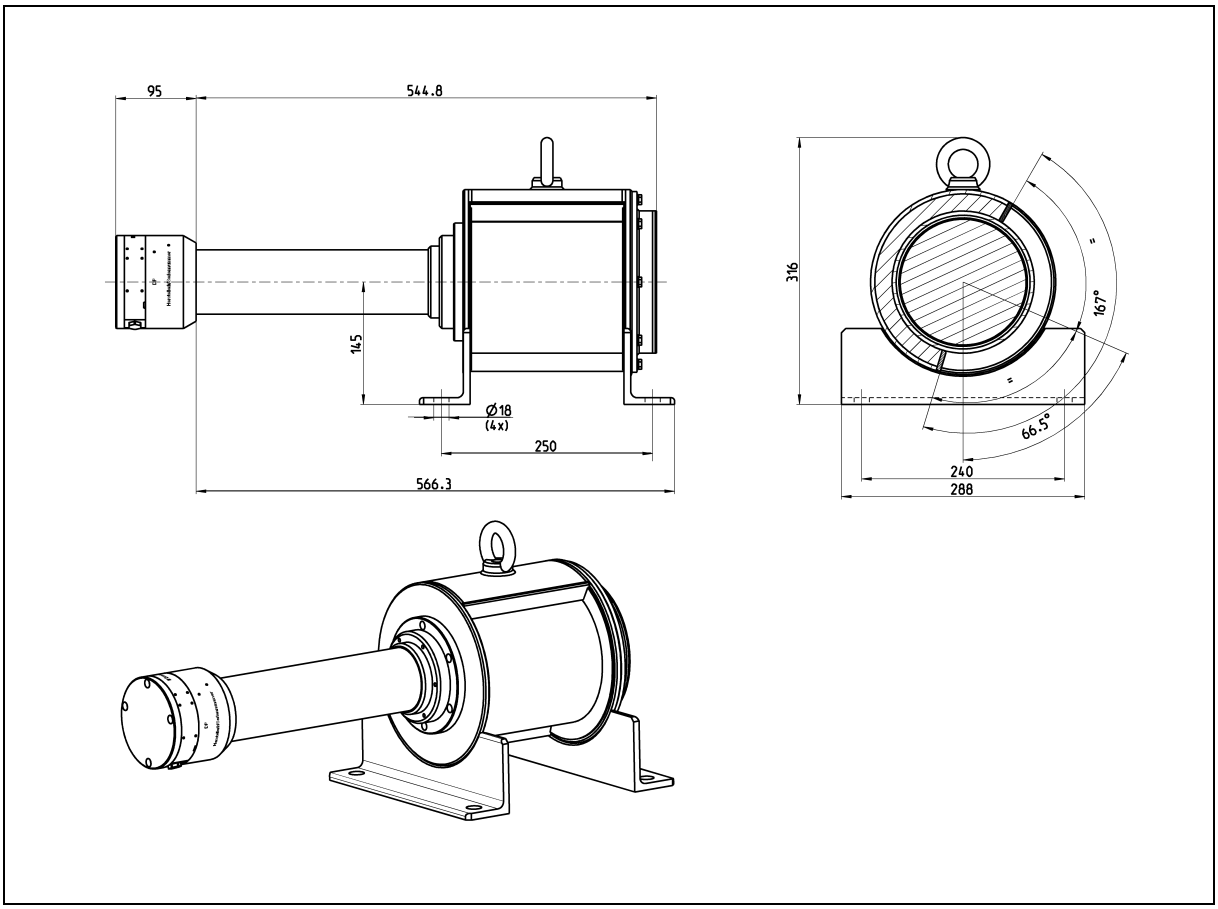
3.1. Clamping Positions for UniSENS Rod Detectors



TI-Fig. 4 Clamping Positions for UniSENS Rod Detectors

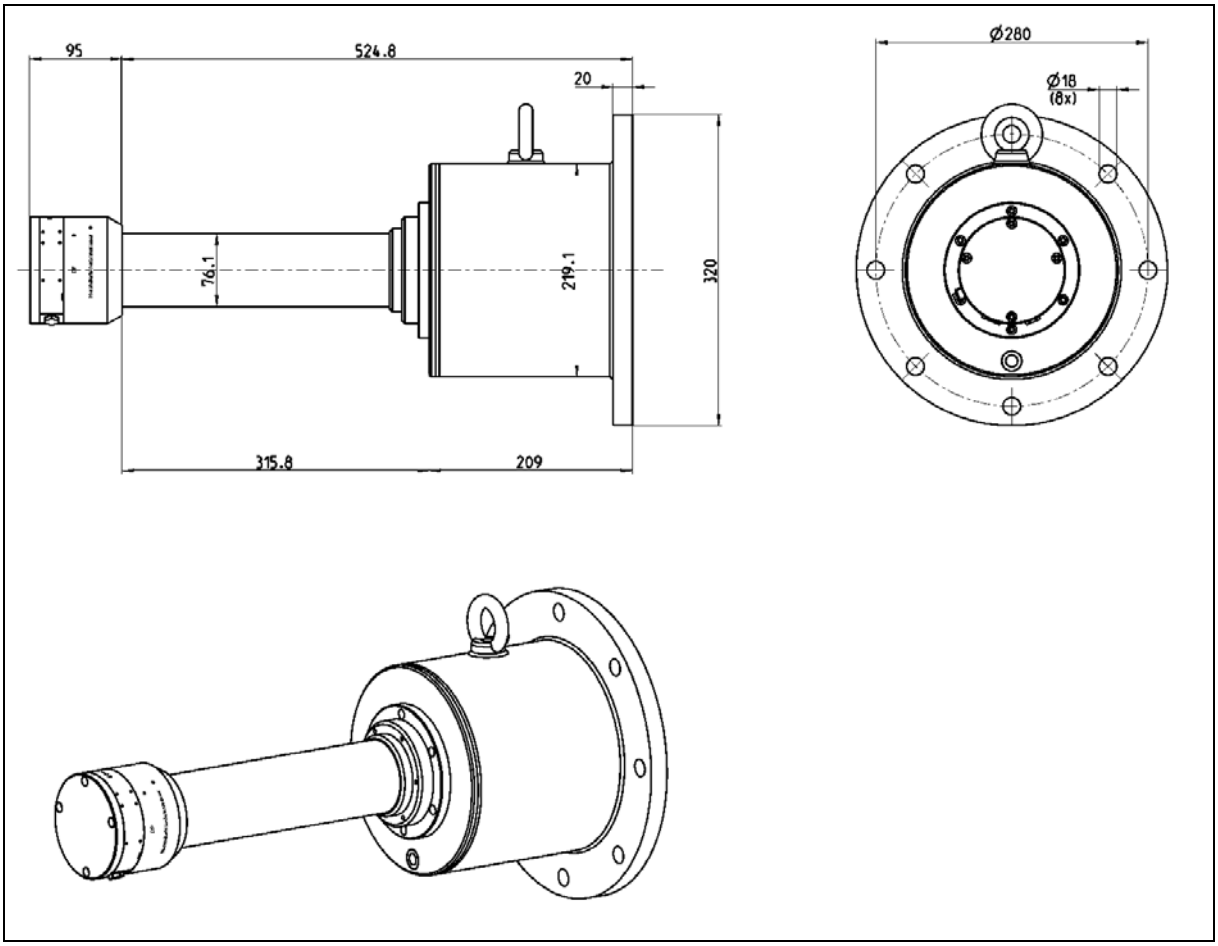
4. SuperSENS

4.1. SuperSENS: without water-cooling (side irradiation)



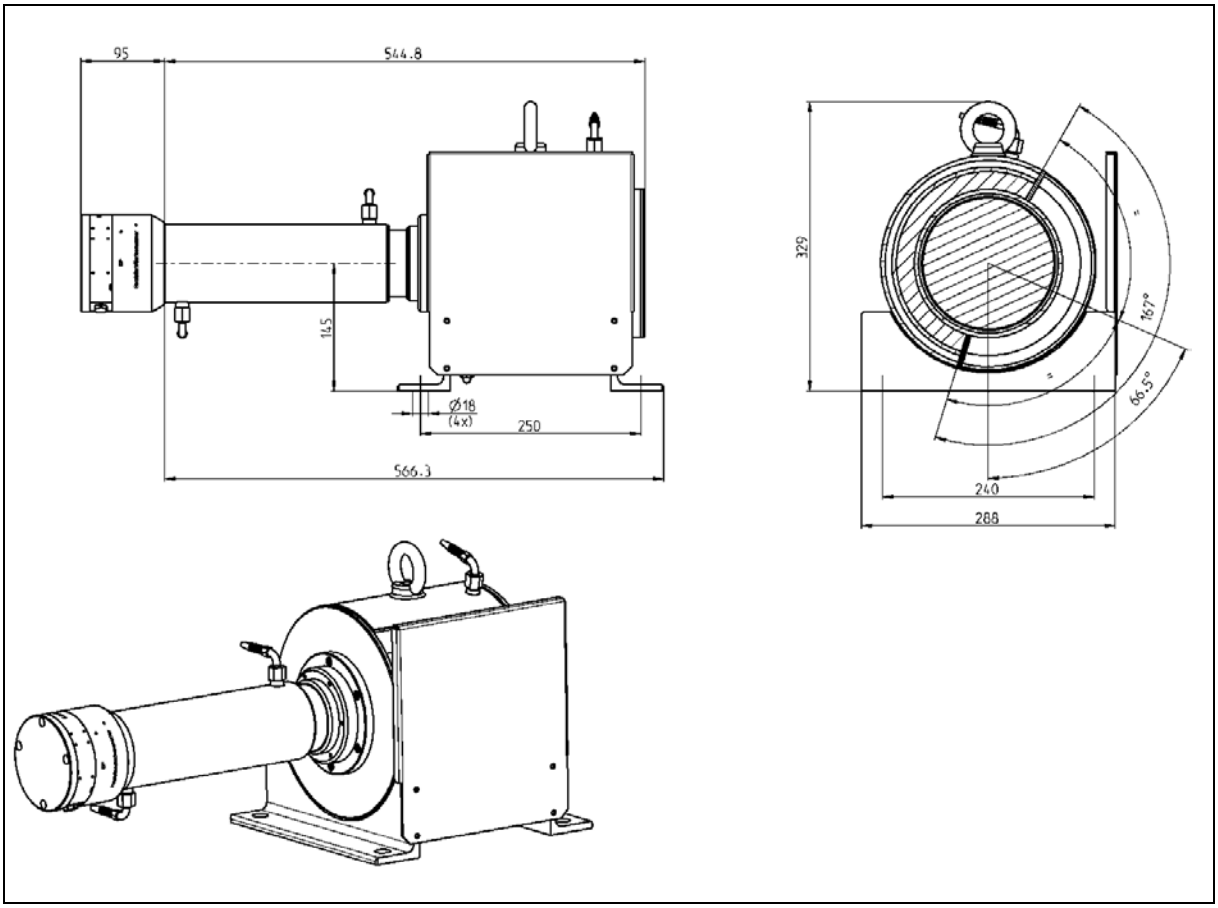
TI-Fig. 5 Dimensions SuperSENS without water-cooling (side irradiation)

4.2. SuperSENS: without water-cooling (frontal irradiation)



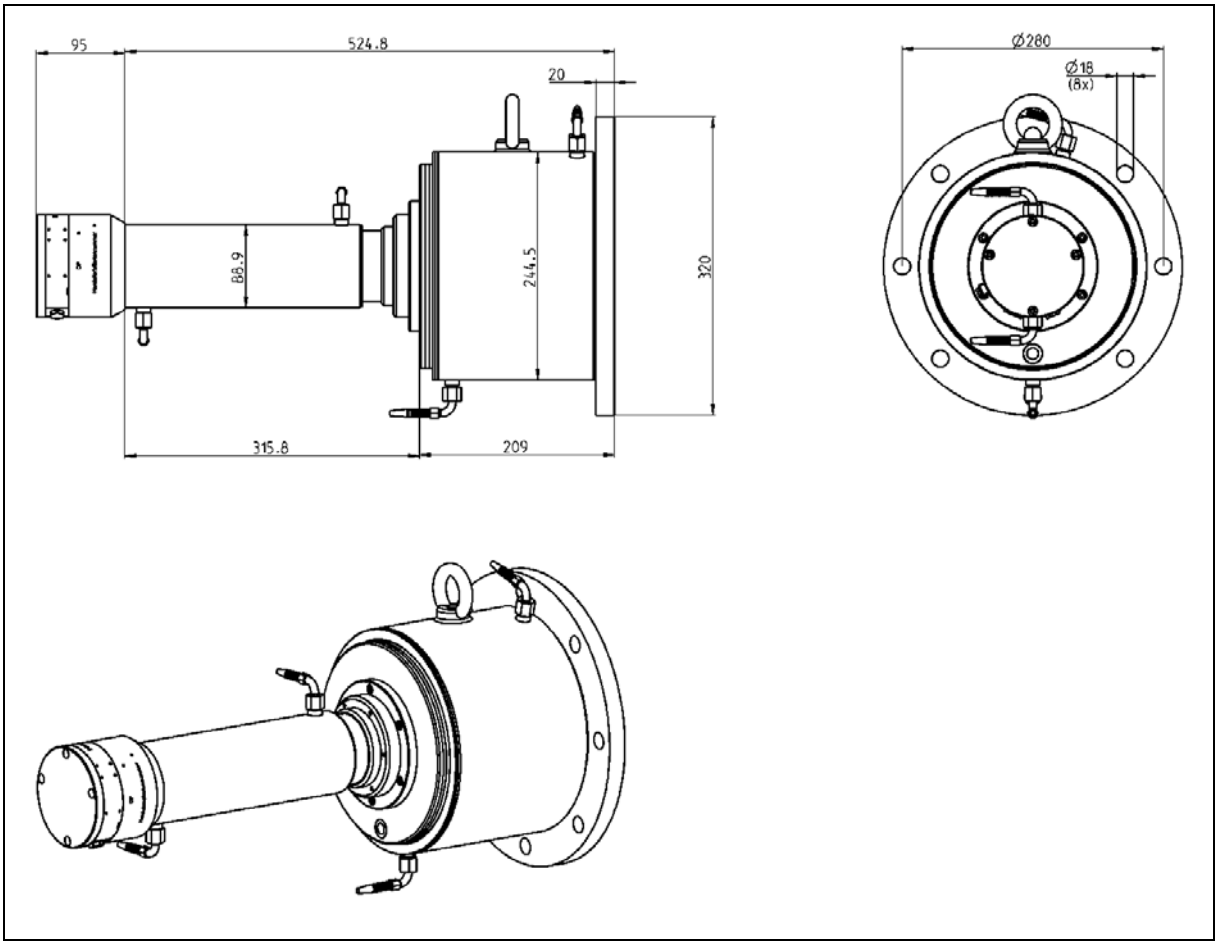
TI-Fig. 6 Dimensions SuperSENS without water-cooling (frontal irradiation)

4.3. SuperSENS: with water-cooling (side irradiation)



TI-Fig. 7 Dimensions SuperSENS with water-cooling (side irradiation)

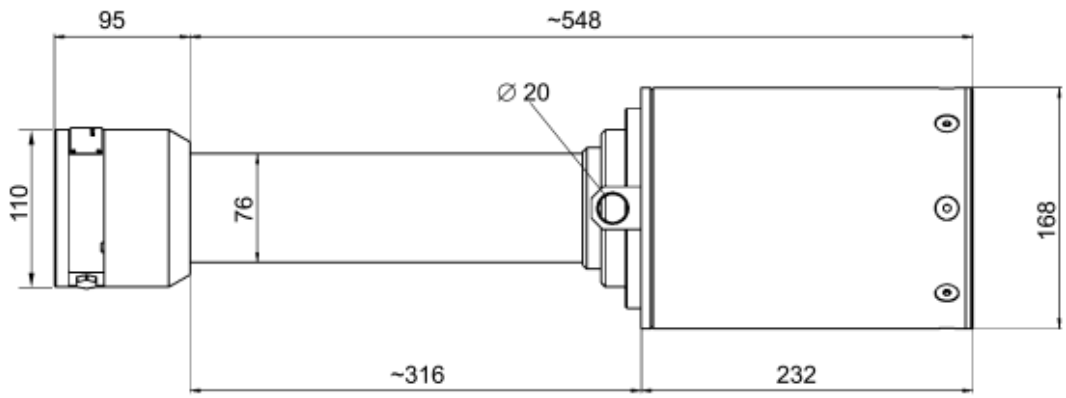
4.4. SuperSENS: with water-cooling (frontal irradiation)

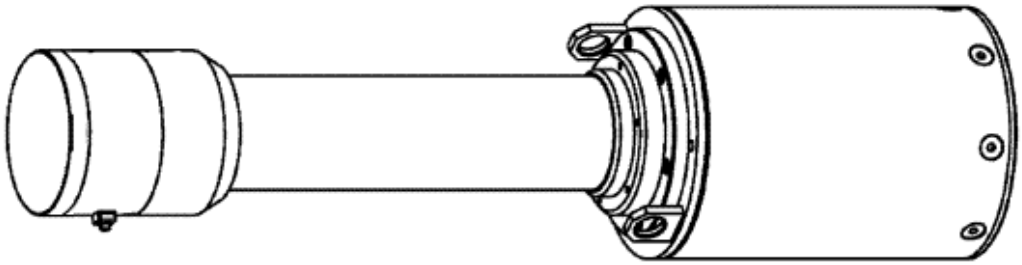


TI-Fig. 8 Dimensions SuperSENS with water-cooling (frontal irradiation)

4.5. SuperSENS: for Dip Pipe

LB 4700-31-00-80-01-100
56926-101

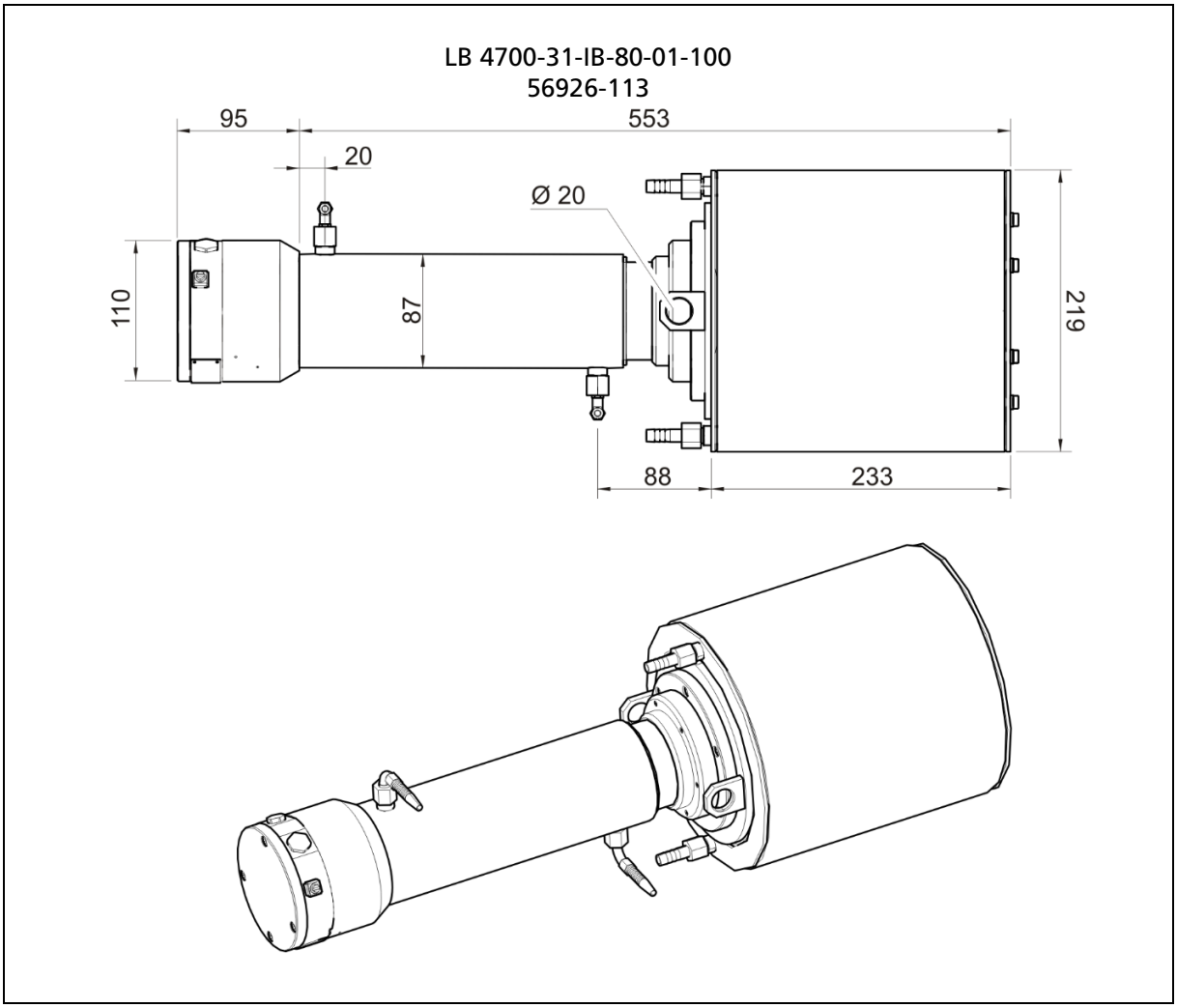




Gewicht ca. 21 kg

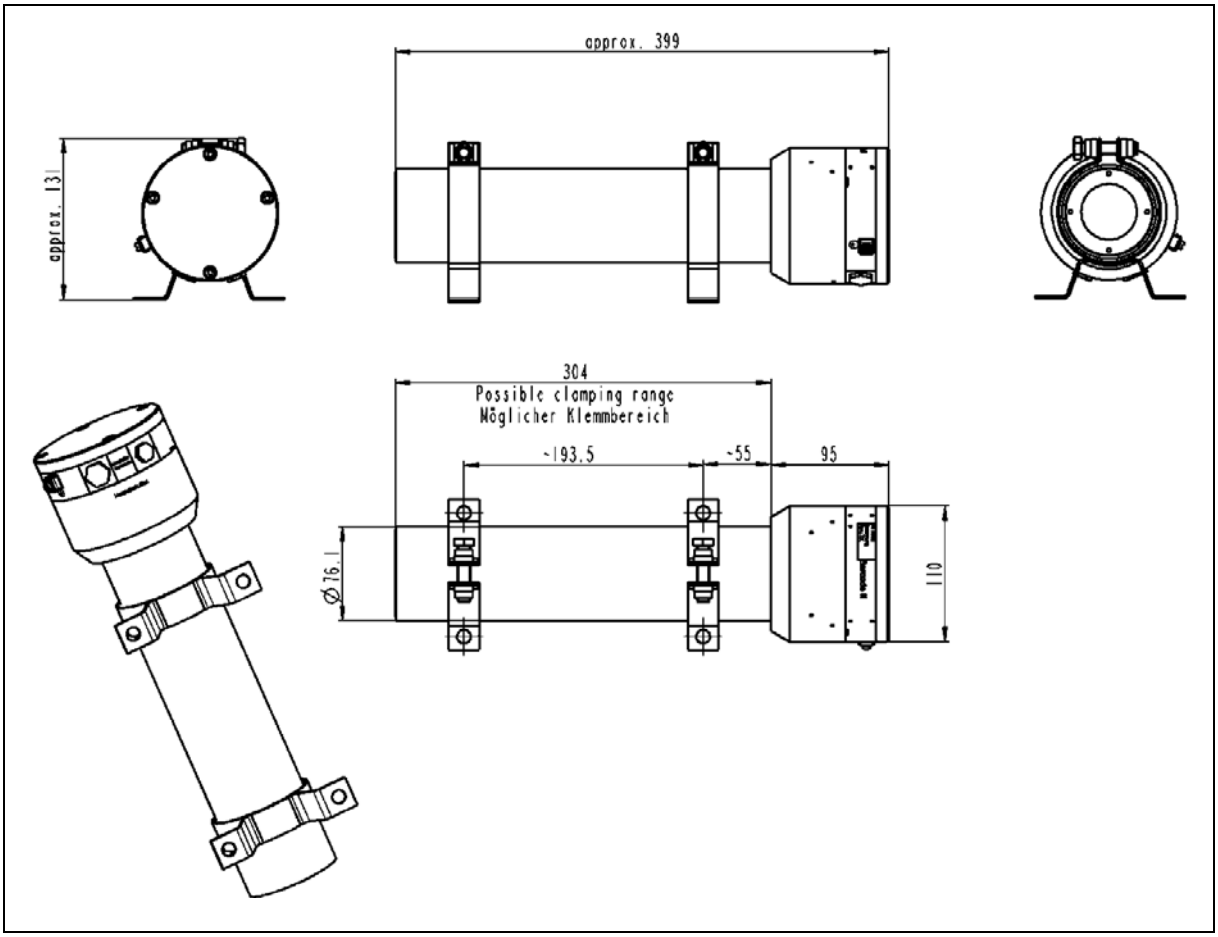
TI-Fig. 9 SuperSENS Detector for Dip Pipe (Dimensions in mm)

4.6. SuperSENS: for Dip Pipe with Water-Cooling



TI-Fig. 10 SuperSENS Detector for Dip Pipe with water-cooling (Dimensions in mm)

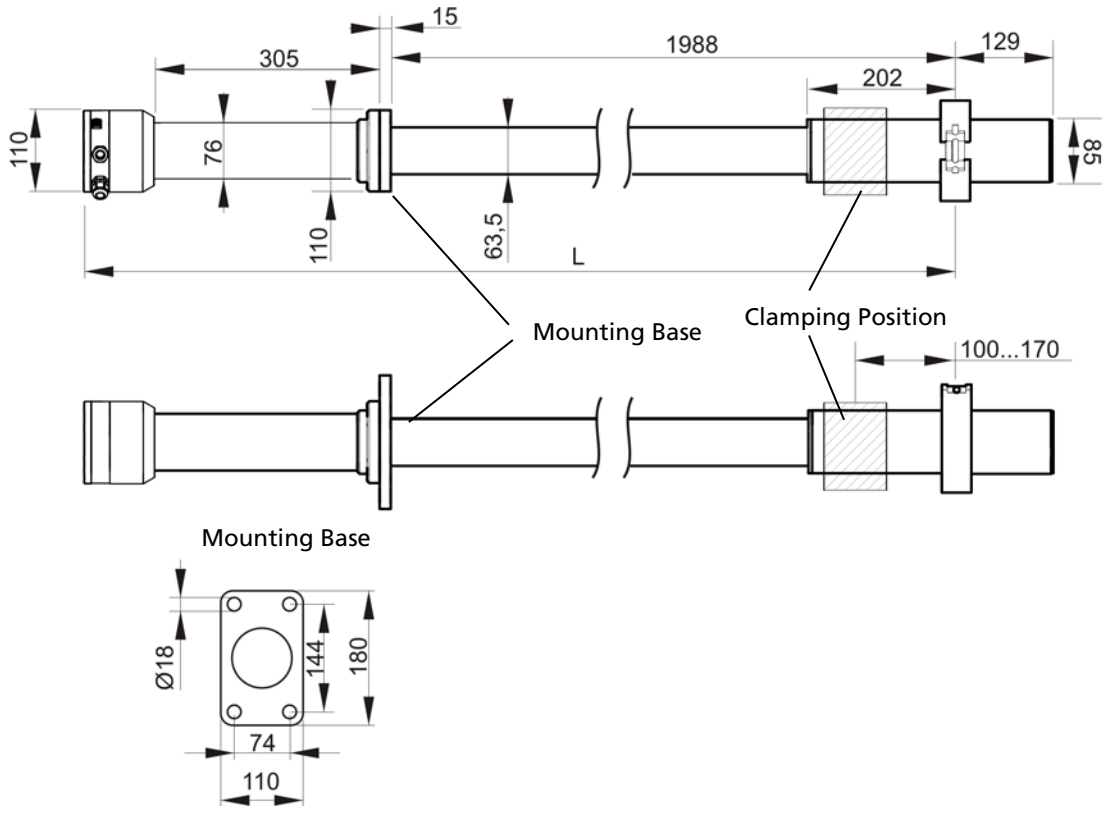
5. Detector for Low Energy Isotopes (like Am-241 / Cm-244)



TI-Fig. 11 Detector for Low Energy Isotopes (Dimensions in mm)

6. TowerSENS

6.1. TowerSENS: without water-cooling

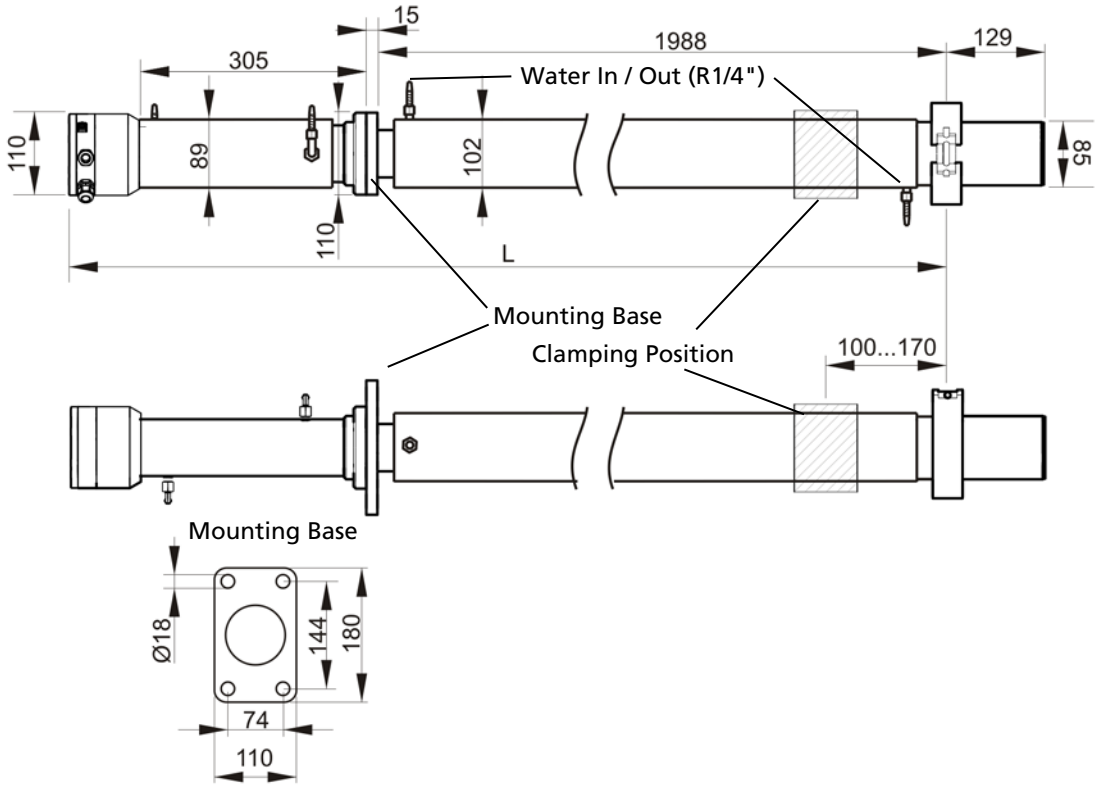


Housing material: stainless steel 1.4301

TI-Fig. 12 Basic Module without water-cooling (Dimensions in mm)

Type	Sensitive Length	Length L	Weight
Basic Module 2 m Zones Variant	1988 mm	2532 mm	26 kg
Basic Module 2 m Divisions Variant	1988 mm	2563 mm	27 kg

6.2. TowerSENS: with water-cooling

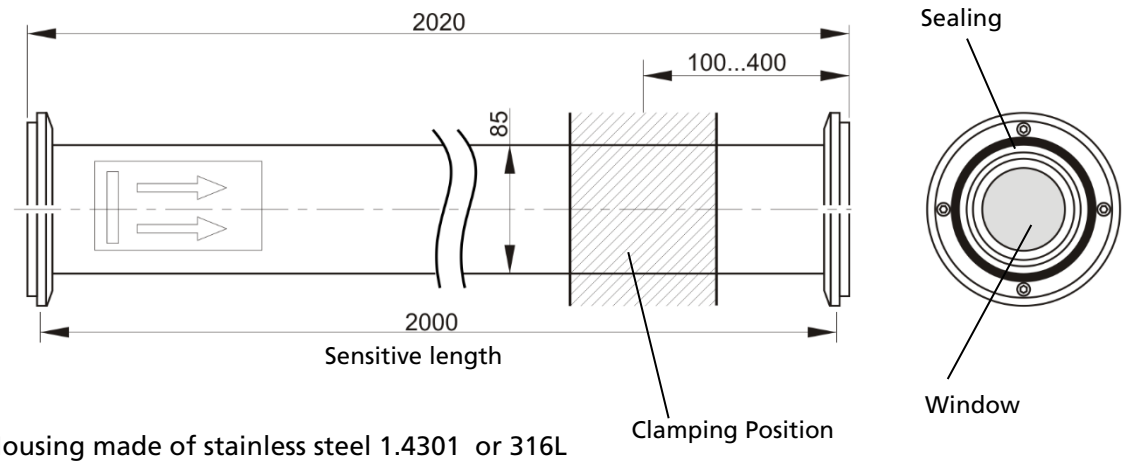


Housing material: stainless steel 1.4301

TI-Fig. 13 Basic Module with water-cooling (Dimensions in mm)

Type	Sensitive Length	Length L	Weight
Basic Module 2 m Zones Variant	1988 mm	2532 mm	41 kg
Basic Module 2 m Divisions Variant	1988 mm	2563 mm	42 kg

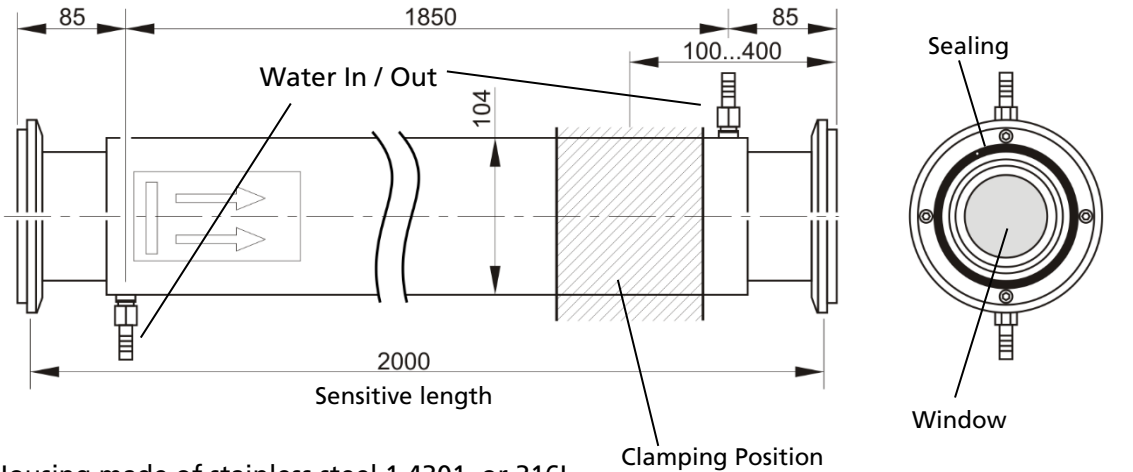
6.3. TowerSENS: 2 m Extension Module without water-cooling



Housing made of stainless steel 1.4301 or 316L
Weight: 17 kg

TI-Fig. 14 TowerSENS: 2 m Extension Module without water-cooling (Dimensions in mm)

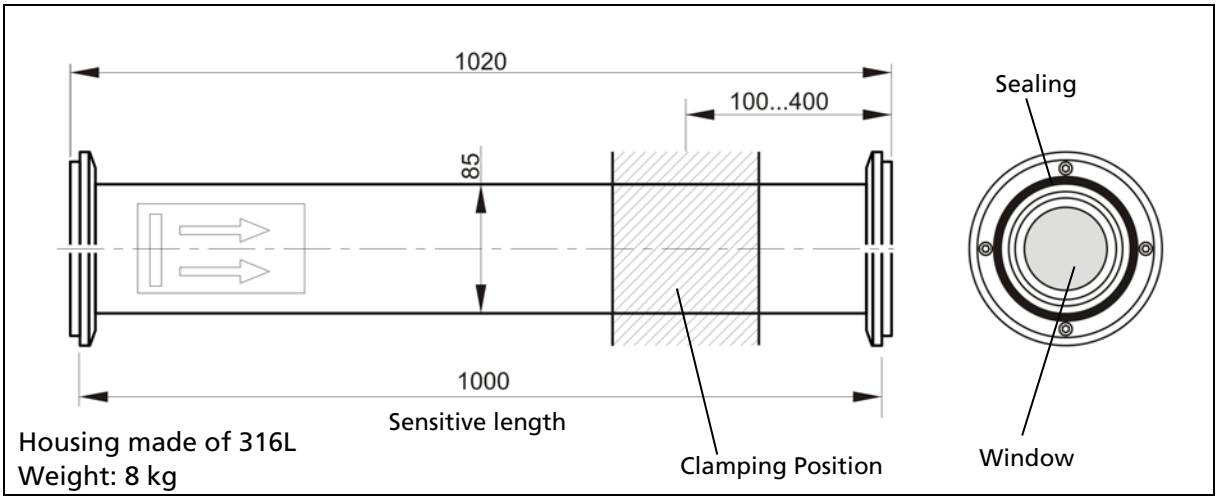
6.4. TowerSENS: 2 m Extension Module with water-cooling



Housing made of stainless steel 1.4301 or 316L
Weight: 32 kg

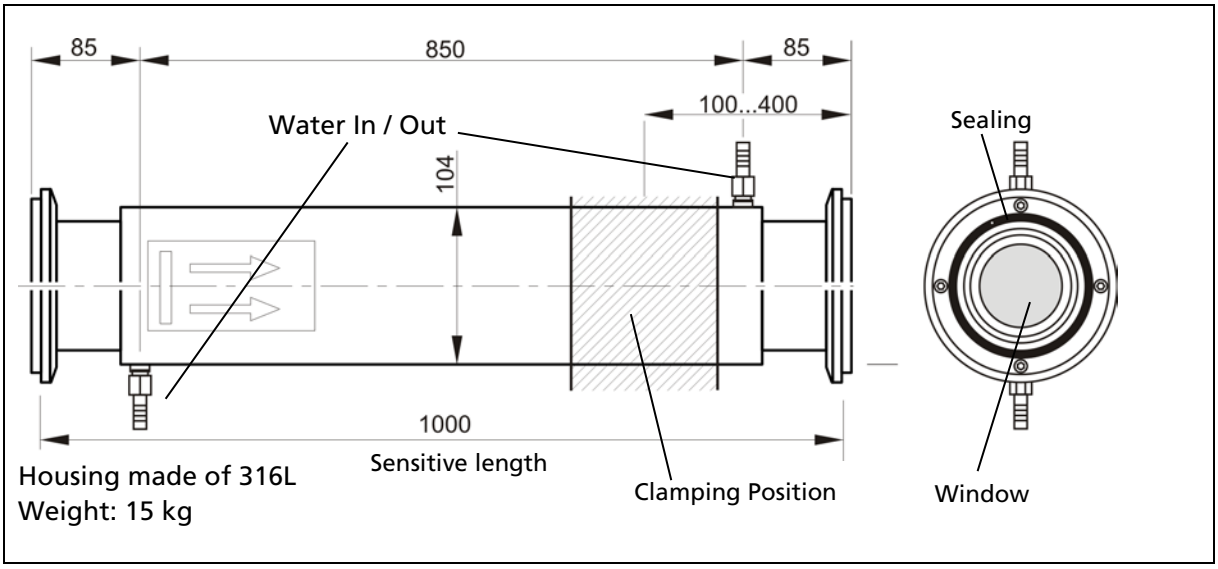
TI-Fig. 15 TowerSENS: 2 m Extension Module with water-cooling (Dimensions in mm)

6.5. TowerSENS: 1 m Extension Module without water-cooling



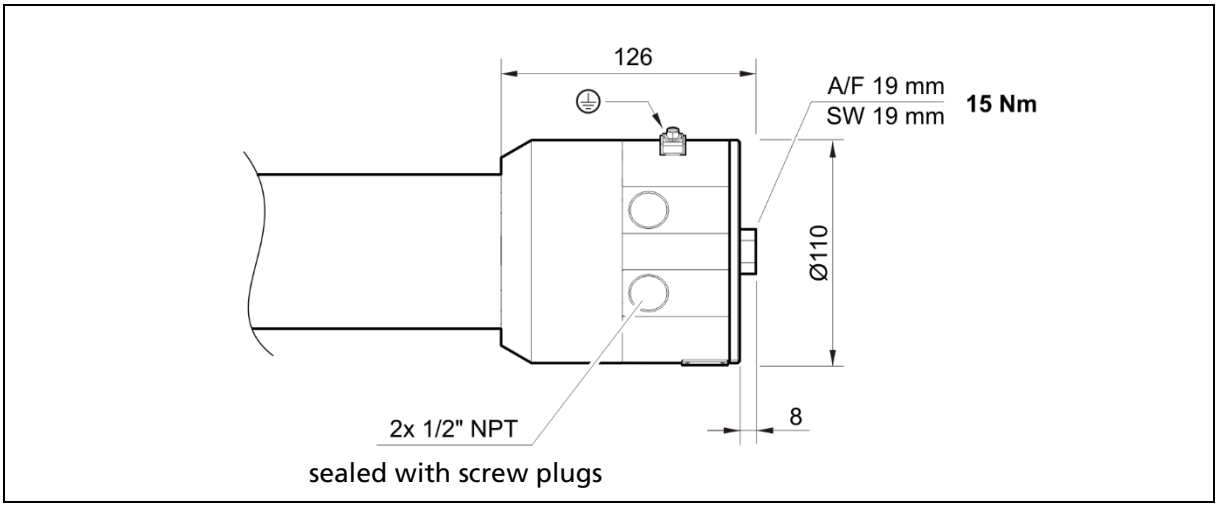
TI-Fig. 16 TowerSENS: 1 m extension module without water-cooling (Dimensions in mm)

6.6. TowerSENS: 1 m Extension Module with water-cooling



TI-Fig. 17 TowerSENS: 1 m extension module with water-cooling (Dimensions in mm)

7. Versions for Class, Divisions: “DIP” / “XP” LB 4700-xx-Fx



TI-Fig. 18 Versions for Class, Divisions: “DIP” / “XP” LB 4700-xx-Fx (Dimensions in mm)

The detector version for divisions (NEC/CEC) differs only in the terminal housing, compared to the standard version illustrated above. The dimensions of this terminal housing are illustrated in this drawing.

Divisions versions are available for all detectors with the following exceptions:

- Am / Cm detector
- CrystalSENS 125/50

8. Mounting Clamps

8.1. Standard Design

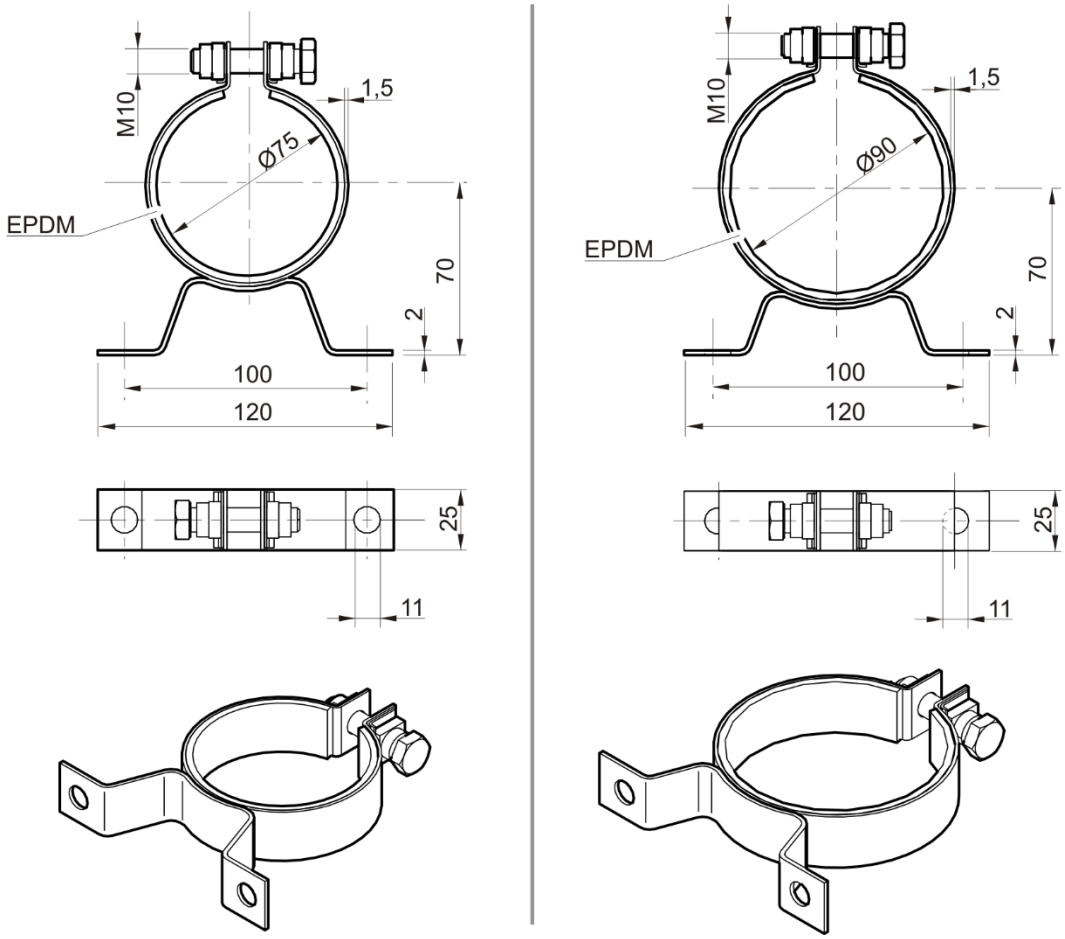
IMPORTANT

The distance from the middle of the detector to the vessel surface or surface of heat insulation should be approx. 100 mm. Care should be taken during mounting to avoid as far as possible heat transfer from the vessel via the clamps to the detector.

for Detectors without water cooling

for Detectors with water cooling

Material
316Ti
1.4571



Mat. No. 31346 (1 set = 2 clamps)
Mat. No. 31345 (single clamp)

Mat. No. 31347 (1 Satz = 2 Schellen)
Mat. Nr. 31344 (single clamp)

Position for the clamps, see detector drawing

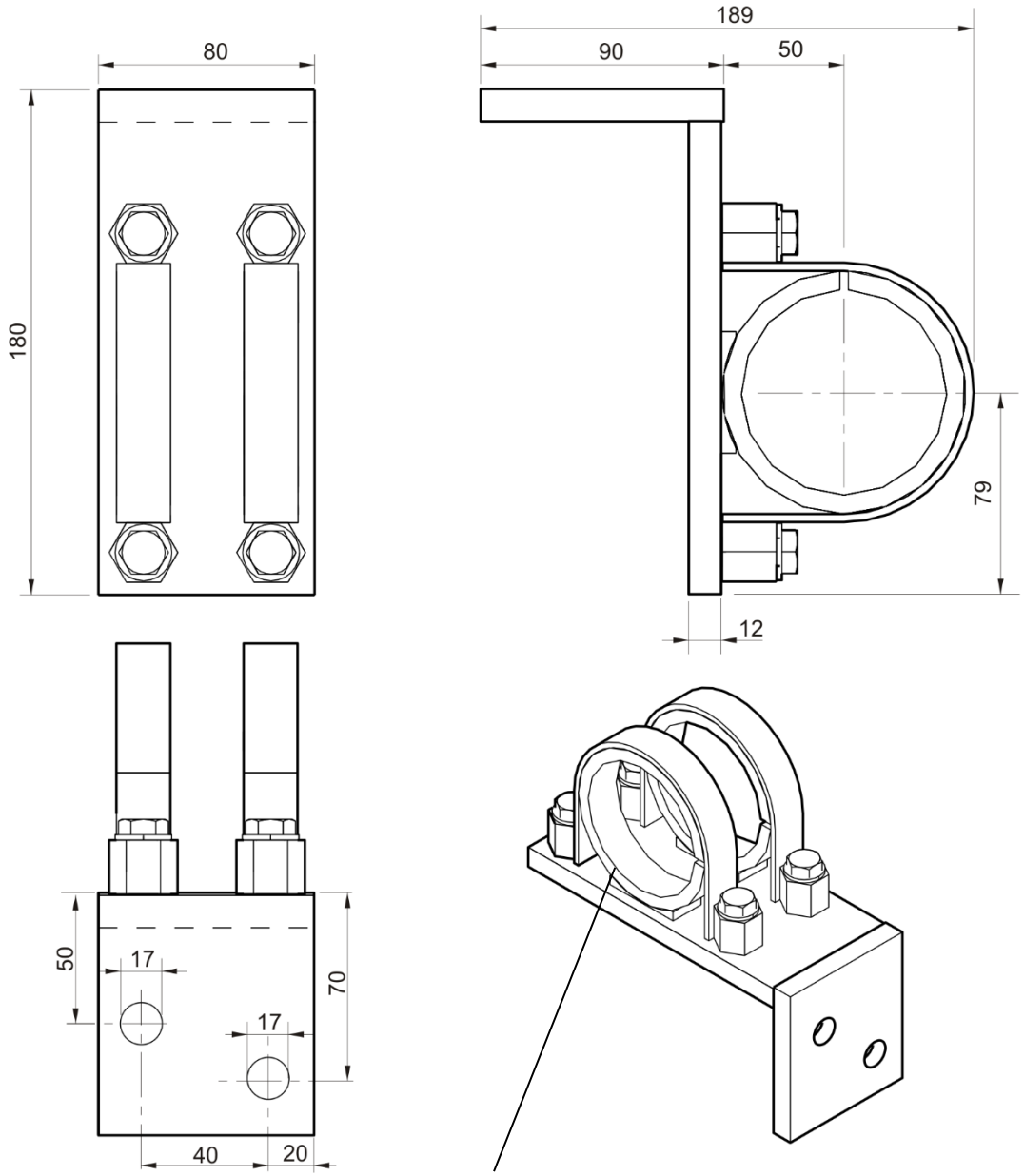
TI-Fig. 19 Mounting clamps for detectors (Dimensions in mm)

8.2. Heavy Duty Detector Holder

For detectors without water cooling
Mat. No. 39246

For detectors with water cooling
Mat. No. 39247

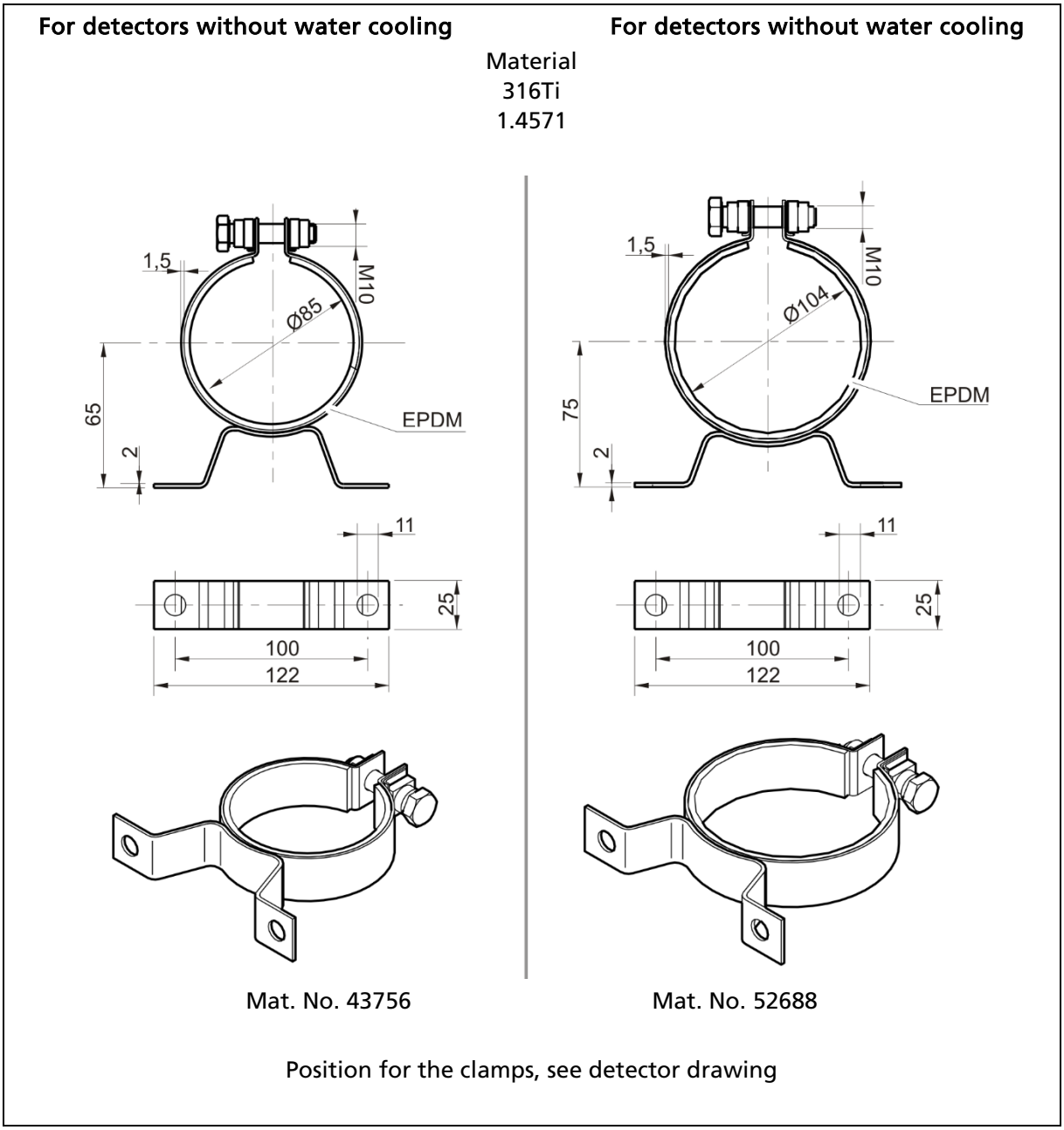
Material: stainless steel



Remove the plastic ring for detectors with water cooling.

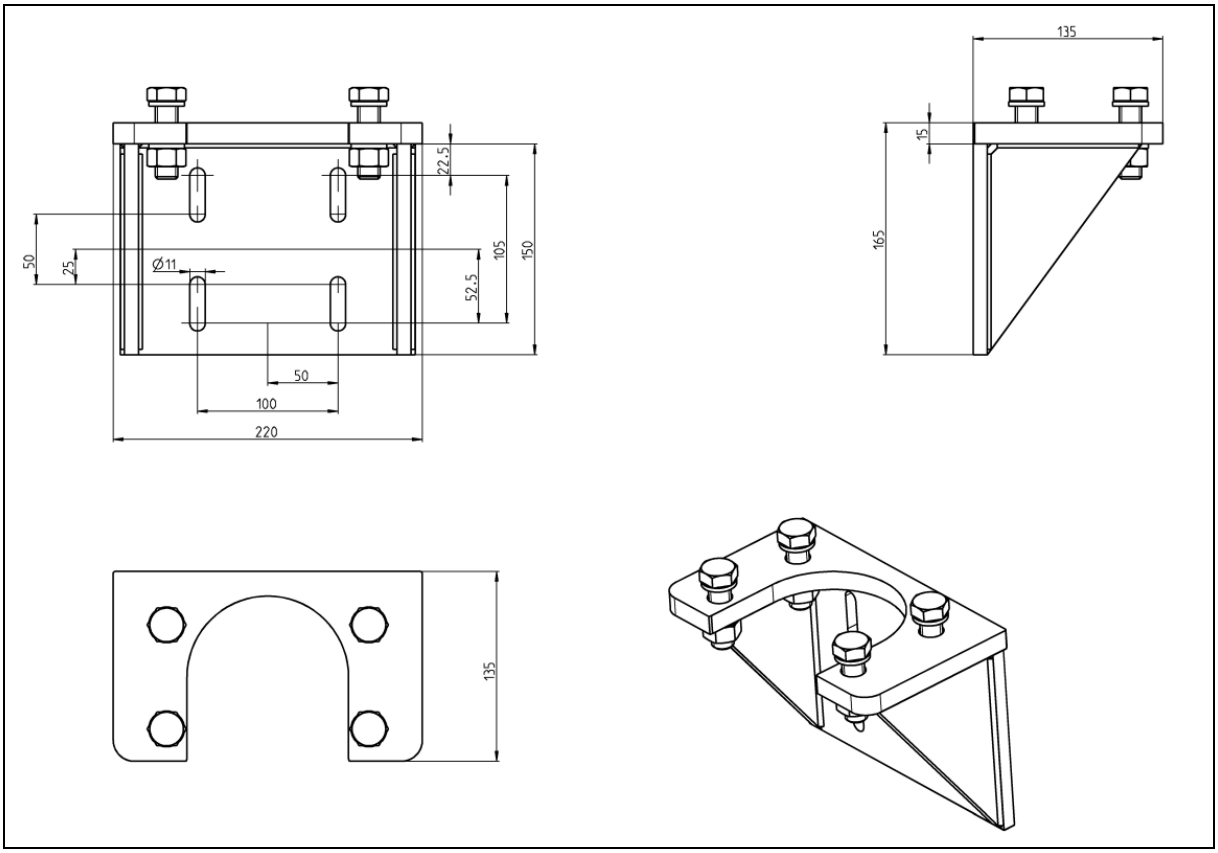
TI-Fig. 20 Heavy duty version (Dimensions in mm)

8.3. Mounting Clamps for TowerSENS



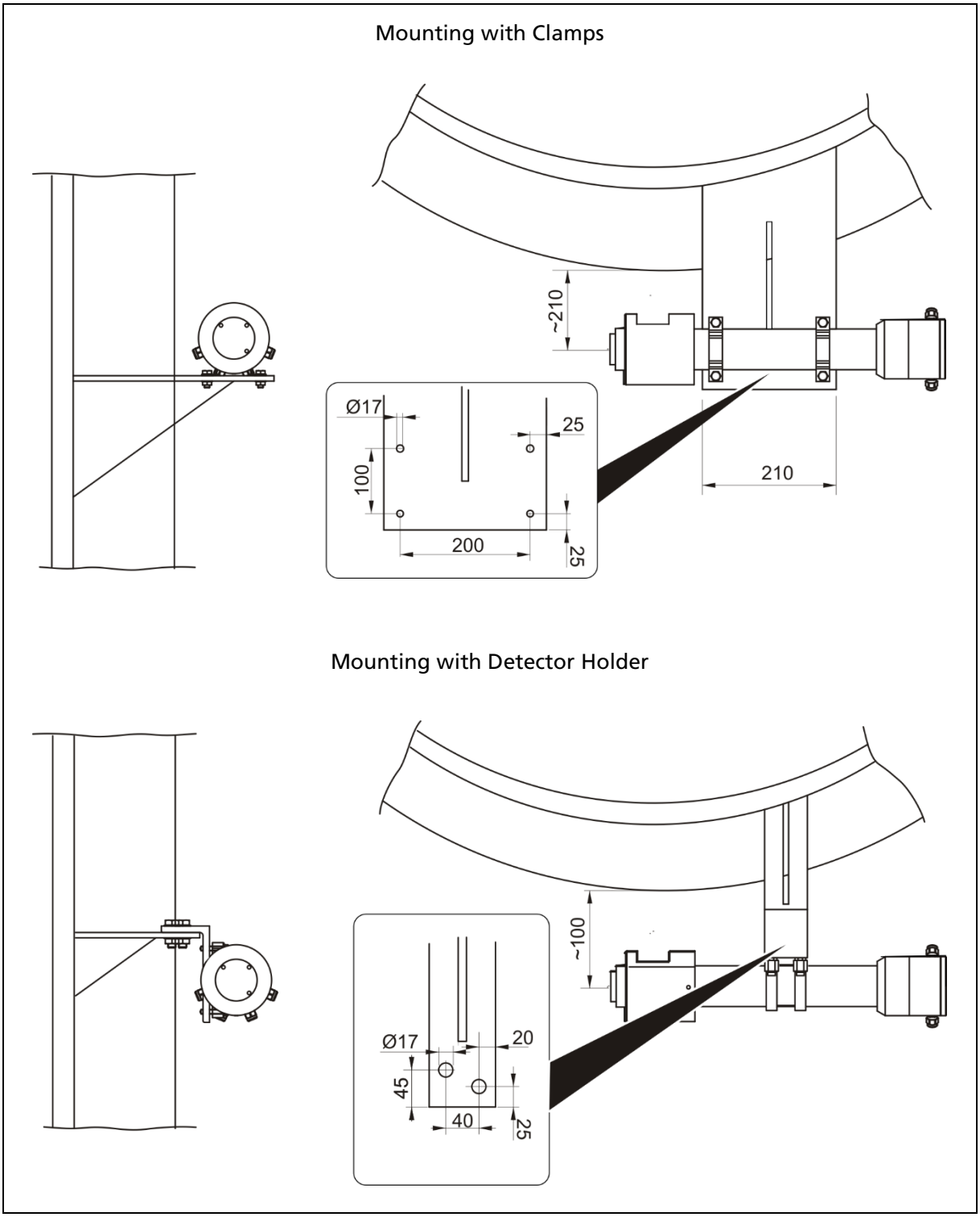
TI-Fig. 21 Mounting Clamps for TowerSENS (Dimensions in mm)

8.4. Mounting Bracket



TI-Fig. 22 Mounting Bracket

8.5. Mounting Point Detector CrystalSENS



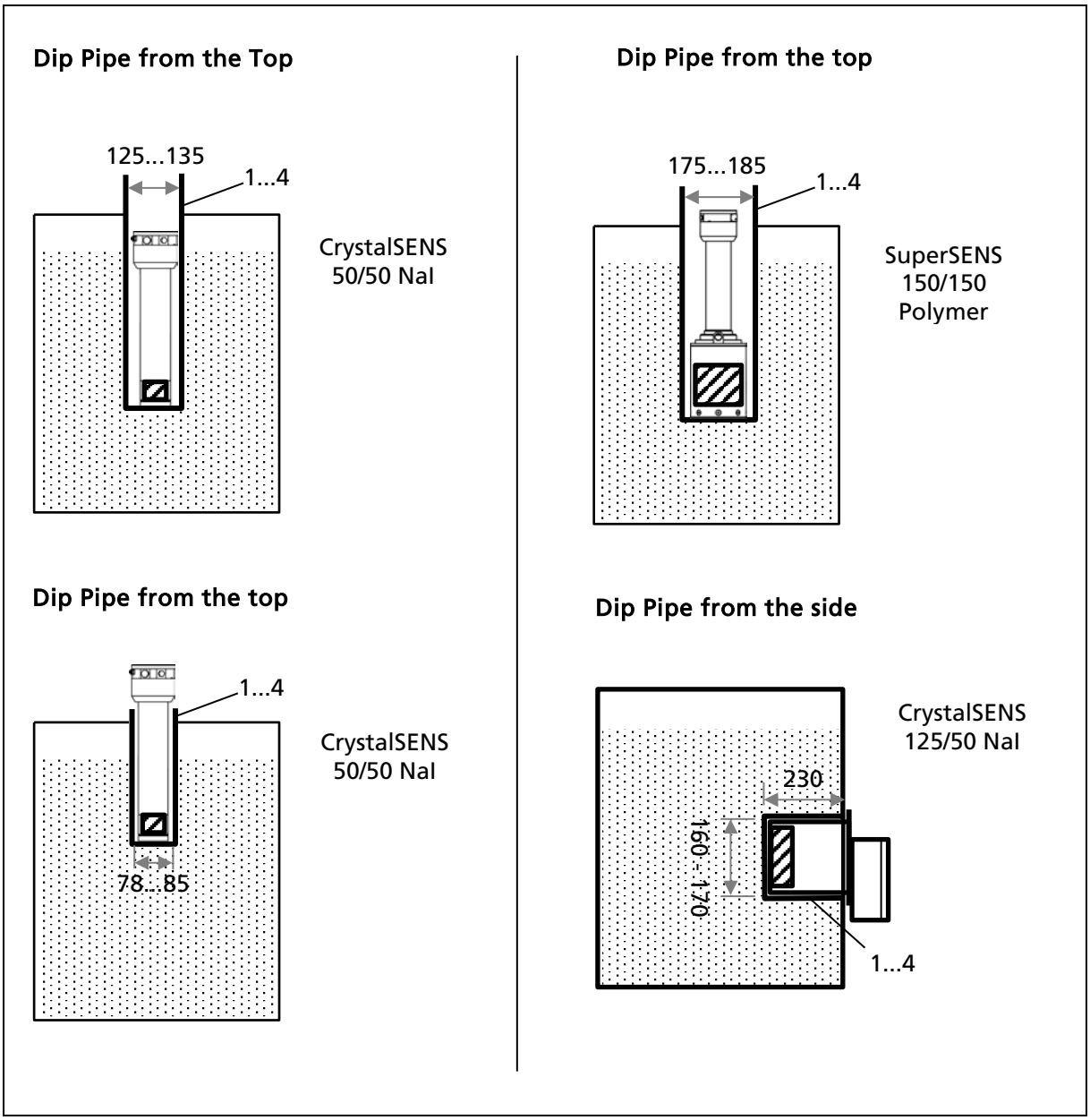
TI-Fig. 23 Mounting Point Detector CrystalSENS (Dimensions in mm)

NOTICE

Direct sun radiation can overheat the detector. If the detector temperature can reach more than 50°C, a suitable sun roof must be installed. The heating of the detector by thermal radiation from the vessel can also be moderated by a thermal sheet, e.g. by a thin metal plate. For each detector a water cooling (option) is available!

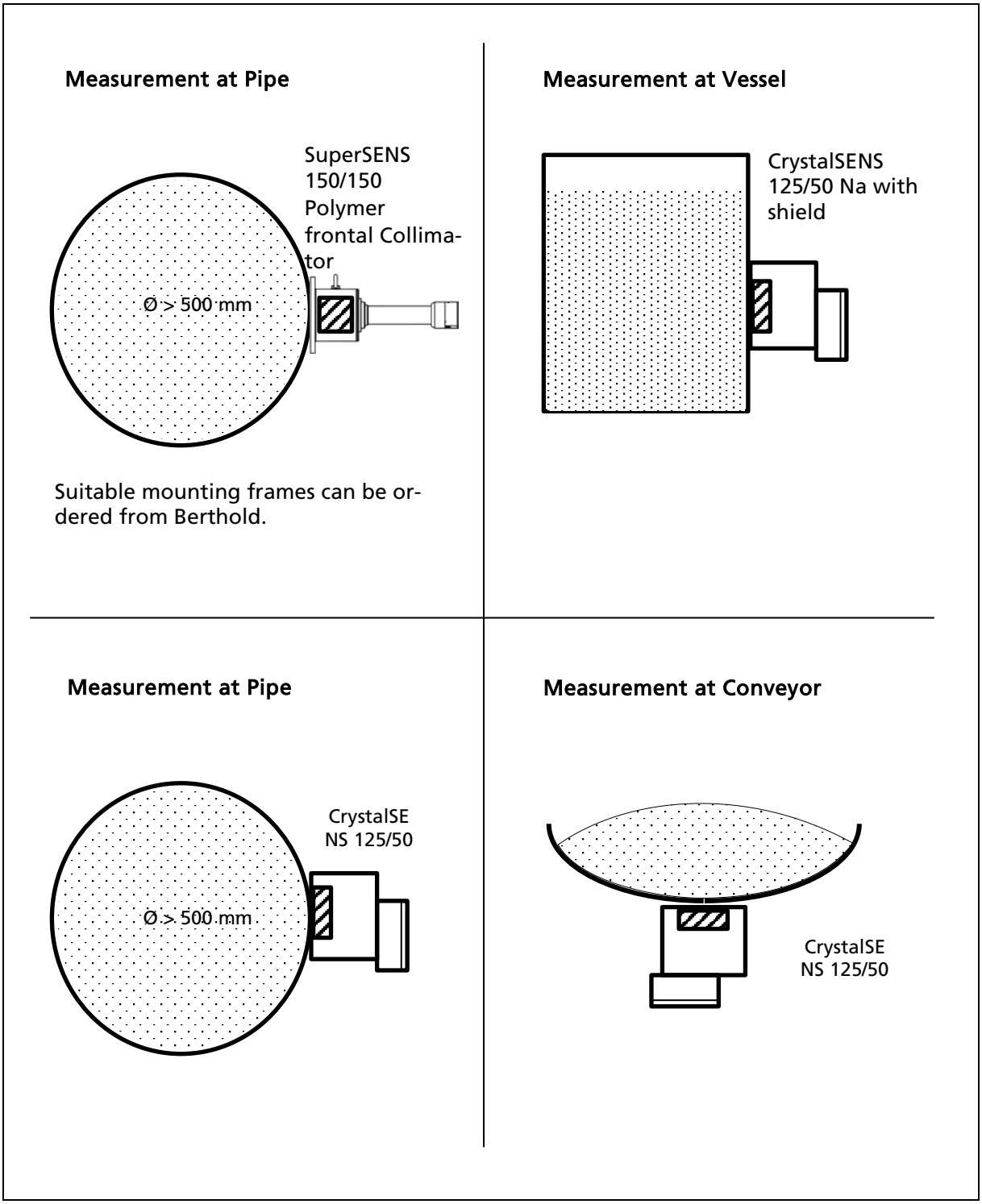
9. Potassium Measurement

9.1. Examples for Arrangements inside the Vessel



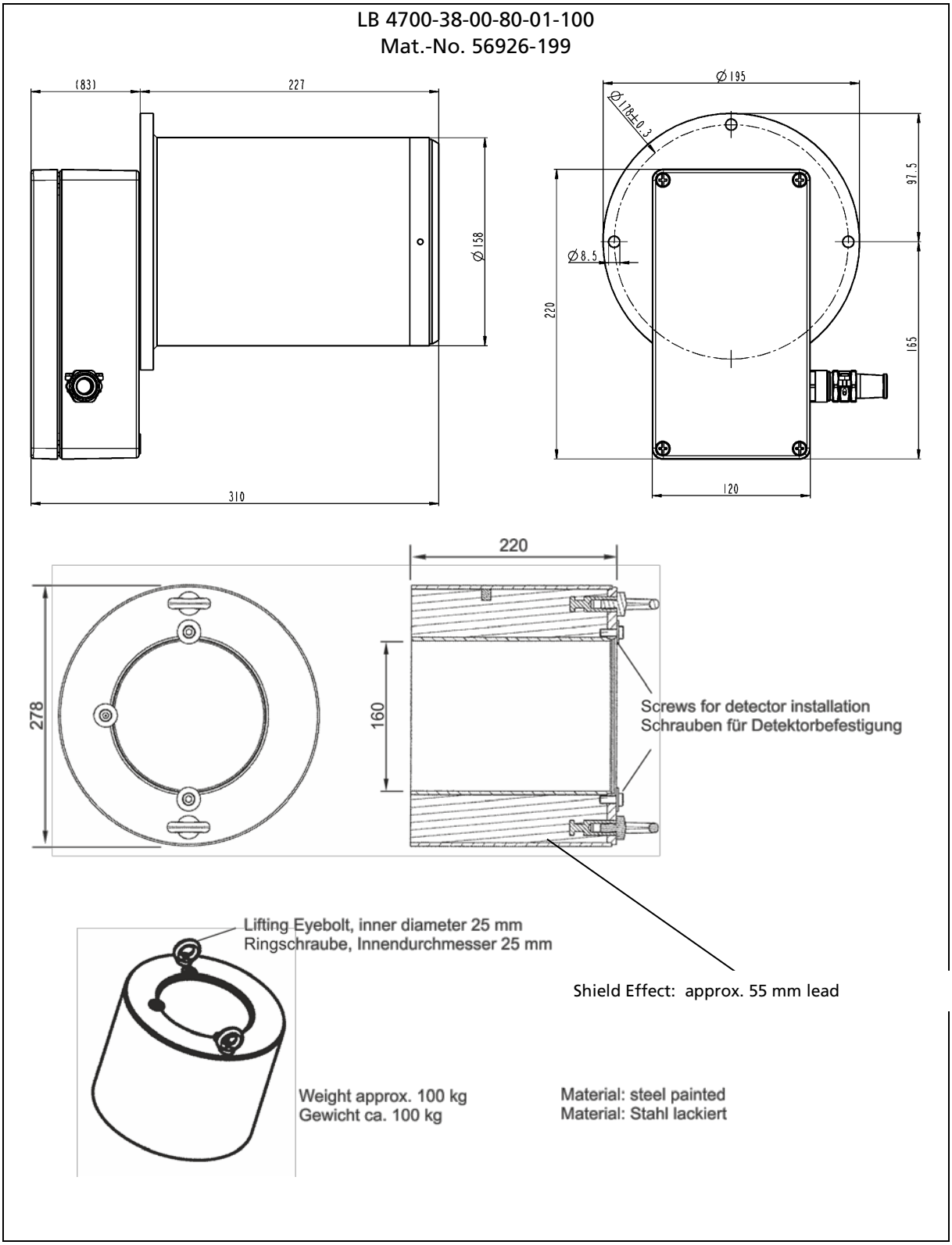
TI-Fig. 24 Examples for Arrangements inside the Vessel (Dimensions in mm)

9.2. Potassium, Examples for Surface Measuring Arrangements



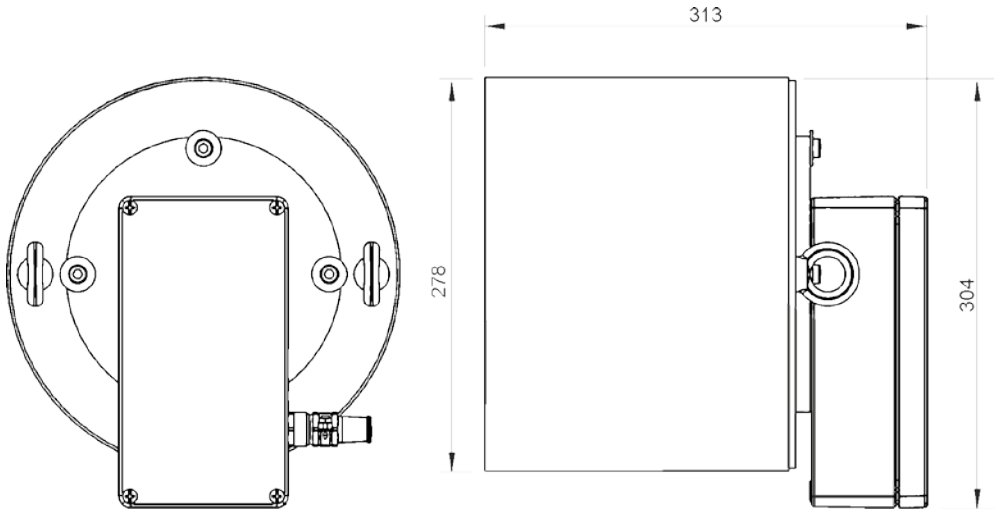
TI-Fig. 25 Examples for Arrangements Surface Measurement (Dimensions in mm)

9.3. CrystalSENS 125/50



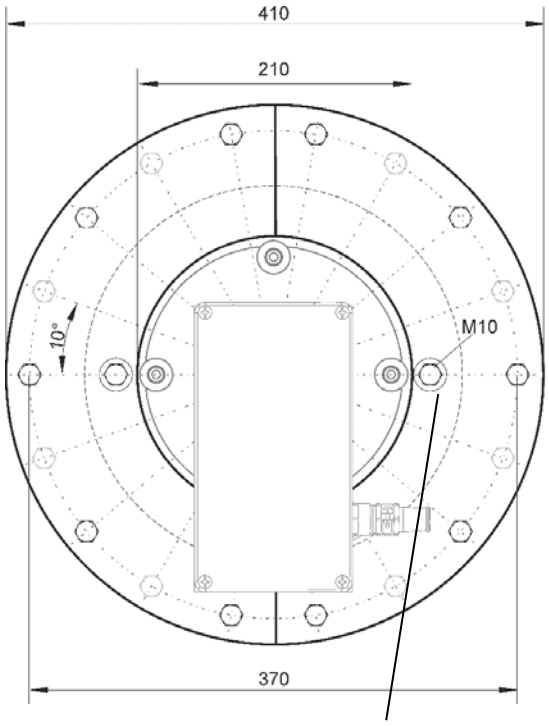
TI-Fig. 26 CrystalSENS 125/50 for potassium measurement (Dimensions in mm)

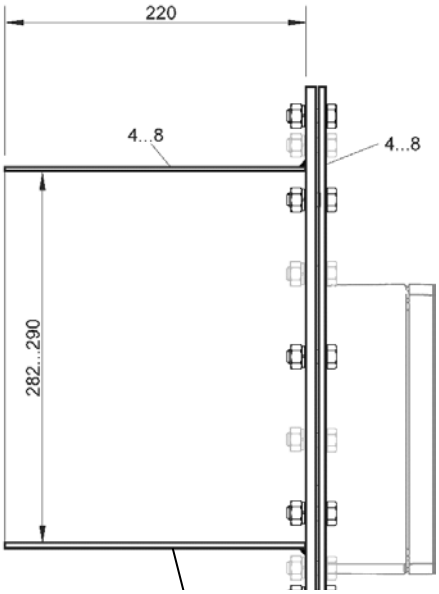
9.4. CrystalSENS 125/50 installed in Shield



Weight approx. 121 kg

Installation Example for CrystalSENS 125/50 with shield (to be made by the customer)





Weld the pipe at the vessel or install it at a appropriate support

Devide the top flange ring into two half shells.
Unscrew the eybolts and use the threated hole to fix the flange.

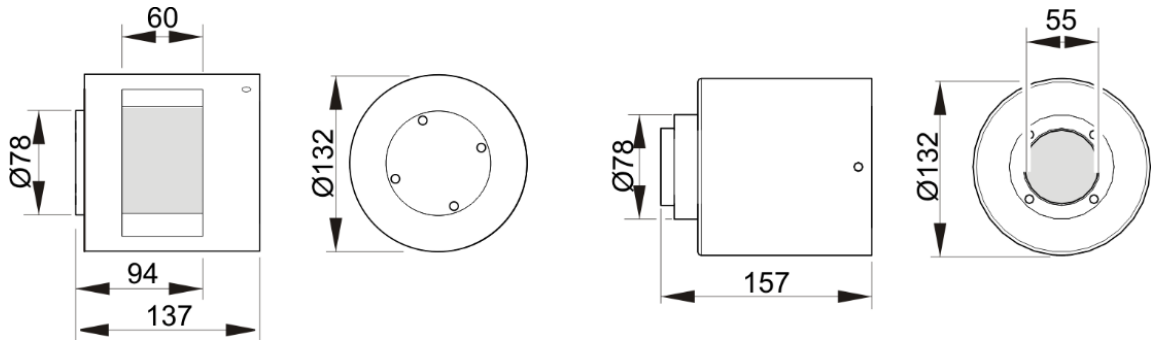
TI-Fig. 27 CrystalSENS 125/50 installed in shield (Dimensions in mm)

10. Collimators and Extension Shields

10.1. Collimator for CrystalSENS Detectors

Collimator for frontal irradation
Mat.-No. 11814

Collimator for side irradation
Mat.-No. **4506**

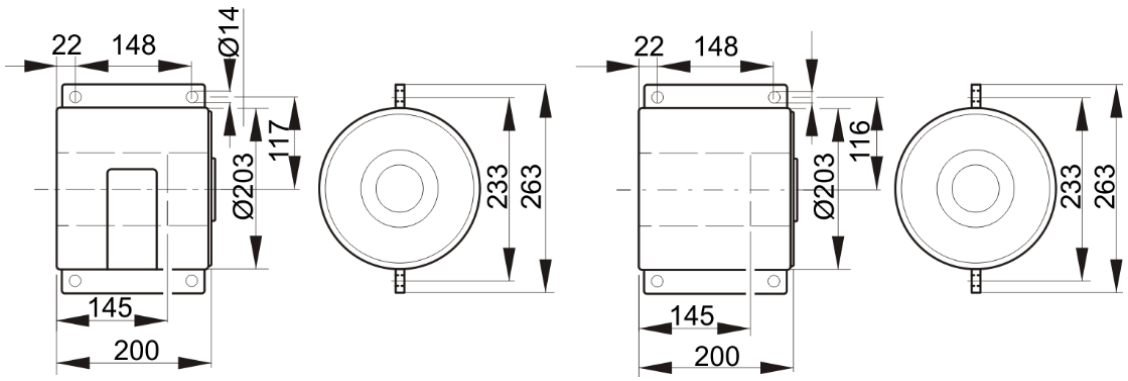


TI-Fig. 28 Collimator for CrystalSENS Detectors (Dimensions in mm)

10.2. Reinforced Collimator for CrystalSENS Detectors

Collimator for frontal irradation
Mat.-No. 48254

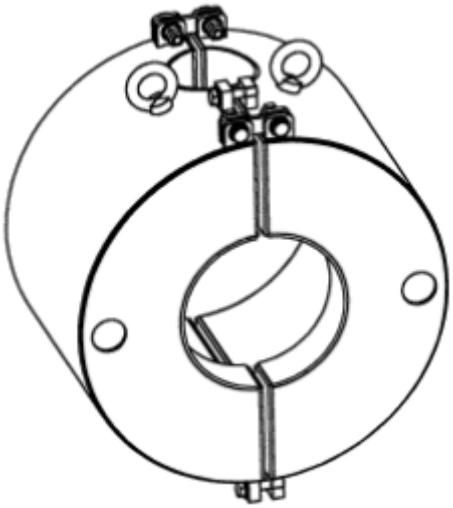
Collimator for side irradation
Mat.-No. 48925



TI-Fig. 29 Reinforced collimator for CrystalSENS (Dimensions in mm)

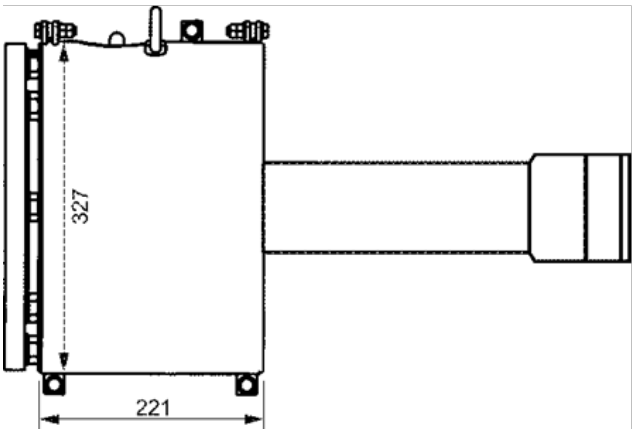
10.3. Extension Shield für SuperSENS with Frontal Irradiation

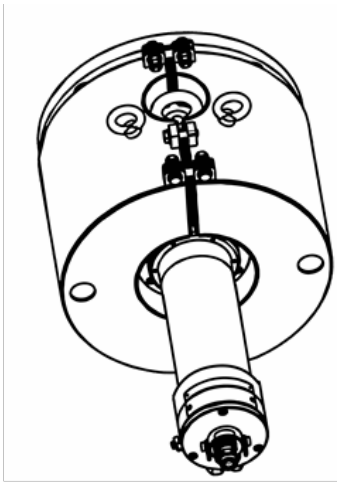
Extension shield Mat.-No. 49825



Shield effect: approx. 45 mm lead
Weight approx. 114 kg

Extension shield installed on SuperSENS

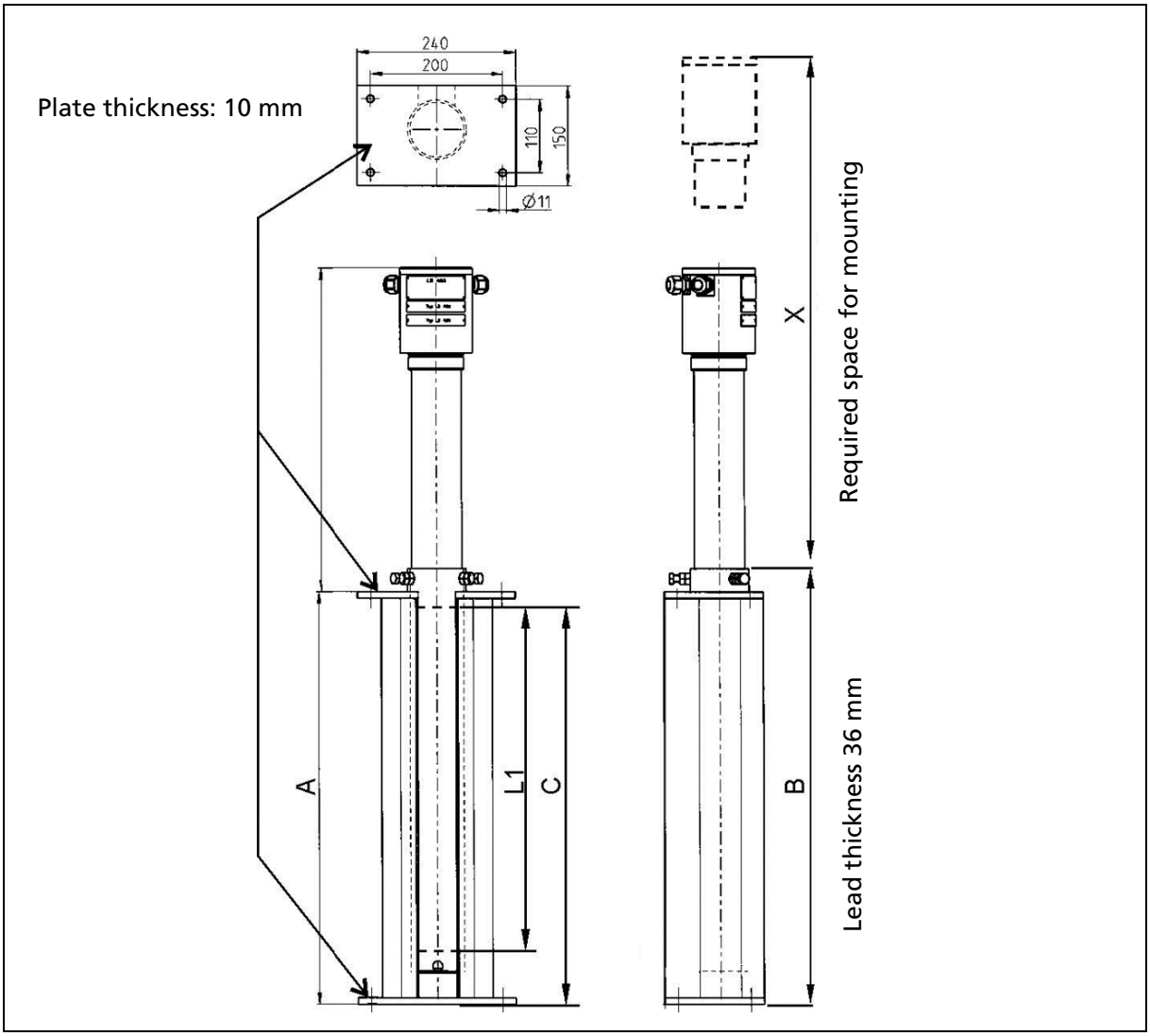




Gesamte Abschirmungswirkung: ca. 70 mm Blei
Gewicht ca. 124 kg

TI-Fig. 30 Extension Shield für SuperSENS (Dimensions in mm)

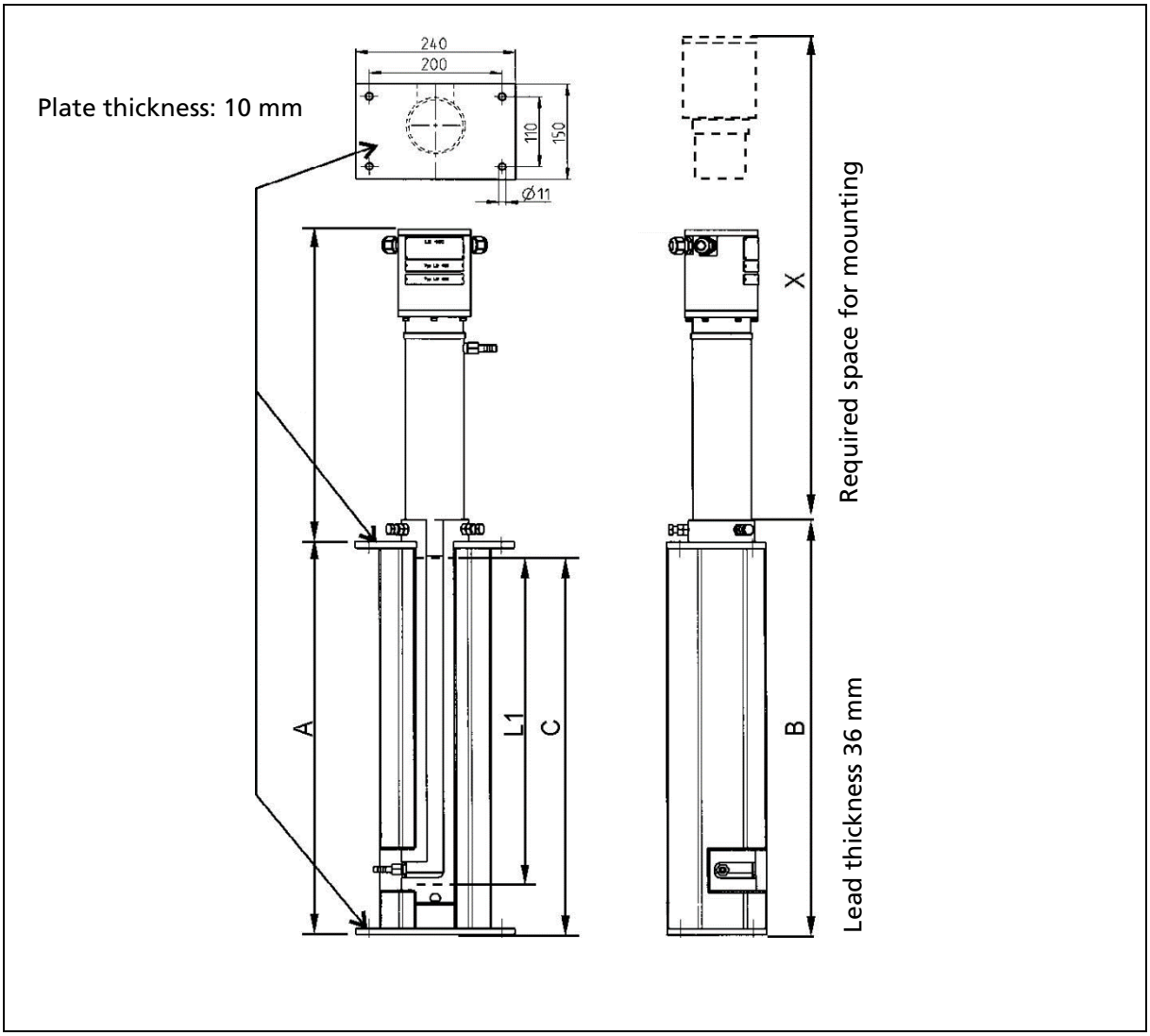
10.4. Collimator for UniSENS Detectors without Water-Cooling



TI-Fig. 31 Collimator for UniSENS without Water-Cooling (Dimensions in mm)

Mat.-No.	L1 sensitive length	A	B	C	X	Weight (kg)
59957-050	500	620	655	590	960	110
59957-100	1000	1120	1155	1090	1460	195
59957-150	1500	1620	1655	1590	1960	280
59957-200	2000	2120	2155	2090	2460	365

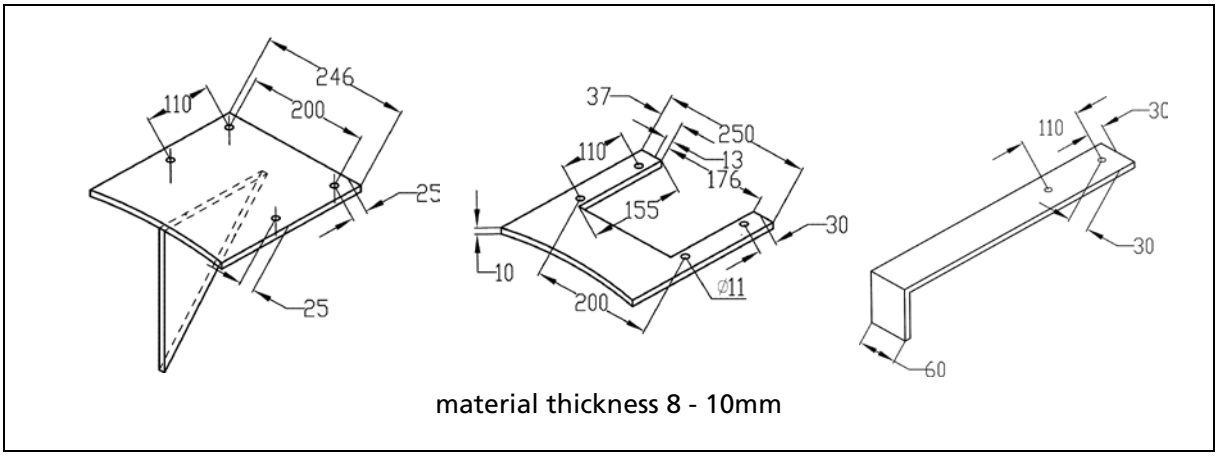
10.5. Collimator for UniSENS Detectors with Water-Cooling



TI-Fig. 32 Collimator for UniSENS with water-cooling (Dimensions in mm)

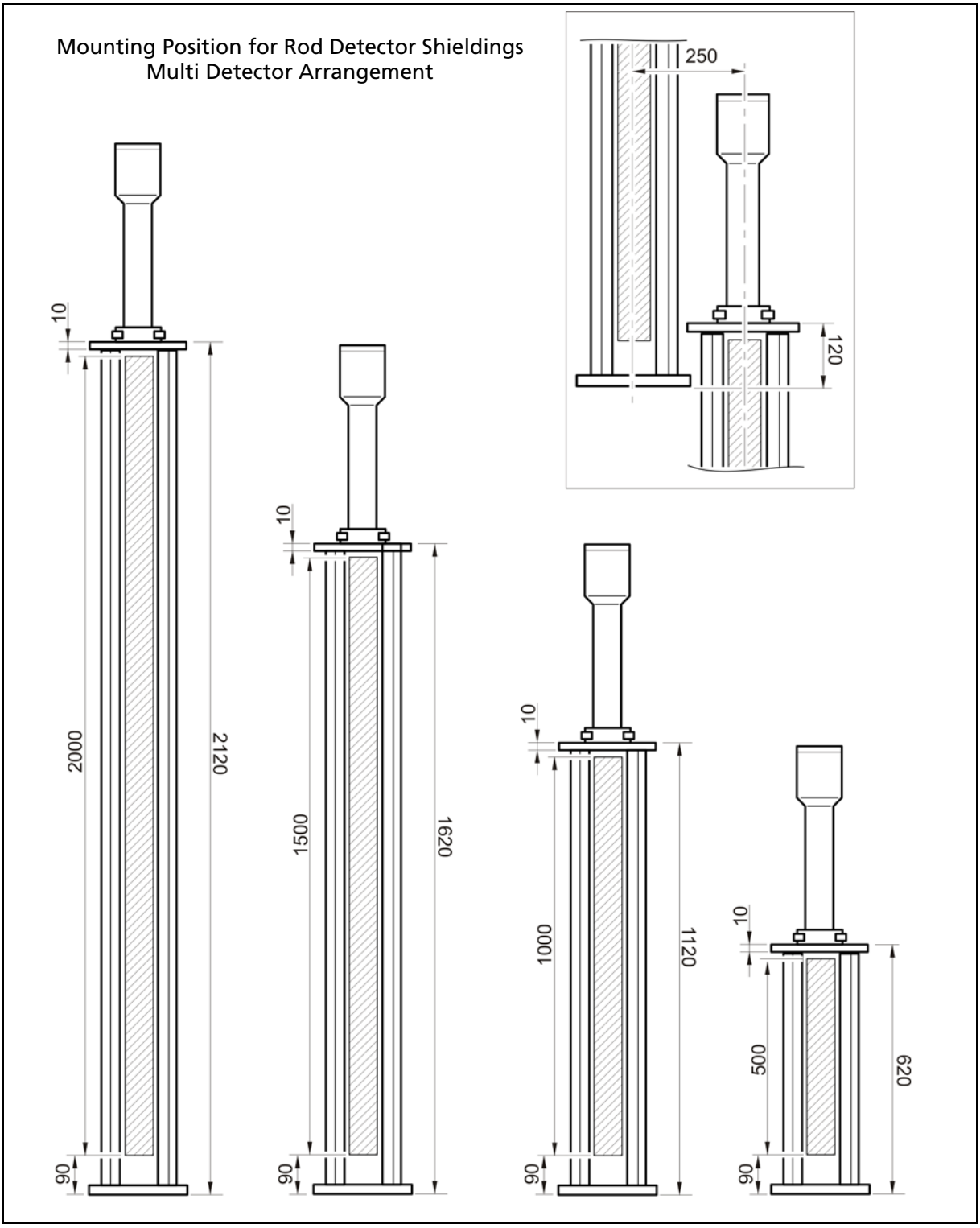
Mat.-No.	L1 sensitive length	A	B	C	X	Weight (kg)
60085-050	500	620	655	590	960	110
60085-100	1000	1120	1155	1090	1460	195
60085-150	1500	1620	1655	1590	1960	280
60085-200	2000	2120	2155	2090	2460	365

10.6. Mounting Parts UniSENS Collimator



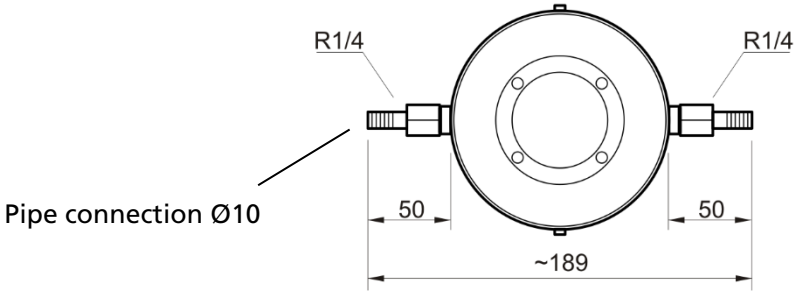
TI-Fig. 33 Mounting parts collimator (Dimensions in mm)

10.7. Mounting Points for UniSENS Shieldings

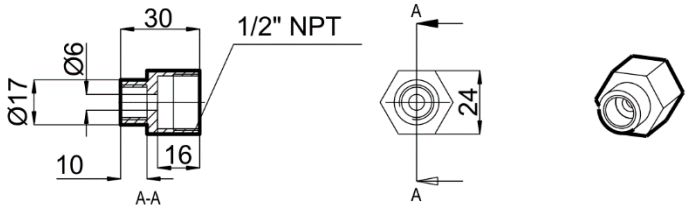


TI-Fig. 34 Mounting positions for UniSENS rod detector shieldings

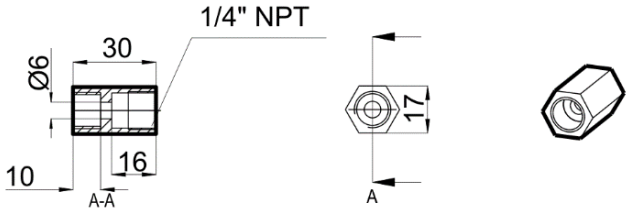
11. Water Cooling Jacket and Adaptor Fittings



Fitting adaptor for standard water cooling
Rp ¼" → ½" NPT female, stainless steel 1.4301 (AISI 304), Mat. No. 47189



Fitting adaptor for standard water cooling
Rp ¼" → ¼" NPT female, stainless steel 1.4301 (AISI 304), part no: 46743



Further fitting adaptors for standard water cooling jacket:
Rp ¼"→ ½" NPT male, stainless steel 304, part no: 6352
Rp ¼"→ ¼" NPT male, stainless steel 304, part no: 6349

TI-Fig. 35 Water cooling jacket and adaptor fittings

Fitting Connection	Mat. No. (material)
R ¼" pipe connection, male European standard Whitworth pipe thread	included in standard water cooling jacket
10 mm hose connection for water hose connection ID 10 mm	
fitting adaptor ½" NPT female	47189 (304/1.4301)
fitting adaptor ¼" NPT female	46743 (304/1.4301)
fitting adaptor ½" NPT male	6352 (304/1.4301)
fitting adaptor ¼" NPT male	6349 (304/1.4301)

12. Technical Data

Mechanical Design	
Operating temperature	extended temperature range with metallic cable glands: -40 ... +60 °C (-40 ... +140 °F) extended temperature range with water cooling system: -40 ... +100 °C (-40 … +212 °F) Observe the max. permissible ambient and surface temperatures for explosion protection (see Safety Manual / Explosion Protection Manual).
Genral ambient conditions	Pollution Degree: 2 Altitude: up to 2000 m Humidity: 90% or less
Housing material	Stainless steel ISO 1.4301/AISI 304 (other materials on request)
Environmental testing	IEC 60068-2-27: mechanical shock (30 g) IEC 60068-2-6: Vibration (1.9 g at resonance, sinusoidal) IEC 60068-2-38: Climate testing (-10 ... +65 °C; relative humidity 90% or less) IEC 60068-2-14 NA: Temperature shock (-45 °C ... 65 °C in 10 s)
Water cooling system	Optional, stainless steel ISO 1.4301/AISI 304 Water pressure up to 6 bar Tube connection R1/4”, d=10 mm Weight approx. 3 kg
Collimator	Optional, lead, painted Frontal or lateral radiation To reduce background radiation Weight approx. 10 kg
Supply voltage	by the connected evaluation unit: LB 44x or LB 47x
EMC	Emissions: according to EN 61326-1, Electrical Equipment Class B Immunity: according to EN 61326-1, according to EN 61326-3 (SIL2) according to NAMUR NE21
Core cross-section for the screw terminals	0.75 mm^2 to 2.5 mm^2
Max. cable length between detector and evaluation unit	1000 m with Berthold cables: Id. Nr. 32024: Signal cable, 2x1.0 mm^2, black Id. Nr. 46413: Signal cable Ex i, 2x1.0 mm^2, blue Line resistance less than 20 ohms/km
Count rate	max. 1,000,000 CPS
Temperature stability	≤ 0.01%/°C (-40 ...+60 °C) for rod detectors ≤ 0.002%/°C (-40 ...+60 °C) for point detectors
Pt100 input	-40°C to 200°C, 0.24°C accuracy

12.1. Point Detectors CrystalSENS

Mechanical Design	
Weights	▪ CrystalSENS, 50x50, 40x35, 25x25 (NaI/Tl): approx. 9 kg ▪ CrystalSENS, 50x60 (polymer): approx. 9 kg with collimator (optional): additional approx. 10 kg with point detector water cooling (optional): additional approx. 3 kg
Installation lengths	▪ CrystalSENS, 50x50 (NaI/Tl): approx. 460 mm ▪ CrystalSENS, 50x60 (polymer): approx. 460 mm with collimator (optional): additional approx. 40 mm with point detector water cooling (optional): additional approx. 15 mm

12.2. Rod Detectors UniSENS

Mechanical Design	
Weights	▪ UniSENS, 50 x 500 (polymer): approx. 13 kg with rod detector water cooling 500 mm (optional): additional approx. 6 kg ▪ UniSENS, 50 x 1000 (polymer): approx. 17 kg with rod detector water cooling 1000 mm (optional): additional approx. 10 kg ▪ UniSENS, 50 x 1500 (polymer): approx. 21 kg with rod detector water cooling 1500 mm (optional): additional approx. 13 kg ▪ UniSENS, 50 x 2000 (polymer): approx. 27 kg with rod detector water cooling 2000 mm (optional): additional approx. 16 kg
Installation lengths	▪ UniSENS, 50 x 500 (polymer): approx. 930 mm ▪ UniSENS, 50 x 1000 (polymer): approx. 1430 mm ▪ UniSENS, 50 x 1500 (polymer): approx. 1930 mm ▪ UniSENS, 50 x 2000 (polymer): approx. 2430 mm with rod detector water cooling (optional): additional approx. 10 mm Class Divison variants additional approx. 30 mm

12.3. Point Detectors SuperSENS

Mechanical Design	
Weights	▪ SuperSENS with side irradiation: approx. 50 kg ▪ SuperSENS with frontal irradiation: approx. 60 kg with water cooling (optional): additional approx. 7 kg
Installation lengths	▪ SuperSENS with side irradiation: approx. 639 mm ▪ SuperSENS with frontal irradiation: approx. 619 mm

12.4. Rod Detectors TowerSENS

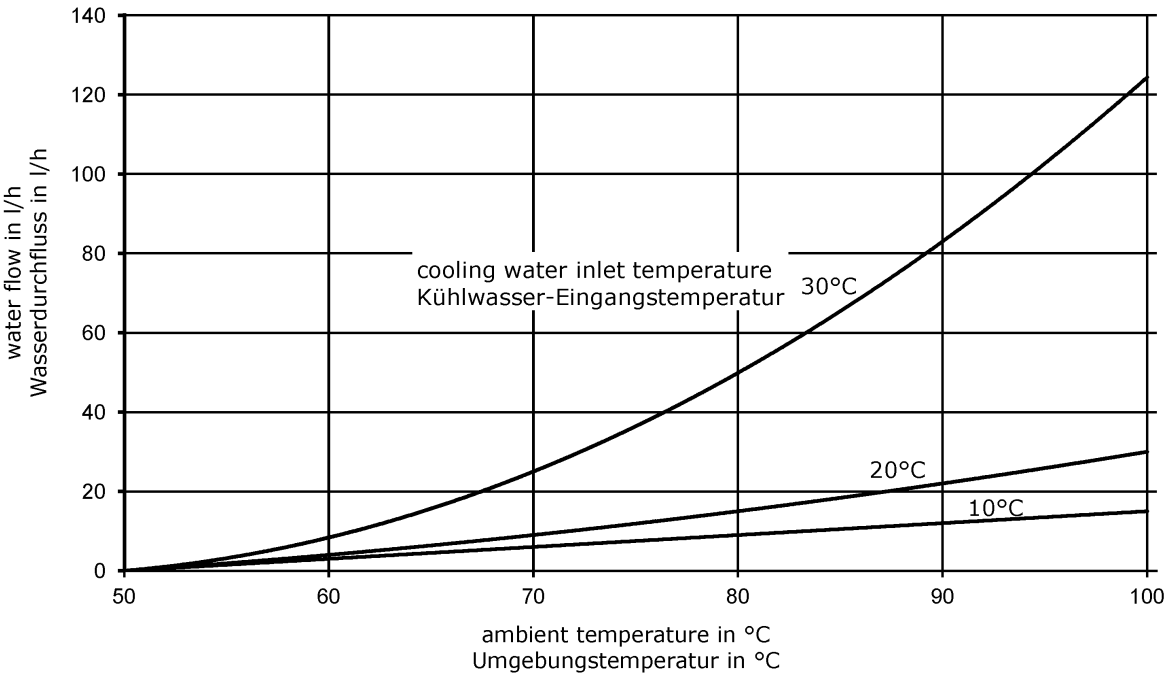
Mechanical Design	
Weights	▪ TowerSENS, 50 x 2000 (polymer): approx. 26 kg with rod detector water cooling 1000 mm (optional): additional approx. 15 kg ▪ TowerSENS, 50 x 3000 (polymer): approx. 34 kg with rod detector water cooling 3000 mm (optional): additional approx. 22 kg ▪ TowerSENS, 50 x 4000 (polymer): approx. 43 kg with rod detector water cooling 4000 mm (optional): additional approx. 30 kg ▪ TowerSENS, 50 x 5000 (polymer): approx. 51 kg with rod detector water cooling 5000 mm (optional): additional approx. 37 kg ▪ TowerSENS, 50 x 6000 (polymer): approx. 60 kg with rod detector water cooling 6000 mm (optional): additional approx. 45 kg ▪ TowerSENS, 50 x 7000 (polymer): approx. 68 kg with rod detector water cooling 7000 mm (optional): additional approx. 52 kg ▪ TowerSENS, 50 x 8000 (polymer): approx. 77 kg with rod detector water cooling 8000 mm (optional): additional approx. 60 kg
Installation lengths	▪ TowerSENS, 50 x 2000 (polymer) without and with water cooling: approx. 2530 mm ▪ TowerSENS, 50 x 3000 (polymer) without and with water cooling: approx. 3550 mm ▪ TowerSENS, 50 x 4000 (polymer) without and with water cooling: approx. 4530 mm ▪ TowerSENS, 50 x 5000 (polymer) without and with water cooling: approx. 5530 mm ▪ TowerSENS, 50 x 6000 (polymer) without and with water cooling: approx. 6530 mm ▪ TowerSENS, 50 x 7000 (polymer) without and with water cooling: approx. 7530 mm ▪ TowerSENS, 50 x 8000 (polymer) without and with water cooling: approx. 8530 mm

12.5. Scintillator

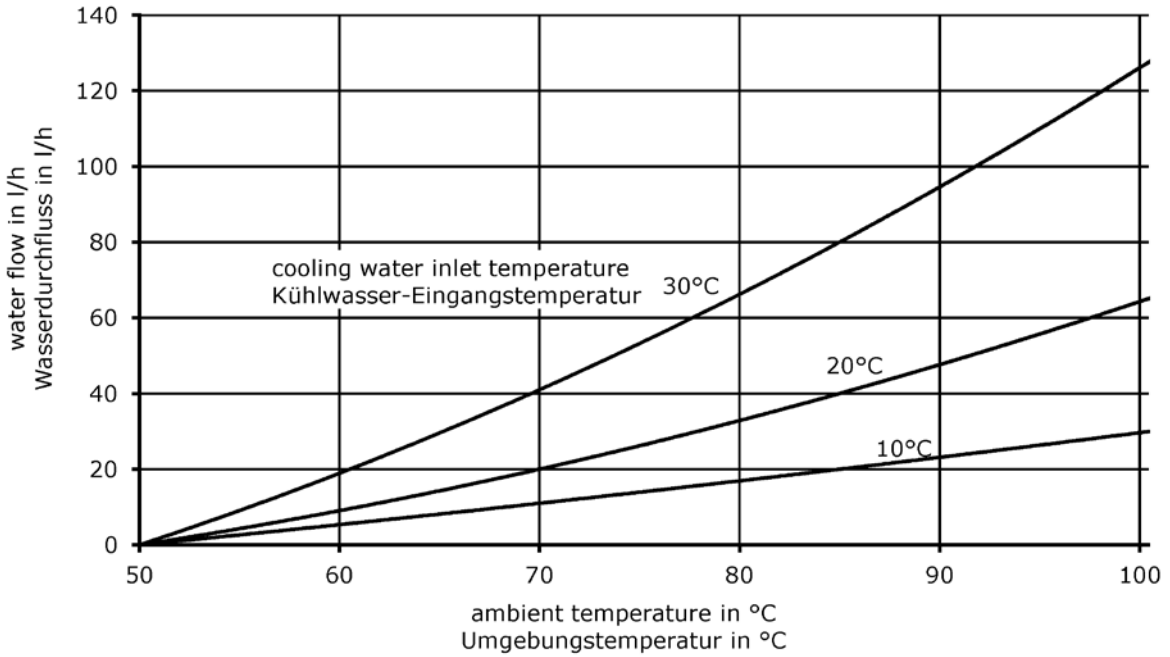
Mechanical Design	
Scintillator	Point detectors: NaI(Tl) crystal 50x50 mm NaI(Tl) Crystal 40x35 mm NaI(Tl) Crystal 25x25 mm Polymer scintillator 50x60 mm NaI(Tl) Crystal 125x50 mm Polymer scintillator 150x150 mm Rod detectors: Polymer scintillator 50x500 mm Polymer scintillator 50x1000 mm Polymer scintillator 50x1500 mm Polymer scintillator 50x2000 mm Polymer scintillator up to 50x8000 mm
Typical sensitivity (Cs-137)	Point detectors: CrystalSENS, 50 x 50 (NaI/Tl): ≥1200 cps / µSv/h CrystalSENS, 40 x 35 (NaI/Tl): ≥600 cps / µSv/h CrystalSENS, 20 x 20 (NaI/Tl): ≥200 cps / µSv/h CrystalSENS, 50 x 60 (polymer): ≥700 cps / µSv/h SuperSENS, 150 x 150 (NaI/Tl): ≥8200 cps / µSv/h Rod detectors: UniSENS, 50 x 500 (polymer): ≥6,000 cps / µSv/h UniSENS, 50 x 1000 (polymer): ≥11,000 cps / µSv/h UniSENS, 50 x 1500 (polymer): ≥17,000 cps / µSv/h UniSENS, 50 x 2000 (polymer): ≥25,000 cps / µSv/h TowerSENS, up to 50 x 8000 (polymer): ≥8000 cps / µSv/h per m

13. Cooling Water Demand

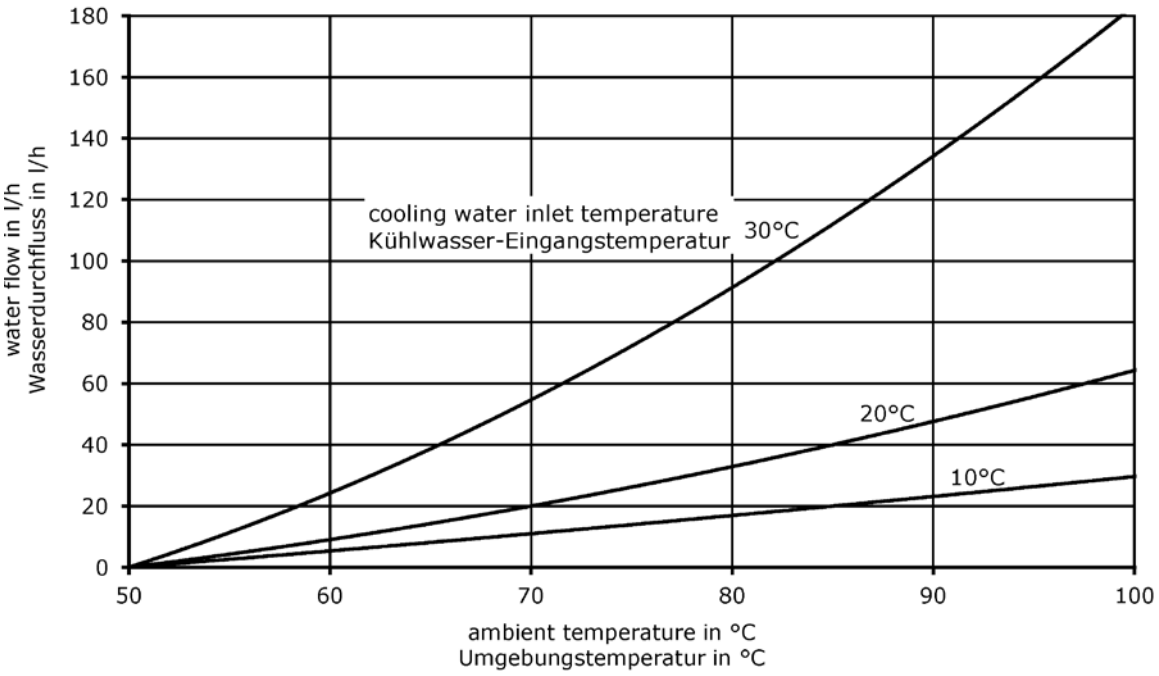
13.1. Cooling Water Demand Point Detector



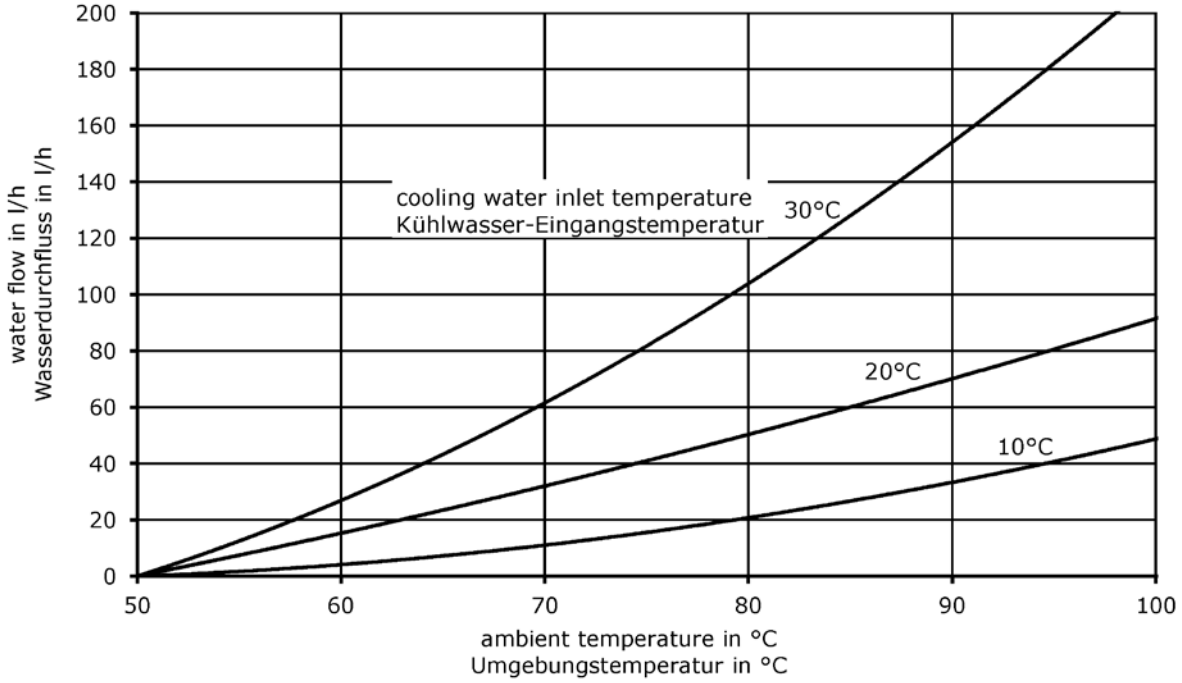
13.2. Cooling Water Demand Rod Detector 500mm



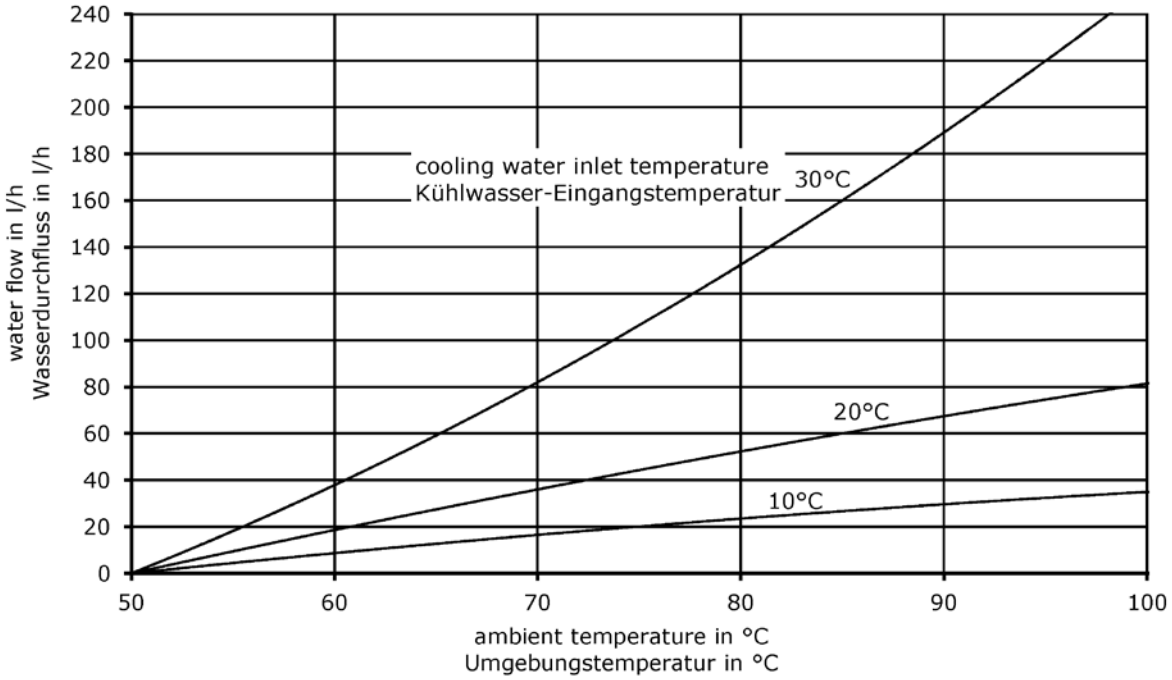
13.3. Cooling Water Demand Rod Detector 1000mm



13.4. Cooling Water Demand Rod Detector 1500mm



13.5. Cooling Water Demand Rod Detector 2000mm



14. Number Key LB 4700 Detectors

1	2	3	4	5	5a	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
L	B	4	7	0	0	-	1	1	-	1	A	-	1	1	-	r	1	-	0	0	0

Device family

47	DuoSeries

Application

00	none

Openings

0	M12x1,5; M16x1.5; radial
1	2x 1/2" NPT; radial
3	M20x1.5; axial
6	1/2" NPT; axial

Temperature range

1	extend

Housing material

1	1.4301
3	316L

Collimator

	none
a	axial (frontal)
r	radial (side)

Power Supply

0	without separate supply

Signal

8	FSK

Ex. Area (certification)

0	0	No explosion protection; without certification
1	☐	Zones (ATEX/IECEx/NEC/CEC); Ex-d/e/t
F	☐	Divisions (NEC/CEC); XP
I	☐	Zones (ATEX/IECEx/NEX/CEC); Ex-d/i/t

☐ = Ex version (A,B,...,Y)

Scintillator

1 1	50/50 NaI Crystal SENS	2 A	500 mm UniSENS	3 1	150/150 SuperSENS
1 2	50/50 NaI Crystal SENS with WC	2 B	500 mm UniSENS with WC	3 2	150/150 SuperSENS with WC
1 3	40/35 NaI Crystal SENS	2 C	750 mm UniSENS	4 1	1000 mm TowerSENS
1 4	40/35 NaI Crystal SENS with WC	2 D	750 mm UniSENS with WC	4 2	1000 mm TowerSENS with WC
1 5	25/25 NaI Crystal SENS	2 E	1000 mm UniSENS	4 3	2000 mm TowerSENS
1 6	25/25 NaI Crystal SENS with WC	2 F	1000 mm UniSENS with WC	4 4	2000 mm TowerSENS with WC
1 A	50/60 NaI Crystal SENS	2 G	1250 mm UniSENS		
1 B	50/60 NaI Crystal SENS with WC	2 H	1250 mm UniSENS with WC		
		2 I	1500 mm UniSENS		
		2 J	1500 mm UniSENS with WC		
		2 K	2000 mm UniSENS		
		2 L	2000 mm UniSENS with WC		

WC = Water cooling
Only by the LB Number Key, the detector can be uniquely identified (Scintillator, size, certification, ect.).

15. Parts Overview

Mat. No.	Description
68640	Water cooling system for point detectors
61231	Water cooling system for rod detector 500 mm
61235	Water cooling system for rod detector 1000 mm
61238	Water cooling system for rod detector 1500 mm
61241	Water cooling system for rod detector 2000 mm
11814	Collimator with frontal irradiation
04506	Collimator with side irradiation
61624	Cable gland set for extended temperature range
31346	Set of mounting clamps for detectors without water cooling system
31347	Set of mounting clamps for detectors with water cooling system
39246	Holder for point detectors without water cooling system
32024	Signal cable
46413	Signal cable for intrinsically safe detectors
59957-050	Rod detector shield L=500
59957-100	Rod detector shield L=1000
59957-150	Rod detector shield L=1500
59957-200	Rod detector shield L=2000
60085-050	Rod detector shield L=500, with water-cooling
60085-100	Rod detector shield L=1000, with water-cooling
60085-150	Rod detector shield L=1500. with water-cooling
60085-200	Rod detector shield L=2000, with water-cooling
70515	TowerSENS shield L=1000 applicable for extension module applicable for TowerSENS with and without water cooling Material: 1.4301 (304)
70518	TowerSENS shield L=2000 applicable for basic module and extension module applicable for TowerSENS with and without water cooling Material: 1.4301 (304)
68188	Lid with axial cable entry for non-Ex detectors

74508	Suspension bracket for dip pipe installation
73859	TowerSENS extension module 1000 mm, 316L
73853	TowerSENS extension module 1000 mm, 316L with water cooling
51574	TowerSENS extension module 2000 mm, 1.4301
52434	TowerSENS extension module 2000 mm, 1.4301 with water cooling
67502	TowerSENS extension module 2000 mm, 316L
67464	TowerSENS extension module 2000 mm, 316L with water cooling

L = scintillator length

16. EU Declaration of Conformity

Berthold Technologies GmbH & Co. KG
Calmbacher Straße 22
75323 Bad Wildbad, Germany
info@berthold.com
www.berthold.com

EU-Declaration of Conformity (original) File No.: CE20027-8

We, hereby declare under our sole responsibility that the design of the following products / systems / units brought into circulation by us comply with the relevant harmonized rules of the EU.

This declaration loses its validity should modifications or unsuitable and improper use take place without our authorisation.

Description: ***detector for radiometrical measurement system in non hazardous environments***

Typ: ***LB 4700-xx-00-xx-xx-xxx***

x = all letters

	directive	applied standards	
EMC	2014/30/EU	EN 61326-1	2013
RoHS	2011/65/EG	EN 50581	2012

This declaration is issued by the manufacturer

BERTHOLD TECHNOLOGIES GmbH & Co. KG
Calmbacher Str. 22, D-75323 Bad Wildbad, Germany

released by

Dr. J. Briggmann

Head of R&D
Bad Wildbad, 23rd of May, 2019

Registergericht / Court of Registration: Stuttgart HRA 330991
Persönlich haftende Gesellschafterin / Fully liable Associates: Berthold Technologies Verwaltungs-GmbH
Registergericht / Court of Registration: Stuttgart HRB 331520
Geschäftsführung / Management: Andreas Dobratz
USt.-Id-Nr. / VAT Reg. No.: DE813050511
Deutsche Steuernummer / German Tax No.: 49038/08038
WEEE-Reg. No.: DE99468690

Bankverbindungen / Bank Details	IBAN	BLZ	Konto / Account	Swift BIC
Sparkasse Pforzheim-Calw	DE37	6665 0085	0008 0450 03	PZHSDE66
Volksbank Pforzheim	DE85	6669 0000	0000 9570 04	VBPFDE66
Commerzbank Pforzheim	DE05	6668 0013	0651 1120 00	DRESDEFF666

detect and identify