



## Lightning and surge protection for Ex areas

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These sheets provide you with information on specific technical subjects. They are based on currently known and valid rules and regulations and on our experience. The content of this document is not legally binding and makes no claim to completeness.

## 2 Basic principles

Every year, explosions endanger people and systems around the world. Any company manufacturing, processing or storing combustible substances must expect possible explosions.

### Application examples:

- Gas pressure regulation and measurement systems
- Valve stations
- Pumping stations
- Fuel depots
- Natural gas storage facilities, natural gas compressor stations
- Petrol stations
- Refineries
- Biogas plants
- Production facilities of the chemicals and pharmaceuticals industry

Potentially explosive areas (Ex areas) are all those rooms and areas in which gases, vapours, mists or dusts, which can form potentially explosive mixtures with air, can collect to a hazardous level. Explosion protection will prevent damage to technical products, systems and other equipment.

### Three factors must exist simultaneously for an explosion to occur:

- Combustible substance
- Oxygen
- Ignition source according to the Technical Rules for Operating Safety (TRBS) 2153/Technical Rules for Hazardous Substances (TRGS) 727: Static electricity, electromagnetic waves or lightning strike

Parts 1 and 2 of TRBS 2153 and 2152 have the same content as those of TRGS 720/721 and 722.



EN 1127-1 states, if lightning strikes a potentially explosive atmosphere, then the atmosphere is always ignited. The strong heating of the arresting paths of the lightning can also trigger ignition. Starting at the lightning strike point, strong currents flow, which can cause sparks close to the impact point. Even without a direct lightning strike, induced voltages can cause damage to electrical devices, systems and components for measurement, control and regulation (MSR) technology and, in the worst case, can lead to an explosion. Lightning protection is preventive fire protection.

### For this reason, the three basic principles of explosion protection are:

- Avoid potentially explosive atmospheres
- Avoid any possibly effective source of ignition
- Limit possible explosion impacts to a reasonable level

## 2.1 Special requirements for lighting and surge protection in Ex areas

The lightning protection measures must be created in such a way that there are no melting and spray impacts. In a lightning protection system erected according to VDE 0185-305-3 (IEC 62305-3), the creation of ignitable sparks, as well as interfering or damaging impacts on electrical systems through the impact of lightning, need not be prevented in every case.

For this reason, when planning and running a lightning protection system through potentially explosive areas – so-called Ex zones – the following rules must additionally be taken into account:

- IEC 62305-3 (VDE 0185-305-3) – Appendix D  
"Additional information for lightning protection systems for structures in areas with the risk of explosion"
- VDE 0185-305-3 – Supplement 2  
"Additional information for special building structures"

In systems with Ex zone 2 and Ex zone 22, an Ex atmosphere will most likely only occur in rare, unforeseen circumstances. Therefore, it is possible to position air-termination systems in Ex zone 2 and Ex zone 22, taking Appendix D in IEC 62305-3 (VDE 0185-305-3) into account.

With regard to the risk of ignition of a dangerous, potentially explosive atmosphere through a lightning strike, the Technical Rules for Hazardous Substances No. 509 refer to TRBS 2152 Part 3 Number 5.8. Appendix 1 of the TRGS lists individual details on the use and requirements of spark gaps in pipe lines, as well as detailed requirements on lightning and surge protection units according to DIN EN 62305 (IEC 62305). Building sections containing tanks to store flammable liquids with an ignition point  $\leq 55\text{ °C}$  and a volume of more than 3,000 l must be protected against ignition risks from lightning strikes using suitable equipment. This also applies to above-ground tanks in the open air and underground tanks with flammable liquids with an ignition point of  $55\text{ °C}$ , which are not completely surrounded by earth, masonry, concrete or multiples of these substances.

## 2.2 Assignment of the Ex zones

Potentially explosive areas are divided up into 3 zones according to the duration and frequency of the occurrence of potentially explosive atmospheres. These zones are always three-dimensional areas or a three-dimensional space.

Level of risk	Interval of occurrences of mixtures (annual)	Interval of occurrences of mixtures (differentiated)	Dwell times of the mixtures
<b>Zone 0, Zone 20:</b> Constant or frequent formation of potentially explosive atmospheres	Greater than for Zone 1, > 1,000 times	Greater than for Zone 1, > 3 times/day	Longer than for Zone 1
<b>Zone 1, Zone 21:</b> Occasional formation of potentially explosive atmospheres	$\geq 10$ times, < 1,000 times	$\geq 1$ time/month, < 3 times/day	Longer than 0.5 hrs, Shorter than 10 hrs
<b>Zone 2, Zone 22:</b> Normally no or short formation of potentially explosive atmospheres	$\geq 1$ time, < 10 times	$\geq 1$ time/year, < 1 time/month	Shorter than 0.5 hrs

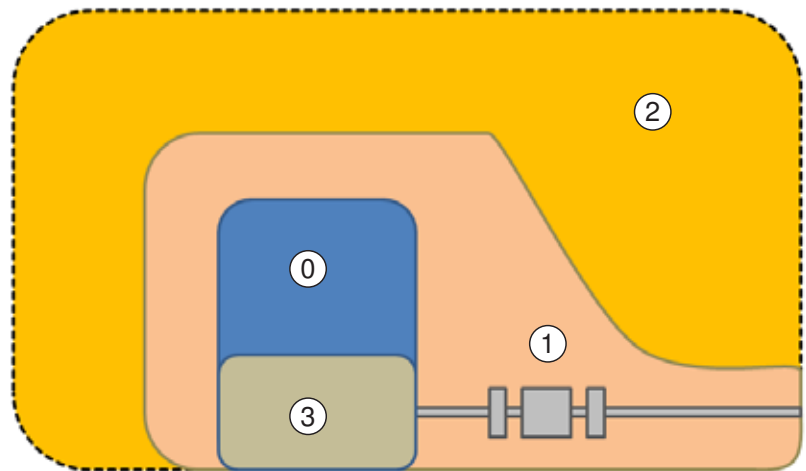
**Tab. 1:** Intervals of the occurrence of potentially explosive atmospheres

A further subdivision of the potentially explosive areas makes a distinction between combustible gases and combustible dusts.

Ex zones	Description
Zone 0	In Zone 0, in normal operation, a dangerous, potentially explosive atmosphere can form over longer periods or at regular intervals as a mixture of air or combustible gases, vapours or mist.
Zone 1	In Zone 1, in normal operation, an atmosphere can occasionally form as a mixture of air or combustible gases, vapours or mist.
Zone 2	In Zone 2, in normal operation, a potentially explosive atmosphere can normally not, or only briefly, form as a mixture of air or combustible gases, vapours or mist.
Zone 20	In Zone 20, in normal operation, a dangerous, potentially explosive atmosphere can form over longer periods or at regular intervals in the form of a cloud of combustible dust contained in the air.
Zone 21	In Zone 21, in normal operation, a dangerous, potentially explosive atmosphere can form occasionally in the form of a cloud of combustible dust contained in the air.
Zone 22	In Zone 22, in normal operation, a dangerous, potentially explosive atmosphere can normally not, or only briefly, form in the form of a cloud of combustible dust contained in the air.

**Tab. 2:** Definition of Ex zones

The operator of a building specifies the appropriate potentially explosive areas, divides them up into zones and labels them in a diagram of the systems to be protected according to the Ordinance on Industrial Safety and Health and the Hazardous Substances Ordinance. For the planning of lightning protection measures, these drawings must be reviewed before the planning and erection of the lightning protection system. According to GefStoffV 2015, the operator is required to compile this explosion protection document.



**Abb. 1:** Example of zone division for the gas Ex areas according to IEC 60079-10-1

Legend	
①	Zone 0
②	Zone 1
③	Zone 2
④	Combustible substance

Electrical devices may be used in different zones, depending on the device protection level EPL and device category.

Zone assignment of devices according to their category and/or protection level according to DIN EN 60079-14 (IEC 60079-14)		
Zone	Device category	Device protection level EPL
0	1G	Ga
1	2G	Gb
2	3G	Gc

**Tab. 3:** Example of zone assignment "Gases"

## 2.3 ATEX guidelines

The EU ATEX directives regulate the requirements resulting from the use of devices and protection systems in potentially explosive areas. Due to increasing international economic intermeshing, major progress has been achieved in the standardisation of the explosion protection regulations.

In the European Union, the preconditions for complete standardisation were created in the directives 2014/34/EU for manufacturers and 99/92/EC for operators. The manufacturers' directive 2014/34/EU (ATEX) regulates the requirements for the structure of explosion-protected devices and protection systems, by prescribing basic health and safety requirements.

Manufacturers of components for potentially explosive areas must obtain an approval for their products. The quality requirements for the production of resources without effective sources of ignition is very high. An approved test office will only certify the function of the components of a manufacturer after a comprehensive test, and will assign them into categories according to failure safety. In addition, the testing offices use regular audits with the manufacturers to ensure continuously guaranteed product quality.

## 3 Solutions

### 3.1 Equipotential bonding systems

Systems in potentially explosive areas require equipotential bonding according to VDE 0165-1 (IEC 60079-14). All the bodies of electrically conductive parts must be connected to the equipotential bonding system. Secure equipotential bonding connections against self-loosening according to VDE 0165-1 (IEC 60079-14) and the Technical Rules for Operating Safety (TRBS) 2152 Part 3.

According to TRBS 2152 Part 3 and VDE 0185-305-3 (IEC 62305-3), the arresting paths of the lightning must be created in such a way that heating or ignitable sparks or spray sparks cannot become the ignition source of a potentially explosive atmosphere. OBO can offer innovative solutions for this.

**Areas of application could include:**

- Chemicals industry
- Paint shops
- Oil and gas industry
- Fuel depots
- Gas pressure regulation and measurement systems (GDRM systems)
- Liquefied gas storage container
- Balance pits and large outdoor filling systems
- Filling and emptying points (e.g. Big-Bag sacking, balances, sack handover)

### 3.1.1 Equipotential busbar for zone 1/21 and 2/22 – EX PAS



**Abb. 2:** Equipotential busbar EX PAS

Type	Article number
EX PAS 5	5015265
EX PAS 10	5015270

VDE 0185-305-3 Supplementary sheet 2 (IEC 62305-3) requires that connections of lightning protection systems in potentially explosive areas are created in such a way that no ignitable sparks are created when the lightning current passes through.

The EX PAS equipotential busbar (equipotential busbar for potentially explosive areas) is used for lightning protection equipotential bonding according to VDE 0185-305-3 (IEC 62305-3) and protective/function equipotential bonding according to DIN VDE 0100 Part 410/540.

The lack of ignition sparks in an explosive atmosphere has been tested according to VDE 0185-561-1 (IEC 62561-1) according to the most demanding explosion group, IIC, with a potentially explosive gas mixture and a lightning current of up to 75 kA. It can thus be used in all explosion groups, even in the explosion groups IIB and IIA. As the EX PAS equipotential busbar does not possess its own potential source of ignition, it does not come under the European Directive 2014/34/EU.

The EX PAS equipotential busbar is tested according to VDE 0185-561-1 (IEC 62561-1) in Class H for high loads and is suitable for indoor and outdoor applications.

Thanks to the patented design, the equipotential busbar can be used in a system according to VDE 0165 Part 1 (IEC 60079-14) and VDE 0185-305-3 (IEC 62305-3) in the Ex zones 1/21 and 2/22. The EX PAS represents the current state of the art for equipotential busbars in Ex areas.

**The EX PAS equipotential busbar for potentially explosive areas possesses the following properties:**

- Suitable for all explosion groups and use in Ex zones 1/21 and 2/22
- Free of ignition sparks with a lightning current of up to 75 kA
- Tested according to Class H for high loads
- Screws protected against self-loosening
- Made from corrosion-resistant material (stainless steel)
- Manufacturer and article labelling permanently attached



### 3.1.2 Ex spark gaps – EX ISG H

According to TRGS 507, electrical separating elements in potentially explosive areas must be bridged with spark gaps. The spark gaps must have a response surge voltage of 50% of the testing AC voltage of the insulating elements, although with a maximum of 2.5 kV.

The ATEX/IECEx-certified OBO EX ISG H spark gap insulates the parts of the system against corrosion currents, fulfilling the requirements for the connection of lightning currents in potentially explosive areas according to VDE 0185-561-3 (IEC 62561-3).

To avoid arcing to insulating pieces in Ex areas, the use of Ex-certified spark gaps is required.



**Abb. 3:** Spark gap EX ISG H

The OBO EX ISG H spark gap is certified according to the following directives:





- ATEX
- IECEx

#### 3.1.2.1 Selection of spark gaps in potentially explosive areas



**Abb. 4:** Spark gap mounted on insulating sections



Spark gaps	Article number	Ex labelling
EX ISG H 350	52400 31	ATEX  II 2 G Ex db IIC T6 Gb
EX ISG H	52400 30	 II 2 D Ex tb IIIC T80°C Db
EX ISG H 350 2L	5240032	IECEx  db IIC T6 Gb
EX ISG H KU	5240033	 tb IIIC Db

**Tab. 4:** OBO Ex spark gaps

Accessories	Article number
Connection cable AL EX ISG 100	52401 02
Connection cable AL EX ISG 200	52401 04
Connection cable AL EX ISG 300	52401 06
Connection clamp, flat M10	52403 60
Connection clamp, flat M12	52403 62
Connection clamp, flat M16	52403 66
Connection clamp, flat M20	52403 70
Connection clamp, flat M24	52403 74
Connection clamp, angled M10	52403 80
Connection clamp, angled M12	52403 82
Connection clamp, angled M16	52403 86
Connection clamp, angled M20	52403 90
Connection clamp, angled M24	52403 94
Connection clamp, universal M10 - M26	52403 96

**Tab. 5:** Ex spark gap accessories

As soon as the EX ISG H responds and conducts, the lightning current  $I_{imp}$  of up to 100 kA is run to the earth along a defined route. This arresting operation only takes a few microseconds. After the arresting operation, the EX ISG H returns to a standard, high-resistance state. The EX ISG H is low maintenance, as it is designed for a wide range of arresting operations.

Flanges and insulating pieces show a relatively low voltage resistance, which is usually in the range of a few kV. Class 1 insulating flanges have a testing AC voltage of  $U_{PW}$  of 5 kV and class 2 insulating flanges of 2.5 kV. In so doing, the technical rules GW 24 of the DVGW require selection of the response surge voltage  $U_{as}$  of the spark gaps in such a way as to be  $0.5 \times U_{PW}$ . Thus, the OBO Ex spark gap, with an  $U_{rimp}$  of  $\leq 1.25$  kV, fulfils the requirements for all insulating flange classes according to VDE 0185-561-3 (IEC 62561-3). The same requirements are made in the European recommendation of Ceacor (European Committee for the study of corrosion and protection of pipes and pipeline systems).

When the spark gap has ignited, the pulse current causes a voltage drop  $U_L$  via the connection cables and the spark gap, whereby the connection technology has the greatest influence. Here, the maximum voltage drop should be smaller than the peak values of the testing AC voltage  $\hat{U}_{PW}$ . Class 1 insulating flanges have approx. 7 kV as the peak value.

Besides the response range, the EX ISG H has a defined lower blocking range. Interfering earth currents or close parallel high-voltage routes can, for example, induce permanent 50 Hz AC voltages into the pipeline segments. To prevent the EX ISG H from igniting every time – and, in consequence, influencing the KKS system (cathodic corrosion protection system) – a so-called 50 Hz withstand AC voltage  $U_{WAC}$  is defined and must be maintained. Here, DVGW GW 24 recommends:  $\leq 250$  V, 50 Hz. This safety-relevant requirement is fulfilled by the OBO Ex spark gap.

Afk recommendation no. 5 of the DVGB e.V. working group (German Technical and Scientific Association for Gas and Water) explains the coordinated use of Ex spark gaps on insulating flanges using examples and detailed calculations.

### 3.1.2.2 Product characteristics of the spark gap EX ISG H

The EX ISG H implements state-of-the-art technologies and innovations:

- Solvent-free, environmentally friendly material
- Modern machining technology from the automotive sector
- Chemical resistance
- Resistance to oils and extreme temperature variations
- Halogen-free
- UV-stable, weatherproof
- Pressure encapsulation "d" for Ex areas – gas and dust-tight
- Resistant to saltwater
- Highest testing Class H in accordance with VDE 0185-561-3 (IEC 62561-3)
- Tested connection technology Class H according to VDE 0185-561-1 (IEC 62561-1)

## 3.2 Surge protection for data and MSR systems – MDP-EX and FDB

All the active conductors run in from outside of the energy, information and MCR technology must be included in the equipotential bonding with type 1 or D1 lightning arrestors.

Surge protection in potentially explosive areas is an important topic. It is important here to protect costly measuring technology against the influence of surge voltages through atmospheric discharge.

OBO lightning barriers of type MDP are tested for intrinsic safety (ia) and are independently certified. The products MDP-EX and FDB have been tested and certified according to the current standards for intrinsically safe measurement and bus systems (Ex (i) systems):

EN 60079-0:2012+A11:2013 – General requirements

EN 60079-11:2012 – Intrinsic safety "i"

EN 60079-25:2010 – Intrinsically safe systems

The OBO products MDP-EX and FDB thus fulfil the testing requirements for intrinsically safe systems and do not need to comply with IEC 60079-26. They only represent alternative testing methods for products that cannot be tested according to Part 25. The products also fulfil the ATEX directive 2014/34/EU.

With a high arresting capacity of 10 kA, they offer optimum protection for two to four-pole measurement and control applications. Different voltage variants offer a wide range of applications.

Type	Article number	Figure	Ex certificate
MDP-4 D-5-EX	5098412		BVS 11 ATEX E 131 X  II 2(1) G Ex ia [iaGa] IIC T4 Gb
MDP-4 D-24-EX	5098432		
MDP-4 D-48-EX	5098452		

Type	Article number	Figure	Ex certificate
FDB-2 24-M	5098380		BVS 10 ATEX E 048
FDB-3 24-M	5098382		
FDB-2 24-N	5098390		
FDB-3 24-N	5098392		

Tab. 6: Ex-certified SPDs

With the Petrol Field Protector, OBO can offer a surge protection device to protect sensors in potentially explosive areas. The Petrol Field Protector permits two or three-pole protection of all kinds of sensors.

The protection device can be fastened directly on the sensor and wired in using the appropriate metric or NPT thread. The robust stainless steel housing means that even aggressive atmospheres are no problem.

The intrinsic safety of the Petrol Field Protector has been independently tested and certified.

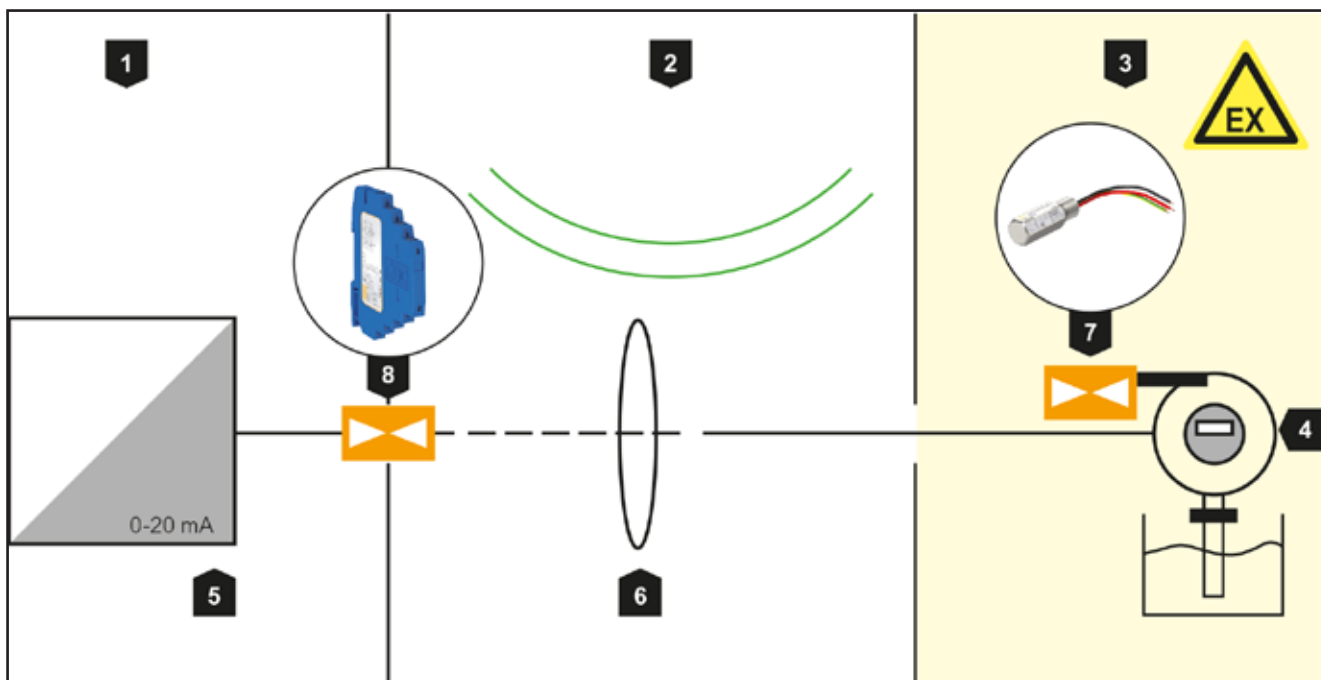


Abb. 5: Connection diagram for MDP-EX and FDB in Ex area

Legend	
1	Protected side
2	Field
3	Ex area zone 1/2
4	Protected sensor
5	Signal source
6	Coupling
7	Surge protection device on field device (e.g. FDB)
8	Surge protection device/Ex separation barrier in front of the signal source (e.g. MDP)

According to VDE 0170-7 (IEC 60079-11), an intrinsically safe electrical resource is an electrical resource, in which all the power circuits are intrinsically safe. The corresponding electrical resource, which contains both intrinsically safe and non-intrinsically safe circuits, is structured in such a way that the non-intrinsically safe circuits cannot influence the intrinsically safe circuits.

According to VDE 0165 Part 1 (IEC 60079-14) and VDE 0170-10-1 (IEC 60079-25), surge protection devices must fulfil the following requirements:

- Minimum arresting capacity of 10 pulses of 10 kA (8/20)
- Protection of the cables between the SPD and operating device against lightning strikes
- Leakage current < 10 µA
- Insulation resistance > 500 V (conductor-protective conductor)
- Corresponds to the device category ia, ib or ic
- Taking the L0 and C0 values into account

**MDP-EX/FDB labelling and areas of use:**

**II 2(1)G Ex ia [ia Ga] IIC T6...T4 Gb**

The surge arrestors may be installed in potentially explosive areas which require Category 2 devices (2G) (Zone 1/2). The intrinsically safe circuits/sensor circuits may be run in areas requiring Category 1 devices (1G) (Zone 0).

Both product ranges are also tested for applications in process technology such as the Profibus PA/DP and Foundation Fieldbus.

**Typical MDP-EX and FDB interfaces are:**

- Profibus PA
- (0)4–20 mA
- RS232/RS485
- Foundation Fieldbus

You can find additional information on MSR systems (including MSR selection aid) in the OBO lightning protection guide (art. no. 9131970).

### 3.3 External lightning protection with high-voltage-resistant, insulated arrester

The OBO isCon<sup>®</sup> conductor prevents direct arcing between the arrester and the building to be protected. After the first potential connection behind the connection element, the isCon<sup>®</sup> conductor reflects an equivalent separation distance  $S_p$  of up to 0.9 metres in the air and up to 1.8 metres in solid substances according to VDE 0185-305-3. This means that installation is possible directly on metallic and electrical structures.



**Abb. 6:** isCon<sup>®</sup>Pro+ conductor on air-termination rod in Ex area

The OBO isCon<sup>®</sup>Pro+ conductor has been tested independently according to the following directives:

- ATEX
- IECEx

OBO manufacturer's declarations can be found at [www.obo-bettermann.com](http://www.obo-bettermann.com).



**Abb. 7:** Wall and pipe mounting: Internally routed isCon<sup>®</sup> arrester in air-termination rod in biogas plant

In Ex zones 1 and 21, after the first potential connection, the OBO isCon® Pro+ conductor should be connected at regular distances (0.5 metres) using a metallic cable bracket (e.g. isCon H VA or PAE) to the equipotential bonding. If there is a lightning strike, the equipotential bonding must not carry lightning current and must be in the protection angle of the lightning protection system.

OBO can offer the right air-termination and arrester system for every application. Chimneys, antenna masts, ventilation pipes, tanks and similar parts of the system can be protected using the OBO isCon® system with separated and isolated air-termination rods.

Type	Article number
isCon Pro+ 750 SW, length 25 m	5408002
isCon Pro+ 750 SW, length 100 m	5408004
isCon Pro+ 750 SW, length 250 m	5408006
isCon Pro+ 750 LGR, length 25 m	5407995
isCon Pro+ 750 LGR, length 100 m	5407997
isCon stripper 2	5408012
isCon connect	5408022
isCon PAE	5408036

Tab. 7: OBO isCon®Pro+ systems

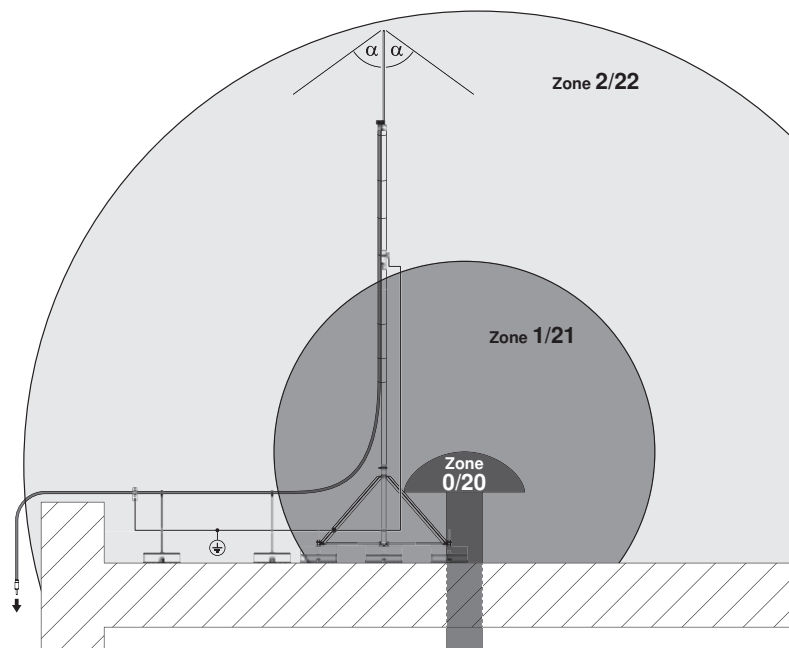


Abb. 8: Example of the installation of the isCon®Pro+ systems in the Ex zones of a potentially explosive area

### 3.4 Earthing systems

In potentially explosive areas, type B according to VDE 0185-305-3 (IEC 62305-3) is recommended for earthing systems.

In this special application, the arresting resistance must be as low as possible and may not reach 10 Ohm.

With the "Earthing Systems" module, the Construct online tool from OBO Bettermann makes efficient support available for project planning and documentation of type B (ring and foundation earthers) and type A (deep earthers) earthing systems.

## 4 Literature index:

- VDE 0185-305-1 (IEC 62305-1) – General principles
- VDE 0185-305-2 (IEC 62305-2) – Risk management
- VDE 0185-305-3 (IEC 62305-3) – Protection of buildings and humans
- VDE 0185-305-4 (IEC 62305-4) – Electrical and electronic systems within structures
- VDE 0185-561-3 (IEC 62561-3) – Requirements for spark gaps
- VDE 0185-56+1-3 (IEC 62561-1) – Requirements for lightning protection connection components
- TRBS 2152/2153
- IEC 60079-25 ( VDE 0170-1-6)
- IEC 60074-14 ( VDE 0165 Part 1)
- IEC 60079-25 ( VDE 0170-1-6)
- AfK recommendation no. 5
- Ordinance on Industrial Safety and Health (BetrSichV)
- BGR 104
- TRGS 509
- DVGW GW 24
- GefStoffV 2015
- OBO Construct Earthing
- OBO Lightning protection guide



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