UNDERSTANDING

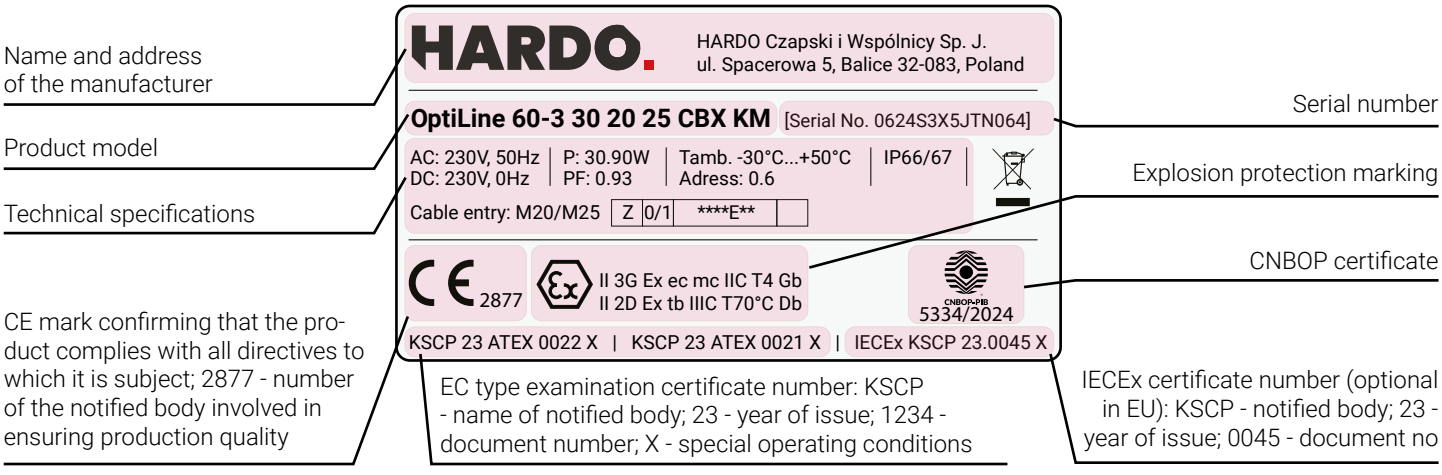
# EX MARKINGS

## GUIDE WITH EXAMPLES AND TASKS

II (1) 2G Ex db eb [ia Ga] IIC T4 Gb

HARDO.

## EXAMPLE OF NAMEPLATE FOR EX EQUIPMENT

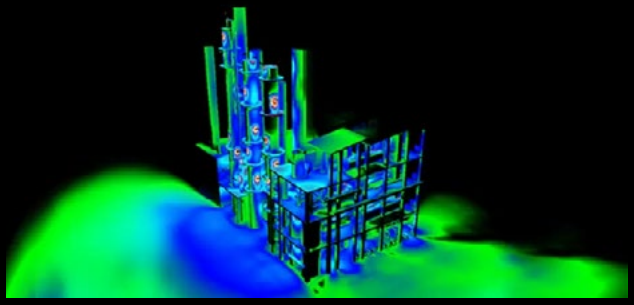


## LIGHTING FIXTURES AND DESIGNING





**Lens directing lens** [more option available]



**Ex / non-Ex LIGHTING**

**Ex CABLE GLANDS**

## ACCORDING TO CUSTOMER REQUIREMENTS

**Ex JUNCTION BOXES**

**Ex CONTROL PANELS AND CASSETTES**

## GASES / VAPOURS - EXAMPLE OF EX MARKING


| | |
|---|---|
| Ex | Explosion-proof device. |
| **II** [device group] | Equipment intended for explosive atmospheres excluding underground parts of mines. |
| **(1) 2G** [equipment category and hazard source: **G** - gases, **D** - dust] | Category 2 equipment designed for operation in zone 1 or 2 [(1) **2**G] caused by gases or vapours [(1) 2**G**]. |
| **(1) 2G** [category of equipment with which this equipment will be connected and source of danger: **G** - gases, **D** - dusts] | The equipment may be associated with a category 1 equipment [**(1)** 2G] designed to operate in zone 0 or 1 or 2 [**(1)** 2G] caused by gases or vapours [(1) 2**G**]. |
| **db eb** [type of explosion protection] | Equipment protected by combined protection. Eg. device protected by flameproof housing [**db** eb], junction box protected by increased safety [db **eb**]. Both protections provide a high level of safety [d**b** e**b**]. |
| **[ia Ga]** [type and level of explosion protection of the equipment with which it will be connected] | The device is designed to work with intrinsically safe devices [**ia** Ga] that are designed to operate in a gaseous atmosphere [ia **G**a] with a very high level of safety [i**a** G**a**]. |
| **IIC** [explosion subgroup (II - gases, III - dust)] | A device for use in atmospheres caused by hydrogen subgroup [**IIC**] gas. The equipment can also be used for ethylene group IIB and propane group IIA gases. |
| **T4** [temperature class (gases)] | The auto-ignition temperature of a gas forming an explosive atmosphere must be higher than 135°C [**T4**]. This can be, for example, ethylene, which has an auto-ignition temperature of 425°C. |
| **Gb** [equipment protection level according to EPP] | Equipment designed for gaseous atmospheres [**G**b] with a high level of safety [G**b**]. Designation according to the EPL (Equipment Protection Level) standard, which integrates the ATEX Directive with IEC standards for the designation of zones and categories for Ex equipment. |
| **PTB 09ATEX113** [certificate number] | The number of the type examination certificate - so called ATEX certificate (PTB - name of the notified body, 09 - year of issue of the certificate, ATEX - scope of certification, 113 - document number). |
| **X** [supplementary mark] | Supplementary mark. The letter 'X' indicates the specific conditions for safe use of the device as specified in the type-examination certificate. |

## DUSTS - EXAMPLE OF EX MARKING


| | |
|---|---|
| | Explosion-proof device. |
| **II** [device group] | Equipment intended for explosive atmospheres excluding underground parts of mines. |
| **3D** [equipment category with hazard source: **G** - gases, **D** - dust] | Category 2 equipment designed for operation in zone 22 [**3**D] caused by dust [3**D**]. |
| **tc** [type of explosion protection] | Device protected by a housing against dust ingress and a means of limiting surface temperature [**t**c]. The protection guarantees an increased level of safety [t**c**]. |
| **IIIB** [explosion subgroup (II - gases, III - dust)] | Device for use in atmospheres caused by non-conductive dusts [IIIB]. The equipment can also be used for volatile fibre agglomerates IIIA. |
| **T120°C** [maximum device surface temperature (dust)] | The glowing temperature of the dust layer concerned and the spontaneous ignition of the dust cloud - with appropriate safety margins - must be higher than the maximum permissible temperature value on the surface of the appliance, which in this case is 120°C. You can find the methods for calculating the safety margins in the section "TEMPERATURE CLASS - dust". |
| **Dc** [equipment protection level according to EPP] | A device designed for dusty atmospheres [**D**c] with an increased level of safety [D**c**] in accordance with the EPL (Equipment Protection Level) standard, which integrates the ATEX Directive with IEC standards for the designation of zones and categories for Ex equipment. |
| **BVS 07ATEX003*** [certificate number] | The number of the type-examination certificate known as the ATEX certificate (BVS - name of the notified body, 07 - year of issue, ATEX - scope of certification, 003 - document number). |
| **U** [supplementary mark] | Supplementary mark. The letter 'U' indicates that it is a certified component that must work with the complete system. |

*__NOTE:__ in most cases, category 3 electrical, non-electrical and combustion engine equipment and category 2 non-electrical equipment will not have a type-examination certificate (commonly referred to as ATEX certification). Thus, the explosion protection feature of these equipment may not include the number of this certificate. This is due to the fact that the conformity assessment process for such equipment does not require the involvement of a notified body, which issues such a certificate. The fact that, in the above example, the category 3 equipment has a certificate number means that the manufacturer has voluntarily decided to involve a notified body in the conformity assessment process.

| Supplementary signs | |
|---|---|
| **Symbol** | **Explanation** |
| No designation | The device may be operated without additional restrictions |
| X | The specific conditions for safe use indicated in the certificate must be complied with |
| U | A certified component cannot be used on its own, but only as part of a complete system |

## EQUIPMENT GROUP AND CATEGORY

Depending on whether we are dealing with equipment operating in a mining plant or in a non-mining plant (see equipment groups), equipment is given different categories. These indicate under which conditions (group I) or in which explosion hazard zone (group II) the equipment can be used.


### Equipment groups

| Group | Purpose of the device | Possible device categories | Application/Zone |
|---|---|---|---|
| I | Underground parts of mines | M1<br>M2 | See below |
| II | Facilities with explosive atmospheres excluding underground parts of mines | 1G<br>2G<br>3G<br>1D<br>2D<br>3D | 0 / 1 / 2<br>1 / 2<br>2<br>20 / 21 / 22<br>21 / 22<br>22 |

### Categories of equipment for <u>underground mines</u>

| | |
|---|---|
| **M1** | Equipment capable of operating even in the case of infrequent events affecting the equipment. The required level of protection will be provided in the event of two independent failures |
| **M2** | The sources of ignition associated with this equipment must not become active even under the most severe operating conditions, particularly those resulting from careless handling and changing environmental conditions. Equipment provided to shut down in the event of an explosive atmosphere |

### Categories of equipment for <u>facilities other than underground mines</u>

| | | |
|---|---|---|
| **1G** | Device designed for zones 0, 1 and 2 generated by gases or vapours. | **Very high** level of safety. The device does not cause any effective ignition sources even during rare malfunctions. |
| **1D** | Device designed for zones 20, 21 and 22 generated by dust. | |
| **2G** | Device designed for zones 1 and 2 generated by gases or vapours | **High** level of safety. The device does not cause any effective ignition sources even during an expected malfunction. |
| **2D** | Device designed for zone 21 and 22 generated by dust | |
| **3G** | Device designed for zone 2 generated by gases or vapours | **Enhanced** safety. The device does not cause any effective sources of ignition during normal operation. |
| **3D** | Device designed designed for zone 22 generated by dust | |

**NOTE:** in some cases, equipment may have different categories in different locations, e.g. a different one inside and a different one outside. An example would be a fan that, internally, has a category 2D (this means that there may be a zone 22 or 21 in the duct), while externally it has a category 3D (it may be installed in zone 22). As a result, the designation of such a fan will be as follows: 2/3D.

# TYPES OF EXPLOSION PROTECTION


## Electrical equipment - dust*

| Symbol | | Types of protection | Standard | The concept of protection | Category | Zone | EPP** |
|---|---|---|---|---|---|---|---|
| t | ta | Protection by means of "t" enclosure | EN 60079-31 | Protection against overheating and ingress of dust | 1D | 20 / 21 / 22 | Da |
| | tb | | | | 2D | 21 / 22 | Db |
| | tc | | | | 3D | 22 | Dc |
| p | px, pxb | Overpressure housing | EN 60079-2 | Protection against dust penetration through the use of a protective gas and overpressure control system inside the housing | 2D | 21 / 22 | Db |
| | py, pyb | | | | 2D | 21 / 22 | Db |
| | pz, pzc | | | | 3D | 22 | Dc |
| i | ia | Intrinsically safe version | EN 60079-11 | Limitation of ignition energy | 1D | 20 / 21 / 22 | Da |
| | ib | | | | 2D | 21 / 22 | Db |
| | ic | | | | 3D | 22 | Dc |
| m | ma | Encapsulation | EN 60079-18 | Isolation of the ignition source from the explosive atmosphere by means of encapsulation masses | 1D | 20 / 21 / 22 | Da |
| | mb | | | | 2D | 21 / 22 | Db |
| | mc | | | | 3D | 22 | Dc |
| op is | - | Radiation optical | EN 60079-28 | Limitation of optical power to safe values | 1D / 2D / 3D | 20 / 21 / 22 | Da / Db / Dc |
| op pr | | | | Radiation protection, e.g. by means of appropriate armouring | 2D / 3D | 21 / 22 | Db / Dc |
| op sh | | | | Blocking of optical radiation, e.g. due to detection of a damaged fibre | 2D / 3D | 21 / 22 | Db / Dc |

*Essential requirements: EN 60079-0
**The EPL (Equipment Protection Level) standard, which integrates the ATEX Directive with IEC standards for the designation of zones and categories for Ex equipment

## Electrical equipment - gases and vapours*

| Symbol | | Types of protection | Standard | The concept of protection | Category | Zone | EPP** |
|---|---|---|---|---|---|---|---|
| **d** | da | Flameproof enclosure | EN 60079-1 | Explosion-transmission protection, explosion-pressure resistant housing;<br>**da** - a very high degree of security<br>**db** - high safety<br>**dc** - increased safety | 1G | 0 / 1 / 2 | Ga |
| | db | | | | 2G | 1 / 2 | Gb |
| | dc | | | | 3G | 2 | Gc |
| **e** | eb | Increased safety | EN 60079-7 | Additional protective measures to prevent excessive heat, arcs and electrical sparks;<br>**eb** - high safety<br>**ec** - increased safety | 2G | 1 / 2 | Gb |
| | ec | | | | 3G | 2 | Gc |
| **i** | ia | Intrinsic safety | EN 60079-11 | Limiting the energy in the intrinsically safe circuit to a value that does not ignite the explosive atmosphere;<br>**ia** - very high degree of safety<br>**ib** - high safety<br>**ic** - increased safety | 1G | 0 / 1 / 2 | Ga |
| | ib | | | | 2G | 1 / 2 | Gb |
| | ic | | | | 3G | 2 | Gc |
| **m** | ma | Encapsulation | EN 60079-18 | Isolating the ignition source from the explosive atmosphere with encapsulating compounds or resin;<br>**has** - a very high degree of safety<br>**mb** - high safety<br>**mc** - increased safety | 1G | 0 / 1 / 2 | Ga |
| | mb | | | | 2G | 1 / 2 | Gb |
| | mc | | | | 3G | 2 | Gc |
| **nA** | nAc | Protection type "n" | EN 60079-15 | Prevention of arcs and electric sparks capable of igniting the atmosphere during normal use and under certain abnormal conditions | 3G | 2 | Gc |
| **nC** | nCc | | | Protection against the transmission of explosions or against the penetration of flammable gases, vapours, mists (shielded contacts, non-ignition-initiating components, sealing or encapsulation, etc.) | 3G | 2 | Gc |
| **nR** | nRc | | | Protection against the intrusion of flammable gases, vapours, mists - housing with breathing difficulties | 3G | 2 | Gc |
| **o** | ob | Liquid immersion | EN 60079-6 | Isolate the ignition source of the equipment from the explosive atmosphere by using a filling of non-combustible and non-heat-conducting liquid;<br>**ob** - high safety<br>**oc** - increased safety | 2G | 1 / 2 | Gb |
| | oc | | | | 3G | 2 | Gc |
| **p** | pxb, pyb | Pressurised enclosure | EN 60079-2 | Protection against the penetration of flammable gases, vapours and mists by means of a protective gas and overpressure control system;<br>**pxb** - high level of safety (non-Ex components inside the device, necessity to use additional safeguards in case of loss of overpressure)<br>**pyb** - high level of safety (necessity to use Ex components inside the device for min. zone 2)<br>**pzc** - increased safety (as in the case of pxb, but with some simplifications) | 2G | 1 / 2 | Gb |
| | pzc | | | | 3G | 2 | Gc |
| **op is** | - | Optical radiation | EN 60079-28 | Limitation of optical power to safe values | 1G, 2G, 3G | 0 / 1 / 2 | Ga, Gb, Gc |
| **op pr** | | | | Protection of optical radiation with elements constraints, e.g. appropriate fibre armouring | 2G, 3G | 1 / 2 | Gb, Gc |
| **op sh** | | | | Blocking of optical radiation, e.g. due to detection of a damaged fibre | 2G, 3G | 1 / 2 | Gb, Gc |
| **q** | qb | Powder filling | EN 60079-5 | The use of a filling of fine loose material to prevent flame transmission;<br>**qb** - high safety | 2G | 1 / 2 | Gb |

*Essential requirements: EN 60079-0
**The EPL (Equipment Protection Level) standard, which integrates the ATEX Directive with IEC standards for the designation of zones and categories for Ex equipment

**NOTE:** it may happen that the Ex marking of a given device contains marking that apply to another device. This is the case with so-called associated equipment (intrinsically safe barriers or separators), which is designed to work with other intrinsically safe electrical equipment (designation i / ia / ib / ic). It is worth emphasising that:

1. the units connected in this way can operate in the same or different explosion risk zones (both explosion-proof units),
2. the intrinsically safe device operates in a potentially explosive atmosphere (explosion-proof device) and the associated equipment operates in a potentially explosive atmosphere (normal equipment).

Importantly, the explosion protection feature of the associated equipment contains information about the equipment with which it may be combined. These are primarily the category (shown in round brackets) and the type of protection with its level (shown in square brackets) - see table below.

If the companion device is designed to:

1. assembly outside the hazardous area (non-Ex equipment), then all the markings in the explosion protection attribute on the nameplate of this equipment will refer to the intrinsically safe equipment with which it will be connected,
2. installation in a potentially explosive atmosphere, the category and type of protection, together with the level of protection for the equipment with which it may be connected, will appear in its Ex marking (these indications will be shown in brackets as indicated above).

## Example of Ex marking for connected devices [intrinsically safe device] <-> [associated device]

| Zone 0 | Zone 1 | Outside the Ex-zone |
|---|---|---|
| **II 1G Ex ia IIC T4 Ga**<br>Marking of intrinsically safe equipment | **II 2(1)G Ex d [ia Ga] IIC T4 Gb**<br>Marking of associated equipment | **II (1)G [Ex ia Ga] IIC**<br>Marking of associated equipment |
| **II 1G Ex ia IIC T4 Ga**<br>Marking of intrinsically safe device | | **II (1)G [Ex ia Ga] IIC**<br>Marking of associated equipment |

## Non-electrical equipment*

| Symbol | | Types of protection | Standard | The concept of protection | Zone | Category | EPP** |
|---|---|---|---|---|---|---|---|
| - | c | Security by design | EN 13463-5 | Elimination of ignition sources by means of appropriate construction methods | 1 | 2 | - |
| | Ex h | | ISO 80079-37 | | | | Gb |
| **Ex fr** | - | Protection by means of a restricted flow enclosure | EN 13463-2 | Isolating an ignition source from an explosive atmosphere | 2 | 3 | - |
| **d** | da | Protection by flameproof enclosure | EN 13463-3 PN-EN 60079-1*** | Explosion-proof, explosion-pressure resistant housing | 0, 1, 2 | 1 | - |
| | db | | | | 1, 2 | 2 | - |
| | dc | | | | 2 | 3 | - |
| - | b | Protection by controlling the ignition source | EN 13463-6 | Emergency detection system, control of ignition sources | 1, 2, 21, 22 | 2 | - |
| | Ex h | | ISO 80079-37 | | | | Gb |
| - | k | Liquid shielding | EN 13463-8 | Isolation of the ignition source from the explosive atmosphere by means of a cover made of non-combustible and non-heat-conducting liquid | 1 | 2 | - |
| | Ex h | | ISO 80079-37 | | | | Gb |
| **Ex p** | Ex pxb | Gas shield with overpressure | EN 13463-7 | Protection against the ingress of dust by means of a protective gas and overpressure control system inside the enclosure | 1, 2 | 2 | - |
| | Ex pyb | | EN 60079-2 | | 1, 2 | 2 | |
| | Ex pzc | | | | 2 | 3 | |
| **t** | Ex ta | Protection by "t" enclosure | EN 60079-31 | Protection against overheating and ingress of dust | 20, 21, 22 | 1 | - |
| | Ex tb | | | | 21, 22 | 2 | |
| | Ex tc | | | | 22 | 3 | |

* Essential requirements: EN 13463-1, ISO 80079-36 and EN 60079-0
** Based on ISO 80079-36, EPP designations will also apply to non-electrical equipment. Example: Therefore, a non-electrical device (c, b, k) mounted in zone 1 will have a marking, e.g. Ex h IIC T4 Gb, as well as ATEX II 2G
*** There are currently no plans to align EN 13463-2; EN 13463-3; EN 13463-7 with ISO 80079; in the absence of relevant standards, EN 60079-1 and EN 60079-2 may be used

## EXPLOSIVITY SUBGROUP

Group II equipment (facilities with explosive atmospheres excluding underground parts of mines) has in its ex marking information on the explosion subgroup of flammable liquids gases and vapours (IIA, IIB, IIC) and flammable dusts and fibres (IIIA, IIIB, IIIC).


## Explosion subgroup for gases and vapours of flammable liquids

Flammable gases and vapours of flammable liquids are assigned explosion subgroups IIA, IIB or IIC. They are determined, among other things, on the basis of the Maximum Experimental Safe Gap (MESG) test or the Minimum Ignition Current (MIC) test.

| Subgroup | MESG* value (mm) |
|---|---|
| IIA | ≥ 0,9 |
| IIB | > 0,5 but < 0,9 |
| IIC | ≤ 0,5 |

*MESG - Maximum Experimental Safe Gap - determined using a test instrument with a gap of 25 mm (a value relevant to flameproofed 'd' equipment).

| Subgroup | MIC* ratio value |
|---|---|
| IIA | > 0,8 |
| IIB | ≥ 0,45 but ≤ 0,8 |
| IIC | < 0,45 |

*MIC - Minimum Igniting Current - the spark gap described in EN 60079-11 should be used to determine this ratio (value relevant for intrinsically safe "i" equipment).

| How to select a device for the explosion subgroup of a flammable liquid gas or vapour | |
|---|---|
| IIA | An appliance with the IIA designation may be used in explosive atmospheres generated exclusively by gases and vapours of subgroup IIA. |
| IIB | A device with the IIB designation can be used in explosion risk areas generated by gases and vapours from subgroups IIA and IIB. |
| IIC | A device with the IIC designation can be used in explosion risk areas generated by gases and vapours from sub-groups IIA, IIB, IIC. |

**NOTE:** for gases and vapours of flammable liquids, the explosion subgroup can be found in EN ISO/IEC 80079-20-1 Explosive atmospheres. Part 20-1: material properties for the classification of gases and vapours. Test methods and tabular data, where you will find a table with results for more than two hundred substances. If necessary, you can also contact us so that we can check the parameters you are looking for in our databases.

If the above methods fail, in order to determine the explosion subgroup according to the said standard, it is necessary to perform:

1. Laboratory testing of the MIC (minimum ignition current),
2. Laboratory testing of the maximum experimental safety clearance (MESG), otherwise known as the minimum extinguishing gap,
3. definition of a subgroup based on similarity of chemical structure (so-called provisional classification).

To determine the explosive subgroup, it is usually sufficient to determine only one of the parameters (most often the MIC). Only if the result is borderline should it be confirmed by determining the other parameter.

## Explosion subgroup for dusts and fibres

Flammable gases and vapours of flammable liquids are assigned explosion subgroups IIA, IIB or IIC. They are determined, among other things, on the basis of the Maximum Experimental Safe Gap (MESG) test or the Minimum Ignition Current (MIC) test.

| Subsroup | Dust/fibre type |
|---|---|
| **IIIA Combustible dusts** | Solid particles containing fibres, of a nominal size of more than 500 µm, which give way under their own weight but are capable of remaining suspended in the air (e.g. rayon, cotton fibres) |
| **IIIB Non-conductive dust** | Combustible dusts with an electrical resistivity greater than 103 Ω·m |
| **IIIC Conductive dust** | Combustible dust with an electrical resistivity of not more than 103 Ω·m |

**NOTE:** in the case of dust/fibres, the explosive subgroup depends on the shape and size of the particles (volatile combustible fibres - subgroup IIIA) and on the electrical resistivity (IIIB - non-conductive dusts or IIIC - conductive dusts). The determination of these parameters is performed according to the provisions of EN ISO/IEC 80079-20-2:2016-05 Explosive atmospheres - Part 20-2: Material properties - Test methods for combustible dusts.

## TEMPERATURE CLASS AND MAXIMUM SURFACE TEMPERATURE

While in the case of most ignition sources that may occur in a device, the use of a given protection reduces the risk of ignition occurrence, this is not the case with temperature. The protection used does not reduce the risk of it occurring, but only limits it to a certain level. What level?

The next item in the explosion protection attribute informs us of this. In the case of dusts, the manufacturer provides a specific value for the maximum surface temperature, while in the case of gases and flammable liquid vapours, the temperature class to which the surface temperature of the device is assigned.

## TEMPERATURE CLASS (GASES)


| Temperature class | Permissible surface temperature of the appliance [°C] | Auto-ignition temperature of gas/vapour [°C] |
|---|---|---|
| T1 | 450 | > 450 |
| T2 | 300 | 300-450 |
| T3 | 200 | 200-300 |
| T4 | 135 | 135-200 |
| T5 | 100 | 100-135 |
| T6 | 85 | 85-100 |

Examples of gases and vapours of flammable liquids divided into temperature classes and additionally divided into explosion subgroups (IIA, IIB, IIC).

| Subsroup | Temperature classes - max. surface temperature | | | | | |
|---|---|---|---|---|---|---|
| | T1 - 450 [°C] | T2 - 300 [°C] | T3 - 200 [°C] | T4 - 135 [°C] | T5 - 100 [°C] | T6 - 85 [°C] |
| IIA Propane group | Acetone, ammonia, benzene, acetic acid, xylene, ethane, ethyl chloride, methanol, naphthalene, phenol, propane | Isoamyl acetate, n-butane, alcohol n-butyl | Petrol, oils diesel fuels, heating oils, n-hexane | Aldehyt acetic | | |
| IIB Ethylene group | Coal gas | Ethylene, ethylene oxide | Hydrogen sulphide | Ethyl ether | | |
| IIC Hydrogen group | Hydrazine, hydrogen | Acetylene | | | | Carbon disulphide |

**NOTE:** The temperature class of a device is determined by its manufacturer and is the maximum temperature that can occur on its surface under the most unfavourable operating conditions (e.g. highest ambient temperature, highest load on the device). If the device can reach different surface temperatures under different operating conditions, the manufacturer may specify different temperature classes in the cessation.

When selecting a device for use in a particular explosive atmosphere, we must compare its temperature class with the temperature class of the gas and/or vapour that can form an explosive atmosphere in that area. The temperature class of the gas or vapour in turn depends on its auto-ignition temperature. In other words, we have to select the equipment in such a way that the temperature at its surface, as expressed by its temperature class, does not exceed the auto-ignition temperature of the substance with which the equipment may come into contact.

## MAXIMUM SURFACE TEMPERATURE (DUST)

For temperature classes (gases and vapours of flammable liquids), the appliance manufacturer is obliged to apply a safety margin. On the other hand, in the case of maximum surface temperatures (dusts), you must take such margins into account yourself in the course of the following calculations. The lower value from the calculations must be taken into account for the selection of the appliance.


| Maximum permissible appliance surface temperature for dust | |
|---|---|
| For dust clouds | For dust layers |
| $T_{safe\ for\ cloud} = 2/3T_{cloud}$ | $T_{safe\ for\ 5mm\ layer} = T_{5mm} - 75°C$ |
| $T_{safe\ for\ cloud}$ temperature of vertical heated surfaces (inclined at an angle greater than 60° to the horizontal) | $T_{safe\ for\ 5mm\ layer}$ temperature of heated surfaces on which a layer of dust not exceeding 5mm may accumulate. |
| | Important: if the thickness of the dust layer exceeds 5 mm, an appropriate correlation showing the relationship between the maximum permissible surface temperature and the thickness of the dust layer must be used or tests must be carried out (as the thickness of the dust layer increases, the minimum ignition temperature of the dust layer decreases). |

Example dusts with ignition temperatures of the cloud and dust layer.

| Type of dust | Ignition temperature [°C] | |
|---|---|---|
| | cloud | layer |
| Aluminium | 650 | 760 |
| Iron | 320 | 310 |
| Zinc | 680 | 460 |
| Kakako | 510 | 200 |
| Phenolic resin | 580 | n.a. |
| Cellulose acetate | 470 | 400 |
| Sugar | 370 | 400 |

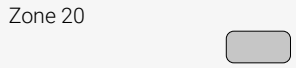
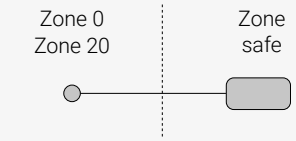
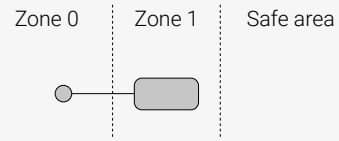
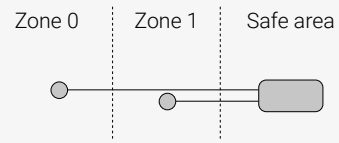
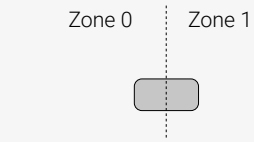
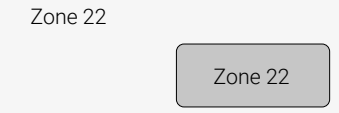
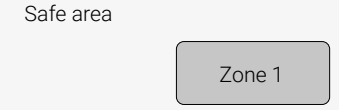
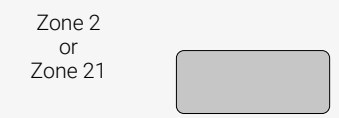
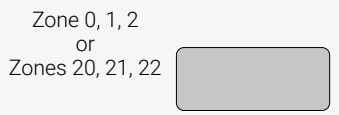
## LEVEL OF PROTECTION OF THE EPP DEVICE


| EN-60079 | ATEX Directive (2014/34/EU) | | | |
|---|---|---|---|---|
| **EPL** | **Group** | **Zone** | **Category** | **Security level** |
| Underground mining facilities | | | | |
| Ma | M1 | Not appli-cable | I | Very high level of safety. A device capable of operating even in the event of infrequent events involving these devices. The required level of protection will be provided in the event of two independent failures |
| Mb | M2 | | | High level of safety. The ignition sources associated with this equipment must not become active even under the most severe operating conditions, particularly those resulting from careless handling and varying environmental conditions. Equipment designed to shut down in the event of an explosive atmosphere |
| Plants other than mining - gas and/or vapour explosion hazards | | | | |
| Ga | 1G | 0 / 1 / 2 | II | Very high level of safety. The device does not cause any effective sources of ignition even during rare malfunctions. |
| Gb | 2G | 1 / 2 | | High level of safety. The device does not cause any effective ignition sources even during an expected malfunction. |
| Gc | 3G | 2 | | Enhanced safety. The device does not cause any effective sources of ignition during normal operation. |
| Plants other than mining - dust explosion hazards | | | | |
| Da | 1D | 20 / 21 / 22 | II | Very high level of safety. The device does not cause any effective sources of ignition even during rare malfunctions. |
| Db | 2D | 21 / 22 | | High level of safety. The device does not cause any effective ignition sources even during an expected malfunction. |
| Dc | 3D | 22 | | Enhanced safety. The device does not cause any effective sources of ignition during normal operation. |

# EXAMPLES

Learn from real-life examples showing how to read both simple and complex EX designations before moving on to solving tasks.

**NOTE:** the following examples focus on Group II equipment, i.e. equipment intended for use in plants other than underground mines. For simplicity exampples only take into account the group and the equipment category. This information allows you to select equipment for use in specific hazardous areas.

| Designation | Explanation | Where to use | |
|---|---|---|---|
| Ex II 1 D | Group II equipment for use outside mines, category 1 dust | Installation in zone 20 |  |
| Ex II (1) G D | Group II equipment, associated equipment, for use with category 1 dust and gas equipment | Mounting outside Ex zones, works with device mounted in zone 0 or 20 |  |
| Ex II 2 (1) G | Group II appliance, associated appliance category 2, for use with category 1 gas appliance | Mounted in zone 1, cooperates with device mounted in zone 0 (e.g. cooperating device mounted in zone 1) |  |
| Ex II (2) G (1) G | Group II appliance, associated equipment, for use with category 1 gas and category 2 gas appliance | Mounting outside the Ex-zone, works with device mounted in zone 1 and device mounted in zone 0 |  |
| II 1/2 G | Group II equipment, part of equipment category 1, part of category 2 gas | Mounting at zone boundaries, part of the unit operates in zone 0, part in zone 1 (e.g. sensor mounted in tank wall between zones 0 and 1) |  |
| II 3/3 D | Group II, category 3 device inside and outside the device | Mounting at zone boundaries, inside the unit zone 22, outside zone 22 (e.g. fan with zone 22 inside, mounted in zone 22) |  |
| II 2/- G | Group II, category 2 device inside | Mounting at zone boundaries, inside the unit zone 1, outside no Ex-zone (e.g. fan with zone 1 inside mounted outside Ex-zone) |  |
| II -/3 D | Group II, category 3 device outdoors | Non-explosive atmosphere equipment, Zone 22 installation (e.g. fan, non-explosive atmosphere switch mounted in Zone 22) |  |
| II 3 G<br>II 2 D | Group II, Category 3 gas and Category 2 dust equipment | Installation in zone 2 or zone 21 |  |
| GD | Protective system for use in gas/vapour/dust atmospheres | Installation in zone 0, 1, 2 or in zones 20, 21, 22 |  |

# TASKS

Check with the examples if you understand Ex marking correctly. Below you will find 3 exercises with precise explanations.

## Exercise 1

You are looking for a luminaire to work in a chemical industrial plant. It will be working in zone 2 of the explosion hazard caused by hydrogen. You know that this gas belongs to explosion subgroup IIC and temperature class T1. Which equipment can operate in these explosion risk conditions?

**Which device(s) is/are appropriate?**

| Device 1 | Device 2 | Device 3 |
|---|---|---|
| II 2 D Ex tb IIIC T70°C Db | II 3 D Ex tc IIIC T70°C Dc | II 3 D Ex tc IIIC T170°C Dc |
| II 3 G Ex ec IIC T4 Gc | II 2 G Ex eb IIC T2 Gb | II 3 G Ex ec IIA T1 Gc |

**Your solution:**

Check answer

## Answer:

Since we are dealing with a gaseous explosive atmosphere, we are only focusing on the second line of the designation, as it refers to gases and liquid vapours. Analysing the situation described, we know that the minimum requirements to be met by the equipment must be to be able to operate under the following conditions:

- gaseous explosive atmosphere,
- zone 2
- explosion sub-group IIC
- temperature class T1
- aTEX type examination certificate (zone 2) not required

### Device 1:

**II 3 G Ex ec IIC T4 Gc**

| | | |
|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 3 G | the device can operate in zone 2 of explosion hazard caused by the presence of gases or liquid vapours | ✓ |
| IIC | the equipment can handle all explosion sub-groups of gases and liquid vapours (IIA, IIB and IIC) | ✓ |
| T4 | means that the unit can handle gases and liquid vapours with the following temperature classes T1, T2, T3 and T4 | ✓ |

### Device 2

**II 2 G Ex eb IIC T2 Gb**

| | | |
|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 2 G | the device can operate in zone 1 and zone 2 of explosion hazard caused by the presence of gases or liquid vapours | ✓ |
| IIC | means that the device can work with all explosion sub-groups of gases and liquid vapours (IIA, IIB and IIC) | ✓ |
| T2 | means that the device can operate with gases and liquid vapours with the following temperature classes T1, and T2 | ✓ |

### Device 3

**II 3 G Ex ec IIA T1 Gc**

| | | |
|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 3 G | the device can operate in zone 2 of explosion hazard caused by the presence of gases or liquid vapours | ✓ |
| IIA | the equipment may only be used with substances in explosion group IIA of gases and vapours of liquids | ✗ |
| T1 | means that the unit can operate with gases and liquid vapours of temperature class T1 | ✓ |

## Exercise 2

Situation as in Task 1 except that, in addition to hydrogen, hydrogen sulphide may also be present in the working area of the luminaire. You will find the parameters of both gases in the table below. As a reminder, we are dealing with a Zone 2 explosion hazard and a non-mining industrial plant.

| | **Explosivity subgroup** | **Temp. class** |
|---|---|---|
| **Hydrogen** | IIC | T1 |
| **Hydrogen sulphide** | IIB | T3 |

**Which device(s) is/are appropriate?**

| **Device 1** | **Device 2** | **Device 3** |
|---|---|---|
| II 2 D Ex tb IIIC T70°C Db | II 3 D Ex tc IIIC T70°C Dc | II 3 D Ex tc IIIC T70°C Dc |
| II 3 G Ex ec IIC T4 Gc | II 2 G Ex eb IIC T2 Gb | II 3 G Ex ec IIA T1 Gc |

**Your solution:**

Check answer

## Answer:

Since we are dealing with a gaseous explosive atmosphere, we only focus on the second line of the designation, as it is the one that refers to gases and liquid vapours. since we are dealing with two gases this time, we have to choose the most demanding/unfavourable? parameters. Thus, analysing the situation described, we know that the minimum requirements to be met by the appliance must be to be able to operate under these conditions:

- gaseous atmosphere
- zone 2
- explosion subgroup IIC (hydrogen)
- temperature class T3 (hydrogen sulphide)
- aTEX type examination certificate (zone 2) not required

### Device 1:

**II 3 G Ex ec IIC T4 Gc**

| | | |
|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 3 G | the device can operate in zone 2 of explosion hazard caused by the presence of gases or liquid vapours | ✓ |
| IIC | means that the appliance can handle all explosion sub-groups of gases and liquid vapours (IIA, IIB and IIC) | ✓ |
| T4 | means that the unit can handle gases and liquid vapours with the following temperature classes T1, T2, T3 and T4 | ✓ |

### Device 2

**II 2 G Ex eb IIC T2 Gb**

| | | |
|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 2 G | the device can operate in zone 1 and zone 2 of explosion hazard caused by the presence of gases or liquid vapours | ✓ |
| IIC | means that the appliance can handle all explosion sub-groups of gases and liquid vapours (IIA, IIB and IIC) | ✓ |
| T2 | the device can operate with gases and vapours of the following temperature classes T1, and T2, but cannot be used with T3, T4, T5 and T6 | ✓ |

### Device 3

**II 2 G Ex eb IIC T2 Gb**

| | | |
|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 3 G | the device can operate in zone 2 of explosion hazard caused by the presence of gases or liquid vapours | ✓ |
| IIA | the device can only work with substances in explosion group IIA of gases and vapours of liquids (it cannot work with IIB and IIC substances) | ✗ |
| T1 | the unit can operate with gases and vapours of the following temperature classes T1 , but cannot be used with T2, T3, T4, T5 and T6 | ✓ |

## Exercise 3

You want to select a luminaire for a plant in the food industry. The luminaire will operate in a space where there may be a 22 explosion hazard zone caused by the presence of flour and sugar dust. You have carried out explosion tests on these dusts. Below you will find an extract from these tests:

| | Ignition temperature of the dust layer [5mm] | Flash point of the dust cloud | Explosivity subgroup |
|---|---|---|---|
| **Flour** | 460°C | 390°C | IIIB |
| **Sugar** | 430°C | 310°C | IIIB |

**Which device(s) is/are appropriate?**

| Device 1 | Device 2 | Device 3 |
|---|---|---|
| II 2 D Ex tb IIIC T70°C Db | II 3 D Ex tc IIIA T70°C Dc | II 3 D Ex tc IIIB T230°C Dc |
| II 3 G Ex ec IIC T4 Gc | II 2 G Ex eb IIC T2 Gb | II 3 G Ex ec IIA T1 Gc |

**Your solution:**

Check answer

## Answer:

Since we are dealing with a dust explosive atmosphere, we only focus on the first line of the designation. Analysing the situation described, we know that the minimum requirements to be met by the equipment must allow it to operate in such conditions:

- dusty atmosphere
- zone 22
- explosivity subgroup IIIB
- the maximum surface temperature of the appliance shall be less than 207°C
- aTEX type examination certificate (zone 22) not required

EXPLANATION: In order to calculate the maximum surface temperature of the device, we took the lower value of the ignition temperature of the dust layer (sugar - 430°C) and the ignition temperature of the dust cloud (sugar - 310°C), and presented them to the formulas below. After performing the calculations, we chose the lower of the results.

$T_{safe\ for\ 5mm\ layer} = T_{5mm} - 75°C$

$T_{safe\ for\ cloud} = 2/3 - T_{cloud}$

$T_{cloud} = 310\ °C - 2/3 \rightarrow 206\ °C$

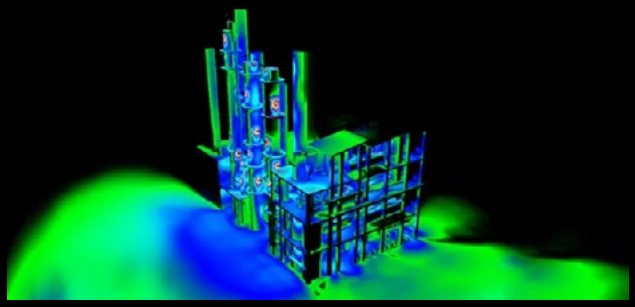
$T_{5mm} = 430°C - 430 - 75 \rightarrow 355\ °C$

**CONCLUSION:** the maximum permissible temperature of the external surface of the appliance must not exceed 206°C.

| Device 1: II 2 D tb IIIC T70°C Db | | | Device 2 II 3 D Ex tc IIIA T70°C Dc | | | Device 3 II 3 D Ex tc IIIB T230°C Dc | | |
|---|---|---|---|---|---|---|---|---|
| II | the luminaire can operate in all industrial plants other than mining | ✓ | II | the luminaire can operate in all industrial plants other than mining | ✓ | II | the luminaire can operate in all industrial plants other than mining | ✓ |
| 2 D | the device can operate in zones 21 and 22 of the danger of explosion caused by the presence of combustible dusts | ✓ | 3 D | the device can operate in zone 22 of the explosion hazard caused by the presence of combustible dusts | ✓ | 3 D | the device can operate in zone 22 of the explosion hazard caused by the presence of combustible dusts | ✓ |
| IIIC | means that the device can work with all dust explosion sub-groups (IIIA, IIIB and IIIC) | ✓ | IIIA | that the equipment can only work with substances in dust explosion sub-group IIIA | ✓ | IIIB | that the equipment can work with substances in dust explosion groups IIIA or IIIB | ✗ |
| T70°C | the maximum surface temperature of this device will not exceed 70°C, which is lower than 206°C | ✓ | T70°C | the maximum surface temperature of this device will not exceed 70°C, which is lower than 206°C | ✓ | T230°C | the maximum surface temperature of this device will not exceed 230°C, which is higher than 206°C | ✓ |

## LIGHTING FIXTURES AND DESIGNING


**Soczewki kierunkujące** [wybrane opcje]



**Ex / non-Ex LIGHTING**

**Ex CABLE GLANDS**

## ACCORDING TO CUSTOMER REQUIREMENTS

**Ex JUNCTION BOXES**

**Ex CONTROL PANELS AND CASSETTES**

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