

HOW TO READ

EX MARKINGS

GUIDE & WORKBOOK



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

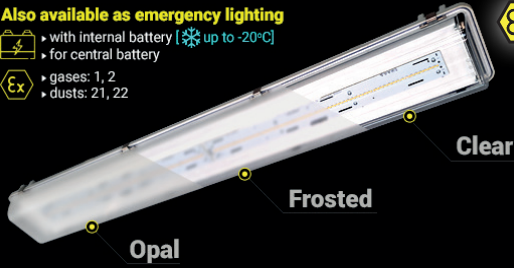
HARDO.

TAILORED LIGHTING SOLUTIONS & DESIGN

Also available as emergency lighting

- ▶ with internal battery [❄️ up to -20°C]
- ▶ for central battery

- ▶ gases: 1, 2
- ▶ dusts: 21, 22



Clear

Frosted

Opal

670 / 1276 mm



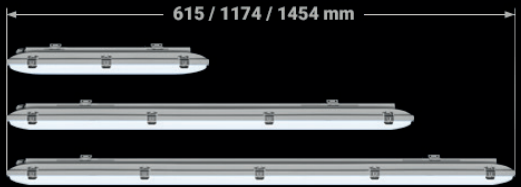
Also available as emergency lighting

- ▶ with internal battery
- ▶ for central battery

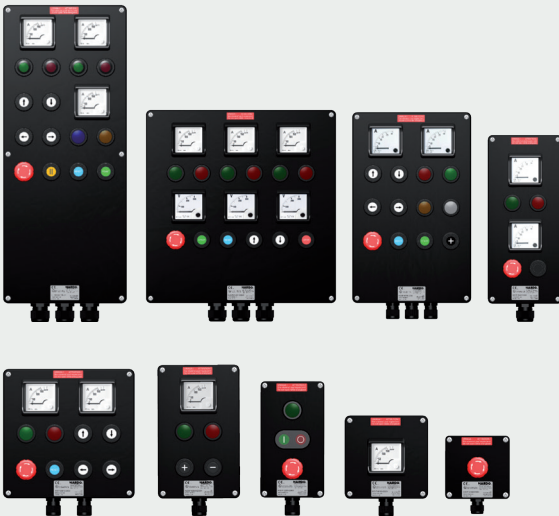
- ▶ **LOW**
- ▶ **DUST**
- ▶ **HUMIDITY**



615 / 1174 / 1454 mm



TERMINAL BOXES CONTROL STATIONS

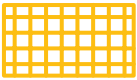


CABLE GLANDS & ACCESSORIES



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CLASSIFICATION OF EXPLOSION HAZARD ZONES*



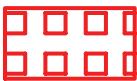
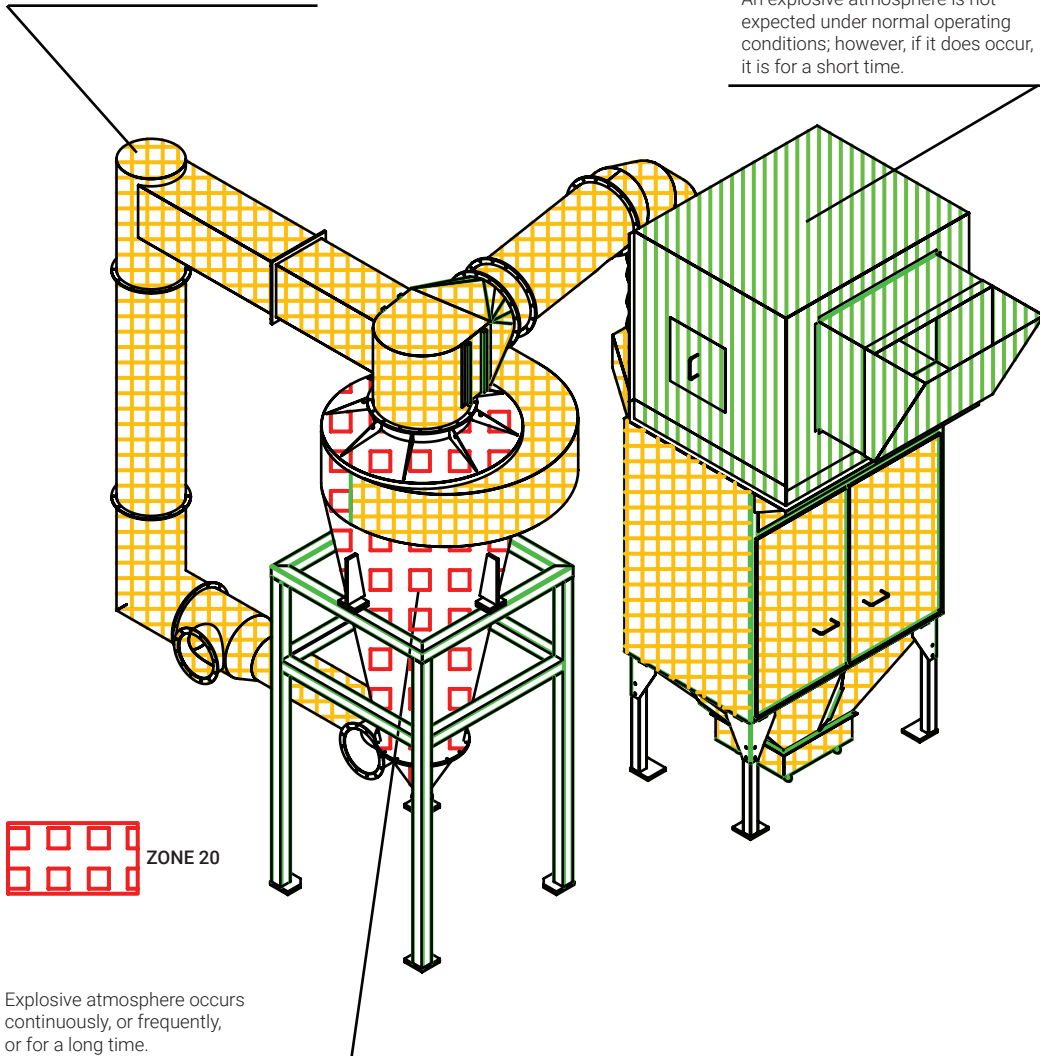
ZONE 21



ZONE 22

Explosive atmosphere can sometimes occur during normal operation.

An explosive atmosphere is not expected under normal operating conditions; however, if it does occur, it is for a short time.



ZONE 20

For vapors and gases, the explosion hazard zones are designated respectively as: 0, 1, 2.

*EN IEC 60079-10-1:2021-09 - Classification of areas - Explosive gas atmospheres.
EN 60079-10-2:2015-06 - Classification of areas - Explosive dust atmospheres.

ATEX DIRECTIVES

According to ATEX USER Directive (1999/92/EC), in explosive atmospheres, electrical and non-electrical equipment of the appropriate category must be used, selected according to the type of designated zone:

- **in Zone 0** – only category **1G** equipment
- **in Zone 1** – category **1G** or **2G** equipment
- **in Zone 2** – category **1G, 2G** or **3G** equipment
- **in Zone 20** – only category **1D** equipment
- **in Zone 21** – category **1D** or **2D** equipment
- **in Zone 22** – category **1D, 2D** or **3D** equipment

The device category is assigned by its manufacturer in accordance with the requirements of the ATEX Directive – 2014/34/EU.

Manufacturers of explosion-proof equipment may adopt various technical solutions to ensure that their devices do not become sources of ignition, thereby complying with the requirements of the ATEX Directive. Compliance is verified through appropriate markings on the label and the accompanying EU Declaration of Conformity issued by the manufacturer. Additionally, for Category 1 devices, as well as for internal combustion engines and Category 2 electrical equipment, manufacturers are required to obtain an EU-type examination certificate (the so called "ATEX certificate") from a notified body. In contrast, this certification is not mandatory for mechanical equipment or devices classified under Category 3.

EXAMPLE OF A LABEL FOR EX EQUIPMENT

HARDO HARDO Czapski i Wspólnicy Sp. J.
ul. Spacerowa 5, Balice 32-083, Poland

OptiLine 60-3 30 20 25 CBX KM [Serial No. 0624S3X5JTN064]

AC: 230V, 50Hz | P: 30.90W | Tamb. -30°C...+50°C | IP66/67 |

DC: 230V, 0Hz | PF: 0.93 | Address: 0.6

Cable entry: M20/M25 | Z 0/1 | ****E**

2877 II 3G Ex ec mc IIC T4 Gb
II 2D Ex tb IIIC T70°C Db

5334/2024

KSCP 23 ATEX 0022 X | KSCP 23 ATEX 0021 X | IECEx KSCP 23.0045 X

EC type examination certificate number:
KSCP – name of the notified body
23 – year of issue
0022 – document number
X – special conditions of use

Manufacturer's name and address

Product model

Technical parameters

Confirmation that the product complies with all applicable directives.

Number of the notified body responsible for ensuring production quality.

Serial number

Ex marking

Marking of a national/regional certification/approval body (optional)

IECEx certificate number (optional in EU):
KSCP – name of the notified body
23 – year of issue
0045 – document number

EXAMPLE OF EXPLOSION-PROOF MARKING – GASES / VAPORS



	Explosion-proof equipment.
II [equipment group]	Equipment intended for use in installations other than mining operations.
2(1)G [type of equipment category and explosive atmosphere: G - gases, D - dust]	Category 2 equipment intended for operation in gas [2G] Zone 1 or 2 [2G].
2(1)G [category of interconnected equipment and type of explosive atmosphere: G - gases, D - dust]	Equipment can be connected to a category 1 equipment intended for operation in Zone 0, 1, or 2, in a gas atmosphere classified as (1) 2G.
db eb [type of explosion protection]	Equipment features mixed explosion protection methods, e.g., a flameproof housing [db eb], a reinforced junction box [db eb]. Both provide a high protection level [db and eb].
[ia Ga] [type and level of explosion protection of interconnected equipment]	This equipment is designed to work with intrinsically safe equipment [ia], intended for use in gas atmospheres [Ga] with a very high protection level [Ga].
IIC [explosion group (II - gases, III - dusts)]	Equipment intended for use in an atmosphere induced by a hydrogen subgroup gas [IIC]. Can also be used for environments where ethylene group gases IIB and propane group IIA are present.
T4 [temperature class]	The ignition temperature of the gas forming the explosive atmosphere must be higher than 135 °C (T4).
Gb [Equipment Protection Level, EPL]	This equipment is designed for gas atmospheres [Gb] and guarantees a high protection level [Gb]. Marking in accordance with the Equipment Protection Level (EPL) standard, which integrates the ATEX Directive with IEC standards for determining explosion zones and Ex equipment categories.
PTB 09ATEX113 [certificate no.]	The number of the type examination certificate referred to as the ATEX certificate (PTB - name of the notified body, 09 - year of issue of the certificate, ATEX - scope of certification, 113 - document number).
X [supplementary marking]	Supplementary marking. The letter "X" indicates the special conditions for safe use of the device as specified in the type test certificate.

Supplementary marking	
Symbol	Meaning
No marking	This equipment can be used without any additional restrictions.
X	The specific conditions of safe use indicated in the certificate must be observed.
U	This certified component cannot be used independently, but only as part of a complete device.

EXAMPLE OF EXPLOSION-PROOF MARKING - DUSTS



	Explosion-proof equipment.
II [equipment group]	Equipment intended for use in installations other than mining operations.
3D [type of equipment category and explosive atmosphere: G - gases, D - dust]	Equipment designed to work in dust [3D] Zone 22 [3D].
tc [type of explosion protection]	Equipment with a „t” protection type (EPL Dc) for explosive dust atmospheres.
IIIB [explosion group (II - gases, III - dusts)]	Equipment intended for use in an atmosphere caused by non-conductive dust [IIIB]. It can also be used for agglomerations of volatile fibers IIIA.
T120°C [maximum equipment surface temperature < 120°C]	The glow temperature of a dust layer and the auto-ignition temperature of the dust cloud – with appropriate safety margins – must be higher than the maximum permissible surface temperature of the equipment – in this case 120 °C. For methods for calculating safety margins, see "Temperature Class – Dust."
Dc [Equipment Protection Level, EPL]	This equipment is designed for dust atmospheres [Dc] and guarantees an increased protection level [Dc] in accordance with the EPL standard, which integrates the ATEX Directive with IEC standards for determining explosion zones and Ex equipment categories.

*ATTENTION

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 an "ATEX certificate"). Therefore, the explosion-proof marking of such equipment may not include this certificate number. This is because the conformity assessment procedure for these types of equipment does not require the involvement of a notified body authorized to issue such certificates.

GROUP AND CATEGORY OF EQUIPMENT

Depending on whether the equipment is intended for use in a mining installation or in a non-mining environment (see equipment groups), different categories are assigned. These categories indicate the conditions under which the equipment may be used (Group I) or the explosion hazard zone applicable to its use (Group II).



Equipment groups

Group	Purpose	Possible categories	Application/Zone
I	Mining plants	M1 M2	See below
II	Plants other than mines	1G	0 / 1 / 2
		2G	1 / 2
		3G	2
		1D	20 / 21 / 22
		2D	21 / 22
		3D	22

Group I: Equipment categories for underground mining plants

M1 **Very high** protection level. Equipment does not produce any effective sources of ignition during normal operation or under expected fault conditions. The required protection level will be ensured in the event of two independent faults.

M2 **High** protection level. Equipment does not produce any effective sources of ignition during normal operation or under expected fault conditions. It must be switched off in the event of an explosive atmosphere.

Group II: Equipment categories for facilities other than underground mining plants

1G	This equipment is intended for gas or vapor zones 0, 1 and 2.	Very high protection level. This equipment does not create any effective sources of ignition even during rare malfunctions.
1D	This equipment is intended for dust zones 20, 21 and 22.	
2G	This equipment is intended for gas or vapor zones 1 and 2.	High protection level. This equipment does not create any effective sources of ignition even during expected malfunctions.
2D	This equipment is intended for dust zones 21 and 22.	
3G	This equipment is intended for gas or vapor Zone 2.	Increased protection level. This equipment does not create any effective sources of ignition during normal operation.
3D	This equipment is intended for dust Zone 22.	

ATTENTION: In some cases, equipment may have different equipment categories assigned to different parts, for example, one category for the internal components and another for the external parts. An example is a fan with a category 2D rating for its internal components (Zone 21 or 22 is allowed inside the duct), and a category 3D rating for its external parts (allowing installation in Zone 22). As a result, the marking of such a fan will be as follows: 2/3D.

TYPES OF EXPLOSION PROTECTION



Electrical equipment - dust*

Symbol	Protection type	Protection concept	Application	Category	Zone	EPL**	
t	ta	Protected by „t“ housing EN 60079-31	Protection against excessive temperature and dust ingress	Switching and control equipment, lighting fixtures, motors	1D	20 / 21 / 22	Da / Db / Dc
	tb				2D	21 / 22	Db / Dc
	tc				3D	22	Dc
p	pxb	Housing with overpressure EN 60079-2	Protection against dust ingress is achieved through the use of a protective gas and an overpressure control system inside the casing	Enclosures for switching and control devices, analyzers, large motors	2D	21 / 22	Db / Dc
	pyb				2D	21 / 22	Db / Dc
	pzc				3D	22	Dc
i	ia	Intrinsically safe design EN 60079-11	Ignition energy is limited to prevent the risk of explosion	Automation systems, communication devices, sensors, transmitters	1D	20 / 21 / 22	Da / Db / Dc
	ib				2D	21 / 22	Db / Dc
	ic				3D	22	Dc
m	ma	Hermetic housing EN 60079-18	Ignition source is isolated from the explosion atmosphere by hermetic sealing	Low-power switching equipment, fuses, control and signaling equipment, displays, sensors, solenoid valve coils	1D	20 / 21 / 22	Da / Db / Dc
	mb				2D	21 / 22	Db / Dc
	mc				3D	22	Dc
op is	Optical radiation EN 60079-28	Optical power is limited to safe levels to prevent ignition in explosive atmospheres	Optoelectronic equipment	1D / 2D / 3D	20 / 21 / 22	Da / Db / Dc	
op pr		Radiation protection, e.g. by using appropriate armor		2D / 3D	21 / 22	Db / Dc	
op sh		Blocking of optical radiation, e.g. when a damaged fiber is detected		2D / 3D	21 / 22	Db / Dc	

* Essential requirements can be found in EN 60079-0.

** In accordance with the EPL standard, which integrates the ATEX Directive with IEC standards for determining explosion zones and Ex equipment categories

Electrical equipment - gases and vapors*

Symbol		Protection type	Protection concept	Application	Category	Zone	EPL**
d	da	Flameproof housing EN 60079-1	Explosion containment: pressure-resistant housing prevents propagation	Switching, control, and signaling equipment; motors, transformers	1G/2G/3G	0/1/2	Ga/Gb/Gc
	db				2G/3G	1/2	Gb/Gc
	dc				3G	2	Gc
e	eb	Reinforced construction EN 60079-7	Additional protective measures to prevent excessive temperatures, flash arcs and electrical sparks	Junction boxes and connection enclosures, control panels, squirrel cage motors, lighting fixtures	2G/3G	1/2	Gb/Gc
	ec				3G	2	Gc
i	ia	Intrinsically safe design EN 60079-11	The energy in an intrinsically safe circuit is limited to a value that does not cause ignition of an explosive atmosphere	Automation systems, communication devices, sensors, transmitters	1G/2G/3G	0/1/2	Ga/Gb/Gc
	ib				2G/3G	1/2	Gb/Gc
	ic				3G	2	Gc
m	ma	Hermetic housing EN 60079-18	The ignition source is isolated from the explosive atmosphere using hermetic sealing	Low-power switching equipment, fuses, control and signaling equipment, displays, sensors, solenoid valve coils	1G/2G/3G	0/1/2	Ga/Gb/Gc
	mb				2G/3G	1/2	Gb/Gc
	mc				3G	2	Gc
nA			The occurrence of flash arcs and electrical sparks capable of igniting the explosive atmosphere during normal operation or under certain abnormal conditions is prevented		3G	2	Gc
nC		Type "n" protection EN 60079-15	Protection against explosion propagation or against the ingress of flammable gases, vapors or mists (shielded contacts, non-ignition elements, sealing or encapsulation, etc.)	Sockets, plugs, lighting accessories, motors	3G	2	Gc
nR			Equipment is protected against the ingress of flammable gases, vapors, and mists by a tight enclosure.		3G	2	Gc
o	ob	Liquid immersion EN 60079-6	The equipment's ignition source is isolated from the explosive atmosphere by means of a non-flammable, non-heat-conductive liquid filling	Transformers, control starter units	2G/3G	1/2	Gb/Gc
	oc				3G	2	Gc
p	pxb, pyb	Pressurization with protective gas EN 60079-2	Protection against the ingress of flammable gases, vapors and mists is achieved through the use of a protective gas and an overpressure control system	Enclosures for switching and control equipment, analyzers, large motors	2G/3G	1/2	Gb/Gc
	pzc				3G	2	Gc
op is			The optical power is limited to safe levels to prevent ignition in explosive atmospheres		1G/2G/3G	0/1/2	Ga/Gb/Gc
op pr		Optical radiation EN 60079-28	Protection against optical radiation is provided by limiting elements, such as appropriate optical fiber armoring	Optoelectronic devices	2G/3G	1/2	Gb/Gc
op sh			Blocking of optical radiation, e.g. when a damaged fiber is detected		2G/3G	1/2	Gb/Gc
q	qb	Protection by filling EN 60079-5	Fine, loose material is used as filling that prevents the transfer of flame;	Transformers, electronic ballasts, sensors, transmitters	2G	1/2	Gb/Gc

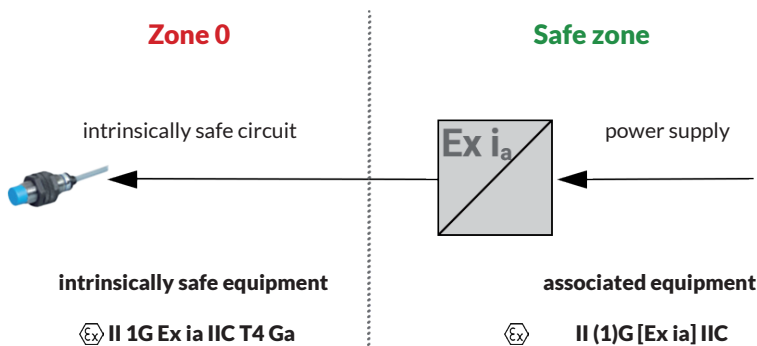
*Essential requirements can be found in EN 60079-0

** In accordance with the EPL standard, which integrates the ATEX Directive with IEC standards for determining explosion Zones and Ex equipment categories.

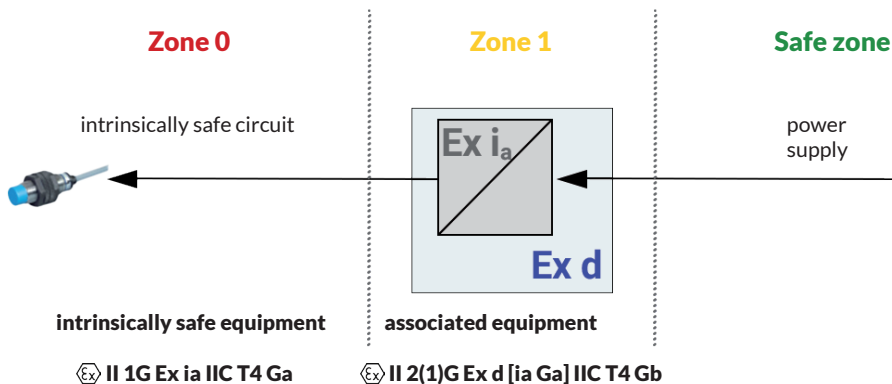
ATTENTION: in some cases, the explosion-proof marking on equipment may include references to other connected systems. This typically occurs with associated equipment, such as intrinsically safe barriers or isolators, which are intended to operate in conjunction with intrinsically safe electrical equipment (intrinsic barriers or separators). The task of these associated devices is to maintain voltage and current in the intrinsically safe circuit at such a low level that even if a spark occurs, the energy of this spark was too small to cause ignition of the explosive atmosphere. Associated equipment is also subject to the ATEX directive requirements.

See the two scenarios described below, with examples of marking of intrinsically safe equipment and associated equipment:

1. Intrinsically safe equipment operates in a hazardous areas (marked with explosion protection symbol "i"), while associated equipment operates in a non-hazardous areas (ordinary equipment).



2. Intrinsically safe equipment operates in a hazardous area (it is explosion-proof equipment "i"). The associated equipment is also installed in a hazardous area (the same or different) and has its own type of protection (such as explosion-proof equipment "d" or "e").



Non-electrical equipment*

Symbol	Protection type	Protection concept	Application	Category	Zone	EPL**	
h	c	Reinforced construction	Ignition sources are eliminated by appropriate construction methods	Clutches, belt and chain drives, fans, mills, pumps	1G / 2G / 3G 1D / 2D / 3D	0 / 1 / 2 20 / 21 / 22	Ga / Gb / Gc Da / Db / Dc
	b	Control of ignition sources	Emergency detection system and ignition source control	Slide bearings, pumps (including vacuum pumps), agitators			
	k	Liquid immersion	Equipment's ignition source is isolated from explosive atmosphere by a non-flammable, non-heat-conductive liquid filling	Transmissions			

* Essential requirements can be found in PN-EN 60079-0

** In accordance with the EPL standard, which integrates the ATEX Directive with IEC standards for determining explosion Zones and Ex equipment categories.

*** The level of protection (a, b or c) does not apply to the letter "h"; the type of protection used by the manufacturer (c, b or k) is not identifiable from the designation of the non-electric equipment "h". The manufacturer provides a description of the solution used in the instruction manual.

EXPLOSION GROUP

The explosion-proof marking of group II equipment (intended for use in facilities other than mining plants) includes the explosion group classification for flammable gases and vapors (IIA, IIB, IIC), as well as for flammable dusts and fibers (IIIA, IIIB, IIIC).



Explosion group for flammable gases and vapors

Flammable gases and liquid vapors are assigned explosion subgroups IIA, IIB or IIC. They are determined, among other factors, based on tests of the Maximum Experimental Safe Gap (MESG) and the Minimum Ignition Current (MIC).

Explosion group	MESG value* (mm)
IIA	≥ 0.9
IIB	0.5 < MESG < 0.9
IIC	≤ 0.5

*MESG (Maximum Experimental Safe Gap) is determined using a testing device with a 25 mm gap (value relevant for equipment in a flameproof enclosure "d").

Explosion group	MIC ratio value*
IIA	> 0.8
IIB	0.45 < MESG ≤ 0.8
IIC	< 0.45

*MIC – Minimum Igniting Current – a value relevant for intrinsically safe equipment („i”); it is determined using a spark gap as specified in EN 60079-11.

How to select equipment for the explosion group of a gas/vapor of a flammable liquid?

IIA	Equipment with the IIA marking can be used in explosion hazard Zones generated only by IIA gases and vapors.
IIB	Equipment with the IIB marking can be used in explosion hazard zones generated only by IIA and IIB gases and vapors.
IIC	Equipment with the IIC marking can be used in explosion hazard zones generated by group IIA, IIB and IIC gases and vapors.

ATTENTION: for flammable gases and liquid vapors, explosion group classification can be found in the standard EN ISO/IEC 80079-20-1 – Explosive Atmospheres, Part 20-1: Material Characteristics for Classification of Gases and Vapors – Test Methods and Data. This standard provides a table of test results for over 200 substances.

To determine the explosion group in accordance with the standard, follow this procedure:

1. Perform a laboratory test to determine the Minimum Igniting Current (MIC).
2. Perform a laboratory test to determine the Maximum Experimental Safe Gap (MESG), also known as the Minimum Extinguishing Gap.
3. Determine the explosion group based on the similarity of chemical structure (provisional classification).

In most cases, it is sufficient to determine only one of these parameters – typically the MIC. Only when the result is borderline should it be verified by determining the second parameter.

Explosion group for dust and fibers

In the case of dusts/fibers, the explosiveness group depends on both the shape and size of the particles (e.g., volatile combustible fibers are classified as group IIIA) and their electrical resistivity (group IIIB for non-conductive dusts, group IIIC for conductive dusts). These parameters are determined in accordance with EN ISO/IEC 80079-20-2:2016-05 – Explosive Atmospheres – Part 20-2: Material Properties – Test Methods for Combustible Dust.

Dust explosion group	Type of dust/fibers
IIIA Flammable dusts	Solid particles, containing fibers, with nominal dimensions greater than 500 µm, which settle under their own weight but may remain suspended in air (e.g. rayon fibers, cotton fibers)
IIIB Non-conductive dusts	Finely divided solid particles, 500 µm or less in nominal size, which may be suspended in air, may settle out of the atmosphere under their own weight, may burn or glow in air, and may form explosive mixtures with air at atmospheric pressure and normal temperatures.
IIIC Conductive dusts	Combustible dusts with electrical resistivity greater than 10 ⁹ Ω·m

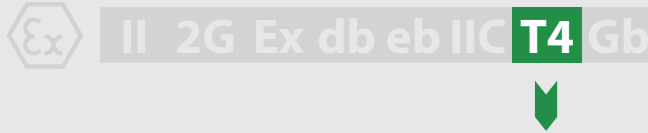
How to select equipment based on explosion subgroup

SUBSTANCE explosion group	EQUIPMENT'S admissible explosion group	SUBSTANCE explosion group	EQUIPMENT'S admissible explosion group
IIA	II, IIA, IIB or IIC	IIIA	IIIA, IIIB or IIIC
IIB	II, IIB or IIC	IIIB	IIIB or IIIC
IIC	II or IIC	IIIC	IIIC

TEMPERATURE CLASS AND MAXIMUM SURFACE TEMPERATURE

One of the more common sources of ignition is hot surfaces. To be able to select a device for work in a given explosive zone, we must check that its surfaces will not heat up above the ignition temperature of the substance that will create an explosive atmosphere in the zone.

TEMPERATURE CLASS (GASES)



It is the responsibility of the manufacturer of an explosion-proof equipment to specify the maximum temperature that can appear on the surface of the equipment under the most unfavorable operating conditions (at the maximum load and the highest permissible ambient temperature).

Group II devices (for gas zones) are assigned one of six temperature classes (T1-T6). Their classification depends on the **maximum temperature allowed at their surface**.

Gases and vapors of flammable liquids are also assigned temperature classes (T1-T6). Classification depends on the **auto-ignition temperature**.

Maximum surface temperature of the equipment	EQUIPMENT temperature class
450°C	T1
300°C	T2
200°C	T3
135°C	T4
100°C	T5
85°C	T6

Auto-ignition temperature of the substance	SUBSTANCE temperature class
≥ 450°C	T1
300 - 450°C	T2
200 - 300°C	T3
135 - 200°C	T4
100 - 135°C	T5
85 - 100°C	T6

When selecting equipment for use in an explosion hazard zone, its temperature class must be compared with the auto-ignition temperature of the gas or vapor that may form an explosive atmosphere in that zone. In other words, the equipment must be selected so that its maximum surface temperature, as indicated by its temperature class, does not exceed the auto-ignition temperature of any flammable substance present in the environment.

Auto-ignition temperature of the substance	SUBSTANCE temperature class
≥ 450°C	T1
300 - 450°C	T2
200 - 300°C	T3
135 - 200°C	T4
100 - 135°C	T5
85 - 100°C	T6



Admissible EQUIPMENT temperature class	Maximum surface temperature of the equipment
T1, T2, T3, T4, T5, T6	450°C
T2, T3, T4, T5, T6	300°C
T3, T4, T5, T6	200°C
T4, T5, T6	135°C
T5, T6	100°C
T6	85°C

Examples of flammable gases and liquid vapors divided into temperature classes and into explosion groups (IIA, IIB, IIC).

Gas explosion group	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, n-Butyl alcohol	Gasolines, diesel fuels, heating oils, n-Hexane	Acetic aldehyde		
IIB Ethylene group	City gas	Ethylene, ethylene oxide	Hydrogen sulfide	Ethyl ether		
IIC Hydrogen group	Hydrazine, hydrogen	Acetylene				Carbon disulfide

MAXIMUM SURFACE TEMPERATURE (DUST)

In the case of Group III equipment (for dust zones), the manufacturer explicitly specifies in the marking the maximum temperature that can occur on the surface of the equipment (e.g., 120°C).



When selecting equipment for operation in a dust explosion hazard zone, it is necessary to compare its maximum surface temperature, as specified by the manufacturer, with the permissible safe temperature of the combustible dust.

The parameters needed to determine the permissible surface temperature of equipment and devices that can be permitted to work in dust hazardous areas are:

- minimum ignition temperature of the dust cloud, T_{cloud}
- minimum ignition temperature of a 5mm dust layer, $T_{5\text{mm}}$

The temperature of the vertical heated surfaces of equipment and devices (inclined at more than 60° with respect to the horizontal) must not exceed 2/3 of the value of the minimum ignition temperature of the dust cloud (T_{cloud}).

The maximum permissible temperature of the surface of equipment inclined not more than 60° from the horizontal, on which a layer of dust can form, is determined taking into account the thickness of this layer. If the dust layer is below 5 mm then the surface temperature should not exceed a value at least 75°C lower than the minimum ignition temperature of the layer, $T_{5\text{mm}}$.

If the thickness of the layers of settled dust will exceed 5 mm, the maximum permissible surface temperature of the equipment should be reduced in accordance with the recommendations of the in EN 60079-14:2014 standard.

Maximum surface temperature of equipment for dust	
For dust clouds	For dust layers
$T_{max} = 2/3 T_{cloud}$	$T_{max} = T_{5mm} - 75^{\circ}C$
T_{max} refers to vertical heated surfaces (angled more than 60° from horizontal).	T_{max} refers to the temperature of heated surfaces where a dust layer no thicker than 5 mm may accumulate.
	Important: if the dust layer thickness exceeds 5 mm, an appropriate correlation must be applied to determine the relationship between the maximum permissible surface temperature and the dust layer thickness, or suitable laboratory tests must be conducted. As the dust layer becomes thicker, its minimum ignition temperature decreases, thereby increasing the risk of ignition.

ATTENTION: The parameters of flammability and explosiveness of dust depend on its fineness, moisture content, and its additives (even in small amounts), etc. Sometimes in different places of the installation the same dust can have different explosive properties due to differences in fineness or moisture content. The actual values of dust parameters may therefore vary during the process from those given in the table.

Dust type	Ignition temperature	
	Cloud	Layer
Aluminum	650°C	760°C
Iron	320°C	310°C
Zinc	680°C	460°C
Cocoa	510°C	200°C
Phenolic resin	470°C	400°C
Sugar	370°C	400°C

EQUIPMENT PROTECTION LEVEL (EPL)





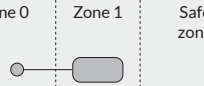
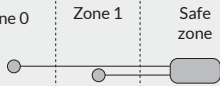

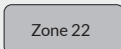
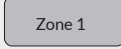
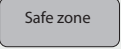
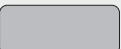
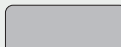
EPL (Equipment Protection Level) is the protection level assigned to a device. It is based on the probability that the device will become a source of ignition and the characteristic differences between explosive atmospheres (gas, dust and those found in a mine).

EN-60079	ATEX Directive (2014/34/EU)			
EPL	Group	Zone	Category	Protection level
Underground mining plants				
Ma	I	n/a	M1	Very high protection level. Equipment designed to remain operational even during rare events affecting it. The required protection level will be ensured in the event of two independent faults.
Mb			M2	High protection level. Ignition sources associated with this equipment must not be activated even under the most severe operating conditions, particularly those resulting from rough handling and changing environmental conditions. This equipment is designed to be switched off in the event of an explosive atmosphere.
Non-mining plants - risk of gas and/or vapor explosion				
Ga	II	0 / 1 / 2	1G	Very high protection level. This equipment does not create any effective sources of ignition even during rare malfunctions.
Gb		1 / 2	2G	High protection level. This equipment does not create any effective sources of ignition even expected malfunctions.
Gc		2	3G	Increased protection level. This equipment does not create any effective sources of ignition during normal operation.
Non-mining plants - dust explosion hazard				
Da	II	20 / 21 / 22	1D	Very high protection level. This equipment does not create any effective sources of ignition even during rare malfunctions.
Db		21 / 22	2D	High protection level. This equipment does not create any effective sources of ignition even expected malfunctions.
Dc		22	3D	Increased protection level. This equipment does not create any effective sources of ignition during normal operation.

EXAMPLES

Before you start working on the exercises,
learn from real examples how to read both simple and complex Ex markings.

The examples below focus on group II equipment, i.e., equipment intended for use in environments other than underground mining plants. For simplicity, only group II and the corresponding equipment category are considered. This information will help in selecting appropriate equipment for use in specific explosion hazard zones.

Marking	Meaning	Purpose of the equipment	
Ex II 1 D	Group II equipment, dust category 1	Installed in Zone 20	
Ex II (1) G D	Group II associated equipment, suitable for connecting to category 1 gas and dust equipment	Installed outside the Ex Zone, but compatible with equipment installed in Zone 0 or Zone 20	
Ex II 2 (1) G	Group II associated equipment, suitable for connecting to category 2 gas equipment	Installed in Zone 1, compatible with equipment located in Zone 0 (e.g., as an associated equipment installed in Zone 1)	
Ex II (2) G (1) G	Group II associated equipment, suitable for connecting to category 1 and 2 gas equipment	Installed outside the Ex zone, but suitable for connecting to equipment located in Zone 0 and Zone 1	
II 1/2 G	Group II equipment, with parts classified under gas category 1 and category 2	Installed at the boundary between zones: one part of the equipment operates in Zone 0, the other in Zone 1	
II 3/3 D	Group II, category 3 equipment inside and outside the equipment	Installed at the boundary between zones, with Zone 22 present both inside and outside the equipment (e.g., a fan with an internal Zone 22 atmosphere, installed in Zone 22)	
II 2/- G	Group II, category 2 equipment inside the equipment	Installed at the boundary between zones, with Zone 1 present inside the equipment, and no Ex zone outside (e.g., a fan with an internal Zone 1, installed outside the Ex zone)	
II -/3 D	Group II, category 3 equipment outside the equipment	Non-explosive atmosphere inside; suitable for installation in Zone 22 (e.g., a fan installed in Zone 22 that moves non-explosive atmosphere)	
II 3 G II 2 D	Group II, category 3 gas and category 2 dust equipment	Installed in Zone 2 or 21	
GD	Protection system for use in gas/vapor/dust atmospheres	Installed in Zone 0, 1, 2 or 20, 21, 22	

EXERCISES

Check if you can read the Ex markings using the examples.
Below you will find three exercises with detailed explanations.

Answer:

Since this is an explosive gas atmosphere, we focus exclusively on the second line of the marking, as it pertains to gases and flammable liquid vapors. Based on the described situation, the minimum requirements that the luminaire must meet should ensure safe operation under the following conditions:

- Gas explosion hazard atmosphere
- Zone 2
- Explosion group IIC
- Temperature class T1
- ATEX type examination certificate (Zone 2) not required

Luminaire 1:

II 3G Ex ec IIC T4 Gc

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
3G	The luminaire is suitable for use in <u>gas or liquid</u> vapor explosion hazard <u>Zone 2</u>	✓
IIC	The luminaire is suitable for use with all explosion groups of gases and liquid vapors (IIA, IIB and IIC)	✓
T4	The luminaire is suitable for use in the presence of gases and liquid vapors of the following temperature classes: <u>T1</u> , T2, T3 and T4	✓

Luminaire 2

II 2G Ex eb IIC T2 Gb

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
2G	The luminaire is suitable for use in <u>gas or liquid vapor explosion hazard Zone 1 and Zone 2</u>	✓
IIC	The luminaire is suitable for use with <u>gases and liquid vapors of all explosion hazard groups (IIA, IIB and IIC)</u>	✓
T2	The luminaire is suitable for use with gases and liquid vapors of the following temperature classes: <u>T1</u> , and T2	✓

Luminaire 3

II 3G Ex ec IIA T1 Gc

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
3G	The luminaire is suitable for use in <u>explosion hazard Zone 2 caused by gases or vapors</u>	✓
IIA	The luminaire is suitable for use <u>only with gas and vapors of IIA group</u>	✗
T1	The luminaire is suitable for use with gases and liquid vapors of temperature class <u>T1</u>	✓

ANSWER: Luminaire 1 and 2 meet all the requirements. Luminaire 3 is not suitable for use in explosion subgroup IIC.

Answer:

Since this is an explosive gas atmosphere, we focus only on the second line of the symbol, because it relates to gases and liquid vapors. This time we are dealing with two gases. Therefore, when selecting a device we have to choose the most stringent parameters. Therefore, in this situation the minimum requirements that the equipment must meet should ensure safe operation under the following conditions:

- Gas atmosphere,
- Zone 2,
- Explosion group IIC (hydrogen),
- Temperature class T3 (hydrogen sulfide),
- ATEX type examination certificate (Zone 2) not required

Luminaire 1:

II 3 G Ex ec IIC T4 Gc

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
3G	The luminaire is suitable for use in <u>gas or liquid</u> vapor explosion hazard <u>Zone 2</u>	✓
IIC	The luminaire is suitable for use with all explosion groups of gases and liquid vapors (IIA, IIB and IIC)	✓
T4	The luminaire is suitable for use in the presence of gases and liquid vapors of the following temperature classes: <u>T1</u> , T2, T3 and T4	✓

Luminaire 2

II 2 G Ex eb IIC T2 Gb

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
2G	The luminaire is suitable for use in <u>gas or liquid vapor explosion hazard Zone 1 and Zone 2</u>	✓
IIC	The luminaire is suitable for use with <u>gases and liquid vapors of all explosion hazard groups (IIA, IIB and IIC)</u>	✓
T2	The luminaire is suitable for use with gases and liquid vapors of the following temperature classes: <u>T1</u> , and T2, but <u>cannot be used with T3, T4, T5 and T6</u>	✗

Luminaire 3

II 2 G Ex eb IIC T2 Gb

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
3G	The luminaire is suitable for use in <u>gas or liquid</u> vapor explosion hazard <u>Zone 2</u>	✓
IIA	The luminaire is suitable for use only with substances from the gas and liquid vapor explosion <u>group IIA (unfit for IIB and IIC substances)</u>	✗
T1	The luminaire is suitable for use with gases and vapors of temperature class <u>T1</u> , but is <u>unfit for T2, T3, T4, T5 and T6</u>	✗

ANSWER: Only Luminaire 1 meets all the requirements. Luminaires 2 and 3 are not suitable for use with substance temperature class T3. Additionally, Luminaire 3 is not suitable for use with explosion group IIC.

Answer:

Since this is an explosive dust atmosphere, we focus solely on the first line of the marking, which pertains to dust protection. Therefore, the minimum requirements the device must meet should ensure safe operation under the following conditions:

- Dust atmosphere
- Zone 22
- Explosion group IIIB
- The maximum surface temperature of the equipment should be below 206°C
- ATEX type examination certificate (Zone 22) not required

EXPLANATION: To determine the maximum permissible surface temperature of the device, we considered both the dust layer ignition temperature (sugar: 430 °C) and the dust cloud ignition temperature (sugar: 310 °C). Next, we applied the appropriate safety formulas, and selected the lower output value:

$$T_{\max 5\text{mm}} = T_{5\text{mm}} - 75^{\circ}\text{C}$$

$$T_{\max \text{cloud}} = 2/3 \times T_{\text{cloud}}$$

$$T_{\max \text{cloud}} = 310^{\circ}\text{C} \times 2/3 \rightarrow 206^{\circ}\text{C}$$

$$T_{\max 5\text{mm}} = 430^{\circ}\text{C} - 75^{\circ}\text{C} \rightarrow 355^{\circ}\text{C}$$

CONCLUSION: the maximum allowable temperature of the external surface of the device must not exceed 206°C.

Luminaire 1:

II 2 D tb IIIC T70°C Db

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
2D	The luminaire is suitable for <u>dust</u> explosion hazard Zone 21 and <u>22</u>	✓
IIIC	The luminaire is suitable for use with all dust explosion groups (IIIA, IIIB and <u>IIIC</u>)	✓
T70°C	Maximum surface temperature of this equipment will not exceed <u>70°C</u> , which is lower than 206°C	✓

Luminaire 2

II 3 D Ex tc IIIA T70°C Dc

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
3D	The luminaire is suitable for <u>dust</u> explosion hazard Zone <u>22</u>	✓
IIIA	The luminaire is suitable for use <u>only</u> with dust explosion group <u>IIIA</u>	✗
T70°C	Maximum surface temperature of this equipment will not exceed <u>70°C</u> , which is lower than 206°C	✓

Luminaire 3

II 3 D Ex tc IIIB T230°C Dc

II	The luminaire is suitable for use in <u>all industrial facilities except those related to mining</u>	✓
3D	The luminaire is suitable for <u>dust</u> explosion hazard Zone <u>22</u>	✓
IIIB	The luminaire is suitable for use with dust explosion groups IIIA or <u>IIIB</u>	✓
T230°C	Maximum surface temperature of this equipment will not exceed <u>230°C</u> , which is higher than 206°C	✗

ANSWER: Only Luminaire 1 meets all the requirements. Luminaire 2 is not suitable for explosion group IIIB, while the maximum surface temperature of Luminaire 3 exceeds the calculated value of 206°C.



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