SOME HISTORY

The classification of hazardous areas into zones established the level of protection required for electrical equipment installed in explosive gas and dust atmospheres.

The two following standards define the areas:

IEC-EN 60079-10-1: Classification of areas, explosive gas atmospheres

IEC-EN 60079-10-2: Classification of areas, combustible dust atmospheres

The selection and construction of electrical installations is defined by standard IEC-EN 60079-14.

DEFINITION OF A PLACE WHERE A POTENTIALLY EXPLOSIVE ATMOSPHERE MAY OCCUR

The classification of an installation into distinct zones has two objectives (according to ATEX 1999/92/EC):

- To define the categories of equipment used in the zones indicated, provided they are suitable for gases, vapours or mists and/or dusts.
- To classify hazardous places into zones to prevent ignition sources and be able to select the correct electrical and non-electrical equipment accordingly. The zones are defined on the basis of the occurrence of explosive gaseous or dusty atmospheres.

GAS GROUPS

Group II : Equipment intended for use in places with an explosive gas atmosphere other than mines susceptible to firedamp.

Group I : Equipment intended for use in mines susceptible to firedamp.

	Zone	*Category (ATEX 2014/34/EU)*	*Presence of explosive atmospheres*
Group II	zone **0**	**1 G** (1)	**Continuous**, **frequent** or for long periods
	zone **1**	**2 G**	**Intermittent** in normal operation (**likely**)
	zone **2**	**3 G**	**Occasional** or for short periods (never in normal operation)
Group I (mines)		**M1** (1)	**Presence** (methane, dust)
		M2	**Risk of presence** (methane, dust)

DUST GROUPS (IEC 60079-0)

Group III : Equipment intended for use in places with an explosive dust atmosphere other than mines susceptible to firedamp.

	Zone	*Category (ATEX 2014/34/EU)*	*Presence of explosive atmospheres*
Group III	zone **20**	**1 D** (1)	**Continuous**, **frequent** or for long periods (air/cloud of combustible dust)
	zone **21**	**2 D**	**Intermittent** in normal operation
	zone **22**	**3 D**	**Occasional** or for short periods

The classification of the installation is **the responsibility of the user.** He must individually evaluate each installation to determine the differences between them.

Separate assessments must be made for places with potentially explosive atmospheres caused by gases or vapours and for those caused by dusts.

EQUIPMENT PROTECTION LEVELS - EPLs

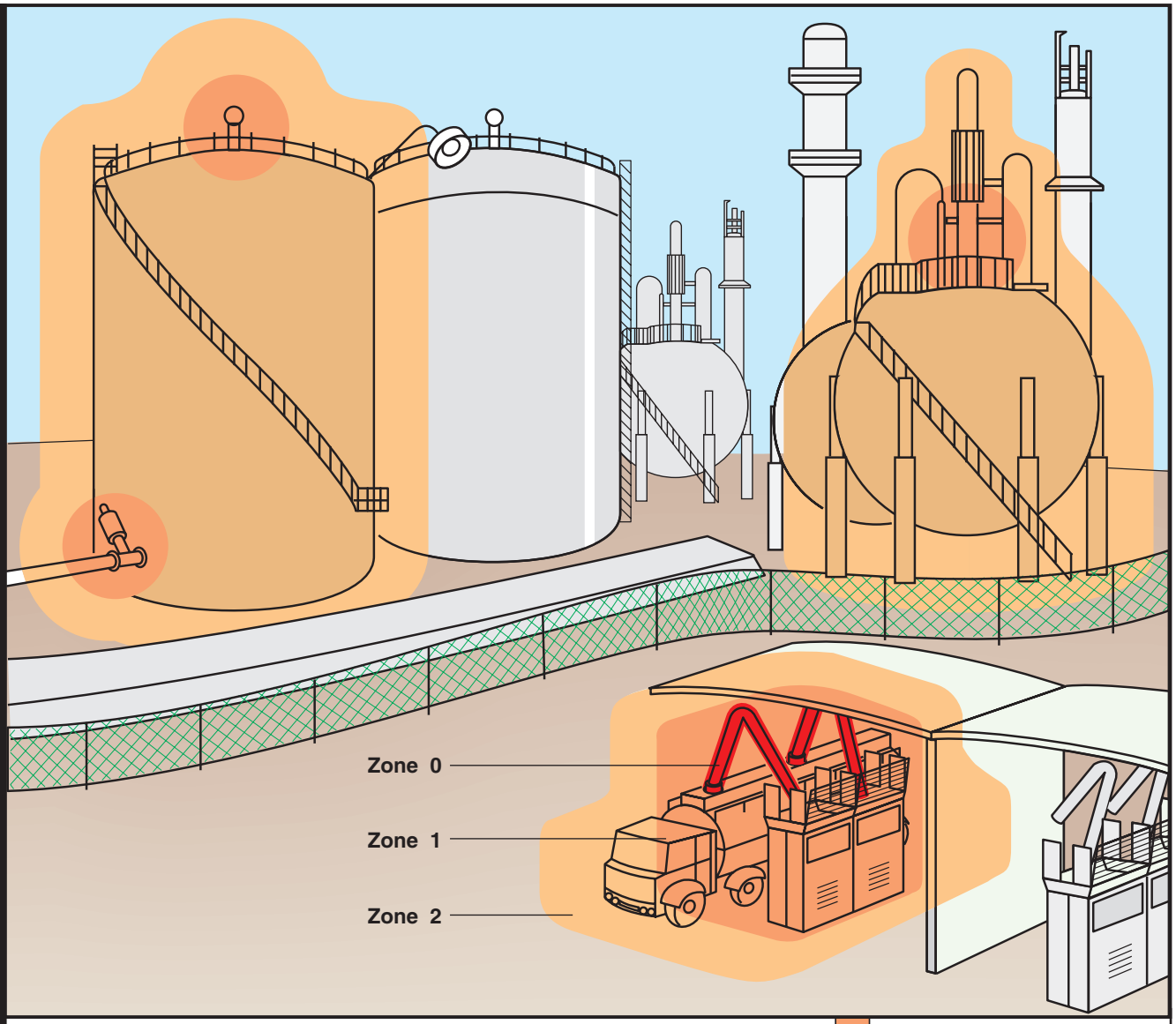
In normal circumstances the effect of the EPLs will be to retain the normal zone/equipment protection relationship. If, however, the risk is considered especially severe, then the required EPL for the zone may be increased. Similarly, if the risk is deemed to be especially small or negligible, the EPL may be reduced from the norm.

The following table shows the normal relationship between EPL and zone/category (without supplementary risk assessment).

Equipment Protection Level (EPL)	Normal Applicable Zone(s)	Category (2014/34/EU)
Ga	0 (and 1 and 2)	1G
Gb	1 (and 2)	2G
Gc	2	3G
Da	20 (and 21 and 22)	1D
Db	21 (and 22)	2D
Dc	22	3D
Ma / Mb	mines	M1 / M2

(1) G = gas ; D = dust ; M = mines

A



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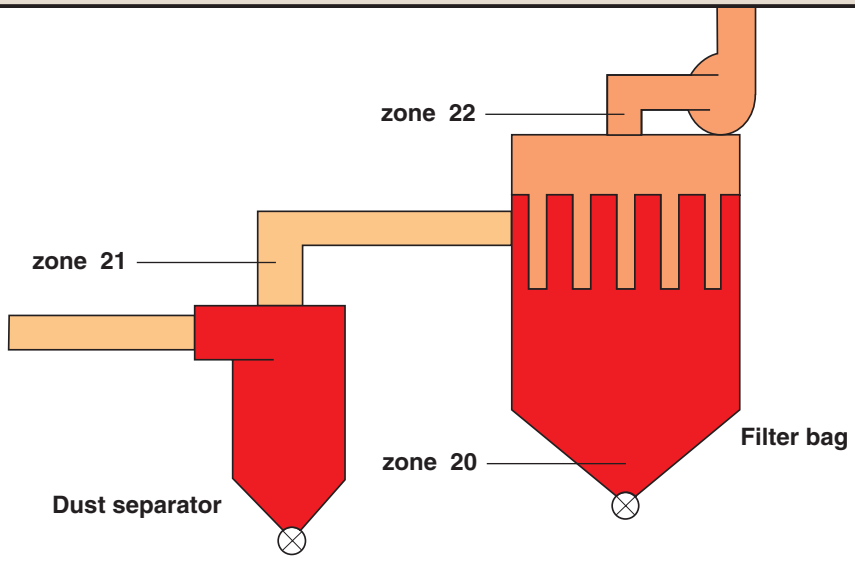


EXAMPLES OF A CLASSIFICATION INTO ZONES

Drawing A of an explosive atmosphere caused by gas:
Drawing B of an explosive atmosphere caused by dust:

Zone 0 | Zone 1 | Zone 2
Zone 20 | Zone 21 | Zone 22

Above drawings **A** *and* **B** *are an example only and must not be used as a model for an actual plant whose design is, in every case, the responsibility of the constructor and operator.*

HOW CAN ATEX, EN-IEC 60079-0 OR EN 13463-1 APPROVED APPARATUS FOR USE IN EXPLOSIVE ATMOSPHERES BE IDENTIFIED?

Conformity to the European Directives, ***CE marking.***

Identification number of the Notified Body *issuing the EC type-examination* ***certificate*** *(Example: 0081 = LCIE).*

Epsilon x *marking for equipment for use in explosive atmospheres.*

I : Mines II : Surface industries

Categories : 1 (zone 0) - 2 (zone 1) - 3 (zone 2)

Mines : M1 M2
Gas : G
Dusts : D

Specific symbol for explosion-proof protection according to EN / IEC

TYPES OF PROTECTION

Electrical apparatus, gas atmospheres:
"d": Flameproof enclosure EN 60079-1
"e": Increased safety EN 60079-7
"i": Intrinsic safety EN 60079-11 (ia/ib/ic)
"m": Encapsulation EN 60079-18 (ma/mb/mc)
"n": Non-incendive EN 60079-15 (nA/..)

Electrical apparatus, dust atmospheres:
"t": Protection by enclosures EN 60079-31 (ta/tb/tc)
"m": Protection by encapsulation EN 60079-18 (ma/mb/mc)
"i": Protection by intrinsic safety EN 60079-11 (ia/ib/ic)

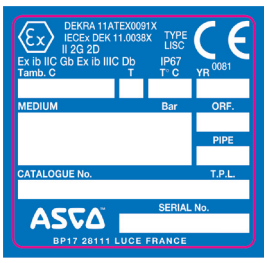
Non-electrical apparatus:
"c": Protection by constructional safety EN 13463-5

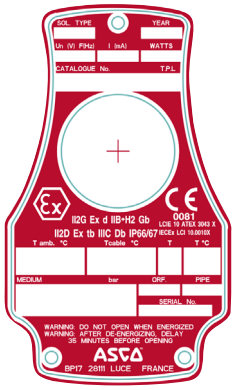
CE 0081 Ex II 2 G — Ex db — IIC Gb — T4

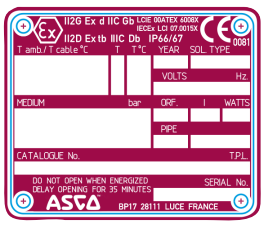
CE 0081 Ex II 2 D — Ex tb — Db — T135°C

CE 0081 Ex II 1 GD — c — T85°C T6

Ex db / Ex tb — IIB Gb / IIIC Db — IP67 — T85°C — T6







ma or ia = for use in zone 0 gas (D = Dusts) mb or ib = for use in zone 1 gas (D = Dusts)

Equipment groups (IIA, IIB, IIC, IIIA, IIIB, IIIC)

Maximum surface temperature

Temperature class

Enclosure ingress protection (IP) rating for dust (EN 60529)

Equipment Protection Level (EPL)

CLASSIFICATION OF GASES INTO EXPLOSION GROUPS

Group I : Electrical equipment intended for use in the underground parts of mines, and to those parts of surface installations of such mines, likely to become endangered by firedamp and/or combustible dust.

Group II : Electrical equipment intended for use in other places likely to become endangered by explosive atmospheres (surface industries).

For the types of protection "**d**" and "**i**", group **II** is subdivided into **IIA**, **IIB**, **IIC**. Electrical apparatus certified for **IIB** may be used in applications requiring apparatus to be certified for group **IIA**. Electrical apparatus certified for **IIC** may be used in applications requiring apparatus to be certified for groups **IIA** and **IIB**.

For example the "d" and "i" types of protection are respectively subdivided according to the Maximum Experimental Safe Gap (MESG) and to the Minimum Igniting Current (MIC).

Electrical apparatus certified for **IIB** may be certified for use with a gas belonging to group **IIC**. In this case, the identification is supplemented with the chemical symbol or the name of the gas (example: Ex d IIB + H_2 according to EN 60079-0 and EN 60079.1).

The table below indicates the groups to which some gas mixtures belong:

Groups		Gas	Ignition temperature (1) (°C)	Temperature class					
				T1	T2	T3	T4	T5	T6
I		methane (firedamp)							
II	A	acetone	540	●					
		acetic acide	485	●					
		ammonia	630	●					
		ethane	515	●					
		methylene chloride	556	●					
		methane (CH_4)	537	●					
		carbon monoxyde	605	●					
		propane	470	●					
		n-butane	365		●				
		n-butyl	370		●				
		n-hexane	240			●			
		acetaldehyde	140				●		
		ethyl ether	160				●		
		ethyl nitrite	90						●
	B	ethylene	425		●				
		ethyl oxyde	429-440		●				
		hydrogen sulfide	270			●			
	C	acetylene (C_2H_2)	305		●				
		carbon disulphide (CS_2)	102						●
		hydrogen (H_2)	560	●					

(1) Temperature of a hot surface able to ignite a gas mixture.
The ignition temperature of the gas mixture must be higher than the maximum surface temperature. In practice, a 10 to 20% safety margin is observed between the ignition temperature and the rated nameplate temperature.
The ignition temperature of a cloud of dust is generally between 300 and 700°C. At 150 to 350°C, the ignition temperature of a layer of dust is far below that of a dust cloud. A burning dust layer can initiate a dust explosion if brought in contact with a combustible dust cloud, so these values must be taken into account to limit the risk.

TEMPERATURE CLASS

The temperature classification is based on the maximum surface temperature of equipment. That is the highest temperature any part of or the entire surface of an electrical device can reach under the most unfavourable operating conditions capable of igniting a surrounding explosive atmosphere.

Group I : Temperature ≤ 150°C or ≤ 450°C according to coal dust accumulation on equipment

Group II : Equipment must be classified and marked:
- preferably with the temperature class (T classification)
- defined by the surface temperature or,
- limited to the specified flammable gases or dusts for which it is approved, if necessary (and marked accordingly).

Temperature class	Maximum surface temperature (°C)	Ignition temperature (1) (°C)
T1	450	> 450
T2	300	> 300
T3	200	> 200
T4	135	> 135
T5	100	> 100
T6	85	> 85

CLASSIFICATION OF DUSTS INTO EXPLOSION GROUPS (IEC 60079-0)

Group III : Electrical equipment intended for use in places with an explosive dust atmosphere other than mines susceptible to firedamp.

Group **III** is subdivided into **IIIA** (combustible flyings), **IIIB** (non-conductive dust) and **IIIC** (conductive dust).

Combustible dust: 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.

Non-conductive dust: Combustible dust with electrical resistivity greater than 10^3 Ω.m

Conductive dust: Combustible dust with electrical resistivity equal to or less than 10^3 Ω.m

Combustible dust	Ignition temperature (1) (°C)	Self-ignition temperature of dust layers (1) (°C)
Starch	440	290
Aluminium	530	280
Cotton	560	350
Cereals	420	290
Magnesium	610	410
Soybean	500	245
Sulphur	280	280
Tabacco	450	300

(1) The maximum surface temperature must be identified and suitable for the specified type of dust present (equipment marked for zone 21). In order to prevent the ignition of dusty atmospheres, the maximum surface temperature needs to be limited. It must not exceed:
- 2/3 of the auto-ignition temperature of the specified **cloud of dust**,
- the auto-ignition temperature of a 5 mm **layer of dust** minus 75°C.

TYPE EXAMINATION CERTIFICATES **SELECTION OF PRODUCTS**

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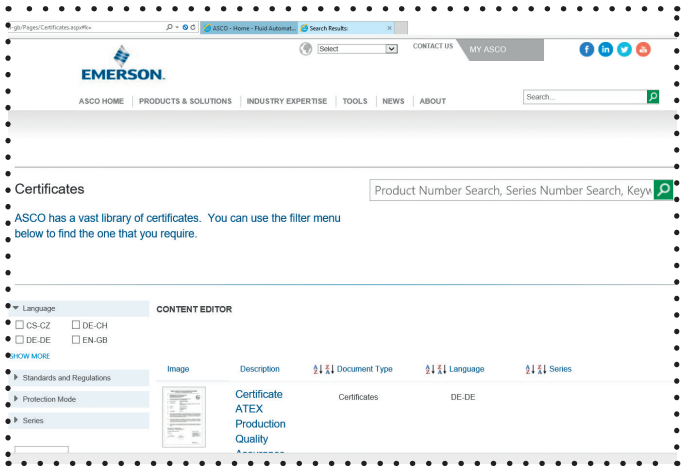

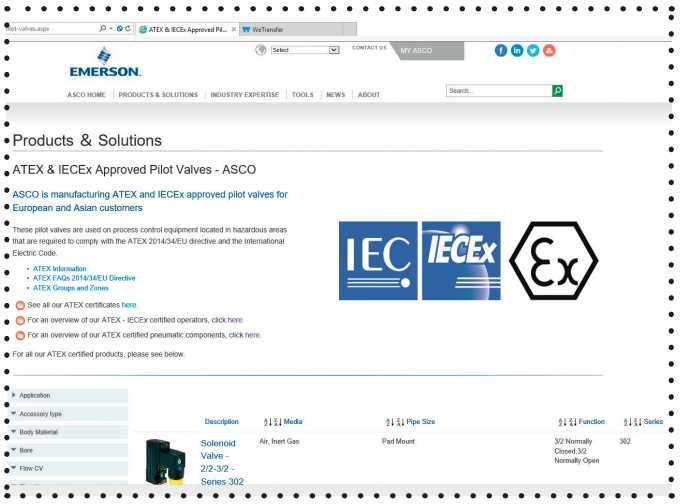

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