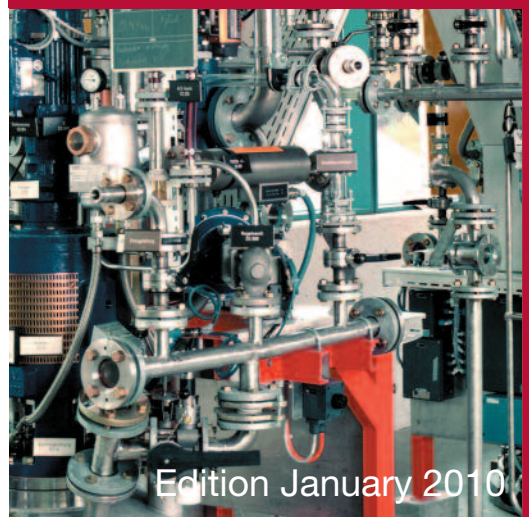




**Explosive atmospheres**

**Selection of equipment**



Edition January 2010



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## 1. Information requirements

In order to be able to select and specify the appropriate electrical equipment, the documentation and area classification drawings shall include the following information:

- classification of hazardous areas with the new associated equipment protection level (EPL)
- the equipment groups for gases, vapours and mists IIA, IIB or IIC or the equipment groups for combustible dusts IIIA, IIIB or IIIC respectively
- for gases, vapours or mists: the temperature class or the ignition temperature
- for combustible dusts: the minimum ignition temperature of the combustible dust cloud, the minimum ignition temperature of the combustible dust layer (smouldering temperature) or the minimum ignition energy of the combustible cloud of dust
- ambient temperatures
- external influences

The requirements described above only pertain to the explosion protection. In addition, it goes without saying that the requisite data of the equipment is available for its correct use.

## 2. Zones

Hazardous areas are classified into zones based on the frequency of the occurrence and duration of an explosive atmosphere.

### 2.1 *Flammable gases, vapours and mists*

#### 2.1.1 Zone 0

Area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of a gas, vapour or mist is present continuously or for long periods or frequently.

#### 2.1.2 Zone 1

Area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of a gas, vapour or mist is likely to occur occasionally in normal operation.

#### 2.1.3 Zone 2

Area in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist is not likely to occur in normal operation but, if it does exist, will persist for a short period only.

### 2.2 *Combustible dusts<sup>1</sup>*

#### 2.2.1 Zone 20

Area in which an explosive atmosphere in the form of a combustible dust in air is present continuously or for long periods or frequently.

#### 2.2.2 Zone 21

Area in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur occasionally in normal operation.

<sup>1</sup> In the case of combustible dusts, layers, deposits and accumulations shall be taken into consideration as the possible cause of explosive atmospheres. Normal operation is the state where installations are used within their design data.

### 2.2.3 Zone 22

Area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

## 3. Relationship between zones and equipment protection levels (EPLs)

Where only the zones are specified in the area classification or installation documentation, the required EPLs can be determined in accordance with Table 1.

Zone	Equipment Protection Levels (EPL)
0	Ga
1	Gb and Ga
2	Gc, Gb and Ga
20	Da
21	Db and Da
22	Dc, Db and Da

Table 1: Equipment protection levels according to zones

## 4. Selection of equipment according to EPLs

### 4.1 Hazardous gas atmospheres – Equipment group II

The standardized types of protection for explosive gas atmospheres in accordance with the IEC/EN standards have been allocated EPLs according to Table 2.

Electrical apparatus for explosive gas atmospheres			
EPL	Standards IEC/EN		Type of protection
	60079-0		General requirements
Ga	60079-11	ia	Intrinsic safety
	60079-18	ma	Encapsulation
	60079-26		Construction, test and marking of Group II electrical apparatus EPL Ga (Zone 0)
	60079-28	op is	Protection of equipment and transmission systems using optical radiation
Gb	60079-1	d	Flameproof enclosures
	60079-2	p, px, py	Pressurized enclosures
	60079-5	q	Powder filling
	60079-6	o	Oil immersion
	60079-7	e	Increased safety
	60079-11	ib	Intrinsic safety
	60079-18	mb	Encapsulation
	60079-25		Intrinsically safe systems
	60079-27		Fieldbus intrinsically safe concept (FISCO)
	60079-28	op is op pr op sh	Protection of equipment and transmission systems using optical radiation

Electrical apparatus for explosive gas atmospheres			
EPL	Standards IEC/EN		Type of protection
Gc	60079-11	ic	Intrinsic safety
	60079-18	mc	Encapsulation
	60079-15	nA	Non sparking
	60079-15	nR	Restricted breathing enclosure
	60079-15	nL	Limited energy
	60079-15	nC	Equipment producing operational sparks
	60079-2	pz	Pressurized enclosures
	60079-28	op is op pr op sh	Protection of equipment and transmission systems using optical radiation

Table 2: Standardized types of protection for explosive gas atmospheres with allocation of EPLs

#### 4.2 Explosive dust atmospheres – Equipment group III

The standardized types of protection for explosive dust atmospheres in accordance with the IEC/EN standards have been allocated EPLs according to Table 3.

Electrical equipment for use in areas with combustible dust			
EPL	Standards IEC/EN		Type of protection
	60079-0		General requirements
Da	60079-31	t (ta)	Protection by enclosure
	61241-11	iaD	Protection by intrinsic safety
	60079-18	ma	Protection by encapsulation
Db	60079-31	t (tb)	Protection by enclosure
	61241-11	ibD	Protection by intrinsic safety
	60079-18	mb	Protection by encapsulation
	61241-4	pD	Type of protection “pD”
Dc	60079-31	t (tc)	Protection by enclosure
	60079-18	mc	Protection by encapsulation
	61241-4	pD	Type of protection “pD”

Table 3: Standardized types of protection for explosive dust atmospheres with allocation of EPLs

#### 4.3 Equipment for use in locations requiring EPL ‘Ga’ or ‘Da’

Electrical equipment and circuits can be used in locations requiring EPL ‘Ga’ or ‘Da’ if the equipment is either marked as EPL ‘Ga’ or ‘Da’ respectively or it uses a type of protection listed in Tables 2 and 3 as meeting the requirements for EPL ‘Ga’ or ‘Da’ respectively. The installation shall comply with the requirements of this standard as appropriate to the type of protection employed. If ‘Ga’ is marked in accordance with 60079-26 for combined types of protection, the installation shall simultaneously comply with the requirements of this standard as appropriate to the types of protection employed.

#### 4.4 *Equipment for use in locations requiring EPL 'Gb' or 'Db'*

Electrical equipment can be used in locations requiring EPL 'Gb' or 'Db' if the equipment is either marked as EPL 'Ga' or 'Gb' and 'Da' or 'Db' respectively or uses a type of protection listed in Tables 2 and 3 as meeting the requirements for EPL 'Ga' or 'Gb' and 'Da' or 'Db' respectively. The installation shall simultaneously comply with the requirements of this standard as appropriate to the type of protection employed.

Where equipment meeting the requirements of EPL 'Ga' or 'Da' is installed in a location which only requires equipment to EPL 'Gb' or 'Db' respectively, it shall be installed in full accordance with the requirements of all the types of protection employed except as varied by the additional requirements for the individual protection techniques.

#### 4.5 *Equipment for use in locations requiring EPL 'Gc' or 'Dc'*

Electrical equipment can be used in locations requiring EPL 'Gc' or 'Dc' if the equipment is either marked as EPL 'Ga' or 'Gb' or 'Gc' and 'Da' or 'Db' or 'Dc' respectively or uses a type of protection listed in Tables 2 and 3. The installation shall comply with the requirements of this standard as appropriate to the type of protection employed.

Where equipment meeting the requirements of EPL 'Ga' or 'Gb' and 'Da' or 'Db' is installed in a location which only requires equipment to EPL 'Gc' or 'Dc' respectively, it shall be installed in full accordance with the requirements of all the types of protection employed.

## 5. Selection according to the grouping of electrical equipment

### 5.1 *Flammable gases, vapours and mists*

Equipment groups (Gas)	
IIA	Acetone, ethane, benzene, petrol, butane, propane, methane
IIB	Ethylene, town gas
IIC	Hydrogen, acetylene

Table 4: Equipment groups for flammable gases, vapours and mists

### 5.2 *Combustible dusts*

Equipment groups (Staub)	
IIIA	Fibres
IIIB	Non-conductive dust
IIIC	Conductive dust

Table 5: Equipment groups for combustible dusts

### 5.3 Relationship between the gas/vapour or dust subdivision and the equipment group

Location gas/vapour or dust subdivision required by the area classification	Permissible equipment group
IIA	IIA, IIB or IIC
IIB	IIB or IIC
IIC	IIC
IIIA	IIIA, IIIB or IIIC
IIIB	IIIB or IIIC
IIIC	IIIC

Table 6: Relationship between the subdivision at the location and the permissible equipment group

## 6. Selection according to the ignition or surface temperature

The electrical equipment shall be so selected that its maximum surface temperature will not reach the ignition temperature of any gas, vapour or dust that may be present.

### 6.1 Selection of ignition temperature of the gas or vapour

Temperature class required by the area classification	Ignition temperature of gas or vapour	Permissible temperature class of equipment
T1	> 450 °C	T1 – T6
T2	> 300 °C	T2 – T6
T3	> 200 °C	T3 – T6
T4	> 135 °C	T4 – T6
T5	> 100 °C	T5 – T6
T6	> 85 °C	T6

Table 7: Relationship between the ignition temperature and the temperature classes

### 6.2 Selection according to the surface temperature of the dust

Dust layers exhibit two properties as the layer thickness increases: a reduction in the smouldering temperature and increase in the thermal insulation. The maximum permissible surface temperature of the apparatus is determined by the deduction of a safety margin from the minimum ignition temperature of the dust concerned. This applies for both dust clouds and dust layers of less than 5 mm.

Examples of dust layers  $\geq 5$  mm can be found in Annex G of IEC/EN 60079-14.



## 7. Ambient temperature

Unless the manufacturer requires otherwise, explosion-protected equipment is generally certified for use within the temperature range  $-20^{\circ}\text{C}$  to  $+40^{\circ}\text{C}$ . Here the ambient temperature range is not marked on the equipment. However, the ambient temperature is often outside this temperature range (for example, in the case of installations with higher ambient temperatures in the Middle East or South East Asia or with extremely low temperatures such as in Siberia). In these cases the equipment shall be tested and certified for the extended ambient temperature range. The extended temperature range is often marked on the equipment (for example,  $-50$  to  $80^{\circ}\text{C}$ ).

Temperature influences from other factors, such as the process temperatures or exposure to solar irradiation, shall also be taken into account and can mean that an extended temperature range is required for the equipment.

Special care shall be taken in cases where the ambient temperature range is restricted. For example, control stations can have a restricted ambient temperature from  $0$  to  $40^{\circ}\text{C}$ ; this equipment cannot be installed everywhere in the open.

## 8. External influences

Equipment shall be selected so that they are protected against external influences. External influences must not adversely affect the explosion protection. These can be caused by:

- thermal influences,
- chemical influences,
- mechanical influences,
- varying pressure conditions,
- vibrations,
- electrical influences,
- moisture,
- ingress of process liquids,
- corrosion or
- small animals, rodents and insects.

External influences shall be taken into consideration during the planning of an installation and the selection of equipment. Special measures relating to the intended use of the equipment shall be documented and included with the installation documentation.



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## Installation material

- terminals and junction boxes
- motor protecting switches up to 63 A
- safety switches 10 to 180 A (for indirect and direct tripping)
- plug-and-socket devices
- socket outlets for clean rooms
- control and indicating devices
- customized control stations
- cable reels
- cable glands
- fastening material

## Explosionproof multipurpose distribution, switching and control units

### Category 2 G/D, protection types

- flameproof enclosure «d»
- increased safety «e»
- pressurized enclosure «px»

### Category 3 G/D, protection types

- non-sparking «nA»
- restricted breathing enclosure «nR»
- pressurized enclosure «pz»

### Categories 2 D and 3 D

for areas at risk of dust explosions

- protection by enclosure «tD»
- type of protection «pD»

### Accessories

- keyboard and mouse
- monitor
- industrial PC

## Electric heaters for industrial applications

- heating of air and gases
- heating of liquids
- reactor heating systems (HT installations)
- heating of solids
- special solutions

## Pipe and tank trace heating systems

- heating cables
  - heating cables with fixed resistors
  - mineral-insulated heating cables
  - self-limiting heating cables
- site installation
- temperature monitoring systems
  - thermostats and safety temperature limiters
  - electronic temperature controllers and safety cutouts

## Lamps

- portable lamps Categories 1, 2 and 3
- hand-held and machine lamps 6 to 58 W
- inspection lamps Category 1 (Zone 0)
- fluorescent light fixtures 18 to 58 W (also with integrated emergency lighting)
- reflector lamps
- safety lighting for Ex areas
- flasher lamps
- boiler flange lamps

## Intrinsically safe devices for instrumentation and control systems

- remote controls for temperature controller
- digital displays
- disconnect amplifiers
- transmitter power packs
- safety barriers
- remote I/O (bus systems)
- resistance temperature detectors Pt-100 Category 1 G
- resistance temperature detectors Pt-100 Category 2 G

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