INTRINSIC SAFETY

EX designation

ATEX (Atmosphere -Explosive)

94//EC Directive

Harmonises legal provisions of member states for devices and protection systems for designated use in potentially explosive areas. New: ATEX 95 (Old: ATEX 100a)

1999/92/CE Directive

Minimum requirements for improving the health and safety protection of the worker at risk from explosive atmospheres. New:ATEX 137 (Old: ATEX 118a)

Designation examples:

- Use in gaseous atmospheres: II G EEx ia IIC T4
- Use in dusty atmospheres: II 2 D T90ºC IP64
- Use for minig applications: I M2 EEx ia I

 II 1 GD | EEx | ia | IIC | T4 | T90°C | IP64	
Device group:	
I	mining
II	all other explosive areas

Category:	
1	Zones 0/20
2	Zones 1/21
3	Zones 2/22
M1	Mining (In case of firedamp, continuation of operation is possible)
M2	Mining (Must be switched off in case of firedamp)

Atmosfera:	
G	Gas
D	Dust

Types of ignition protection:	
o	oil immersion
p	pressurisation
q	powder filling
d	pressure-proof housing

e	increased safety
ia	intrinsic safety (required for Zone 0*) *depends on device category
ib	intrinsic safety (adequate for Zone 1 (+2))
m	encapsulation
s	special protection
n	normal operation under normal conditions (for Zone 2 only)
nA	non-sparking
nC	protected contacts
nR	carcasa resistente al vapor
nL	limited energy
nP	simplified

Temperature classes:	
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

Explosion group:	
I	Methane (mining)
IIA	Propane
IIB	Ethylene
IIC	most dangerous group (e.g. hydrogen)

Max. surface temperature:
a) Limit temperature 1=213 of min. ignition temperature of dust present
b) Limit temperature 2=min. glow temperature of dust present minus 75k (applies for layer hicknesses of up to 5mm)
The smaller value for the limit temperature must be aboye the indicated max. surface temperature of the device.

IP Code:	
Figure 1 Contact and foreign body protection:	
5	Protection against dust deposits
6	Protection against dust penetration
Figure 2 Water protection:	
0	(no protection)

1	vertically falling drip water
2	drip water on operating device inclined to 15° 3=spray water
3	spray water
4	spray water
5	jet water
6	strong jet water
7	temporary immersion
8	continuous immersion

Explosion Protection

The important principles for integrated safety explosion protection are as follows:

1. Measures are taken to avoid hazardous atmospheres whenever possible.
2. Measures are taken which prevent the ignition of hazardous atmospheres.
3. Measures are taken which limit the explosive effect to a safe degree.

This differs from:

Primary explosive protection:
These are precautions taken to prevent or restrict the formation of hazardous explosive atmospheres.

Secondary explosive protection:
This covers the second group of measures, which are intended to prevent the ignition of an atmosphere that is capable of exploding.

Definition in accordance with 1999/92/EC Directive (ATEX 137)	***Reference values (not standardised)***	**Zone**	**A device from the following device category must be used (see 1999/92/EC-ATEX 137 Directive)**	***e***
Area in which a potentially explosive atmosphere as a mixture of air and flammable gases, vapours or mists is present either frequently or over a prolonged period.	P>1000 h/a	0	1	G
Area in which under normal operation a potentially explosive atmosphere as a mixture of air and flammable gases, vapours or mists can occasionally form	10…1000 h/a	1	2 (1G also possible)	G
Area in which under normal operation a potentially explosive atmosphere as a mixture of air and flammable gases, vapours or mists is not normally present but may occur for just a short period.	<10 h/a	2	3 (1G, 2G also possible)	G
Area in which a potentially explosive atmosphere in the form of a cloud of flammable airborne dust is present either constantly, over prolonged periods or frequently.	>1000 h/a	20	1	D
Area in which under normal operation a potentially explosive atmosphere in the form of a cloud of flammable air-borne dust can occasionally form.	10…1000 h/a	21	2 (1D also possible)	D
Area in which under normal operation a potentially explosive atmosphere in the form of a cloud of flammable air-borne dust is not normally present although may occur for just a short period.	<10 h/a	22	3 (1D, 2D also possible)	D

Division into Temperature Classes

The temperature class indication can be guaranteed only if the ambient temperature specified for the operating device is respected (seeTechnical Data or Rating Plate). Strict compliance is a mandatory requirement.

Once the maximum surface temperature of any apparatus reaches the ignition temperature of the surrounding hazardous atmosphere an explosion can occur.

Because of this, all equipment classified to Group II is divided into temperature classes. To allow for the possibility of potential hazardous atmospheres, the lowest ignition temperature must always be higher than the maximum surface temperature.

Temperature classes of flammable gases and vapours and permitted surface temperatures of the operating device in accordance with DIN EN 50014						
Temperature class	T1	T2	T3	T4	T5	T6
Ignition temperature in °C	>450	>300	>200	>135	>100	>85
Maximum temperature in C°	450	300	200	135	100	85
Examples	Propane / Methane / Ammoniac	Ethylene / Alcohols / Acetylene	Petrol / Solvents	Ethylether / Acetaldehyde	-	Carbon-disulphide

Below Explosive Level	***Explosive Area***	***Above Explosive Level***
Mixture to thin		Mixture too rich
No combustion		Partial combustion
No explosion		No explosion
100% <<<<<<<<<<<< Concentration of air<<<<<<<<<<<<< 0%		
0% >>>>>>>>>> Concentration of substance>>>>>>>>>> 100%		

Explosions are dependent on many parameters.

Only for atmospherical conditions and pure substances sufficient comparative values and data are shown. An explosion can only occur where a flammable substance in the form of gases, vapours, smoke and dust exists along with sufficient oxygen to support -combustion and there is a source of ignition.

E.g.:

Hydrogen: 4,0 to 77,0 % in air
Propane: 1,7 to 10,6 % in air
Ammonia: 15,4 to 33,6 % in air
Methane: 4,4 to 16,5 % in air

Fundamentals of dust explosion protection

Fundamental principles:

The manufacturer of operating devices for areas rendered potentially explosive through dust must indicate the maximum surface temperature of all devices that dust can penetrate (usually expressed in °C - indication of the temperature class should be avoided here).This temperature is part of the dust Ex-designation.

Designation examples:

II 2 D T90°C IP64

(If the ignition protection type is based on the housing, the housing protection rating should also be stated as an IP Cede). or il 2 D Ex iaD 21 T96°C

Dust explosion protection - temperature:

Combustion and explosion parameters for dusts depend on the their condition. Parameters that affect combustion and explosion behaviour include particle size, particle shape, water content, purity and where applicable the content of the flammable solvents. The particle size distribution and the mean value (value for average particle size) should also be known.

In accordance with 1999/921/G Directive (ATEX 137, replacing:ATEX 118a), the system operator employer is obliged to make a hazard assessment and must therefore be aware of the minimum glow temperature of the dust.

There are simple calculations to determine the two " temperatures " and they are carried out thus:

1. Limit temperature 1 = 213 of minimum ignition temperature
2. Limit temperature 2 = minimum ignition temperature* mines 75°K

These two limit temperatures must now be examined to confirm which guarantees the greater safety..

Example 1:
Minimum ignition temperature = +330°C, minimum glow temperature = +300°C:

1. Limit temperature 1 = 213 x +330°C = +220°C
2. Limft temperature 2 = +300°C - 75°K = +225°C

Greater safety: Limit temperature (1) = +220°C Here a device with a max. surface temperature in the event of failure <= +220°C must be used. As stated, the device designation includes a corresponding value.

Example 2:

Minimum ignition temperature = +186°C, minimum glow temperature = +180°C:

1. Limit temperature 1=213 x +186°C = +124°C
2. Limit temperature 2=+180°C- 75°K = +105°C

Greater safety: Limit temperature (2) = +105°C.
Here a device with a max. surface temperature in the event of failure <= +105°C must be used.

The value for the glow temperature applies with a dust layer thickness of 5mm.The temperature safety distance must be increased for larger layer thicknesses.

Special case - Category 3 devices:

In contrast to Category 1 and 2 devices, potential hazards in the event of failure (e.g. short circuiting, connection break etc.) do not have to be considered for Category 3 devices (for use only in Zones 2 respectively 22).The device is evaluated only in respect of hazards during normal operation, it is relatively unlikely that the device should fail at the same time as a shortterm explosive atmosphere is present No EC Type Approval Test Certificate is therefore required for Category 3 operating devices. The manufacturer may confirm that the operating device complies with the relevant standard. Nonetheless, Category 3 devices are still tested by a certified centre and. EGAMASTER, S.A is then awarded a declaration of conformity. (- Of course, Category 2 operating devices also offer significantly greater safety in Zones 2 respectively 22.)

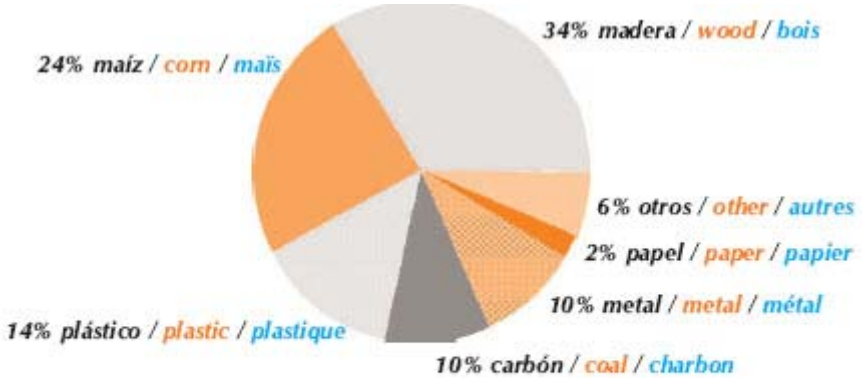
Dust explosions - albeit of a predominantly minor nature - occur relatively frequently.

A leaflet issued by the Government Safety Organisation of the Federal Republic of Germany states:

"According to documentation published by property insurers, it can be assurned that an average of one dust explosion per day occurs in the Federal Republic of Germany; around one in four of these explosions are caused by foodstuff or animal feed dusts."

Dust explosions are a world-wide problem. Between 1980 and 1990 in the USA, for example, some 200 serious foodstuff or animal feed related dust explosions were recorded, causing 54 deaths, 256 injuries and property damage amounting to 165 million US dollars.

Fuentes de ignición de aparatos eléctricos
Ignition sources by electrical operating device type
Sources d'ignition d'appareils électriques



Explosiones de polvo por tipo de polvo
Dust explosions by dust type
Explosions de poudre par type de poudre

Electrical operating devices represent only a small proportion of the ignition sources found to cause dust explosions -not least due to the safety stipulations in the regulations for erecting electrical plants in potentially-explosive areas.

The introduction of the (Regulation on electrical plants in potentially-explosive areas) - ElexV" [1.4] in 1980 specified a type examination certificate for electrical operating devices used in Zone 10 (from 01.07.2003 in Zones 20 and 21).

"Dust explosion-protected" operating devices, the surface temperatures of which lies below the acceptable limit for standardised dust thickness of 5mm, can, despite the existence of an official test certificate, become a danger source if, contrary to the conditions, they become covered or completely encased with a thick layer of dust.

Types of ignition protection

Ignition protection type "n":

Ignition protection type n is applicable only for Category 3 operating devices used in areas rendered potentially explosive by gases. Because only normal operation and no equipment failures are considered here, small differences occur in the designation for ignition protection type:

nA: non-sparking electrical equipment (revolving machines, fuses, lamps, gauges and equipment with low energy).

nC: Sparking equipment or equipment with hot surface under operating conditions (dosed indexing mechanism and non-ignitable components, air-tight equipment, leak-proof sealed equipment.

nR: vapour-proof casing.

nL: equipment and circuit with limited energy.

nP: simplified overpressure casing.

Form of ignition protection		***Schematic description***	***Basic principie***	***standard***
General			General provisions for the design and testing of electrical equipment which is designed for the ex range.	EN 50014
Increased safety	e		Only applies to equipment or the components of which usually do not generate sparks or arcs, do not adopt dangerous temperatures and the mains voltage of which does not exceed 1 kV.	EN 50 019 IEC 60 079-7 FM 3600 UL 2279
Pressure-proof casing	d		In the case of an ignition inside the casing, the explosion is contained within the casing.	EN 50 018 IEC 60 079-1 FM 3620 UL 2279
Pressurisation	p		Ignition source is sealed in by an ignition protection gas which a under overpressure (mind, 0.5 mbar) Ignition protection gas the environment atmosphere cannot enter.	EN 50016 IEC 60 079-2 FM 3620 NFPA

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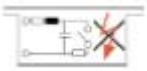
Intrinsic safety	i		By restriction of the energy in the circuit the development of inadmissibly high temperatures, ignition sparks and arcs are avoided.	EN 50 020 IEC 60 079-11 FM 3610 UL 2279
Oil immersion	o		Equipment or parts of the equipment are put into an oil casing - by which they are separated from the ex atmosphere.	EN 50 015 IEC 60 079-6 FM 3600 UL 2279
Powder filling	q		Ignition source encased by fine-grained sand -the enviroment ex atmosphere cannot be ignited by an arc.	EN 50 017 IEC 60 079-18 FM 3600
Encapsulation	m		By encapsulating the ignition source into a grouting material, it cannot ignite an ex atmosphere.	EN 50 028 IEC 60 079-18 FM 3600 UL 2279
Non-incendive	n	Zone 2. In this form of ignition protection multiple methods of ignition are combined.	Slightly simplified application of other zone-2 forms of ignitioh protection - "n" stands for "non-incendive".	EN 50 021 IEC 60 079-15

IP protection

IP 2 3 C H	
IP	Identification letters
2	Protection against penetration by foreign bodies and dust (1st identification letter) *)
3	Protection against penetration by water (2nd identification letter) *)
C	Additional letter
H	Supplementing letter

*) Should no degree of protection be specified, then the characters are replaced with the letter X e.g. IP X4

1st ident letter	***Degree of protection***	*Symbol*
0	No protection	
1	Protection against penetration by large foreign bodies, 0>50 mm. No protection against intentional access	

1st ident letter	**Degree of protection**	**Symbol**
0	No protection	
1	Protection against drops of water falling vertically (water drop)	
2	Protection against water falling at an angle (water drop),	

2	Protection against small foreign bodies, 0>12,5 mm, exclusion of fingers or similar objects.	
3	Protection against small foreign bodies, 0>2,5mm, exclusion of tools, wires or similar objects.	
4	Protection against small foreign bodies, 0>1mm, exclusion of tools, wires or similar objects.	
5	Protection against dust deposits (dustprotected), complete exclusion of access./	
6	Totally protection against dust deposits (dust protected), complete exclusion of access.	

	inclined at 15° to the normal operating position.	
3	Protection against water spray, up to 60° from the vertical.	
4	Protection against water splashes from any direction.	
5	Protection against water jet from any direction.	
6	Protection against heavy sea or strong water jet (Flooding protection).	
7	Protection against submersion in water at a certain pressure and for a certain period.	
8	Protection against continuous submersion in water.	 ...

Aditional letter	***Significante (facultative)***
A	Back of the hand
B	Finger
C	Tools
D	Wire

Supplementing letter	***Significante (facultative)***
H	High voltage apparatus
M	Machine running
S	Machine not running
W	Weather conditions

Division into zones

Safety is our first st priority

At all places where inflammable substances are produced, processed, transported or stored, safety is extremely important - especially in the chemical and petrochemical industry, in oil and natural gas production and in mining.

In order to provide the highest level of safety possible, most state's legislations have developed corresponding conditions in the form of laws, regulations and standards. In the course of globalisation, enormous progress could be made in uniform guidelines for explosion protection, It is the European Union that is leading the way. The 94/9/EG guideline lays the foundation for a complete unification. As of 01 july 2003, all new devices must be approved in accordance with this guideline.

Meaning of the zone classification:

Zone 0/20: Danger is always present, for a long time or frequently

Zone 1/21: Danger is occasionally present

Zone 2/22: Danger is seldom present or present for a short time