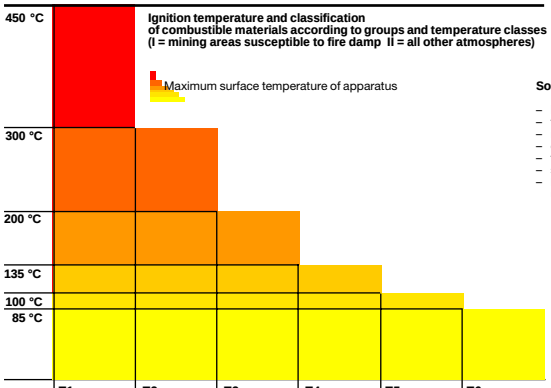
Classification of potentially explosion hazardous areas			
Duration/year – for information only:	**Continuous hazard** More than 1000 hours /years	**Occasional hazard** Between 10 and 1000 hours/year	**Hazard only during abnormal operating conditions** Less than 10 hours/year
IEC CENELEC Europe	Zone 0 (gas) Zone 10 (Z) (dust) Zone 20 (IEC)	Zone 1 (gas) Zone 10 (Z) (dust) Zone 21 (IEC)	Zone 2 (gas), Zone 11 (Y) (dust) Zone 22 (IEC)
North America	Division 1 (gas and dust)		Division 2 (gas and dust)

Gases			
Zone	Symbol	Category	Protection requirements
0		1 G required	2 independent means of protection
1		2 G required, 1 G possible	1 independent means of protection
2		3 G required 1 G, 2 G possible	normal operation

Dusts				
Zone	Zone(old)	Symbol	Category	Protection requirements
20	10		1 D required	2 independent means of protection
21			2 D required,1 D possible	1 independent means of protection
22	11		3 D required 1 D, 2 D possible	normal operation

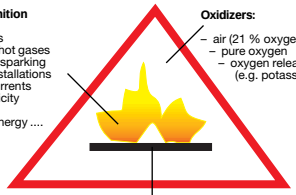
Ignition temperature and classification of combustible materials according to groups and temperature classes (I = mining areas susceptible to fire damp II = all other atmospheres)



	T1	T2	T3	T4	T5	T6
I	Methane					
II A	Acetone Ethane Ethyl acetat Ammonium, Benzol (pure) Acetic acid Carbon monox. Methanol Propane Toluone	Ethyl alcohol i-Amylacetate n-Butane n-Butylalcohol n-Hexane	Gasolines Diesel fuel Aircraft fuel n-Hexane	Acetaldehyde Ethyl ether		
II B	City gas	Aethylene				
II C	Hydrogen	Aethylen*)				Carbon dissulfide*)

*) no authorised regulations

Ignition Triangle



Sources of ignition

- hot surfaces
- flames and hot gases
- mechanical sparking
- electrical installations
- transient currents
- static electricity
- lightning, ultrasonic energy ....

Oxidizers:

- air (21 % oxygen)
- pure oxygen
- oxygen releasing compounds (e.g. potassium manganate)

Fuels (flammable substances):

"Flammable concentrations of gases and dusts from liquids or solids which have the potential to ignite an explosive atmosphere"

IP ingress protection (protection against accidental contact and ingress of solid objects and water)

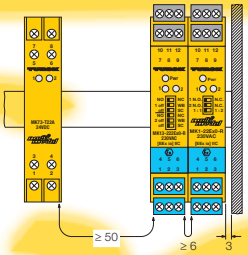
Degree of protection against access to hazardous parts and ingress of solid objects		Degree pf protection against ingress of water	
No protection	0	0	No protection
Protection against large solid objects	1	1	Vertically dripping water has no harmful effect
Protection against medium-sized solid objects > 12 mm	2	2	Drops of water in any angle up to 15° from the vertical have no harmful effect
Protection against small solid objects > 2.5 mm	3	3	Drops of water in any angle up to 60° from the vertical have no harmful effect
Protection against granular solid objects > 1 mm	4	4	Water sprayed from all directions onto equipment has no harmful effect
Protection against dust deposits	5	5	Jets of water from all directions onto equipment have no harmful effect
Protection against ingress of dust	6	6	Limited ingress of water has no harmful effects during temporary immersion, e.g. due to heavy sea
		7	Water must not enter the device under specified conditions, e.g. pressure and duration of immersion in water (immersion depth of lowest part 1 m for 30 min).
		8	Water may not enter the equipment when immersed in water continuously under specified pressure condtions.

Overview of Protection Types

Symbol	Name	Standard	Comments
	General requirements	EN 50014	DIN EN 50014 comprises general regulations on the construction and testing of electrical apparatus for use in explosion hazardous areas.
	Oil immersion(o)	EN 50015	Protection type „oil immersion" implies that the electrical apparatus and its components are separated from the potentially explosive atmosphere by immersion in oil.
	Pressurised (p) enclosure	EN 50016	A protective gas, which is under overpressure, (min 0.5 mbar) encloses and separates the ignition source from the surrounding atmos-phere.
	Sand filling (q)	EN 50017	The finely grained material encloses the ignition source. An electric arc generated in the inside of the housing must not be capable of igniting the potentially explosive atmosphere during normal operation.
	Flameproof (d) enclosure	EN 50018	In the event of an ignition within the enclosure, the housing must be able to withstand the pressure and prevent the ignition from propagating to the surrounding atmosphere.
	Increased (e) safety	EN 50019	This protection type (e) applies only to electrical equipment and its components which is incapable of generating dangerous sparks, electrical arcs or thermal effects during normal operation. The voltage rating of this type of equipment may not exceed 1 kV.
	Intrinsic (i) safety	EN 50020	The energy in the current circuit is limited to such an extent that sparks, electrical arcs or high temperatures cannot be generated.
	„Non-incendive" (n)	EN 50021	Simplified application of other protection types for zone 2
	Encapsulation(m)	EN 50028	Possible ignition sources are encapsulated in a potting material so that they are incapable of igniting an explosive atmosphere.
	Intrinsically safe electrical systems (i-SYST)	EN 50039	One distinguishes between two types: - certified intrinsically safe systems - non-certified intrinsically safe systems An intrinsically safe system is the approved assembly of interconnected electrical equipment (intrinsically safe and associated apparatus). It is documented accordingly in the system description.

General guidelines for the use of devices with intrinsically safe circuits

It is required to observe a safety distance of 3 mm (EN50020, chapter 6.3, table 4) to earthed components, such as covers or side panels of mounting cabinets. A thread measure of 50 mm must be observed between intrinsically safe connections and non-safe connections.



Proof of intrinsic safety

According to EN 60079-14 a proof of intrinsic safety must be provided to confirm that the equipment which is interconnected within an assembly accords to the requirements of intrinsic safety. In this context there is a clear distinction between two basically different circuits:
1. a simple intrinsically safe circuit with a single associated apparatus and at least one intrinsically safe apparatus without additional supply
2. more than one associated apparatus which is capable of supplying electrical energy to the intrinsically safe circuit, not only during normal service but also in a fault condition.

Simple circuits

The first definition of a simple intrinsically safe circuit requires to observe all electrical limit values stated in the EC type examination certificate and the power characteristics. If these conditions are met, the user is entitled to keep a proof of intrinsic safety. Inductances and capacitances of the installed cables must be taken into account. Intrinsic safety of a simple circuit is given, if the following conditions are met:

Associated apparatus	Condition	Intrinsically safe equipment + cable
U_0	≤	U_i
I_0	≤	I_i
P_0	≤	P_i
L_0	≥	$L_i + L_C$
C_0	≥	$C_i + C_C$

The cable characteristics provided by the manufacturer should be used. Should these not be available, it is recommended to apply the following typical values (BASEEFA Newsletter no. 3, October 1980): L_C = 1 mH/km, C_C = 110 nF/km

Connection of proximity switches to isolating switching amplifiers, or 2-wire transmitters to isolating transducers, or solenoid valves to a valve control module can be considered as simple circuits.

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Ex INFO

After 30 June 2003 all new devices must conform to directive 94/9/EC (ATEX 100a).

Marking of electrical equipment

Following an example of marking of intrinsically safe electrical equipment:

EEx ia IIC T6
- T6 — temperature class
- IIC — explosion group
- ia — type of protection
- EEx — conform to European standard

Following an example of marking of associated apparatus:

[EEx ia] IIC
- IIC — explosion group
- ia — type of protection
- EEx — acc. to European standard
- [ ] — associated apparatus

To date, the test certificate number of the test authority used to contain the generation number of the applicable standard to indicate the amendment status, e.g.:

PTB Nr. Ex-85.B.2128X

PTB Nr.	authorised body
Ex-	explosion protected apparatus
85.	year of issue
B.	generation indicator
2128	serial certificate number
X	special conditions

According to ATEX marking must be as follows:

PTB 97 ATEX 2128X

PTB	authorised body
97	year of issue
ATEX	accord. to 94/9/EC
2128	serial certificate number
X	special conditions

Within the European Union the devices must meet the respective requirements. If the manufacturer fulfills these, he is permitted to affix the CE sign. The ATEX directive extends marking: the identification number of the notified body, which carried out the quality assurance system approval, is added to the CE sign.

CE 0032

For example, the test body of the TÜV Hannover uses the identification code 0032, the PTB in Braunschweig code 0102 and the DMT (BVS) in Dortmund code 0158. Additionally, the year of production and the constructional level of safety must be contained in the device's marking. Marking of intrinsically safe apparatus according to ATEX would be as follows:

II 1 G
- II — explosion protected against gas, vapour and mist
- 1 — very high safety level suited for zone 0
- G — all areas except mining

Associated equipment is identifiable by round brackets enclosing the device category:

II (1) G
- (1) — may not be installed in hazardous areas

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