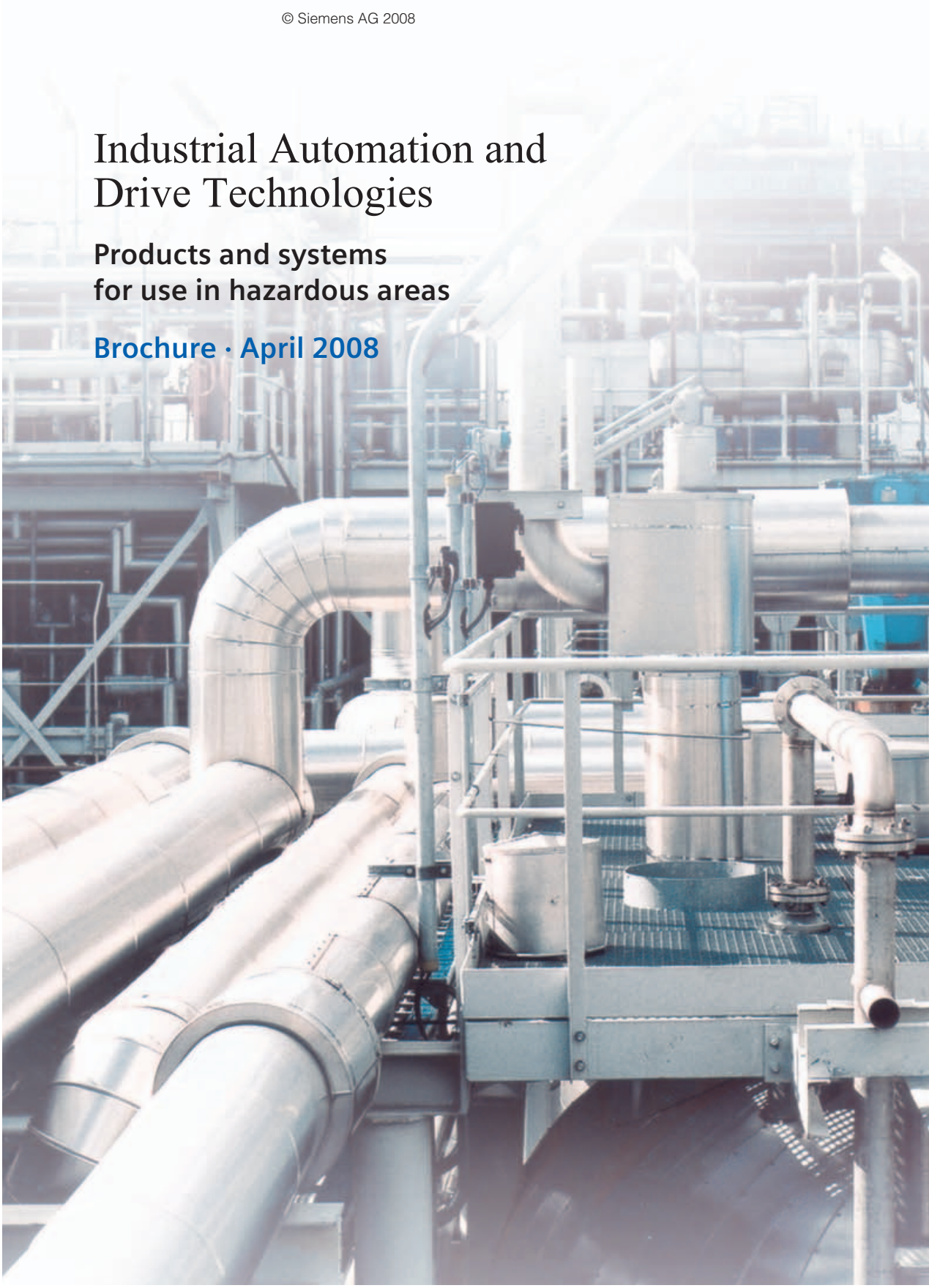
Industrial Automation and Drive Technologies

Products and systems for use in hazardous areas

Brochure · April 2008



Explosion Protection

www.siemens.com/industry

SIEMENS

The hazardous area completely under control

In many industries, the manufacture, processing, transport or storage of combustible materials results in the creation or release of gases, vapors or mist into the environment. Other processes create combustible dust. An explosive atmosphere can form in conjunction with the oxygen in the air, resulting in an explosion if ignited.

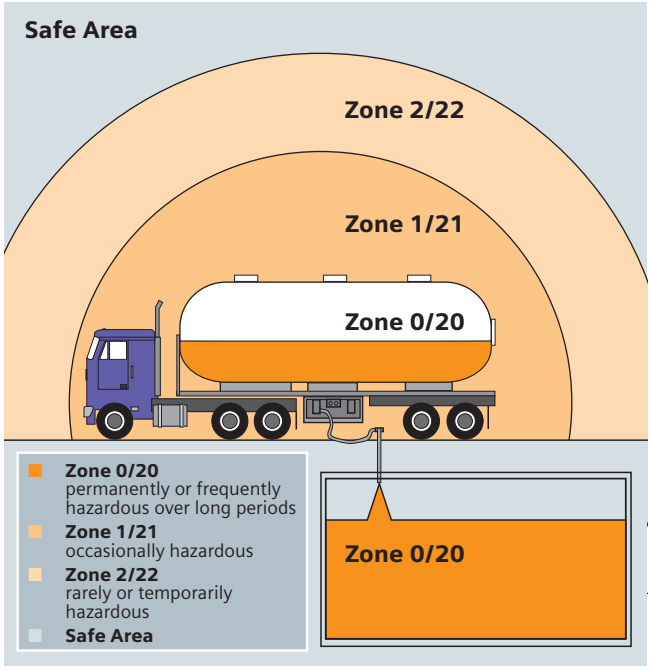
Particularly in areas such as the chemical and petrochemical industries, the transport of crude oil and natural gas, the mining industry, milling (e.g. grain and granular solids) and many other branches of industry, this can result in serious injury to personnel and damage to equipment.

To guarantee the highest possible level of safety in these areas, the legislatures of most countries have developed appropriate obligations in the form of laws, regulations and standards. In the course of globalization, it has been possible to make significant progress toward harmonizing guidelines for explosion protection.

With Directive 94/9/EC, the European Union has created the prerequisites for complete standardization because all new devices must be approved in accordance with this directive since July 1, 2003.

This brochure is designed to provide users and interested readers with an overview of explosion protection in conjunction with electrical equipment and systems. It is also a reference manual for decoding device labels.

However, it does not replace intensive study of the relevant fundamentals and guidelines when planning and installing electrical systems.



Zone definition

Contents

Physical principles and parameters

Explosion

An explosion is the sudden chemical reaction of a combustible substance with oxygen, involving the release of high energy. *Combustible substances* can be present in the form of gases, mist, vapor or dust. An explosion can only take place if the following three factors coincide:

- Combustible substance
  (in the relevant distribution and concentration)
- Oxygen (in the air)
- Source of ignition (e.g. electrical spark)

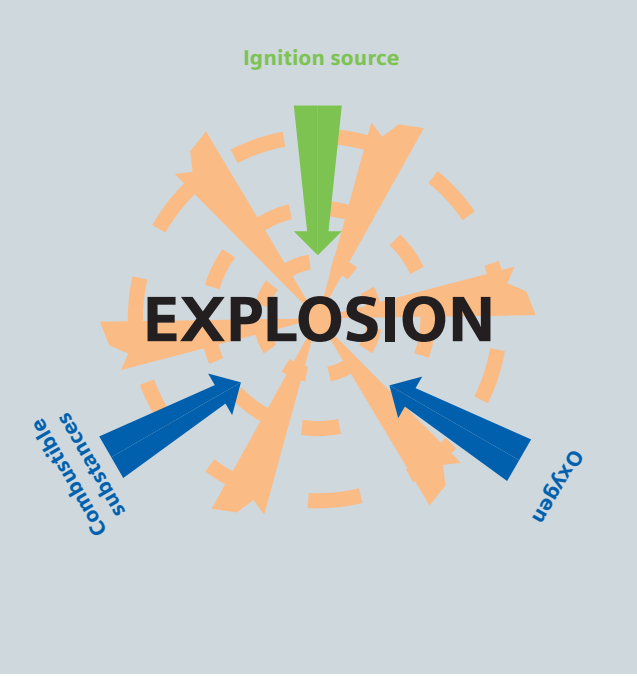
Primary and secondary explosion protection

The principle of integrated explosion protection requires all explosion protection measures to be carried out in a defined order.
A distinction is made here between *primary* and *secondary* protective measures.

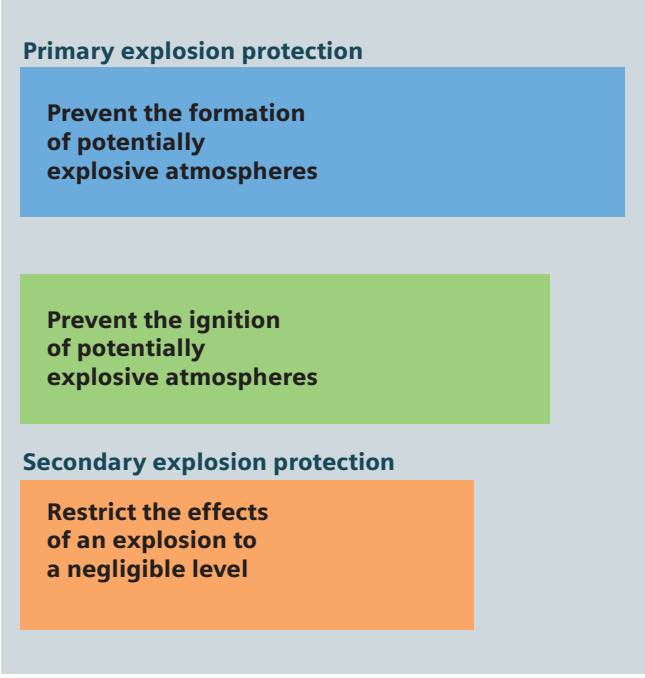
Primary explosion protection covers all measures that prevent the formation of a potentially explosive atmosphere.

What protective measures can be taken to minimize the risk of an explosion?

- Avoidance of combustible substances
- Inerting (addition of nitrogen, carbon dioxide, etc.)
- Limiting of the concentration
- Improved ventilation
- Secondary explosion protection is required if the explosion hazard cannot be removed or can only be partially removed using primary explosion protection measures.



Discharge of an explosion



Integrated explosion protection

The consideration of technical safety parameters is necessary for the characterization of potential dangers:

Flash point

The flash point for flammable liquids specifies the lowest temperature at which a vapor/air mixture forms over the surface of the liquid that can be ignited by a separate source. If the flash point of such a flammable liquid is significantly above the maximum prevailing temperatures, a potentially explosive atmosphere cannot form there. However, the flash point of a mixture of different liquids can also be lower than the flash point of the individual components.

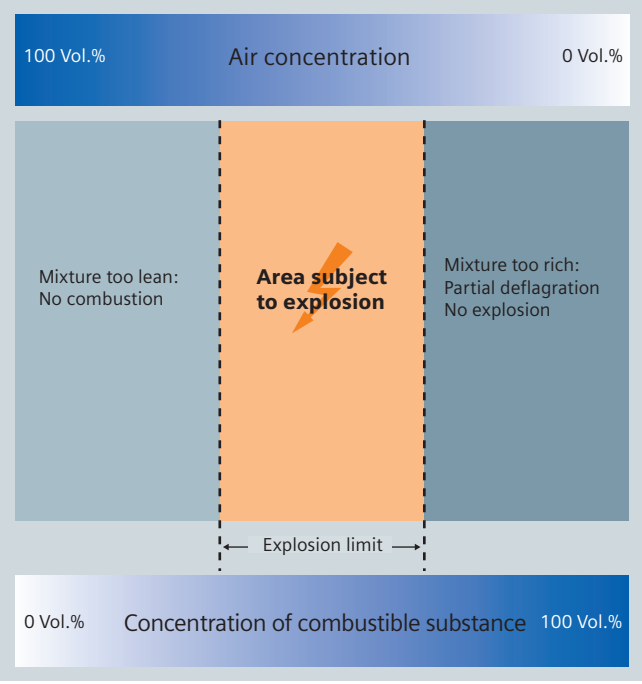
In technical regulations, flammable liquids are divided into four hazard classes:

Hazard class	Flash point
AI	< 21 °C
AII	21 ... 55 °C
AIII	> 55 ... 100 °C
B	< 21 °C, soluble in water at 15 °C

Explosion limits

Combustible substances form a potentially explosive atmosphere when they are present within a certain range of concentration.

If the concentration is too low (lean mixture) and if the concentration is too high (rich mixture) an explosion does not take place. Slow burning takes place instead, or no burning at all. Only in the area between the upper and the lower explosion limits does the mixture react explosively if ignited.



The explosion limits depend on the surrounding pressure and the proportion of oxygen in the air. Below are examples of the explosion limits of some common materials.

Substance designation	Lower explosion limit	Upper explosion limit
Acetylene	2.3 vol. %	78.0 (self-decomposing) vol. %
Ethylene	2.3 vol. %	32.4 vol. %
Petroleum spirit	~ 0.6 vol. %	~ 8 vol. %
Benzene	1.2 vol. %	8 vol. %
Natural gas	4.0 (7.0) vol. %	13.0 (17.0) vol. %
Heating oil/diesel	~ 0.6 vol. %	~ 6.5 vol. %
Methane	4.4 vol. %	16.5 vol. %
Propane	1.7 vol. %	10.9 vol. %
Carbon disulfide	0.6 vol. %	60.0 vol. %
City gas	4.0 (6.0) vol. %	30.0 (40.0) vol. %
Hydrogen	4.0 vol. %	77.0 vol. %

We refer to a *deflagration, explosion or detonation* depending on the speed of combustion.

A potentially explosive atmosphere is present if ignition represents a hazard for personnel or materials.

A potentially explosive atmosphere, even one of low volume, can result in hazardous explosions in an enclosed space.

Dusts

In industrial environments, e.g. in chemical factories or corn mills, solids are frequently encountered in fine form (as dust, for example).

The term dust is defined in EN 61241-14 as "small solid particles that can be suspended for some time in the atmosphere but then settle under their own weight (includes dust and coarse dust, as defined in ISO 4225)". Deposits of dust are comparable with a porous body, and have a hollow space of up to 90%. If the temperature of dust deposits is increased, the result may be spontaneous ignition of the combustible dust.

If dust deposits with a small particle size are whirled up, there is a risk of explosion. This risk increases as the particle size decreases, since the surface area of the hollow space increases. Dust explosions are frequently the result of whirled-up glowing layers of dust that carry the initial spark within them. Explosions of gas/air or vapor/air mixtures can also whirl up dust, in which case the gas explosion can become a dust explosion. In collieries, explosions of methane gas frequently lead to explosions of coal dust whose effect was often greater than that of the gas explosion.

The risk of an explosion is prevented by using explosion-proof devices according to their suitability. The identification of the device category reflects the effectiveness of explosion protection, and this the application in corresponding hazardous areas. The potential risk of explosive dust atmospheres and the selection of appropriate protective measures are assessed on the basis of safety parameters for the materials involved. Dusts are considered according to two material-specific characteristics:

- Conductivity
  Dusts are referred to as conductive if they have a specific electric resistance up to 10^3 Ohms.
- Combustibility
  Combustible dusts can burn or glow in air, and form explosive mixtures with air at atmospheric pressure and at temperatures from -20 to +60 °C.

Safety parameters for whirled-up dusts are, for example, the *minimum ignition energy* and the *ignition temperature*, whereas for deposited dusts, the glow temperature is a characteristic property.

Minimum ignition energy

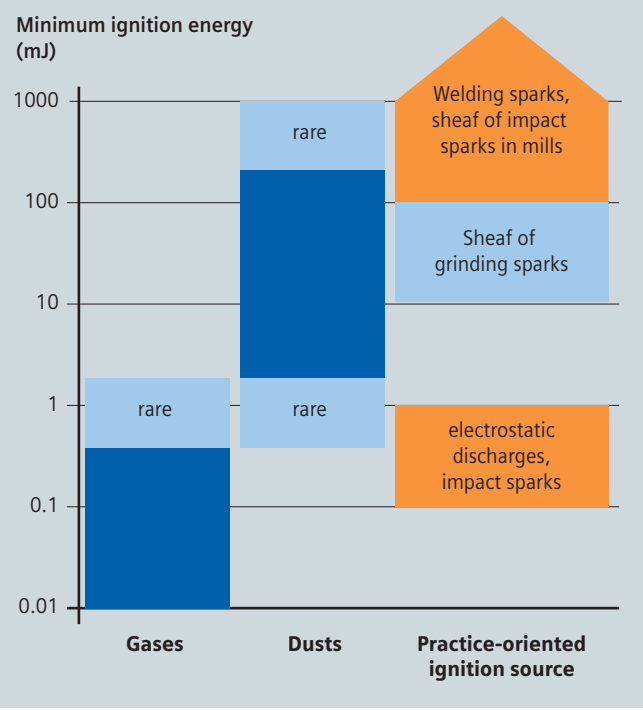
The application of a certain amount of energy is required to ignite a potentially explosive atmosphere.

The minimum energy is taken to be the lowest possible converted energy, for example the discharge of a capacitor, that will ignite the relevant flammable mixture.

The minimum energy lies between approximately 10^{-5} Joules for hydrogen, and several Joules for certain dusts.

What can cause ignition?

- Hot surfaces
- Adiabatic[1)] compression
- Ultrasound
- Ionized radiation
- Open flames
- Chemical reaction
- Optical radiation
- Electromagnetic radiation
- Electrostatic discharge
- Sparks caused mechanically by friction or impact
- Electrical sparks and arcs
- Ionized radiation



Minimum ignition energy of different environments

[1)] *An adiabatic state change is a thermodynamic process in which a system is changed from one state to another state without exchanging heat with its surroundings.*

Legislative basis and standards

Legislative basis of explosion protection

Globally, explosion protection is regulated by the legislatures of the individual countries. National differences in technical requirements and the required approvals for explosion-protected devices make significant demands primarily on global players, and require considerable overhead in development and approval testing.

For some time now, particularly among the leading industrial nations, there has therefore been interest in removing barriers to trade by harmonizing the appropriate technical standards, and in implementing uniform safety standards in parallel. Within the European Union, the harmonization process in the area of explosion protection is largely complete.

At the international level, the IEC is attempting to get closer to the aim of "a single global test and certificate" with the IECEx Scheme (www.iecex.com) that still enjoys only very limited acceptance.

1) ATEX is the abbreviation for ATmosphaére EXplosible

EU directives/CE mark

In the European Union, explosion protection is regulated by directives and laws. Electrical devices must satisfy the corresponding requirements within the EU. The manufacturer can attach the CE mark to the respective device if these requirements have been fulfilled. Any violations in this context are a punishable offence. In accordance with the ATEX guideline [1)], the number of the notified office that has carried out the acceptance of the quality assurance system, for example, the German national metrology institute in Brunswick (Physikalisch Technische Bundesanstalt) CE 0102, is added to this explosion protection symbol in the case of specific device classification, if demanded. In contrast to non-European laws, the ATEX guidelines also apply to non-electrical equipment, e.g. pneumatic drives.

The respective equipment and systems have been classified as *systems requiring monitoring* and must only make use of devices permitted for the purpose. Furthermore, start-up, changes and regular safety inspections must be carried out by registered institutes or authorized companies. The EU directives are binding for all Member States and form the legal framework.

Important EU directives

Abbreviation	Full text	Directive No.	Valid since
Low-voltage directive	Directive 2006/95/EC of the European Parliament and Council of December 12, 2006, on the harmonization of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits	2006/95/EC	16.01.2007
EMC directive	Directive 2004/108/EC of the European Parliament and Council of December 15, 2004, on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing the Directive 89/336/EEC	2004/108/EC	20.01.2005
Machinery directive	Directive 2006/42/EC of the European Parliament and Council of May 17, 2006, on machinery, and amending Directive 95/16/EC (recast)	2006/42/EC	29.06.2006
ATEX directive	Directive 94/9/EC of the European Parliament and Council of March 23, 1994, on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in hazardous areas	94/9/EC	09.05.1994
Pressure directive	Directive 97/23/EC of the European Parliament and Council of May 29, 1997, on the approximation of the laws of the Member States concerning pressure equipment	97/23/EC	29.07.1997
ATEX 137 (old: ATEX 118a)	Minimum regulations for improving the health protection and safety of employees who could be endangered by potentially explosive atmospheres	99/92/EC	16.12.1999[2)]

2) The transitional regulations are defined in the relevant national legislation. In Germany, this is the working reliability regulation (BetrSichV)

National laws and regulations

In general, EU directives are European law that must be incorporated by the individual member states unmodified and "one-to-one" by ratification. Directive 94/9/EC was adopted completely into the German explosion protection regulation ExVO. The underlying legislation for technical equipment is the Equipment Safety Law (GSG) to which the ExVO is appended as a separate regulation (11. GSGV).

In contrast, ATEX 137 (Directive 1999/92/EC) contains only "Minimum regulations for improving the health protection and safety of employees who could be endangered by potentially explosive atmospheres", so that each EU member state can define its own regulations beyond the minimum requirements. In the German Federal Republic, the contents of the directive have been implemented in the working reliability regulation. In order to simplify the legislation, the contents of several earlier regulations have been simultaneously integrated into the working reliability regulation ('BetrSichV'). From the area of explosion protection, these are:

- The regulation concerning electrical installations in hazardous areas (ElexV)
- The acetylene regulation
- The regulation concerning flammable liquids

These regulations became defunct when the working reliability regulation came into force on 01.01.2003.

Guidelines for Explosion Protection of the Employer's Liability Insurance Associations

In the "Guidelines for the prevention of hazards from potentially explosive atmospheres with listed examples" of the *Employer's Liability Insurance Association (chemicals)*, specific information is given on the hazards of potentially explosive atmospheres, and measures for their prevention or limitation are listed. Of special use are the examples of individual potentially explosive process plants in the most diverse industrial sectors in which these measures are listed in detail.

Valuable suggestions and risk evaluations are available for planners and owners of such plants or similar process plants. While the EX guidelines have no legal status, they are nevertheless to be regarded as important recommendations that can also be called upon for support in deciding legal questions in the event of damage.

Standards

There are a host of technical standards worldwide for the area of explosion protection. The standards environment is subject to constant modification. This is the result both of adaptation to technical progress and of increased safety demands in society.

International efforts at standardization also contribute, with the aim of achieving the most uniform global standards possible and the resulting removal of barriers to trade.

EU standards

The standards for explosion protection valid in the European Union are created on the basis of the EU directives under the leadership of CENELEC (European Committee for Electrotechnical Standardization). CENELEC comprises the national committees of the member states. Since, in the meantime, standardization at international level gained greatly in importance through the dynamism of the IEC (International Electronic Commission), CENELEC has decided only to define standards in parallel with the IEC.

In practice, this means European standards in the area of electrical/electronic systems will now be created or redefined almost exclusively on the basis of IEC standards as harmonized EN standards. For the area of explosion protection, this primarily affects the standards of the EN 60079 and EN 61241 series.

The numbers of harmonized European standards are structured according to the following scheme:

Example				Meaning
EN	60079-0	:	2004	
				Year of issue
				Number of standard
				Harmonized European standard

IEC

At the international level, the IEC (International Electrotechnical Commission) issues standards for explosion protection. The Technical Committee TC31 is responsible. The IECEx certification is based on the IEC standards. Standards for explosion protection are found in the IEC 60079-x series (previously IEC 79-x). The x represents the numbers of the individual technical standards, e.g. IEC 60079-11 for intrinsic safety.

Classification of explosion-proof equipment

Marking

The identification of electrical equipment for explosion-proof areas indicates the following:

- The vendor of the equipment
- A designation by which it can be identified
- The area of use
  - Below ground I
  - Other areas II
- Gases and vapors - G -, dusts - D - or mines - M -
- The categories which indicate whether the device can be used for particular zones
- The type(s) of protection to which the equipment complies
- The entire identification of the certificate, provided a certificate has been issued by the testing agency.
  This identification includes: The symbol of the testing agency, the year of issue of the certificate, ATEX and a consecutive number. The entire identification is defined by the testing station and also recorded on the associated certificate.
- In addition, the data usually required for such a device of industrial design must be provided

Example of identification according to 94/9/EC

>	0344	II 2G	Ex ia IIC	T4	
					Temperature class
					Indication of the type(s) of protection with which the equipment complies
					Representation of the application area
					Named authority for certification of the QA system according to 94/9/EC
					Conformity marking

Example of a device identification

EXAMPLE COMPANY type 07-5103-.../...					Identification of vendor and type
	Ex II 2G Ex ia IIC T4				Type(s) of protection and temperature class
		KEMA	00	ATEX	1081	Consecutive number of testing agency
						Mandatory indication that the certificate can be used to verify compliance with the ATEX Directive 94/9/EC.
						Year of issue of the certificate
						Symbol of testing authority

Equipment groups/categories

Devices are classified into equipment groups. Each equipment group contains equipment that is in turn assigned to different categories (Directive 94/9/EC). The category specifies the zone in which the equipment may be used.

Equipment group I (underground workings, mines and above-ground workings)				
Category	M1: Extremely high level of safety		M2: High level of safety	
Level of danger	Continuous, long-term and frequent danger		Occasional danger	Infrequent and short-term danger
Sufficient safety	Through 2 protective measures/in the event of 2 faults		Must be switched off in the presence of an Ex atmosphere.	

Equipment group II (other areas subject to explosion hazard)						
Category	1: Extremely high level of safety		2: High level of safety		3: Normal level of safety	
Danger level	Continuous, long-term and frequent danger		Occassional danger		Infrequent and short-term danger	
Sufficient safety	Through 2 protective measures/ in the event of 2 faults		In the case of frequent device faults/ in the case of one fault		In the case of fault-free operation	
Use in	Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22
Atmosphere	G (gas)	D (dust)	G	D	G	D

Zones

Hazardous areas are divided into zones (see page 2). Division into zones depends on the chronological and geographical probability of the presence of a hazardous, potentially explosive atmosphere.

Information and specifications for zone subdivision can be found in EN 60079-10 and in EN 61241-10.

Equipment in continuously hazardous areas (Zone 0/20) are subject to stricter requirements and, by contrast, equipment in less hazardous areas (Zone 1/21, Zone 2/22) is subject to less stringent requirements.

Flammable gases, vapors and mist		
Zone	**Category and atmosphere**	**Description**
0	1G	Hazardous, potentially explosive atmosphere is present **continuously** and **over extended periods**.
1	2G 1G	It is to be expected that a hazardous, potentially explosive atmosphere will occur **occasionally**.
2	3G 2G 1G	It is to be expected that a hazardous, potentially explosive atmosphere will occur **only rarely** and then only **for a short period**.

Flammable dusts		
20	1D	Areas where a potentially explosive atmosphere comprising dust/air mixtures is present **continuously, over extended periods, or frequently**.
21	2D 1D	Areas where it is expected that a hazardous, potentially explosive atmosphere comprising dust/air mixtures will occur **occasionally and for short periods**.
22	3D 2D 1D	Areas where it is not to be expected that a potentially explosive atmosphere will be caused by whirled-up dust. If this does occur, then in all probability **only rarely** and **for a short period**.

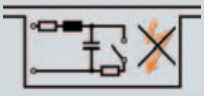
Protection types

The protection types are design measures and electrical measures carried out on the equipment to achieve explosion protection in the areas subject to explosion hazard. Protection types are secondary explosion protection measures.

The scope of the secondary explosion protection measures depends on the probability of the occurrence of a hazardous, potentially explosive atmosphere.

Electrical equipment for hazardous areas must comply with the general requirements of EN 60079-0 and the specific requirements for the relevant type of protection in which the equipment is listed.

According to EN 60079-0, the types of protection listed below are of significance. All types of protection are based on different protection concepts.

Types of protection for gases						Use in zone		
Type of protection	**K** [1]	**Schematic representation**	**Basic principle**	**Standard**	**Examples**	**0**	**1**	**2**
General requirements			General requirements for the type and testing of electrical equipment intended for the Ex area	EN 60079-0 IEC 60079-0 ANSI/UL 60079-0 FM 3600				
Increased safety	**e**		Applies only to equipment, or its component parts, that normally does not create sparks or arcs, does not attain hazardous temperatures, and whose mains voltage does not exceed 1 kV	EN 60079-7 IEC 60079-7 ANSI/UL 60079-7	Terminals, terminal boxes		■	■
Flameproof enclosure	**d**		If an explosion occurs inside the enclosure, the housing will withstand the pressure and the explosion will not be propagated outside the enclosure	EN 60079-1 IEC 60079-1 ANSI/UL 60079-1	Switchgear, transformers		■	■
Pressurized enclosure	**p**		The ignition source is surrounded by a pressurized protective gas (min. 0.5 mbar) – the surrounding atmosphere cannot enter	EN 60079-2 IEC 60079-2 ANSI/UL 60079-2	Control cabinets, switchgear cabinets		■	■
Intrinsic safety	**i**		By limiting the energy in the circuit, the formation of impermissibly high temperatures, sparks, or arcs is prevented	EN 60079-11 IEC 60079-11 ANSI/UL 60079-11 FM 3610	Actuators, sensors, PROFIBUS DP RS 485-iS	■	■	■
Oil immersion	**o**		Equipment or equipment parts are immersed in oil and thus separated from the Ex atmosphere	EN 60079-6 IEC 60079-6 ANSI/UL 60079-6	Transformers, switching devices		■	■
Sand filling	**q**		Ignition source is buried in sand. The Ex atmosphere surrounding the housing cannot be ignited by an arc	EN 60079-5 IEC 60079-5 ANSI/UL 60079-5	Strip heaters, capacitors		■	■
Encapsulation	**m**		By encapsulation of the ignition source in a molding, it cannot ignite the Ex atmosphere	EN 60079-18 IEC 60079-18 ANSI/UL 60079-18	Sensors, switching devices	■	■	■
Types of protection	**n**	Zone 2: This type of protection includes several types	Slightly simplified application of the other protection types – "n" stands for "non-igniting"	EN 60079-15 IEC 60079-15 ANSI/UL 60079-15 FM 3611	Programmable controllers			■

[1] *Marking*

Types of protection for dusts					Use in zones		
Type of protection	**Marking**	**Basic principle**	**Standard**	**Examples**	**20**	**21**	**22**
General requirements		General requirements for the type and testing of electrical equipment intended for the Ex area	EN 61241-0 [1)] IEC 61241-0 [1)]				
Pressurized enclosure	**pD**	The penetration of a surrounding atmosphere into the enclosure of electrical equipment is prevented in that a protective gas (air, inert gas or other suitable gas) is kept within the enclosure at a pressure higher than the surrounding atmosphere	IEC 61241-4	Equipment where sparks, arcs or hot components occur during normal operation		■	■
Encapsulation	**mD**	Parts which could ignite a potentially explosive atmosphere through sparks or heating are encapsulated in a potting compound such that the explosive atmosphere cannot ignite. This is achieved by completely covering the components with a potting compound that is resistant to physical (particularly electrical, thermal and mechanical) and chemical influences.	EN 61241-18 IEC 61241-18	Large machines, slip ring or collector motors, switchgear and control cabinets		■	■
Protection by enclosure	**tD**	The enclosure is sealed so tight that no combustible dust can penetrate into it. The surface temperature of the external enclosure is limited.	EN 61241-1 IEC 61241-1	Measuring and monitoring systems	■	■	■
Intrinsic safety	**iaD, ibD**	Current and voltage are limited such that intrinsic safety is guaranteed. No sparks or thermal effects can ignite a dust/air mixture.	EN 61241-11 IEC 61241-11	Sensors and actuators	■	■	■

[1)] *In certain applications, the previous standards EN 50281-1-1 or IEC 61241-1-1 apply*

Explosion groups

In the explosion groups, a distinction is first made between equipment of Group I and Group II:

Electrical equipment of Group I is used for mines subject to *fire-damp*.

Electrical equipment of Group II is divided further into explosion groups. The division depends on the safe gap and the minimum ignition current ratio.

Electrical equipment with approval for explosion group IIC can also be used in explosion groups IIA and IIB.

Explosion groups					
Equipment group	**Use**	**Explosion group**	**Safety gap for flameproof enclosure**	**Degree of hazard**	**Equipment requirements**
Group I	Electrical equipment for mines subject to firedamp. ==> fire-damp protection EEx...I				
Group II	Electrical equipment for all other hazardous areas ==> explosion protection EEx...II	IIA	> 0.9 mm		
		IIB	0.5 mm to 0.9 mm		
		IIC	< 0.5 mm		

[1)] *The safe gap is the gap width between two 25-mm long, parallel flange surfaces of an explosion chamber*

Safety parameters

Flammable dusts

Temperature classes

The ignition temperature of flammable gases or a flammable liquid is the lowest temperature of a heated surface at which the gas/air or vapor/air mixture ignites.

Thus the highest surface temperature of any equipment must always be less than the ignition temperature of the surrounding atmosphere.

Temperature classes T1 to T6 have been introduced for electrical equipment of explosion group II. Equipment is assigned to each temperature class according to its maximum surface temperature.

Temperature class	Maximum surface temperature of the equipment	Ignition temperatures of combustible substances
T1	450 °C	> 450 °C
T2	300 °C	> 300 °C
T3	200 °C	> 200 °C
T4	135 °C	> 135 °C
T5	100 °C	> 100 °C
T6	85 °C	> 85 °C

Equipment that corresponds to a higher temperature class can also be used for applications with a lower temperature class. Flammable gases and vapors are assigned to the relevant temperature class according to ignition temperature.

Dust from natural products	Ignition temperature	Smoldering temperature
Cotton	560 °C	350 °C
Wood dust	400 °C	300 °C
Fodder concentrate	520 °C	295 °C
Grain	420 °C	290 °C
Soya	500 °C	245 °C
Tobacco	450 °C	300 °C
Starch	440 °C	290 °C

Dust from technical/ chemical products	Ignition temperature	Smoldering temperature
Polyester	560 °C	
Rubber	570 °C	
Washing agent	330 °C	
Polyethylene	360 °C	
Polyvinyl acetate	500 °C	340 °C
Aluminum	530 °C	280 °C
Magnesium	610 °C	410 °C
Sulfur	280 °C	280 °C

Flammable gases and vapors

Substance designation	Ignition temperature	Temperature class	Explosion group
1,2-dichloroethane	440 °C	T2	II A
Acetaldehyde	140 °C	T4	II A
Acetone	540 °C	T1	II A
Acetylene	305 °C	T2	II C [3)]
Ammonia	630 °C	T1	II A
Petroleum spirit, gasoline, Initial boiling point < 135 °C	220 ... 300 °C	T3	II A
Benzene (pure)	555 °C	T1	II A
Cyclohexanone	430 °C	T2	II A
Diesel fuels (DIN 51601)	220 ... 300 °C	T3	II A
Jet fuel	220 ... 300 °C	T3	II A
Acetic acid	485 °C	T1	II A
Acetic acid anhydride	330 °C	T2	II A
Ethane	515 °C	T1	II A
Ethyl acetate	460 °C	T1	II A
Ethyl alcohol	425 °C	T2	II A / II B
Ethyl chloride	510 °C	T1	II A
Ethylene	425 °C	T2	II B
Ethylene oxide	440 (self-decomposing) °C	T2	II B
Ethyl ether	170 °C	T4	II B
Ethylene glycol	235 °C	T3	II B
EL heating oil (DIN 51603)	220 ... 300 °C	T3	II A
L heating oil (DIN 51603)	220 ... 300 °C	T3	II A
M and S heating oils (DIN 51603)	220 ... 300 °C	T3	II A
i-amyl acetate	380 °C	T2	II A
Carbon monoxide	605 °C	T1	II A / II B
Methane	595 (650) °C	T1	II A
Methanol	455 °C	T1	II A
Methyl chloride	625 °C	T1	II A
Naphthalene	540 °C	T1	II A
n-butane	365 °C	T2	II A
n-butyl alcohol	340 °C	T2	II A
n-hexane	240 °C	T3	II A
n-propyl alcohol	405 °C	T2	- *)
Oleic acid	360 °C (self-decomposing)	T2	- *)
Phenol	595 °C	T1	II A
Propane	470 °C	T1	II A
Carbon disulfide	95 °C	T6	II C [1)]
Hydrogen sulfide	270 °C	T3	II B
Special petroleum spirits, initial boiling point < 135 °C	200 ... 300 °C	T3	II A
City gas (illuminating gas)	560 °C	T1	II B
Tetralin (tetrahydronaphthalene)	425 °C	T2	- *)
Toluene	535 °C	T1	II A
Hydrogen	560 °C	T1	II C [2)]

Extract from the table "Safety parameters for combustible gases and vapors" by K. Nabert and G. Schön - (6th Edition)
*) The explosion group has not yet been established for this substance.
1) Also Explosion Group II B + CS2
2) Also Explosion Group II B + H2
3) Also Explosion Group II B + C2 H2

Installing and operating electrical systems in hazardous areas

Standards

The installation and erection regulations specified in EN 60079-14 apply, as well as national regulations.

Installation

Three installation systems are used for electrical systems in hazardous areas (see table on page 17).

Service and maintenance

Regular servicing is required to maintain the safety of electrical systems in hazardous areas.

Some of the most important safety measures are:

- Carrying out work on live electrical systems and equipment is prohibited in hazardous areas. Work on intrinsically-safe circuits is a permissible exception.
- In hazardous areas, grounding or short-circuiting is only permissible if there is no danger of explosion.
- In the case of all work carried out in hazardous areas, there must be no possibility of ignitable sparks or excessively hot surfaces occurring that cause an explosion in conjunction with a potentially explosive atmosphere.

Service and maintenance principles for the plant operator

- **Maintenance** of the proper state of the system
- **Continuous monitoring** of the electrical system
- Undelayed execution of the necessary **maintenance measures**
- **Proper operation** of the system
- **Cessation of operations** in the case of unrectifiable faults that can constitute a hazard to personnel

Installation systems in hazardous areas		
Cable systems with indirect cable inlet	**Cable systems with direct cable inlet**	**Piping systems**
The cables are inserted into the connection area of the protection type "Increased safety" via cable inlets and connected to the terminals. The terminals also have protection type "Increased safety".	The cables are run direct into the device installation areas. Only cable glands specially certified for this purpose can be used.	The electrical cables are fed into the closed metal piping as single cores. The piping is connected to the housing using glands and provided with a seal at every inlet point. The entire piping system is flameproof in design. The piping system is also known as a *conduit* system.

Obligations of the manufacturer, installer and plant owner		
Manufacturer	**Installer**	**Plant owner**
Tasks		
Development of the electrical equipment intended for use in hazardous areas.	Selection and installation of electrical equipment according to application.	Safe operation of the plant.
Obligations		
Observation of general and special design requirements and technological state-of-the-art. Request for testing by an independent institution if specified by the associated standard. Passing on of all approvals and manufacturer declarations to the user. Manufacture of each electrical unit according to the test documents and test specimens.	Selection and installation observing the installation requirements and the application. If the installer is not the owner at the same time, the installer is obliged on request of the owner to provide an installation certificate. This confirms that the electrical equipment corresponds to the requirements. If such a certificate is available, additional testing by the owner prior to first startup is no longer required.	Responsibility for safety of the plant. Zone assignment according to explosion hazards. Testing of correct, safe state of plant: • Prior to first startup • At specific intervals Correct operation of the electrical equipment. Every explosion which may be caused by operation of the plant must be reported to the supervisory authority.

Intrinsic safety

The intrinsic safety of a circuit is achieved by limiting the current and voltage. This characteristic limits the type of protection "Intrinsic safety" to circuits with a relatively low power. Applications include e.g. measuring and control technology.

The basis for the protection type "Intrinsic safety" is that a certain minimum ignition energy is required to ignite a potentially explosive atmosphere. In an intrinsically-safe circuit, no sparks or thermal effects occur in operation or in the event of a fault that ignite a potentially explosive atmosphere.

Categories of intrinsically-safe equipment

Intrinsically-safe electrical equipment and intrinsically-safe parts of associated equipment are divided into categories (safety levels). The safety levels depend on the safety requirements when designing the equipment.

Isolating amplifiers and isolating transformers

Isolating amplifiers and isolating transformers between the intrinsically-safe and non-intrinsically-safe circuits of the equipment provide the voltage and current limiting necessary for use in hazardous areas. The isolating amplifiers and isolating transformers can be designed as separate equipment or integrated in the modules.

Maintaining intrinsic safety

All devices in an intrinsically-safe circuit must correspond to the intrinsically safe type of protection. When wiring the nodes in this circuit (typically transmitters, sensors and the wiring itself), the characteristic electrical values must be maintained to ensure intrinsic safety.

Terms and definitions for intrinsic safety	
Intrinsically-safe circuit	A circuit in which no spark and no thermal effect can cause the ignition of a potentially explosive atmosphere.
Intrinsically-safe electrical equipment	All circuits of the electrical equipment are intrinsically safe. The voltage and current in the intrinsically-safe circuit are low enough such that a short-circuit, interruption or short-circuit to ground will not ignite the potentially explosive atmosphere. Intrinsically-safe electrical equipment is suitable for operation **direct in the hazardous area**. Typical marking: Ex ib IIC
Associated electrical equipment	At least one circuit of the associated electrical equipment is intrinsically safe. **Actuators and sensors connected to this intrinsically-safe circuit** can be located in the hazardous area. However, the associated electrical equipment **must not be located in the hazardous area** without further protection types. In the marking of associated electrical equipment, the type of protection is placed in brackets. Typical marking: [Ex ib] IIC
Minimum ignition energy	The minimum ignition energy of a gas and a vapor/air mixture is the smallest possible electrical energy discharged by a capacitor that can ignite the most ignitable mixture of a gas or a vapor with air at atmospheric pressure and 20 °C.

Safety level of intrinsically-safe equipment	Description	Installation of the equipment
ia	The intrinsically-safe electrical equipment must not cause an ignition • During normal operation • When a single fault occurs • When a combination of faults occurs	Up to zone 0
ib	The intrinsically-safe electrical equipment must not cause an ignition • During normal operation • When a single fault occurs	Zone 2, zone 1

Ex protection in North America Comparison of zones and divisions

The basic principles of explosion protection are identical all over the world. However, techniques and systems have been developed in North America in the area of explosion protection that differ significantly from those of the IEC (International Electrotechnical Commission).

The differences from IEC (International Electrotechnical Commission) technology include division of the hazardous areas, the design of equipment, and the installation of electrical systems.

Classification of hazardous areas

Areas subject to explosion hazard are termed "hazardous (classified) locations" in North America. In the US, they are defined in Sections 500 to 506 of the National Electrical Code (NEC), and in Canada they are defined in Section 18 and Annex J of the Canadian Electrical Code (CEC). They encompass areas in which flammable gases, vapors, or mist (Class I), dusts (Class II) or fibers and threads (Class III) can be present in hazardous quantities.

The hazardous areas are traditionally divided into Division 1 and Division 2 according to the frequency and duration of their occurrence.

In 1996, the US introduced the IEC classification system additionally to the existing system for Class I. This change was made by Article 505 of the NEC, enabling users to select the optimum system from a technical and economic point of view.

The IEC Zone concept was also introduced in Canada (CEC Edition 1988). Since then, all newly installed systems there must be classified according to this system.

In the traditional North American classification system, potentially explosive gases, vapors, and mist of Class I are arranged in Gas Groups A, B, C and D, and flammable dusts of Class II are arranged in Groups E, F and G.

The letter A here indicates the most hazardous gas group, while according to IEC and the new classification in accordance with Article 505, Group C is the most hazardous gas group.

In Canada, it is possible to use both gas group systems for zone classification.

Determination of the maximum surface temperature in accordance with Article 505 in the NEC takes place in agreement with IEC in six temperature classes T1 to T6, with an additional division into temperature subclasses in the division system.

The existing system of temperature classes has not been changed following the CEC 1998.

Degrees of protection provided by enclosures

Just as the IP degrees of protection have been defined in accordance with IEC 60529, the US has Standard Publ. No. 250 of NEMA (National Electrical Manufacturing Association) that deals with the degree of protection of housings.

These degrees of protection cannot be equated exactly with those of the IEC since NEMA takes account of additional environmental influences (e.g. coolants, cutting coolants, corrosion, icing, hail). The following table is therefore intended as a non-binding guideline.

Degrees of protection according to NEMA	Degrees of protection according to IEC
1	IP10
2	IP11
3	IP54
3R	IP14
3S	IP54
4 and 4X	IP56
5	IP52
6 and 6P	IP67
12 and 12K	IP52
13	IP54

Note:
*Since the degree of protection requirements of NEMA correspond to, or are higher than, the IP degrees of protection of IEC, the table **cannot** be used to convert the IEC degrees of protection into corresponding NEMA degrees of protection!*

Classification of hazardous areas

Gases, vapors, or mist Classification Class I		Dusts Classification Class II	Fibers and threads Classification Class III
NEC 500-5 **CEC J18-004**	**NEC 505-7** **CEC 18-006**	**NEC 500-6** **CEC 18-008**	**NEC 500-7** **CEC 18-010**
Division 1 Areas in which hazardous concentrations of flammable gases, vapors or mist are present continuously or occasionally under normal operating conditions.	Zone 0 Areas in which hazardous concentrations of flammable gases, vapors or mist are present continuously or over long periods under normal operating conditions. Zone 1 Areas in which hazardous concentrations of flammable gases, vapors or mist are present occasionally under normal operating conditions.	Division 1 Areas in which hazardous concentrations of flammable dusts are present continuously or occasionally under normal operating conditions.	Division 1 Areas in which hazardous concentrations of flammable fibers and threads are present continuously or occasionally under normal operating conditions.
Division 2 Areas in which hazardous concentrations of flammable gases, vapors or mist are not expected under normal operating conditions.	Zone 2 Areas in which hazardous concentrations of flammable gases, vapors or mist are not expected under normal operating conditions.	Division 2 Areas in which hazardous concentrations of flammable dusts are not expected under normal operating conditions.	Division 2 Areas in which hazardous concentrations of flammable fibers and threads are not expected under normal operating conditions.
Class I Groups		**Class II Groups**	**Class III**
NEC 500-3 **CEC J18-050**	**NEC 505-7** **CEC J18-050**	**NEC 500-3** **CEC J18-050**	
Division 1 and 2 A (acetylene) B (hydrogen) C (ethylene) D (propane)	Zone 0, 1 and 2 IIC (acetylene + hydrogen) IIB (ethylene) IIA (propane)	Division 1 and 2 E (metal) F (coal) G (grain)	Division 1 and 2 None
Class I **Temperature classes** **Division 1 and 2**	**Zone 0, 1 and 2**	**Class II** **Temperature classes** **Division 1 and 2**	**Class III** **Temperature classes** **Division 1 and 2**
T1 (≤450 °C)	T1	T1	None
T2 (≤300 °C)	T2	T2	
T2A (≤280 °C) T2B (≤260 °C) T2C (≤230 °C) T2D (≤215 °C)	–	T2A, T2B, T2C, T2D	
T3 (≤200 °C)	T3	T3	
T3A (≤180 °C) T3B (≤165 °C) T3C (≤160 °C)	–	T3A, T3B, T3C	
T4 (≤135 °C)	T4	T4	
T4A (≤120 °C)	–	T4A	
T5 (≤100 °C)	T5	T5	
T6 (≤85 °C)	T6	T6	

Installation regulations

Electrical equipment and systems for use in hazardous locations are covered by the National Electrical Code (NEC) in the USA, and the Canadian Electrical Code (CEC) in Canada. These assume the character of installation regulations for electrical systems in all areas and they refer to a number of further standards from other institutions that contain regulations for the installation and construction of suitable equipment.

The installation methods for the NEC's Zone concept largely correspond to those of the traditional Class/Division system. A new stipulation in the NEC 1996 is the use of metal-clad (MC) cables in addition to rigid conduits and mineral-insulated cables of Type MI in Class I, Division 1 or Zone 1.

Construction requirements

The regulations of the National Electrical Code and the Canadian Electrical Code specify which equipment or types of protection can be used in the individual hazardous areas.

In North America, different standards and regulations apply to the construction and testing of explosion-proof electrical systems and equipment. In the US, these are primarily the standards of Underwriters Laboratories Inc. (UL), Factory Mutual Research Corporation (FM) and the International Society for Measurement and Control (ISA). In Canada, it is the Canadian Standards Association (CSA).

Certification and designation

In the US and Canada, electrical equipment and resources in workplaces subject to explosion hazard generally require approval. Electrical equipment that cannot ignite the potentially explosive atmosphere in which it is used by virtue of its design or special properties, is an exception to this rule. The competent authority decides if approval is required.

Equipment that has been developed and manufactured for use in hazardous areas is tested and approved in the USA and Canada by nationally recognized testing agencies. In the USA, these include the testing agencies of the Underwriters Laboratories or Factory Mutual, and in Canada, the Canadian Standards Association. The UL and FM testing agencies are also the competent agencies for issuing approvals for Canada.

Any information relating to explosion protection must be shown on the marking of the equipment, along with information such as manufacturer, model, serial number and electrical specifications. The requirements for this are specified in the NEC, the CEC, and in the relevant construction regulations of the testing agencies.

Class I, II & III, Division 1 and 2

Approved electrical equipment for Class I, Class II and Class III, Division 1 and 2 must be marked to show the following information:

- Class(es), division(s)
  (optional except for Division 2)
- Gas/dust group(s)
- Operating temperature or temperature class
  (optional for T5 and T6)

Example: Class I Division 1 Groups C D T6

Class I, Zone 0, 1 and 2

In the case of equipment for use in Class I, Zone 0, Zone 1 or Zone 2, a distinction is made between "Division Equipment" and "Zone Equipment".

- Division Equipment:
  Equipment approved for Class I, Division 1 and/or Class I, Division 2, can also be provided with the equivalent zone marking:
  - Class I, Zone 1 or Class I, Zone 2
  - Gas group(s) IIA, IIB or IIC
  - Temperature class

Example: Class I Zone 1 IIC T4

- Zone Equipment:
  Equipment that corresponds to one or more protection types in accordance with Article 505 of the NEC and Section 18 of the CEC must be labeled as follows:
  - Class (optional in Canada)
  - Zone (optional in Canada)
  - Symbol AEx (USA) or Ex or Ex (Canada)
  - Short codes of protection type(s) used
  - Electrical equipment Group II or gas group(s) IIA, IIB or IIC
  - Temperature class

Example: Class I Zone 0 AEx ia IIC T6

Approval and testing agencies

Country	Approval/testing agency
Australia	International Testing and Certification Services (ITACS) 4-6 Second Street, Bowden South Australia 5007 Phone: +61-8-8346-8680, Fax: +61-8-8346-7072 E-mail: itacs@itacslab.com Internet: www.itacslab.com SAI Global Assurance Services 286 Sussex Street, GPO Box 5420, Sydney NSW 2001 Phone: +61-2-8206-6060, Fax: +61-2-8206-6061 E-mail: assurance@sai-global.com Internet: www.sai-global.com Simtars Head Office 2 Smith Street, Redbank Qld 4301, PO Box 467, Goodna Qld 4300, Australia Phone: +61-7-3810-6333, Fax: +61-7-3810-6363 E-mail: mare.tanner@nrm.gld.gov.au Internet: www.nrm.qld.gov.au/simtars/index.html TestSafe Australia 919 Londonderry Road, Londonderry NSW 2753 P.O.Box 592, Richmond NSW 2753 Phone: +61-2-4724-4900, Fax: +61-2-4724-4999 E-mail: testsafe@workcover.nsw.gov.au Internet: www.testsafe.com.au
Bosnia and Herzegovina	Institut za standarde, mjeriteljstvo i intelektualno vlasni tvo Hamdije Cemerlica 2/7, BiH - 71000 Sarajevo Phone +387-(0)33-65 27 65 Fax +387-(0)33-652757 E-mail: info@basmp.gov.ba Internet: www.basmp.gov.ba
Brazil	CEPEL Caixa Postal 68.007, CEP: 21.944-970, Rio de Janeiro, Brazil Tel: +55-21-2598-6458, Fax: +55-21-2280-3687 E-mail: pilotto@cepel.br
China	Shanghai Institute of Process Automation Instrumentation (SIPAI) 103 Cao Bao Road, Shanghai 200233, China Phone: +86-21-64368180, Fax: +86-21-64333566 E-mail: info@sipai.com Internet: www.sipai.com
Denmark	UL Internationales Demko A/S Lyskaer 8, P.O.Box 514, DK-2730 Herlev Phone: +45-44-85-65-65, Fax: +45-44-85-65-00 E-mail: info.dk@dk.ul.com Internet: www.ul-europe.com
Germany	DEKRA EXAM GmbH Dinnendahlstr. 9 44809 Bochum Phone: +49-234-36960, Fax: +49-234-3696111 E-mail: info@bg-exam.de Internet: www.bg-exam.de DMT GmbH Am Technologiepark 1, D-45307 Essen Phone: +49-201-172-01, Fax: +49-201-172-1462 E-mail: dmtinfo@dmt.de Internet: www.dmt.de FSA - Forschungsgesellschaft f. angewandte Systemsicherheit u. Arbeitsmedizin mbH Dynamostraße 7-11, D-68165 Mannheim Phone: +49-621-4456-1555, Fax: +49-621-4456-3645 E-mail: klaus.marsch@fsa.de Internet: www.fsa.de IBExU Institut f. Sicherheitstechnik GmbH Fuchsmühlenweg 7, D-09599 Freiberg Phone: +49-3731-3805-0, Fax: +49-3731-23650 E-mail: post@ibexu.de Internet: www.ibexu.de

Country	Approval/testing agency
Germany (continued)	Physikalisch-Technische Bundesanstalt (PTB) Bundesallee 100, D-38116 Braunschweig Phone: +49-531-592-0, Fax: +49-531-592-3008 Abbestraße 2-12, D-10587 Berlin Phone: +49-30-3481-1, Fax: +49-30-3481-490 E-mail: info@ptb.de Internet: www.ptb.de TÜV NORD AG Am Tüv 1, D-30519 Hanover Phone: +49-511-986-0, Fax: +49-511-986-1237 E-mail: info@tuev-nord.de Internet: www.tuev-nord.de TÜV Nord e.V. Große Bahnstraße 31, D-22525 Hamburg Phone: +49-40-8557-0, Fax: +49-40-8557-2295 E-mail: hamburg@tuev-nord.de Internet: www.tuev-nord.de
Finland	VTT Technical Research Centre of Finland P.O.Box 1000, FIN - 02044 VTT Phone: +358 20 722 111, Fax: +358 20 722 7001 E-mail: kirjaamo@vtt.fi Internet: www.vtt.fi
France	INERIS Headquarter Parc Technologique ALATA BP 2, F-60550 Verneuil en Halette Phone: +33-3- 44 55 66 77, Fax: +33-3-44 55 66 99 E-mail: ineris@ineris.fr Internet: www.ineris.fr LCIE - Laboratoire Central des Industries Électriques 33 av du Général Leclerc, F-92260 Fontenay-aux-Roses Phone: +33-1-40 95 60 60, Fax: +33-1-40 95 5529 E-mail: contact@lcie.fr Internet: www.lcie.com
United Kingdom	Baseefa (2001) Ltd, Rockhead Business Park, Staden Lane, Buxton, Derbyshire, SK17 9RZ Phone: +44 (0) 1298 766600, Fax: +44 (0) 1298 766601 E-mail: info@baseefa.com Internet: www.baseefa.com ERA Technology Ltd Cleeve Road, GB - Leatherhead Surrey KT22 7SA Phone: +44-1372-367-000, Fax: +44-1372-367-099 E-mail: info@era.co.uk Internet: www.era.co.uk SIRA Head Office South Hill, GB - Chiselhurst Kent BR7 5EH Phone: +44-20-846872636, E-mail: info@sira.co.uk Internet: www.sira.co.uk SIRA Certification Service (SCS) Rake Lane, Eccleston Chester England CH4 9JN Phone: +44 (0) 1244 670 900, Fax: +44 (0) 1244 681 330 E-mail: certification@siratec.co.uk Internet: www.siraservices.com SIRA Test and Certification Ltd The Hazardous Area Centre, Rake Lane, Eccleston, Chester, Cheshire, CH4 9JN, England Phone: +44-1244-670-900, Fax: +44-1244-681-330 E-mail: info@siracertification.com Internet: www.siraservices.com
Italy	Centro Elettrotecnico Sperimentale Italiano (CESI) Via Rubattino 54, I-20134 Milano Phone: +39-02 21251, Fax: +39-02 2125 5440 Internet: www.cesi.it

Country	Approval/testing agency
Japan	The Technical Institution of Industrial Safety (TIIS) Kiyose Test House 1-4-6 Umezono Kiyose, Tokyo 204-0024 Japan Phone: +81-424-91-4519, Fax: +81-424-91-4846 Internet: www.ankyo.or.jp The Technical Institution of Industrial Safety (TIIS) Headquarter 837-1 Higashi-Nakahara, Kamihirose Syama-shi, Saitama, 350-1321 Japan Phone: +81-42-955-9901, Fax: +81-42-955-9902 Internet: www.ankyo.or.jp
Korea	Korea Industrial Safety Corp. (KISCO) 34-4 Kusa-dong, Poopyoung-gu, Inchon 403-120, The Republic of Korea Phone: +82 32 5100 865, Fax: +82 32 518 6483-4
Croatia	ZIK - Zavod za Ispitivanje Kvalitete Robe d.d. Ljudevita Gaja 17/3, 10000 Zagreb, Croatia Phone: +385 (0) 1 4806 777, Fax: +385 (0) 1 4806 700 E-mail: info@zik.hr Internet: www.zik.hr
Netherlands	KEMA Quality B.V. P.O.Box 9035, NL-6800 ET Arnhem, Utrechtseweg 310, NL-6812 AR Arnhem Phone: +31-26 3 56 91 11, Fax: +31-26 3 89 24 77 E-mail: information@kema.com Internet: www.kema.com
Norway	Nemko AS (Head Office) PO Box 48, Blindern, Gaustadalleen 30, N-0314 Oslo Phone: +47-22 96 06 00, Fax: +47-22 96 06 01 E-mail: ncs@norsert.no Internet: www.nemko.de
Austria	TÜV Österreich Krugerstraße 16, A-1015 Wien Phone: +43-1-514-07-0, Fax: +43-1-514-07-6005 E-mail: office@tuv.at Internet: www.tuev.at
Sweden	Swedish National Testing and Research Institute (SP), Brinellgatan 4 Box 857, S-501 15 Boras Phone: +46 10-516 50 00, Fax: +46 33-13 55 20 E-mail: info@sp.se Internet: www.sp.se/eng
Switzerland	Eidgenössisches Starkstrominspektorat (ESTI) Luppmenstraße 1, CH-8320 Fehraltorf Phone: +41-44-956-1212, Fax: +41-44-956-1222 E-mail: esti@esti.ch Internet: www.esti.ch Electrosuisse Luppmenstraße 1, CH-8320 Fehraltorf Phone: +41 44 956 11 11, Fax: +41 44 956 11 22 E-mail: info@electrosuisse.ch Internet: www.electrosuisse.ch

Country	Approval/testing agency
Slovakia	EVPU a.s., SKTC 101 Trencianska 19, SK - 01851 Nova Dubnica (Slovakia) Phone: +421 42 44 32 161, Fax: +421 42 44 03 502 E-mail: trade@evpu.sk Internet: www.evpu.sk
Slovenia	SIQ - Slovenian Institute of Quality and Metrology Mr. Igor Likar Trzaska cesta 2, SI - 1000 Ljubljana Phone: +386-1-4778-100, Fax: +386-1-4778-444 E-mail: info@siq.si Internet: www.siq.si
Spain	Laboratorio Official Jose Maria Madariaga (LOM) Calle Alenzaa 1-2, E - 28003 Madrid Phone: +34 913367009, Fax: +34 914419933 E-mail: lom@lom.upm.es Internet: www.lom.upm.es
South Africa	South African Bureau for Standards (SABS) 1 Dr. Lategan Road; Groenkloof, Private Bag X191, Pretoria 0001, South Africa Phone: +27-12-428-7911/6405, Fax: +27-12-344-1568 E-mail: info@sabs.co.za Internet: www.sabs.co.za
Czech Republic	Physical-technical testing institute, Ostrava-Radvanice Pikartska 7, CZ - 71607 Ostrava-Radvanice Phone: +420 595223111, Fax: +420 59 62 326 72 E-mail: ftzu@ftzu.cz Internet: www.ftzu.cz
Ukraine	Testing Certification Center of Explosion protected and mining Electrical Equipment 50-ty Gvardeysky, divizii str., 17, Ukraine, 83052 Donetsk Phone: +38-(0622)-941243, Fax: +38-(0622)-3450417 E-mail: chuglazov@iscve.donetsk.na Internet: www.tccexec.org
Hungary	Prüfstelle für Ex-geschützte Elektrische Betriebsmittel, BKI Mikoviny Sámuel u. 2-4, H - 1300 Budapest, Pf. 115 Phone: (361) 368 9697, 388-9101, Fax: (361) 250 1720 E-mail: bkiex@bki.hu Internet: www.bki.hu
USA	Underwriter Laboratories Inc. Northbrook Division, Illinois, Corporate Headquarters 333 Pfingsten Road, Northbrook, IL 60062-2096; USA Phone: +1-847-272-8800, Fax: +1-847-272-8129 E-mail: John.P.Drengenberg@us.ul.com Internet: www.ul.com Factory Mutual FM Approvals 1151 Boston-Providence Turnpike P.O. Box 9102 Norwood, MA 02062 Phone: +1(1)7817624300 Fax: +1(1)7817629375 E-mail: approvals@fmglobal.com Internet: www.fmglobal.com/approvals

Product range for the hazardous area

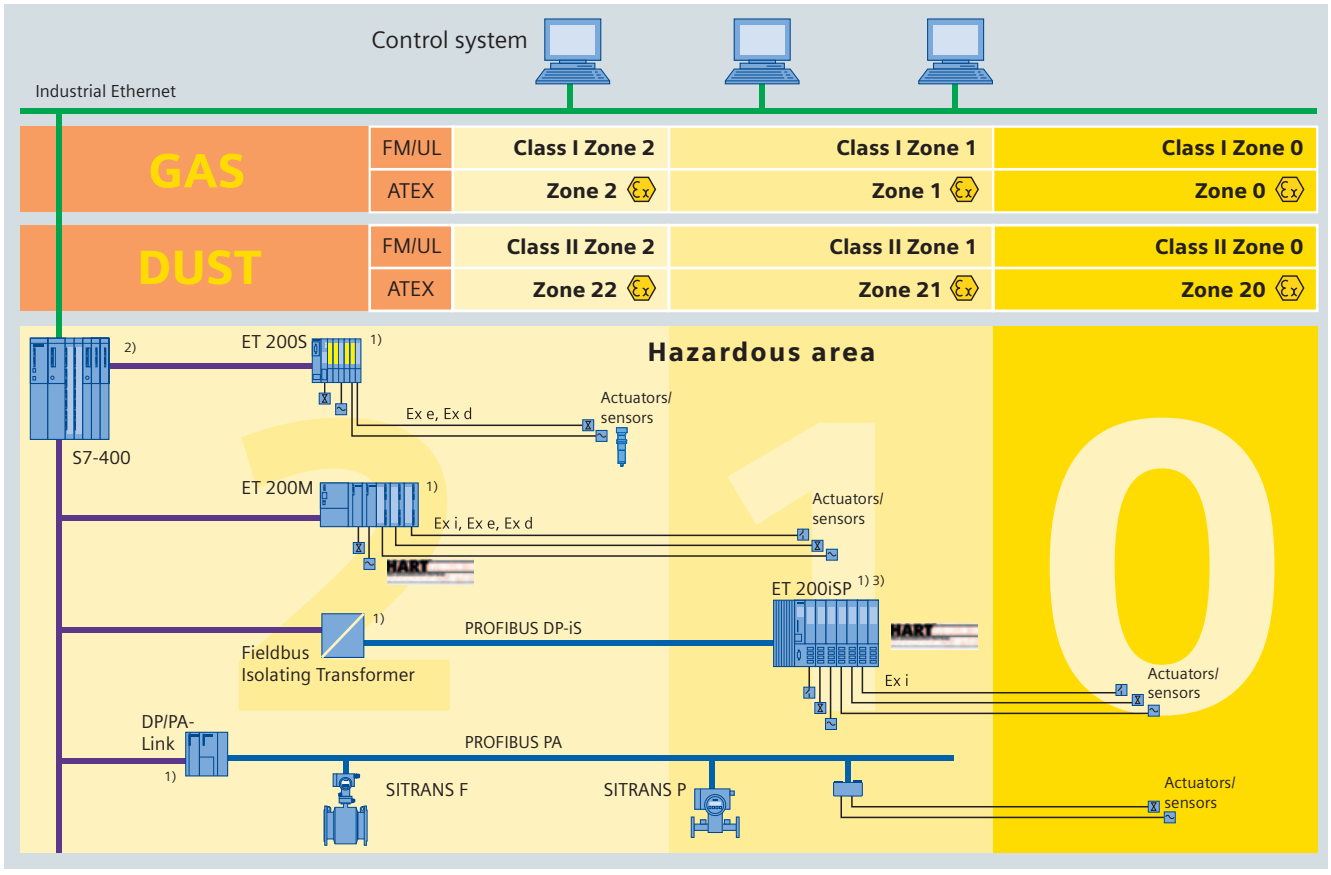
Siemens offers a wide range of products for use in hazardous areas.
Both components with conventional wiring as well as solutions based on communication buses can be found here. AS-i and PROFIBUS are used as communication buses.

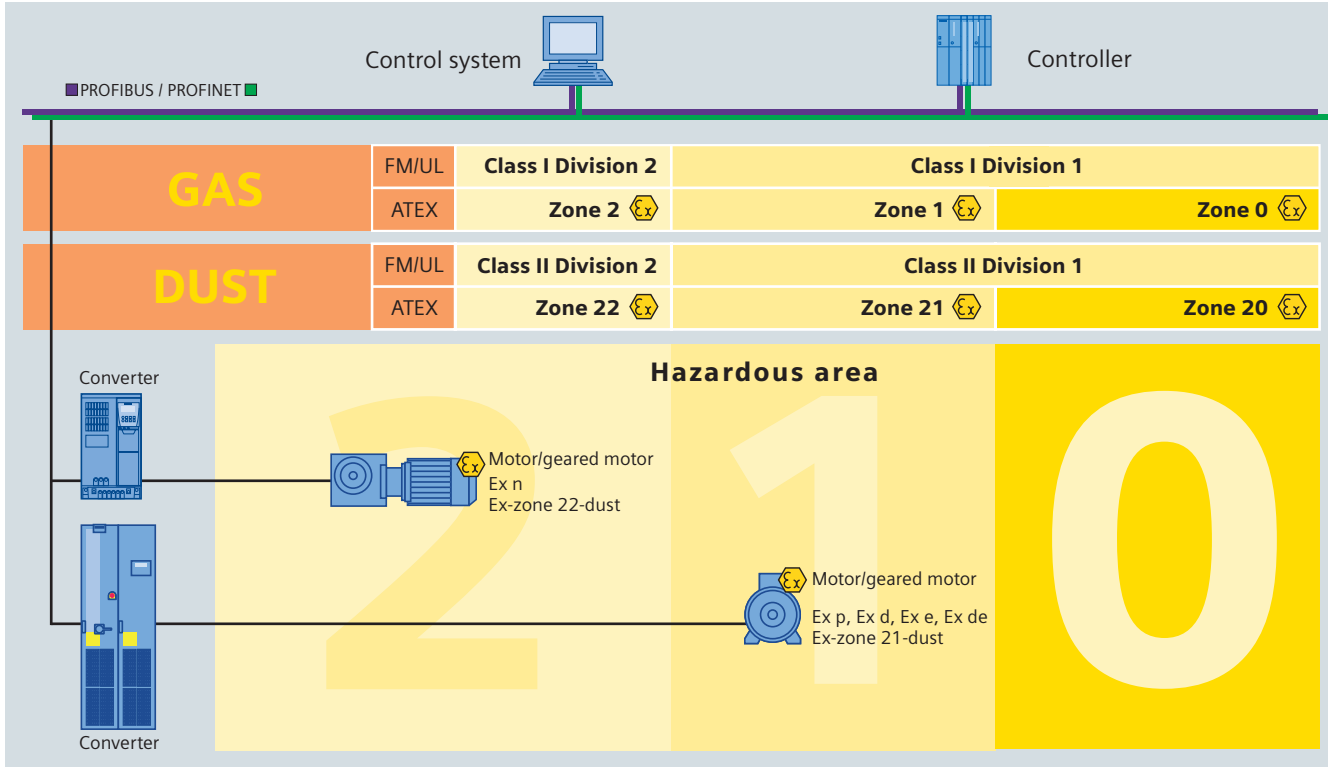
PROFIBUS is a powerful, open and rugged fieldbus system with short response times for use in all areas of production and process automation. PROFIBUS has integral diagnostics functions and can also be used for HART devices. Optical and wireless transmission technologies expand the possible applications of PROFIBUS.

The AS-Interface (Actuator-Sensor-Interface, AS-i) is an open, international standard for fieldbus communication of geographically distributed binary actuators and sensors at the lowest control level. In this purely electrical network, small volumes of data and energy are transmitted across the same bus cable.

The following components are available for the hazardous area:

- SIMATIC ET 200 distributed I/O
- SIMATIC HMI Touch Panels and Multi Panels
- SIMATIC NET, SCALANCE communications products
- SIRIUS low-voltage switchgear
- SIMATIC PX inductive, optical and ultrasonic proximity switches
- Asynchronous motors, synchronous motors, and geared motors of all performance classes





Use in hazardous gas and dust atmospheres

1) *Dust atmospheres: installation of components always in an enclosure with IP6X degree of protection.*

2) *With 10 A DC standard power supply*

3) *Installation of the station in accordance with FM/UL up to Class I, Division 2; connected sensors and actuators also up to Class I, Division 1 or installation of station and sensors/actuators in accordance with FM/UL up to Class II/III, Division 1*

Product range Industrial Automation Systems

SIMATIC ET 200

SIMATIC ET 200 provides different distributed I/O systems for solutions with or without a control cabinet direct at the machine, as well as for use in the hazardous area. The modular design makes it possible to scale and expand the ET 200 systems simply and in small stages. Already integrated add-on modules reduce costs, and at the same time offer a widely diverse range of possible applications. You can choose from the most varied combination options: digital and analog inputs/outputs, intelligent modules with CPU functionality, safety technology, motor starters, pneumatic systems, frequency converters, and diverse technology modules.

The ET 200 systems can be used in different zones – either in Zones 2 and 1 in the case of gaseous atmospheres, or in Zones 22 and 21 in the case of dusty atmospheres. The sensors and actuators linked to the I/Os can even be in Zone 0 or Zone 20.

A manufacturer's declaration (compliance of the control cabinet with the ATEX directive) is necessary for installation in Zone 2/22. Certification of the control cabinet for the gas/dust area must be procured for installation in Zone 1/21.

SIMATIC ET 200S

The all-rounder with the comprehensive range of modules

The multifunctional and bit-modular SIMATIC ET 200S I/O system with IP20 degree of protection can be exactly tailored to the most diverse automation tasks by using, for example:

- Technology modules, e.g. for counting and positioning tasks, cam control, or closed-loop control tasks.
- Pneumatic connection using modules from Bürkert
- Fail-safe I/O modules for integrating into safety-oriented plants with SIMATIC Safety Integrated

SIMATIC ET 200S COMPACT

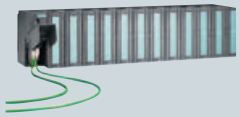
The IM 151-1 COMPACT interface module supplements the familiar module range of the proven ET 200S and enables its use as block I/O. The functionality is based on the IM 151-1 BASIC and comprises an interface module and 32 channels in one block. By expanding the block with ET 200S modules (up to 12 modules), a total of 128 channels can be connected to the SIMATIC ET 200S COMPACT. Extensive diagnostics functions are also available.

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
ET 200S		●		●	●		0 °C ... +60 °C	ATEX II 3 G	EEx nA II T4 or T5 or T6
								FM Class I	Division 2, Groups A,B,C,D T4 or T4A or T5 or T6
								FM Class I	Zone 2, Group IIC, T4 or T5 or T6
								cULus Class I	Division 2, Groups A,B,C,D T4 or T4A or T5 or T6
								cULus Class I	Zone 2, Group IIC, T4 or T5 or T6
ET 200S COMPACT				●			0 °C ... +60 °C	ATEX II 3 G	EEx nA II T4 bzw. T5 bzw. T6
								FM Class I	Division 2, Groups A,B,C,D T4 or T4A or T5 or T6
								FM Class I	Zone 2, Group IIC, T4 or T5 or T6
								cULus Class I	Division 2, Groups A,B,C,D T4 or T4A or T5 or T6
								cULus Class I	Zone 2, Group IIC, T4 or T5 or T6

SIMATIC ET 200M

The S7-300 I/O with high channel density

The ET 200M distributed I/O system is modulary designed with IP20 degree of protection. Up to 12 multi-channel signal modules (e.g. 64 digital inputs) and function modules as well as communications processors from the S7-300 range can be used as I/O modules (the interface to the process).



System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
ET 200M	● [1]	●	●	●	●		0 °C ... +60 °C	ATEX II 3 (2) G	EEx nA [ib] IIC T4(EEx ib HART modules)
								ATEX II 3 G	EEx nA II T4 or T5 or T6 (all other modules)
								FM Class I	Division 2, Groups A,B,C,D, T4 or T4A or T5 or T6
								FM Class I	Zone 2, Group IIC, T4 or T5 or T6
								cULus Class I	Division 2, Groups A,B,C,D, T4 or T4A or T5 or T6
								cULus Class I	Zone 2, Group IIC, T4 or T5 or T6

[1] *CiR in conjunction with S7-400*

SIMATIC ET 200iSP

The intrinsically-safe version for hazardous areas

The SIMATIC ET 200iSP has been specially designed for use under hazardous ambient conditions. Use of an isolating transformer makes PROFIBUS DP intrinsically safe. This is done by isolating the bus and limiting the energy in the safe area. The most varied modules are available for the SIMATIC ET 200iSP:

- 2-channel, 4-channel and 8-channel digital and analog input/output modules
- Pneumatic connection using modules from Bürkert
- Watchdog module for selective reading or writing of input/output data, for example, and the provision of an intrinsically-safe power supply for the shutdown signal of the digital outputs

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
ET 200iSP	●	●	●	●			-20 °C ... +70 °C	ATEX II 2 G (1) GD I M2	Ex de [ia/ib] IIC T4, Ex de [ia/ib] I
								IECEx Zone 1	Ex de [ia/ib] IIC T4
								cFMus, Class I, II, III	NI Division 2, Groups A,B,C,D,E,F,G T4 AIS Division 1, Groups A,B,C,D,E,F,G
								cFMus, Class I	Zone 1, AEx de [ia/ib] IIC T4
								cULus, Class I, II, III	Division 2, Groups A,B,C,D,E,F,G T4 providing int. safe circuits for Division 1, Groups A,B,C,D,E,F,G
								cULus, Class I	Zone 1, AEx de [ia/ib] IIC T4

SIMATIC Panels

SIMATIC Panels are rugged and are used for machine-level operator control and monitoring in harsh industrial environments. Their brilliant displays in different sizes and with long service life are a convincing argument. Communication is handled via PROFIBUS or PROFINET. WinCC flexible is used for configuring. Up to 32 project languages facilitate worldwide use.

Touch Panels

Touch Panels have pixel-graphics displays and are operated by means of a touch screen.

Panel	Display size	Membrane keyboard	Touch screen	PB	PN	AS-i	Temperature	Approval	Marking
TP 177B Inox	6"		●	●	●		0 °C ... +50 °C	IEC 61241-0 EN 61241-1	Ex nA II Tx Ex tD A22 Tx
TP 277	6"		●	●	●		0 °C ... +50 °C	IEC 61241-0 EN 61241-1	Ex tD A22 Tx

Multi Panels

Multi Panels are multi-functional platforms without fans or hard disk and with the Windows CE operating system.

Panel	Display size	Membrane keyboard	Touch screen	PB	PN	AS-i	Temperature	Approval	Marking
MP 277	8", 10"	●	●	●	●		0 °C ... +50 °C	IEC 61241-0 EN 61241-1	Ex tD A22 Tx
MP 277 Inox	10"		●	●	●		0 °C ... +50 °C	IEC 61241-0 EN 61241-1	Ex tD A22 Tx
MP 377	12", 15", 19"		●	●	●		0 °C ... +50 °C	IEC 61241-0 EN 61241-1	Ex tD A22 Tx

Communications products

SIMATIC NET system connections for SIMATIC S7

The communications processors (CPs) for SIMATIC S7-200, S7-300 and S7-400 offload the CPU and are designed for use in harsh industrial environments with wide temperature ranges. They are available in different versions and with different functions.

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
CPs for SIMATIC S7-200, S7-300 und S7-400, CSM 377	●	●	●	●	●	●	0 °C ... +60 °C	ATEX II 3 G	EEx nA II T4
								FM Class I	Division 2, Groups A,B,C,D, T4 or T4A
								FM Class I	Zone 2, Group IIC, T4
								cULus	UL 60950-1; CSA C22.2 60950-1-03
								cULus	UL 508; CSA C22.2 No. 142
								cULus Class 1	Division 2, Groups A,B,C,D
								cULus Class 1	Zone 2, GP IIC
								cULus Class 1	Zone 2, AEx nC IIC

Gateways

The benefits of Industrial Ethernet, PROFIBUS and AS-Interface can be ideally combined into one shared bus system using special links.

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
Gateways		●		●	●	●	0 °C ... +60 °C	FM Class I	Division 2, Groups A,B,C,D, T4 or T4A
								FM Class I	Zone 2, Group IIC, T4
								cULus	UL 60950-1; CSA C22.2 60950-1-03

Optical link modules for PROFIBUS

Optical PROFIBUS networks (line, ring, star) can be established using glass or plastic fiber optic cables with the help of optical link modules. They also enable use in the outdoor area down to -20 °C.

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
OLM optical link modules for PROFIBUS		●	●	●			-20 °C ... +60 °C	ATEX II 3 G	Ex nA IIC T4
								FM Class I	Division 2, Groups A,B,C,D, T4
								FM Class I	Zone 2, Group IIC, T4
								cULus Class I	Division 2, Groups A,B,C,D T4 or T4A
								cULus	UL 60950-1; CSA C22.2 60950-1-03

Security modules

The rugged and user-friendly security modules SCALANCE S effectively protect information within a system and also over public networks such as the Internet. They provide protection against data spying and manipulation, overload of the communication system, and mutual interference or incorrect addressing.

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
SCALANCE S		●			●		-20 °C ... +70 °C	ATEX II 3 G	EEx nA II T4
								FM Class I	Division 2, Groups A,B,C,D, T4
								FM Class I	Zone 2, Group IIC, T4
								cULus Class I	Division 2, Groups A,B,C,D, T4

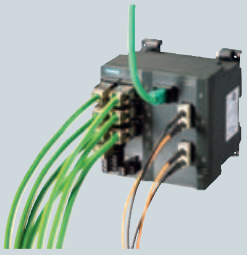
IWLAN components

The SCALANCE W components offer a unique combination of reliability, ruggedness and security. Industrial Wireless LAN (IWLAN) provides an expansion of the IEEE 802.11 standard aimed especially at industrial customers requiring strict real time and redundancy. This provides customers for the first time with a single radio link both for process-critical data (e.g. alarm messages) and for non-critical communication (e.g. service and diagnostics).

System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
SCALANCE W		●	●		●		-20 °C ... +60 °C	ATEX II 3 G	EEx nA II T4
								FM Class I	Division 2, Groups A,B,C,D, T4
								FM Class I	Zone 2, Group IIC, T4
								cULus Class I	Division 2, Groups A,B,C,D, T4
								cULus	UL 60950-1; CSA C22.2 60950-1-03

Industrial Ethernet switches

Industrial Ethernet switches of the SCALANCE X product family are active network components with which networks can be established in line, ring or star topologies, and data can be distributed selectively to the corresponding addressees. SCALANCE X offers a wide range of products that includes the right Industrial Ethernet switch for each automation task.



System	Configuration in Run	Hot swapping	Redundancy	PROFIBUS	PROFINET	AS-Interface	Temperature	Approval	Marking
SCALANCE X		●	●		●		-20 °C ... +70 °C	ATEX II 3 G	EEx nA II T4
								FM Class I	Division 2, Groups A,B,C,D T4 or T4A
								FM Class I	Zone 2, Group IIC, T4
								cULus Class I	Division 2, Groups A,B,C,D T4 bzw. T4A
								cULus Class I	Zone 2, GP, IIC, T4
								cULus Class I	Zone 2, AEx nC, IIC, T4
								cULus	UL 60950-1; CSA C22.2 60950-1

Product range
Low-voltage switchgear

Much low-voltage switchgear, such as overload relays and motor protecting switches, are intended for switching and controlling equipment in explosive atmospheres **while the switchgear itself is located outside the hazardous area.** This equipment is marked with the category of the electrical equipment to be protected but the category is set within round brackets, for example: Ex II (2) GD

Systems

AS-Interface – integrated system, superior strategy

- As a low-cost and rugged bus system for the field level, AS-Interface – open and vendor-independent – connects actuators and sensors with the control level – for standard applications as well as safety applications.
- A serial fieldbus provides simple, safe and integrated connection here for all the automation components. Thanks to the ATEX-certified K60 compact module, the AS-Interface can also be used in hazardous areas.

	Type	Series	Certificate number	Basis for approval	Type of protection/ marking
Digital I/O modules IP67 – K60	3RK1 400-1DQ05-0AA3, 3RK1 200-0CQ05-0AA3	K60	ATEX 2705	EN 60947-5-2 EN 50281-1-1	Ex II (3) D X

You can find more information on this product in the Catalog LV 1 and in the technical information LV 1 T in Chapter 2 (Information and Download Center: www.siemens.com/simatic/printmaterial).

[1] *Information on the use of current-monitoring motor protection devices. Definition of the heating time tE: If the rotor of an explosion-proof AC motor of protection type "Increased Safety" EEx e stalls (locks) at operating temperature during runtime, the motor must be switched off at the very latest when either the rotor or the stator winding has reached its maximum temperature. The time that elapses until the rotor or stator winding has reached maximum temperature is called the heating time tE or tE time.*
Demands made on overload protection devices with regard to the tE time: for trip units and relays with inverse time-delay tripping operation, tripping characteristics must be available at the operating site. The characteristics should show the tripping time for 3-pole loading, assuming a cold state and a room temperature of 20 °C, depending on at least a 3 to 8-fold current setting. The protective devices must comply with the specified tripping times with a permissible deviation of ± 20%. The tripping devices and relays for machines with cage rotors must be selected such that the tripping times for 3-pole loading do not exceed the heating time tE specified on the rating plate of the motor.

Protecting

SIRIUS circuit-breakers for motor protection

- The 3RV circuit-breakers are compact, current-limiting circuit-breakers. They guarantee safe shutdown in the event of a short circuit and protect loads and systems against overload. They are also suitable for switching loads under field conditions at low switching frequencies, and for safely isolating the load from the main power supply when maintenance work or modifications are necessary. SIRIUS 3RV is the only integrated product family on the market for circuit-breakers up to 100 A.

	Type	Series	Certificate number	Basis for approval	Type of protection/ marking
Circuit-breakers for motor protection	3RV10 11	S00	DMT 02 ATEX F 001, DMT 02 ATEX F 001 N1	IEC 60947-4-1, DIN EN 60079-14	Ex II (2) GD
	3RV10 21	S0			
	3RV10 31	S2			
	3RV10 41	S3			
	3RV10 42	S3			

Protecting

SIRIUS 3RB2 and 3RU1 overload relays

- The overload relays of the SIRIUS series, available in solid-state versions (3RB2) and thermal versions (3RU1), handle current-dependent overload protection in the main circuit. This encompasses all electrical loads – as well as all other, relevant switching and protection devices in the relevant load feeder. The overload relays are certified in accordance with ATEX and are thus suitable for motors of the protection type "Increased Safety" EEx e.

	Type	Series	Certificate number	Basis for approval	Type of protection/ marking
Solid-state overload relay 3RB					
for standard applications	3RB20, 3RB21	S00 ... S12	PTB 06 ATEX 3001	DIN EN 60079-1, DIN EN 60079-7, DIN EN 60079-14, IEC 60947-4-1, IEC 60947-5-1, IEC 60947-8, IEC 61508	Ex II (2) GD
for high-feature applications	3RB22, 3RB29		PTB 05 ATEX 3022		
Thermal overload relays 3RU1					
for standard applications	3RU11 1	S00	DMT 98 ATEX G 001, DMT 98 ATEX G 001 N1	IEC 60079-14, DIN EN 60079-14	Ex II (2) GD
	3RU11 2	S0			
	3RU11 3	S2			
	3RU11 4	S3			

You can find tripping characteristics for our circuit-breakers and overload relays on the Internet at:
www.siemens.com/lowvoltage/manuals

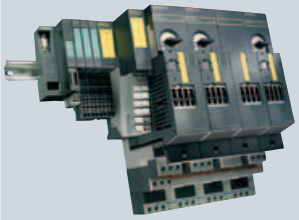
Starting

SIRIUS 3RW soft starters

- The soft starters offer a comprehensive range of products covering all standard and high-feature motor-starting applications. The advantages of soft start-up and smooth ramp-down with these devices can therefore be exploited in the most varied of applications for simple and economically efficient machinery and equipment layouts.

ET 200S 3RK standard motor starter

- Any three-phase current loads can be protected and started with the ET 200S motor starters. The fully pre-wired devices are available in different performance classes as direct starters, reversing starters and soft starters, up to a power rating of 7.5 kW.



	Type	Series	Certificate number	Basis for approval	Type of protection/ marking
Soft starters for standard applications	3RW40	S6, S10/S12	BVS 05 ATEX F 002	DIN EN 60079-14, IEC 60947-4-2, IEC 61508	Ex II (2) GD
Standard motor starters ET 200S	3RK13 01	S00	DMT 02 ATEX F 001 DTM 02 ATEX F 001 N1	DIN EN 60079-14 IEC 60947-4-1	Ex II (2) GD

Monitoring and controlling

SIMOCODE pro 3UF7 motor management system

- The communication-capable, modular motor management system SIMOCODE pro (SIRIUS Motor Management and Control Devices) provides quick and reliable protection for motors of the protective types Exe and Exd in hazardous areas. SIMOCODE pro is certified in accordance with the latest ATEX standards. Furthermore, the use of SIMOCODE pro does not involve any time constraints with regard to the periodically necessary function tests of branches in the Ex area.

SIMOCODE-DP 3UF5 motor protection and control devices

- SIMOCODE-DP is the predecessor of the SIMOCODE pro motor management system and offers the solution for the most diverse tasks in a single device.

	Type	Series	Certificate number	Basis for approval	Type of protection/ marking
SIMOCODE pro motor management and control devices	3UF7	S00 ... S12	BVS 06 ATEX F 001	DIN EN 60079-1, DIN EN 60079-7, DIN EN 60079-14, IEC 60947-4-1, IEC 60947-5-1 IEC 60947-8 IEC 61508	Ex I (M2), Ex II (2) GD
SIMOCODE-DP motor protection and control devices	3UF5	S00 ... S12	PTB 01 ATEX 3219	DIN EN 50019 DIN EN 60079-7 DIN EN 60079-14 IEC 60079-7	Ex II (2) G

Monitoring and controlling

SIRIUS 3RN1 thermistor motor protection relays for PTC sensors

- 3RN1 thermistor motor protection relays offer substantial advantages wherever current-dependent protection by means of circuit-breakers or overload relays is not the ideal solution. This is the case, for example, when in certain situations and often as a result of external influences, overheating occurs which the thermal mapping in the circuit-breakers/overload relays is unable to detect. SIRIUS thermistor motor protection relays have ATEX certification for gases and dust.

	Type	Width (mm)	Certificate number	Basis for approval	Type of protection/ marking
Thermistor motor protection relays for PTC thermistors (Type A)	3RN10 3RN10 11-.B 3RN10 11-.G 3RN10 12-.B 3RN10 12-.G 3RN10 13-...0	22,5; 45	PTB 01 ATEX 3218	DIN EN 60079-14, DIN EN 50281-1-1 IEC 60947-1, IEC 60947-5-1, IEC 60947-8	Ex II (2) G Ex II (2) GD

You can find more information on this product in the Catalog LV 1 and in the technical information LV1 T in Chapter 7 (Information and Download Center: www.siemens.com/simatic/printmaterial).

Detecting

3SE5 position switch

- Position switches are used wherever moving parts in plants and machines have to be positioned, controlled and monitored. Whether you use them to monitor protective equipment with rotary joints, or to monitor laterally sliding protective devices, or to detect hazardous machine part movements – our devices can meet just about all industrial requirements.

	Type	Width (mm)	Certificate number	Basis for approval	Type of protection/ marking
Position switch	3SE5112-.....-1DA0	56	ATEX 2829	DIN EN/IEC 61241-0	Ex II 3D
	3SE5122-.....-1DA0	40		DIN EN/IEC 61241-1	

You can find more information on this product in the Catalog LV 1 and in the technical information LV1 T in Chapter 8

Commanding and signaling

3SB3 command and signaling devices

- Commanding and signaling devices ensure that statuses of machines and plants (e.g. fault sources or interference factors) are reported reliably and at the right time and machines and plants can be controlled and brought to a safe state in hazardous situations.
  Our comprehensive portfolio includes both the actuators and contact blocks as well as the lamp holders with LEDs that have been categorized as simple electrical equipment in accordance with ATEX Directive 94/9/EC and are thus suitable for use in intrinsically-safe circuits.

	Type	Design	Certificate number	Basis for approval	Type of protection/ marking
Actuating elements					
Actuator	3SB30.. 3SB35..	Plastic or metal actuator	ATEX 2690b	Simple electrical equipment in accordance with EN 50020, IEC 60947-5-1	Use in circuits of type of protection i (intrinsically-safe) in accordance with EN 50020
Contact block	3SB34..	Spring-loaded terminals or screw terminals			
Components for actuating elements					
Lamp holder	3SB34..-1A	Spring-loaded terminals or screw terminals	ATEX 2689b	Simple electrical equipment in accordance with EN 50020, IEC 60947-5-1	Use in circuits of type of protection i (intrinsically-safe) in accordance with EN 50020 Use up to voltage 26.4 V (LEDs)
LED	3SB39 01-1.A	Rated voltage 24 V AC/DC, base BA9s			

Product range Sensors

SIMATIC PX proximity switches

As the sensory organs of the automation system, sensors must be used at exposed locations in the process. This applies also and especially for plants and machines in potentially explosive atmospheres. Sensors face special demands here with regard to explosion protection.

With the inductive, optical and ultrasonic proximity switches with ATEX certification for Zone 2 or Zone 22 SIMATIC PX proximity switches, for example, also open up typical Ex area applications from the food and beverages industry, paint shops, the chemicals industry, or woodworking.

Plug-in devices are protected against unauthorized disconnection by means of a security clamp on the plug.

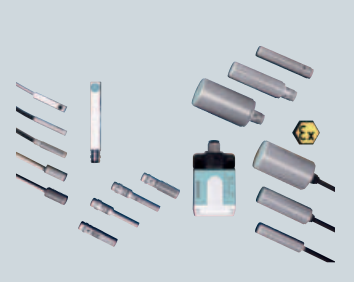
You can find more information on proximity switches in Chapter 2 of the Catalog FS10 or on the Internet at:
www.siemens.com/simatic-sensors/px

SIMATIC PXI600 inductive proximity switches

Thanks to their contact-less and thus spark-free switching characteristics, inductive proximity switches are especially suitable for use in explosive environments compared to conventional limit switches.

Sensing distances of 2 mm to 35 mm with compact and rugged designs offer diverse application possibilities even when space is restricted.

PXI600 inductive proximity switches are available in the designs M12, M18, M30, and C40S.



Compact series	Installation conditions	Operating distance	Connection	Approval	Marking
M12	Flush	2 mm	M12 connector Cable	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
	Non-flush	4 mm	M12 connector Cable	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
M18	Flush	5 mm	M12 connector Cable	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
	Non-flush	8 mm	M12 connector Cable	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
M30	Flush	10 mm	M12 connector Cable	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
	Non-flush	15 mm	M12 connector Cable	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
C40Shorty	Flush	15 mm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X
	Non-flush	35 mm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T80°C X

EC Declaration of Conformity:
http://support.automation.siemens.com/WW/view/en/22917125

SIMATIC PXO600 optical proximity switches

Optical proximity switches with large sensing ranges enable flexible and precise detection of objects over long distances regardless of the material.

You can select retroflective sensors, diffuse sensors, or thru-beam sensors for hazardous zone 2 and 22.

The optical proximity switches of the type K80 from the SIMATIC PXO600 series offer diverse fixing options. Output versions are available with two antivalent switching outputs or with one switching output and one surplus light emission output.

Operating mode	Switching output	Connection	Sensing range	Approval	Marking
Diffuse sensor	Light-on and dark-on pnp	M12 connector	2 m	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
Retroflective sensor	Light-on and dark-on pnp	M12 connector	6 m	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80°C X
		M12 connector	12 m	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
Thru-beam sensor	Emitter with enable input	M12 connector	50 m	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
	Light-on and dark-on pnp	M12 connector	50 m	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
	Light-on and dark-on pnp; surplus light emission with timer function 0.01 to 1 s	M12 connector	50 m	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X

EC Declaration of Conformity:
http://support.automation.siemens.com/WW/view/en/22919388

SIMATIC PXS810 ultrasonic proximity switches

Thanks to their detection principle, ultrasonic sensors are especially suitable for use in the frequently harsh environment of hazardous areas. Whether conditions are misty, dusty or contaminated: the sensor works reliably. Even levels in tanks or silos can be detected reliably with ultrasonic technology.

There are also devices of stainless steel available for contact with corrosive media or for use in the food and beverages industry.

Design	Switching output	Sensing range	Connection	Approval	Marking
M18	Switch output: NC contact Switch output: NO contact Analog output Frequency output	5 ... 30 cm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
		15 ... 100 cm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80°C X
M30	Switch output: NC contact Switch output: NO contact Analog output	6 ... 30 cm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
		20 ... 130 cm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
		40 ... 300 cm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X
		60 ... 600 cm	M12 connector	ATEX Zone 2/22	EX II 3G EEx nA II T6 X EX II 3D IP65 T 80 °C X

EC Declaration of Conformity:
http://support.automation.siemens.com/WW/view/en/22918207

Product range
Motors and geared motors

Gap-free portfolio for maximum safety

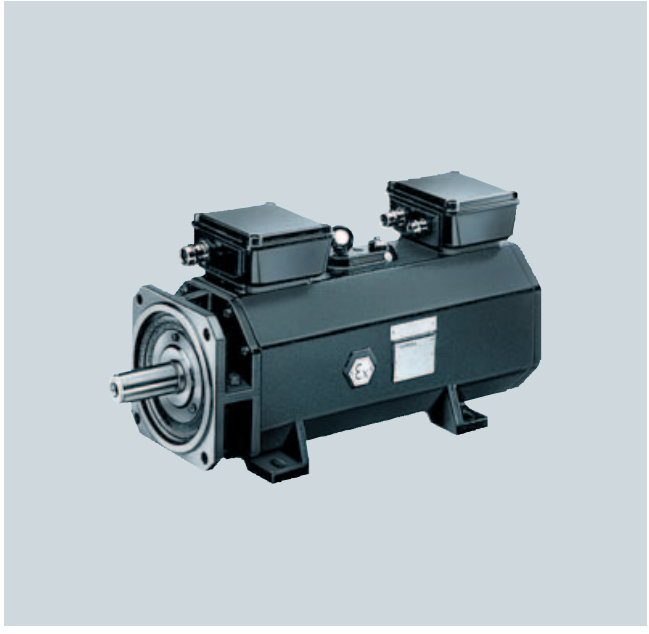
Siemens has for decades offered explosion-proof motors across all performance classes, thus ensuring reliable operation and maximum safety for personnel, machinery, and the environment, even in potentially explosive atmospheres. The acquisition of Loher GmbH in 2005 has significantly expanded and rounded-off the range in the area of explosion-proof drives.

For all applicable types of protection

The products offered by Siemens and Loher form a gap-free range – from 60 W to 100 MW, in a standard version or as a tailor-made customized solution, and with all applicable types of protection for gas and dust.

For motion control applications in explosion protection zones, such as are found in the printing industry and in paint shops, synchronous and asynchronous motors are available for use in Zone 1 and 2, as well as Zone 22.

1MJ explosion-proof asynchronous motor for use in Ex Protection Zone 1



1FS6 synchronous servomotor for use in Ex Protection Zone 1

Double protection for unusual requirements

Motors with double protection are available for special requirements: On one hand, this is the combination of gas and dust explosion protection for locations where fine explosive dust or gases can occur.

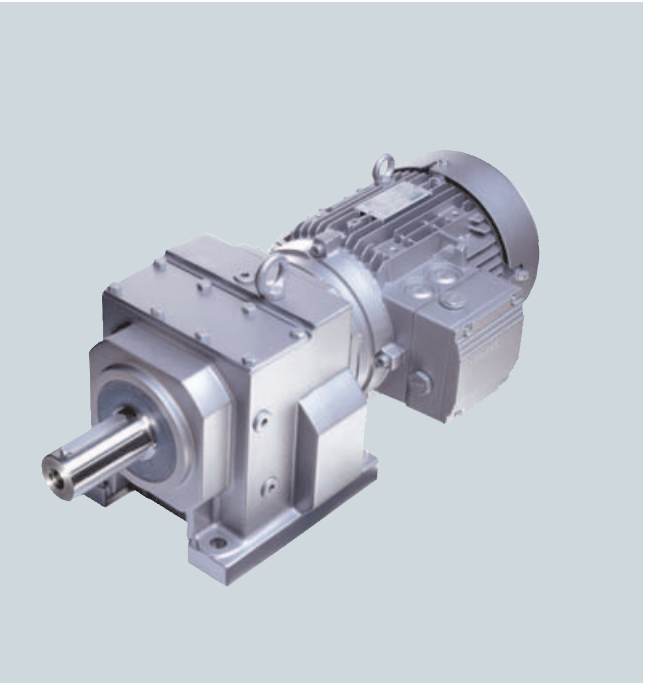
Equally possible is double protection in Ex d and Ex e, especially for locations with extremely high safety requirements, such as liquid gas tankers.

Geared motor version in accordance with ATEX

Like the motors, the geared motors are also offered in versions complying with ATEX. There are geared motors available here with all types of gears: Helical, helical bevel, helical worm, offset and worm gearboxes.

Converter systems for hazardous areas

With MICROMASTER, SIMOVERT MASTERDRIVES, SINAMICS and DYNAVERT, we offer frequency converters/inverters that are also tailored to the requirements of explosion protection. The DYNAVERT T, for example, has an ATEX-certified electronic shutdown mechanism thanks to integral TMS I/O board for Ex motors of Zone 1 and 2. In mining, special fire-damp-protected mining converters DYNAVERT I or DYNAVERT T are used.



MOTOX helical geared motor

Motor type	Protection types	Performance range/torque	Frame size (shaft height)	Speeds	Degrees of protection	Certifications
Asynchronous motors low-voltage	Ex n AII, Ex e II, Ex de IIC, Ex d IIC, Ex de I, Ex d I, Ex p II, dust Ex, double protection Ex d and Ex e as well as gas/dust	0.06 ... 4 000 kW	56 ... 630 mm	... 12 000 min^{-1}	IP20, IP55, IP56 (non heavy sea), IP65, IP67, IP68	ATEX, NEPSI, Rostekhnadzor etc.
Asynchronous motors high-voltage	Ex n AII, Ex e II, Ex de IIC, Ex d IIC, Ex de I, Ex d I, Ex p II, dust Ex, double protection Ex d and Ex e as well as gas/dust	200 ... 100 000 kW	350 ... 1 250 mm	... 15 000 min^{-1}	IP20, IP55, IP56 (non heavy sea), IP65, IP67, IP68	ATEX, NEPSI, Rostekhnadzor etc.
Synchronous motors for high-dynamic applications	Ex n, Ex d, Ex e, dust Ex	0.2 ... 385 kW	28 ... 280 mm	... 7 000 min^{-1}	IP64, IP65	ATEX
Gears and geared motors	Ex n AII, Ex de IIC, Ex d IIC, Ex e, dust Ex	0.12 - 200 kW; 50 ... 20 000 Nm	Gear frame size 18 ... 188	0.1 ... approx. 700 rpm	IP55, IP65	ATEX, Rostekhnadzor

Further information

SIMATIC ET 200 for distributed automation solutions
Brochure: Order No. 6ZB5310-0FM02-0BA.

SIRIUS Infinite Possibilities
Introduction to Industrial Controls
Brochure: Order No. E20001-A1000-P302

A gap-free range of
low-voltage motors up to 1250 KW
Brochure: Order No. E20001-A450-P220

MOTOX geared motors
Brochure: Order No. E80001-A440-P220-V1

SIMATIC PX proximity switches for reliable sensing, counting, measurement or monitoring
Brochure: Order No. 6ZB5330-0DA02-0BA.

References

Directive 94/9/EC of the European Parliament and Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres
Official Journal of the European Communities, No. L 100/1

Directive 1999/92/EC of the European Parliament and Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.
Official Journal of the European Communities, No. L 23/57

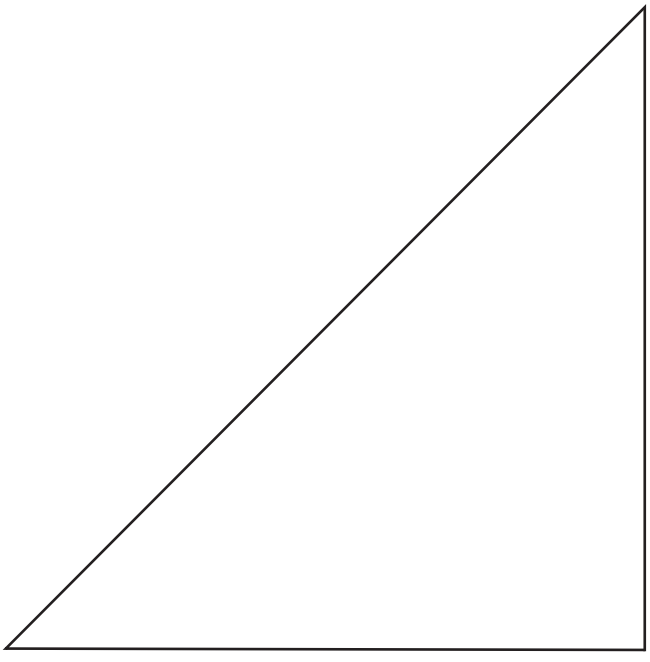
Working reliability regulation - BetrSichV: Ordinance concerning the protection of safety and health in the provision of work equipment and its use at work, concerning safety when operating installations subject to monitoring and concerning the organization of industrial safety and health at work.

K. Nabert and G. Schön:
Safety parameters for combustible gases and vapors
Published by Deutscher Eichverlag, Brunswick, Germany

EN 60529: 2000 (VDE 0470 Part 1)
Degrees of protection provided by enclosures (IP code)
EN 60079-14: 2004 (VDE 0165 Part 1)
Electrical apparatus for explosive gas atmospheres -
Part 14: Electrical installations in hazardous areas
(other than mines)
EN 61241-14: 2005 (VDE 0165 Part 2) Electrical apparatus for use in the presence of combustible dust - Part 14:
Selection and installation
Published by VDE-Verlag GmbH, Berlin

NFPA 70 - 1996 National Electrical Code, 1996 Edition
National Fire Protection Association, Quincy, MA, USA
NFPA 70 - 1999 National Electrical Code, 1999 Edition
National Fire Protection Association, Quincy, MA, USA
NFPA 70 - 2005 National Electrical Code, 2005 Edition
National Fire Protection Association, Quincy, MA, USA
2006 Canadian Electrical Code, 20th Edition
Canadian Standards Association, Etobicoke, ON, Canada
1996 National Electrical Code Review and Application Guide
Killark Electric Manufacturing Company, St. Louis, MO, USA
1998 Canadian Electrical Code Review and Application Guide
Hubbell Canada Inc. - Killark, Pickering, ON, Canada

Publication
Fundamentals of Explosion Protection
R. STAHL SCHALTGERÄTE GMBH,
Waldenburg



Get more information

Distributed I/O:
www.siemens.com/et200

Low-voltage switchgear and controlgear:
www.siemens.com/lowvoltage

Sensor technology:
www.siemens.com/simatic-sensors

Drives:
www.siemens.com/drives

SIMATIC Guide Manuals:
www.siemens.com/simatic-docu

Further publications on the topic of SIMATIC:
www.siemens.com/simatic/printmaterial

Service & Support portal:
www.siemens.com/automation/support

Contact persons in your region:
www.siemens.com/automation/partners

You can use the A&D Mall for direct orders via Internet:
www.siemens.com/automation/mall

Siemens AG
Industry Sector
Postfach 48 48
90026 NÜRNBERG
GERMANY

Subject to change without prior notice
Order No.: 6ZB5310-0LE02-0BA4
Dispo 26100
BS 0408 5. WE 44 En / 801554
Printed in Germany

www.siemens.com/automation

CLASSIFICATION OF HAZARDOUS AREAS

	Constant or occasional hazard	Rare or temporary hazard
USA NEC 500 Class I (gas) Class II (dust) Class III (fibers)	Division 1	Division 2

CLASSES AND GROUPS ACCORDING TO NEC 500

Typical types of gas/dust/ lint/fiber	Group	
Acetylene	Class I	Group A
Hydrogen	Class I	Group B
Ethylene	Class I	Group C
Propane	Class I	Group D
Methane	Mining	
Metal dust	Class II	Group E
Coal dust	Class II	Group F
Particle dust	Class II	Group G
Fibers/lint	Class III	

TEMPERATURE CLASSES

Maximum surface temperature	USA (NEC 500)	Maximum surface temperature	USA (NEC 500)
450 °C	T1	180 °C	T3A
300 °C	T2	165 °C	T3B
280 °C	T2A	160 °C	T3C
260 °C	T2B	135 °C	T4
230 °C	T2C	120 °C	T4A
215 °C	T2D	100 °C	T5
200 °C	T3	85 °C	T6

NEC 500	**Class I**	**Division 2**	**Groups A, B, C, D**		**T4**
NEC 505	**Class I**	**Zone 1**	**AEx**	**ib [ib/ia] de**	**IIC T4**
IEC			**Ex**	**ib [ib/ia] de**	**IIC T4**
CENELEC		**II 2 (1)*G**	**Ex**	**ib [ib/ia] de**	**IIC T4**

EXPLOSION GROUPS ACCORDING TO CENELEC, IEC, NEC 505

Explosion group	Typical gas
I	Methane
II A	Propane
II B	Ethylene
II C	Hydrogen

CLASSIFICATION OF GASES AND VAPORS IN EXPLOSION GROUPS AND TEMPERATURE CLASSES

	T1	T2	T3	T4	T5	T6
I	Methane					
IIA	Acetone Ethane Ethyl acetate Ammonia Benzene (pure) Acetic acid Carbon oxide Methane Methanol Propane Toluene	Ethyl alcohol i-Amylacetat n-Butane n-Butyl alcohol	Gasoline Diesel fuel Kerosene Fuel oil n-Hexane	Acetyl aldehyde Ethyl ether		
IIB	Town gas (Illuminating gas)	Ethylene				
IIC	Hydrogen	Acetylene				Carbon disulfide

EQUIPMENT GROUP I (Mining)

	Category M1	Category M2
Hazard level	Constant, long-term or frequent hazard	Occasional hazard

TEMPERATURE CLASSES

Maximum surface temperature	CENELEC IEC USA (NEC 505)
450 °C	T1
300 °C	T2
200 °C	T3
135 °C	T4
100 °C	T5
85 °C	T6

ZONE CLASSIFICATION

		Constant, long-term or frequent hazard	Occasional hazard	Rare or short-term hazard
CENELEC/IEC		Zone 0 (Zone 20 – dust)	Zone 1 (Zone 21 – dust)	Zone 2 (Zone 22 – dust)
USA	**NEC 505** Class I (gas)	Zone 0	Zone 1 [1)]	Zone 2

[1)] A device which has been approved for Class 1, Zone 1 can automatically be used in Class 1, Division 2.

EQUIPMENT GROUP II (other hazardous areas)

	Category 1		Category 2		Category 3		No category
Hazard level	Constant, long-term or frequent hazard		Occasional hazard		Rare or short-term hazard		No hazard
Application in	Zone 0	Zone 20	Zone 1	Zone 21	Zone 2	Zone 22	Safe area
Atmosphere G = gas, D = dust	G	D	G	D	G	D	

* (1) = The information in brackets refers to the associated device; in this case: associated electrical apparatus – installation in Category 1.

Types of protection for gases

Type of protection	K [1)]	Schematic representation	Basic principle	Standard	Examples	Use in zone 0	1	2
General requirements			General requirements for the type and testing of electrical equipment intended for the Ex area	EN 60079-0 IEC 60079-0 ANSI/UL 60079-0 FM 3600				
Increased safety	**e**		Applies only to equipment, or its component parts, that normally does not create sparks or arcs, does not attain hazardous temperatures, and whose mains voltage does not exceed 1 kV	EEN 60079-7 IEC 60079-7 ANSI/UL 60079-7	Terminals, terminal boxes		■	■
Flameproof enclosure	**d**		If an explosion occurs inside the enclosure, the housing will withstand the pressure and the explosion will not be propagated outside the enclosure	EN 60079-1 IEC 60079-1 ANSI/UL 60079-1	Switchgear, transformers		■	■
Pressurized enclosure	**p**		The ignition source is surrounded by a pressurized protective gas (min. 0.5 mbar) – the surrounding atmosphere cannot enter	EN 60079-2 IEC 60079-2 ANSI/UL 60079-2	Control cabinets, switchgear cabinets		■	■
Intrinsic safety	**i**		By limiting the energy in the circuit, the formation of impermissibly high temperatures, sparks, or arcs is prevented	EN 60079-11 IEC 60079-11 ANSI/UL 60079-11 FM 3610	Actuators, sensors, PROFIBUS DP RS 485-iS	■	■	■
Oil immersion	**o**		Equipment or equipment parts are immersed in oil and thus separated from the Ex atmosphere	EN 60079-6 IEC 60079-6 ANSI/UL 60079-6	Transformers, switching devices		■	■
Sand filling	**q**		Ignition source is buried in sand. The Ex atmosphere surrounding the housing cannot be ignited by an arc	EN 60079-5 IEC 60079-5 ANSI/UL 60079-5	Strip heaters, capacitors		■	■
Encapsulation	**m**		By encapsulation of the ignition source in a molding, it cannot ignite the Ex atmosphere	EN 60079-18 IEC 60079-18 ANSI/UL 60079-18	Sensors, switching devices	■	■	■
Types of protection	**n**	Zone 2: This type of protection includes several types	Slightly simplified application of types of protection in Zone 2. "n" stands for "not igniting"	EN 60079-15 IEC 60079-15 ANSI/UL 60079-15 FM 3611	Programmable controllers			■

[1)] Marking

Explosion Protection

www.siemens.com/industry

SIEMENS