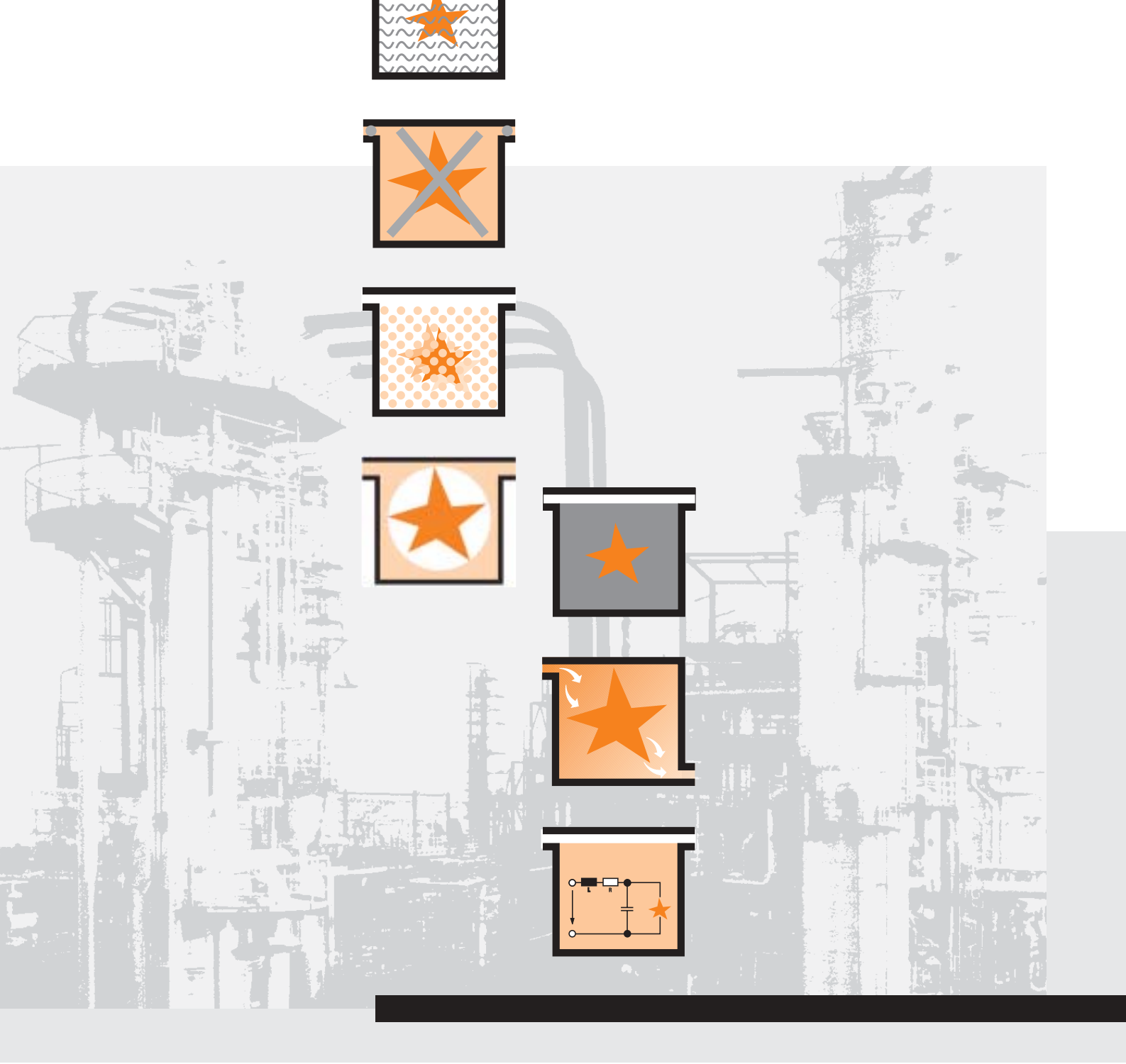
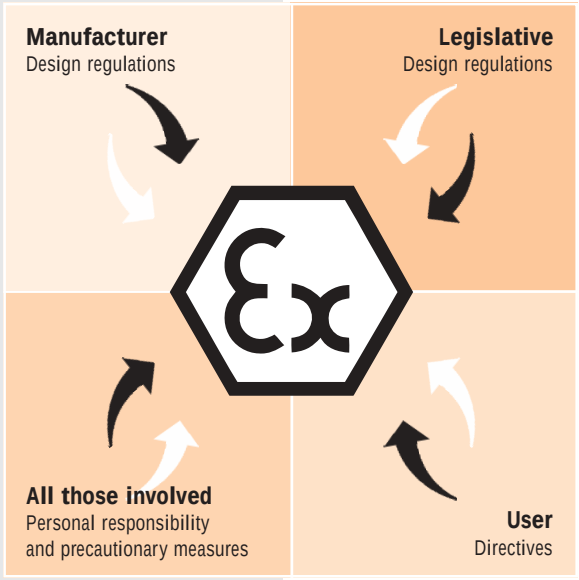


Basic concepts for explosion protection

Contents

Technical Development of Explosion Protection

Electrical equipment was introduced into industry and the household in the last century. Immediately afterwards, because of the methane and coal dust occurring in coal mines, the basics of electrical explosion protection were developed. The advantages of electricity were so convincing, that intensive work was carried out to find the means of reliably preventing contact between a potentially explosive atmosphere and ignition sources - originating from the use of electrical equipment - and thus preventing explosions.



After bitter experiences in the beginning, mine explosions were able to be made very much rarer, and well-monitored electrical equipment was utilised with very high safety standards.

Even more relevant than these solutions which concentrate on the ignition sources (the so-called secondary explosion protection) is primary explosion protection, i.e. the use of non-flammable materials which cannot form a potentially explosive atmosphere.

However, it is not always possible to exclude flammable material such as methane or coal dust in mines, or petrol, and in the future maybe hydrogen, in vehicles. Protection and safety are in such cases provided by equipment which is reliably protected against explosions.

These days, the construction of explosion-protected equipment has long left electrical engineering. As will be demonstrated by further descriptions, in the future non-electrical equipment will also require testing or at least assessing. Here the knowledge about the explosion protection of electrical equipment that manufacturers have collected over the decades is particularly important, and now it also benefits the manufacturers of non-electrical equipment. Often these manufacturers buy in electrical goods, therefore a contact can easily be made.

There are many applications which require explosion protected equipment. During the over 100 years of electrical explosion protection, principles and techniques have been developed which allow the use of electrical measuring technology, even where, e.g. in reaction vessels, an explosion hazard is permanently present.

Mining applications were only the beginning. The utilisation and processing of mineral oil and natural gas offer a wide scope for the utilisation of explosion protected equipment. Organic chemistry, the paint industry and the pharmaceutical industry all process flammable liquids and gases. Because of the production and utilisation of biogas and the ecological utilisation of waste dumps, new applications constantly are developing. The utilisation of hydrogen is being intensively discussed and practised in experimental installations and exhibited at trade fairs.

Technical development

Internationally unified design regulations for electrical engineering have been drawn up in the form of IEC standards and reports have been formulated, largely in agreement with those in the CENELEC standards.

The European Community has provided itself with an obligatory, uniform design requirement for the explosion protection of systems, devices and components with the Ex directive 94/9/EC, which is supported by the EN standards mentioned above and the CENELEC and CEN standardisation organisation.

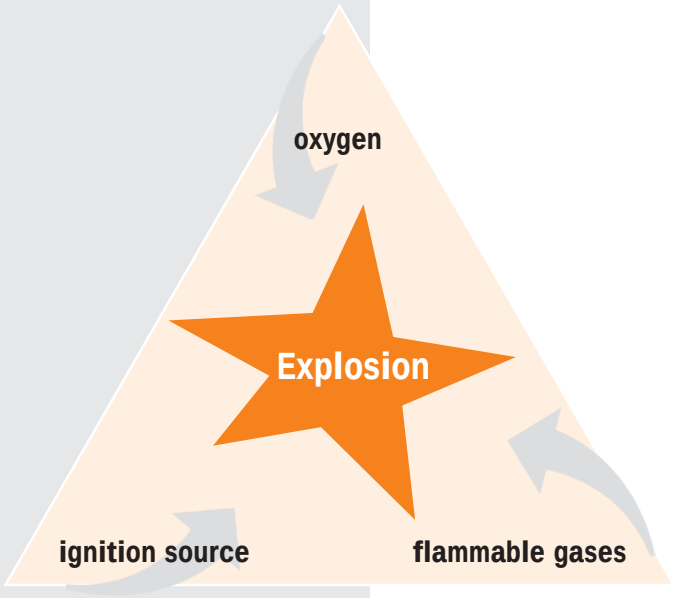
With the help of these standards, the manufacturer is safe to assume during the design and assessment of the explosion protection, that he is developing safe, explosion protected systems, devices and components conforming to the Ex directive 94/9/EC, which will be tested by applying uniform and obligatory criteria in an authorised EC test centre. The EC authorised test centres provide a manufacturer-independent EC prototype certification which guarantees a uniform quality throughout, with regard to the required safety of the explosion protected equipment, at a very high or enhanced safety level. These EC prototype certificates, or assessments provided by the manufacturer, are the prerequisite for the production and distribution of systems, devices and components at a very high or enhanced safety level.

Constant, uniform quality requirements are, according to Ex directive 94/9/EC, also required for the type of the installation and for the servicing required for maintaining the safe state. The technical parameters are also defined in EN standards.

Uniform classification of the explosion-hazard equipment is the basis for the selection and classification of systems and devices, including their installation. The appropriate EN standards are being developed and passed step by step as directive 1999/92/EC is becoming adopted. According to this EC directive, an Ex document is the precondition for setting up and operating an explosion-hazard facility. Only such a document makes it possible to select and install, operate, maintain and eventually repair it as required by the standard systems, devices and components.

Using the two EC directives mentioned above, a consistent system is created which allows successful prevention of explosions for the effective protection of people, the environment and property.

Explosion protection



Explosion

An explosion is defined as a sudden reaction involving a rapid physical or chemical oxidation reaction or decay generating an increase in temperature or pressure or both simultaneously. The most familiar reactions are those of flammable gases, vapours or dust with the oxygen contained in the air.

Basis for an explosion

As a rule, for explosions to happen in atmospheric air, three factors have to be present at the same time:

- flammable substance
- oxygen (air)
- source of ignition

In production and work areas an increased risk of explosion can develop wherever the preconditions for an explosion are fulfilled. Typical explosion-hazard areas form in chemical factories, refineries, enamelling plants, paint workshops, cleaning equipment, mills and stores for milled products and other combustible dust, in tank facilities and loading areas for flammable gases, liquid and solids.

The first two components - the flammable substance and air - must be present in sufficient quantities to form a potentially explosive atmosphere. The statutory definitions of explosion protection - deduced from the health and safety at work regulations - are concerned with workplaces. For this reason discussions about explosion protection are usually restricted to reactions with the oxygen in the air. Oxidation reactions normally involve the release of heat and a pressure increase, and therefore fulfil the criteria of an explosion.

It is generally assumed that a volume of 10 l of a potentially explosive mixture in an enclosed space can cause damage - particularly to people. For this reason, any area in which such a volume of a potentially explosive mixture can collect is described as an explosion hazard zone.

Other compounds such as chlorine in reaction with hydrogen are also capable of forming potentially explosive mixtures and have already led to explosions in the past. However, as these reactions usually take place inside containers or reactors, they concern the safety of these facilities and their effects on the environment are therefore dealt with in the EC machinary directive and incident analysis.

Explosion range

In the internal combustion engine the three components work together in a sensible way: petrol, air/oxygen and the ignition spark produce an explosion inside the enclosed cylinder. For this to take place the ratio of petrol to air must be correct. If the petrol tank is empty, the air filter is blocked or if the ignition does not work, one of the components for triggering this controlled, useful explosion is missing and the motor will not start.

Combustible materials mixed with air have a lower and an upper explosion limit, between these limits the explosion range is found. When considering the safety of workplaces, the lower explosion limit is the more important value, a possible concentration of at least 20 % less than that value is often regarded as safe.

Prevention of explosions

Explosion protected equipment is able to exclude one of the preconditions for an explosion - the ignition source - and is in that way an important contribution to explosion protection.
In domestic areas, constructional measures ensure that normally an explosive atmosphere cannot form. The conscious restriction of these measures, e.g. the intended, unimpeded flow of flammable gases or a reduction in ventilation can lead to explosion if an ignition source is also present.

The easiest and simplest way to understand small and safe explosions is by looking at a gas lighter. When the nozzle of the lighter is opened it releases a small amount of flammable gas. This gas mixes with the surrounding air, the spark from the flint ignites the mixture, and a weak sound is heard - the burning.
Some distance away from the nozzle the proportion of the flammable gas is already so low that the explosion and the flame are restricted to the immediate vicinity of the nozzle. In other words, the design of the gas lighter has ensured that it is safe to use.

The effect of an explosion in enclosed spaces and under non-atmospheric conditions is often more powerful. Just think of the useful application of explosions in vehicle engines.

Effective preventive explosion protection for non-controlled, unintended and therefore very damaging explosions can only be achieved by removing one of the three components.

Primary explosion protection

Primary explosion protection aims at substituting something else for the flammable substances or the atmospheric oxygen or reducing their quantities to the point where there is no danger of a potentially explosive mixture forming.

Increased air circulation, air flushing, through ventilation can be achieved by structural measures; e.g. the open layout of filling stations where the explosion hazard area is very small.

Replacing the atmospheric oxygen is not an option for areas where people work. For this reason the measures available for such locations are limited to:

- avoidance or restriction of substances which are capable of forming a potentially explosive atmosphere
- avoidance or restriction of release of the flammable substances and therefore formation of potentially explosive mixtures, both inside and around fittings, e.g. by
  - limiting their concentration
  - using enclosures filled with an inert substance
  - natural or artificial ventilation
  - concentration monitoring by means of a gas detection system, which will give an alarm /or switch off the system

Three factors

Flammable substances

Flammable substances can be gaseous, liquid or solid. For a general discussion relevant to workplaces, their reactivity with atmospheric oxygen is considered.

Flammable gases

A flammable gas may be an element such as hydrogen which can be made to react with oxygen with very little additional energy. Flammable gases are often compounds of carbon and hydrogen. These flammable gases require only small amounts of energy to react with atmospheric oxygen.

A vapour is the proportion of a liquid - if talking about the explosion protection of flammable liquids - which has evaporated into the surrounding air as the result of the vapour pressure above the surface of the liquid, around a jet of that liquid or around droplets of the liquid. Mist is a special type, which because of its explosion behaviour, can be included with the vapours, for the purposes of fulfilment of safety considerations.

Hydrogen

Carbon

Hydrogen

Flammable liquids

Flammable liquids are often hydrocarbon compounds such as ether, acetone or petroleum spirit. Even at room temperature, sufficient quantities of these can change into the vapour phase so that a potentially explosive atmosphere forms near their surface. Other liquids form such an atmosphere near their surface only at increased temperatures. Under atmospheric conditions this process is strongly influenced by the temperature of the liquid.

Petrol

Ether

Nitrogen

Nitrogen

Oxygen

For this reason the **flash point**, or rather the flash point temperature, is an important factor when dealing with flammable liquids. The flash point relates to the lowest temperature at which a flammable liquid will, under certain test conditions, form a sufficient quantity of vapour on its surface to enable an effective ignition source to ignite the vapour air mixture.

The flash point is important for the classification of hazardous areas. Flammable liquids with a high flash point are less dangerous than those with a flash point at room temperature or below.

When spraying a flammable liquid, **a mist** can form consisting of very small droplets with a very large overall surface area, as is well-known from spay cans or from car spraying stations. Such a mist can explode. In this case the flash point is of lesser importance. For a fine mist - made from a flammable liquid - the behaviour relevant to safety can be roughly derived from the known behaviour of the vapour.

Acetone

Flour dust

Wood-Dust

Sugar dust

Oxygen

O_2

Flammable solids

Flammable solids in the form of **dust, fibres** or **flock** can react with atmospheric oxygen and produce disastrous explosions. Normally more energy is required for activating the explosion in air than with gases and vapours. However, once combustion starts, the energy released by the reaction produces high temperatures and pressures. In addition to the chemical properties of the solid itself, the fineness of the particles and the overall surface area, which increases with increasing fineness, play an important part. The properties are processes which take place immediately at the surface of the solid. Lighting and extinguishing a paraffin wax candle provides a demonstration of a series of processes undergone by a solid material within a short period of time which cannot easily be presented in a simplified form.

An experiment shows that when the wick of a candle is lit, the paraffin wax melts and then vaporises and that this vapour feeds the flame. After extinguishing the candle, the paraffin vapour can still be smelled, the melted paraffin wax solidifies and the paraffin vapours disperse. Now the paraffin wax candle is once again a harmless object.

Dust reacts very differently, depending on whether it is in a deposited layer or whether it is in a suspended dust cloud. Dust layers are liable to begin smouldering on hot surfaces, while a dust cloud which has been ignited locally or through contact with a hot surface can explode immediately. Dust explosions are often the consequence of smouldering dust layers which become stirred up and already carry the ignition initiation. When such a layer is stirred up, for example by mechanical cleaning methods or inappropriate extinguishing attempts, this can lead to a dust explosion.

A gas or vapour/air explosion can also stir up the dust, which then often leads to the first, the gas explosion, turning into the second, the dust explosion. In deep coal mines methane/firedamp explosions often have triggered off coal dust explosions whose consequences were more serious than those of the original firedamp explosion.

Wood-Dust

Oxygen

The quantity of oxygen available in the air is only sufficient to oxidise/burn a certain quantity of the flammable material. The ratio can be determined theoretically, it is called the stoichiometric mixture. When the quantity of the flammable substance and the available atmospheric oxygen are near to at the correct ratio, the effect of the explosion - temperature and pressure increase - is most violent. If the quantity of flammable material is too small, combustion will only spread with difficulty or will cease altogether. The situation is similar when the quantity of flammable material is too great for the amount of oxygen available in the air.

All flammable materials have their explosive range, which also depend on the available activation energy. This is usually determined by igniting the mixture with an electric spark. The explosion range is bounded by the lower explosion limit and the upper explosion limit. This means that below and above these limits, explosions will not happen. This fact can be utilised by sufficiently diluting the flammable substances with air or by preventing the ingress of air/oxygen into parts of the equipment. The latter option is, however, not, or only with restrictions, possible in environments where people regularly work and must therefore be reserved for technological equipment.

Sources of ignition

With technical equipment a large number of ignition sources is possible. In the following overview the numbers given behind the ignition sources refer to the appropriate sections of the basic standard:

EN 1127-1:1997 „Explosive atmospheres - Explosion prevention and protection- Part 1: Basic concepts and methodology.“

Hot surfaces (6.4.2) arise as the result of energy losses from systems, devices and components during normal operation. In the case of heaters they are desired. These temperatures can usually be controlled.
In the event of a malfunction - for example with overloading or tight bearings - the energy loss, and therefore the temperature, increases unavoidably. Technical equipment must always be assessed as to whether it is stabilising - i.e. whether it can attain a final temperature, or whether non-permissible temperature increases are possible which need to be prevented by taking appropriate measures.

Examples: coils, resistors or lamps, hot equipment surfaces, brakes or overheating bearings

For example, grinding and cutting devices **mechanically generated sparks (6.4.4)** during normal operation are therefore not permitted in explosion hazard zones. Cracks in rotating parts, parts sliding over each other without sufficient lubrication and similar situations can generate such sparks when malfunctioning, and this must be carefully thought about when considering malfunctions.
Special requirements on the housing materials are intended to reduce the risks from such ignition sources.

Examples: tools such as a rusty hammer and chisel in contact with light alloys or the metal fork of a fork lift truck

Visible electric sparks - lightning (6.4.8) must normally be regarded as a sufficient ignition source. Only very low energy sparks with energies of only microwatt seconds may be regarded as too weak to start an explosion. For this reason, suitable measures must be adopted to prevent these ignition sources.

Examples: switching sparks, sparks at collectors or slip rings

Independently of whether or not there is an electrical voltage supply, electrical sparks can be caused by **static electricity - (6.4.7)**. The stored energy can be released in the form of sparks and function as an ignition source. Because this ignition source can arise quite independently of an electrical voltage supply, it must also be considered with non-electrical devices and components. It is connected with separation processes; therefore these cases must be assessed where this ignition source needs to be taken into account.
Friction during normal operation can be the cause of electrostatic charging. For example, portable devices cannot - due to their portability - be earthed or connected to an equipotential bonding ring. When interacting with the clothes of the user, static charging can occur during normal operation. Static electricity must be prevented from becoming an ignition source by taking appropriate measures.

Examples: Transmission belts made from plastic materials, housings of portable devices, synthetic clothing material. Separation processes when rolling out paper or plastic film, plastic pipe systems

Electric rails and other earthed voltage supplies e.g. for electric corrosion protection of equipment, can result in **stray electric currents, cathodic corrosion protection (6.4.6)** which then may result in a potential difference between different earthing points. This is why a highly conductive connection to all the electrically conductive parts of the equipment must be provided so that the potential difference is reduced to a safe level. It is not relevant whether the conductive equipment is electrical or non-electrical parts of the installation, as the cause of the current may be found outside of the equipment.

An equipotential bonding must always be provided, irrespective of whether or not such currents are expected or whether its sources are known.

Flames, hot gases and particles (6.4.3) can occur inside combustion engines or analysis devices during normal operation and when a fault has occurred. Protective measures are required here which are able to permanently prevent them from leaving the housing.

Examples: Exhausts from internal combustion engines or
particles which are formed by the switching sparks
of power switches eroding material from the switch contacts

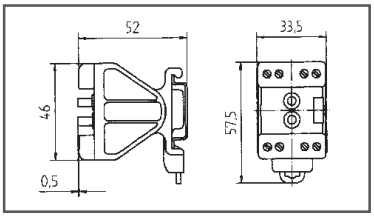
Among the ignition sources where radiation energy enters the potentially explosive mixture, the following deserve to be mentioned:
Ultrasonic (6.4.12),
Electro-magnetic radiation - radio waves (6.4.9),
Electro-magnetic radiation - IR radiation, visible light (6.4.10)
ionising radiation - UV radiation (6.4.11).

If their parameters are permanently and securely limited and tested, systems, devices and parameters utilising radiation can be operated in explosion hazard zones, otherwise the radiation must be reliably prevented from entering the explosion hazard area.

Examples: transmitting and receiving equipment, mobile telephones, photoelectric barriers and scanners

Finally, **adiabatic compression and shock waves (6.4.13)** as they occur inside tube-shaped structures operated at an underpressure can become an ignition source.
Examples: breakage of a long fluorescent tube which is filled with a hydrogen/air atmosphere

Prevention of ignition sources



Idea

Designed to design regulations
EN 50014 to EN 50020

Approval by an accredited organisation
EC prototype certification

Quality assurance system in operation in
conformity with directive 94/9/EC

Manufacturer – Routine tests

Installation in conformity with the regulations
regarding manufacture EN 60079-14

Commissioning

Commissioning e.g. by an accredited expert

Maintenance

Maintenance by safety engineering personnel

Protection principles

This refers to principles which are suitable for preventing ignition sources in systems, devices and components.

Ignition sources which are caused by sparks from friction or impact or from electro-static charging have to be prevented in explosion-protected equipment by selecting an appropriate material and by constructive measures, and this must be verified and confirmed by the appropriate tests.

Four protection principles can prevent equipment from becoming an ignition source. The types of protection listed in the examples are discussed in a different section.

An important precondition for all the protection principles is that parts which are in unhindered contact with the potentially explosive atmosphere must not be able to reach non-permitted temperatures, which depend on the ignition temperature. This means that the ignition temperature is relevant for all protection principles.

The protection principles can be equally applied to electrical and non-electrical devices and for gases and for dust. The principles allow construction in the different safety categories, category 1 - with the highest protection and therefore a very high degree of safety, category 2 - with increased protection and therefore a high degree of safety and category 3 - with the usual protection and therefore the usual degree of safety. Which classification can be achieved, is stated with the protection types.

Overview

Protection principles	flammable substances	Types of Protection	category
1. Potentially explosive mixtures can penetrate the item of electrical equipment and be ignited. Measures are taken to ensure that the explosion cannot spread to the surrounding atmosphere.	Gases	Flammeproof enclosure Powder filling Enclosed break device	2 2 3
2. The item of equipment is provided with an enclosure that prevents the ingress of a potentially explosive mixture and/or contact with sources of ignition arising from the normal.	Gases and dust Gases Dust	Pressurized apparatus encapsulation Oil immersion Restricted breathing enclosure Non-incendive component Hermetically sealed device Sealed device Encapsulated device n-pressurizatio Protection by enclosure	2 2 2 3 3 3 3 3 3 2
3. Potentially explosive mixtures can penetrate the enclosure but can not be ignited. Sparks and temperatures capable of causing ignition must be prevented.	Gases	Increased safety Non-sparking device Protection by constructional safety	2 3 2
4. Potentially explosive mixtures can penetrate the enclosure but can not be ignited. Sparks and temperatures able to cause ignition may only occur within certain limits.	Gases and dust Gases	Energy limited circuit Intrinsic safety Protection by control of ignition sources	3 2 3

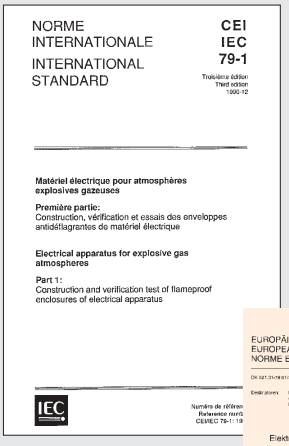
Non-technical measures

The requisite preconditions for the safe operation of electrical equipment in hazardous areas are created in a joint effort by the manufacturers of explosion-proof electrical equipment and the constructors and operators of industrial plants. It is important that the operator of such plants should ensure that their personnel know how the danger of explosions is likely to arise and the measures that are to be taken to prevent it.

Courses should be held for employees at regular intervals to inform them about the explosion protection documentation according to directive 1999/92/EC the company-internal rules and written, regularly updated operating instructions should be issued.

Design regulations for explosion protected systems, devices and components - equipment

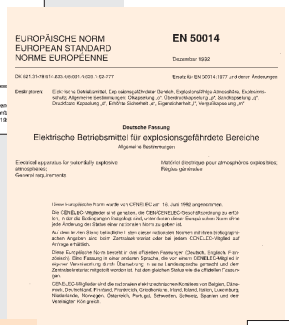
Hazards arising from the handling of flammable gases, vapours and dust are caused by uniform chemical and physical processes. For this reason, the protection against these hazards must be carried out in a uniform manner.
Nearly universal uniform requirements have now been formulated by the International Electrotechnical Commission IEC, by the European Standardisation Committees CENELEC and CEN and by DKE and DIN.
Manufacturers and operators are required to adhere to these, and where there is an increased protection requirement, they are monitored by accredited test houses and the authorities.


NORME INTERNATIONALE
INTERNATIONAL STANDARD
CEI IEC 79-1
Troisième édition
Third edition
1990-12

Matériel électrique pour atmosphères explosives gazeuses
Première partie:
Construction, vérification et essais des enveloppes antidéflagrantes du matériel électrique

Electrical apparatus for explosive gas atmospheres
Part 1:
Construction and verification test of flameproof enclosures of electrical apparatus

IEC


EUROPÄISCHE NORM
EUROPEAN STANDARD
NORME EUROPÉENNE
EN 50014
Dezember 1992

Deutsche Fassung
Elektrische Betriebsmittel für explosionsgefährdete Bereiche


DK 621.316.543/.621.3.027.2-820.1 DEUTSCHE NORM Juli 1992

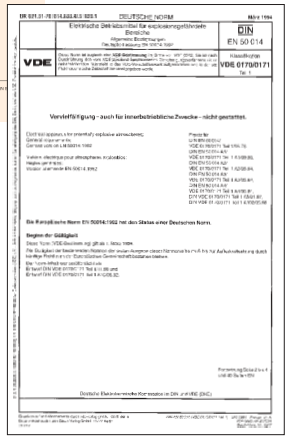
DIN VDE 0660 Teil 200

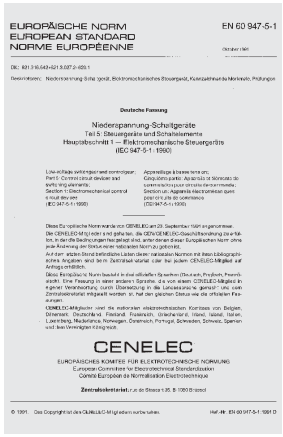
Niederspannung-Schaltgeräte
Teil 5-1: Steuergeräte und Schaltelemente
Elektromechanische Steuergeräte
(IEC 947-5-1:1990)
Deutsche Fassung EN 60 947-5-1:1991

Vervielfältigung — auch für innerbetriebliche Zwecke — nicht gestattet.

Deutsche Elektrotechnische Kommission im DIN und VDE (DKE)


CENELEC
Europäisches Komitee für Elektrotechnische Normung
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Électrotechnique
Zentralsekretariat: rue de Stassart 35, B-1050 Brüssel


DEUTSCHE NORM März 1994
Elektrische Betriebsmittel für explosionsgefährdete Bereiche
DIN EN 50 014
VDE 0170/0171
Vervielfältigung - auch für innerbetriebliche Zwecke - nicht gestattet.
Die Europäische Norm EN 50014:1992 hat den Status einer Deutschen Norm.
Beginn der Gültigkeit


EUROPÄISCHE NORM
EUROPEAN STANDARD
NORME EUROPÉENNE
EN 60 947-5-1
Deutsche Fassung
Niederspannung-Schaltgeräte
Teil 5: Steuergeräte und Schaltelemente
Hauptabschnitt 1 — Elektromechanische Steuergeräte
(IEC 947-5-1:1990)
CENELEC
EUROPÄISCHES KOMITEE FÜR ELEKTROTECHNISCHE NORMUNG
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Électrotechnique
Zentralsekretariat: rue de Stassart 35, B-1050 Brüssel

Regulations

An overview of the regulations for the determination of the parameters, the classification of the zone, the design regulations for systems, devices and components as well as installation and operation in the area where potentially explosive gases, vapours and dust is present, is shown in the table below.

Title/Content	Document ident. IEC Publication date	Document ident. CEN/CENELEC Publication date	Document ident. DIN Publication date
Basics			
Explosive atmospheres - Explosion prevention and protection Part 1: Basic concepts and methodology	-	EN 1127-1 1997-08-00	DIN EN 1127-1 1997-00-00
Potentially explosive atmospheres - Explosion prevention and protection Part 1: Terms and definitions for equipment and protective systems intended for use in potentially explosive atmospheres	-	prEN 13237-1 1998-05-00	DIN EN 13237-1 1998-00-00
Characteristics of combustible gases and vapours			
Determination of the maximum explosion pressure and maximum rate of pressure rise of gases and vapours - Part 1: Determination of the maximum explosion pressure	-	prEN 13673-1 1999-08-00	DIN EN 13673-1 1999-11-00
Electrical apparatus for explosive gas atmospheres Part 1: Construction and test of flameproof enclosures of electrical apparatus. First supplement: Appendix D: Method of test for ascertainment of maximum experimental safe gap	IEC 60079-1A 1975-00-00	-	-
Electrical apparatus for explosive gas atmosphere. Part 12: Classification of mixtures of gases or vapours with air according to their maximum experimental safe gaps and minimum igniting currents	IEC/TR 60079-12 1978-00-00	-	-
Electrical apparatus for explosive gas atmospheres Part 20: Data for flammable gases and vapours, relating to the use of electrical apparatus	IEC/TR3 60079-20	-	-
Electrical apparatus for explosive gas atmospheres Part 4: Method of test for ignition temperature	IEC 60079-4 1975-00-00	-	-
Electrical apparatus for explosive gas atmosphere Part 4: Method of test for ignition temperature; Amendment 1	IEC 60079-4 AMD 1		
Electrical apparatus for explosive gas atmospheres Part 4: Method of test for ignition temperature 1. Amendment	IEC 60079-4 1970-00-00	-	DIN 51794* 1961-07-00
Characteristics of combustible dusts			
Electrical apparatus for use in the presence of combustible dust Part 2: Test methods - Section 1: Methods for determining the minimum ignition temperatures of dust Attention: Included Corrigendum at August 1999	IEC 61241-2-1	EN 50281-2-1	DIN EN 50281-2-1 1999-11-00
Electrical apparatus for use in the presence of combustible dust Part 2: Test methods - Section 2: method for determining the electrical resistivity of dust in layers Attention: Included Corrigendum at May 1994	IEC/TR 61241-2-2 1993-08-00	EN 61241-2-2 1995-00-00	DIN EN 61241-2-2 1996-04-00
Electrical apparatus for use in the presence of combustible dust Part 2: Test methods - Section 3: Method for determining minimum ignition energy of dust/air mixtures	IEC 61241-2-3 1994-09-00	*EN 50281-2-3**	-
Electrical apparatus for use in presence of combustible dust Part 4: Test methods - Section 4: Method for determining the low explosive limit of dust/air mixtures	*IEC 61241-2-4**	*EN 50281-2-4**	-

Title/Content	Document ident. IEC Publication date	Document ident. CEN/CENELEC Publication date	Document ident. DIN Publication date
Classification of hazardous areas with combustible Gases and vapours			
Electrical apparatus for exlosive gas atmosphere Part 10: Classification of hazardous areas Attention: Included Corrigendum at May 1996	IEC 60079-10 1995-12-00	EN 60079-10 1996-00-00	DIN EN 60079-10 1996-00-00
Classification of hazardous areas with combustible Dusts			
Electrical apparatus for use in the presence of combustible dust Part 3: Classification of areas where combustible dusts are or may be present	IEC 61241-3 1997-05-00	-	-
Type of Protection for electrical apparatus for explosive gas atmospheres			
■ **combustible gases and vapours**			
Electrical apparatus for explosive gas athmospheres Part 0: General requirements	IEC 60079-0 1998-04-00	EN 50014 1997-00-00	DIN EN 50014 2000-02-00
Electrical apparatus for explosive gas atmospheres Part 1: construction and verification test of flameproof enclosures of electrical apparatus Attention: Summery of IEC 60079-1(1990-12) and IEC 60079-1 AMD 1(1993-08) and AMD 2(1998-95)	IEC 60079-1 Edition 3.2 1998-08-00	*EN 50018** 1999-00-00	*DIN EN 50018** 1999-12.00
Electrical apparatus for explosive gas atmospheres Part 2 : Electrical apparatus-type of protection "p"	IEC/TR 60079-2 1983-00-00	*EN 50016** 1998-00-00	*DIN EN 50016** 1998-09-00
Electrical apparatus for explosive gas atmospheres Part 5: Powder filling "q"	IEC 60079-5 1997-04-00	*EN 50017** 1998-00-00	*DIN EN 50017** 2000-02-00
Electrical apparatus for explosive gas atmospheres Part 6: Oil-immersion "o"	IEC 60079-6 1995-05-00	*EN 50015** 1998-00-00	*DIN EN 50015** 2000-02-00
Electrical apparatus for explosive gas atmospheres Part 7: increased safety "e"	IEC 60079-7 Draft 1999-00-00	*EN 50019** 1999-00-00	*DIN EN 50019** 1999-11-00
Electrical apparatus for explosive gas atmospheres Part 11: Intrinsic safety "i"	IEC 60079-11 1999-02-00	*EN 50020** 1994-00-00	*DIN EN 50020** 1996-04-00
Electrical apparatus for potentially explosive atmospheres. Intrinsic safety "i" Systems	-	*EN 50039** 1980-00-00	*DIN EN 50039** 1982-04-00
Electrical apparatus for explosive gas atmospheres Part 18: encapsulation "m"	IEC 60079-18 1992-10-00	*EN 50028** 1987-00-00	*DIN VDE 0170/** *0171-9;* 1988-07
Electrical apparatus for explosive gas atmospheres Part 26: Special requirements for construction, test and marking of electrical apparatus for use in Zone 0	*IEC 60079-26** 1999-04-00	EN 50284 2000-00-00	DIN EN 50284
Electrical apparatus for explosive gas atmospheres Part 15 : Electrical apparatus with type of protection "n"	IEC/TR 60079-15 1987-00-00	EN 50021 1998-00-00	DIN EN 50021 2000-02-00

* Changes to the registration number can arise due to the comparison between IEC or ISO and CENELEC or CEN. Information that is ambiguous to the author or incomplete is for this reason given in italics.

Title/Content	Document ident. IEC Publication date	Document ident. CEN/CENELEC Publication date	Document ident. DIN Publication date
combustible dust			
Electrical apparatus for use in the presence of combustible dust Part 1-1: Electrical apparatus protected by enclosures and surface temperature limitation - Specification for apparatus Attention: In connection with EN 50014 (1997-06) Included Corrigendum at July 1999, and August 1999	IEC 61241-1-1 1999-05-00	EN 50281-1-1 1998-09-00	DIN EN 50281-1-1 1999-10-00
Electrical apparatus for use in the presence of combustible dus Part 4: Type of Protection "pD"	*IEC 61241-4**	*EN 50281-4**	*DIN EN 50281-4**
Electrical apparatus for use in the presence of combustible dus Part 5: Type of Protection „ iD“	*IEC 61241-5**	*EN 50281-5**	*DIN EN 50281-5**
Electrical apparatus for use in the presence of combustible dus Part 6: Type of Protection „ mD“	*IEC 61241-6**	*EN 50281-6**	*DIN EN 50281-6**
Type of Protection explosion protection		**Non-electrical equipment**	
combustible gases, vapours and dust			
Non-electrical equipment for potentially explosive atmospheres Part 1: Basic methodology and requirements	-	prEN 13463-1 1999-02-00	DIN EN 13463-1 1999-00-00
Non-electrical equipment for potentially explosive atmospheres Part 2: Protection by flow restricting enclosure "fr"	-	*prEN 13463-2**	*DIN EN 13463-2** 1999-04-00
Non-electrical equipment for potentially explosive atmospheres Part 3: Protection by flameproof enclosure "d"	-	*prEN 13463-3**	*DIN EN 13463-3**
Non-electrical equipment for potentially explosive atmospheres Part 4: Protection by inherent safety "g"	-	*prEN 13463-4**	*DIN EN 13463-4**
Non-electrical equipment for potentially explosive atmospheres Part 5: Protection by constructional safety	-	*prEN 13463-5**	*DIN EN 13463-5**
Non-electrical equipment for potentially explosive atmospheres Part 6: Protection by control by ignitin sources "b"	-	*prEN 13463-6**	*DIN EN 13463-6**
Non-electrical equipment for potentially explosive atmospheres Part 7: Protection by pressurisation "p"	-	*prEN 13463-7**	*DIN EN 13463-7**
Non-electrical equipment for potentially explosive atmospheres Part 8: Protection by liquid immersion "k"	-	*prEN 13463-NN**	*DIN EN 13463-NN**

* Changes to the registration number can arise due to the comparison between IEC or ISO and CENELEC or CEN. Information that is ambiguous to the author or incomplete is for this reason given in *italics*.

Title/Content	Document ident. IEC Publication date	Document ident. CEN/CENELEC Publication date	Document ident. DIN Publication date
Explosion Protection in plants: Installation, maintenance and repair			
Electrical apparatus for explosive gas atmospheres Part 13 : Construction and use of rooms or buildings protected by pressurization pressurization	IEC/TR 60079-13 1982-00-00	-	-
Electrical apparatus for explosive gas atmospheres part 16: artificial ventilation for the protection of analyzer(s) houses	IEC/TR 60079-16 1990-04-00	-	-
Electrical apparatus for explosive gas atmosphere Part 14: Electrical installations in hazardous areas (other than mines) Attention: In connection with IEC 60079-0	IEC 60079-14 1996-12-00	EN 60079-14 1997-00-00	DIN EN 60079-14 1998-00-00
Electrical apparatus for use in the presence of combustible dust part 1: electrical apparatus protected by enclosures; section 2: selection, 2: selection, installation, and maintenance Attention: In connectin with EN 50281-1-1 (1998-09) Included Corrigendum at July 1999 and August 1999	IEC 61241-1-2 1999-06-00	EN 50281-1-2 1998-09-00	DIN EN 50281-1-2 1999-11-00
Electrical apparatus for explosive gas atmospheres part 19: repair and overhaul for apparatus used in explosive atmospheres (other than mines or explosives)	IEC 60079-19 1993-09-00	*EN 60079-19**	*EN 60079-19**
Electrical apparatus for explosive gas atmospheres Part 17: Inspection and maintenance of electrical installations in hazardous areas (other than mines)	IEC 60079-17 1996-12-00	EN 60079-17 1997-00-00	DIN EN 60079-17 1999-00-00

* Changes to the registration number can arise due to the comparison between IEC or ISO and CENELEC or CEN. Information that is ambiguous to the author or incomplete is for this reason given *in italics*.

Note about how to use the table

The information is based on the IEC titles, in cases where there is no IEC document available, the EN titles have been used.

The year information has been standardised. It refers to the state on 2000-03-19 which was accessible to the author. This style seems to be becoming universally accepted, but has not been introduced in all the documents.

The table is to provide an information overview of the standard. For concrete work with the standards and their procurement, the latest update should be requested from the publisher or from the standardisation committee. According to our experience, it must be expected that in the years up to 2003, a number of the standards will be modified.

With the help of this table, the following contents listed in the title/contents column can be correlated to the regional and national equivalents. The regional and national title does not need to correspond to the „world“ title. (Please also note the footnote for the table!)

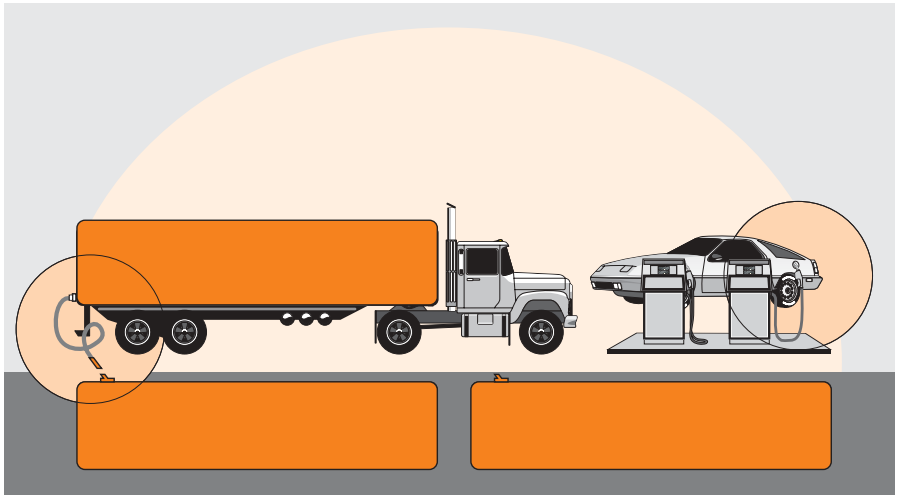
Relevance and advantage of the classification in zones

The practice has been established of dividing hazardous areas into zones. This classification takes the different dangers from potentially dangerous atmospheres into account and allows explosion protection measures to be taken which reflect the situation both from the point of view of safety engineering and of economics. For the European community, the zone definitions are uniformly provided in directive 1999/92/EC. It must be applied with technical unterstanding of the concrete situation.

IEC 60079-10 assumes an approximately similar classification for gases and vapours which will also apply to future facilities constructed conforming to the USA standard NEC 505. IEC 61241-3 provides support for the zone classification with dust.

Explosion hazard zones are classified depending on the frequency and duration of the potentially explosive atmosphere.

This classification provides the scope of the measures to be taken according to annex II section A in the directive 1999/92/EC in conjunction with annex I of the directive 94/9/EC.

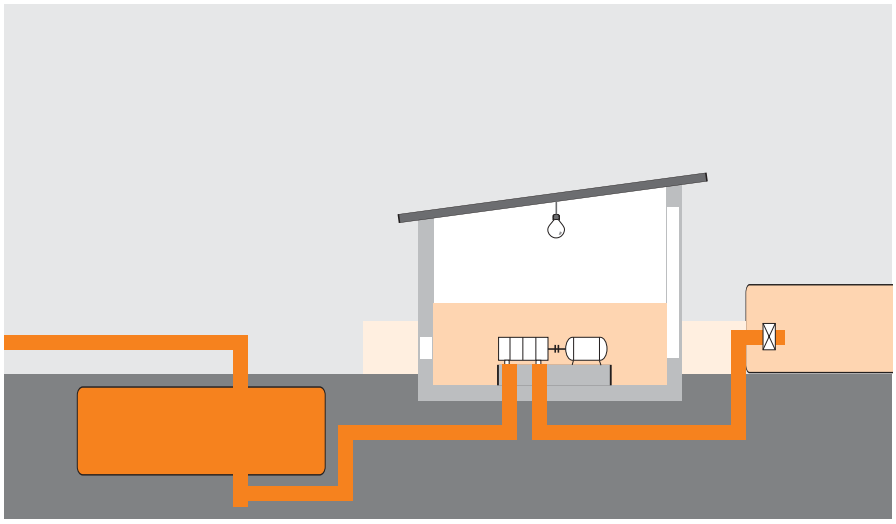


Classification of hazardous places

Zone 0	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist **is present continuously** or for long periods or frequently.
Zone 1	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist **is likely to occur** in normal operation occasionally.
Zone 2	A place in which an explosive atmosphere consisting of a mixture with air of flammable substances in the form of gas, vapour or mist **is not likely to occur** in normal operation but, if it does occur, will persist for a short period only.
Zone 20	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air **is present continuously**, or for long periods or frequently.
Zone 21	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air **is likely to occur** in normal operation occasinoally.
Zone 22	A place in which an explosive atmosphere in the form of a cloud of combustible dust in air **is not likely to occur** in normal operation but, if it does occur, will persist for a short period only.

Notes:
1. Layers, deposits and heaps of combustible must be considered as any other source which can form an explosive atmosphere.
2. 'Normal operation' means the situation when installations are used within their design parameters.

In places of work the explosion hazard areas are normally classified at most as zone 1 and 2 and/or 21 and 22. Zones 0 and 20 are restricted to very small inaccessible areas in workplaces or are usually estricted to the inside of technical equipment.



Explosion engineering parameters

In order to allow a combination of measures for explosion protection, which is optimised with respect to the chemical-physical properties of the flammable gases, vapours or dust to be made, and therefore a standardisation of the types of protection to be possible for the manufacturer, a system of explosion engineering parameters has been created. These are determined using an application orientated testing method.

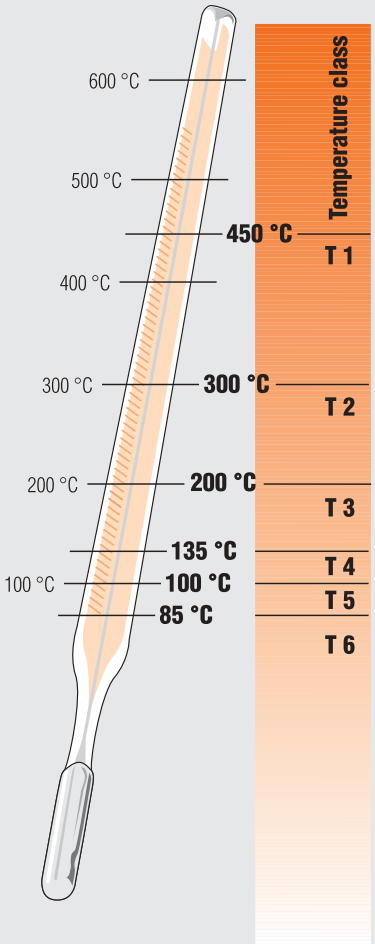
Before flammable substances can react with the atmospheric oxygen in an explosion, energy must be provided.

This energy may, for example, be exchanged on a surface. A heated surface increases the energy content of the potentially explosive mixture in contact with it. If the surface temperature is sufficiently high, this increased energy content can lead to the explosive reaction. However, the energy may also be supplied through a spark or a hot gas jet flowing out of a gap into the potentially explosive mixture. Both types lead to different explosion engineering parameters being defined.

Ignition temperature - temperature class

Many factors such as size, shape, type and surface quality have an influence on the ignition temperature. IEC, CENELEC and other standardisation committees have agreed on a method for gases and vapours defined in IEC 60079-4 „Method of test ignition temperature“. This method is defined in such a way, that a value very close to the lowest practically possible, is determined.

By means of this method, gases and vapours are divided into temperature classes. According to these temperature classes, the surface temperatures in explosion-protected equipment and other technological objects is designed in such a way that ignition by the surface is not possible. In the standard, permissible excess values and necessary safety margins below these standard values are defined in detail.



Temperature classes	Ignition temperature range of the mixture	Permissible surface temperature of the electrical equipment
T1	> 450 °C	450 °C
T2	> 300 ... ≥ 450 °C	300 °C
T3	> 200 ... ≥ 300 °C	200 °C
T4	> 135 ... ≥ 200 °C	135 °C
T5	> 100 ... ≥ 135 °C	100 °C
T6	> 85 ... ≥ 100 °C	85 °C

For different types of dust, the method for determining the ignition temperature has also been unified and coded in document IEC 61241-2-1. Please note that dust in its deposited form - determined using procedure A - has a different ignition temperature than in its stirred form - determined as a cloud using procedure B.

The permissible surface temperature for those parts of the systems, devices and components accessible to the dust is determined by subtracting 75 K from the value determined using procedure A and by multiplying by 2/3 the value determined using procedure B. The smaller of the 2 values determined in this way corresponds to the lowest permissible surface temperature of the equipment. The surface is the area accessible to the dust, temperature classes are not defined for dust, so that a concrete type of dust must always be assumed. The parameters are made available in comprehensive tables, laboratories determine the values on request, and a small, non-official overview is contained in the following table.

Examples of the ignition temperatures of different types of dust

Designation of the solid material	A values ignition temperature IEC 50381-2-1 procedure A deposit (°C)	B values ignition temperature IEC 50381-2-1 procedure B cloud (°C)	Permissible limiting temperature lowest value of the calculation (A-75K) und 2/3*B									
			450... > 300	300... > 280	280... > 260	260... > 230	230... > 215	215... > 200	200... > 180	180... > 165	165... > 160	160... > 135
Dust from natural materials (examples)												
Cotton	350	560			275							
Brown coal	225	380										150
Cellulose	370	500		295								
Cereals	290	420						215				
Wood resin	290	500						215				
Sawdust (wood)	300	400					225					
Cocoa	460	580	385									
Copra	290	470						215				
Cork	300	470					225					
Fodder concentrate	295	525					220					
Linen	230	440										155
Milk powder	340	440			265							
Paper	300	540					225					
Pectin sugar	380	410			273							
Soya	245	500								170		
Starch	290	440						215				
Hard coal	245	590								170		
Tabacco	300	450					225					
Tapioca	290	450						215				
Tea	300	510					225					
Peat	295	360					220					
Wheat flour	450	480	320									
Sugar beet	290	460						215				
Dust of chemical technical products (examples)												
Cellulose ether	275	330							200			
Isosorbide dinitrate	240	220										146
Unvulcanised rubber	220	460										145
Petroleum coke	280	690						205				
Polysaccharide deriv.	270	580							195			
Polyvinyl acetate	340	500			265							
Polyvinyl chloride	380	530	305									
Soot	385	620	310									
Laminated plastic	330	510				255						
Sulphur	280	280							186			
Metal dust (examples)												
Aluminium	280	530						205				
Bronze	260	390							185			
Iron	300	310						206				
Copper silicon alloy	305	690					230					
Magnesium	410	610	335									
Manganese	285	330						210				
Zinc	440	570	365									

Minimum ignition current ratio - Maximum experimental safe gap – Explosions Sub-group

Ignition on a hot surface occurs in a relatively large „macroscopic“ part of the mixture. In contrast, the ignition from a spark spreads in a relatively small „microscopic“ part of the volume. The discharge from a capacitor or the interruption of a predefined resistive/inductive electric circuit can be used for classifying gases and vapours or dust according to their ease of ignition in the microscopic part of the mixture volume.

For the assessment of the ignition of the gases and vapours in a circuit using a device defined in IEC 60079-11, a comparative value with methane as reference in a standardised circuit is used. This comparative value is the minimum ignition ratio, MIC. It is the means used for classifying gases and vapours within explosion group II in the subgroups II A, II B and II C.

An analogue value is found when the ease of ignition by a hot gas jet flowing through a gap is used for the classification. In IEC 60079-1A „Determination of the experimental safe gap“ a test apparatus is specified in which a spherical gas volume of 20 cm^3 is enclosed by two hemispheres. They are equipped with a 25 mm wide flange. This ball-shaped object is placed into a larger vessel and both spaces are filled with the mixture for which the safe gap is to be determined. The gap between the 25 mm wide flanges for which ten ignitions inside the ball volume just fail to ignite the mixture in the outer vessel is a value specific to the mixture and is called the maximum experimental safe gap, MESG.

The processes involved in the prevention or spread of the explosion in the gap are very complex. Classifying the gases and vapours by the safe gap results approximately - with a small overlap - in the same classification as that obtained with the minimum ignition current. IEC/TR 60079-12 provides an overview of the classification using the two measuring methods MESG and MIC.

The safe gap value is of considerable importance for designs of ignition protection type „Flameproof enclosure“. The value for the minimum ignition current is important for those of ignition protection type „Intrinsic safety“. For these two types of protection, the subgroups II A, II B and II C for gases and vapours are relevant. The information about gases and vapours can also be applied approximately to mists.

For dust, standards for the determination of parameters are already available or are in preparation.

The minimum ignition energy, a parameter similar to the minimum ignition current, is determined in accordance with IEC 61241-2-3.

Examples of the classification of gases and vapours into temperature classes and explosion hazard subgroups are listed in the following table:

Explosion groups Classification according to MESG			
Temperature class	**IIA** > 0,9 mm	**IIB** ≤ 0,9... ³ 0,5 mm	**IIC** < 0,5 mm
T1 > 450 °C	Acetone Ammonia Benzene - pure Acetic acid Ethane Ethyl acetate Ethyl chloride Carbon monoxide Methane Methanol Methylene chloride Naphthalene Phenol Propane Toluene	Town gas	Hydrogen
T2 > 300 ... ≤ 450 °C	Ethyl alcohol, i amyl acetate n butane n butyl alcohol Cyclohexane Acetic anhydride	Ethylene Ethylene oxide	Ethine (acetylene)
T3 > 200 ... ≤ 300 °C	Petroleum spirit - gen. Diesel fuel Jet propulsion fuel Heating fuel DIN 51603 n hexane	Ethylene glycol Hydrogen sulphide	
T4 > 135 ... ≤ 200 °C	Acetaldehyde	Ethyl ether	
T5 > 100 ... ≤ 135 °C			
T6 > 85 ... ≤ 100 °C			Carbon bisulphide

Types of protection

It applies to all types of protection that parts that are in unhindered contact with the potentially explosive atmosphere must not reach unacceptable temperatures.
Taking into account both the environmental temperature and the heating effect, the temperature may at most only reach a value which corresponds to the temperature class in which the potentially explosive atmosphere has been classified.

General requirements

Principle

All the general requirements for the equipment are summarised in this standard. The ignition protection type standards may raise these requirements or lower them.

Uniform protection requirements concerning several types of protection such as protection against electrostatic charging, provision of a potential bond for metal housings, or mechanical strength against impact, are summarised in this standard under general engineering requirements. In this case, individual, more specific standards can demand either more stringent requirements or less stringent ones.

These requirements are based partially on those for electrical equipment for gases and vapours, deviations for dust and non-electric equipment are contained in the individual basic standards. Categories 1 to 3 which the equipment has to fulfil can also include different general requirements.

The general temperature range for the application of explosion-protected equipment is defined as - 20 °C to + 40 °C. Permissible deviations extending or restricting the temperature range must be specified.

The parameters determined at approximately + 20 °C in the laboratory for the subgroups II A, II B and II C apply for a temperature range of ± 40 K - that is to say also from - 20 °C to + 60 °C.

These two temperature ranges take, on the one hand, the situation at the workplace into account and also, on the other, a certain heating up of the equipment when operating. The explosion pressure, permissible gap widths and permissible non-igniting currents change outside this temperature range. This has to be considered when using the equipment, and it can require different test conditions.

Information about the use of the markings

The markings used below for non-electrical equipment and dust explosion protection are still under discussion. For this reason they have to be treated as provisional.

Ignition protection type	Gases/vapours electrical equipment	Gases/vapours non-electrical equipment	Dust electrical equipment
Flameproof enclosure	■	■	-
Enclosed break device	■	-	-
Non-incendive component	■	-	-
Pressurized apparatus	■	■	■
n-pressurizatio	■	-	-
Powder filling	■	-	-
Oil immersion	■	■	-
Increased safety	■	-	-
Non sparking apparatus	■	-	-
Encapsulation	■	-	■
Hermetically sealed device	■	-	-
Encapsulated device	■	-	-
Sealed device	■	-	-
Protection by enclosure	-	-	■
Intrinsic safety	■	-	■
Energy limited circuit	■	-	-
Restricted breathing enclosure	■	■	-
Protection by constructional safety	-	■	-
Protection by control of ignition sources	-	■	-

Flameproof enclosure

Marking „EEx d“ in accordance with EN 50014
Marking „EEx d“ in accordance with prEN 13463

Principle

A type of ignition protection in which the parts which could ignite a potentially explosive atmosphere are located inside an enclosure which can withstand the pressure of an explosion of the potentially explosive mixture inside, and prevents the transmission of the explosion to the potentially explosive atmosphere surrounding the enclosure.

Technically unavoidable gaps are so long and narrow that hot gases jetting out will have lost their power to cause ignition by the time they reach the outside of the housing, or, alternatively, if the gaps are only required for the manufacturing process they might be sealed with adhesive.

Important design parameters

- Mechanical strength in accordance with a defined safety factor to withstand internal explosion pressure
- As an orientation value, it may be assumed that inside the sphere approx. 0.8 MPa (8 bar) can be generated and that this sphere used as an EEx d enclosure must be able to withstand a pressure of 1.2 MPa (12 bar).
- Any gap between two parts of the enclosure must be kept so narrow and long that hot gas flowing out will not be able to ignite any potentially explosive atmosphere which may be present in the explosion hazard zone.
- The parameters for the gaps preventing the transmission of the ignition, width/length, are different for the explosion hazard subgroups II A, II B and II C. The most stringent requirements with regard to the gap parameters apply to enclosures in explosion hazard subgroup II C.

Applications

- Equipment where, during normal operation, sparks, electric arcs and/or hot surfaces are generated such as switchgear, slip rings, collectors, adjustable resistors, fuses or lamps, andheating cartridges.

Enclosed break device

Marking „EEx nC“ in accordance with EN 50021

Principle

switchgear as a variant of the Ex n type of ignition protection, with contacts which close and open a circuit potentially able to trigger an explosion, where the enclosure will withstand an internal explosion of a mixture of subgroup II A, II B or II C without being damaged and without transferring the explosion to the external mixture in the surrounding area.

Important design parameters

- Free internal volume ≤ 20 cm³
- The encapsulation must permit a permanent temperature of the ≥ 10 K compared to the maximum operating temperature
- Limited to AC 690 V and 16 A.

Applications

- Contact systems

Non-incendive component

Marking „EEx nC“ in accordance with EN 50021

Principle

Variant of the Ex n type of ignition protection with contacts which close and open a circuit potentially able to trigger an explosion, where the contact mechanism or the enclosure into which the contacts are enclosed is designed in such a way that the ignition of a mixture of subgroup II A, II B or II C in the surrounding environment is prevented as long as defined operating conditions apply.

Important design parameters

- Free internal volume ≤ 20 cm³
- The encapsulation must permit a permanent temperature of ≥ 10 K compared to the maximum operating temperature
- The combination of the parts is tightly sealed or
- The design of the contacts will extinguish any incipient flame
- Limited to AC 254 V and 16 A.
- L and C are part of the test.
- Explosion hazard subgroups II A, II B and II C are to be treated differently.

Applications

- Contact systems

Pressurized apparatus

Marking „EEx p“ in accordance with EN 50014
Marking „Ex pD“ in accordance with IEC 61241-4
Marking „EEx p“ in accordance with prEN 13463

Principle

The ingress of the surrounding atmosphere into the housing of electrical equipment is prevented by maintaining an ignition shield gas (air, inert or a different suitable gas) inside it at a pressure above atmospheric pressure. The overpressure is maintained with or without constant flushing of the protective gas.

Important design parameters

- Housing strength; the enclosing, flushed housing must withstand 1.5 times the overpressure experienced during normal operation.
- Flush before commissioning the electrical equipment.
- Shut-down or alarm if the flushing gas flow or overpressure fails.

Applications

- Equipment where during normal operation sparks, electric arcs or hot surfaces are generated and complex industrial equipment (controls) which must be operated in explosion hazard zones protected by this type of ignition protection.
- Large machines, slip ring or collector motors, switch cabinets and control cabinets and analytical apparatus.

n-pressurization

Marking „EEx nP“ in accordance with EN 50021:

Principle

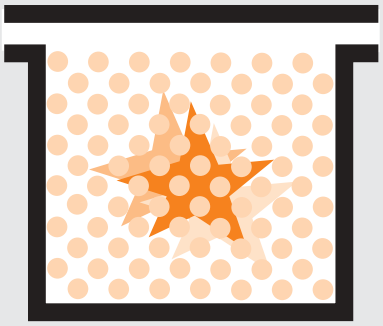
Use of a protective gas preventing ignition inside a housing to prevent the formation of a potentially explosive atmosphere inside the housing by maintaining a pressure greater than the that in the surrounding atmosphere.

Important design parameters

- The important difference from the pressurised enclosure is the restriction to a housing where no internal sources are available and no flammable gases or vapours can be released.
- Housing strength.
- Flush before commissioning the electrical equipment.
- Shut-down or alarm if the flushing gas flow or overpressure fails.

Applications

- Equipment where during normal operation sparks, electric arcs or hot surfaces are generated and complex industrial equipment (controls) which must be operated in explosion hazard zones protected by this type of ignition protection.
- Analytical apparatus without internal sources.



Powder filling

Marking „EEx q“ in accordance with EN 50014

Principle

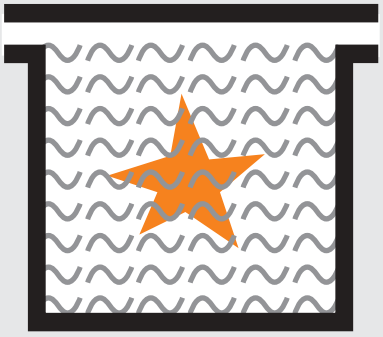
By filling the housing with a finely grained powder, an arc within the housing is unable, with correct use, to ignite the potentially explosive atmosphere outside. There must be no risk of ignition by flames, nor by increased temperatures at the housing surface.

Important design parameters

- The filling such as sand, glass balls etc. has to fulfil specific requirements, as must the housing design. The filling must not be able to leave the housing, neither during normal operation, nor as the result of electric arcs or other processes inside the powder-filled enclosure.

Applications

- Capacitors, electronic assembly groups or transformers which are used in an explosion hazard zone. Often components where sparks or hot surfaces occur but whose functioning is not affected by the finely grained filling.



Oil immersion

Marking „EEx o“ in accordance with EN 50014
Marking „EEx k“ in accordance with prEN 13463

Principle

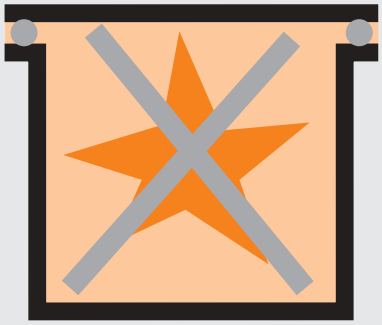
Parts which might ignite a potentially explosive atmosphere are immersed in oil or other non-flammable, insulating liquid so that gases and vapours above the oil level and outside the housing cannot be ignited by electric arcs or sparks generated below the oil level, or by hot residual gases from the switching process or by hot surfaces - e.g. on a resistor.

Important design parameters

- Stipulated, insulating liquids, e.g. oil
  Protection of the liquid from contamination and moisture.
- Assurance and possibility of monitoring that the oil level is safe
  - when heated up or cooled
  - for identification of leaks
- Restricted to non-portable devices

Applications

- Large transformers, switchgear, starting resistors and complete starting controllers.



Increased safety

Marking „EEx e“ in accordance with EN 50014

Principle

Additional measures provide a higher degree of safety. This ensures reliable prevention of unacceptably high temperatures and sparks or electrical arcs, both on the internal and on the external parts of electrical equipment whose normal operation does not involve unacceptably high temperature sparks or arching.

Important design parameters

- For uninsulated, live parts, special protective requirements apply.
- Air and creepage gaps are made wider than is generally the case in industry. Special conditions apply to the IP protection degree to be adhered to.
- For windings, their construction, mechanical strength and insulation, higher requirements apply and the windings must be protected from increased temperatures.
- Minimum cross sections are stipulated for winding wire, the impregnation and reinforcement of coils and for thermal monitoring devices.

Applications

- Installation material such as junction boxes, connection cabinets for heating systems, batteries, transformers, ballasts and cage motors.

Non-sparking apparatus

Marking „EEx nA“ in accordance with EN 50021

Principle

The construction ensures reliable prevention of unacceptably high temperatures and sparks or electrical arcs, both on the internal and on the external parts of electrical equipment whose normal operation does not involve unacceptably high temperature sparks or arcing.

Important design parameters

- For uninsulated, live parts, special protective requirements apply.
- Air and creepage gaps are specified.
- Special requirements must be fulfilled by certain types of equipment.

Applications

- Installation material such as junction boxes, connection cabinets, rotating electrical machines, special fuses, lamps, cells and batteries, transformers and low energy equipment

Encapsulation

Marking „EEx m“ in accordance with EN 50014
Marking „Ex mD“ in accordance with IEC 61241-6

Principle

Parts that could ignite a potentially explosive atmosphere by means of sparks or heat are potted soas to prevent ignition of the potentially atmosphere. This is achieved by encapsulating the components in a compound resistant to physical - especially electrical, thermal and mechanical - and chemical influences.

Important design parameters

- Encapsulation:
  - Breakdown strength
  - Low water absorption
  - Resistance to various influences
  - Potting must be of the stipulated thickness all round
  - Cavities are only permitted to a limited extent
  - As a rule the potting is only penetrated by the cable entries
- The load on the components is limited or reduced
- Increased clearance between live parts

Applications

- Static coils in ballasts, solenoid valves or motors, relays and other control gear, of limited power and complete PCBs with electronic circuits.

Hermetically sealed device

Marking „EEx nC“ in accordance with EN 50021

Principle

The equipment may include cavities. It is constructed in such a way that the external atmosphere cannot enter.

Important design parameters

- Sealed by means of a melting process e.g.:
  - Soft solder
  - Hard solder
  - Welding
  - Fusing of glass and metal

Applications

- Spark generating equipment

Encapsulated device

Marking „EEx nC“ in accordance with EN 50021

Principle

The equipment may include cavities which are fully enclosed similar to the encapsulation type of ignition protection e.g. in a potting compound, so that ingress of the outer atmosphere is prevented.

Important design parameters

- It must be impossible to open the equipment during normal operation, internal free volume ≤ 100 cm³
- External connections, terminals or cables must be available
- Cast seal must permit permanent operating temperature ≥ 10 K compared to the maximum operating temperature
- It must not be possible for elastic seals to become mechanically damaged under normal operating conditions; they must maintain their sealing properties over the service life of the equipment

Applications

- Contact systems, static coils in ballasts, solenoid valves or motors and complete PCBs with electronic circuits.

Sealed device

Marking „EEx nC“ in accordance with EN 50021

Principle

The equipment may include cavities, which are fully enclosed similar to the encapsulation type of ignition protection so that ingress of the outer atmosphere is prevented.

Important design parameters

- It must be impossible to open the equipment during normal operation, internal free volume ≤ 100 cm³
- External connections, terminals or cables must be available
- It must not be possible for elastic seals to become mechanically damaged under normal operating conditions; they must maintain their sealing properties over the service life of the equipment

Applications

- Contact systems, static coils in ballasts, solenoid valves or motors and complete PCBs with electronic circuits.

Protection by enclosure

Marking „Ex tD“ in accordance with IEC 61241-1-1

Principle

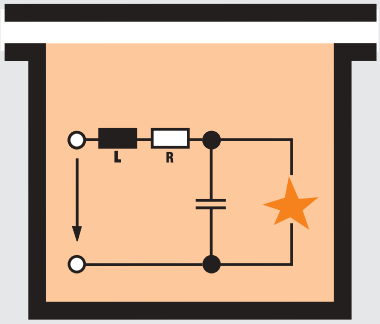
The housing is sealed so tight, that no combustible dust can enter. The surface temperature of the external housing is limited.

Important design parameters

- Minimum degree of protection in accordance with IEC/EN 60529 ? IP 6X
- Consideration of dust accumulating on the surface and reduction of permissible surface temperature with dust layer ≥ 5 mm are possible.

Applications

- Various equipment where during normal operation sparks, electric arcs or hot surfaces occur and complex industrial designs (controllers) which by means of this type of ignition protection can be utilised in explosion hazard zones.



Intrinsic safety

Marking „EEx i“ in accordance with EN 50014
Marking „Ex iD“ in accordance with IEC 61241-5

Principle

Intrinsically safe electrical equipment contains only circuits that meet the requirements of intrinsically safe circuits.

Intrinsically safe circuits are circuits in which no spark or thermal effect occurring under the test conditions laid down in the standard can ignite the potentially explosive atmosphere of subgroups II A, II B and II C or of an air/dust mixture. The test conditions cover normal operation and certain fault conditions stipulated in the standard.

Important design parameters

- Use of certain components for electrical and electronic circuits
- Lower permitted load on the components than in ordinary industrial applications with regard to
  - voltage related to electric strength
  - current related to heat
- Voltage and current, including a safety margin, are kept permanently so low that no impermissible temperatures can occur, and, in the event of open circuit or short-circuit, sparks and electric arcs possess so little energy that they are unable to ignite a potentially explosive atmosphere.
- An impression of this protection type is provided by the fact that potentially explosive atmospheres of subgroup IIA require only a few hundred µW and those of subgroup IIC only 10µW for ignition.

Applications

- Measuring and monitoring instrumentation and control
- Sensors working on the basis of physical, chemical or mechanical principles and at limited power
- Actuators working on the basis of optical, acoustic and, to a certain extent, mechanical principles.

Energy limited circuit

Marking „EEx nL“ in accordance with EN 50021

Principle

These are circuits in which no spark or thermal effect occurring under the test conditions laid down in the standard can ignite the potentially explosive atmosphere of subgroups II A, II B and II C or of an air/dust mixture.

The test conditions cover normal operation and certain fault condition stipulated in the standard. The permissible currents or voltages exceed those stipulated for the intrinsic safety type of ignition protection.

Important design parameters

- The requirements to be fulfilled by the circuit and the loads on the components are lower than those for the intrinsic safety type of ignition protection.
- Also with regard to errors, lower requirements apply.

Applications

- Measuring and monitoring instrumentation and control
- Sensors working on the basis of physical, chemical or mechanical principles and at limited power
- Actuators working on the basis of optical, acoustic and, to a certain extent, mechanical principles.

Restricted breathing enclosure

Marking „EEx nR“ in accordance with EN 50021:
Marking „EEx fr“ in accordance with prEN 13463

Principle

The housings are designed in such a way that the ingress of gases is restricted.

Important design parameters

- The powerloss in the housing may, if it contains sparking components, only lead to a temperature increase compared to the surrounding of ≤ 10 K.
- Equipment with these housings must allow monitoring of the vapour tightness and tightness after installation and maintenance.
- The allocation to the temperature class by the external surface temperature applies to all housings with and without sparking components.
- It must not be possible for elastic seals to become mechanically damaged under normal operating conditions; they must maintain their sealing properties over the service life of the equipment.
- Cast seals must permit a permanent operating temperature ≥ 10 K compared to the maximum operating temperature

Applications

- Switchgear, measuring and monitoring instrumentation and information systems and devices

Protection by constructional safety

Marking „EEx c“ in accordance with prEN 13463

Principle

The systems, devices and components are designed in such a way that they cannot become an ignition source neither during normal operation nor when a fault has occurred.

Important design parameters

- The requirements for the housing material are the same as for the other types of protection. (see e.g. EN 50014)
- The components have to be selected in such a way that heat generation e.g. from friction is not possible.
- The friction occurring during normal operation must not lead to electrostatic charging or spark generation.
- The constructive requirements should be checked with regard to possible ignition sources similarly to that described for EN 1127-1.

Applications

- Currently only few experiences are available, as this standard is only available as a draft.

Protection by control of ignition sources

Marking „EEx b“ in accordance with prEN 13463

Possible principle

By monitoring during normal operation for ignition sources which are not present but might develop, such as parts warming up, reaction in critical situations is possible. Currently there is the idea to draft such a standard.

Important design parameters

- Under construction - must be observed.

Applications

- None yet known on the basis of the current development of the standard.

Marking

Contents of the marking

The rules for the marking of systems, devices and components are uniformly defined in the standards relating to the general technical requirements.

Because the European Community has agreed in the future to also formulate uniform requirements and to introduce a uniform classification for devices, systems and component, other than electrical equipment, the marking has also been unified. Additional symbols have been introduced.

This has been defined in the directive 94/9/EC on "Devices and protective systems for use in hazardous areas".

This directive includes electrical equipment, and for this reason the markings are prefixed by additional symbols.

The marking on all devices and protective systems for hazardous areas must indicate the area of their designated use.

Principle

The marking must indicate the following

- The manufacturer who has put the item of equipment on the market
- A designation which allows it to be identified
- The application zone underground I
  other areas II,
  gases and vapours - G -, dust - D - or mines - M -
- The categories which indicate whether the device is only suitable for specific zones.
- The type(s) of ignition protection the equipment fulfils
- The explosion group, and if required, the explosion hazard subgroup for which it is suitable and
- The temperature class for which the piece of equipment is suitable
- The test centre where the test certificate was issued, the standard or revision of a standard applicable to the piece of equipment including the registration number of the certificate at the test centre, and, if necessary, which special conditions must be observed.

In addition, the information which is required for a similar device of industrial construction must be available.

In accordance with EC directive 94/9/EC the future marking for all equipment will be as follows:

CE **0032** **II 2 G**

in accordance with EC directive 94/9/EC

CE Conformity mark

0032 notified body who certified the QA system in accordance with 94/9/EC

The following device groups are distinguished

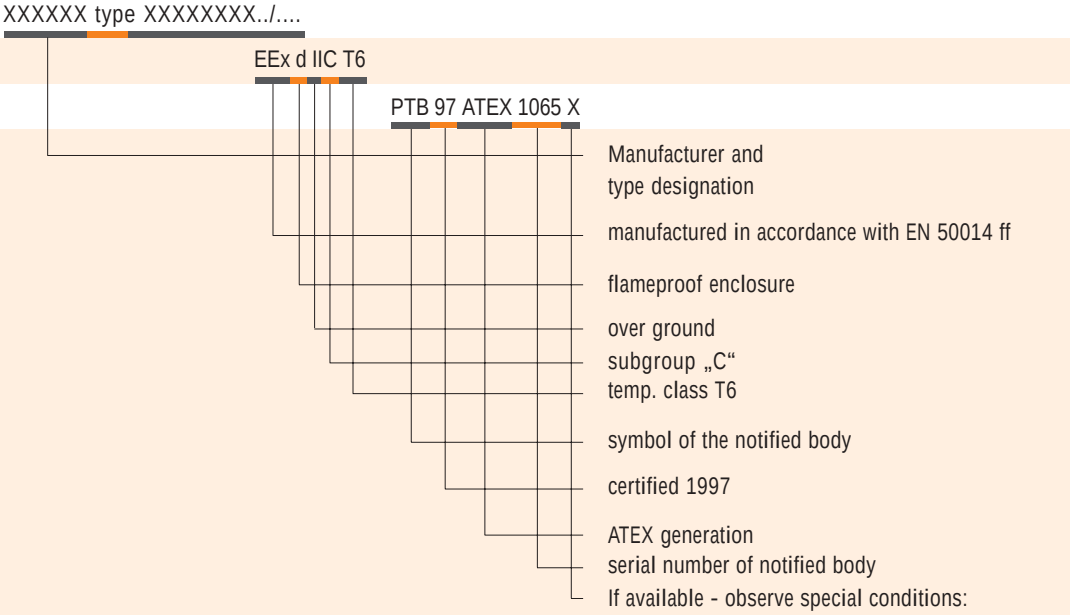
Device group II	other areas
Category / protection level 2	suitable for zone 1
Gases, vapours or mists	marking with prefix G

Area	Classification of the explosion hazard	required marking of the used equipment	
		Device group	Category
Underground	Operation with explosion hazard	I	M 1
Underground	Shut down with explosion hazard	I	M 2 und M 1
other	Zone 0	II	1 G
other	Zone 1	II	2 G + 1 G
other	Zone 2	II	3 G + 2 G + 1 G
other	Zone 20	II	1 D
other	Zone 21	II	2 D + 1 D
other	Zone 22	II	3 D + 2 D + 1 D

Type of ignition protection, explosion group/subgroup and temperature class, conforming to which the piece of equipment has been produced and is suitable for, will continue to be found using the marking customary for electrical equipment.

Example of a marking - electrical equipment

XXXXXX type XXXXXXXX../.... EEx d IIC T6 PTB ATEX 1065 X



Certificate of conformity:

PTB 97 ATEX 1065 X
X = special conditions
PTB 97 ATEX 1064 U
U = component certificate - no temperature class

CE-Conformity

The following route to CE conformity for electrical apparatus is prescribed according to EC directive 94/9/EC.

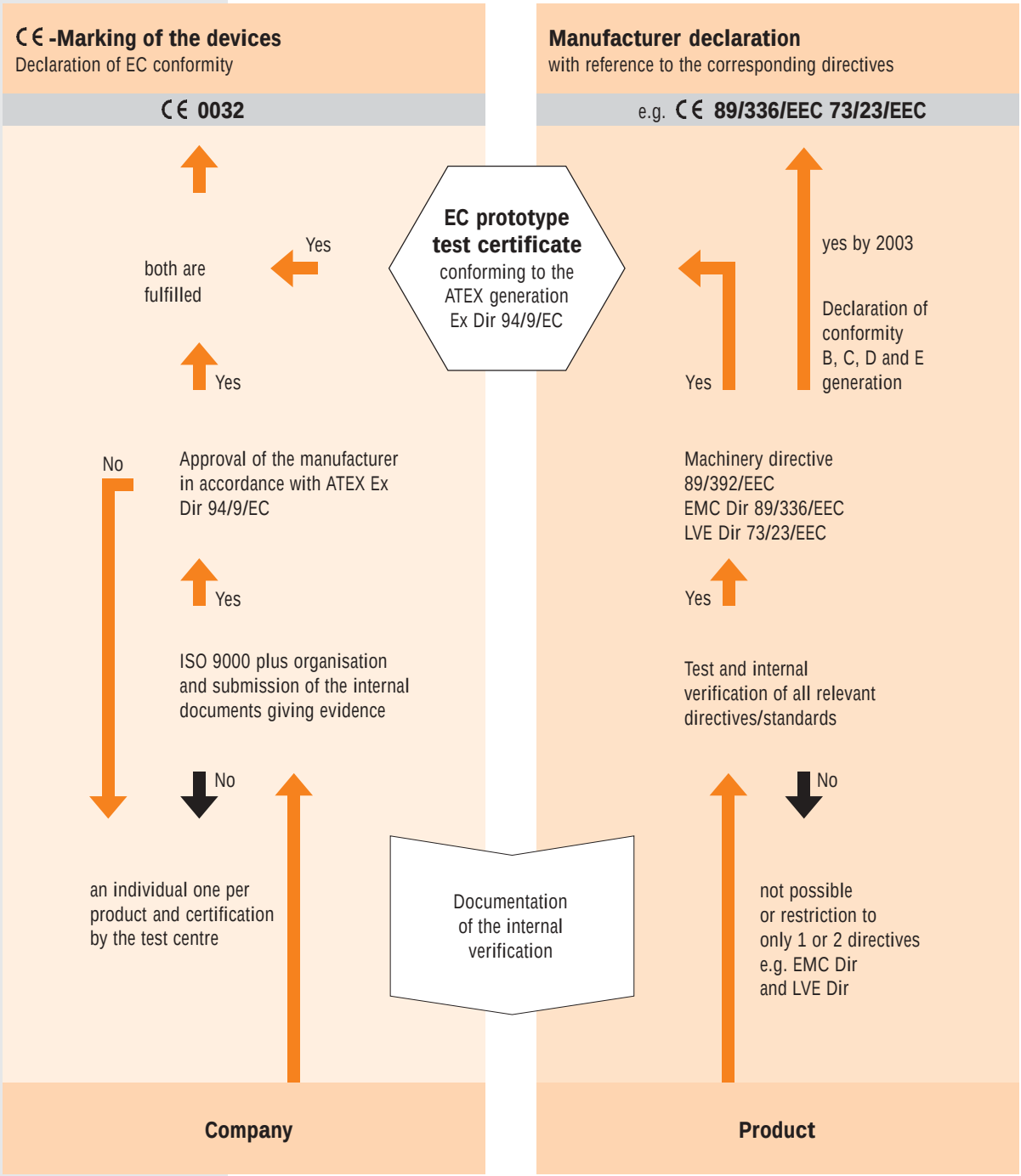
Depending on the conformity category, it defines which path the manufacturer has to follow towards making the CE conformity declaration. The overview below shows these paths for the different electrical equipment conformity categories.

Intended use of the equipment:	**Zone 0**	**Zone 1**	**Zone 2**
Conformity category to be satisfied:	**1**	**2**	**3**
Requirements for the conformity declaration			
1. - on manufacturer's premises	Fulfilment of the requirements of the directive 94/9/EC EN 50284 el. BM II 1 G	Fulfilment of the requirements of directive 94/9/EC, e.g. by conformity to EN 50014 ff „ conventional types of protection“	Fulfilment of the requirements of directive 94/9/EC type of ignition protection EEx n IEC 60079-15 and EN 50021
2. - at the notified testing body	EC prototype testing by a notified body e.g. IBExU, BVS or BASEEFA	Prototype testing by a notified body e.g. PTB, TÜV-A or KEMA	Not required
3.- on manufacturer's premises	QA production EN 29002 / Product testing in production	Conformity with design / QA products EN 29003	Assessment
Declaration of conformity issued by	Manufacturer	Manufacturer	Manufacturer
CE mark issued by	Manufacturer	Manufacturer	Manufacturer

During the transitional period, equipment will be distributed which corresponds to the EC directives, which by then will have become valid, such as the EMC directive, the machinary directive and the low voltage directive. Stepwise, the Ex directive 94/9/EC will also have to be complied wiht and EC prototype certificates will be issued which will be marked „ATEX“. Until this happens the EC directives which are being fulfilled will be listed in the Declaration of CE conformity. With the EC prototype certificate according to the ATEX generation, the CE mark will be shown and the EC registration number issued in Brussels, at the notified body, where the quality assurance system according to directive 94/9/EC has been certified.

This is the reason why equipment certified according to the ATEX generation has been able to be marked with CE 0032 since June 1996. Until June 2003 there are two transitional ways in which to get the CE declaration of conformity, as shown in the diagram below:

Marking during the transitional period until 2003



Directive 94/9/EC

Of the european parliament
and the 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

Directives are subject to variations.

The european parliament and the council of the european union,

Having regard to the Treaty establishing the European Community, and in particular Article 100a thereof,

Having regard to the proposal from the Commission[1],
Having regard to the opinion of the Economic and Social Committee [2],
Acting in accordance with the procedure referred to in Article 189b of the Treaty establishing the European Community;

Whereas it is the duty of Member States to protect, on their territory, the safety and health of persons and, where appropriate, domestic animals and property and, in particular, that of workers, especially against the hazards resulting from the use of equipment and systems providing protection against potentially explosive atmospheres;

Whereas mandatory provisions within the Member States determine the level of safety to be achieved by protective equipment and systems intended for use in potentially explosive atmospheres; whereas these are generally electrical and non-electrical specifications having an effect on the design and structure of equipment which can be used in potentially explosive atmospheres;
Whereas the requirements to be met by such equipment differ from one Member State to another in respect of their extent and differing inspection procedures; whereas these differences are, therefore, likely to raise barriers to trade within the Community;

Whereas harmonization of national legislation is the only way in which to remove these barriers to free trade; whereas this objective cannot be satisfactorily achieved by the individual Member States; whereas this Directive merely lays down the requirements vital to freedom of movement for the equipment to which it applies;

Whereas the regulations intended to remove technical barriers to trade are required to follow the new approach provided for in the Council resolution of 7 May 1985 [3], which requires a definition of the essential requirements regarding safety and other requirements of society without reducing existing, justified levels of protection within the Member States; whereas that resolution provides that a very large number of products be covered by a single Directive in order to avoid frequent amendments and the proliferation of Directives;

Whereas the existing Directives on the approximation of the laws of the Member States to electrical equipment for use in potentially explosive atmospheres have made positive steps towards protection against explosions via measures linked with the structure of the equipment at issue and which have helped to remove barriers to trade in this area; whereas, in parallel, a revision and expansion of the existing Directives is necessary since, more particularly, in an overall context, action must be taken to guard against the potential hazards arising from such equipment. This implies in particular that measures intended to guarantee effective protection of users and third parties must already be contemplated at the design and manufacturing states;

Whereas the form taken by the hazard, the protective measures and the test methods are often very similar, if not identical, for both mining and surface equipment; whereas it is, therefore, absolutely necessary to cover by a single Directive protective equipment and systems falling within both groups;
Whereas the two groups of equipment referred to above are used in a large number of commercial and industrial sectors and possess considerable economic significance;

Whereas compliance with the basic safety and health requirements is essential in order to ensure the safety of protective equipment and systems; whereas those requirements have been subdivided into general and additional requirements which must be met by protective equipment and systems; whereas, in particular, the additional requirements are intended to take account of existing or potential hazards; whereas protective equipment and systems will, therefore, embody at least one of those requirements where this is necessary for their proper functioning or is to apply to their intended use; whereas the notion of intended use is of prime importance for the explosion-proofing of protective equipment and systems; whereas it is essential that manufacturers supply full information; whereas specific, clear marking of said equipment, stating its use in a potentially explosive atmosphere, is also necessary;

Whereas the intention is to prepare a Directive on operations in potentially explosive atmospheres which is based on Article 118a; whereas that additional Directive will, in particular, aim at explosion hazards which derive from a given use and/or types and methods of installation;

Whereas compliance with essential health and safety requirements is imperative if the safety of equipment is to be ensured; whereas judgment will have to be exercised in the implementation of those requirements in order to take account of both the technology obtaining at the time of manufacture and overriding technical and economic requirements;

Whereas, therefore, this Directive sets out essential requirements only; whereas, in order to facilitate the task of proving compliance with the essential requirements, harmonized European standards are necessary, more especially with regard to the non-electrical aspects of protection against explosions - standards relating to the design, manufacture and testing of equipment, compliance with which enables a product to be presumed to meet such essential requirements; whereas harmonized European standards are drawn up by private bodies and must retain their non-mandatory status; whereas, for this purpose, the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (Cenelec) are recognized as the bodies competent to adopt harmonized standards which follow the general guidelines for cooperation between the Commission and those two bodies, signed on 13 November 1984; whereas, for the purposes of this Directive, a harmonized standard is a technical specification (European Standard or harmonization document) adopted by one or other of those bodies, or by both, at the prompting of the Commission pursuant to Council Directive 83/189/EEC of the 28 March 1983 providing for a procedure governing the provision of information on technical standards and regulations[4] and pursuant to the general guidelines referred to above;
Whereas the legislative framework should be improved in order to ensure that employers and workers make an effective and appropriate contribution towards the standardization process; whereas this should be completed by the time this Directive is implemented;

Whereas, in view of the nature of the risks involved in the use of equipment in potentially explosive atmospheres it is necessary to establish procedures applying to the assessment of compliance with the basic requirements of the Directives; whereas these procedures must be devised in the light of the level of risk which may be inherent in equipment and/or against which systems must protect the immediate environment; whereas, therefore, each category of equipment conformity must be supplemented by an adequate procedure or a choice between several equivalent procedures; whereas the procedures adopted comply fully with Council Decision 93/465/EEC of 22 July 1993 concerning the modules for the various phases of the conformity assessment procedures which are intended to be used in the technical harmonization Directives[5];

[1] OJ No C 46, 20. 2. 1992, p. 19.
[2] OJ No C 106, 27. 4. 1992, p. 9.
[3] OJ No C 136, 4. 6. 1985, p. 1.
[4] OJ No L 109, 26. 4. 1983, p. 8. Directive as last amended by Directive 88/182/EEC (OJ No L 81, 26. 3. 1988, p. 75).
[5] OJ No L 220, 30. 8. 1993, p. 23.

Whereas the Council has provided for the affixing of the CE marking by either the manufacturer or his authorized representative within the Community; whereas that marking means that the product complies with all the basic requirements and assessment procedures provided for by the Community law applying to that product;

Whereas it is appropriate that the Member States, as provided for by Article 100a of the Treaty, may take temporary measures to limit or prohibit the placing on the market and the use of equipment and protective systems in cases where they present a particular risk to the safety of persons and, where appropriate, domestic animals or property, provided that the measures are subject to a Community control procedure;

Whereas the recipients of any decision taken as part of this Directive must be aware of the reasons behind that decision and the means of appeal open to them;

Whereas, on 18 December 1985, the Council adopted a framework Directive on electrical equipment for use in potentially explosive atmospheres (76/117/EEC)[1] and, on 15 February 1982, a Directive concerning electrical equipment for use in potentially explosive atmospheres in mines susceptible to fire damp (82/130/EEC)[2]; whereas, from the outset of harmonization work, the conversion into total harmonization of the optional and partial harmonization on which these Directives are based had been contemplated; whereas this Directive fully covers the scope of the abovementioned Directives and whereas, therefore, these Directives must be repealed;

Whereas the internal market incorporates an area without internal frontiers within which the free movement of goods, persons, services and capital is assured;

Whereas it is necessary to provide for a transitional arrangement enabling equipment manufactured in compliance with the national regulations in force at the date of adoption of this Directive to be marketed and placed in service,

- have adopted this directive:

Chapter I

Scope, placing on the market and freedom of movement

Article 1

(1) This Directive applies to equipment and protective systems intended for use in potentially explosive atmospheres.

(2) Safety devices, controlling devices and regulating devices intended for use outside potentially explosive atmospheres but required for or contributing to the safe functioning of equipment and protective systems with respect to the risks of explosion are also covered by the scope of this Directive.

(3) For the purposes of this Directive, the following definitions shall apply: Equipment and protective systems intended for use in potentially explosive atmospheres

a) 'Equipment' means machines, apparatus, fixed or mobile devices, control components and instrumentation thereof and detection or prevention systems which, separately or jointly, are intended for the generation, transfer, storage, measurement, control and conversion of energy for the processing of material and which are capable of causing an explosion through their own potential sources of ignition.

b) 'Protective systems' means design units which are intended to halt incipient explosions immediately and/or to limit the effective range of explosion flames and explosion pressures. Protective systems may be integrated into equipment or separately placed on the market for use as autonomous systems.

(c) 'Components' means any item essential to the safe functioning of equipment and protective systems but with no autonomous function.

Explosive atmospheres

Mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

Potentially explosive atmosphere

An atmosphere which could become explosive due to local and operational conditions.

Equipment groups and categories

Equipment group I applies to equipment intended for use in underground parts of mines, and to those parts of surface installations of such mines, liable to be endangered by firedamp and/or combustible dust.

Equipment group II applies to equipment intended for use in other places liable to be endangered by explosive atmospheres.

The categories of equipment defining the required levels of protection are described in Annex I.

Equipment and protective systems may be designed for a particular explosive atmosphere. In this case, they must be marked accordingly.

Intended use

The use of equipment, protective systems, and devices referred to in Article 1 (2) in accordance with the equipment group and category and with all the information supplied by the manufacturer which is required for the safe functioning of equipment, protective systems and devices.

(4) The following are excluded from the scope of this Directive:

- medical devices intended for use in a medical environment,
- equipment and protective systems where the explosion hazard results exclusively from the presence of explosive substances or unstable chemical substances,
- equipment intended for use in domestic and non-commercial environments where potentially explosive atmospheres may only rarely be created, solely as a result of the accidental leakage of fuel gas,
- personal protective equipment covered by Directive 89/686/EEC[3],
- seagoing vessels and mobile offshore units together with equipment on board such vessels or units,
- means of transport, i.e. vehicles and their trailers intended solely for transporting passengers by air or by road, rail or water networks, as well as means of transport in so far as such means are designed for transporting goods by air, by public road or rail networks or by water. Vehicles intended for use in a potentially explosive atmosphere shall not be excluded,
- the equipment covered by Article 223[4] (b) of the Treaty.

[1] OJ No L 24, 31. 1. 1976, p. 45. Directive as last amended by Directive 90/487/EEC (OJ No L 270, 2. 10. 1990, p. 23).

[2] OJ No L 59, 2. 3. 1982, p. 10.

[3] OJ No L 399, 30. 12. 1989, p. 18.

[4] OJ No L 43, 20. 2. 1979, p. 20. Directive as last amended by Directive 90/487/EEC (OJ No L 270, 2. 10. 1990, p. 23).

Article 2

(1) Member States shall take all appropriate measures to ensure that the equipment, protective systems and devices referred to in Article 1 (2) to which this Directive applies may be placed on the market and put into service only if, when properly installed and maintained and used for their intended purpose, they do not endanger the health and safety of persons and, where appropriate, domestic animals or property.

(2) The provisions of this Directive shall not affect Member States' entitlement to lay down, in due observance of the provisions of the Treaty, such requirements as they may deem necessary to ensure that persons and, in particular, workers are protected when using the equipment, protective systems, and devices referred to in Article 1 (2) in question provided that this does not mean that such equipment, protective systems, or devices are modified in a way not specified in the Directive.

(3) At trade fairs, exhibitions, demonstrations, etc., Member States shall not prevent the showing of equipment, protective systems, or the devices referred to in Article 1 (2) which do not conform to the provisions of this Directive, provided that a visible sign clearly indicates that such equipment, protective systems, and devices referred to in Article 1 (2) do not conform and that they are not for sale until they have been brought into conformity by the manufacturer or his authorized representative established in the Community. During demonstrations, adequate safety measures shall be taken to ensure the protection of persons.

Article 3

Equipment, protective systems, and the devices referred to in Article 1 (2) to which this Directive applies must meet the essential health and safety requirements set out in Annex II which apply to them, account being taken of their intended use.

Article 4

(1) Member States shall not prohibit, restrict or impede the placing on the market and putting into service in their territory of equipment, protective systems, or devices referred to in Article 1 (2) which comply with this Directive.

(2) Member States shall not prohibit, restrict or impede the placing on the market of components which, accompanied by a certificate of conformity as referred to in Article 8 (3), are intended to be incorporated into equipment or protective systems within the meaning of this Directive.

Article 5

(1) Member States shall regard as conforming to all the provisions of this Directive, including the relevant conformity assessment procedures laid down in chapter II:

- equipment, protective systems, and devices referred to in Article 1 (2) accompanied by the EC declaration of conformity referred to in Annex X and bearing the CE marking provided for in Article 10,

- the components referred to in Article 4 (2), accompanied by the certificate of conformity referred to in Article 8 (3).

In the absence of harmonized standards, Member States shall take any steps which they deem necessary to bring to the attention of the parties concerned the existing national technical standards and specifications regarded as important or relevant to the proper implementation of the essential health and safety requirements in Annex II.

(2) Where a national standard transposing a harmonized standard, the reference for which has been published in the Official Journal of the European Communities, covers one or more of the essential health and safety requirements, the equipment, protective system, device referred to in Article 1 (2), or the component referred to in Article 4 (2), constructed in accordance with that standard shall be presumed to comply with the relevant essential health and safety requirements. Member States shall publish the references of national standards transposing harmonized standards.

(3) Member States shall ensure that appropriate measures are taken to enable the social partners to influence the process of preparing and monitoring the harmonized standards at national level.

Article 6

(1) Where a Member State or the Commission considers that the harmonized standards referred to in Article 5 (2) do not entirely satisfy the relevant essential health and safety requirements referred to in Article 3, the Commission or the Member State concerned shall bring the matter before the Committee set up under Directive 83/189/EEC, hereinafter referred to as 'the Committee', giving reasons therefor. The Committee shall deliver an opinion without delay.

Upon receipt of the Committee's opinion, the Commission shall inform the Member States whether or not it is necessary to withdraw those standards from the published information referred to in Article 5 (2).

(2) The Commission may adopt any appropriate measure with a view to ensuring the practical application in a uniform manner of this Directive in accordance with the procedure laid down in paragraph 3.

(3) The Commission shall be assisted by a Standing Committee, consisting of representatives appointed by the Member States and chaired by a representative of the Commission.

The Standing Committee shall draw up its own rules of procedure.

The representative of the Commission shall submit to the Committee a draft of the measures to be taken. The Committee shall deliver its opinion on the draft, within a time limit which the chairman may lay down according to the urgency of the matter, if necessary by taking a vote.

The opinion shall be recorded in the minutes; in addition, each Member State shall have the right to ask to have its position recorded in the minutes.
The Commission shall take the utmost account of the opinion delivered by the committee. It shall inform the committee of the manner in which its opinion has been taken into account.

(4) The Standing Committee may furthermore examine any question relating to the application of this Directive and raised by its chairman either on the latter's initiative, or at the request of a Member State.

Article 7

(1) Whee a Member State ascertains that equipment, protective systems or devices referred to in Article 1 (2) bearing the CE conformity marking and used in accordance with their intended use are liable to endanger the safety of persons and, where appropriate, domestic animals or property, it shall take all appropriate meaures to withdraw such equipment or protective systems from the market, to prohibit the placing on the market, putting into service or use thereof, or to restrict free movement there of. The Member State shall immediately inform the Commission of any such measure, indicating the reasons for its decision and, in particular, whether non-conformity is due to:

(a) failure to satisfy the essential requirements referred to in Article 3;

(b) incorrect application of the standards referred to in Article 5 (2);

(c) shortcomings in the standards referred to in Article 5 (2).

(2) The Commission shall enter into consultation with the parties concerned without delay. Where the Commission considers, after this Consultation, that the measure is justified, it shall immediately so inform the Member State which took the initiative and the other Member States. Where the Commission considers, after this consultation, that the action is unjustified, it shall immediately so inform the Member State which took the initiative and the manufacturer or his authorized representative established within the Community. Where the decision referred to in paragraph 1 is based on a shortcoming in the standards and where the Member State at the origin of the decision maintains its position, the Commission shall immediately inform the Committee in order to initiate the procedures referred to in Article 6 (1).

(3) Where equipment or a protective system which does not comply bears the CE conformity marking, the competent Member State shall take appropriate action against the person(s) having affixed the marking and shall so inform the Commission and the other Member States.

(4) The Commission shall ensure that the Member States are kept informed of the progress and outcome of this procedure.

Chapter II

Conformity assessment procedures

Article 8

(1) The procedures for assessing the conformity of equipment, including where necessary the devices referred to in Article 1 (2), shall be as follows:

a) equipment-group I and II, equipment-category M 1 and 1.
The manufacturer or his authorized representative established in the Community must, in order to affix the CE marking, follow the CE type-examination procedure (referred to in Annex III), in conjunction with:

- the procedure relating to production quality assurance (referred to in Annex IV),

or

- the procedure relating to product verification (referred to in Annex V);

b) Equipment-group I and II, equipment-category M 2 and 2

i) In the case of internal combustion engines and electrical equipment in these groups and categories, the manufacturer or his authorized representative established in the Community shall, in order to affix the CE mark, follow the EC-type examination procedure (referred to in Annex III), in conjunction with:

- the procedure relating to conformity to type referred to in Annex VI, or
- the procedure relating to product quality assurance referred to in Annex VII;

ii) In the case of other equipment in these groups and categories, the manufacturer or his authorized representative established in the Community must, in order to affix the CE mark, follow the procedure relating to internal control of production (referred to in Annex VIII) and communicate the dossier provided for in Annex VIII, paragraph 3, to a notified body, which shall acknowledge receipt of it as soon as possible and shall retain it.

c) equipment-group II, equipment-category 3

The manufacturer or his authorized representative established in the Community must, in order to affix the CE marking, follow the procedure relating to internal control of production referred to n Annex VIII;

d) equipment-groups I and II

In addition to the procedures referred to in paragraph 1(a), (b) and (c), the manufacturer or his authorized representative established in the Community may also, in order to affix the CE marking, follow the procedure relating to CE unit verification (referred to in Annex IX).

(2) The provisions of 1(a) or 1(d) above shall be used for conformity assessment of autonomous protective systems.

(3) The procedures referred to in paragraph 1 shall be applied in respect of components as referred to in Article 4 (2), with the exception of the affixing of the CE marking. A certificate shall be issued by the manufacturer or his authorized representative established in the Community, declaring the conformity of the components with the provisions of this Directive which apply to them and stating their characteristics and how they must be incorporated into equipment or protective systems to assist compliance with the essential requirements applicable to finished equipment or protective systems.

(4) In addition, the manufacturer or his authorized representative established in the Community may, in order to affix the CE marking, follow the procedure relating to internal control of production (referred to in Annex VIII) with regard to the safety aspects referred to in point 1.2.7 of Annex II.

(5) Notwithstanding the previous paragraphs, the competent authorities may, on a duly justified request, authorize the placing on the market and putting into service on the territory of the Member State concerned of the equipment, protective systems and individual devices referred to in Article 1 (2) in respect of which the procedures referred to in the previous paragraphs have not been applied and the use of which is in the interests of protection.

(6) Documents and correspondence relating to the procedures referred to in the abovementioned paragraphs shall be drawn up in one of the official languages of the Member States in which those procedures are being applied or in a language accepted by the notified body.

(7) (a) Where the equipment and protective systems are subject to other Community Directives covering other aspects which also provide for the affixing of the CE marking referred to in Article 10, that marking shall indicate that the equipment and protective systems are also presumed to conform with the provisions of those other Directives.

(b) However, where one or more of those Directives allow the manufacturer, during a transitional period, to choose which arrangements to apply, the CE marking shall indicate conformity only with the Directives applied by the manufacturer. In this case, particulars of the said Directives, as published in the Official Journal of the European Communities, must be given in the documents, notices or instructions required by the Directives and accompanying the equipment and protective systems.

Article 9

(1) Member States shall notify the Commission and the other Member States of the bodies which they have appointed to carry out the procedures referred to in Article 8, together with the specific tasks which these bodies have been appointed to carry out and the identification numbers assigned to them beforehand by the Commission. The Commission shall publish in the Official Journal of the European Communities a list of the notified bodies, with their identification numbers and the tasks for which they have been notified. The Commission shall ensure that this list is kept up to date.

(2) Member States shall apply the criteria laid down in Annex XI in assessing the bodies to be indicated in such notification. Bodies meeting the assessment criteria laid down in the relative harmonized standards shall be presumed to fulfil those criteria.

(3) A Member State which has approved a body must withdraw its notification if it finds that the body no longer meets the criteria referred to in Annex XI. It shall immediately inform the Commission and the other Member States accordingly.

Chapter III CE conformity marking

Article 10

(1) The CE conformity marking shall consist of the initials 'CE'. The form of the marking to be used is shown in Annex X. The CE marking shall be followed by the identification number of the notified body where such body is involved in the production control stage.

(2) The CE marking shall be affixed distinctly, visibly, legibly and indelibly to equipment and protective systems, supplementary to the provisions of point 1.0.5. of Annex II.

(3) The affixing of markings on the equipment or protective systems which are likely to deceive third parties as to the meaning and form of the CE marking shall be prohibited. Any other marking may be affixed to the equipment or protective systems, provided that the visibility and legibility of the CE marking is not thereby reduced.

Article 11

Without prejudice to Article 7:

a) where a Member State establishes that the CE marking has been incorrectly affixed, the manufacturer or his authorized representative established within the Community shall be obliged to make the product conform as regards the provisions concerning the CE marking and to end the infringement under the conditions imposed by the Member State;

b) in the event of continuing non-conformity, the Member State must take all appropriate measures to restrict or prohibit the placing on the market of the product in question or to ensure that it is withdrawn from the market in accordance with the procedures laid down in Article 7.

CHAPTER IV

Final provisions

Article 12

Any decision taken pursuant to this Directive which restricts or prohibits the placing on the market and/or the putting into service or requires the withdrawal from the market of equipment, a protective system, or a device referred to in Article 1 (2) shall state the exact grounds on which it is based. Such a decision shall be notified forthwith to the party concerned, who shall at the same time be informed of the legal remedies available to him under the laws in force in the Member State concerned and of the time limits to which such remedies are subject.

Article 13

Member States shall ensure that all the parties involved in the application of the Directive are bound to observe confidentiality in respect of all information obtained in the performance of carrying out their tasks. This does not affect the obligations of the Member States and of the notified bodies regarding reciprocal information and the dissemination of warnings.

Article 14

(1) Directive 76/117/EEC, Directive 79/196/EEC (1) and Directive 82/130/EEC shall be repealed as from 1 July 2003.

(2) EC certificates of conformity to the harmonized standards obtained in accordance with the procedures laid down in the Directives referred to in paragraph 1 shall continue to be valid until 30 June 2003 unless they expire before that date. Their validity shall continue to be limited to the harmonized standards indicated in the aforementioned Directives.

(3) Member States shall take the necessary action to ensure that the notified bodies which are responsible pursuant to Article 8 (1) to (4) for the assessment of the conformity of electrical equipment placed on the market before 1 July 2003 take account of the results of tests and verifications already carried out under the Directives referred to in paragraph 1.

Article 15

(1) Member States shall adopt and publish the laws, regulations and administrative provisions necessary to comply with this Directive before 1 September 1995. They shall forthwith inform the Commission thereof. The Member States shall apply these measures with effect from 1 March 1996. When Member States adopt the measures referred to in the first subparagraph, they shall contain a reference to this Directive or shall be accompanied by such reference at the time of their official publication. The methods of making such reference shall be laid down by Member States.

(2) However, Member States shall allow the placing on the market and the putting into service of equipment and protective systems conforming with the national regulations in force in their territory at the date of adoption of this Directive for the period until 30 June 2003.

Article 16

This Directive is addressed to the Member States.

Done at Brussels, 23 March 1994.

For the European Parliament

The President

E. KLEPSCH

For the Council

The President

TH. PANGALOS

Directive1999/92/EC

Of the european parliament
and the council of 16 December 1999

on minimum requirements for improving
the safety and health protection of workers
potentially at risk from explosive atmospheres
(15th individual Directive within the meaning of
Article 16(1) of Directive 89/391/EEC)

Directives are subject to variations.

The european parliament and the council of the european union,

Having regard to the Treaty establishing the European Community, and in particular Article 137 thereof,

Having regard to the proposal from the Commission[1], submitted after consultation with the Advisory Committee on Safety, Hygiene and Health Protection at Work and the Safety and Health Commission for the Mining and Other Extractive Industries, Having regard to the opinion of the Economic and Social Committee[2], After consulting the Committee of the Regions, Acting in accordance with the procedure referred to in Article 251 of the Treaty, in the light of the joint text approved by the Conciliation Committee on 21 October 1999[3], Whereas:

(1) Article 137 of the Treaty provides that the Council may adopt, by means of Directives, minimum requirements for encouraging improvements, especially in the working environment, to guarantee a better level of protection of the health and safety of workers;

(2) Under the terms of that Article, those Directives are to avoid imposing administrative, financial and legal constraints in a way which would hold back the creation and development of small and medium-sized undertakings;

(3) The improvement of occupational safety, hygiene and health is an objective which should not be subordinated to purely economic considerations;

(4) Compliance with the minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres is essential if workers' safety and health protection is to be ensured;

(5) This Directive is an individual Directive within the meaning of Article 16(1) of Council Directive 89/391/EEC of 12 June 1989 on the introduction of measures to encourage improvements in the safety and health of workers at work[4]; therefore, the provisions of the said Directive, in particular those relating to worker information, to the consultation and participation of workers and to the training of workers, are also fully applicable to cases in which workers are potentially at risk from explosive atmospheres, without prejudice to more restrictive or specific provisions contained in this Directive;

(6) This Directive constitutes a practical step towards the achievement of the social dimension of the internal market;

(7) Directive 94/9/EC of the European Parliament and of the 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[5] states that it is intended to prepare an additional Directive based on Article 137 of the Treaty covering, in particular, explosion hazards which derive from a given use and/or types and methods of installation of equipment;

(8) Explosion protection is of particular importance to safety; whereas explosions endanger the lives and health of workers as a result of the uncontrolled effects of flame and pressure, the presence of noxious reactin products and consumption of the oxygen in the ambient air which workers need to breathe;

(9) The establishment of a coherent strategy for the prevention of explosions requires that organisational measures complement the technical measures taken at the workplace; Directive 89/391/EEC requires the employer to be in possession of an assessment of the risks to workers' health and safety at work; this requirement is to be regarded as being specified by this Directive in that it provides that the employer is to draw up an explosion protection document, or set of documents, which satisfies the minimum requirements laid down in this Directive and is to keep it up to date; the explosion protection document includes the identification of the hazards, the evaluation of risks and the definition of the specific measures to be taken to safeguard the health and safety of workers at risk from explosive atmospheres, in accordance with Article 9 of Directive 89/391/EEC; the explosion protection document may be part of the assessment of the risks to health and safety at work required by Article 9 of Directive 89/391/EEC;

(10) An assessment of explosion risks may be required under other Community acts; whereas, in order to avoid unnecessary duplication of work, the employer should be allowed, in accordance with national practice, to combine documents, parts of documents or other equivalent reports produced under other Community acts to form a single „safety report";

(11) The prevention of the formation of explosive atmospheres also includes the application of the substitution principle;

(12) Coordination should take place when workers from several undertakings are present at the same workplace;

(13) Preventive measures must be supplemented if necessary by additional measures which become effective when ignition has taken place; maximum safety can be achieved by combining preventive measures with other additional measures limiting the detrimental effects of explosions on workers;

(14) Council Directive 92/58/EEC of 24 June 1992 on the minimum requirements for the provision of safety and/or health signs at work (ninth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)[6] is fully applicable, in particular to places immediately contiguous to hazardous areas, where smoking, crosscutting, welding and other activities introducing flames or sparks may interact with the hazardous area;

(15) Directive 94/9/EC divides the equipment and protective systems which it covers into equipment groups and categories; this Directive provides for a classification by the employer of the places where explosive atmospheres may occur in terms of zones and determines which equipment and protective systems groups and categories should be used in each zone,

1) OJ C 332, 9.12.1995, p. 10 and OJ C 184, 17.6.1997, p. 1.

2) OJ C 153, 28.5.1996, p. 35.

3) Opinion of the European Parliament of 20 June 1996 (OJ C 198, 8.7.1996, p. 160) confirmed on 4 May 1999 (OJ C 279, 1.10.1999, p 55), Council Common Position of 22 December 1998 (OJ C 55, 25.2.1999, p. 45), Decision of the European Parliament of 6 May 1999 (OJ C 279, 1.10.1999, p. 386). Decision of the European Parliament of 2 December 1999 and Council Decision of 6 December 1999.

4) OJ L 183, 29.6.1989, p. 1.

5) OJ L 100, 19.4.1994, p. 1.

6) OJ L 245, 26.8.1992, p. 23

- have adopted this directive:

Section I

GENERAL PROVISIONS

Article 1

Object and scope

(1) This Directive, which is the 15th individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC, lays down minimum requirements for the safety and health protection of workers potentially at risk from explosive atmospheres as defined in Article 2.

(2) This Directive shall not apply to:

a) areas used directly for and during the medical treatment of patients;

b) the use of appliances burning gaseous fuels in accordance with Directive 90/396/EEC[1];

c) the manufacture, handling, use, storage and transport of explosives or chemically unstable substances;

d) mineral-extracting industries covered by Directive 92/91/EEC[2] or Directive 92/104/EEC[3];

e) the use of means of transport by land, water and air, to which the pertinent provisions of the international agreements (e.g. ADNR, ADR, ICAO, IMO, RID), and the Community Directives giving effect to those agreements, apply. Means of transport intended for use in a potentially explosive atmosphere shall not be excluded.

(3) The provisions of Directive 89/391/EEC and the relevant individual Directives are fully applicable to the domain referred to in paragraph 1, without prejudice to more restrictive and/or specific provisions contained in this Directive.

Article 2

Definition

For the purposes of this Directive, „explosive atmosphere" means a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

Section II

Obligations of the employer

Article 3

Prevention of and protection against explosions

With a view to preventing, within the meaning of Article 6(2) of Directive 89/391/EEC, and providing protection against explosions, the employer shall take technical and/or organisational measures appropriate to the nature of the operation, in order of priority and in accordance with the following basic principles:

- the prevention of the formation of explosive atmospheres, or where the nature of the activity does not allow that,
- the avoidance of the ignition of explosive atmospheres, and
- the mitigation of the detrimental effects of an explosion so as to ensure the health and safety of workers.

These measures shall where necessary be combined and/or supplemented with measures against the propagation of explosions and shall be reviewed regularly and, in any event, whenever significant changes occur.

Article 4

Assessment of explosion risks

(1) In carrying out the obligations laid down in Articles 6(3) and 9(1) of Directive 89/391/EEC the employer shall assess the specific risks arising from explosive atmospheres, taking account at least of:

- the likelihood that explosive atmospheres will occur and their persistence,
- the likelihood that ignition sources, including electrostatic discharges, will be present and become active and effective,
- the installations, substances used, processes, and their possible interactions,
- the scale of the anticipated effects.

Explosion risks shall be assessed overall.

(2) Places which are or can be connected via openings to places in which explosive atmospheres may occur shall be taken into account in assessing explosion risks.

Article 5

General obligations

To ensure the safety and health of workers, and in accordance with the basic principles of risk assessment and those laid down in Article 3, the employer shall take the necessary measures so that:

- where explosive atmospheres may arise in such quantities as to endanger the health and safety of workers or others, the working environment is such that work can be performed safely,
- in working environments where explosive atmospheres may arise in such quantities as to endanger the safety and health of workers, appropriate supervision during the presence of workers is ensured in accordance with the risk assessment by the use of appropriate technical means.

Article 6

Duty of coordination

Where workers from several undertakings are present at the same workplace, each employer shall be responsible for all matters coming under his control. Without prejudice to the individual responsibility of each employer as provided for in Directive 89/391/EEC, the employer responsible for the workplace in accordance with national law and/or practice shall coordinate the implementation of all the measures concerning workers' health and safety and shall state, in the explosion protection document referred to in Article 8, the aim of that coordination and the measures and procedures for implementing it.

Article 7

Places where explosive atmospheres may occur

(1) The employer shall classify places where explosive atmospheres may occur into zones in accordance with Annex I.

(2) The employer shall ensure that the minimum requirements laid down in Annex II are applied to places covered by paragraph 1.

(3) Where necessary, places where explosive atmospheres may occur in such quantities as to endanger the health and safety of workers shall be marked with signs at their points of entry in accordance with Annex III.

[1] OJ L 196, 26.7.1990, p. 15. Directive as amended by Directive 93/68/EEC (OJ L 220, 30.8.1993, p. 1).

[2] OJ L 348, 28.11.1992, p. 9.

[3] OJ L 404, 31.12.1992, p. 10.

Article 8

Explosion protection document

In carrying out the obligations laid down in Article 4, the employer shall ensure that a document, hereinafter referred to as the „explosion protection document", is drawn up and kept up to date.

The explosion protection document shall demonstrate in particular:

- that the explosion risks have been determined and assessed,
- that adequate measures will be taken to attain the aims of this Directive,
- those places which have been classified into zones in accordance with Annex I,
- those places where the minimum requirements set out in Annex II will apply,
- that the workplace and work equipment, including warning devices, are designed, operated and maintained with due regard for safety,
- that in accordance with Council Directive 89/655/EEC[1], arrangements have been made for the safe use of work equipment.

The explosion protection document shall be drawn up prior to the commencement of work and be revised when the workplace, work equipment or organisation of the work undergoes significant changes, extensions or conversions.

The employer may combine existing explosion risk assessments, documents or other equivalent reports produced under other Community acts.

Article 9

Special requirements for work equipment and workplaces

(1) Work equipment for use in places where explosive atmospheres may occur which is already in use or is made available in the undertaking or establishment for the first time before 30 June 2003 shall comply from that date with the minimum requirements laid down in Annex II, Part A, if no other Community Directive is applicable or is so only partially.

(2) Work equipment for use in places where explosive atmospheres may occur which is made available in the undertaking or establishment for the first time after 30 June 2003 shall comply with the minimum requirements laid down in Annex II, Parts A and B.

(3) Workplaces which contain places where explosive atmospheres may occur and which are used for the first time after 30 June 2003 shall comply with minimum requirements set out in this Directive.

(4) Where workplaces which contain places where explosive atmospheres may occur are already in use before 30 June 2003, they shall comply with the minimum requirements set out in this Directive no later than three years after that date.

(5) If, after 30 June 2003, any modification, extension or restructuring is undertaken in workplaces containing places where explosive atmospheres may occur, the employer shall take the necessary steps to ensure that these comply with the minimum requirements set out in this Directive.

Section III

Miscellaneous privisions

Article 10

Adjustments to the annexes

Purely technical adjustments to the annexes made necessary by:

- the adoption of Directives on technical harmonisation and standardisation in the field of explosion protection, and/or
- technical progress, changes in international regulations or specifications, and new findings on the prevention of and protection against explosions, shall be adopted in accordance with the procedure laid down in Article 17 of Directive 89/391/EEC.

Article 11

Guide of good practice

The Commission shall draw up practical guidelines in a guide of good practice of a non-binding nature. This guide shall address the topics referred to in Articles 3, 4, 5, 6, 7 and 8, Annex I and Annex II, Part A.
The Commission shall first consult the Advisory Committee on Safety, Hygiene and Health Protection at Work in accordance with Council Decision 74/325/EEC[2].
In the context of the application of this Directive, Member States shall take the greatest possible account of the abovementioned guide in drawing up their national policies for the protection of the health and safety of workers

Article 12

Information to undertakings

Member States shall, on request, endeavour to make relevant information available to employers in accordance with Article 11, with particular reference to the guide of good practice

Article 13

Final provisions

(1) Member States shall bring into force the laws, regulations and administrative provisions necessary to comply with this Directive not later than 30 June 2003. They shall forthwith inform the Commission there of.
When Member States adopt these measures, they shall contain a reference to this Directive or shall be accompanied by such reference on the occasion of their official publication. The methods of making such reference shall be laid down by the Member States.

(2) Member States shall communicate to the Commission the text of the provisions of domestic law which they have already adopted or adopt in the field governed by this Directive.

(3) Member States shall report to the Commission every five years on the practical implementation of the provisions of this Directive, indicating the points of view of employers and workers. The Commission shall inform thereof the European Parliament, the Council, the Economic and Social Committee and the Advisory Committee on Safety, Hygiene and Health Protection at Work.

Article 14

This Directive shall enter into force on the day of its publication in the Official Journal of the European Communities.

Article 15

This Directive is addressed to the Member States.
Done at Brussels, 16 December 1999.

For the European Parliament	For the Council
The President	The President
N. FONTAINE	K. HEMILÄ

[1] OJ L 393, 30.12.1989, p. 13. Directive as amended by Directive 95/63/EC (OJ L 335, 30.12.1995, p. 28).

[2] OJ L 185, 9.7.1974, p. 15. Decision as last amended by the 1994 Act of Accession.