GENERAL

The accidental ignition of an atmosphere containing a large quantity of gas, vapour, mists and/or dust may cause an explosion. Specific ***measures*** *have been taken on an* ***international level*** *in order to avoid any material damage or the loss of human lives.*
These measures mainly apply to chemical and petrochemical industries where such hazardous atmospheres may be developed during the production, transformation, transport and storage of flammable products. They also cover installations where combustible dust is produced in the processing of pulverised and grain products (grinding and sieving).

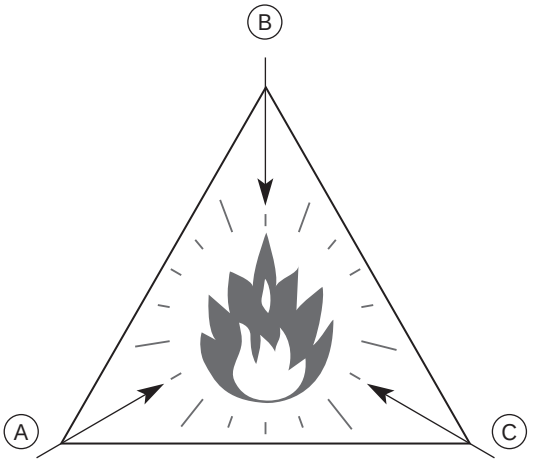
SOME DEFINITIONS

What is a potentially explosive atmosphere?

3 elements must be combined to trigger an explosion:

- (A) **The oxygen in the surrounding air = always present**
- (B) A **flammable substance** (gas, vapours, mists or dusts)
- (C) A **source of ignition**: Electrical equipment / installation or any source of heat

A **spark** or a **flame** are not the only sources of ignition. An **increase of the surface temperature** of an electrical equipment may cause an explosion if it exceeds the ignition temperature of the surrounding gas or mixture of substances.



Removing just one of the 3 elements eliminates the entire risk

What is an explosive atmosphere?

This is an atmosphere which could become explosive (the danger is potentially present) due to the local or operational condition in an installation such as: leaks, rupture of pipeline, temperature variations, etc.

What is a gaseous or dusty explosive atmosphere?

This is 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 (definition according to Directive 1999/92/EC).

What is the fundamental difference between a gaseous and a dusty atmosphere?

It's the density. The density of gases and vapours is approximately 1,000 times less than that of dusts. Gases are dispersed in the air due to convection and diffusion, thereby creating a homogeneous atmosphere. Since dusts are much heavier than air, they have the tendency to settle to the bottom more or less quickly.

What are the characteristic features of an explosive atmosphere caused by dust?

For a dusty atmosphere to become explosive, the following four conditions must be present:
- The dust must be flammable (particle size < 0.3 mm in general).
- The atmosphere must contain an oxidiser (generally oxygen, even in a very small quantity).
- The dusts must be in suspension. (The explosion will be caused by the extremely rapid rate of combustion of the dust in the oxygen in the air.)
- The dust concentration must be in the explosive range. (As a rule, the lower limit of explosion is around 50 g/m³.)

OBJECTIVES OF THE ATEX DIRECTIVE 94/9/EC ("**AT**mosphères **EX**plosibles")

To ensure free circulation of the products to which it is applicable throughout the territory of the European Union.

To remove barriers to trade via the **New Approach** by requiring a definition **of essential requirements regarding safety and health** by which a high level of protection will be ensured (Annex II of Directive 94/9/EC).

To cover by a single directive both mining and surface equipment.

To increase the scope as compared to national regulations by providing for the first time essential safety and health requirements for:
- **Non-electrical equipment** intended for use in potentially explosive atmospheres [EN 13463-1 (2001)];
- Equipment intended for use in **dusty environments** as well as protective systems;
- Devices intended **for use outside explosive atmospheres** which are required for or contribute to the **safe functioning** of equipment or protective systems.

WHAT OBLIGATIONS DOES THE MANUFACTURER HAVE UNDER THIS DIRECTIVE?

The manufacturer has sole and ultimate responsibility for the conformity of his product to the applicable directives. He bears responsibility for:

- Ensuring the conformity of his products to the Directive (providing for certificates of conformity);
- Designing and constructing his products in accordance with the essential safety and health requirements;
- Following the procedures for the assessment of the conformity of the product.

EFFECTIVE DATE

Since 1 July 2003, all products placed on the market in the European Union have to conform to Directive 94/9/EC. Already installed equipment need, however, not be replaced by equipment conforming to the ATEX directive.

WHAT ABOUT THE PRODUCTS AFTER 30 JUNE 2003?

After 30 June 2003, conformity to the ATEX directive is obligatory in order to enable free movement of products throughout the European Union. Only the New Approach remains valid. It takes into account:

- Hazardous areas;
- CE Marking;
- Dust atmospheres;
- The CENELEC standards EN 60079-0 (EN 50014) for electrical equipment for explosive gas atmosphere;
- Standard EN 13463 for non-electrical equipment for potentially explosive atmospheres.

WHAT ABOUT THE PRODUCTS AFTER 1 JULY 2006?

After 1 July 2006, standards EN 50014..28 are progressively replaced by the EN 60079 series of standards in the list of harmonised standards. The same applies for EN 50281-1-1 (electrical apparatus for the use in the presence of combustible dust) which is replaced by the EN 61241 series of standards.

If the equipment is not affected by substantial modifications of the new standards, the manufacturer does not need to apply for an addition to the EC type-examination certificate.

Status of the harmonisation of these standards at the end of 2006:

EN 50014		Replaced by EN 60079-0.
EN 50018	«d»	Replaced by EN 60079-1.
EN 50019	«e»	Replaced by EN 60079-7.
EN 50020	«i»	To be harmonised by 1 October 2009, then replaced by EN 60079-11.
EN 50021	«n»	Replaced by EN 60079-15.
EN 50028	«m»	Replaced by EN 60079-18.
EN 50281-1-1		Replaced by EN 61241-0 and EN 61241-1.

WHAT IS THE IECEx CERTIFICATION?

The IECEx International Certification Scheme is a voluntary certification system. It offers a certification of conformity with the IEC series of standards 60079, 61241 and 61779. This certification facilitates the international trade of electrical equipment intended for use in explosive atmospheres and contributes to avoiding the multiplicity of national certifications while guaranteeing an adapted level of safety. The certification is issued by an organisation recognised by IECEx, an ExCB (Ex Certification Body).

- It provides direct access to the markets in Australia, New Zealand etc.
- It simplifies access to local certifications in Russia, China, USA etc.
- It reduces the time and costs for certification due to its international recognition.
- All certificates issued are available for download worldwide under «Online Certificates» at IECEx.com.

WHAT ARE EQUIPMENT PROTECTION LEVELS (EPLs)?

The degree of hazard is currently defined according to the probability of the occurrence of explosive atmospheres. Equipment Protection Levels (EPLs) are introduced to enable an alternative approach to selecting Ex equipment by taking into account the potential consequences of an explosion and other factors such as the toxicity of materials.

A risk assessment approach for the acceptance of explosion protected equipment has been introduced to clearly indicate the inherent ignition risk of the equipment, no matter what type of protection is used.

IEC / CENELEC COOPERATION

The main CENELEC EN 50014 standard (General Requirements) pertaining to electrical apparatus for potentially explosive atmospheres was originally published in 1977. It is derived from the IEC Publications 79.
From that date, these 2 organisations have constantly intensified their cooperation. The new series of standards 6 (60079-0, etc.) which gradually replace the old standards are an example for the approximation between European and international standards.

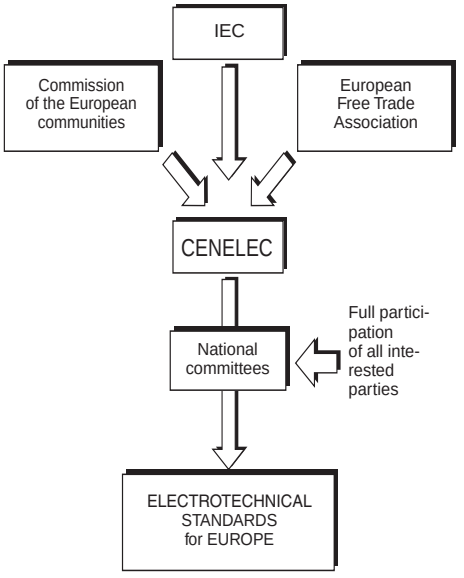
WHAT ARE THESE 2 ORGANISATIONS?

IEC

The "International Electrotechnical Commission" (IEC), founded in 1906, has its head office in Geneva. The commission is currently composed of 55 national committees and 19 associate members. Its purpose is "fostering international cooperation in all issues relative to standardisation and in related subjects such as certification in the fields of electricity and electronics, and thus favouring international exchanges".
Since 1976, the IEC has been cooperating with the International Standard Organisation (ISO), among others.

CENELEC

The "European Committee for Electrotechnical Standardisation" (CENELEC) is a technical organisation located in Brussels. It is composed of the National Electrotechnical Committees from 31 European countries and 11 affiliated countries. The committee's major role is to harmonise national standards to produce a single European Standard ("EN").
In 1958, the standardisation process started, and in 1973, the name CENELEC was adopted with the expansion of the Common Market.
Within the CENELEC, the Technical Committee 31 is in charge of elaborating the standards for electrical apparatus intended for use in explosive atmospheres.



WHAT IS CEN?

CEN (European Committee for Standardisation) works in close partnership with CENELEC. CEN is a “European forum” for standardisation, with the exception of electro-technology, which fosters and organises relations between governments, governmental bodies, producers, users, consumers, trade unions etc. This is, in particular achieved by:

- harmonising published national standards and promoting ISO standards;
- elaborating new EN standards, developing procedures for the mutual recognition of test results etc. (Example: Standards EN 13463-1 to 8 for non-electrical apparatus).

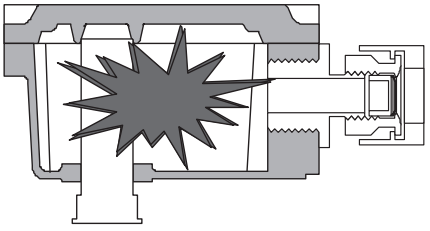
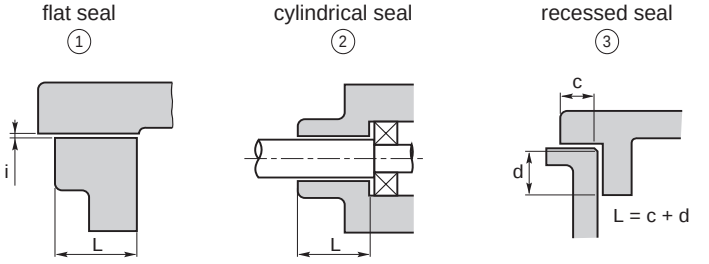
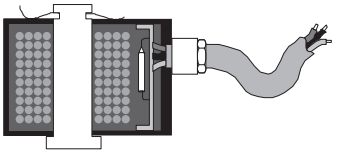
LATEST DEVELOPMENTS IN THE STANDARDISATION OF EXPLOSIVE ATMOSPHERES

CENELEC and **CEN** have been entrusted with developing new directives as a support to harmonise the legislation of the Member States of the European Union.

Key dates to bear in mind:

- 23 March 1994: Creation of Directive **94/9/EC** (also called **ATEX** or **ATEX 100A)** in replacement of Directives 76/117/EEC, 79/196/EEC, 82/130/EEC. **The directive is to form the basis of the current regulations relating to electrical and non-electrical equipment for explosive atmospheres.**
- From 1996, transposition of the directive in the Member States of the European Union. Start of the **transitory period** allowing for a progressive adaptation of the manufacture of products to the requirements of the directive.
- **30 June 2003**, end of the transitory period: All products placed on the market throughout the European Union from **1 July 2003** must fulfil the safety and health requirements of Directive 94/9/EC.
- **2006-2009:** Gradual application of the new harmonised series of standards “6” (EN 60079-0, EN 60214-0, etc.). The series of standards “5” (EN 50014, EN 50281-1-1 etc.) will cease to apply due to the substantial modifications required by some of the series of standards “6”.
- **2007:** The significant changes in the 5th edition of IEC 60079-0 are:
  - Requirements for explosive dust atmospheres transferred from IEC 61241-0
  - The marking Group II alone has been replaced by IIA, IIB or IIC
  - Dusts groups defined as Group IIIA, IIIB and IIIC
  - Limits for ultrasonic and electromagnetic radiation introduced
  - Remainder of “electrostatic” requirements transferred from IEC 60079-26
  - Equipment protection levels (EPLs) introduced

What are the types of protection derived from standard EN 60079-0 (EN 50014) for ASCO Numatics?

	Description	Characteristics
	FLAMEPROOF ENCLOSURE	
"d"	The most currently used type of protection. Standard equipment is contained in a sturdy casing specifically designed for use in explosive atmospheres.  **Features** - *keeps* an internal inflammation within a dimensionally stable enclosure; - *prevents* inflammation from penetrating the ambient atmosphere; - *keeps* the outside temperature of the enclosure below the ignition temperature of the ambient gas, vapours or dusts. 	**CONSTRUCTION** Standard **EN IEC 60079-1** includes elements of standard **EN 50018** and specifies the 2 following main characteristics for the construction of a "d" type enclosure to prevent an internal inflammation from igniting the ambient atmosphere: - the length "L" (in mm) of the flameproof seal; - the maximum experimental safe gap (MESG) "i" (in mm).  The dimensions given depend on the seal and volume of the enclosure and gas groups. Example: with a seal length L = 12.5 mm and an enclosure volume ≤ 100 cm³, the MESG "i" will be: I : 0,5 mm seals included ① / ② IIB : 0,2 mm seals included ① / ② IIA : 0,3 mm seals included ① / ② IIC : 0,15 mm seals included ③ EN 60079-1: All non-threaded flamepaths have to be at 1.5 times the maximum gap (if the maximum gap stated for a flange joint is 0.1 mm, the product will be tested at 0.15 mm. **OPERATING VOLTAGE, TEMPERATURE** EN 60079-1: - All equipment needs to be tested within the range of ±10 % of its operating voltage; - If the ambient temperature is below -20°C, a test to determine the reference pressure is required unless a statement that the enclosure is unaffected by lower temperatures (i.e. it does not become more brittle) is furnished. **WIRING** (by cable gland certified to ATEX) Standard EN 60079-1 specifies that the thread sizes (3/4 NPT, 1/2 NPT or M20) must be marked on the product or label or indicated in the installation and maintenance instructions. The cable glands must be certified in accordance with this new standard and must be appropriate for use within the ambient temperature range for which the product is certified.
	ENCAPSULATION	
"m"	Easy to install, the enclosure with this type of protection can be adapted to many models of electrical equipment.  **Features** - *encloses* in a compound the electrical parts which are likely to ignite the ambient explosive atmosphere; - *prevents* ignition of the ambient explosive atmosphere.	**CONSTRUCTION** Standard **EN 60079-18 (EN 50028)** defines that this type of protection must be used even in case of overvoltage or excessive current as a result of: - an internal short-circuit; - the valve with blocked core in an open circuit. A fuse is required with alternating current. The maximum surface temperature may not exceed the certified temperature class. The coil and electrical components must be enclosed in a compound (example: epoxy resin). **EN 60079-18: ma** for zone 0 and **mb** for zone 1.  **WIRING** By cable with 3 flying leads embedded in a compound. This airtight sealing prevents the ambient explosive atmosphere from penetrating the enclosure.

Description

INTRINSIC SAFETY

"i"

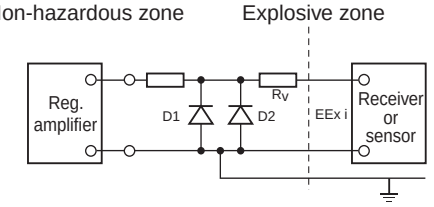
This type of protection takes into account the minimum energy necessary to ignite an explosive atmosphere. The whole circuit is designed in such a way that this energy must never be available, neither in normal operation nor in specific faulty operating conditions.

How?

- By limiting peak current and no-load voltage;
- By limiting thermal and electric energy storage.

Unlike the other types of protection which apply to single electrical components, this one applies to the *whole* circuit.

Example of an intrinsically safe circuit:



What about the zones?

Some components may present defects (reliability). Intrinsically safe components are classified into "**ia**" and "**ib**" groups depending on the number of defects and their location in hazardous area:

"**ia**" (zones **0**, **1** & **2**): 2 defects = intrinsically safe

"**ib**" (zones **1** & **2**): 1 defect = intrinsically safe

INCREASED SAFETY

"e"

Prevents the occurrence of any accidental ignition source: arcs or sparks. Sparking components are excluded from this method of protection.

How?

- Use of high quality insulation materials;
- Min. IP54 ingress protection to reduce the probability of contamination by dirt and moisture ingress;
- Special enclosure with connections which cannot become loose;
- Taking account of specified temperature classes;
- Conformity of cable entries and labelling.

Characteristics

WHAT IS EN 50020 BASED ON?

(Future EN 60079-11)

Explosion groups:
identical to the type of protection "d", IIA-IIB-IIC.

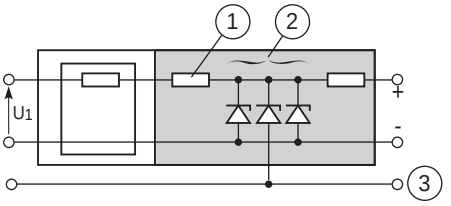
Energy storage:
During circuit opening / closing, inductance or capacitance may partially release its energy in addition to the ignition power already available. A safety factor must then be applied.

What about the electrical components?
A distinction is made between apparatus rated intrinsically safe and their "associated components" in which the circuits may themselves be either intrinsically safe or not.

DEVICES FOR ELECTRICAL SUPPLY

Safety barrier

It limits the available power in a circuit to specific values. The voltage is limited by Zener diodes, current by resistances (standard barriers) or by electronic systems (special barriers).
It isolates the intrinsically safe circuit *without galvanic barriers*. To operate correctly, it must be connected to a reference potential = 0 (equipotential earth). This solution is preferable to interfaces (see below) which require a common earth.



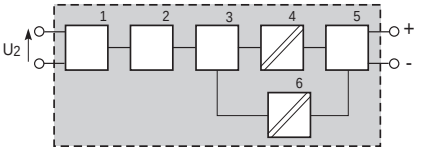
1. fuse
2. Zener diodes
3. zero potential (equipotential earth or interconnected earth)

Galvanic barrier (interface)

Other intrinsically safe apparatus *with galvanic barriers* are used for various applications:

- Current-transmitters for 2-lead converters;
- Transmitters;
- Converters: temperature converters, electropneumatic I/P or P/I;
- Amplifier relays;
- Power packs with galvanic barriers.

The voltage U_2 at the entrance of an interface must be lower than the barrier voltage U_1 ($U_2 < U_1$).



1. rectifier
2. filter
3. logic control
4. galvanic protection (transformer)
5. output voltage adjustment
6. galvanic isolation (optocoupler)

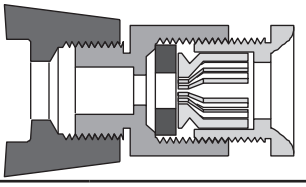
WHAT IS EN 60079-7 (EN 50019) BASED ON?

Explosion group:
I or II; Group II includes subdivisions IIA-IIB-IIC.

Temperature class:
The temperature which must be taken into account is that of the *hottest point of the equipment as a whole* and not that of the external temperature as is the case with flameproof enclosures.
The temperature classification is identical to that of protection type “d”.

CONNECTION

Securely fastened certified cable gland **always** supplied mounted on the product.



OBJECTIVES OF DIRECTIVE 97/23/CE

The European Union Pressure Equipment Directive is intended to protect the environment and users of industrial equipment and be applied alongside the Machinery Directive (98/37/CE), the Low Voltage Directive (73/23/EEC) and the Electromagnetic Compatibility Directive (89/336/EEC). It does not cover the operational function of the equipment.

The Directive covers equipment such as pressurised storage containers, industrial piping, safety devices and pressure accessories. It applies to the design, manufacture and conformity assessment of pressure equipment and assemblies of pressure equipment with a maximum allowable pressure greater than 0.5 bar.

Article 3 (3) covers pressure equipment and assemblies of pressure equipment below or equal to the specified pressure and/or volume or nominal size (DN) thresholds.

Classification under categories 1 and higher covers pressure equipment and assemblies of pressure equipment above the specified pressure and/or volume or nominal size (DN) thresholds. They must:

- be safe;
- meet essential requirements covering design, manufacture, inspection and testing;
- satisfy appropriate conformity assessment procedures; and
- carry the CE marking and other information.

EFFECTIVE DATE

The application of and compliance with the Directive is mandatory **from 29 May 2002**.

EQUIPMENT COVERED

Any equipment or assembly intended to contain gaseous or liquid fluids at a pressure greater than 0.5 bar is covered by the Directive.
Pressure is not a significant design factor for cylinders and control valves and, consequently, they are excluded. These components are built to withstand external mechanical stress (exclusion referred to in Article 1 section 3.10 of the Directive).

CLASSIFICATION
(see glossary of terms on the following page)

For equipment above the pressure, DN and internal volume thresholds and for fluids specified in the Directive, ASCO has drawn up technical files covering the following categories.

Article 3 (3) PED
Equipment below the specified thresholds is covered by Article 3 (3) of the Directive.
It must:
- be designed and manufactured in accordance with the sound engineering practice of a Member State in order to ensure safe use;
- bear specified markings (but not the CE marking).
  Solenoid and pressure-operated valves with a nominal diameter equal to or less than DN25 (1" dia.) as well as air service equipment (volume) are covered by Article 3 (3).

Categories 1 to 4
(according to ascending level of hazard for products within the scope of the Directive)

Category 1 equipment is subject to in-house conformity assessment procedures.

Category 2 to 4 equipment is subject to a conformity assessment performed by a notified body.

In order to determine which category an item of the equipment falls into, the manufacturer needs to identify:

- the type of equipment - **vessel / steam generator / piping** etc.
- the state of the intended fluid contents - **gaseous or liquid**
- the fluid group of the intended contents - **Group I or Group II**

Group I comprises those fluids classified according to the EC Directive on the classification of dangerous substances as:

- explosive
- extremely flammable
- highly flammable
- flammable (where the maximum allowable temperature is above flashpoint)
- very toxic
- toxic
- oxidising

Group II comprises all other fluids including air, neutral gases, oil, water and steam.

COMPLIANCE

None of our products need to undergo technical modifications. The conformity concerns marking aspects and documents relating to putting the equipment into service.

Conformity assessment activities
For products under Article 3 (3) PED:

- Marking of the manufacturer's name.
- Equipment designed and manufactured taking account of state-of-the-art and current practice at the time of design and manufacture.
- No CE marking is required. **Nevertheless, all solenoid valves will bear the CE marking in accordance with other directives (LVD, EMC, ATEX 94/9/EC etc.).**
- The General Instructions in 12 languages relating to putting the equipment into service takes account of the essential safety requirements of the Directive.