# Electrical equipment in potentially explosive atmospheres

## Introduction

Potentially Explosive Atmospheres exist where there is a risk of explosion due to mixtures of gas/air, vapour/air, dust/air or other flammable combinations.

In such areas there is a necessity to eliminate sources of ignition such as sparks, hot surfaces or static electricity which may ignite these mixtures.

Where electrical equipment has to be used in these areas it must be so designed and constructed as to not create sources of ignition capable of igniting these mixtures.

Before electrical equipment can be used in a potentially explosive atmosphere a representative sample has to be fully tested and certified by an independent authority such as Baseefa in Europe or UL in the U.S.A.

This information is intended as a guide only and further expert guidance should be sought before placing into service, maintaining or repairing any item of equipment in a Potentially Explosive Atmosphere.

Where comparisons are shown between, for example, European and North American practice this may be an approximation and individual standards/codes of practice should be consulted for precise details.

MEDC have been designing and manufacturing electrical equipment suitable for use in potentially explosive atmospheres since 1975. We deal with all the major testing and certification authorities throughout the world and have a diverse range of internationally approved products.

## Area Classification

Process plants are divided into Zones (European and IEC method) or Divisions (North American method) according to the likelihood of a potentially explosive atmosphere being present.

Note : North American legislation now allows Zones to be used to classify areas, where this practice is used it follows the IEC Zone method.

| European & IEC Classification | Definition of zone or division | North American Classification |
|---|---|---|
| Zone 0 (gases)<br>Zone 20 (dusts) | An area in which an explosive mixture is continuously present or present for long periods | Class I Division 1 (gases)<br>Class II Division 1 (dusts) |
| Zone 1 (gases)<br>Zone 21 (dusts) | An area in which an explosive mixture is likely to occur in normal operation | Class I Division 1 (gases)<br>Class II Division 1 (dusts) |
| Zone 2 (gases)<br>Zone 22 (dusts) | An area in which an explosive mixture is not likely to occur in normal operation and if it occurs it will exist only for a short time | Class I Division 2 (gases)<br>Class II Division 2 (dusts)<br>Class III Division 1 (fibres)<br>Class III Division 2 (fibres) |

## Gas & Dust Groups

There are two main gas groups, Group I - Mining only, Group II - Surface Industries and one combustible dust group - Group III. These categories are used in European and I.E.C. groupings.

**Group I** is concerned only with underground mining where methane and coal dust are present.

**Group II & Group III** gases and dusts occurring in surface industries, are sub-grouped according to their volatility. This enables electrical equipment to be designed to less onerous tolerances if it is to be used with the least volatile gases and dusts.

| Typical gas/material | European/I.E.C. Gas & Dust Group | North American Gas & Dust Group |
|---|---|---|
| Methane | I | - |
| Acetylene | IIC | A |
| Hydrogen | IIC | B |
| Ethylene | IIB | C |
| Propane | IIA | D |
| Metal dust | - | E |
| Coal dust | - | F |
| Grain dust | - | G |
| Combustible Flyings | IIIA | - |
| Non Conductive Dust | IIIB | - |
| Combustible Dust | IIIC | - |

## Temperature

Hot surfaces can ignite explosive atmospheres. To guard against, this all Electrical Equipment intended for use in a potentially explosive atmosphere is classified according to the maximum surface temperature it will reach in service. This temperature is normally based on a surrounding ambient temperature of 40 degrees Centigrade (102 degrees Fahrenheit). This temperature can then be compared to the ignition temperature of the gas(es) which may come into contact with the equipment and a judgement reached as to the suitability of the equipment to be used in that area.

Many MEDC products are certified for use in ambient temperatures up to 70 degrees Centigrade, see individual data sheets for details.

| Temperature Classification | | Maximum Surface Temperature |
|---|---|---|
| **European/I.E.C.** | **North American** | |
| T1 | T1 | 450° C |
| T2 | T2<br>T2A<br>T2B<br>T2C<br>T2D | 300° C<br>280° C<br>260° C<br>230° C<br>215° C |
| T3 | T3<br>T3A<br>T3B<br>T3C | 200° C<br>180° C<br>165° C<br>160° C |
| T4 | T4<br>T4A | 135° C<br>120° C |
| T5 | T5 | 100° C |
| T6 | T6 | 85° C |

e.g. Butane has an ignition temperature of 365° Centigrade, equipment used in the vicinity of this gas would need a T rating of T2 or higher.

## Types of Electrical Equipment Suitable for use in Potentially Explosive Atmospheres

| Different techniques are used to prevent electrical equipment from igniting explosive atmospheres. There are restrictions on where these different types of equipment can be used as follows : | **European**<br>Area of use<br>Designation<br>Standard | **IEC**<br>Area of use<br>Designation<br>Standard | **USA**<br>Area of use<br>Designation<br>Standard |
|---|---|---|---|
| **Flameproof Enclosure** – An enclosure used to house electrical equipment, which when subjected to an internal explosion will not ignite a surrounding explosive atmosphere. | **Zones 1 & 2**<br>Exd<br>EN60079-1 | **Zones 1 & 2**<br>Exd<br>IEC60079-1 | **Class I**<br>**Divisions 1 & 2**<br>UL1203 |
| **Intrinsic Safety** – A technique whereby electrical energy is limited such that any sparks or heat generated by electrical equipment is sufficiently low as to not ignite an explosive atmosphere. | **Zones 0,1 & 2**<br>Exi<br>EN60079-11 | **Zones 1 & 2**<br>Exi<br>IEC60079-11 | **Class I**<br>**Divisions 1 & 2**<br>UL913 |
| **Increased Safety** – This equipment is so designed as to eliminate sparks and hot surfaces capable of igniting an explosive atmosphere. | **Zones 1 & 2**<br>Exe<br>EN60079-7 | **Zones 1 & 2**<br>Exe<br>IEC60079-7 | - |
| **Purged and Pressurised** – Electrical equipment is housed in an enclosure which is initially purged to remove any explosive mixture, then pressurised to prevent ingress of the surrounding atmosphere prior to energisation. | **Zones 1 & 2**<br>Exp<br>EN60079-2 | **Zones 1 & 2**<br>Exp<br>IEC60079-2 | **Class I**<br>**Divisions 1 & 2**<br>NFPA496 |
| **Encapsulation** – A method of exclusion of the explosive atmosphere by fully encapsulating the electrical components in an approved material. | **Zones 1 & 2**<br>Exm<br>EN60079-18 | **Zones 1 & 2**<br>Exm<br>IEC60079-18 | - |
| **Oil Immersion** – The electrical components are immersed in oil, thus excluding the explosive atmosphere from any sparks or hot surfaces. | **Zones 1 & 2**<br>EExo<br>EN60079-6 | **Zones 1 & 2**<br>Exo<br>IEC60079-6 | **Class I**<br>**Divisions 1 & 2**<br>UL698 |
| **Powder Filling** – Equipment is surrounded with a fine powder, such as quartz, which does not allow the surrounding atmosphere to come into contact with any sparks or hot surfaces. | **Zones 1 & 2**<br>EExq<br>EN60079-5 | **Zones 1 & 2**<br>Exq<br>IEC60079-5 | - |
| **Non-sparking** – Sparking contacts are sealed against ingress of the surrounding atmosphere, hot surfaces are eliminated. | **Zones 1 & 2**<br>Exn<br>EN60079-15 | **Zones 1 & 2**<br>Exn<br>IEC60079-15 | - |

## Selection, Installation and Maintenance of Electrical Equipment Intended for use in Potentially Explosive Atmospheres

International and national standards are published giving details of requirements for the safe use of Electrical Equipment in Potentially Explosive Atmospheres as follows :

| | International | Europe | U.S.A. |
|---|---|---|---|
| General Recommendations | IEC60079-14 | EN60079-14 | N.E.C. Chapter 5 |
| Classification of Hazardous Areas | IEC60079-10 | EN60079-10 | N.E.C. Chapter 5 |
| Inspection and Maintenance of Electrical Equipment | IEC60079-17 | EN60079-17 | - |
| Requirements for Flameproof Enclosures | IEC60079-14 | EN60079-14 | N.E.C. Chapter 5 |
| Requirements for Intrinsically Safe Equipment | IEC60079-14 | EN60079-14 | N.E.C. Chapter 5 |
| Requirements for Increased Safety Equipment | IEC60079-14 | EN60079-14 | N.E.C. Chapter 5 |
| Requirements for Purged and Pressurised Equipment | IEC60079-14 | EN60079-14 | N.E.C. Chapter 5 |
| Requirements for Non-Sparking Equipment | IEC60079-14 | EN60079-14 | - |

MEDC recommends all Explosion-proof electrical equipment is maintained, by suitably trained personnel, in accordance with the Manufacturers' recommendations.

Any spare parts used should be purchased from the original Manufacturer and repairs should be carried out by the Manufacturer or under his supervision, in order that the item remains in conformance with the certification documents.

## The Certification Process

All Electrical Equipment, intended for use in a Potentially Explosive Atmosphere, should be certified as suitable for such use.

The methods of obtaining certification differ in detail, see below, between each certifying body or group of bodies (e.g. CENELEC). Basically this process consists of supplying a representative sample of the equipment along with a set of drawings to a recognised test/certification body e.g. Baseefa 2001 who in turn test the equipment against a recognised Standard e.g. EN60079-14 and issue a Certificate. The user of the equipment can then refer to this Certificate to enable him to safely put the item into service in a zone appropriate to the Certification.

## European Practice

ALL EQUIPMENT, BOTH ELECTRICAL AND MECHANICAL, INTENDED TO BE PUT INTO SERVICE WITHIN THE EEC HAS TO BE CERTIFIED IN ACCORDANCE WITH THE ATEX DIRECTIVE.

It should be noted also that MECHANICAL equipment is covered by the ATEX Directive so items such as gearboxes will have to carry ATEX certification.

The equipment coding signifying compliance with ATEX is as follows:

 II2GD i.e.

 – Explosion proof in accordance with ATEX.

II – Group II surface industries.

2 – category 2 equipment (suitable for use in Zone 1) note: Category 1 is suitable for Zone 0.
Category 3 is suitable for Zone 2.

G – suitable for atmospheres containing gas.

D – suitable for atmospheres containing dusts.

Equipment will be CE marked when certified to ATEX.

## North American practice

Sample equipment and supporting documentation are submitted to the appropriate authority e.g.U.L., F.M., C.S.A. The equipment is tested in accordance with relevant standards for explosion protection and also for general electrical requirements e.g. light fittings.

After successful testing a listing is issued allowing the manufacturer to place the product on the market. The product is marked with the certification details such as the gas groups A,B,C,D the area of use e.g. Class 1 Division 1.

## World Wide Approval

The objective of the IECEx System is to facilitate international trade in equipment and services for use in explosive atmospheres, while maintaining the required level of safety.

The IECEx and ATEX standards have been technically identical since 2006. IECEx is internationally recognised and accepted worldwide, ATEX is recognised across Europe and is a mandatory requirement in the EEC.

Equipment certified under the IECEx system (and equivalent ATEX standards) carry the following coding:

Gb

Db

Where:

Ga - Suitable for Zone 0

Gb - Suitable for use in a Zone 1 surface industries area in the presence of gas

Gc - Suitable for Zone 2

Da - Suitable for Zone 20

Db - Suitable for use in a Zone 21 surface industries area in the presence of dust

Dc - Suitable for Zone 22

## Ingress Protection

2 digits are used to denote the level of ingress protection that a piece of apparatus enjoys:–

IP □□

| SOLIDS | | LIQUIDS | |
|---|---|---|---|
| 0 | No protection. | 0 | No protection. |
| 1 | Protected against solid objects up to 50mm, e.g. hands. | 1 | Protected against vertically falling drops of water. |
| 2 | Protected against solid objects up to 12mm, e.g. fingers. | 2 | Protected against water spray up to 15 degrees from vertical. |
| 3 | Protected against solid objects up to 2.5mm, e.g. tools. | 3 | Protected against water spray up to 60 degrees from vertical. |
| 4 | Protected against solid objects over 1mm, e.g. wires. | 4 | Protected against water sprays from all directions. |
| 5 | Protected against dusts. (No harmful deposits). | 5 | Protected against water jets from all directions. |
| 6 | Totally protected against dust. | 6 | Protected against strong water jets from all directions, e.g. Offshore. |
| | | 7 | Protected against immersion between 15cm and 1m in depth. |
| | | 8 | Protected against long immersion under pressure. |

North American practice is to use NEMA standards to describe ingress protection, i.e.:

NEMA 3 is similar to IP55

NEMA 4 is similar to IP66

NEMA 4x is similar to IP66

NEMA 6 is similar to IP67



Most countries outside Europe or North America use the IEC Standards as a basis for their own national standards.

Certification in Brazil (Inmetro) and China is usually based on compliance with IEC international standards.

The Russian Federation and Kazakhstan certify equipment to CUTR standards, which closely follow IEC practice.*

In Russia, certain products used in fire alarm systems may be required to carry the Russian Fire Approval. Note that not all MEDC products that have been certified to CUTR are also Russian Fire Approval Certified as standard. Check specification on technical data sheets before ordering.

*Note: There is an important change to the Ex certification system for Russia and Kazakhstan. The previous GOST R and GOST K certificates for Russia and Kazakhstan are no longer being renewed, but are instead being replaced by CUTR certification. The new certification will be applicable in Russia, Kazakhstan and Belarus, these 3 countries have formed a customs union. All MEDC products previously certified to GOST R and GOST K standards, now have CUTR certification.