

A GUIDE TO THE USE OF 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 2001 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 spent 25 years designing and manufacturing electrical equipment suitable for use in potentially explosive atmospheres. 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) Zone 20 (dusts)	An area in which an explosive mixture is continuously present or present for long periods	Class I Division 1 (gases) Class II Division 1 (dusts)
Zone 1 (gases) Zone 21 (dusts)	An area in which an explosive mixture is likely to occur in normal operation	Class I Division 1 (gases) Class II Division 1 (dusts)
Zone 2 (gases) 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) Class II Division 2 (dusts) Class III Division 1 (fibres) Class III Division 2 (fibres)

Gas Groups (plus dusts and fibres)

There are two main gas groups, Group I – Mining only and Group II – Surface Industries
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 gases 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.

Typical gas/material	European/I.E.C. Gas Group	North American Gas Group
Methane	I	-
Acetylene	IIC	A
Hydrogen	IIC	B
Ethylene	IIB	C
Propane	IIA	D
Metal dust	-	E
Coal dust	-	F
Grain dust	-	G

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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 55 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 T2A T2B T2C T2D	300° C 280° C 260° C 230° C 215° C
T3	T3 T3A T3B T3C	200° C 180° C 165° C 160° C
T4	T4 T4A	135° C 120° C
T5	T5	100° C
T6	T6	85° C

e.g. Butane has an ignition temperature of 365 degrees 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 Area of use Designation Standard	IEC Area of use Designation Standard	USA Area of use Designation 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 Exd EN60079-1	Zones 1 & 2 Exd IEC60079-1	Class I Divisions 1 & 2 – 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 Exi EN60079-11	Zones 1 & 2 Exi IEC60079-11	Class I Divisions 1 & 2 – UL913
Increased Safety – This equipment is so designed as to eliminate sparks and hot surfaces capable of igniting an explosive atmosphere.	Zones 1 & 2 Exe EN60079-7	Zones 1 & 2 Exe 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 Exp EN60079-2	Zones 1 & 2 Exp IEC60079-2	Class I Divisions 1 & 2 – NFPA496
Encapsulation – A method of exclusion of the explosive atmosphere by fully encapsulating the electrical components in an approved material.	Zones 1 & 2 Exm EN60079-18	Zone 1 & 2 Exm IEC60079-18	– – –
Oil Immersion – The electrical components are immersed in oil, thus excluding the explosive atmosphere from any sparks or hot surfaces.	Zone 1 & 2 EExo EN50015	Zones 1 & 2 Exo IEC60079-6	Class I Division 2 – 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 EExq EN50017	Zones 1 & 2 Exq IEC60079-5	– – –
Non-sparking – Sparking contacts are sealed against ingress of the surrounding atmosphere, hot surfaces are eliminated.	Zone 2 Exn EN60079-15	Zone 2 Exn 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 advise that 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 for the first time items such as gearboxes will have to carry ATEX certification.

The equipment coding signifying compliance with ATEX is as follows:

 II2G i.e.

 – Explosionproof 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 is 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.

Worldwide Certification

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

The Russian Federation certifies equipment to GOST 'R' standards, these closely follow CENELEC practice.

In Russia, certain products used in fire alarm systems may be required to carry the Russian fire approval (VNIPO). Note that not all MEDC products that have been certified to GOST 'R' are VNIPO approved. Check specification on technical data sheets before ordering.

Kazakhstan has a certification process (GOST 'K') where approval is normally based on compliance with CENELEC standards.

Certification in China is based on compliance with international standards such as CENELEC or UL.

There is a scheme in place which will when fully adopted allow for internationally recognised certification to become a reality, this is the IEC EX SCHEME. This uses the IEC standards and IEC recognised test and certification bodies to issue mutually recognised test reports and certificates. The scheme is in its infancy and its level of success cannot yet be measured.

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	IP 54
NEMA 4	is similar to	IP 55
NEMA 4x	is similar to	IP 56
NEMA 6	is similar to	IP 67