EQUIPMENT FOR INSTALLATION IN HAZARDOUS AREAS

CONTENT

1. Introduction

Equipment installed in hazardous areas must comply with standards and directives prior to commercialization and commissioning worldwide.

2. Global regulations

There are two main global organizations that set standards for hazardous areas around the world.

• International Electrotechnical Commission (IEC), applied in Europe, Asia, Australia, Africa and some other regions
• National Electrical Code (NEC), applied in the United States and Canada

The requirements for hazardous areas and safety in the workplace are defined in:
• ATEX directives (in the European Union)
• Articles of the NEC (USA)
• Canadian Electrical Code CEC (Canada)
• IEC / CENELEC standards
The NEC and CEC partially support the IEC / CENELEC hazardous zone certification system.

Other national regulations are normally based on the two below mentioned but may be applicable locally.

3. ATEX directives

It is a mandatory legal directive within the European Community.
• The ATEX 94/9 / CE directive applies to the manufacture and distribution of protective equipment and systems intended for use in potentially explosive atmospheres.
• The ATEX 99/92 / CE directive applies to users of equipment in potentially explosive atmospheres and provides the minimum requirements to improve the protection of workers' health and safety, and is intended to complement ATEX Directive 94/9 / EC. It applies to the installation and use of electrical equipment.

ATEX Directive 94/9 / CE

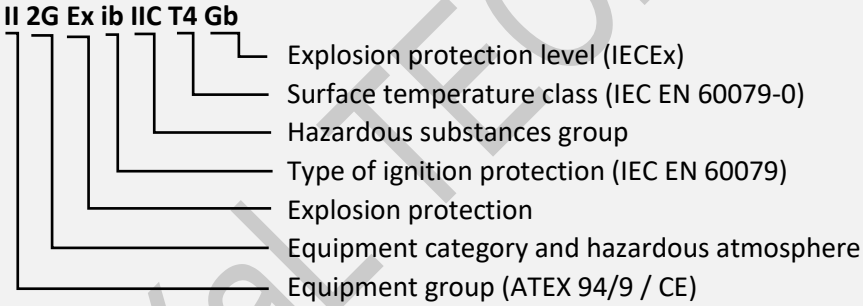
The equipment manufacturer is responsible for guaranteeing the equipment, produced and certified for use in potentially explosive atmospheres.

The main objective of the directive is to avoid its own potential source of ignition.

Zone classification according to ATEX 99/92/CE

Gas	Zone 0	Presence of an explosive atmosphere continuously or for long periods of time
	Zone 1	An explosive atmosphere may be created occasionally during normal operation
	Zone 2	An explosive atmosphere can be created infrequently or for short periods of time
Dust	Zone 20	Presence of an explosive atmosphere continuously or for long periods of time
	Zone 21	An explosive atmosphere may be created occasionally during normal operation
	Zone 22	An explosive atmosphere can be created infrequently or for short periods of time

Typical marking of electrical equipment



Equipment group

Group I: Applies to equipment used in underground operations, such as mining
Group II: Applies to equipment used by surface processing industries, such as petrochemical, chemical, pharmaceutical and food.
Group III: Applies to equipment installed in dust or fiber atmospheres

Equipment category and hazardous atmosphere

In Group I
M1 - Very high level of protection against ignition, continuous presence or very frequent explosive atmosphere
M2 - High ignition protection level, sporadic presence of explosive atmosphere

In Group II
1 - Very high level of protection against ignition, continuous presence or very frequent explosive atmosphere
G (gas) Zone 0
D (dust) Zone 20
2 - High level of protection against ignition, sporadic presence of explosive atmosphere
G (gas) Zone 1
D (dust) Zone 21
3 - Standard ignition protection level, presence of atmosphere explosive rarely and for a short time
G (gas) Zone 2
D (dust) Zone 22

In group III
A - Zone 20, 21 and 11 with presence of flammable fibers
B - Zones 20, 21 and 22 with presence of non-conductive dust
C - Zones 20, 21 and 22 with the presence of conductive dusts

Explosion protection

Characterized by the acronym Ex

Type of ignition protection

An electrical equipment will only be suitable for installation in explosive areas if it is built with one of the following protection modes:

d = flameproof enclosure. The electrical equipment is installed inside an enclosure capable of resisting an internal explosion and not transmitting inflammation to the surrounding environment, neither by their union boards, nor by the cable connections.
e = increased security. It is based on ensuring the non-formation of arcs, sparks or overheating in devices, using: a high safety coefficient, special terminals, high quality insulators and a minimum protection class IP54.
i = intrinsic safety. A device or circuit is intrinsically safe when it is not capable of produce sparks by thermal effects enough to cause the inflammation. It is used in instrumentation, using low voltage circuits design and measures to reduce the electrical intensity that can be produced by energy storage in capacitors, cables and inductances.
ia = protection is maintained after two independent failures.
ib = protection is maintained after one failure
ic = protection is given under normal conditions

p = internal overpressure. The electrical devices are provided with an enclosure or installed in a room where the entry of flammable gases or vapors is prevented by maintaining in its interior air or a non-flammable gas at a pressure higher than the exterior atmosphere
o = immersion in oil. The parts under tension are immersed in oil so that no flammable gases or vapors that are above the oil level may ignite
q = sand immersion. The parts under tension are completely submerged in insulation sand (fine quartz grains).
m = encapsulated. The elements to protect are immersed in a resin.

Hazardous substances group

I	Methane
IIA	Propane
IIB	Ethylene
IIC	Hydrogen
IIIA	Flammable fibers
IIIB	Nonconductive Powder
IIIC	Conductive Powder

Temperature classes

The temperature class defines the maximum permissible temperature on the surface of the equipment

Class	Max. Surface temperature	Examples of ignition temperatures
T1	450°C	Propane (510°C) o natural gas (650°C)
T2	300°C	Acetylene (305°C)
T3	200°C	Fuel (260 to 450°C) or diesel (220°C)
T4	135°C	Diethyl ether (170°C)
T5	100°C	
T6	85°C	Carbon sulfide

Explosion protection level

Additional nomenclature according to the directive IEC / Ex and ATEX 2014/34 / EU and defines the area in which the equipment can be used.

G: Gas	**a:** very high level of protection. The equipment is safe even when there is the possibility of up to 2 failures.
D: Dust	**b**: high protection level. The equipment is suitable for normal operation with usual disturbances and safe with a fault.
M: Mining	**c**: Normal protection level, suitable in areas with explosive atmosphere occasional

Protection level		Equipment category	Zone
Atmosphere	**Risk**		
G	a	1G	0, 1 y 2
G	b	2G	1 y 2
G	c	3G	2
D	a	1D	20, 21 y 22
D	b	2D	21 y 22
D	c	3D	22
M	a	M1	
M	b	M2	

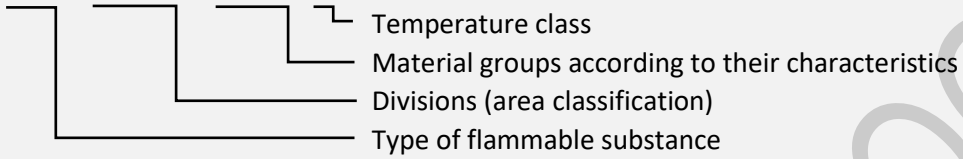
4. Standards and regulations in the US and Canada

Classification of hazardous areas according to NEC / CEC standards

Articles NEC 500, 501, 502 and 503 define the requirements for the classification of hazardous areas into classes, groups and divisions.

The marking of electrical equipment to be installed in hazardous areas is (example):

Class I Division 1 Group B T6



Type of flammable substance

Class I: The area has flammable gases and vapors in enough quantities to produce an explosion or flammable mixtures (NEC 501)

Class II: In the area there is presence of dust in enough quantities to pose a fire hazard or explosion (NEC 502)

Class III: This area is dangerous due to the presence of suspended fibers or highly flammable particles (NEC 503)

Divisions according to NEC 500 (Area classification)

Division 1: Explosion risk present continuously or occasionally under normal operating conditions.

Division 2: There are no flammable or explosive concentrations on a regular basis, but it may be present in case of failure.

Areas (only in areas with presence of gas or explosive vapors) according to NEC 505

Zone 0: Explosion risk present continuously or occasionally in conditions of normal operation

Zone 1: Explosion risk occasionally in conditions of normal operation

Zone 2: There are no flammable or explosive concentrations on a regular basis, but they can be present in case of failure.

Material groups according to NEC 500-3

Each class is also divided into groups of materials A, B, C, D, E, F and G according to their properties

Material class	Material group (NEC 500)	Material group (NEC 505)	Material
Class I	A	IIC	Acetylene
	B		Hydrogen
	C	IIB	Ethylene
	D	IIA	Propane
Class II	E (only Div. 1)	IIIC	Combustible metal powder
	F		Coal powder
	G		Non-conductive powders (flour, wood, plastic)

Temperature class

According to article NEC 500-5 (d), the surface temperature in contact with the explosive medium must not exceed the following values:

Temperature class	Admissible temperature
T1	450°C
T2	300°C
T2A	280°C
T2B	260°C
T2C	230°C
T2D	215°C
T3	200°C

Temperature class	Admissible temperature
T3A	180°C
T3B	165°C
T3C	160°C
T4	135°C
T4A	120°C
T5	100°C
T6	85°C