



HAZARDOUS AREAS

Hazardous areas are locations in which an explosive atmosphere may develop under certain conditions. The explosive atmosphere is a mixture of air and flammable substances in the form of gas, vapour, mist or dust in which, after the ignition, the combustion spreads rapidly to the whole mixture (explosion). In compliance with the 1999/92/EC directive, the user is bound to subdivide the hazardous areas in classes according to the frequency and the period of time in which an explosive atmosphere can occur. In the presence of substances that emit gasses and flammable vapours, the classification is carried out in compliance with the 60079-10 EN standard and generates three zones with different risk levels:

Zone 0: area in which an explosive gas atmosphere is present continuously or for long periods.

Zone 1: area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2: area in which an explosive gas atmosphere it is not likely to occur in normal operation and, if it does occur, is likely to do so only infrequently and will exist for a short period only.

In the areas with combustible dusts the classification generates three dangerous zones (20, 21 and 22) with risk levels defined similarly to zone 0, 1 and 2 respectively.

The 94/9/EC (ATEX) directive classified the equipment in three categories with different protection levels to be used in the different areas, in order to guarantee always the same safety level.

COMBUSTIBLE SUBSTANCES AREAS	GAS AND VAPOUR			DUST		
	0	1	2	20	21	22
EQUIPMENT CATEGORIES	1G	2G	3G	1D	2D	3D

TYPES OF PROTECTION FOR GAS AND VAPOUR

The use of electrical apparatus in potentially explosive atmospheres is quite usual today.

This equipment has to be manufactured in such a way that there is no risk of explosion.

An explosion occurs when the three following conditions happen:

- presence of a potentially explosive atmosphere;
- existence of an ignition source;
- possibility of transmission of the explosion.

The recognized types of protection eliminate one of these conditions and thus make an explosion impossible.

Two types of protection prevent the presence of a potentially explosive atmosphere inside the electrical apparatus:

- oil immersion (safety "o");
- pressurized apparatus (safety "p").

Two types of protection make the transmission of an internal explosion to the potentially explosive atmosphere surrounding the electrical apparatus impossible:

- sand filling (safety "q");
- flameproof enclosure (safety "d").

Lastly, three types of protection eliminate any source of ignition such as sparks, overheating, etc...:

- increased safety (safety "e");
- intrinsic safety (safety "i");
- protection "n" .

In practice, only four of these seven types of protection are applicable to electric motors:

- pressurized apparatus (symbol Ex-p);
- flameproof enclosure (symbol Ex-d);
- increased safety (symbol Ex-e);
- non sparking protection (symbol Ex-n).

Electric motors have an additional type of protection (symbol Ex-de) which is a combination of:

- flameproof enclosure "d" for motor frame
- increased safety "e" for terminal box.



TYPES OF PROTECTION FOR DUST

Electrical equipment can be also installed outdoors and in dusty, moist and chemically aggressive environment.

The protection systems for the electrical motors in this environment are classified with the IP (International Protection) code followed by 2 numbers and, in some application, by a letter.

IP - it stands for every kind of protection against accidental contacts of foreign bodies and against water;

First digit (0-6) - it stands for the kind of protection against accidental contacts of foreign bodies;

Second digit (0-8) - it stands for the kind of protection against water.

W, S and M - additional letters for special protections: § W - it means that the machine has to be used in specified weather conditions and with special protections. This letter has to be added to the IP code (e.g. IPW55); § S - protection against the water only with standing still motor; § M - protection against the water when the motor is running.

IP 5X: Complete protection against contact and approaching of voltage-carrying parts inside the housing. Protection against harmful dust deposits.

The penetration of dust is not completely prevented but the dust cannot enter in such quantities as to affect operation.

IP 6X: Complete protection against contact and approaching of voltage-carrying parts as well against contact with rotating parts inside the housing. Protection against the penetration of dust (dustproof).

Ignition temperature of medium relative to limit temperature (°C)	Temperatur class	Maximum surface temperature of electrical equipment including 40 °C ambient temperature	
		(°C)	(°F)
		over 450	T1
from 300 to 450	T2	300	572
from 200 to 300	T3	200	392
from 135 to 200	T4	135	275
from 100 to 135	T5	100	212
from 85 to 100	T6	85	185

ENCLOSURE GROUPS OF ELECTRICAL APPARATUS FOR GAS AND VAPOUR

Electrical apparatus are divided into two groups:

Group I : electrical apparatus for mines susceptible to firedamp

Group II : electrical apparatus for other explosive atmospheres.

Group II is divided into three subgroups for certain types of protection (in particular protection "d").

Rules for motor design, construction and testing have been laid down with the following increasing sequence of severity grades: IIA, IIB, IIC, meaning that a motor complying with a certain grade can suit any group with a lower security grade: a IIB motor is suitable for group IIA; a IIC motor is suitable for groups IIA and IIB.

TEMPERATURE CLASSES

The electrical apparatus are classified into 6 classes according to their maximum surface temperature. The maximum surface temperature is the highest temperature which is attained in service under the conditions described in the Standards, by any part of an electrical apparatus, which is able to produce an ignition of the surrounding atmosphere.

For motors, it concerns:

* the temperature of the external surface for types of protection "d" or "p"

* the temperature of any internal or external point for type of protection "e" or "n".



TEMPERATURE CLASSES FOR DUST

To protect against flammable dust it is also necessary to check the ignition temperature of dust, both in the form of cloud and layer. The surface temperature of the frame, indicated on the motor nameplate, must be lower than the maximum allowable surface temperature T_{amb} that is the lowest between the following two values:

		Zone	Motor category	Protection type			
Hazardous area's class	Presence of flammable gas atmosphere	0	1G				
		1	2G	Ex-d	Ex-de	Ex-e	
		2	3G	Ex-d	Ex-de	Ex-e	Ex-n
	Presence of flammable dust atmosphere	20	1D				
		21	2D	IP 6X			
		22	3D	IP 6X		Conductive dust	
				IP 5X		Non conductive dust	

Motors are classified according to the potentially explosive atmospheres which are present at the place of installation. Depending on the nature of the atmosphere, it is the responsibility of the user to determine type of protection, group and maximum surface temperature of the motor to be installed.

It is also his responsibility to meet safety regulations concerning the connection to the mains, the use and the maintenance of motor.

The certificates of conformity of the CESI according to the European standards are valid in all EU member countries and in all other CENELEC member countries except Switzerland.

Explosion-proof motors put into operation in Switzerland may require SEV certificates. CENELEC member countries are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

TESTING LABORATORIES

According to the 94/9/EC directive flameproof and increased safety motors must be approved by a notified body for compliance with European standards. The notified body carries out the verifications and tests on the prototype supplied by the manufacturers and issues the relevant EC examination certificate. The certification procedures also comprise quality system inspection, issuing of the "production quality assurance" and periodical production supervision.