# ATEX DIRECTIVE 99/92/EC (ATEX 137) USE

The last few years have seen many changes to the regulations that apply to industry:

- **Directive 94/9/EC (ATEX 95): Products.**
- **Directive 98/24/EC: Chemical Agents.**
- **Directive 99/92/EC (ATEX 137): Use.**

Directive 99/92/EC requires employers to protect workers from the risk of explosive atmospheres.
An explosive atmosphere is defined as a mixture with air, under atmospheric conditions, of dangerous substances in the form of gases, vapour, mist or dust in which after ignition has occurred, combustion spreads to the entire unburned mixture.
With a clear focus on worker safety and employer responsibility, **ATEX 137** demands careful consideration.
Since 30 June 2003, all new and modified workplaces, where potentially atmospheres may occur, have had to comply with this Directive.
By June 2006 all such workplaces must comply.
The Directive provides workers with a minimum level of protection in hazardous areas throughout the member states.

**ATEX 137** Directive is based on 3 straightforward principles:

- Where possible, to prevent the formation of explosive atmospheres.
- Where such atmospheres are unavoidable, to prevent ignition, and
- To ensure the health and safety of workers by mitigating the effects of any explosions that do occur.

There are a number of specific exclusions to **ATEX 137**.
These include areas for medical treatment.
The mineral extraction industry and transportation by land, sea or international waters.
The drilled oil and gas extraction industry is also outside the scope of **ATEX 137** as it is covered by the separate Directive 92/91/EC.
However, generally **ATEX 137** applies to all EU workplaces where explosive atmospheres could occur from small garages to large petrochemical plants.
This applies to millions of workplaces in the EU/EEA area.

# Obligation of Employer under ATEX 137

## General Obligations

The employer has a duty to ensure that where explosive atmospheres could occur, workers can carry out their work in safety. Appropriate supervision must be given to such workers and the use of appropriate safety equipment such as **ATEX 95** certified gas alarms should be used to help ensure safety.
Where workers from different organizations are present on one site, it is the employer who has responsibility for the workplace that must coordinate and implement the safety measures for all workers.

## Assessment of Explosion Risk

There is a requirement for an overall assessment of the explosion risk to be carried out. The responsibility lies with the employer although outside specialists can obviously be used if required. There are a number of independent organizations that run training courses or who can be employed to carry out the audit and assessments.The assessment should include anticipating the likelihood and persistence of any explosive atmospheres; the likelihood of ignition sources being present (including electrostatic discharge); the installations, substances and processes used on site and any possible interaction; the scale of any anticipated effects. The assessment must be reviewed regularly and at any significant change to the workplace. The guidelines of IEC 61508, standard for Functional Safety of Electrical-Electronic-Programmable Electronic Safety-Related Systems, may help the assessment.

## Zoning and Warning Signs

Places where explosive atmospheres can occur must be classified into zones by the employer.
These zones are the same as in use for the Directive 94/9/EC (ATEX 95).
At locations where explosive atmospheres may occur, the “Ex” warning sign must be displayed at the point of entry. These signs need to conform to the shape, colours and proportions laid down in the Directive and can display further information if required to clarify risks or actions to be taken.

## Eplosion Protection Document

| Classification criteria occurrence | Area classification for gas, vapour and mists | Area classification for dusts |
|---|---|---|
| Frequently likely or for long periods or continuously | Zone 0 | Zone 20 |
| Occasionally likely in normal operation | Zone 1 | Zone 21 |
| Unlikely in normal operation and only for short periods | Zone 2 | Zone 22 |

Classification of hazardous places – Annex I of ATEX 137

An important and mandatory part of the process is the recording of the risk assessment.
An "Explosion Protection Document" must be created before work commences on a site and kept current.
The purpose of the document is to demonstrate that the risks have been determined and suitably assessed and that measures put in place meet the aims of the Directive.
It must detail,


- Places classified as zoned areas.
- Places where particular organizational measures or explosive protection measures apply.
- A demonstration that the workplace and equipment have been designed and operated with safety in mind.
- Arrangements for the safe use of work equipment.

## Work Equipment and Protective System Requirements

All work equipment and protective systems need to be assessed.
Their design, constructions, installation and maintenance must minimise the explosion risk.
This includes ensuring they are suitable for the type of explosion hazard whether gas, vapour, mist or dust.
After 30 June 2003, equipment and systems must be approved to ATEX 95: Products.
These will be marked as detailed in the table presented at page 240 for the category 1, 2 or 3.

## Workplace Requirements

All workplaces put into service or modified after 30 June 2003 must fully meet the requirements of **ATEX 137**.
Those in use before 30 June 2003 date have until June 2006 to show they fully comply.
It is worth noting that unlike the rule for products **(ATEX 95)**, all workplaces will need to comply, it is just a matter of by what date.
The workplace requirements are divided into organizational measures and explosion protection measures. These include but not necessarily limited to the following:

## Organizational Measures

- Training of Workers: sufficient and appropriated training on explosion protection must be provided.
- Written Instructions: must be given for work in hazardous areas.
- Permit to Work: permit system must be used for carrying out hazardous work activities which could cause hazardous situations.

## Explosion Protection Measures

- Assessment before use: before its first use, any areas containing potentially explosive atmospheres must be assessed and verified and any conditions required for ensuring safety identified and maintained.
  Such verification must be carried out by someone "competent in the field of explosion protection" through experience or professional training.
- Dealing with Releases: any potentially explosive release should be diverted to a safe place or rendered safe.

- Multiple Hazard: where several type of hazards exist (eg. different types of gas and dust), protection measures must be appropriate for the hazard that poses the greatest risk.

- Ignition Prevention: static discharge must be considered as a source of ignition.
  Workers must be provided with suitable work clothes that cannot create sufficient static to ignite.

- Adherence to Explosion Protection Document: plant, equipment, protecting system and any associated connecting devices can only be brought into service if the Explosion Protection Document indicates they can be safely used.

- Safety Warnings: where necessary workers must be given visual and acoustic warning and withdrawn before explosive conditions are reached.

- Worker Evacuation: emergency evacuation procedures and facilities must be in place to ensure endangered areas can be evacuated promptly and safely.

- Additional Risk: consideration must be given to any additional risks that may arise due to power failure.

- Manual Override: manual override must be possible on automatic protective systems and only to be used by workers competent to do so.

- Energy Dissipation: in the event of emergency shutdown, accumulated energy must be dissipated quickly and safely.

# Useful Standards

**EN 1127-1**

Explosion Prevention and Protection Basic concepts and methodology. This is the main standard for "how to control ignition sources".

**EN 50014-28 and EN 50039**

for Electrical Equipment: (generic/construction).

**EN 60079-10**

Classification of Hazardous areas (Gas).

**EN 50281-3**

Classification of areas where combustible dust are or may be present.

**EN50284-1**

Special Requirements for construction, test and marking of electrical apparatus of equipments group II, category 1G.

**EN 60079-14**

Electrical Installation in Hazardous areas (other than mines).

**EN 60079-17**

Inspection and maintenance of electrical installations in hazardous areas (other than mines).

**EN 60079-19**

Repair and overhaul for apparatus used in explosive atmosphere (other than mines).

**EN 13463, part 1 to part 8**

for non Electrical Equipment. Typical non-Electrical Equipments are:

- Drilling Equipment (top drive, rough neck, draw work.
- Cranes.
- Mud handling Equipments.
- Gas turbines.
- Compressors, pumps, fans-skids, that shall be placed in Zone 1 or Zone 2 areas.
- Diesel engines for generators of pumps.
- Various not defined rotating machine, assembly line and also provisional equipment and containers.

**EN 13980**

for application of quality systems (production).

**EN 12874**

for flame arresters (protective systems).

**EN 62013-1**

for caplights for use in mines susceptible to firedamp.

**EN 1755**

for safety of industrial truck.

**EN 1834**

for series for reciprocating internal combustion engines.

**EN 50303**

Group I, category M1 equipment intended to remain functional in atmospheres endangered by firedump and / or coal dust.

Following standards are under work:

**EN 14373**

for explosion suppression systems.

**EN 14460**

for explosion resistant equipments.

**EN 14797**

for explosion venting devices.

**EN 14491**

for dust explosion venting systems.

**EN 14994**

for gas explosion venting protective systems.

**EN 14986**

for safety requirements for ignition protected fans.

# ATEX DIRECTIVE 94/9/EC (ATEX 95) PRODUCTS AND OTHER HARMONIZED STANDARDS

Directive 94/9/EC (ATEX 95) Equipment and Protective Systems for use in potentially explosive atmospheres. Covers electrical and non electrical products intended for use in hazardouse areas (Gas, vapours or dust atmospheres).

The Directive 94/9/EC was first issued in 1996 and is a product directive. It gives the manufacturer requirements to fulfill regarding construction, certification, conformity, and QA requirements.

The Directive is mandatory 1/July/2003 for all countries within the EU/EEA area.

It includes electrical equipment, non-electrical equipment and protective systems.

The Directive applies for dust, gas and mines.

Potentially explosive atmospheres are classified with respect to the possibility of the presence of an explosive mixture due to:

**dust** in air

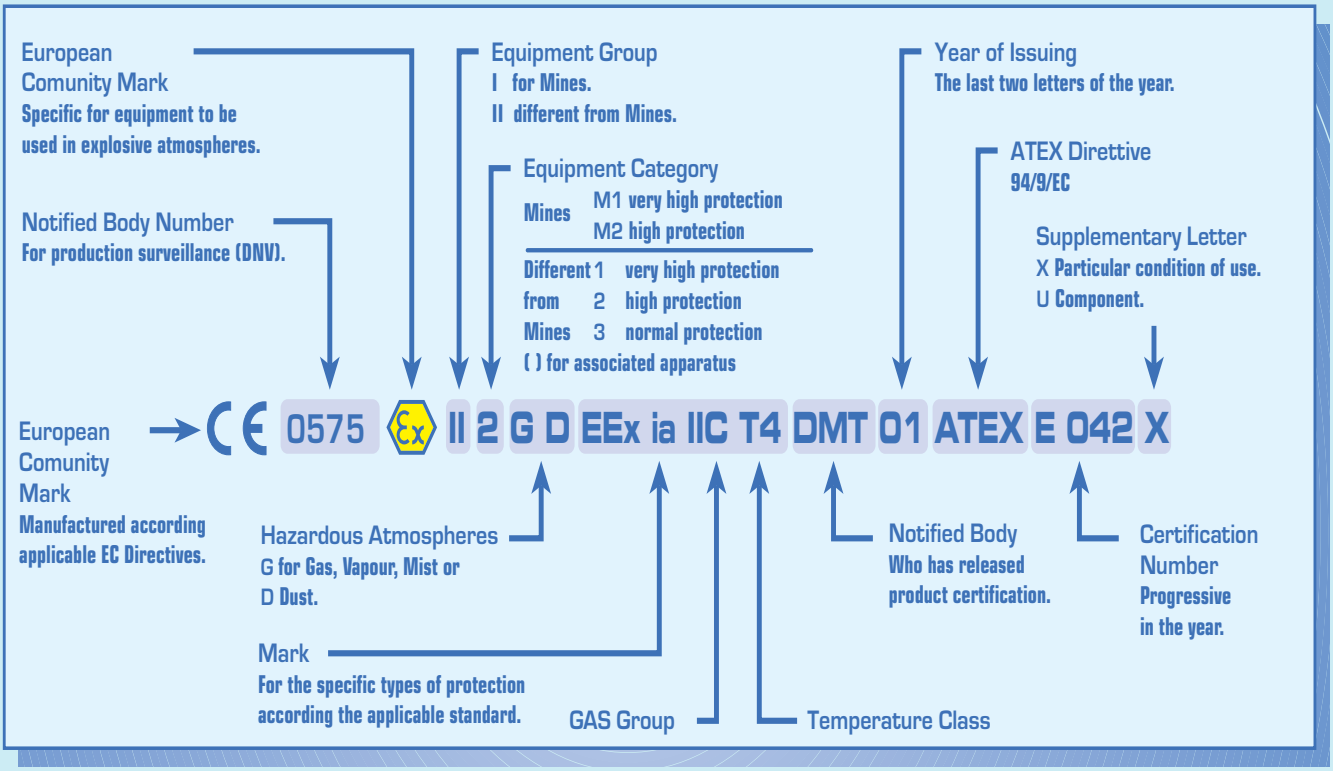
**gas** in air

**vapours** and **mists** in air

## ATEX ZONES and CATEGORIES

| | | Level of Protection | Equipment Category Directive 94/9/EC | Area Classification Directive 1999/92/EC |
|---|---|---|---|---|
| GAS | Dust | Definitions | ATEX | Typical Zone Suitability |
| EN 60079-10<br>0 | EN 50281-3<br>20 | Very High: two independent means of protection or safe even when two faults occur independently of each other. Place in which an explosive atmosphere is frequently likely or for long periods or continuosly present | High probability of Explosive Atmosphere 1G / 1D / M1 | Equipment for Zone 0<br>Equipment for Zone 20 |
| 1 | 21 | High: suitable for normal operation and frequently occuring disturbances or equipment where faults are taken into account. A place in which an explosive atmosphere is occasionally likely to occur in normal operation | Possibility of Explosive Atmosphere 2G / 2D / M2 | Equipment for Zone 1<br>Equipment for Zone 21 |
| 2 | 22 | Normal: suitable for normal operation. A place in which an explosive atmosphere is unlikely to occur in normal operation, and only for short periods. | Low probability of Explosive Atmosphere 3G / 3D | Equipment for Zone 2<br>Equipment for Zone 22 |

## MARKING ACCORDING ATEX DIRECTIVE 94/9/EC




## DIRECTIVE 94/9/EC

### Equipment and Protective Systems

| Group | Substance | Potentially Explosive Atmosphere | Protection Level | Fault or Protection Mode | Category | Zone |
|---|---|---|---|---|---|---|
| **I** Mines and surface installation | Methane (Grisou) and coal dusts | Present | Very High | 2 independent faults or 2 protection modes. | M1 | |
| | | Probably present | High | 1 fault or 1 protection mode. | M2 | |
| **II** Surface industries and other sites | Gas, Vapours, Fogs or Powder | Continuosly present, or for long periods. | Very High | 2 independent faults or 2 protection modes. | 1 | Zone 0 (G) Zone 20 (D) |
| | | Probably present during normal operation. | High | 1 fault or 1 protection mode. | 2 | Zone 1 (G) Zone 21 (D) |
| | | Occasionally present, for short periods only. | Normal | No fault during normal operation. | 3 | Zone 2 (G) Zone 22 (D) |

**Note:** Group II (Category 1 and Category 2) electric, or internal combustion motor, certification mandatory (Notified Body).
(Category 2 non electric) manufacturer declaration and deposit of technical file to Notified Body.
(Category 3) manufacturer declaration.

## Electrical apparatus for Potentially Explosive Atmospheres

### CATEGORY 1 and 2 apparatus GAS

| Type of protection | CENELEC Code | EN Standard | New Numbers IEC |
|---|---|---|---|
| General requirements | | EN 50014 | EN 60079-0 |
| Intrisic Safety | EEx ia; ib | EN 50020 | EN 60079-11 |
| Increased Safety | EEx e | EN 50019 | EN 60079-7 |
| Flameproof | EEx d | EN 50018 | EN 60079-1 |
| Pressurization | EEx p | EN 50016 | EN 60079-2 |
| Powder Filling | EEx q | EN 50017 | EN 60079-5 |
| Encapsulation | EEx m | EN 50028 | EN 60079-18 |
| Oil Immersion | EEx o | EN 50015 | EN 60079-6 |
| Type n | EEx n | EN 50021 | EN 60079-15 |
| Intrinsically Safe Systems | EEx ia; ib | EN 50039 | EN 60079-25 |
| Special requirements for construction, test and marking of electrical apparatus of equipment group II, Category 1G | | | EN 50284-1 |

### CATEGORY 3 GAS

| Type n equipment containing: | Additional code letter |
|---|---|
| Enclosed break device | C |
| Non incendive component | C |
| Ermetically sealed device | C |
| Sealed device | C |
| Encapsulated device | C |
| Energy limited apparatus and circuits | L |
| Restricted breathing enclosure | R |
| Simplified pressurization | P |
| Non sparking | A |

A: for non sparking apparatus.
C: for sparking apparatus in which the contacts are suitably protected.
R: for restricted breathing enclosures.
L: for energy limited apparatus.
Z: for enclosure with n-pressurization.

## Electrical apparatus for use in the presence of combustible dust Category 1, 2 and 3 Dust

EN 50281-1-1 Electrical apparatus protected by enclosures - Construction and Testing.

EN 50281-1-2 Electrical apparatus protected by enclosures - Selection, installation and maintenance.

EN 50281-2-1 Test methods - Methods for determining the minimun ignition temperatures of dust.

Note: EN 50281-1-1 can be combined with other EN standards where appropriate.

## Dust Explosions in General

A dust explosion occurs when fine particles suspended in the air ignite and burn rapidly, causing a violent increase in pressure. In order to cause an explosion, the combustible mixture of air and dust must be contained in some type of vessel. Grains and other agricultural products are a common fuel for dust explosions due to the nature of their handling and storage. Any time that grain is handled or moved, potentially explosive dust is generated.

Grain is usually stored in large upright silos. The grain is elevated to an entrance in the top of a silo and allowed to fall down and gradually fill the silo. As it falls, dust separates out and becomes suspended in the airspace of the silo, creating an explosion hazard.

than a cloud of coarser particles. In addition, fine particles weigh less and tend to stay suspended in air longer. Generally speaking, particles smaller than 840 microns (0.033 inches) can be an explosion hazard.

Dust particles must reach some minimum concentration in the air before they can support combustion. This concentration varies with the material in question. In addition, dust that has settled on walls or surfaces may be stirred up by a primary explosion, possibly causing secondary explosions.

In a dust cloud containing 20 g (0.70 ounces) per cubic meter (35 cubic feet) of dust, a human being would not be able to see beyond about one meter (three feet). A concentration

| Dust Explosion Class | Kst (BAR • m/sec) | Type of Explosion |
|---|---|---|
| St 0 | 0 | No Explosion |
| St 1 | > 0 < 200 | Weak |
| St 2 | > 200 < 300 | Strong |
| St 3 | > 300 | Very Strong |

Note: Kst is the maximum rate of pressure rise, in bar • m/sec, and is used to measure the explosivity value of a combustible dust.

Many factors have an effect on the violence of a dust explosion. First and most obvious is the dust material itself. Some materials that are not even considered combustible in bulk form, such as aluminum, are capable of high-pressure explosions when they are in dust form. Most grain dusts are combustible and can cause an explosion, but some types are much more dangerous than others, especially dust associated with corn or sugar.

The size of the dust particles also plays an important role in determining the severity of an explosion. A solid fuel only burns at its surface, where it is exposed to air. A cloud of very fine dust particles has a much greater surface area

of 20 g (0.70 onces) per cubic meter (35 cubic feet) is below the minimum explosive limit for most grain dusts. Obviously, concentrations of dust above the minimum explosive limit usually do not occur in occupied areas. However, these concentrations frequently exist in bucket elevators, conveyor housings, bins, silos, and other such structures where grain is moved around.

Different types of grain dust have different combustibility and explosive characteristics.

The United States Bureau of Mines has devised a scale to relate the explosion severity of one type of dust to another.

This is shown in the table above.

The Explosibility Index is included in the explosion hazard comparison of several agricultural dusts found in the table below.
This table lists several common agricultural product dusts and gives a comparison of the hazards associated with each one.
Do not be misled by the table above.
The maximum explosion pressure for any one of these grain dusts is rarely reached. In order for grain dust to reach its maximum possible pressure, two things must happen.
First, the dust must mix with air in much higher proportions than the minimum explosive limit.
For maximum explosive pressure there must be enough dust to consume all available oxygen without any leftover dust.
This proportion is around one ounce per cubic foot for most grains.
Second, the explosive mixture must be contained in a vessel strong enough to withstand the maximum pressure.
If the vessel breaks, all of the pressure is vented immediately and the maximum pressure is not achieved.
Perhaps the most damaging property of grain dust explosions is the cascade effect.
Grain dust that has settled on floors or walls can be thrown into the air by a dust explosion, thus providing fuel for secondary explosions.
Often, these secondary explosions cause more damage than the first.
In this way, a dust explosion can jump from room to room or from silo to silo.
This is a common phenomenon in grain dust explosions. For example, one of the most dangerous areas for grain dust explosions is in the

## Explosive Properties of Agricultural Dusts

| Type of Dust | MIT Minimum Ignition Temperature of Cloud °F | °C | MIE Minimum Ignition Energy m Joul | LEL Explosivity Level Oz/Ft$^3$ | g/m$^3$ | Maximum Explosion Pressure psig | bar | Kst Maximum Rate of Pressure Rise psi/sec | bar•m/sec | Relative Explosion Hazard Class. |
|---|---|---|---|---|---|---|---|---|---|---|
| **Alfalfa** | 860 | 460 | 320 | 0.1 | 100 | 66 | 4.55 | 1100 | 25 | Weak |
| **Cocoa** | 788 | 420 | 100 | 0.045 | 45 | 65 | 4.50 | 1200 | 28 | Weak |
| **Corn** | 752 | 400 | 40 | 0.045 | 45 | 95 | 6.55 | 6000 | 137 | Weak |
| **Corn Cob** | 752 | 400 | 40 | 0.030 | 30 | 110 | 7.6 | 5000 | 115 | Weak |
| **Cornstarch** | 716 | 380 | 20 | 0.040 | 40 | 115 | 7.9 | 9000 | 206 | Strong |
| **Cotton linters** | 968 | 520 | 192 | 0.500 | 500 | 48 | 3.3 | 150 | 3.5 | Weak |
| **Cottonseed** | 878 | 470 | 60 | 0.050 | 50 | 104 | 7.2 | 3000 | 69 | Weak |
| **Grain, mixed** | 806 | 430 | 30 | 0.055 | 55 | 115 | 7.9 | 5500 | 126 | Weak |
| **Rice** | 824 | 440 | 40 | 0.045 | 45 | 93 | 6.4 | 3600 | 82 | Weak |
| **Sugar** | 662 | 350 | 30 | 0.035 | 35 | 91 | 6.3 | 5000 | 115 | Weak |
| **Tobacco** | 788 | 420 | - | - | - | 7 | 0.5 | 200 | 4.5 | Weak |
| **Wheat** | 896 | 480 | 60 | 0.055 | 55 | 103 | 7.1 | 3600 | 82 | Weak |
| **Wheat flour** | 716 | 380 | 50 | 0.050 | 50 | 95 | 6.55 | 3700 | 85 | Weak |

bucket elevator area of a silo. The grain is always in motion, so dust is constantly generated. In addition, possible sources of ignition such as static discharge and friction heated bearings are always present. Frequently, a primary explosion in this area cascades into the silo itself, causing a much larger and more damaging secondary explosion.

The importance of good housekeeping in preventing cascade explosions cannot be overemphasized. It is necessary to remove dust buildup on interior surfaces regularly.

Often, the ignition source and location of the primary explosion are unknown.

This is due in part to the fact that not all of these explosions are investigated.

Grain dust is nine times as explosive as coal dust and pound for pound it is more explosive than TNT.