USEFUL INFORMATION

NEMA and UL Types of Enclosures - North America Classifications

Ingress Protection (IP CODES) - International IEC Classifications

Conversion of Enclosure Type numbers to IEC Classification Designations

The following information should only be used as a general reference only. For more detailed information concerning hazardous location definitions and equipment installation requirements, refer to the 2005 National Electrical Code (NEC), Chapter 5 Articles 500 through 516, available from the National Fire Protection Association, or the current version of the Canadian Electrical (CE) Code, Part 1 Section 18, available from the Canadian Standards Association, and the 94/9/EC ATEX Directive from the European Commission.

Combustion Principles:

There are three basic conditions that must be satisfied for a fire or explosion to occur. First, a flammable liquid, vapor or combustible dust must be present in sufficient quantity. Second, the flammable liquid, vapor or combustible dust must be mixed with air or oxygen in the proportions required to produce an explosive mixture. Finally, a source of energy (arcs or sparks, high surface temperatures or electrical equipment failure) must be applied to the explosive mixture.

These three elements combine to form what is known as the combustion triangle.

In applying these principles, the quantity of the flammable liquid or vapor that may be liberated and its physical characteristics must be recognized. Vapors from flammable liquids also have a natural tendency to disperse into the atmosphere, and rapidly become diluted to concentrations below the lower explosion limit, particularly when there is natural or mechanical ventilation. In order to have an explosive gas atmosphere, the concentration of the gas or vapor must be above the Lower Explosive Limit (LEL) but below the Upper Explosive Limit (UEL). The possibility that the gas concentration may be above the upper explosion limit does not afford any degree of safety, as the concentration must first pass through the explosive range to

reach the upper explosion limit.

You can eliminate a combustion hazard by eliminating any one of the three triangle elements.

Hazardous Location Definitions:

Hazardous Locations

Hazardous locations are areas where fire or explosion hazards exist due to the presence of flammable gases or vapors, flammable liquids, combustible dusts, or ignitable fibers or flyings.

The determination that areas are classified as hazardous locations is based on the following:

► **Class** - The possible presence of an explosive atmosphere such as flammable gases, vapors, or liquids (Class I), combustible dusts (Class II) or ignitable fibers & flyings (Class III).

► **Division or Zone** - Identifies the conditions under which the explosive atmosphere is present (is the hazard normally present continuously or for long periods, under normal operating conditions, or under abnormal operating conditions?)

► **Group** - The ignition related properties of the explosive atmosphere that is present (auto ignition temperature, explosive pressure, minimum ignition current, and maximum experimental safe gap.

North American System - NEC and CE Classifications

► **Classes of Hazardous Locations**

Class I - A location where there is a danger of explosion due to the presence of a flammable gas or vapor.

Examples include petroleum refineries, gasoline storage and dispensing areas, dry cleaning plants where vapors from cleaning fluids can be present, spray finishing areas, aircraft device and fueling areas, utility gas plants and operations involving storage and handling of LPG or natural gas products.

Class II - A location where there is a danger of explosion due to the presence of a flammable dust.

Examples include grain elevators, flour and feed mills, plants that manufacture, use or store magnesium or aluminum powders, producers of plastics, medicines or fireworks, coal preparation plants or other carbon handling and processing areas.

Class III - A location where there is a danger of explosion due to the presence of flammable fibers or flyings.

Examples include paper mills, textile mills, cotton gins, cotton seed mills, flax processing plants, and plants that shape, pulverize or cut substances such as wood that creates flyings. These fibers and flyings are decidedly dangerous not only because they are easily ignited, but also becasue of the speed at which flames spread through them. Such fires, usually called "flash fires", have been the origin of tremendous disasters.

► Divisions of Hazardous Locations

Division 1 - A location where the hazard is expected to be present during normal operating conditions.

Examples include areas near open dome loading facilities or adjacent to relief valves in a petroleum refinery, because the hazardous material would be present during normal plant operations.

Division 2 - A location where the hazards would only exist as a result of an accident or other abnormal event, such as an accidental rupture of a vessel or container or failure of a ventilating system.

Examples include areas where closed storage drums containing flammable liquids are stored in an inside storage room. While closed drums would not normally allow the hazardous vapors to escape into the atmosphere, what happens if one of the drums were to leak? You would end up with a Division 2

abnormal condition. So the area rating would be designated a Class I, Division 2 location.

Note: In the case of Class II or III, Division 2 also includes the possibility of electrical equipment overheating because of the possibility of the enclosure being covered with dust, fibers, or flyings.

► Groups

Class I Groups

The gases and vapors of Class I locations are broken into four groups under Article 500 of the NEC: A, B, C, and D. These materials are grouped according to:

1) The auto ignition temperature (AIT) of the substance (AIT is the temperature at which a gas, vapor, or dust will ignite spontaneously without any source of ignition),
2) The explosive pressure generated by the substance for a given volume,
3) The maximum experimental safe gap (MESG) which is the distance through which an explosion can propagate if the gap between two machined surfaces exceeds a certain value, and
4) The minimum ignition current of the substance (MIC) since each gas or vapor will ignite at a different level of current when tested in a standard intrinsic safety test apparatus.

Group A - Atmospheres containing **acetylene**.

Acetylene makes up only a very small percentage of hazardous locations. Consequently, little equipment is available for this type of location. Acetylene is a gas with extremely high explosion pressures.

Group B - Atmospheres containing **hydrogen** (H2), fuel and combustible process gases containing more than 30% hydrogen by volume, or gases or vapors of equivalent hazard such as butadiene, ethylene oxide, propylene oxide, acrolein and other gases.

Group B gases also represent only a small segment of classified areas.

Group C - Atmospheres containing Ethyl Ether, **Ethylene**, Acetaldehyde, Allyl Alcohol, N-Butyraldehyde, Carbon Monoxide, Crontonaldehyde, Cyclopropane, Diethyl Ether, Diethylamine, Epichlorohydrin, Ethylene, Ethylenimine, Hydrogen Sulfide, Morpholine, 2-Nitropropane Tetrahydrofuran, Isoprene, Unsymmetrical Dimethyl Hydrazine (UDMH) and other gases.

Group D - Atmospheres containing Acetic Acid (glacial), Acetone, Acrylonitrite, Ammonia, Benzine, **Butane**, 1-Butanol (Butyl Alcohol), 2-Butanol (Secondary Butyl Alcohol), N-Butyl Acetate, Isobutyl Acetate, Di-Isobutylene, Ethane, Ethanol (Ethyl Alcohol), Ethyl Acetate, Ethyl Acrylate (Inhibited), Ethylene Diamine (anhydrous), Ethylene Dichloride, **Gasoline**, Heptanes, Hexanes, Isoprene, Isopropyl, Ether, Mesityl Oxide, **Methane (Natural Gas)**, Methanol, Methyl Amyl Alcohol, Methyl Ethyl Ketone, Methyl, Isobutyl Ketone, 2-Methyl-1-propanol (Isobutyl Alcohol), 2-Methyl-2-Propanol (Tertiary Butyl Alcohol), petroleum Naphtha, Pyridine, Octanes, Pentanes, 1-Pentanol (army Alcohol), **Propane**, 1-Propanol (Propyl Alcohol), 2- Propanol (Isopropyl Alcohol), Propylene, Styrene, Tolvene, Vinyl Acetate, Vinyl Chloride, Xylenes and other gases.

Class II Groups

The **dusts of Class II** locations are broken into 3 groups under Article 500 of the NEC: E, F, and G. These dusts are grouped according to:

1) The auto ignition temperature of the substance, and
2) The Conductivity of the substance. Conductivity is an important consideration in Class II locations, especially with metal dusts.

Group E - Atmospheres containing combustible **metal dusts**, including aluminum, magnesium, and their commercial alloys, or other combustible dusts whose particle size, abrasiveness, and conductivity present similar hazards in the use of electrical equipment.

Group F - Atmospheres containing combustible **carbonaceous dusts** including **coal**, coke, carbon black, and charcoal dust having more than 8% total entrapped volatiles; or dusts that have been sensitized by other materials so that they present an explosion hazard.

Group G - Atmospheres containing combustible dusts not included in Group E or F, including **agricultural dusts** such as flour, cocoa, starch, **grain** and wood, thermoplastic resins and molding compounds, pharmaceutical drugs, and various chemical powders.

Introduced to North America in 1996 as an attempt to harmonize European and North American standards, the European Committee for Electrotechnical Standardization (CENELEC) and International Electrotechnical Commission (IEC) system of classification of hazardous locations is also permitted to apply to installations in the U.S. and Canada as an alternative in Class I Locations, and is now part of the NEC (Article 505) and CE Code (Section 18).

International System - CENELEC and IEC Zone Classifications

Zone Classifications

Class I, Zone 0 - A location in which explosive gas atmospheres are present continuously or for long periods of time.

A typical example would include a vapor space in a vented tank.

Class I, Zone 1 - A location in which explosive gas atmospheres are likely to exist in normal operation or may exist frequently because of repairs, maintenance operations, and leakage or where equipment breakdowns could release gases or vapors and also cause simultaneous failure of electrical equipment in a mode to cause the electrical equipment to become a source of ignition.

A typical example would include a container filling area in a refinery.

Class I, Zone 2 - A location in which explosive gas atmospheres are not likely to occur in normal operation and, if they do occur, will exist for a short time only; or where volatile flammable liquids, flammable gas, or flammable vapors are handled, processed, or used, but are normally confined within closed containers or systems from which they can escape only as a result of accidental rupture or breakdown of the containers or system, or as a result of abnormal operation of the equipment with which the liquids or gases are handled, processed, or used; or where ignitable concentrations of flammable gases or vapors are normally prevented by adequate ventilation, but which may occur as a result of failure or abnormal operation of the ventilation system.

A typical example would include a container storage area.

Class I Groups

Group I - Atmospheres containing explosive gas in underground coal mines. Electrical apparatus that is intended for use in underground mines.

Group II - Atmospheres containing explosive gas in non-mining applications and is subdivided according to the nature of the gas atmosphere as follows:

Group IIC - Atmospheres containing acetylene, hydrogen (H2), or gases of equivalent hazard.

Group IIB - Atmospheres containing acetaldehyde, ethylene, or gases or vapors of equivalent hazard.

Group IIA - Atmospheres containing acetone, ammonia, ethyl alcohol, gasoline, methane, propane, or gases or vapors of equivalent hazard.

Comparing the two systems

	Example	**NEC & CE** **NEC 500-503**	**CENELEC & IEC** **NEC 505**
CLASS I (Gases and Vapors)	Acetylene Hydrogen Ethylene Propane	Group A Group B Group C Group D	IIC IIC or IIB + H2 IIB IIA
CLASS II (Dusts)	Metal dust Coal dust Grain Dust	Group E Group F Group G	
CLASS III (Fibers & Flyings)	Wood, paper or cotton processing	No sub-groups	

Note: There is potential for confusion between the NEC/CE and IEC gas classification systems since the Group letters are reversed and even combined. Care should also be taken to avoid confusing Group II and Class II, since both use Roman numerals. An unintended result of specifying the IEC gas groups, which combine the traditional Groups A and B into Group IIC, is that equipment approved for hydrogen (H2) would also have to be approved for acetylene. Since very little equipment is designed for acetylene, the wording as originally adopted severely limits the availability of equipment for hydrogen applications. As a result, NEC Section 505-7(d) now allows for equipment to be listed for a specific gas or vapor, specific mixtures of gases or vapors, or any specific combination of gases or vapors. One common example is equipment marked for "IIB + H2".

At present, the NEC or CE Code does not recognize any CENELEC or IEC dust classifications.

Maximum Surface Temperature Class Codes:

Within a hazardous area, the maximum surface temperature of an electrical apparatus must not reach the ignition temperature of the potentially explosive atmosphere it operates in. Since each explosive substance has a defined auto ignition temperature (AIT), it can be assigned within a corresponding Temperature Class . Maximum Surface Temperature Codes indicate the maximum temperature a device's external enclosure can reach. Therefore, the equipment's temperature code marking shall not exceed the the ignition temperature of the specific gas, vapor, dust, fibre or flying to be encountered.

Maximum Surface Temperature Codes

Maximum Surface Temperature °C (°F)	Identification Number NEC/CE T-Code	IEC T-Code
450°C (842°F)	T1	T1
300°C (572°F)	T2	T2
280°C (536°F)	T2A	
260°C (500°F)	T2B	
230°C (446°F)	T2C	
215°C (419°F)	T2D	
200°C (392°F)	T3	T3
180°C (356°F)	T3A	
165°C (329°F)	T3B	
160°C (320°F)	T3C	
135°C (275°F)	T4	T4
120°C (248°F)	T4A	
100°C (212°F)	T5	T5
85°C (185°F)	T6	T6

Always compare the auto ignition temperature of the specified hazard with the maximum surface temperature of the equipment you wish to install. The auto ignition temperature must be higher than the T-rating of the equipment. If they cross over, you may not install the equipment. Also compare the T-Code rating and the Group rating of the equipment together. For example, Ethyl Ether is rated as a Class I, Group C substance, with an AIT of 160°C (320°F) and Hydrogen is rated as a Class I, Group B substance with an AIT of 520°C (968°F). If a piece of equipment is rated for Class I, Group C & D with a T-Code of T3B -165°C (329°F) then it would not be suitable for either environment. However, if you were selecting the equipment just based on T-Code alone then it would incorrectly appear that it is suitable for a Hydrogen environment. Inversely, if you were selecting the equipment based on the Group rating alone, then it would incorrectly appear that it is suitable for an Ethyl Ether environment.

You must compare the equipment's T-Code and Group rating together as they are not mutually exclusive.

Equipment Marking Requirements:

Electrical equipment permitted for use in hazardous locations must be marked to show the Class, Division (or Zone under NEC Article 505 and CE Section 18), Group, and maximum surface operating temperature or temperature code referenced to a 40oC (104oF) ambient temperature (some exceptions apply). Note that the maximum external temperature of the equipment shall not exceed the minimum ignition temperature of the atmosphere that the equipment is located in.

Electrical equipment approved for operation at ambient temperatures exceeding 40oC shall be marked with the maximum ambient temperature for which the equipment is approved, and the operating temperature or temperature range at that ambient temperature.

Equipment not marked to indicate a division, or marked "Division 1" or "Div. 1", is suitable for both Division 1 and 2 locations. Equipment marked "Division 2" or "Div. 2" is suitable for Division 2 locations only. Equipment that is listed for a Zone 0 location shall be permitted in a Zone 1 or Zone 2 location of the same gas or vapor. Equipment that is listed for a Zone 1 location shall be permitted in a Zone 2 location of the same gas or vapor.

Equipment is required to be marked with the operating temperature or operating temperature code only if the maximum operating temperature is more than 100°C (212°F).

Methods of Protection:

There are several ways to protect electrical equipment so that arcing or hot components will not be an ignition source causing an explosion.

► **Explosion-proof or flameproof** protection requires an enclosure that:
● can withstand an internal explosion without rupture, and
● prevents flame or an explosion inside the enclosure from causing an explosion in the surrounding atmosphere outside the enclosure.

► **Intrinsic safety** involves limiting the electrical energy at potential sources of ignition in electrical circuits (hot components and spark sources) to such low levels that-even under abnormal (fault) conditions-there is no possibility of the electrical energy igniting an explosive atmosphere. This method of protection may be used for a wide range of low power equipment, including pagers, process control tank level transmitters, and portable gas detectors.

► **Non-incendive equipment** also limit energy at potential sources of ignition in electrical circuits (hot components and spark sources). But unlike the intrinsic safety method described above, non-incendive equipment is designed to provide protection only under normal operating conditions, which may include opening, shorting or grounding of field wiring. This method of protection may be used for a

wide range of equipment, including pagers, process control tank transmitters, and portable gas detectors.

► **Increased safety** protection establishes safeguards against the possibility of gas or vapor mixtures being ignited by high temperatures or arcing or sparking under worst-case operating conditions. Increased safety is typically applied to luminaires, motors, and junction boxes.

► **Pressurization** involves using a protective gas to purge and maintain an internal pressure in the equipment. This prevents an external potentially explosive atmosphere or flammable gas or vapor from leaking into the equipment and contacting otherwise unprotected components. Pressurization is used in equipment such as motors, control panels, and gas chromatographs.

► **Encapsulation** involves molding the parts that could cause an explosion in a compound to exclude the external atmosphere. It is usually applied to components, such as valve solenoids.

► **Dust-tight** construction of electrical equipment prevents the entry of combustible or electrically conductive dust in Class II hazardous locations. A bin level indicator would be a typical application.

Summary of commonly used protection methods for different Divisions and Zones

NEC & CEC (North America) / North America, CENELEC (European Union) & IEC (International)

Method of Protection	**Division**	**NEC & CEC M.O.P.**	**Zone**
Intrinsic Safety	1 or 2	Instrinstic Safety "ia", "ib"	ia: 0, 1 or 2; ib: 1 or 2
Explosion Proof	1 or 2	Flame-Proof "d"	1 or 2
Pressurization	1 or 2	Pressurization "p"	1 or 2
Non-incendive equipment	2	Increased Safety "e"	1 or 2
*Specially assessed equip.	2		

*No excessive heat-generating devices or ignition-capable arcing/sparking devices.

European Union (EU) Requirements - ATEX "New Approach" Directives:

ATEX Equipment

'CE' Marking and the 94/9/EC ATEX Directive on equipment and protective systems intended for use in potentially explosive atmospheres.

ATEX is named after the French "**AT**mosphere **EX**plosible".

'CE' marking has been introduced as part of the European Union's new approach to technical harmonisation as a means of identifying products that comply with all relevant EC directives.

Subject to certain safeguards, products bearing the 'CE' mark are permitted to be sold throughout the EU without interference from national regulatory authorities. The Directives have been put in place in order to remove artificial trade barriers within the European Union previously caused by individual countries' national standards, a secondary function is as a means of regulating safety.

The Explosive Atmospheres 94/9/EC ATEX (Equipment) Directive came into force on 1 March 1996. The Directive was in transition, where product compliance was optional, until 1 July 2003 when it became mandatory.

On this date the previous Explosive Atmospheres and Gassy Mines Directives was repealed. Now only equipment and systems 'CE' marked as compliant with the ATEX Equipment Directive (and all other relevant mandatory directives) may be placed on the market within the EU.

The Directive applies to all equipment and systems for use in potentially explosive atmospheres within the EU. The scope of the directive includes electrical and mechanical equipment for use in Group I (mining) or Group II (industrial) applications, both on and offshore and considers risks of ignition of potentially explosive gas, vapour, mist and dust atmospheres. In addition, devices intended for use outside potentially explosive atmospheres that contribute to the safe functioning of equipment and systems with regard to explosion risk are also included.

Compliance of products to the ATEX Equipment Directive, through conformity assessment, takes a modular approach, and is generally in two stages; design and production.

A common route to product design compliance is to apply to a Notified Body (Ex. Test House) for an EC Type Examination Certificate. To comply, the equipment or system must meet the Essential Health and Safety Requirements (EHSRs) listed in the Directive. Harmonised EU standards have been adopted by CENELEC and CEN, relating to the design, construction and testing of equipment; a product complying with these standards is deemed to meet the

EHSRs to which the standards relate.

The production quality stage of the conformity assessment procedures ensure continued product compliance in manufacturing. Typically a manufacturer should have a certified ISO 9000 quality management system and comply with one of the quality modules in the ATEX Equipment Directive, however this will vary depending on product equipment category; equipment used in higher risk areas will require more onerous conformity assessment procedures to be applied.

In addition to the 94/9/EC ATEX (Equipment) Directive, products for use in potentially explosive atmospheres may require to be compliant with other directives including the 89/336/EEC Electro-Magnetic Compatibility (EMC) Directive, which became mandatory on 1/1/96. This Directive applies to virtually all electrical and electronic apparatus potentially able to generate interfering emissions or exhibit an undue sensitivity to interference sources.

Once compliance with the relevant directives is complete and an EC Declaration of Conformity issued by the manufacturer, the 'CE' mark may be applied and the product placed on the market.

The ATEX Equipment Directive in full, and EC Commission guidance on the Directive, may be found on the European Commision website.

Groups and Categories of Apparatus

Apparatus are classified into groups and categories:

Group of apparatus I - applies to apparatus for mining operations above ground and underground that may be endangered by methane gas and/or inflammable dusts. This group is subdivided into the categories **M1**and **M2**.

Category	Group of Apparatus I
M1	The apparatus must continue to work even in the event of infrequent failures coinciding with an existing explosive atmosphere, and . feature such protective measures against explosion that:
or	● if one constructional protective meauure fails, at least one other independent constructional measure will ensure the required safety, ● if two independent faults occur in combination, the required safety will be ensured.
M2	When an explosive atmosphere occurs, it must be possible to switch off the apparatus. The constructional

protective measures against . explosion ensure the required amount of safety in normal operation, also under rugged operational conditions and particularily in case of . rough handling and changing surroundings.

Group of apparatus II - applies to apparatus for use in all other areas which may be subject to the hazard of an explosive atmosphere. This group is subdivided into the categories **1**, **2** and **3**.

Category	Group of Apparatus II
1	The apparatus are intended for use in such areas in which an explosive atmosphere exists **constantly or for long perioods or frequently**. Even in the event of failures occuring infrequently on the apparatus, these must ensure the required degree of safety and feature such . protective measures against explosion that: ● should one constructional protective meauure fail, at least one other independent constructional measure will ensure the required . safety, ● if two independent faults occur in combination, the required safety will be ensured.
2	The apparatus are intended for use in areas in which an explosive atmosphere is to be expected **occasionally**. Even in case of frequent failures of the apparatus or faulty conditions that are normally to be expected, the protective measures against . explosion will ensure the required degree of safety.
3	The apparatus are intended for use in areas in which no occurrences of an explosive atmosphere on account of gases, vapors, mists . or whirled-up dust is to be expected. If it occurs nevertheless, then in all probability **only rarely or for a short period only**. In normal operation the apparatus will ensure the required degree of safety.

EQUIPMENT GROUP & EQUIPMENT CATEGORY

Mining

Industrial

Equipment Group	Equipment Category	Protection Level	Hazard		Use
			Gas	Dust	
I	M1	Very high protection	–	–	Operable in Ex atmosphere
	M2	High protection	–	–	De-energised in Ex atmosphere
II	1	Very high protection	G		Zones 0,1,2,
				D	Zones 20,21,22
	2	High protection	G		Zones 1,2
				D	Zones 21,22
	3	Normal protection	G		Zones 2
				D	Zones 22

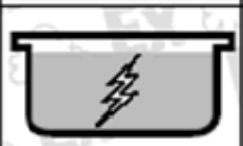
Equipment Group and Category identify the areas in which equipment may be safely used

Graphic examples are compliments of the The Wolf Safety Lamp Company Ltd., Sheffield, England

Types of Protection of Explosion Protected Apparatus

According to the European standard DIN EN 50 014 (VDE regulations 0170/01710 part 1) explosion protected apparatus can be designed so that they meet the requirements of several types of protection. Here, eight types of protection based on different principles, are taken into consideration.

PROTECTION CONCEPTS FOR ELECTRICAL APPARATUS

Concept	Symbol	Icon	Description	Category	EN Standard
General req.	–		General requirements	–	EN 50014
Oil immersion	Ex o		explosive gas excluded by immersing ignition source in oil	2	EN 50015
Pressurised	Ex p		explosive gas excluded by surrounding ignition source with pressurised inert gas	2	EN 50016
Powder filled	Ex q		explosive gas excluded by immersing ignition source in sand	2	EN 50017
Flameproof	Ex d		ignition within the apparatus enclosure is contained and will not ignite surrounding explosive atmosphere	2	EN 50018
Increased safety	Ex e		design excludes the possibility of incendive arcs, sparks or hot surfaces	2	EN 50019
Intrinsic safety	Ex ia Ex ib		energy in circuit and temperature on components reduced to a safe level	1 2	EN 50020
Encapsulation	Ex m		flammable gas excluded by encapsulating the ignition source in resin	2	EN 50028
Non-incendive	Ex n		will not ignite explosive gas in normal operation, faults unlikely to occur	3	EN 50021

Protection concept identifies the means by which explosion protection is achieved.

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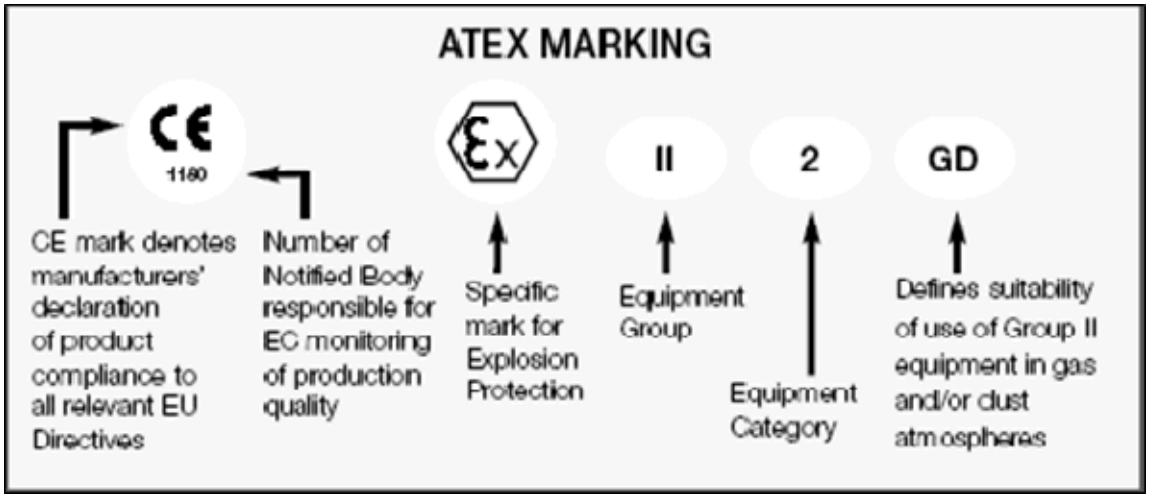
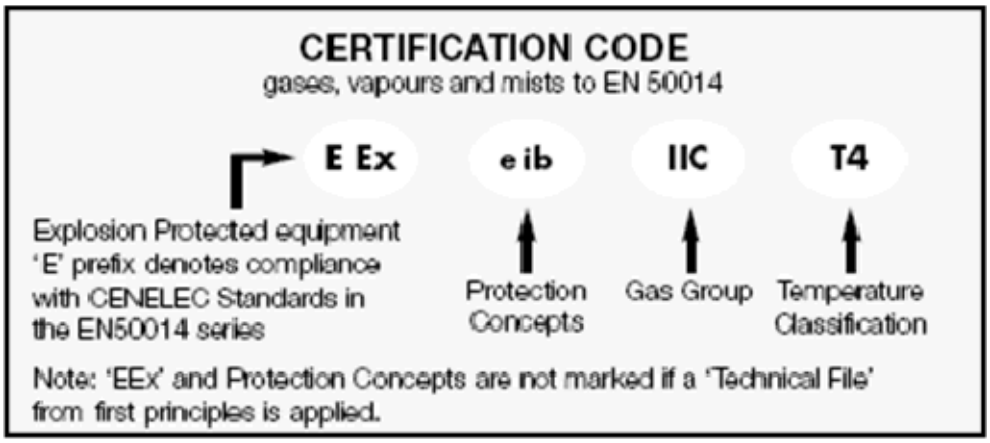
Equipment Marking

Each piece of equipment and protective system must be marked in a clear and identifiable manner with the following minimum data:

- manufacturer's name and address
- CE marking and number of Notified Body responsible for testing
- designation of the series and of the type
- serial No. when required
- the year of construction
- the particular Ex marking which means prevention of explosion in conjunction with the marking referring to the category.
- the letter "G" for the group of apparatus II for areas with the presence of explosive gas, vapour, mist with air mixtures
- and/or the letter "D" for areas where an explosive atmosphere can be built up caused by dust
- In addition and where required, also any details or certification code that are indespensable for the safety of operation will have to be affixed, i.e. .. . also the normal CENELEC marking, e.g. EEXE eib IIC T4





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ATEX Workplace

99/92/EC ATEX (Workplace) Directive on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres.

The Directive covers both Group I and Group II activities, on shore and offshore within the EU, and aims to provide a better level of protection for the health and safety of workers in potentially explosive gas, vapour, mist and dust atmospheres.

It lists a set of obligations and safety measures for employers, requiring the adoption of a coherent risk assessment based strategy for the prevention of explosions. These obligations include:

► Generation of an explosion protection document, evaluating explosion risk, including: likelihood of the presence of the explosive atmosphere, the presence of ignition sources (including electrostatic discharge), identification of the substances and processes in use, definition of specific measures taken to safeguard the health and safety of workers.

► Classification of areas into zones and marking points of entry with safety signs.

► Appropriate training and supervision for workers.

► Use of written instructions and permits to work.

► Special requirements for work equipment:

- Equipment in service before 30 June 2003 may continue to be used after this date if the explosion protection document indicates it can be safely used.

- Equipment brought into service after 30 June 2003 must be CE marked as compliant with the 94/9/EC ATEX (Equipment) Directive.

► Due consideration of explosion protection measures, encompassing issues such as:

- Control of releases.

- Use of protective measures appropriate to the greatest potential risk.

- Selection of appropriate equipment by referencing the explosion protection document.

- Ensuring equipment is correctly maintained and operated.

- Minimising the risk of explosion and the effect of explosion in the workplace.

- Provision of suitable warning and escape facilities.

99/92/EC is a separate directive specifically covering workers in explosive atmospheres, working within the more general 89/391/EEC Directive on the introduction of measures to encourage improvements in the safety and health of workers at work.

Enclosure Types:

NEMA and UL Types of Enclosures - North American Classifications

Type 3 Enclosure - Enclosures that are intended for outdoor use primarily to provide a degree of protection against windblown dust, rain, sleet and external ice formation.

Type 3R Enclosure - Enclosures that are intended for outdoor use primarily to provide a degree of protection against falling rain and external ice formation.

Type 3S Enclosure - Enclosures that are intended for outdoor use primarily to provide a degree of protection against rain, sleet, windblown dust, and to providefor operation of external mechanisms when ice laden.

Type 4 Enclosure - Enclosures that are intended for indoor or outdoor use primarily to provide a degree of protection against windblown dust and rain, splashing water, hose-directed water and external ice formation.

Type 4X Enclosure - Enclosures that are intended for indoor or outdoor use primarily to provide a degree of protection against corrosion, windblown dust and rain, splashing water, hose-directed water and external ice formation.

Type 7 Enclosure - Enclosures that are for use indoors in locations classified as Class I, Groups A, B, C or D, as defined in the National Electrical Code®.

Type 9 Enclosure - Enclosures that are for use in indoor locations classified as Class II, Groups E, F or G, as defined in the National Electrical Code®.

Type 12 Enclosure - Enclosures that are intended for indoor use primarily to provide degree of protection against dust, falling dirt and dripping noncorrosive liquids.

Ingress Protection (IP CODES) - International IEC Classifications

FIRST NUMERAL Protection against solid bodies	SECOND NUMERAL Protection against liquid
0 - NO PROTECTION	0 - NO PROTECTION
1 - OBJECTS EQUAL TO OR GREATER THAN 50MM	1 - VERTICALLY DRIPPING WATER
2 - OBJECTS EQUAL TO OR GREATER THAN 12.5MM	2 - 75 TO 105° - ANGLED DRIPPING WATER
3 - OBJECTS EQUAL TO OR GREATER THAN 2.5MM	3 - SPRAYING WATER
4 - OBJECTS EQUAL TO OR GREATER THAN 1.0MM	4 - SPLASHING WATER
5 - DUST-PROTECTED	5 - WATER JETS
6 - DUST-TIGHT	6 - HEAVY SEAS, POWERFUL WATER JETS
	7 - EFFECTS OF IMMERSION
	8 - INDEFINITE IMMERSION

Conversion of Enclosure Type numbers to IEC Classification Designations

(Cannot be used to convert IEC Classification Designations to NEMA Type Numbers)

NEMA ENCLOSURE TYPE NUMBER	**IEC ENCLOSURE** CLASSIFICATION DESIGNATION
3	**IP54**
3R	**IP54**
3S	**IP54**
4 and 4X	**IP56**
5	**IP52**
6 and 6P	**IP67**
12 and 12K	**IP52**