Ex Regulation

Ex Regulation

EXPLOSIVE ATMOSPHERE

The Directive defines 'explosive atmosphere' as mixture with air, under atmospheric conditions of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture.

Explosive atmospheres can be caused by flammable gases, mists or vapours or by combustible dusts. If there is enough of the substance, mixed with air, then all it needs is a source of ignition to cause an explosion.

ATEX (ATmosphères EXplosibles) is the name commonly given to the two European Directives for controlling explosive atmospheres:

1. Directive 99/92/EC: deals with the precautions to be taken in workplaces where explosive atmospheres might be present due to flammable dusts vapours or gases (or mixtures of these);
2. Directive 2014/34/EU: is concerned with products that may be supplied for use in potentially explosive atmospheres.

Directive 99/92/EC

Directive 99/92/EC requires employers to protect workers from the risk of explosive atmospheres. The Directive provides workers with a minimum level of protection in hazardous areas throughout the member states.

The directive is based on 3 straightforward principles:

1. Where possible, to prevent the formation of explosive atmosphere;
2. Where such atmosphere are unavoidable, to prevent ignition and
3. To ensure the heath and safety of workers by mitigating the effects of any explosions that does occur.

Where the workers from different organizations are present on site, it is the employer who has responsibility for the workplace that must coordinate and implement the safety measures for all workers.

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Directive 2014/34/EU

Directive 2014/34/EU “Equipment and Protective Systems for use in potentially explosive atmospheres”. Covers electrical and non-electrical products intended for use in hazardous areas. Potentially explosive atmosphere are classified with respect to the possibility of the presence of an explosive mixture due to:

- Gas;
- Dust;
- Vapours;
- Mists.

CONDITIONS TO CREATE AN EXPLOSIONE

An explosion can only take place if the following three factors coincide:

- Combustible substance - Gas, liquid or solid substance:
  - **Gas**: A gas is a sample of matter that conforms to the shape of a container in which it is held and acquires a uniform density inside the container, even in the presence of gravity and regardless of the amount of substance in the container. If not confined to a container, gaseous matter, also known as vapour, will disperse into space. The term gas is also used in reference to the state, or condition, of matter having this property;
  - **Vapour**: The term vapour is used to describe the state of a substance when it’s gaseous phase is in equilibrium with it’s liquid or solid phases, below it’s boiling point;
  - **Fog**: Droplet of liquid dispersed in a gas (ex. Air) following strong accelerations (Ex. Vibrations or by condensation);
  - **Dust**: Is made by small solid particles which are present in the atmosphere, deposit themselves for the effect of their weight, but that can remain suspended for a certain period. A set of solid dust particles, smaller than 500µm, is considered “dust”. (Only dust smaller than 200µm can provoke explosions).
- Oxygen (in the air).
- Source of ignition (e.g. electrical spark).

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Combustible substances form a potentially explosive atmosphere when they are present within a certain range of concentration.

If the concentration is too low (lean mixture) and if the concentration is too high (rich mixture) an explosion does not take place. Slow burning takes place instead, or no burning at all. Only in the area between the upper and the lower explosion limits does the mixture react explosively if ignited.
The explosion limits depend on the surrounding pressure and the proportion of oxygen in the air.

Flammability limit (LEL e UEL): Minimum or maximum concentration levels of vapour of a flammable or combustible material (expressed as per cent by volume in air) at which an explosion will occur in a confined area if an ignition source is present. No explosion can occur in the presence of very low or very high concentrations.

LEL (lower explosive limit): Lowest concentration (percentage) of a gas or vapour in air capable of producing a flash of fire in presence of an ignition source (arc, flame, heat). Concentrations lower than LEL are 'too lean' to burn. Also called lower flammable limit (LFL).

UEL (upper explosive limit): Highest concentration (percentage) of a gas or vapour in air capable of producing a flash of fire in presence of an ignition source (arch, flame, heat). Concentrations higher than UEL are 'too rich' to burn. Also called upper flammable limit (UFL).

IECEx

IEC (International Electro-technical Commission) promote international co-operation on all questions of standardization and related matters in the fields of electro-technology, including Conformity Assessment.

IECEx is the International Standard way of doing Ex Certification.
The IEC's System with Schemes covering Certification to Standards that relate to Equipment, Services and Persons in areas relating to Explosive Atmospheres, to provide an Internationally accepted means of demonstrating claimed compliance with International Standards.

The objective of the IECEx System is to facilitate international trade in equipment and services for use in explosive atmospheres, while maintaining the required level of safety:

- Reduced testing and certification costs to manufacturer;
- Reduced time to market;
- International confidence in the product assessment process;
- One international database listing;
- Maintaining International Confidence in equipment and services covered by IECEx Certification.

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Ex EQUIPMENT

Ex equipment in such areas include:

- Automotive refuelling stations or petrol stations;
- Oil refineries, rigs and processing plants;
- Chemical processing plants;
- Printing industries, paper and textiles;
- Hospital operating theatres;
- Aircraft refuelling and hangars;
- Surface coating industries;
- Underground coalmines;
- Sewerage treatment plants;
- Gas pipelines and distribution centres;
- Grain handling and storage;
- Woodworking areas;
- Sugar refineries:
- Metal surface grinding, especially aluminium dusts and particles;

HAZARDOUS AREA ZONES AND EQUIPMENT CATEGORIES

GASES, VAPOURS AND MISTS

ZONE 0 = A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mists is present continuously or for long periods or frequently.

ZONE 1 = A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mists is likely to occur in normal operation.

ZONE 2 = A place in which an explosive atmosphere consisting of a mixture with air of dangerous substances in the form of gas, vapour or mists is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

DUSTS

ZONE 20 = A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

ZONE 21 = A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

ZONE 22 = A place in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

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EQUIPMENT CATEGORIES AND ZONES

The hazardous area zone classification and corresponding equipment categories are:
ZONE 0 or ZONE 20 -> Category 1 equipment
ZONE 1 or ZONE 21 -> Category 2 equipment
ZONE 2 or ZONE 22 -> Category 3 equipment

Note: Category 1 equipment can also be used in Zones 1 and 21 and Category 1 and 2 equipment can be used in Zones 2 and 22.

Zone of use	ATEX category	IECEx ELP
Zone 0	1G	Ga
Zone 20	1D	Da
Zone 1	2G	Gb
Zone 21	2D	Db
Zone 2	3G	Gc
Zone 22	3D	Dc

GAS AND VAPOURUS – Classifications

Mining	Surface Industy		
Group I	Group II		
Methane (Grisoul)	IIA	IIB	IIC
	Propane	Ethylene	Acetylene
	Acetone	Methyl Ethyl Ketone	Hydrogen
	Toluene	Coal Gas	Carbon Disulphide

Group IIC is the most severe group. Hazards in this group can be ignited very easily indeed. Equipment marked as suitable for Group IIC is also suitable for Group IIB and Group IIA. Equipment marked as suitable for IIB is also suitable for Group IIA but NOT for IIC.

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Ex EQUIPMENT

Group	Surface Industry
IIIA	Combustible flyings
IIIB	Non-conductive dust
IIIC	Conductive dust

The presence of dust layers does not automatically lead to the dust zone. The likelihood of the dust layer being disturbed to create a cloud needs to be considered. Dust layers also need careful consideration in terms of ignition temperature. Because the dust layer can make the equipment under it hotter then normal, a factor of safety is applied to the layer ignition temperature.

EQUIPMENT CATEGORIES AND ZONES

As well as considering the protection against electrical arcs and sparks igniting a flammable atmosphere, consideration needs to be given to the surface temperature of equipment. Flammable materials are categorized according to their ignition temperature. Again, rather than work with an infinite range, six temperature classes are defined as follows:

Temperature Class	Max. Surface Temperature	Ignition Temperature
T1	450°C	>450°C
T2	300°C	>300°C
T3	200°C	>200°C
T4	135°C	>135°C
T5	100°C	>100°C
T6	85°C	>85°C

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Apparatus Groups and Temperature Classes for common flammable gases and vapours:

Gas Group	Temperature Class					
	T1	T2	T3	T4	T5	T6
I	Methane	-	-	-	-	-
IIA	Propane	Ethanol	Heptane	Benzaldehyde	-	-
IIB	Hydrogen	Ethylene	Acryl Aldehyde	Dibutyl Ether	-	-
IIC	Hydrogen	Acetylene	-	-	-	Carbon Disulphide

The bigger the “T” number the lower is the temperature.

The Temperature classification will be marked on items of equipment. If the hazardous area in which you are installing equipment has gases or vapours with a low auto ignition temperature then you will need equipment with a bigger “T” Number so as to ensure that any hot surfaces on the equipment will not ignite the hazard.

For example, if a hazard has an auto ignition temperature of 180°C, then it would be safe to use equipment which is marked T6 or T5 or T4. It would not be safe to use equipment marked T3 or T2 or T1 as this equipment could exhibit surface temperatures, which are hot enough to ignite the hazardous atmosphere.

TEMPERATURE CLASSES FOR COMMON FLAMMABLE DUSTS AND FIBERS

When considering installations that are risk of a potential explosion due to dust ignition, the equipment used is classified in much the same way as with gases. No equipment should be installed where the surface temperature of the equipment is greater than the ignition temperature of the given hazard. Below there are some common dust hazardous and their minimum ignition temperature:

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Ignition Temperatures for Common Flammable Dusts and Fibres		
Substance	Ignition Temperature	
	Cloud	Layer
Sugar	490°C	460°C
Aluminium	590°C	>450°C
Flour	490°C	340°C
Coal dust	380°C	225°C
Methyl Cellulose	420°C	320°C
Grain dust	510°C	300°C
Starch	460°C	435°C
Phenolic Resin	530°C	>450°C
Soot	810°C	570°C

IGNITION SOURCES - Identification and Control

- Flames and hot gases;
- Electric arcs and spark;
- Cutting and welding flames;
- Electrostatic sparks;
- Electromagnetic waves;
- Mechanical friction;
- Mechanical sparks produced by grinding;
- Adiabatic compression and shock waves;
- Optical radiation;
- Electromagnetic radiation;
- Chemical reactions;
- Ultrasonic;
- Direct fired space and process heating;
- Use of cigarettes/matches etc;
- Hot surfaces;
- Heated process vessels such as dryers and furnaces;
- Hot process vessels;
- Space heating equipment;
- Mechanical machinery;
- Electrical equipment and lights;
- Spontaneous heating;
- Friction heating or sparks;

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- Impact sparks;
- Sparks from electrical equipment;
- Stray currents from electrical equipment
- Electrostatic discharge sparks:
- Lightning strikes;
- Electromagnetic radiation of different wavelengths
- Vehicles, unless specially designed or modified are likely to contain a range of potential ignition sources;

Sources of ignition should be effectively controlled in all hazardous areas by a combination of design measures, and systems of work:

- Using electrical equipment and instrumentation classified for the zone in which it is located. New mechanical equipment will need to be selected in the same way;
- Earthing of all plant / equipment;
- Elimination of surfaces above auto-ignition temperatures of flammable materials being handled/stored;
- Provision of lightning protection;
- Correct selection of vehicles/internal combustion engines that have to work in the zoned areas;
- Correct selection of equipment to avoid high intensity electromagnetic radiation sources, e.g. limitations on the power input to fibre optic systems, avoidance of high intensity lasers or sources of infrared radiation;
- Prohibition of smoking/use of matches/lighters;
- Controls over the use of normal vehicles;
- Controls over activities that create intermittent hazardous areas, e.g. tanker loading/ unloading;
- Control of maintenance activities that may cause sparks/hot surfaces/naked flames through a Permit to Work System;
- Precautions to control the risk from pyrophoric scale usually associated with formation of ferrous sulphide inside process equipment.

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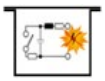
TYPES OF PROTECTION FOR ELECTRICAL EQUIPMENT IN EXPLOSIVE GAS ATMOSPHERES

Types of protection for electrical equipment in explosive gas atmospheres					
Type of protection	**Symbol**	**Zone**	**Diagram**	**Main Application**	**Standard**
Flameproof	d	1, 2		switchgears, control stations, indicating equipment, control systems, motors, transformers, heating equipment, light fittings	IEC 60079-1 EN 60079-1
Increased safety	e	1, 2		junction boxes, control stations for installing Ex-components (with a different type of protection), squirrel-cage motors, light fittings	IEC 60079-7 EN 60079-7
Pressurized	px py pz	1, 2 1, 2 2		switchgear and control cabinets, analyzers, large motors	IEC 60079-2 EN 60079-2
Encapsulation	ma mb mc	0, 1, 2 1, 2 2		switchgear with small capacity, control and signalling units, display units, sensors	IEC 60079-18 EN 60079-18
Powder filling	q	1, 2		sensors, display units, electronic ballasts, transmitters	IEC 60079-5 EN 60079-5
Oil immersion	o	1, 2		transformers, starting resistors	IEC 60079-6 EN 60079-6
Intrinsic safety	ia ib ic	0, 1, 2 1, 2 2		instrumentation technology, fieldbus technology, sensors, actuators [Ex ib] = associated electrical apparatus – installation in the safe area	IEC 60079-11 EN 60079-11
Type of protection 'n'	nA nC nR	2 2 2		all electrical equipment for Zone 2 nA = non-sparking device nC = sparking devices and components nR = restricted breathing enclosures	IEC 60079-15 EN 60079-15
Optical radiation	op is op pr op sh	0, 1, 2 1, 2 1, 2		op is = inherently safe optical radiation op pr = protected optical radiation op sh = optical radiation interlock	IEC 60079-28 EN 60079-28

Ex Regulation

TYPES OF PROTECTION FOR ELECTRICAL EQUIPMENT IN EXPLOSIVE DUST ATMOSPHERES

Types of protection for electrical equipment in explosive dust atmospheres					
Protection by enclosure	ta tb tc	20, 21, 22 21, 22 22		switchgear, control stations, junction boxes, control boxes, motors, light fittings	IEC 60079-31 EN 60079-31
Pressurized	p	21,22		switchgear and control cabinets, motors	IEC 61241-4 EN 61241-4
Encapsulation	ma mb mc	20, 21, 22 21,22 22		switchgear with small capacity, control andsignalling units, display units, sensors	IEC 60079-18 EN 60079-18
Intrinsic safety	ia ib ic	20, 21, 22 21,22 22		instrumentation technology, fieldbus technology, sensors, actuators [Ex ib] = associated electrical apparatus – installation in the safe area	IEC 60079-11 EN 60079-11

Ex d “Flameproof Enclosures”
Parts that can ignite an explosive atmosphere are contained within an enclosure into which the explosive atmosphere can enter but which will contain any resultant explosion and prevent its transmission outside of the enclosure.

Ex p “Pressurized Equipment”
The ingress of an explosive atmosphere in a housing containing electrical equipment, is avoided by maintaining a protective gas (air or an inert gas) at a slight overpressure to the surrounding atmosphere. The overpressure may or may not be maintained by continuous flow.

Ex q “Powder Filling” / “Sand encapsulation”
All equipment that has the potential to arc or to spark is contained within an enclosure filled with quartz or glass powder particles. The powder filling prevents the possibility of an ignition.

Ex o “Oil Immersion”
Electrical equipment or parts of it are immersed in oil, thus avoiding ignition of the explosive atmosphere above the oil surface or outside the housing. This protection method is rarely applied now.

Ex e “Increased Safety”
This protection method refers to equipment that does not ordinarily produce sparks and for which special precautions must be taken during construction. Unacceptably high temperatures must also be avoided, during both regular operation and certain irregular situations.

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Ex i “Intrinsic Safety”
Intrinsic safety is intended for products in which the level of electrical energy circulating or stored in the product is insufficient to ignite a surrounding explosive atmosphere even under fault conditions. Because of the method by which intrinsic safety is achieved it is necessary to ensure that not only the electrical apparatus exposed to the potentially explosive atmosphere but also other electrical apparatus with which it is interconnected, is suitably constructed.

Ex m “Encapsulation”
With this protection method all parts that may ignite an explosive atmosphere, are encapsulated in a resin that is sufficiently resistant to ambient influences. The atmosphere must neither be ignited by sparks, nor by heating inside the encapsulation.

Ex n “Non-Sparking”
A type of protection where precautions are taken so that electrical equipment that has the potential to arc is not capable of igniting a surrounding explosive atmosphere. This can be further categorized as follows:
Ex nA - Where components used in construction are no sparking;
Ex nC - Where components used in construction are non-incendive;
Ex nR - Where components used are tightly enclosed to restrict the breathing and prevent ignition.

Ex op “Optical Radiation”
This is primarily concerned with the control of pulsed and continuous wave optical radiation through fiber optic cable with restrictions on the ratio of emitted optical power to the irradiated area. The protection concepts include Inherently Safe, which is analogous to Ex i and provides over-power/energy fault protection. Other methods include mechanical protection of the fiber and optical interlocks.

Ex t “Dust Protection by Enclosures”
This method is applicable to electrical equipment protected by enclosure and surface temperature limitation for use in explosive and dust atmospheres.

Ex Regulation

IP – Ingress Protection

What is IP code?
The IP code or Ingress Protection is used to define levels of sealing effectiveness of enclosures against intrusion from foreign matter and moisture.

The IP number is composed of two numbers, the first referring to the protection against solid objects and the second against liquids. The higher the number - the better the protection.
The IP code IPXX means that the type of protection is not defined because the electrical equipment has not been subjected to testing. If the IP code is not stated, then the electrical equipment is protected in accordance with IP20.

The IP codes refer only to:
- Solid foreign objects and dust;
- Water and moisture.

IP Codes = Ingress Protection - Protection of the equipment			
First Number		Second Number	
0	No protection at all against solid objects (Sometimes X)	0	No protection against liquid object (Sometimes X)
1	Protected against solid objects up to 50mm^2	1	Protection against vertically falling drops of water
2	Protected against solid objects up to 12mm^2	2	Protection against direct sprays of water up to 15° from vertical
3	Protected against solid objects up to 2.5mm^2	3	Protection against direct sprays of water up to 60° from vertical
4	Protected against solid objects up to 1mm^2	4	Protection against water splashed from all directions - limited ingress permitted
5	Complete protection against contact and dust deposit (no harmful deposit)	5	Protected against low pressure jets of water from all directions- limited ingress permitted
6	Complete protection against contact and from infiltration of dust	6	Protected against powerful jets of water or heavy seas - limited ingress permitted
		7	Protected against the effect of immersion- between 15cm and 1m for 30 minutes
		8	Protected against long periods of immersion under pressure - user stated requirement

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GENERAL COMPARISON BETWEEN IEC / CENELEC AND NEC PRACTICE

Classification of Zones and Divisions				
Dangerous explosive atmosphere		**Continuously, long term or frequently**	**Occasionally**	**Not likely to occur and for short period only**
Gas	IEC / CENELEC / NEC 505	Zone 0	Zone 1	Zone 2
	NEC 500 (Class I)	Division 1		Division 2
Dust	IEC / CENELEC / NEC 506	Zone 20	Zone 21	Zone 22
	NEC 500 (Class II, III)	Division 1		Division 2

NEC 500 SCOPE

Articles 500 through 504 cover the requirements for electrical and electronic equipment and wiring for all voltages in Class I, Divisions 1 and 2; Class II, Divisions 1 and 2; and Class III, Divisions 1 and 2 locations where fire or explosion hazards may exist due to flammable gases, flammable liquid–produced vapors, combustible liquid–produced vapors, combustible dusts, or ignitable fibers/flyings.

NEC 505 SCOPE

Article 505 is an alternative to the method of area classification for Class I locations as permitted in Article 500. The Zone Classification System is based on that of the International Electrotechnical Commission (IEC).

NEC 506 SCOPE

Article 506 is an alternative Classification System to Class II, and Class III that is based on the International Electrotechnical Commission System (IEC). Zones 20, 21 and 22 apply to combustible dusts or ignitable fibers/flyings. Combustible metallic dusts are not covered by Article 506.

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GENERAL COMPARISON BETWEEN IEC / CENELEC AND NEC PRACTICE

Groups			
IEC / CENELEC / NEC 505		NEC 500	
Group I	Mines susceptible to firedamp		-
	Methane		
GROUP II Subdivisions	Explosive gas atmosphere Typical gas		Class I Subdivisions
IIA	Propane	Propane	Class I Group D
IIB	Ethylene	Ethylene	Class I Group C
IIC	Hydrogen	Hydrogen	Class I Group B
IIC	Acetylene	Acetylene	Class I Group A
GROUP III Subdivisions	Explosive dust atmosphere Typical dust		Class II / III Subdivisions
IIIA	Combustible flyings	fibers / flyings	Class III
IIIB	non-conductive dust	non-conductive dust	Class II Group G
IIIC	conductive dust	carbonaceous dust	Class II Group F
		combustible metal dust	Class II Group E

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Temperature classification		
IEC / CENELEC / NEC 505	NEC 500	Maximum surface temperature
T1	T1	450°C
T2	T2	300°C
-	T2A	280°C
-	T2B	260°C
-	T2C	230°C
-	T2D	215°C
T3	T3	200°C
-	T3A	180°C
-	T3B	165°C
-	T3C	160°C
T4	T4	135°C
-	T4A	120°C
T5	T5	100°C
T6	T6	85°C
Dust: indication of the maximum surface temperature in °C (e.g. T135°C)		

Ex Regulation

EQUIPMENT MARKING

1 EU type-examination certificate

ID No.	Notified Body		Country
0080	INERIS	INE	FR

2 3 Conditions in potentially explosive areas ATEX 2014/34/EU

Explosive Atmosphere	Behavior flammable substances in the Ex area	Categorization of the potentially explosive areas	Required of the used items in accordance with CENELEC		EPL
			Equipment group	Equipment category	Equipment protection level
Coal mine atmosphere	Parts at coal mines endangered by firedamp and/or combustible dust		I	M1	Ma
			I	M2	Mb
Atmosphere from Gas / Liquid / Fog	Continuous, long periods, frequent	Zone 0	II	1G	Ga
	Occasional	Zone 1	II	2G	Gb
	Normally not, only for a short period	Zone 2	II	3G	Gc
Dust atmosphere	Continuous, long periods, frequent	Zone 20	II	1D	Da
	Occasional	Zone 21	II	2D	Db
	Normally not, only for a short period	Zone 22	II	3D	Dc

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4 Ex identification acc. to standard (i.e.)

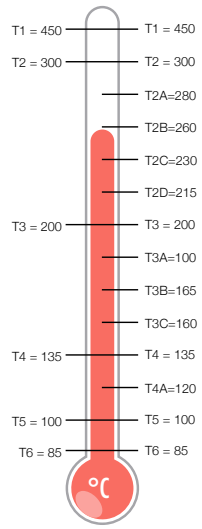
Ex db IIB+H_2	EN/IEC 60079-1	Installation in Ex area	Equipment

4 Protection Type (See the table page 53 / 54)

5 Gas and dust groups

Typical gas / dust	Identification
Methane	I
Propane	II A
Ethylene	II B
Hydrogen	II C or IIB+H_2
Combustible flyings	III A
Non-conducting dust	III B
Conducting dust	III C

6 Permissible surface temperature

Temperature class	Gas	Ignition temperature
	Ammonia	630°
	Methane	595°
	Hydrogen	560°
	Propane	470°
	Ethylene	425°
	Butane	365°
	Acetylene	305°
	Cyclohexane	259°
	Diethyl ether	170°
	Carbon disulfide	95°

Ex Regulation

INSTALLATIONS OF CABLE GLANDS IN HAZARDOUS AREAS

(Extract from IEC/EN 60079-14 : 2014)

Clause 10.2 Selection of Cable Glands

The cable entry system shall comply with one of the following:

a) Cable **glands sealed** with setting compound (barrier cable glands) in compliance with IEC 60079-1 and certified as equipments;

b) Cables and **glands** meeting all of the following:
- cable glands comply with IEC 60079-1 and are certified as equipment
- cables used comply with 9.3.2(a) [sheathed with thermoplastic, thermosetting, or elestomeric material. They shall be circular and compact. Any bedding or sheath shall be sxtruded. Fillers, if any, shall be non-hygroscopic.]
- the connected cable is at least 3 m in length;

c) indirect cable entry using combination of flameproof enclosure with a bushing and increased safety terminal box (required **glands sealed**);

d) mineral-insulated metal-sheathed cable with or without plastic outer covering with appropriate flameproof cable gland complying with IEC 60079-1 (required **glands sealed**);

e) flameproof sealing device (for example a sealing chamber) specified in the equipment documentation or complying with IEC 60079-1 and employing a cable gland appropriate to the cables used. The sealing device shall incorporate compound or other appropriate seals which permit stopping around individual cores. The sealing device shall be fitted at the point of entry of cables to the equipment. (required **glands sealed**).

NOTE 1 The minimum length of cable is to minimize the potential for flame transmission through the cable (see also Annex E);

NOTE 2 If the cable gland and actual cable are certified as a part of the equipment (enclosures) then compliance to 10.6.2 is not necessary. (Source: IEC 60079-14:2013 Ed.5).

Annex E (informative)

Restricted breathing test forcables

E.1 Test procedure

A piece of cable with a length of 0,5 m should be type tested when installed into a sealed enclosure of 5 l (+/– 0.2 l), under constant temperature conditions. The cable is considered acceptable if the time interval required for an internal overpressure of at least 0,3 kPa (30 mm water gauge) to drop by 0,15 kPa (15 mm water gauge) is not less than 5 s. The enclosure must be completely tight to avoid pressure loss through the enclosure gaps.

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To provide a better understanding of the older and new standard with regards to the use of barrier glands, a few examples are shown below. The following four situations involve a flameproof motor starter and a flameproof motor connected via an cable meeting the requirements of direct entry into a flameproof enclosure:

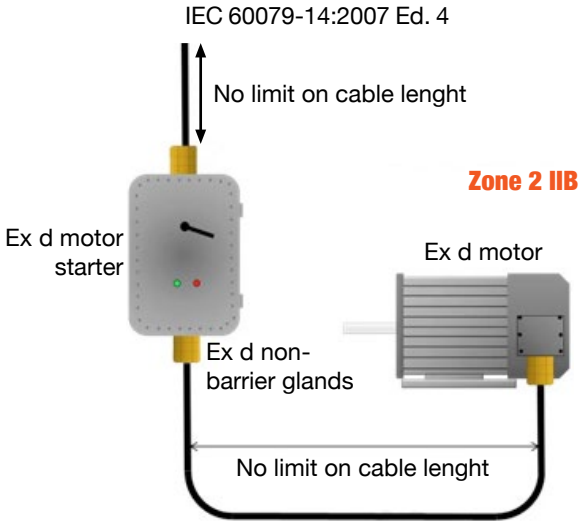

Figure 1: The use of non-barrier glands for direct entry into Ex d enclosures per IEC 60079-14:2007 4th Ed. Note that the use of non-barrier glands are acceptable even into Ex d arcing/sparking enclosures if the environment is Zone 2, IIB.

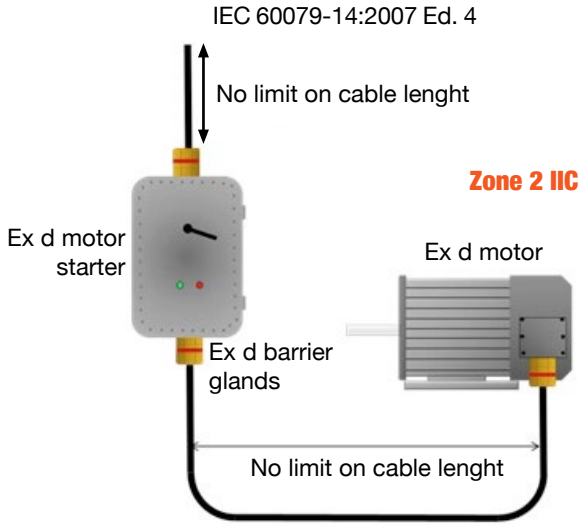

Figure 2: The use of barrier glands for direct entry into Ex d enclosures per IEC 60079-14:2007 4th Ed. Note that the use of barrier glands are required for all Ex d enclosures housing arcing/sparking components in a IIC environment (or also in a Zone 1 IIB if the enclosure volume is greater than 2 liters).

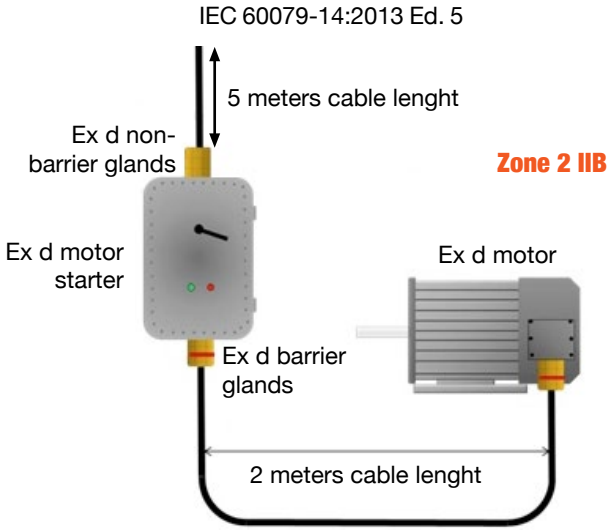

Figure 3: The use of barrier glands and non-barrier glands for direct entry into Ex d enclosures per IEC 60079-14:2013 5th Ed. Note the issue with cable length is now the critical factor of more or less than 3 meters, not the area classification or gas group.

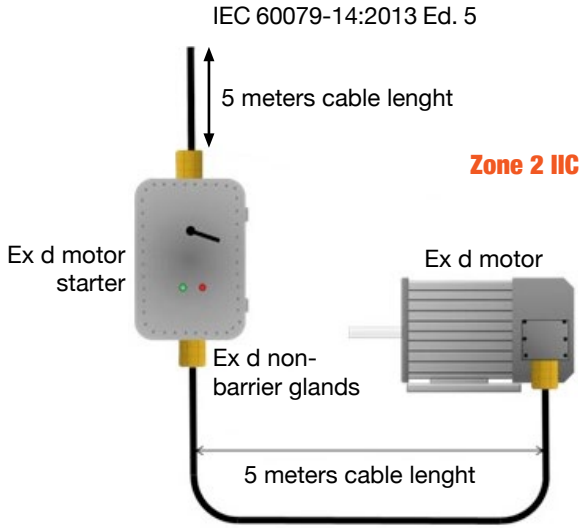

Figure 4: The use of non-barrier glands for direct entry into Ex d enclosures per IEC 60079-14:2013 5th Ed. Note the use of non-barrier glands even in a Zone 1 IIC environment with the connecting cable lengths exceed the 3 meter rule.