

Apparatus Classification

The German term “explosions-geschützt” (frequently translated as “explosion-proof”) is used also to denote apparatus protected otherwise than by means of an explosion-proof case. Such other methods include those described in the code under the definitions of “Intrinsically Safe apparatus”, “Pressurised apparatus”, and “Type e apparatus”.

Markings for Hazardous area apparatus are vitally important, as these indicate:

- Zone class
- Gas group
- Temperature class
- Protection type, i.e. Ex “d” or Ex “e”
- Voltage

- Maximum wattage lamp
- Manufacturer and Catalogue number
- Test Authority approval number.

Most importantly the “Test Authority” is indicated. It is illegal to market a light fitting without a certificate. The inability of the vendor to supply this certificate probably means the goods are not in accordance with their claims and the onus rests with the purchaser to protect himself and his installation.

Temperature limits are also indicated on the label so that the matching of ignition temperatures and light fitting limitations can be assessed for suitability. If the light fittings are not switched external to the hazardous area, a flame proof isolating switch must be used which cuts both the live and neutral i.e. two pole.



NOTE:

Hazardous Area Certified products are approved on a country specific basis.

Please contact Hella for details.

Flameproof (FLP) and Explosion Proof (Ex d)

Flame Proof (FLP) is of UK origin and Explosion Proof (Ex “d”) is of German origin. They share two common features:

- Heavy cast components and
- Very thick lenses, the manufacture of which is strictly specified and controlled.

Most flameproof housings are made of cast iron, phosphor bronze or brass, primarily for underground use. Aluminium alloy Ex d lights can only be considered for surface use. Lamp protection is usually by means of a glass dome, however, polycarbonate has recently been allowed.

As is evident from the materials used in the construction of these lights, there is sufficient mechanical strength to withstand an explosion of gas within the light fitting without damage. The ignition (by arcs, sparks, or explosions that occur inside the case) of a specific gas or vapour surrounding the enclosure by escaping flames or hot gasses is also prevented. When the light is operating, the external surface temperature is never high enough to ignite a prescribed gas or vapour-air mixture.

The flanged joints are accurately machined, with the width of the flange determined by the volume and group of the enclosure. The glass

is in turn cemented and clamped into position to ensure the strength of the housing.

As the material of the body is metal, earth continuity is essential and the correct glanding must be strictly adhered to. Unused entries must be plugged. This seems an obvious statement, but often during maintenance or installation, small modifications can occur which may result in unused entries being left open. The means of mounting is always external to the enclosure and the joint is lightly coated with a protective grease. Electrical components are of normal construction, similar to those used in unprotected apparatus.

Increased Safety - Ex e

These light fittings are not generally used in underground mines due to their much lighter construction. The materials used are normally glass-fibre-reinforced polyester, aluminium alloy or glass and stainless steel.

Special care is taken to ensure that there is absolutely no risk of producing electrical sparks, arcs or excessive temperature in normal operation. This is achieved through high quality insulation, electrical connections without the possibility of loose terminations and special construction of low temperature control gear and lamps.

It is not only the surface temperature in this type of fitting that is important but also the surface temperature of each individual component inside the light fitting.

Type Ex "e" glands must be used and earth continuity provided for when steel armoured cable is used. For flexible or sheathed cable, Ex e compression glands are to be used.

The minimum required IP rating for Type Ex e lamps is IP 54, although most have a higher rating. Lamp protection is either by means of armoured plate glass, a very thick borosilicate glass dome, or a polycarbonate lens.

A step down from Ex d and Ex e is Ex n (commonly known as non-sparking,

a term which describes the method of construction). These light fittings would be used in Zone 2 locations where the degree of hazard is lower. Of fibre-glass-reinforced polyester or polycarbonate design, they have slightly lower insulation and creepage distances than the Ex e on lampholders and terminal blocks.

Other types of apparatus include:

- *Ex r – Non-sparking apparatus*
Apparatus that in normal operation, and in the absence of electrical or mechanical failure, does not spark or arc or develop temperatures high enough to ignite a prescribed gas or vapour/air mixture
- *Dust-ignition-proof apparatus*
Apparatus so enclosed as:
 - a) to prevent the entry of enough dust to be ignited or to impair the performance of the apparatus, and
 - b) to prevent arcs, sparks, and heat, generated or liberated in the enclosure by other means, from igniting accumulations of a dust on the outside of the enclosure and atmospheric suspensions of a dust in the vicinity of the enclosure.

In each case the degree of protection of the housing or enclosure must be indicated.

Intrinsically Safe - Ex i

Intrinsically Safe Ex "i" equipment is designed to limit the amount of energy in an electrical circuit to a safe level below what is required to ignite an explosive gas/vapour mixture. Even under fault conditions the system must maintain the energy level below the required threshold.

This system offers some major operational advantages over Ex d and Ex e type technology because loads and cables can be connected and disconnected "live" without the need to first isolate the whole circuit. The SELV nature of Ex i systems also removes the risk of electrical shock, making this system very attractive for use in applications where people and electrical

equipment must operate in close proximity in hazardous areas.

The method to limit the energy requires highly robust regulation of both the maximum voltage and maximum current in the circuit. Some limited scope for a trade-off between current and voltage can be applied on a case-by-case basis to best meet the need of the particular load that needs to be powered, however, absolute maxims of voltage and current that cannot be exceeded is specified in the IEC 60079 regulations.

The design of the regulation circuits, barriers,

cables, connectors, and the loads, is tightly specified in IEC 60079. The practical outcome is that only low powered devices of less than 30W with no inductive or capacitive components can be approved to the requirements of Ex i.

Power supplies require double-redundant barrier circuits for use in Zone 1 areas, and triple-redundant systems in Zone 0. This and several other aspects of the Intrinsically Safe system ensures that it can tolerate a wide combination of internal and external fault conditions simultaneously, without creating a hazard.

Special Systems

No mention has been made of some of the more specific forms of protection which are available. Light fittings such as those driven by compressed air and suitable for Zone 0 locations are categorised Ex "s", as they are specially designed and pressure positive.

Other light fittings or components can be classified under the following designations:

- Encapsulated - Ex "m"
- Pressured or purged - Ex "p"
- Sand filled - Ex "q"

Light fittings must be checked and serviced regularly and special care must be taken when relamping to see that machine faces are not corrosion pitted or gaskets damaged.

Also, checks are required to ensure that glands are still tight and not corroded and that the sealing screws and devices are all tightly replaced and none missing.

IEC 79-14 of 1984 covers most of the pitfalls in the wiring of electrical apparatus for explosive gas atmospheres.

Classification of Apparatus by Gas Group, Temperature Class and Gas/Vapour Type

Temperature Classes						
Gas Group Classification	450° C - T1	300°C - T2	200°C - T3	135°C - T4	100°C - T5	85°C - T6
I for use underground in mines in the presence of Methane (fire damp)		Methane				
IIA For use above ground, and subdivided according to their suitability for use in atmospheres containing specific gases and vapours as identified in the the subgroups.	Ammonia Carbon Monoxide Chlorobenzine Pentane	Xylene Acetone Ethanol Propane Methanol Ethylacetate Benzene Amylacetate n-Butyl Alcohol n-Butane	Cyclohexane Diesel Aviation Fuel n-Propul Alcohol	Heptane Hexane		
IIB	Coal Gas	Ethylene Buta 1:3 Diene		Diethyl Ether		
IIC	Hydrogen		Acetylene			Carbon Sulphide

*Apparatus classified in a temperature class is deemed to be suitable for use in gases and vapours appropriate to that and all lower temperature classes. For instance, a lamp reaching a temperature of 130 °C would be marked T4. That temperature would not ignite the gases or vapours in the T4 row; neither would it ignite the gases or vapours in the T3, T2 or T1 rows. However, that temperature would ignite gases or vapours in the T5 or T6 rows, such as carbon disulphide.

Classification of Apparatus Protection Type

IECEx Standard		Protection Type	Protection Type Code		Hazard Zone Class	
Gas	Dust		Gas	Dust	Gas	Dust
60079-0	61241-0	General Information				
60079-1	61241-1	Flameproof	Ex d	Ex tD	1	20
60079-2	61241-2	Pressurized	Ex p	Ex pD	1	21
60079-5	–	Powder filled	Ex q		1	–
60079-6	–	Oil filled	Ex o	–	1	–
60079-7	–	Increased safety	Ex e	–	1	–
60079-11	61241-11	Intrinsic safety	Ex ia	Ex iaD	0	20
			Ex ib	Ex ibD	1	21
60079-15	–	Non sparking	Ex nA	–	2	–
		Energy limited	Ex nL			
		Restricted breathing	Ex nR			
		Enclosed break	Ex nC			
		Pressurized	Ex nP			
60079-18	61241-18	Encapsulation	Ex ma	Ex maD	0	20
			Ex mb	Ex mbD	1	21