Hazardous areas are defined by three main criteria:

- The type of hazard
- The likelihood of the hazard being present in flammable concentrations
- The (auto) ignition temperature of the hazardous material

The type of hazard (Groups)

The hazard will be in the form of a gas, vapor, dust or fiber.

Gases and Vapors

Gases and vapors are categorized in terms of their ignition energy or the maximum experimental safe gap (in respect of flameproof protection). This categorization leads to the Gas Groups:

Mining	Surface Industry		
Group I	Group II		
Methane	IIA	IIB	IIC
	Propane	Ethylene	Hydrogen

(The gases noted in the table are typical gases for each group.)

Group IIC is the most severe group. Hazards in this group can be ignited very easily indeed.

Dusts and Fibers (Group III)

Dusts and fibers are also defined in terms of their ignition properties including dust cloud ignition properties.

The likelihood of the hazard being present in flammable concentrations (Zones)

The likelihood of the hazard being present in flammable concentrations will vary from place to place. A location very close to an open source of hazard will have a high likelihood of a flammable atmosphere. On the other hand, outside a flanged pipe containing a flammable liquid, the likelihood of a

flammable atmosphere being present is much lower since it will only occur if the flange leaks. Rather than work with an infinite range of possibilities, three zones are defined.

Gases and Vapors

There are three zones for gases and vapors:

Zone 0	Flammable atmosphere highly likely to be present - may be present for long periods or even continuously
Zone 1	Flammable atmosphere possible but unlikely to be present for long periods
Zone 2	Flammable atmosphere unlikely to be present except for short periods of time - typically as a result of a process fault condition.

Zone zero is the most severe zone (the highest probability of flammable atmosphere presence). Equipment for this zone needs to be very well protected against providing a source of ignition.

Dusts

There are three zones for dusts:

Zone 20	Dust cloud likely to be present continuously or for long periods
Zone 21	Dust cloud likely to be present occasionally in normal operation
Zone 22	Dust cloud unlikely to occur in normal operation, but if it does, will only exist for a short period

(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 than normal, a factor of safety is applied to the layer ignition temperature.)

The (auto) ignition temperature of the hazardous material (Temperature Classes)

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. (Most electrical apparatus dissipates some heat!) Flammable materials are categorized according to their ignition temperature. Again, rather than work with an infinite range, six temperature

classes are defined as follows:

T-Class	Hazards which will not ignite at temperatures below:
T1	450°C
T2	300°C
T3	200°C
T4	135°C
T5	100°C
T6	85°C

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 vapors 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 T1as this equipment could exhibit surface temperatures which are hot enough to ignite the hazardous atmosphere.

Don't forget that, unless the certification documents state otherwise *(in which case there will be an addition to the T-Classification code on the equipment label such as T4 (60°C Amb))* the equipment is only certified in ambient temperatures up to 40°C. If exposed to higher temperatures there are two possible dangers. First the stated T-Class temperature may be exceeded and secondly safety components within the equipment could fail to an unsafe condition. If you expect equipment to be subjected to temperatures above 40°C (such as in direct sunshine or in a roof space) you should install equipment which is certified for a higher ambient temperature.

Protecting Electrical Apparatus to make it suitable for use in hazardous areas

Electrical apparatus for use in hazardous areas needs to be designed and constructed in such a way that it will not provide a source of ignition. There are ten recognized types of protection for hazardous area electrical apparatus. Each type of protection achieves its safety from ignition in different ways and not all are equally safe. In addition to the equipment being suitable for the Gas Group and the Temperature Class required, the type of

protection must be suitable for the zone in which it is to be installed. The different types of protection and the zones for which they are suitable are as follows:

Type of Protection for Gas / Vapor Hazards

Equipment Code	Description	Suitable for zones...
Ex ia	Intrinsic safety 'ia'	0, 1, 2
Ex ib	Intrinsic safety 'ib'	1,2
Ex ic	Intrinsic Safety 'ic'	2
Ex d	Flameproof protection	1,2
Ex p	Purge/pressurized protection	1,2
Ex px	Purge/pressurized protection 'px'	1,2
Ex py	Purge/pressurized protection 'py'	1,2
Ex pz	Purge/pressurized protection 'pz'	2
Ex e	Increased safety	1,2
Ex m	Encapsulation	1,2
Ex ma	Encapsulation	0,1,2
Ex mb	Encapsulation	1.2
Ex o	Oil immersion	1,2
Ex q	Sand / powder (quartz) filling	1,2
Ex n	Type - n protection	2
Ex s	Special protection	Normally 1 and 2

Equipment complying with European (CENELEC) standards will frequently bear the code EEx (as opposed to Ex) But note that the use of EEx is being phased out for equipment designed and certified to the latest editions of the European Standards.

Types of Protection for Equipment for Dust Hazard Locations

Equipment Code	Description	Suitable for Zones...
tDA20	Protection by enclosure	20, 21, 22
tDB20	Protection by enclosure	20,21,22
iaD	Intrinsic Safety	20,21,22
maD	Encapsulation	20,21,22
tDA21	Protection by enclosure	21,22
tDB21	Protection by enclosure	21,22

ibD	Intrinsic Safety	21,22
mbD	Encapsulation	21,22
pD	Pressurization	21,22
tDA22	Protection by enclosure	22
tDB22	Protection by enclosure	22
icD	Intrinsic Safety	22

Equipment Protection Levels - EPL

From 2007 onwards, the IEC Technical Standards in the series IEC 60079, and in particular IEC 60079 Part 14, have recognized that there may be occasions where it is necessary to increase, above the normal levels, the protection against ignition sources. This concept allows for consideration of risk (i.e. consequences of an explosion) as opposed to just the probability of a flammable atmosphere existing - the conventional selection criteria between the types of protection and the zone of use.

Three Equipment Protection Levels are specified as shown in the table below.

In normal circumstances the effect of these EPLs will be to retain the normal zone/equipment protection relationship. If, however, the risk is considered especially severe, then the required EPL for the zone may be increased. Similarly, if the risk is deemed to be especially small or negligible, the EPL may be reduced from the norm.

The following two tables show the normal relationship between EPL and zone, and the EPL awarded to each type of protection.

Equipment Protection Level (EPL)	Normal Applicable Zone(s)
Ga	0 (and 1 and 2)
Gb	1 (and 2)
Gc	2

Equipment Code	Description	EPL
Ex ia	Intrinsic safety 'ia'	Ga
Ex ib	Intrinsic safety 'ib'	Gb
Ex ic	Intrinsic Safety 'ic'	Gc
Ex d	Flameproof protection	Gb
Ex p	Purge/pressurized protection	Gb

Ex px	Purge/pressurized protection 'px'	Gb
Ex py	Purge/pressurized protection 'py'	Gb
Ex pz	Purge/pressurized protection 'pz'	Gc
Ex e	Increased safety	Gb
Ex m	Encapsulation	Gb
Ex ma	Encapsulation	Ga
Ex mb	Encapsulation	Gb
Ex o	Oil immersion	Gb
Ex q	Sand / powder (quartz) filling	Gb
Ex n	Type - n protection	Gc
Ex s	Special protection	Refer to equipment marking and documentation

For dust hazards, the EPLs are as follows:

Equipment Protection Level (EPL)	Normal Applicable Zone(s)
Da	20 (and 21 and 22)
Db	21 (and 22)
Dc	22

Standards

There are various standards which give details of hazardous area requirements. In the main, the IEC standards are now parallel voted by CENELEC (Europe). New standards are being introduced at a bewildering rate and it is always worth checking against, for example, the BSI website. (See Useful Links Page)

It is important for equipment designers to design to the latest edition of ATEX harmonized standards - the up to date list can be found on the EC ATEX website. (See Useful Links Page)

Gradually, the technical standards for the technology for gas/vapor hazards and those for dust hazards are being incorporated into the same series. For example IEC 60079-10 covers area classification IEC 60079-10-1 deals with gas/vapor hazards and IEC 60079-10-2 deals with dust hazards. Similar numbering will apply for other aspects such as installation.

Top level standard

EN1127-1 Explosive atmospheres: Explosion prevention and protection

Standards for Equipment

IEC 60079- ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES

Standards for Installation etc. (gases and vapors)

IEC 60079- ELECTRICAL APPARATUS FOR EXPLOSIVE GAS ATMOSPHERES

Standards for Dust Hazard Equipment and Installation

IEC 61241 ELECTRICAL APPARATUS FOR USE IN THE PRESENCE OF COMBUSTIBLE DUST

ATEX Directives