IEC Standards and the Use of Equipment in Explosive Atmospheres

There are now a number of IEC standards[1], in particular the 60079 series, that cover the use of equipment in explosive atmospheres and are recognised in most countries around the world including the USA. The acceptance of these international standards has made it possible to carry out hazardous area classification and select appropriate electrical equipment using the same approach in most countries around the world.

These standards apply to explosive atmospheres - a mixture with air, under atmospheric conditions of flammable substances in the form of gas, vapour, mist, dust, fibres or flyings which, after ignited, permits self-sustaining flame propagation. Where atmospheric conditions are defined as "conditions that include variations in pressure and temperature above and below reference levels of 101.3 kPa and 20°C, provided that the variations have negligible effect on the explosive properties of the flammable materials".

It is important to note that whilst explosive atmospheres obviously exist outside the conditions used in the definitions, the standards do not apply to conditions other than those covered by the definitions. These rather narrow definitions have almost certainly arisen for a number of historic reasons but for the purposes of a risk assessment it will be necessary to go beyond these definitions and look at all hazardous conditions.

The new IEC standards for hazardous area classification recognise that this exercise constitutes a formal part of a risk assessment but does not take into account the consequences of an explosion nor does it cover all the risks associated with equipment use in explosive atmospheres particularly those that lie outside the narrow definitions contained within the standards. The required risk assessment is therefore more extensive than a hazardous area classification.

IEC-60079-0 introduces some important new concepts and there are now some differences between the requirements of the standards and the requirements of the EU ATEX Directive 94/9/EC as shown in the table below.

IEC 60079-0		**EU Directive 94/9/EC**		**IEC 60079-10-X**
Equipment Protection Level	Group	Equipment Group	Equipment Category	Zones
Ma	I	I	M1	NA
Mb			M2	
Ga	II	II	1G	0
Gb			2G	1
Gc			3G	2
Da	III		1D	20
Db			2D	21
Dc			3D	22

[1] The IEC standards are identical to the EN standards of the same number.

Equipment Protection Level (EPL) is defined by IEC 60079-0 as – "level of protection assigned to equipment based on its likelihood of becoming a source of ignition and distinguishing the differences between explosive gas atmospheres, explosive dust atmospheres, and the explosive atmospheres in mines susceptible to firedamp. The primary intent of EPLs is to allow flexibility in the use of equipment in the various zones. For example it may be appropriate to use Gc equipment in a Zone 1 where the quantity of flammable is small and the location is unmanned virtually all of the time. Conversely Gb equipment may be selected in a Zone 2 to allow this equipment to be used in the event of a persistent emergency condition. IEC 60079-14 explains in detail how to use EPLs in a risk assessment.

In IEC 60079-0 a group III has been created for dusts. This is to allow the recognition of conductive and non-conductive dusts and flyings. This brings European and American practice into line. The three categories are defined below.

Dusts and Flyings	
IIIA	Combustible flyings
IIIB	Non-conductive dusts Electrical resistivity > $10^3\Omega m$
IIIC	Conductive dusts Electrical resistivity < $10^3\Omega m$

IEC 60079-10-2 (covering hazardous area classification for dusts) defines a combustible dust as "finely divided solid particles, 500 μm or less in nominal size, which may be suspended in air, may settle out of the atmosphere under their own weight, can burn or glow in air, and may form explosive mixtures with air at atmospheric pressure and normal temperatures".

IEC 60079-10-2 defines combustible flyings as "solid particles, including fibres, greater than 500 μm in nominal size, which may be suspended in air, may settle out of the atmosphere under their own weight, can burn or glow in air, and may form explosive mixtures with air at atmospheric pressure and normal temperatures." Examples of fibres and flyings include rayon, cotton (including cotton linters and cotton waste), sisal, jute, hemp, cocoa fibre, oakum, and baled waste kapok.

IEC 60079-10-1 (covering hazardous area classification for gases) introduces a formal assessment for the impact of ventilation as shown in the table below. It is important to note that this breaks the link between the grade of release and the hazardous zone. The degree of ventilation and the availability of ventilation is defined in the standard.

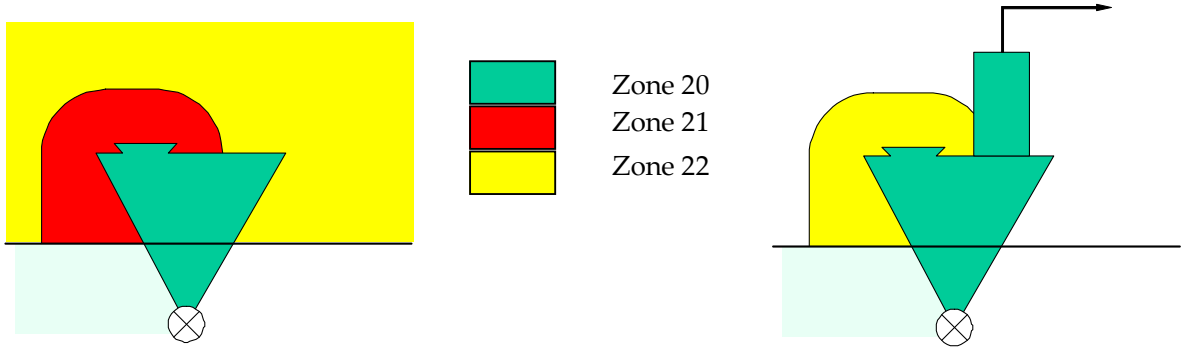
Grade of Release	Degree of Ventilation						
	High			Medium			Low
	Availability of Ventilation						
	Good	Fair	Poor	Good	Fair	Poor	Good, fair or poor
Continuous	(Zone 0 NE) NH	(Zone 0 NE) Zone 2	(Zone 0 NE) Zone 1	Zone 0	Zone 0+Zone 2	Zone 0+Zone 1	Zone 0
Primary	(Zone 1 NE) NH	(Zone 1 NE) Zone 2	(Zone 1 NE) Zone 2	Zone 1	Zone 1+Zone 2	Zone 1+Zone 2	Zone 1 or 0†
Secondary	(Zone 2 NE) NH	(Zone 2 NE) NH	Zone 2	Zone 2	Zone 2	Zone 2	Zone 1 or 0†

Notes

1. NH = Non-hazardous
2. NE = Negligible extent. In each case a theoretical zone would exist but of negligible extent.
3. "+" symbol indicates surrounded by
4. "†" There will be a Zone 0 if the ventilation is so weak and the release is such that in practice an explosive gas atmosphere exists virtually continuously i.e. approaching a no ventilation condition.

IEC 60079-10-1 also gives a method for calculating the extent of gas zones but unfortunately personal experience has shown that this calculation method is very difficult to use. Personal discussions with the Health and Safety Laboratories at Buxton suggest that this calculation method is inappropriate and not based on the most up to date methods. The standard also gives some simple rules for the extent of zones which are much easier to use.

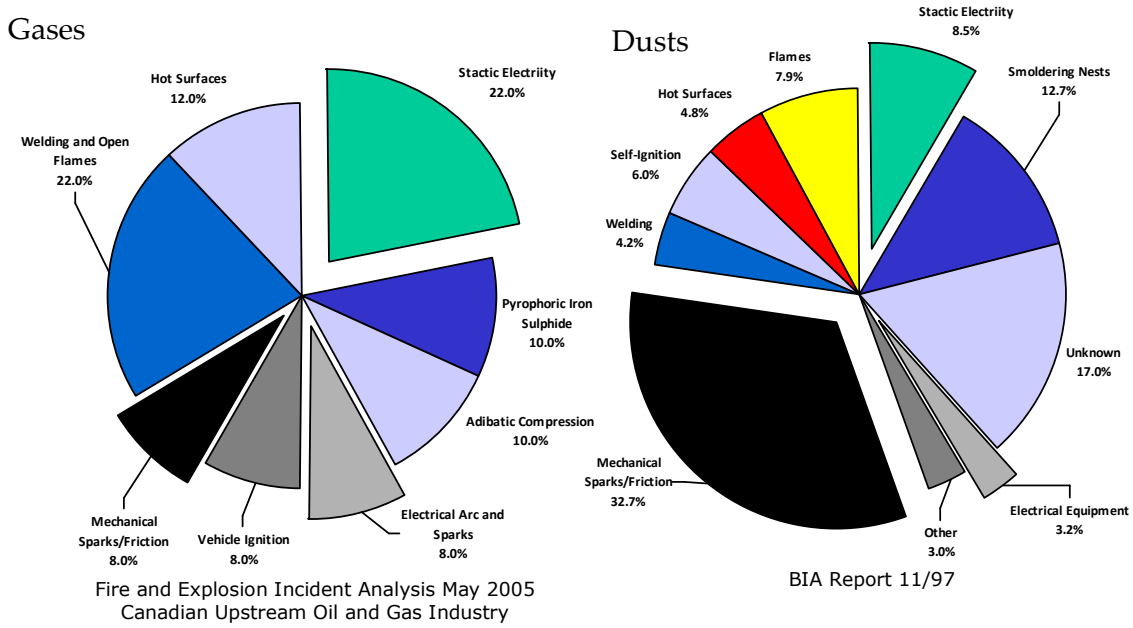
IEC 60079-10-2 is straightforward to use and give details of how to take into account housekeeping. Although the impact of ventilation is included in the gas standard it is not formally included in the same way in this dust standard. However, the example zoning diagrams do indicate the way that the ventilation can be taken into account as illustrated below.



Bag handling station within a building with No LEV

Bag handling station within a building with LEV

One area that has not been covered by the new IEC standards is non-electrical equipment. In my own sphere of activity pharmaceuticals, biopharmaceuticals and speciality chemicals the impact of non-electrical equipment as a source of ignition is particularly important. As the diagrams below show electrical equipment is only a small contributor to sources of ignition in real incidents (8% for gases and 3.2% for dusts) and reader is urged to consider non-electrical equipment as part of their risk assessment even if the national standards do not cover this area.



BS EN 13463-1:2009 provides a wealth of important information on the use of non-electrical equipment in potentially explosive atmospheres. If you are involved with risk assessments for the use of equipment in potentially explosive atmosphere I would urge you to get a copy of this standard and read it carefully. The data also indicate that static electricity is a significant problem and ways of reducing the risk of a discharge of static electricity also needs to given careful consideration.

The author presented a webinar giving more details of the use of equipment in explosive atmospheres. This is available at www.icheme.org. (select "Subject Groups" and then "Pharma")

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