HAZARDOUS AREAS

SCOPE

This application note provides general information on subjects of area and gas classification for hazardous areas. In many industrial processes where flammable materials are handled, any leak or spillage may give rise to an explosive atmosphere. To protect both plant and personnel, precautions must be taken to ensure that this atmosphere cannot be ignited.
The areas at risk are know as hazardous areas and the materials involved include crude oil and its derivatives, alcohols, natural and synthetic process gases, metal dusts, carbon dust, flour, starch, grain, fibres and flyings.

AREA CLASSIFICATION

When dealing with equipment for explosion-risk areas, the first important task is to define the various hazardous zones. The purpose of sub-dividing the hazardous area into zones is to attempt to indicate the probability of a hazardous mixture being present. This probability can then be matched to the probability of equipment becoming dangerous.
The present IEC standard defines the zones as follows:

CLASSIFICATION OF HAZARDOUS AREAS - GAS / AIR	
Zone 0	An explosive gas-air mixture is continuously present or present for long periods.
Zone 1	An explosive gas-air mixture is likely to occur in normal operation.
Zone 2	An explosive gas-air mixture is not likely to occur and if it occurs it will only exist for a short term. Usually Zone 2 must be a freely ventilated situation.
CLASSIFICATION OF HAZARDOUS AREAS - DUSTS	
Zone Z / Zone 10	An area in which combustible dust is, or may be, present as a cloud during normal processing, handling or cleaning operations in sufficient quantity to be capable of producing an explosive concentration of combustible or ignitable dust in a mixture with air.
Zone Y / Zone 11	An area not classified as Zone Z, in which accumulations or layers of combustible or ignitable dust may be present under abnormal conditions and give rise to ignitable mixtures of dust and air.

In general, any location which is not a hazardous area is a safe area. Many authorities prefer the use of "non-hazardous area" for semantic and legalistic reasons.
In the United States the practice is still to divide hazardous areas into two divisions. Division 1 is the more hazardous of the two and embraces both zone 0 and 1. Zone 2 and division 2 are roughly equivalent.

In any plant the decision as to the classification of each zone must be made by the plant operation team. Although instrumentation and electrical engineers may have some relevant experience, it is probably a chemical engineer's basic problem.

Some of the factors to be considered are:

- *The probability of the presence of hazardous gas or dust.*
- *The quantity of hazardous vapour.*
- *The degree of ventilation.*
- *The nature of the gas (is it heavier than air etc.).*
- *The consequences of an explosion. If an explosion could cause considerable loss of life, locations are frequently upgraded. Very few users include this factor in their written analysis of area classification, but almost all engineers are influenced by this consideration. An obvious example is the caution that is applied to classifying areas on ships carrying petroleum products.*

APPARATUS OR GAS GROUPING

One of the benefits that happened in recent years is the almost universal use of the IEC system of grouping apparatus in a way which indicates that it can safely be used with certain gases. Pedantically, it is the apparatus that is grouped, but the distinction between grouping gases or equipment is an academic point which does not affect safety.
This grouping considers only the spark ignition or flame-propagation aspect of the explosion-proof technique.
The international gas grouping allocates the Roman numeral "I" to the underground mining activity, where the predominant risk is methane and coal dust, usually called firedamp.
All surface equipment is marked with the Roman numeral "II" and the gas groups are sub-divided into IIA (propane), IIB (ethylene) and IIC (hydrogen), IIA being the least incendiary.
In EN 50 014, acetylene, carbon disulphides and ethyl nitrate have been included in group IIC. This approach resolves the problem of classifying these rather difficult gases. The additional risk with acetylene is the formation of acetylides on copper and silver parts of the circuit to which the gas has access. These parts are required to be plated, or varnished.
If acetylides do form, they become like small detonators and can cause ignition when struck. Carbon disulpide and ethyl nitrate both have very low ignition temperatures.
Unfortunately the America and Canada authorities have opted to maintain their present gas and dust classification. The classifications and subdivisions are gases and vapours (Class I), dusts (Class II) and fibres (Class III).

Representative (test) gas	**GAS CLASSIFICATION**		Ignition energy (microjoules)
	IEC Countries	USA & Canada	
Acetylene	Group IIC	Class I, Group A	20
Hydrogen	Group IIC	Class I, Group B	20
Ethylene	Group IIB	Class I, Group C	60
Propane	Group IIA	Class I, Group D	180
Methane	Group I (mining)	No classification	

TEMPERATURE CLASSIFICATION

Gas-air mixtures can be ignited not only by a spark but also by contact with hot surfaces. Consequently all electrical equipment used in hazardous atmospheres must be classified according to its maximum surface temperature.

For intrinsically safe circuits the maximum surface temperature is calculated or measured, including the possibility of faults occurring, in just the same way as the electrical spark energy requirements are derived.

All temperature classifications, unless otherwise specified, are assessed with reference to a maximum ambient temperature of 40 EC. If equipment is used in a temperature higher than this, then its temperature classification should be re-assessed.

TEMPERATURE CLASSIFICATION	
Class	Max. surface temp. in EC
T1	450
T2	300
T3	200
T4	135
T5	100
T6	85

EXPLOSION PROTECTION

To enable electrical equipment to be used safely in hazardous areas, eight different explosion protection techniques have been developed over the years. National or in most cases international (European), standards and codes of practice govern each technique and define in detail how the equipment should be designed and applied. The different techniques lend themselves to different applications and instrumentation.

CENELEC METHODS OF PROTECTION				
Technique	Protection type	Ex	CENELEC standard	Typical applications
Energy limiting	Intrinsic safety	ia/ib	EN50 020	Instrumentation, control gear
Segregation	Pressurisation	p	EN50 016	Control rooms, analysers
	Oil immersion	o	EN50 015	Transformers, switchgear
	Powder filling	q	EN50 017	Instrumentation
	Encapsulation	m	EN50 028	Instrumentation, control
Refined Mechanical design	Increased safety Non-incendiary	e n(N)	EN50 019 EN50 021	Motors, lighting fittings Motors, lighting (Draft)
Containment	Flameproof	d	EN50 018	Switchgear, motors, pumps
Special	Special	s	-	
General requirements for all methods			EN50 014	

Intrinsic safety protection is subdivided into two separate categories "ia" and "ib". In category "ia", ignition should not occur as a result of an error or a combination of any two errors, whilst category "ib" ignition should not occur as a result of one error.

All circuits installed within Zone 0 must have "ia" protection and circuits installed in Zone 1 at least "ib".

MARKING OF EXPLOSION PROTECTED APPARATUS

In addition to the general data (make, type, serial number, etc), data concerning the explosion protection has to be added. In the case of a certified RTE load cell, the European Standards call for the following marking, adapting to the IEC Recommendation :

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EEx ib IIC T6
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Temperature class
Explosion group
Intrinsic safety ib ( protection type )
Symbol for apparatus built in accordance with
a European standard
Approved mark for apparatus certified by an
EC test authority
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Further to this a certificate number has to be added. Each load cell bearing this number should be built in agreement with the specifications and drawings corresponding to the certificate of conformity. Each individual load cell will be tested to withstand a 500 volts to earth RMS-test. All RTE load cells carry a certificate of conformity number e.g. Ex-92.C.6588

Barriers or isolators are placed between the "safe" and the "hazardous" circuits. These devices are usually not placed into the hazardous area and will bear the following marking (without a temperature class):

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[EEx ib] IIB
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Specifications for electrical equipment must be at least comply with the regulations prescribed for the safety class to which the gas involved belongs, they may of course also be more stringent.

This application note is written as a short guide in understanding gas classification for hazardous areas. *Over the last years, the protection type "Intrinsic safety" has become established as the required standard for weighing applications in hazardous areas. For more information about this subject, we refer to application note 09/3-03/02 "SHUNT-DIODE BARRIERS".*

Customer support:

The Revere Transducers group combines fifty years of load cell manufacturing with fifty years of application know how. For any further question, please contact our manufacturing operation or any one of our regional sales offices.

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