

# EXPLOSIVE ATMOSPHERES - CLASSIFICATION OF HAZARDOUS AREAS (ZONING) AND SELECTION OF EQUIPMENT

## OVERVIEW

## ASSESSING THE RISK

## RELATIONSHIP BETWEEN FIRES AND EXPLOSIONS

## CLASSIFYING HAZARDOUS AREAS INTO ZONES

## MAINTENANCE

## EQUIPMENT IN HAZARDOUS AREAS

## MARKING OF EQUIPMENT

## SELECTION OF EQUIPMENT

## HAZARDOUS AREA ZONES AND EQUIPMENT CATEGORIES

### Overview

Gases, vapours, mists and dusts can all form explosive atmospheres with air. Hazardous area classification is used to identify places where, because of the potential for an explosive atmosphere, **special precautions** over sources of ignition are needed to prevent fires and explosions.

Hazardous area classification should be carried out as an integral part of the risk assessment to identify places (or areas) where controls over ignition sources are needed (hazardous places) and also those places where they are not (non hazardous places). Hazardous places are further classified in Zones which distinguish between places that have a high chance of an explosive atmosphere occurring and those places where an explosive atmosphere may only occur occasionally or in abnormal circumstances. The definitions of the Zones (which are included in DSEAR) also recognise that the chance of a fire or explosion depends on the likelihood of an explosive atmosphere occurring at the same time as an ignition source becomes active.

DSEAR defines a place where an explosive atmosphere may occur in quantities that require special precautions to protect the health and safety of workers as **hazardous**. A place where an explosive atmosphere is not expected to occur in quantities that require such special precautions is deemed to be **non-hazardous**. For these purposes “**special precautions**” means precautions to control potential ignition sources within a hazardous area, particularly in relation to the construction, installation and use of equipment.

The term “not expected to occur in such quantities” means that employers should consider the likelihood of releases of explosive atmospheres as well as the potential quantity of such releases when considering area classification. So if a release is extremely unlikely to occur and/or if the quantities released are small, it may not be necessary to classify the area as hazardous.

For example, if a dangerous substance is being carried through a seamless pipe, and that pipe has been properly installed and maintained, it is extremely

unlikely that the substance will be released. An explosive atmosphere would not be expected to occur from this source and the area surrounding the pipe would be non-hazardous.

A spillage from a small bottle of solvent would release so little flammable material that no special precautions are needed other than the general control of ignition sources (for example, no smoking) and cleaning and disposing of the spillage. It would not be classified as a hazardous area. When considering whether hazardous area classification is necessary for "small" quantities of dangerous substances the actual circumstances of use and any specific industry guidance should also be taken into account.

Dangerous substances in small pre-packaged containers for sale, display, etc. in retail premises would not normally ("normal" is intended to ensure that atypical situations such as a poorly ventilated basement in a Shop etc. where aerosols or other flammables are present remains subject to a hazardous area classification study) require the area to be classified as hazardous. However we would expect a hazardous area classification to be carried out for prepackaged containers held in large quantities e.g. in warehouses. Procedures to clean up and dispose of any spillage/release and to control ignition sources in the event of such a release would be needed.

### **Assessing the risk**

Identifying hazardous or non-hazardous areas should be carried out in a systematic way. Risk assessment should be used to determine if hazardous areas exist and to then assign zones to those areas. The assessment should consider such matters as:

- (a) the hazardous properties of the dangerous substances involved;
- (b) the amount of dangerous substances involved;
- (c) the work processes, and their interactions, including any cleaning, repair or maintenance activities that will be carried out;
- (d) the temperatures and pressures at which the dangerous substances will be handled;
- (e) the containment system and controls provided to prevent liquids, gases, vapours or dusts escaping into the general atmosphere of the workplace;
- (f) any explosive atmosphere formed within an enclosed plant or storage vessel; and,
- (g) any measures provided to ensure that any explosive atmosphere does not persist for an extended time, e.g. ventilation.

Taken together these factors are the starting point for hazardous area classification, and should allow for the identification of any zoned areas. The following paragraphs give further information on what to consider during an assessment.

#### The hazardous properties of dangerous substances

The properties of a dangerous substance that need to be known include the boiling point and flash point of any flammable liquid, and whether any flammable gas or vapour that may be evolved is lighter or heavier than air. For dusts, information on particle size and density will be needed, once it has been shown that a particular dust can form an explosive atmosphere. Often, relevant information is contained on a safety data sheet provided with the product.

#### The size of potential releases

Some potential sources of release may be so small that there is no need to specify a hazardous area. This will be the case if the consequence of an ignition following a release is unlikely to cause danger to people in the vicinity. However, in the wrong circumstances ignition of quite small quantities of flammable gas/vapour mixed with air can cause danger to anyone in the immediate vicinity. Where this is the case, as in a relatively confined location, from which rapid escape would be difficult, area classification may be needed even where quite small quantities of dangerous substance are present.

The size of any potential explosive atmosphere is, in part, related to the amount of dangerous substances present. Industry specific codes have been published by a variety of organizations to provide guidance on the quantities of various dangerous substances that should be stored. For example, the *“Code of Practice on Storage of Full and Empty LPG Cylinders and Cartridges”* produced by the LP Gas Association.

#### Temperatures and pressures

Additional information relating to the process that involve the dangerous substances should also be taken into account, including the temperatures and pressures used in the process, as this will influence the nature and extent of any release, and the extent of any subsequent hazardous areas. Some substances do not form explosive atmospheres unless they are heated, and some liquids if released under pressure will form a fine mist that can explode even if there is insufficient vapour.

#### Ventilation

Ventilation, either natural, or mechanically (e.g. produced by fans), can both dilute sources of release, and remove dangerous substances from an enclosed area. As a result there is a close link between the ventilation at any given location, and the classification and extent of a zone around a potential source of release. Well designed ventilation may prevent the need for any zoned area, or reduce it so it has a negligible extent.

#### Extent of hazardous areas

The assessment needs to identify areas within a workplace that are connected to places where an explosive atmosphere may occur. This will provide information on any areas away from the source of the hazard to which an explosive atmosphere may spread, for example through ducts. Such areas should be included in the classification system for places where explosive atmospheres may occur. An approach to assessing this risk is described in BS EN 60079/10. A technique for preventing this risk is

described in BS EN 50016, on pressurisation of enclosures or rooms containing electrical equipment.

### Other considerations

When considering the potential for explosive atmospheres, it is important to consider all dangerous substances that may be present at the workplace, including waste products, residues, materials used for cleaning or maintenance, and any used only as a fuel. Also some combinations of dangerous substances may react together, forming an ignition source, or in combination may form an explosive atmosphere, where singly this does not occur.

Some repeated activities such as refuelling cars, or loading and unloading tankers intended for use on the public roads, involve the introduction of potential sources of ignition into an area where a spill is possible, and which would meet the description of a hazardous area. In these circumstances, safety can be achieved by isolating power sources (e.g. turning off engines, etc) while a transfer is taking place, and making suitable checks before and after a transfer, before moving a vehicle into or out of a hazardous area.

Activities, such as maintenance, may incur risks not covered by the normal area classification of the area where the activity is taking place, for instance the introduction of sources of ignition into a hazardous area. Sometimes the dangerous substance can be removed before the maintenance work activity starts. Sometimes, special control measures can be taken to prevent the release of any dangerous substance during the work. In such cases the additional risks associated with the activity should be assessed before work starts.

### **Relationship between fires and explosions**

In many cases where an explosive atmosphere can form, any ignition will cause a fire rather than an explosion. Both fire and explosion cause dangers to workers, and in many cases the precautions required to prevent an ignition are the same. The overall package of precautions required will depend on the possible consequences of a fire or explosion.

Many factors influence the risks from a fire involving dangerous substances. In particular, employers should consider whether a fire could lead to an explosion, how fast a fire might grow, what other materials might be rapidly involved, any dangers from smoke and toxic gases given off, and whether those in the vicinity would be able to escape.

### **Classifying hazardous areas into zones**

Once an area has been identified as hazardous it should be classified into zones based on the frequency and persistence of the potentially explosive atmosphere. This then determines the controls needed on potential sources of ignition that may be present or occur in that area. These controls apply particularly to the selection of fixed equipment that can create an ignition risk; but the same principles may be extended to control the use of mobile

equipment and other sources of ignition that may be introduced into the area (for example, matches and lighters) and the risks from electrostatic discharges.

An international standard, BS EN 60079/10, explains the basic principles of area classification for gases and vapours, and its equivalent for dusts was published in 2002 as BS EN 61241/3. These standards form a suitable basis for assessing the extent and type of zone, and can be used as a guide to complying with the requirements in DSEAR. However, they cannot give the extent and type of zone in any particular case, as site-specific factors should always be taken into account.

Industry specific codes have also been published by various organisations and, provided they are applied appropriately, they are valuable in encouraging a consistent interpretation of the requirements.

Area classification studies usually take the form of drawings identifying the hazardous areas and zones. Additional text gives information about the dangerous substances that will be present, the work activities that have been considered, and other assumptions made by the study. Whenever such drawings and documents have been produced, they should be included in the risk assessment record required by DSEAR. These documents should be considered whenever new equipment is to be introduced into a zoned area.

## **Maintenance**

During a period when maintenance is being carried out the normal area classification drawings may not be applicable. If dangerous substances have been removed, it may be possible to treat areas normally classified as hazardous as non-hazardous. Alternatively, if the maintenance creates the larger than normal risk of a release of a dangerous substance, larger areas may need to be treated as hazardous. It is not normally necessary to create new area classification drawings for the duration of the maintenance work.

## **Equipment in hazardous areas**

Special precautions need to be taken in hazardous areas to prevent equipment from being a source of ignition. In situations where an explosive atmosphere has a high likelihood of occurring, reliance is placed on using equipment with a low probability of creating a source of ignition. Where the likelihood of an explosive atmosphere occurring is reduced, equipment constructed to a less rigorous standard may be used. Equipment is categorised (1, 2 or 3) depending on the level of zone where it is intended to be used.

A number of ways of constructing equipment to prevent ignition risks have been published as harmonised European Standards, and in some cases, additional requirements are set out in the Standards relating to installation and use.

## **Marking of equipment**

A standardised marking scheme is applied to identify equipment suitable for a specific location. Equipment built to the requirements of EPS will carry the explosion protection symbol “Ex” in a hexagon, the equipment category number (1, 2, or 3), the letter G and/or D depending on whether it is intended for use in gas or dust atmospheres, and other essential safety information. In many cases this will include a temperature rating expressed as a “T” marking, and sometimes a gas group. These indicate limitations to safe use. Employers and those installing equipment should consider the marking and documentation provided with “Ex” equipment when it is being installed.

## **Selection of equipment**

From 1 July 2003 DSEAR requires that new equipment and protective systems used in a hazardous area must be selected on the basis of the requirements set out in the DTI’s Equipment and Protective Systems for Use in Potentially Explosive Atmospheres Regulations 1996 (as amended) (EPS) unless the risk assessment finds otherwise

For much electrical equipment, employers will notice comparatively little change from the situation now, except in the details of the marking on equipment. The EPS regulations, however, also apply to mechanical equipment that is a potential ignition source. This is a new requirement, and until recently there has been no mechanical equipment that has been certified for use in a hazardous area. A harmonised European standard for category 3 mechanical equipment is now available as BS EN 13463 part 1.

DSEAR recognises that there might be circumstances where the risk assessment finds that the selection criteria for equipment is inappropriate, or unnecessarily restrictive. A degree of flexibility has been introduced into Schedule 3 of the Regulations - by allowing employers to use equipment that does not conform to the requirements in the DTI’s Regulations, where the employer’s risk assessment finds otherwise.

It is important to understand, however, that it would normally be expected that equipment used in zoned areas would comply with the requirements in the DTI Regulations and that equipment of a higher or lower category than that usually required would only be present in special circumstances. For example:

- (a) during maintenance operations where alternative effective precautions are provided to control the risk;
- (b) where workers can be excluded from the hazardous area, and will not be at risk from any ignition of an explosive atmosphere.
- (c) where equipment of the required category is simply not available, but a lower category can be used in combination with other protective measures to achieve the purposes of these regulations.

Where employers intend to use the flexibility provided in DSEAR, their decision must be fully justified in their assessment of risk. It should also be

considered in the context of other requirements placed on employers by these Regulations.

The flexibility in DSEAR does not effect in any way the duties placed on manufactures, suppliers, importers and other “responsible persons” under the EPS Regulations 1996. Equipment they place on the market must comply with the requirements of EPS. In many cases however, manufacturers will have a choice to make, whether they build to category 2 or 3 standards. Their decision will depend on the needs of the customers. In particular, DSEAR should not be used:

- (a) to allow equipment imported from outside the EU, built to other standards, to be used without complying with the EPS Regulations;
- (b) to justify explosion protected equipment built to lower standards than that specified by EPS.

Employers who manufacture equipment for their own use, or who import directly from outside the European Economic Area (EEA) are considered to be a “responsible person” under EPS and take on the full responsibility for complying with those Regulations when putting that equipment into the EEA.

### **Hazardous area zones and equipment categories**

Hazardous places are classified in terms of zones on the basis of the frequency and duration of the occurrence of an explosive atmosphere.

#### Gases, vapours and mists

For gases, vapours and mists the zone classifications are:

- 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 mist 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 mist is likely to occur in normal operation occasionally.
- 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 mist is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

#### Dusts

For dusts the zone classifications are:

- 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.

Notes:

1. Layers, deposits and heaps of combustible dust must be considered as any other source which can form an explosive atmosphere.
2. "Normal operation" means the situation when installations are used within their design parameters.

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

Notes

- 1 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.