



HEALTH AND SAFETY
AUTHORITY

Guide to the Safety, Health and Welfare at Work (General Application) Regulations 2007



Part 8:
Explosive Atmospheres at
Places of Work

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Safety, Health and Welfare at Work
(General Application)
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**Part 8:
Explosive Atmospheres at
Places of Work**

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Guide to Part 8 of the General Application Regulations 2007

PART 8: EXPLOSIVE ATMOSPHERES AT PLACES OF WORK

Introduction

This Guide is aimed at safety and health practitioners, employers, managers, employees, safety representatives and others to give guidance on Part 8 and the related Schedule 10 to the Safety, Health and Welfare at Work (General Application) Regulations 2007 (S.I. No. 299 of 2007) relating to explosive atmospheres at places of work. The objective of the Guide is to give general guidance aimed at the prevention of occupational accidents or ill health. *It is not intended as a legal interpretation of the legislation.*

From 1 November 2007, Part 8 of the General Application Regulations 2007 retransposes the (ATEX) Directive 1999/92/EC¹ of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres and the risks from fire and explosion arising from flammable substances stored or used in the workplace. Part 8 of the General Application Regulations 2007 also replaces the Safety, Health and Welfare at Work (Explosive Atmospheres) Regulations 2003 (S.I. No. 258 of 2003), which are revoked from that date.

In this Guide the text of the Regulations is shown in italics.

The General Application Regulations 2007 are made under the Safety, Health and Welfare at Work Act 2005 (No. 10 of 2005) referred to elsewhere in this Guide as “the Act” or the “2005 Act”.

“Flammable substance” includes any substance or preparation which, because of its properties or the way it is used, can cause harm to people from fires and explosions. Examples of a flammable substance are petrol, liquefied petroleum gas (LPG), paints, varnishes, solvents and dust which when mixed with air could cause an explosive atmosphere (e.g. dust from milling and sanding operations). Flammable substances may be found, in varying quantities, in most workplaces.

An explosive atmosphere means a mixture with air, under atmospheric conditions, of flammable substances in the form of gases, vapours, mists or dusts in which, after ignition has occurred, combustion spreads to the entire unburned mixture. An explosive atmosphere does not always result in an explosion, but if it caught fire, the flames would quickly travel through it. If this happens in a confined space (e.g. in plant or equipment) the rapid speed of the flames or rise in pressure could also cause an explosion.

It should be noted that the European Commission has issued its own guidance with regard to Directive 1999/92/EC.²

The Health and Safety Executive in Britain has prepared a series of codes of practice covering dangerous substances and explosive atmospheres.³

Regulation 167: Interpretation for Part 8

167. In this Part:

“ADR” means—

- (a) the European Agreement concerning the international carriage of dangerous goods by road,
- (b) the protocol of signature to that agreement, done at Geneva on 30 September 1957,
- (c) the amending protocol to that agreement adopted at Geneva on 28 October 1993, and
- (d) Annexes A and B to the ADR referred to in Annexes A and B to Council Directive No. 94/55/EC⁴ of 21 November 1994 as amended;

“explosion protection document” shall be construed in accordance with Regulation 169;

“hazard” means the physico-chemical or chemical property of a substance which has the potential to give rise to fire, explosion, or other events which can result in harmful physical effects of a kind similar to those which can be caused by fire or explosion, affecting the safety of a person, and cognate words shall be construed accordingly;

“risk” means the likelihood of a person’s safety being affected by harmful physical effects being caused to him or her from fire, explosion or other events arising from the hazardous properties of a substance in connection with work;

“substance” includes any natural or artificial substance whether in solid or liquid form or in the form of a gas or vapour;

“workplace” means any premises or part of premises used for or in connection with work, and includes—

- (a) any place within the premises to which a person has access while at work, and
- (b) any room, lobby, corridor, staircase, road or other place—
 - (i) used as a means of access to or egress from that place of work, or
 - (ii) where facilities are provided for use in connection with that place of work, other than a public road.

Regulation 168: Application of Part 8

168. (1) Subject to paragraph (2), this Part applies to a workplace where employees are potentially at risk from an explosive atmosphere.

(2) This Part does not apply to—

- (a) areas used directly for and during the medical treatment of patients,

- (b) *the use of appliances burning gaseous fuels in accordance with Council Directive 90/396/EEC of 29 June 1990⁵ on the approximation of the laws of the Member States relating to appliances burning gaseous fuels as amended by Council Directive 93/68/EEC of 22 July 1993⁶,*
- (c) *the manufacture, handling, use, storage and transport of explosives or chemically unstable substances,*
- (d) *mineral extractive industries as referred to in the relevant statutory provisions, and*
- (e) *the use of means of transport by land, water and air, to which the relevant provisions of the international agreements, including ADR, and the European Community directives giving effect to those agreements apply, but means of transport intended for use in a potentially explosive atmosphere shall not be excluded.*

The Regulations apply at most workplaces where flammable substances are stored or used, for example factories where flammable liquids are present or where flammable dusts are produced in the process. They also apply at workplaces such as tunnels and sewers where flammable vapours may be present.

All substances capable of an exothermic reaction are to be regarded as flammable, including, in particular, all substances which are already classified and labelled under the Classification, Packaging and Labelling (CPL) of Dangerous Substances Regulations as extremely flammable (F+ and R12), highly flammable (F and R11/R15/R17) or flammable (R10). Examples of such substances include petrol, liquefied petroleum gas (LPG), paints, solvents, varnishes, naturally occurring methane and certain types of dust produced, for example, in machining and sanding operations. In addition, substances which meet the flammability criteria for CPL but are technically excluded from CPL also come within the Regulations.

The Regulations may also apply because of the way a substance is used. For example, diesel oil is not classified as flammable under CPL; nevertheless, its physical properties are such that when heated to a high temperature it can present a fire risk and will in such circumstances come within the scope of the Regulations. The dusts of combustible materials such as coal, wood, grain, flour, sugar, certain metals and synthetic organic chemicals can form explosive atmospheres when dispersed in air to form a cloud. An assessment of the work processes and handling of the dust and an analysis of the physical and chemical characteristics of the dust may be necessary to determine whether there is a risk of formation of explosive atmospheres. Further guidance on this is contained in the Electro-Technical Council of Ireland (ETCI) *Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres*.⁷

There are a number of exemptions from the Regulations, some of which are covered by other legislation such as:

- **Medical treatment of patients**

This exemption covers areas specifically used for the treatment of patients such as treatment rooms and operating theatres. However, areas in a hospital where treatment does not take place, such as waiting rooms, corridors, boiler rooms, laundries or workshops, come within the scope of Part 8 of the Regulations.

- **Gas appliances**

Appliances which come within the scope of the European Communities (Appliances Burning Gaseous Fuels) Regulations 1992 and 1995 (S.I. No. 101 of 1992 and S.I. No. 150 of 1995) are not covered by Part 8 of the Regulations. These appliances burn gaseous fuels for cooking, water heating, refrigeration, lighting and washing, with a water temperature normally not exceeding 105°C. However, appliances specifically designed for use in industrial processes on industrial premises come within the scope of Part 8 of the Regulations.

- **Explosives or chemically unstable substances**

The Regulations do not apply to explosives or chemically unstable substances. The safety of activities involving explosives is covered by other, more specific legislation.

For the purpose of Part 8 of the Regulations ‘chemically unstable substances’ are substances or preparations which, under conditions likely to occur during the course of a work activity, on its own, or mixed with a combustible material, can, without the need for the involvement of air, undergo a self-sustaining chemical reaction capable of producing heat and/or gas at such a temperature or rate as to present a risk by thermal, blast or fragment projection effects. The safety of processes involving such substances is covered by the Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001 (S.I. No. 619 of 2001).

- **The extractive industries including mines, quarries and offshore installations**

These are covered by separate legislation.

- **The transport of dangerous goods by road, rail, air or sea**

These activities which are covered by international agreements such as ADR are excluded from the scope of Part 8 of the Regulations. However, any means of transport which is intended for use in a potentially explosive atmosphere is covered by the Regulations. The transport of dangerous goods outside the scope of international agreements is not covered by the exemption and Part 8 of the Regulations applies. Generally this includes vehicles that do not leave the employer’s premises, such as forklift trucks working in potentially explosive atmospheres.

Regulation 169: Assessment of explosion risk and explosion protection document

169. (1) *An employer shall—*

(a) *where an explosive atmosphere is or is likely to be present at or may, from time to time, arise in a workplace, make a suitable and appropriate assessment of the risk arising from*

such explosive atmosphere to the employees concerned having regard to all the circumstances,

- (b) in carrying out the assessment referred to in paragraph (a), have regard to—*
- (i) the likelihood that explosive atmospheres will occur and their persistence,*
 - (ii) the likelihood that ignition sources, including electrostatic discharges, will be present and become active and effective,*
 - (iii) the installations, substances used, work processes and their possible interactions,*
 - (iv) the scale of the anticipated effects,*
 - (v) any places which are or can be connected via openings to places in which explosive atmospheres may occur, and*
 - (vi) such additional safety information as the employer may need in order to complete the assessment;*

(2) Having carried out an assessment under and in accordance with this Regulation, an employer shall—

- (a) prepare an explosion protection document, as soon as practicable and before the commencement of work,*
- (b) revise that document as necessary if the workplace, work equipment or organisation of work undergoes significant changes, extensions or conversions,*
- (c) include that document, or make reference to it, in the employer's safety statement and*
- (d) make that document or any revision of it available to the employees concerned.*

(3) The employer shall specify in the explosion protection document each of the following:

- (a) that the explosion risks have been determined and assessed;*
- (b) that measures have been or will be taken pursuant to this Part and that such measures are adequate having regard to the risks;*
- (c) the places which have been classified into zones in accordance with Regulation 170 and, in respect of such classification, where Schedule 10 applies;*
- (d) that the workplace and work equipment, including warning devices, are designed, operated and maintained with due regard for safety and that, in accordance with Part 2, Chapter 1 and Part 7, Chapter 1,*

adequate arrangements have been made for the safe use of work equipment;

(e) the purpose of any co-ordination required by Regulation 175 and the measures and procedures for implementing it.

(4) An employer, in drawing up the explosion protection document, may combine existing explosion risk assessments, documents or other equivalent reports which have been prepared by or on behalf of the employer under any other enactment.

Employers and the self-employed must carry out a risk assessment of any work activities involving flammable substances and record the findings of the risk assessment in a document called the 'explosion protection document'.

Employers and the self-employed must carry out a risk assessment regardless of the quantity of flammable substances present, as it will enable them to decide whether existing measures are sufficient or whether any additional controls or precautions are necessary. As well as assessing the normal activities within the workplace, an employer will also need to assess non-routine activities, such as maintenance and repair, where there is often a higher potential for fire and explosion incidents to occur.

The risk assessment is an identification and careful examination of the:

- Flammable substances present in the workplace
- Work activities involved
- Safety control measures in place and how they might fail and lead to fire or explosion.

The purpose of the risk assessment is to enable the employer to decide what he or she needs to do to eliminate or reduce these risks.

A number of factors will need to be considered when carrying out the risk assessment. These include:

- Identifying the flammable substances present in the workplace: some substances such as petrol and LPG are obviously hazardous while others may be hazardous only in certain situations such as flour dust or high-flash-point liquids such as diesel fuel
- The hazardous properties of those substances: useful information on the properties and hazards of flammable substances may be available from suppliers, e.g. in safety data sheets. This could include information on flash points or explosive or chemical properties. Other information could relate to safe methods of use, storage or handling
- The way they are used or stored: this includes consideration of the work activities such as loading and unloading, dispensing and decanting, movement of flammable substances around the site and how spillages and leaks are dealt with
- The potential for flammable substances to be released from plant or equipment or during handling and the likelihood that an explosive atmosphere will occur
- The work equipment used, including work equipment brought into a hazardous area. The assessment must consider whether adequate work equipment is being used, including work equipment which is within the scope of the European Communities (Equipment and

Protective Systems Intended for Use in Potentially Explosive Atmospheres) Regulations (S.I. No. 83 of 1999). Work equipment within the scope of those Regulations must be selected on the basis of the categories set out in Regulation 172(g) of S.I. No. 83 of 1999 which transposed Directive 94/9/EC⁸ and places duties on the manufactures and suppliers of equipment that is intended for use in explosive atmospheres to design and manufacture such equipment in accordance with the essential health and safety requirements of Directive 94/9/EC and to affix the CE marking

- All potential ignition sources: flammable substances in the form of explosive atmospheres are readily ignited, therefore it is essential to identify where ignition sources could be present. Some ignition sources are obvious, such as naked flames, but others may be less obvious, such as sparks from friction in mechanical parts of equipment, the operation of electrical equipment, hot surfaces, and electrostatic discharges
- The scale of anticipated effects: these will depend on the amount of material involved, how quickly they can be consumed, how the incident could escalate and whether conditions exist, or could develop, to cause a fire or explosion. Where an explosion is possible, the scale of the effects will depend on the characteristics of the material, the size of the potential explosive atmosphere, the shape and strength of the containment and whether the internal configuration or any obstructions will accelerate the burning rates
- Any areas within the workplace which are connected via openings to places in which explosive atmospheres may occur need to be identified. This will provide information on areas away from the source of the hazard to which an explosive atmosphere may spread, for example through ducts
- Openings between rooms within a building also provide a route for the spread of flammable material that is released in an incident and also a route for flames, burning particles or pressure waves to spread to other parts of the building or plant. These possibilities should be considered in any risk assessment so that the appropriate measures may be determined
- Additional information that may help in completing the risk assessment includes the skills, knowledge, experience, training and supervision of employees. Information on adjacent areas or premises which could present an ignition risk should also be included.

The risk assessment and the recording of its findings in the explosion protection document will enable employers and the self-employed to demonstrate that they have followed a structured and thorough approach in considering the risks and the control measures required.

The risk assessment should be reviewed at least annually and if developments suggest that it is no longer valid or following an accident or dangerous occurrence. Changes

in the workplace which would trigger a review include:

- Changes to the substances used
- Replacement or modification to plant or equipment
- Changes in processes or work practices
- Changes in the workforce.

Further information on how to undertake a suitable and sufficient risk assessment is provided in the HSA publication *Guidelines on Risk Assessment and Safety Statements* available on the HSA website.

An explosion protection document must be prepared based on the findings of the risk assessment and it must include all the elements listed below. It should demonstrate that the workplace and work processes are safe for work with hazardous substances, taking into account their properties, the equipment provided and the way they will be used. In particular, it must show what engineering controls and protective systems are provided. The document should also show that the workplace and work equipment are maintained in a safe condition and, where necessary, that arrangements are in place for periodic maintenance, testing and other checks or inspections.

Existing explosion protection documents or similar reports may be used in completing the explosion protection document. It may be incorporated into an overall risk assessment and should be included or referenced in the employer's safety statement. The explosion protection document will need to be revised if there are significant changes to the workplace, work equipment or organisation of work and where the risk assessment is reviewed and updated. It must be made available to the employees concerned.

The explosion protection document must show at least:

- That the explosion risks have been determined and assessed. The results of the risk assessment will need to be documented including the identification of the flammable substances present in the workplace, all possible sources of release and consequent formation of potentially explosive atmospheres
- That adequate measures have been taken to reduce the risk of an explosion, including those required by Regulation 171
- The places classified into hazardous zones in accordance with Regulation 170 and Schedule 10. Hazard area classification drawings would be suitable for this purpose
- That adequate work equipment is being used in accordance with the risk assessment. For work equipment intended for use in a potentially explosive atmosphere this can be done by reference to the classification of hazardous places in accordance with Regulation 170 and the selection of a suitable category of equipment in accordance with the manufacturer's instructions. The document should also identify any equipment not located within hazardous areas but which is required for the safe operation of equipment located in zoned areas.

Where employers share workplaces, the explosion protection document should show the coordination arrangements between employers. The document should demonstrate the purpose of the coordination arrangements. For example, the aim might be to alert employees of another employer to the presence of

hazardous substances or places, or to facilitate emergency arrangements in the event of an accident. It should also specify the arrangements for achieving the desired aims. These may include reference to other documents, for example instructions given to other employers or information for contractors on supervision arrangements or handover procedures.

Regulation 170: Classification of places where explosive atmospheres may occur

170. (1) *An employer shall—*

- (a) *classify places at the workplace where explosive atmospheres may occur into hazardous or non-hazardous places in accordance with Part A of Schedule 10,*
- (b) *having done so, classify those places classified as hazardous into zones in accordance with paragraph 2 of that Part, and*
- (c) *display in a prominent position in any place that is classified as hazardous in accordance with paragraph (b), a sign at or near each point of entry to the hazardous place and ensure that the sign complies with Part B of Schedule 10.*

(2) *Before a workplace containing a place that is classified as hazardous pursuant to paragraph (1) is used for the first time, an employer shall ensure that—*

- (a) *the overall explosion safety of both the workplace and that place it contains is verified by a competent person, and*
- (b) *any condition or conditions that are necessary, pursuant to this Part, for ensuring protection from explosion, is or are maintained.*

(3) *This Part applies to—*

- (a) *the places classified as hazardous under paragraph (1)(a), as required by the features of workplaces, workstations, the equipment or substances used or the danger caused by the activity related to the risks from explosive atmospheres, and*
- (b) *equipment in non-hazardous places which is required for, or helps to ensure, the safe operation of equipment located in hazardous places.*

Regulation 170 and Schedule 10 require that places where explosive atmospheres may occur be classified into hazardous and non-hazardous workplaces. Any hazardous workplace must then be classified into zones.

Hazardous area classification should be carried out as an integral part of the risk assessment process. Its purpose is to define the extent, frequency and duration of any

occurrence of an explosive atmosphere. The zone in turn defines the requirements for the selection and installation of equipment and protective systems so as to prevent sources of ignition.

The controls apply particularly to the selection of fixed equipment that can create an ignition risk. However, they also apply to mobile equipment and other sources of ignition that may be introduced into the workplace, e.g. matches and lighters and the risks from electrostatic discharges. Equipment and protective systems are selected which meet the requirements of the European Communities (Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres) Regulations 1999 (S.I. No. 83 of 1999). Equipment already in use before July 2003 may continue to be used indefinitely provided the risk assessment shows it is safe to do so.

The area classification usually takes the form of drawings identifying the hazardous areas and types of zone. Whenever such drawings are produced they should be retained and form part of the risk assessment documentation. These documents should be considered whenever new equipment is being introduced into a zoned area.

Where necessary, places classified into zones are marked with a specified 'EX' sign at their points of entry. The purpose of the sign is to alert personnel to the presence of hazardous areas so that they can take the necessary precautions.

Signs are useful for identifying places where:

- Special site rules apply such as no smoking, antistatic footwear to be worn or access restricted to authorised people
- Portable or mobile equipment must be of an explosion-protected design, e.g. hand torches, vehicles or cleaning machines
- Fixed equipment should be of an explosion-protected design.

Signs should be positioned at the points of entry to the place where an explosive atmosphere may exist. In cases where this is impractical, it may be more appropriate to mark points of entry to the workplace as a whole if all the special precautions apply throughout the entire site. In other cases where there are no obvious entry points, for example around large-scale, open-air chemical plants, hazardous areas may already be indicated by painted lines on the ground.

European standards EN 60079/10⁹ for gases and vapours and EN 50281-3¹⁰ for dusts explain the basic principles of area classification. These standards can assist in assessing the extent and type of zone. 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 codes can also provide useful information and examples of area classification. Such guidance and codes include the Institute of Petroleum's *Model Code of Safe Practice* (Part 15)¹¹ and the ETCI's *Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres* (see Regulation 168).

Before a workplace which contains places classified as hazardous is used for the first time, the overall explosion safety of the workplace and the hazardous areas within it must be confirmed (verified) by a competent person. The person carrying out the verification must be competent to consider the particular risks at the workplace and the adequacy of the safety measures in place.

The employer must ensure that work equipment in the hazardous area is safe, that protective systems

associated with these areas are suitable and that work activities have been designed so they can be carried out safely. These actions collectively comprise verification. The purpose of verifying overall explosion safety is to confirm that the workplace can operate in accordance with Part 8 of the General Application Regulations.

Verification should include consideration of the:

- Flammable substances present and their properties
- Suitability of plant, equipment and protective systems
- Work processes, operating procedures and systems of work
- Effectiveness of control measures to prevent formation of explosive atmospheres, to control the risks and to mitigate the effects of an explosion
- Adequacy of emergency arrangements.

Verification can be carried out by an examination of documents, visual inspection or physical checks and measurements. Much of the work may be a normal part of the commissioning process. Examples of the work involved include:

- Checks that ventilation systems are producing the intended air flows
- Inspection of records showing that process equipment is leak tight
- Ensuring that hazardous area classification drawings have been prepared
- Ensuring that the correct categories of equipment are used in the zones
- Ensuring that appropriate information is available.

Documentation produced during verification may be useful in preparing the risk assessment or vice versa. Any information available in safety reports produced under the European Communities (Control of Major Accident Hazards Involving Dangerous Substances) Regulations 2006 (S.I. No. 74 of 2006) may be useful for explosion safety verification. The employer must ensure that the verification process is carried out by a competent person. The installer of new equipment, the final user or an independent person may carry out the verification. The person selected must have sufficient practical and theoretical knowledge from actual experience and/or professional training relevant to the particular workplace and work activity.

Regulation 171: Prevention against explosion

171. *An employer shall—*

(a) for the purpose of preventing and providing protection against

explosions, take technical and organisational measures that are appropriate to the nature of the operation and in order of priority ensure that those measures—

- (i) either*
 - (I) prevent the formation of explosive atmospheres, or*
 - (II) where the nature of the activity does not allow that, avoid the ignition of explosive atmospheres including by electrostatic discharges where persons at work or the working environment act as charge carrier or charge producer, and*
 - (ii) mitigate the detrimental effects of an explosion so as to ensure the health and safety of persons at work,*
- (b) where necessary, combine and supplement the measures referred to in paragraph (a) with measures against the propagation of explosion,*
- (c) review the foregoing measures regularly and whenever significant changes occur,*
- (d) take the necessary measures, in compliance with Regulation 169, to ensure that—*
- (i) where explosive atmospheres may or are likely to arise in such quantities as to endanger the safety and health of persons at work, or of others, the working environment is such that work can be performed safely,*
 - (ii) in working environments where explosive atmospheres may arise in such quantities as to endanger the safety and health of employees—*
 - (I) there is appropriate supervision of employees, and*
 - (II) that supervision includes the appropriate technical measures,*
 - (iii) any escape or any release, or both, whether intentional or not, of flammable gases, vapours, mists or combustible dusts which may give rise to explosion hazards are suitably diverted or removed to a safe place or, if that is not practicable, safely contained or rendered safe by some other suitable method, and*
 - (iv) if an explosive atmosphere contains several types of flammable or combustible gases, vapours, mist or dusts, or any combination of them, protective measures are appropriate to the greatest potential risk.*

Employers and the self-employed are required to take technical and organisational measures to eliminate the risk from explosive atmospheres or, where this is not possible, to take measures to control the risks and to minimise the harmful effects of any fire or explosion.

Elimination of the risk should be given priority and is best achieved by replacing a flammable substance with a substance or process that totally eliminates the risks. In practice, this may be difficult to achieve but there may be an option to replace the flammable substance with one that is less hazardous (e.g. by replacing a low-flash-point solvent with a high-flash-point one, i.e. one which is less easily ignited). An alternative is to design the process so that it is less dangerous by, for example, changing to a continuous production process from a batch process. Where risk cannot be entirely eliminated, it is necessary to apply control and mitigation measures to reduce the risk in line with the risk assessment.

Control and mitigation measures

Where risks cannot be completely eliminated through substitution, an employer should use a combination of control and mitigation measures to ensure the safety of employees and others. The measures selected should be appropriate to the nature of the work activity, consistent with the risk assessment and sufficient to reduce the risk as far as is reasonably practicable. Priority should be given to ensuring safety at source and thereby preventing the dangerous situation happening. The control measures may include:

- Reducing the quantity of flammable substance to a minimum
- Avoiding or minimising releases
- Removal of dust deposits
- Preventing formation of an explosive atmosphere by enclosure or ventilation
- Collecting and containing releases
- Avoiding ignition sources
- Avoiding adverse conditions (e.g. high temperatures)
- Segregating incompatible substances
- Selecting and providing suitable equipment for use in the zones (see Regulation 173).

In many cases it is not possible to avoid explosive atmospheres and sources of ignition with a sufficient degree of certainty. Mitigation measures can then be taken to limit the effects of an explosion. Such measures include:

- Preventing fires and explosion from spreading to other plant and equipment or to other parts of the workplace
- Reducing to a minimum the number of employees exposed
- Providing plant and equipment that can safely contain or suppress an explosion
- Providing explosion pressure relief
- Providing suitable personal protective equipment.

In addition to the technical measures for explosion prevention, an employer should consider a number of organisational measures which complement the technical measures in place. These include:

- Providing written instructions where necessary
- Ensuring that workers have adequate competence and have received instruction in explosion protection
- Applying a permit to work system
- Carrying out inspections and surveillance
- Ensuring adequate supervision
- Marking hazardous places
- Ensuring adequate maintenance of plant.

The control measures necessary for the safe handling and use of flammable substances often require employees to carry out the appropriate operating procedures correctly and to comply with written or verbal instructions. Employers, therefore, should provide employees with sufficient supervision and training to ensure that the systems of work required by Part 8 of the General Application Regulations are fully implemented and that operating procedures are correctly followed.

Regulation 172: Safety of plant, equipment and protective systems

172. (1) *An employer shall ensure that—*

(a) *plant, equipment, protective systems and any associated connecting devices are only brought into service if the explosion protection document indicates that they can be safely used in an explosive atmosphere,*

(b) *necessary measures are taken to prevent confusion between connecting devices,*

(c) *all necessary measures are taken to ensure that the workplace, work equipment and any associated connecting device made available to employees are—*

(i) *designed,*

(ii) *constructed,*

(iii) *assembled,*

(iv) *installed,*

(v) *maintained, and*

(vi) *operated,*

in such a way as –

(I) *to minimise the risks of an explosion, and*

(II) *if an explosion does occur to control or minimise the propagation of the explosion within that workplace, work equipment, or both,*

- (d) for a workplace referred to in paragraph (c), appropriate measures are taken to minimise the risks to employees from the physical effects of an explosion,
- (e) where the risk assessment shows it to be necessary—
- (i) it is possible, where power failure can give rise to the spread of additional risks, to maintain equipment and protective systems in a safe state of operation independently of the rest of the installation in the event of power failure,
 - (ii) manual override by a competent employee is possible in order to shut down the equipment and protective systems incorporated within automatic processes which deviate from the intended operating conditions, provided that this does not compromise safety, and
 - (iii) on operation of the emergency shutdown, accumulated energy is dissipated as quickly and as safely as possible or isolated so that it no longer constitutes a hazard,
- (f) if the explosion protection document drawn up pursuant to Regulation 169(2) does not state otherwise, equipment and protective systems for all places in which explosive atmospheres may occur is selected on the basis of the categories set out in the relevant statutory provisions intended for use in potentially explosive atmospheres, and
- (g) in particular, the following categories of equipment are used in the zones indicated in Schedule 10, provided they are suitable for gases, vapours, mists or dusts, or any combination of them, as appropriate—
- (i) in zone 0 or zone 20, category 1 equipment,
 - (ii) in zone 1 or zone 21, category 1 or 2 equipment, and
 - (iii) in zone 2 or zone 22, category 1, 2 or 3 equipment.
- (2) Paragraph (1)(a) applies also to any equipment or protective systems to which the relevant statutory provisions relating to equipment and protective systems intended for use in potentially explosive atmospheres do not apply if their incorporation into an installation can in itself give rise to an ignition hazard.

Regulation 172 requires employers to ensure that plant, including work equipment, protective systems and associated connecting devices, is designed, constructed, assembled, installed, maintained and operated in such a way as to reduce risk. This requirement relates not only to preventing sources of ignition but also to other safety measures necessary to ensure that fires and explosions are prevented in the workplace. It is similar to the general requirements of Chapter 2 of Part 2 of the General Application Regulations 2007 relating to the use of work equipment, to provide and maintain work equipment which is safe. It applies to all work equipment in use in the workplace, including work equipment not subject to the European Communities (Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres) Regulations 1999 (S.I. 83 of 1999).

Plant and equipment must be suitable for its intended use. The matters to be taken into account include:

- The temperature and pressure under which it will operate
- Its ability to withstand the process or activity without risk of failure
- Suitability of the construction materials regarding compatibility with the flammable substances and with materials
- Resistance to internal and external corrosion.

Protective systems are systems that are intended to stop a fire, explosion or similar event or to limit its spread. They include such things as flame arrestors, pressure relief venting systems and suppression systems. They must be sufficient to deal with the likely size and spread of a fire, explosion or similar event having regard to the equipment to which they are fitted.

Connecting devices connect together pieces of equipment or apparatus and include items such as coupling devices or pipe connectors. Incorrect connections which could result in the mixing of incompatible substances, or the use of unsuitable equipment, must be avoided. Many such devices are made in such a way as to prevent incorrect connections. However, where it is possible to make incorrect connections, further measures such as labelling or colour-coding may be necessary. Employees will require training and instruction in accordance with Regulation 173 in respect of such measures.

Regulation 172 also requires that employers provide a workplace that is suitable for the storage and/or use of flammable substances. The risk assessment will determine what design features are needed in the workplace to reduce risk. Examples of precautions that may be required include ventilation openings, fire-resistant walls, explosion relief panels etc.

Regulation 172(e) requires that, where the risk assessment shows it to be necessary, the consequences of a power failure or the deviation of a process from its normal operating conditions must be taken into account. It may be sufficient to ensure that the plant can be shut down manually. Alternatively, control systems should maintain safety if loss of power could lead to the unintentional release of a flammable substance. The employer should ensure that arrangements are in place so that equipment and/or protective systems remain safe in the event of a power failure and that the removal of the original source of power will not lead, for example, to over-pressurisation, over-filling or temperatures that are too low or too high. It should also be possible to shut down an automatic process through a manual override system before it reaches its safe operating limit. In the event of such a shutdown, any energy that has been created by the process must be either dispersed quickly and safely through a suitable discharge system or safely isolated. The employer must ensure that only competent persons may take such action.

Paragraphs (f) and (g) of Regulation 172 set out the requirements for selecting equipment which comes within the scope of the European Communities (Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres) Regulations 1999 (S.I. No. 83 of 1999) which transpose Directive 94/9/EC. Such equipment is defined in those Regulations as ‘capable of causing an explosion through their own potential sources of ignition’. Such equipment and protective systems must be selected on the basis of the zones and categories set out in Regulation 172(g). The equipment must be CE marked to show that it complies with S.I. No. 83 of 1999 and will also 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 ‘T’ marking and sometimes a gas group. Employers and installers of

equipment should consider the marking and documentation provided with ‘EX’ equipment when it is being installed.

Note that the European Commission has produced guidance documentation for Directive 94/9/EC,¹² which, although intended for the benefit of manufacturers of equipment for use in explosive atmospheres, may also be useful for users of such equipment.

In accordance with the risk assessment and as set out in the explosion protection document, work equipment already in use before 30 June 2003 which does not comply with the requirements of paragraphs (f) and (g) of Regulation 172 may continue to be used provided that it complies with the other relevant paragraphs of Regulation 172. Such equipment, which meets the requirements of Directives 76/117/EEC on the approximation of the laws of the Member States concerning electrical equipment for use in potentially explosive atmospheres employing certain types of protection as amended and 79/196/EEC on the approximation of the laws of the Member States concerning electrical equipment for use in potentially explosive atmospheres employing certain types of protection as amended, can be assumed to be suitable for use in an explosive atmosphere as far as electrical hazards are concerned provided that the equipment has not been modified and has been properly maintained.

Regulation 173: Training, instructions, permits to work

173. An employer shall—

- (a) provide persons at work in workplaces where explosive atmospheres may occur with sufficient and appropriate training with regard to explosion protection, and*
- (b) ensure that, where required by the explosion protection document—*
 - (i) work in hazardous places is carried out in accordance with written instructions issued by the employer,*
 - (ii) a system of permits to work is applied for carrying out both hazardous activities and activities which may interact with other work to cause hazards, and*
 - (iii) permits to work are issued by a competent person responsible for this function, before the activity concerned commences.*

The requirements of Regulation 173 complement the requirements for instruction, training and supervision in Sections 9 and 10 of the 2005 Act and in Regulation 29 of the General Application Regulations 2007. They also require a system of permits to work to be employed where hazardous work is being carried out. The objective in providing instructions and training is to ensure that the employees can work with flammable substances without putting themselves or others at risk. The extent of the information, instruction and training required will vary with the degree of the complexity of the hazards, risks, processes and controls. The risk assessment will

identify these but where risks are comparatively low and adequately controlled, basic instructions and training may be all that is required. The training required will provide adequate information and should include:

- The identity of any flammable substances and where they are used
- The type and extent of the risks (much of this information will be contained in safety data sheets (SDS))
- The significant findings of the risk assessment
- The control/mitigation measures adopted, including methods of work, the reasons for them and how to use them properly
- Any procedures for dealing with accidents and emergencies
- The necessity and use of personal protective equipment (PPE) and special work wear.

The employer should select appropriate methods for providing the necessary information and training. Options include:

- Class or group tuition
- Individual tuition
- Written instructions for specific tasks.

New employees will require induction training which should always cover emergency and evacuation procedures.

The system of work should ensure that the control measures necessary for a particular activity are properly understood and implemented. The level of control required will depend on the risks associated with the activity and may be based on simple operating procedures, safety method statements or permit to work systems. Permit to work systems can play an important part in organising and controlling work activities, particularly where these are high risk, unfamiliar or non-routine. High-risk activities are those where the foreseeable consequences of an error or omission could result in immediate and serious injuries, for example an explosion or a fire that immediately affects people or traps them. They will normally include:

- Hot work on or in any plant or equipment
- Carrying out hot work or introducing ignition sources in areas zoned hazardous
- Entry into and work in a confined space which contains or has contained flammable substances
- Opening or breaking into plant and equipment that contains or has contained flammable substances.

Employers must ensure that permit to work systems are only issued by a competent person who is sufficiently knowledgeable about permit systems and the work processes, including the materials,

processes, plant and equipment associated with the proposed work, to be able to identify all the potential hazards and precautions.

Regulation 174: Protection of employees from explosion

174. *An employer shall—*

- (a) *provide work clothing which does not give rise to electrostatic discharges for use in places classified as hazardous pursuant to Regulation 170(1)(b) to any employee who is obliged to carry out work or duties in such places and is appropriate for the carrying out of such work or duties in such places;*
- (b) *where necessary, ensure that persons at work are given optical or acoustic warnings, or both, and are withdrawn before the explosion conditions are reached; and*
- (c) *where required by the explosion protection document, provide and maintain escape facilities to ensure that, in the event of danger, persons at work can leave endangered places promptly and safely.*

Some clothing, including footwear, contains materials that can generate electrical discharges during use. Such discharges can ignite certain types of explosive atmospheres. The risk from electrostatic discharges can be reduced if the wearer is earthed by means of suitable footwear and flooring, such as concrete or steel grids. This is sufficient for zones classified into 0, 1 or 2 as specified in Schedule 10 to the General Application Regulations 2007. In a small number of cases special footwear may also be necessary in Zones 20, 21 and 22. Accordingly, employees working in explosive atmospheres formed by gases and vapours should be provided with antistatic footwear if the risk assessment indicates that electrostatic discharges could ignite the atmosphere. This is also necessary for some dusts that are very easily ignited. Other antistatic work clothing must also be provided if the risk assessment shows this to be necessary.

Employers must also ensure that any personal protective equipment provided for other purposes, such as to prevent contact with substances hazardous to health, which may be used in an explosive atmosphere will not create electrostatic discharges. Antistatic or ordinary clothing should not be removed in places where an explosive atmosphere may occur and a safe area should be established where workers are able to remove or change clothing in safety.

Employers need to be aware that electrostatic risks can be created by personal items brought into a hazardous area and may need to provide instructions for employees and visitors.

More detailed guidance on the avoidance of static is contained in I.S.CLC/TR 50404.2006 available from the NSAI.¹³ British Standard 5958:1991 Parts 1 and 2 contains general guidance (Part 1) and a range of measures applicable to various industrial situations such as petrochemical installations and flammable powder handling (Part 2).¹⁴

The requirements of paragraphs (b) and (c) of Regulation 174 are in addition to those of Section 11 of the 2005 Act and Regulation 12 of the General Application Regulations 2007 to have emergency arrangements in place and adequate means of escape in case of fire or other emergency.

Where a potential incident involving flammable substances arises, warning and communication systems must be provided, including visual and audible alarms. The system should be appropriate to the level of risk foreseeable and provide sufficient time and information to allow the necessary emergency action to be taken. The warning system should not require persons to remain in the affected area to give the alarm during an emergency. The warning system must be capable of being seen or heard in all parts of the workplace likely to be affected by the incident.

Warning systems can also be used to alert employees to an incident or emergency in order that they can take appropriate action to contain or mitigate the incident. Where there are multiple alarm systems in a workplace, employers must ensure that these are clearly discernible and employees have the necessary training and equipment to be able to carry out safely the correct actions required.

Where required by the explosion protection document, employers must ensure that adequate escape facilities are provided to enable employees and other persons present to reach readily and safely a place of safety. The presence of flammable substances can significantly enhance the speed at which fire develops and also the amount of smoke and fume involved. When considering escape facilities, employers should consider the potential for explosions, rapid fire development and ingress of flammable substances into escape routes to compromise escape and how these events may be mitigated or prevented in such circumstances by appropriate design of the escape route and/or means of suppressing or containing the fire.

Regulation 175: Coordination at workplaces

175. Without prejudice to section 21 of the Act—

- (a) where employees are present in or at the same workplace to which this Part refers and they are employed by different employers, each employer shall ensure the safety of the employer's employees and for that purpose shall ensure that the matters that arise under the employer's control comply with this Part, and*
- (b) where 2 or more employers share the same workplace in which an explosive atmosphere may occur, the employer responsible for the workplace shall co-ordinate the implementation of all the measures required by this Part to be taken to protect employees from any risk from the explosive atmosphere.*

Regulation 175 complements Section 21 of the 2005 Act, which requires cooperation between employers at the same workplace and which also requires them to coordinate their actions and share information. Paragraph (a) requires an employer to comply with the Regulations in so far as he or she has control over the matters giving rise to explosive or similar risks. Paragraph (b) requires the employer responsible for the workplace to coordinate the implementation of the necessary measures under the Regulations.

In shared workplaces, such as docks and airports, it may be the employer responsible for the workplace or one of the other employers whose work activity creates the risk of an explosive atmosphere. Effective coordination will require the employer responsible for the workplace to obtain sufficient information from all employers at the workplace about the nature of their work activity, whether any flammable

substances are present and the likelihood of an explosive atmosphere occurring. All employers at the workplace should provide the responsible employer with the information required and assist in assessing the shared risks and implementing any necessary safety measures.

SCHEDULE 10

EXPLOSIVE ATMOSPHERES Regulations 169 and 170

Part A — Classification of places where explosive atmospheres may occur

1. Places where explosive atmosphere may occur:

- (a) *A place in which an explosive atmosphere may occur in such quantities as to require special precautions to protect the health and safety of the workers concerned is deemed to be hazardous within the meaning of Part 8 of these Regulations.*
- (b) *A place in which an explosive atmosphere is not expected to occur in such quantities as to require special precaution is deemed to be non-hazardous within the meaning of Part 8 of these Regulations.*

Flammable or combustible substances are considered as materials, which may form an explosive atmosphere unless an investigation of their properties has shown that in mixtures with air they are incapable of independently propagating an explosion.

2. Classification of hazardous places

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

The extent of the measures to be taken in accordance with Part 8 is determined by this classification.

Zone 0:

A place in which an explosive atmosphere consisting of a mixture with air of flammable 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 flammable 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 flammable 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.

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:

Layers, deposits and heaps of combustible dust must be considered as any other source, which can form an explosive atmosphere.

“Normal operation” means the situation when installations are used within their design parameters.

Part B – Warning sign for places where explosive atmospheres may occur



Place where explosive atmospheres may occur

Distinctive features:

triangular shape,

black letter on a yellow background with black edging (the yellow part to take up at least 50% of the area of the sign).

Endnotes

¹ Directive 1999/92/EC of the European Parliament and the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (OJ L23, 28.1.2000, p. 57)

² *Non-binding guide to good practice for implementing Directive 1992/92/EC 'ATEX' (explosive atmospheres)*, published by the European Communities, 2005 (ISBN 92-894-8721-6)

³ Dangerous Substances and Explosive Atmospheres Regulations 2002, Approved Codes of Practice L134, L135, L136, L137, L138 (available from HSE Books, PO Box 1999, Sudbury, Suffolk CO10 2WA)

⁴ Directive 94/55/EC on the approximation of the laws of the Member States with regard to the transport of dangerous goods by rail (OJ L319, 12.12.1994)

⁵ Council Directive 90/396/EEC of 29 June 1990 on the approximation of the laws of the Member States relating to appliances burning gaseous fuels (OJ L196, 26.07.1990, p. 15)

⁶ Council Directive 93/68/EEC of 22 July 1993 on the approximation of the laws of the Member States relating to appliances burning gaseous fuels (OJ L220, 30.08.1993, p. 1)

⁷ *Guide to the Selection of Electrical Apparatus for Use in Potentially Explosive Atmospheres*, ET 202: 2001. published by the Electro-Technical Council of Ireland (ETCI) (ISBN 0 9539380 2 6)

⁸ Directive 94/9/EC of the European Parliament and the Council of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres (OJ No. L100, 19.4.94. p.1.)

⁹ Electrical apparatus for explosive gas atmospheres. Part 10 – Classification of hazardous areas. EN 60079/10 (available from NSAI, Glasnevin, Dublin 9)

¹⁰ Equipment for use in the presence of combustible dusts. Part 3 – Classification of areas where combustible dusts are or may be present EN 50281-3:2002 (available from NSAI, Glasnevin, Dublin 9)

¹¹ *Model Code of Safe Practice*. Part 15: Area classification code for installations handling flammable fluids, Institute of Petroleum (now the Energy Institute), 2002 (ISBN 0 85293 223 5) (available from Portland Press Ltd, Commerce Way, Colchester CO2 8HP)

¹² Guidance on the application of Council Directive 94/9/EC of 23 March 1994 on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres, 2nd edition, July 2005 (updated May 2007) (available from the European Commission)

¹³ Electrostatics. Code of practice for the avoidance of hazards due to static electricity (I.S.CLC/TR 50404.2006) (available from NSAI, Glasnevin, Dublin 9)

¹⁴ (i) Code of Practice for control of undesirable static electricity – General considerations, BS 5958:1991-1, British Standards Institution (BSI); (ii) Code of Practice for control of undesirable static electricity. Recommendations for particular situations, BS 5958:1991-2, British Standards Institution (BSI)

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