

# Controlling fire and explosion risks in the workplace

## A brief guide to the Dangerous Substances and Explosive Atmospheres Regulations



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### Introduction to DSEAR

This leaflet provides a brief introduction to the requirements of the Dangerous Substances and Explosive Atmospheres Regulations 2002 – known as DSEAR.<sup>1,2</sup>

It explains what employers may need to do to protect their employees from fire and explosion risks. It will also be useful to employees and their representatives.

The Regulations aim to protect people from fire and explosion risks related to dangerous substances and potentially explosive atmospheres.

DSEAR places duties on employers to protect people from risks to their safety from fires, explosions and similar events in the workplace.

These duties also apply to those self-employed people whose work activities may pose a risk to others.

### What is a dangerous substance?

Dangerous substances are any substances used or present at work that could, if not properly controlled, cause harm to people as a result of a fire, explosion or similar incident, such as an uncontrolled chemical reaction.

They can be found in nearly all workplaces and include such things as solvents, paints, varnishes, flammable gases, liquefied petroleum gas (LPG), dusts from machining and sanding operations, and dusts from foodstuffs.

Dangerous substances do not include all materials that can catch fire in the workplace. However, some materials that can cause the rapid escalation of a fire if handled in a certain way are also classed as dangerous substances under DSEAR (eg cellular plastic foams).

### What is an explosive atmosphere?

An explosive atmosphere is a mixture of a dangerous substance or substances (gas, mist, dust or vapour) with the air, which has the potential to catch fire or explode. An explosive atmosphere does not always result in an explosion but, if it does catch fire, the flames travel quickly. If this happens in a confined space (eg in plant), the rapid spread of the flames or rise in pressure could also cause an explosion.

## **When does DSEAR apply?**

The Regulations apply to the majority of work activities, including those carried out in moveable structures, outdoor areas and domestic premises, where:

- work is being carried out by an employer (or self-employed person);
- a dangerous substance is present (or is liable to be present or generated) at the workplace;
- a potentially explosive atmosphere may occur;
- the dangerous substance and/or potentially explosive atmosphere could be a risk to the safety of people as a result of fires, explosions or similar energetic events.

For example, DSEAR covers the following activities:

- storage and use of flammable liquid-based paints and inks;
- storage of LPG;
- storage and use of oxygen;
- storage and transport of powders in pharmaceutical and food industries;
- storage and display of flammable goods, such as paints in shops;
- handling and storage of flammable waste solvents;
- welding or other 'hot work' on tanks and drums that have contained flammable material;
- use of flammable gases, such as acetylene, for welding;
- use of flammable solvents in laboratories;
- transport of flammable substances in containers around a workplace;
- deliveries from road tankers, such as flammable liquids, gases and bulk powders;
- chemical manufacturing, processing and warehousing.

## **What must I do to comply?**

DSEAR places duties on employers and the self-employed (considered employers for the purposes of the Regulations) to assess and eliminate or reduce risks from dangerous substances so far as is reasonably practicable. To comply you should do the following.

### ***Assess the risks***

Where a dangerous substance is, or is liable to be, present in the workplace the employer should assess the risk of harm this poses to people in the event of a fire, explosion or similar event.

Ideally, you should carry out a risk assessment in relation to DSEAR as part of the overall workplace risk assessment required under the Management of Health and Safety at Work Regulations 1999.<sup>3</sup>

You may also find it convenient to carry out the risk assessment in combination with that required under the general fire precautions legislation in the workplace – the Regulatory Reform (Fire Safety) Order 2005 and the Fire (Scotland) Act 2005.<sup>4</sup>

More information about risk assessments can be found on HSE's risk management website.<sup>5</sup> The risk assessment under DSEAR includes five steps:

### ***Step 1 Identify the fire and explosion hazards and hazards from similar energetic events***

This should be an identification and careful examination of:

- the dangerous substances present, including those that may be formed in the workplace;
- the potential ignition sources of the dangerous substances;
- the work activities involving the dangerous substances;
- the possible formation and extent of explosive atmospheres;
- the scale of the anticipated effects from the fire, explosion or similar energetic event.

The supplier's Material Safety Data Sheet should provide key information on the properties and hazards of the dangerous substance to assist you in this task. It should also provide information on the safe methods for the storage, use and handling of the dangerous substance, or make reference to where this may be found.

### ***Step 2 Decide who might be harmed and how***

Identify the people at risk from the fire, explosion hazards or similar energetic event involving the dangerous substance.

Based on your consideration of the anticipated effects of the incident, determine who might be potentially harmed by it. This includes members of the public who might be put at risk by the work activity.

### ***Step 3 Evaluate the risks and decide on precautions***

You should determine whether the measures taken are adequate to eliminate or reduce the risks from dangerous substances, so far as is reasonably practicable.

This should take account of such things as:

- the possible substitution of the dangerous substance by one that is non-hazardous, or one that is less hazardous;
- the control measures to prevent a fire, explosion or similar energetic incident from occurring;
- the mitigation measures to limit the scale and magnitude of the incident should it occur.

### ***Step 4 Record your findings and implement control measures***

If you employ five or more employees, you should record the significant findings of your risk assessment. This should include the location and extent of explosive atmospheres and their classification in terms of zones.

The risk assessment should also help you decide on:

- the information, instruction and training you give to your employees. This should be sufficient for them to safeguard themselves and others from the risks presented by the dangerous substances;
- the arrangements to deal with accidents, incidents and emergencies, including involvement of the emergency services.

### ***Step 5 Review your risk assessment and update if necessary***

If you introduce significant changes to your workplace, such as changing the dangerous substances present or their quantities, or changing the work equipment or processes, you should review your risk assessment.

Similarly, you should do this in the event of an incident, including a near miss – for example a release of a dangerous substance without ignition – to determine if the measures you have in place are sufficient.

You should carry out a risk assessment regardless of the quantity of dangerous substance present, as it will enable you 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, you will also need to assess non-routine activities, such as maintenance work, where there is often a higher potential for fire and explosion incidents to occur.

If there is no risk to safety from fires and explosions, or the risk is trivial, no further action is needed. If there are risks then you should consider what you need to do to comply fully with the requirements of DSEAR.

## **Eliminate or reduce the risks from dangerous substances**

DSEAR requires a hierarchical approach for the elimination or reduction of the risks from dangerous substances.

You should first consider how to eliminate or reduce the risk by replacing the dangerous substance with another substance, or using a different work process. This is called substitution in the Regulations.

In practice, it is recognised this may be difficult to achieve, eg where the dangerous substance is used as a fuel. However, for some work activities and processes it may be possible to eliminate or reduce the risk by using a non- or less dangerous substance, eg by replacing a low-flashpoint liquid with a non-flammable liquid, or one with a higher flashpoint.

Where this is not reasonably practicable, you should consider what control measures to take to prevent a fire, explosion or similar energetic incident from occurring.

## **Control measures<sup>6</sup>**

Prioritise your control measures as follows:

- reduce the quantity of dangerous substances to a minimum;
- avoid or minimise releases of dangerous substances;
- control releases of dangerous substances at source;
- prevent the formation of an explosive atmosphere, including by ventilation;
- collect, contain and remove any releases to a safe place;
- avoid ignition sources;
- avoid adverse conditions (such as exceeding pressure/temperature limits) that could lead to danger;
- keep incompatible substances apart.

Following implementation of the control measures, the next priority is the identification and implementation of mitigation measures to reduce the detrimental effects of a fire, explosion or similar incident.

## Mitigation measures<sup>6</sup>

These are as follows:

- reduce the number of employees exposed to the risk;
- provide plant that is explosion resistant;
- provide explosion suppression or explosion relief equipment;
- take measures to control or minimise the spread of fires or explosions;
- provide suitable personal protective equipment (PPE).

The provision of suitable PPE should not be a substitute for providing appropriate protective measures on the plant, equipment or workplace itself.

The control and mitigation measures you implement should be consistent with the findings of the risk assessment and appropriate to the nature of the activity or operation.

## Additional requirements where explosive atmospheres can occur

The correct implementation of control measures aims to prevent the formation of potentially explosive atmospheres, or limit their extent. However, due to the way dangerous substances are stored, handled and used, you cannot fully avoid the risk of potentially explosive atmospheres occurring.

The areas where hazardous explosive atmospheres may occur should be identified and classified into zones, based on their likelihood and persistence. This is known as Hazardous Area Classification.

The zone classifications are:

**Zone 0 (Zone 20)** That part of a hazardous area in which an explosive atmosphere is continuously present, or present for long periods, or frequently.

**Zone 1 (Zone 21)** That part of a hazardous area in which an explosive atmosphere is likely to occur occasionally in normal operation.

**Zone 2 (Zone 22)** That part of a hazardous area in which an explosive atmosphere is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

Zones 0, 1 and 2 are used for explosive atmospheres formed of flammable gases, vapours or mists. Zones 20, 21 and 22 are used for explosive atmospheres formed of combustible dusts.

**There are a number of approaches you can use for this which are discussed in the guidance listed in 'Further reading'. Your supplier and relevant trade association are also likely to be able to provide useful advice on Hazardous Area Classification for your workplace.**

For the hazardous areas identified, you should ensure that:

- all potential ignition sources, including sparks, hot surfaces, smoking materials, naked flames, unsuitable equipment etc are excluded;
- only equipment and protective systems, including portable equipment that meets the requirements of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996,<sup>7</sup> should be used and installed. Such equipment will be CE marked and carry the Ex symbol in a hexagon – see below. Equipment and protective systems in use before July 2003 can continue to be used provided the risk assessment shows it is safe to do so;



- before bringing them into operation for the first time, as part of the commissioning procedure, a person competent to do so should verify that the equipment and protective systems provided are suitable and sufficient to make sure the fire and explosion risks are properly controlled;
- people who provide, maintain or verify electrical installations and equipment in, or associated with, the hazardous areas are competent to undertake the task (eg CompEx trained);
- where necessary, a warning sign is posted at the entry points of places that have been classified as hazardous areas to warn those entering those areas that special precautions are required;



*Example of warning sign with supplementary text*

- employees working in these areas are provided with appropriate clothing that does not create a risk of an electrostatic discharge capable of igniting the explosive atmosphere.

## **Provide information, instruction and training for employees**

Relevant information, instruction and training for employees includes:

- details of dangerous substances in the workplace and the risks they present, including access to any relevant safety data sheets and information on any other legislation that applies to the dangerous substance;
- the findings of the risk assessment and the control and mitigation measures put in place as a result (including their purpose and how to follow and use them);
- emergency procedures.

You only need to provide information, instruction and training to other people (non-employees) where it is required to ensure their safety, and it should be in proportion to the level and type of risk.

The contents and associated hazards of pipes, containers etc used for dangerous substances in the workplace should be clearly identifiable so that employees and others are alerted to the presence of the dangerous substance. Where you have already identified the contents to meet the requirements of other law, this does not need to be done again under DSEAR.

## **Prepare for accidents, incidents and emergencies**

The Regulations require employers to assess the likelihood of, and scale or magnitude of the effects that may result from, any foreseeable accident, incident, emergency or other event involving dangerous substances present in the workplace. Based on this assessment, you should put in place appropriate emergency arrangements to safeguard people on your premises, mitigate the effects of any such event, and restore the situation to normal.

Such arrangements include the plans and procedures for safety drills, warning and other communication systems, and first-aid facilities. These are also required under general fire precautions legislation – the Regulatory Reform (Fire Safety Order 2005 and the Fire (Scotland) Act 2005) – and the Health and Safety (First Aid) Regulations 1981.<sup>8</sup>

They are included in DSEAR to require the employer to put in place additional arrangements to deal with the accidents, incidents and emergencies that may arise or be enhanced due to the presence of dangerous substances in the workplace.

Equally, no additional arrangements are required where your risk assessment determines that the dangerous substance poses only a slight risk – because of the quantity present, and your assessment that the measures you have put in place to comply with the general fire precautions legislation and the Health and Safety (First Aid) Regulations are sufficient.

If an accident, incident or emergency occurs, you should provide employees tasked with carrying out repairs or other necessary work with the appropriate equipment, including PPE and information, instruction and training to enable them to carry out this work safely.

The information in the emergency plans and procedures should be made available to the emergency services to allow them to develop their own plans if necessary.

## References

- 1 *Dangerous Substances and Explosive Atmospheres Regulations* SI 2002/2776 [www.legislation.gov.uk/ukxi/2002/2776/contents/made](http://www.legislation.gov.uk/ukxi/2002/2776/contents/made)
- 2 *Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L138 HSE Books 2003 ISBN 978 0 7176 2203 0 [www.hse.gov.uk/pubns/books/l138.htm](http://www.hse.gov.uk/pubns/books/l138.htm)
- 3 *Management of health and safety at work. Management of Health and Safety at Work Regulations 1999. Approved Code of Practice and guidance* L21 HSE Books 2000 ISBN 978 0 7176 2488 1 [www.hse.gov.uk/pubns/books/l21.htm](http://www.hse.gov.uk/pubns/books/l21.htm)
- 4 For up-to-date information on fire precautions legislation see [www.hse.gov.uk/fireandexplosion/dsear.htm](http://www.hse.gov.uk/fireandexplosion/dsear.htm)
- 5 HSE's risk management website: [www.hse.gov.uk/risk](http://www.hse.gov.uk/risk)
- 6 *Control and mitigation measures. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L136 HSE Books 2003 ISBN 978 0 7176 2201 6 [www.hse.gov.uk/pubns/books/l136.htm](http://www.hse.gov.uk/pubns/books/l136.htm)
- 7 *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996* SI 1996/192 [www.legislation.gov.uk/ukxi/1996/192/contents/made](http://www.legislation.gov.uk/ukxi/1996/192/contents/made)
- 8 Up-to-date first aid legislation: [www.hse.gov.uk/firstaid/legislation.htm](http://www.hse.gov.uk/firstaid/legislation.htm)

## Further reading

Fire and explosion pages of HSE's website: [www.hse.gov.uk/fireandexplosion/](http://www.hse.gov.uk/fireandexplosion/)

*Design of plant, equipment and workplaces. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L134 HSE Books 2003 ISBN 978 0 7176 2199 6 [www.hse.gov.uk/pubns/books/l134.htm](http://www.hse.gov.uk/pubns/books/l134.htm)

*Storage of dangerous substances. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L135 HSE Books 2003 ISBN 978 0 7176 2200 9 [www.hse.gov.uk/pubns/books/l135.htm](http://www.hse.gov.uk/pubns/books/l135.htm)

*Safe maintenance, repair and cleaning procedures. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance* L137 HSE Books 2003 ISBN 978 0 7176 2202 3 [www.hse.gov.uk/pubns/books/l137.htm](http://www.hse.gov.uk/pubns/books/l137.htm)

(For England & Wales) *Fire Safety Risk Assessment – Factories and Warehouses* ISBN 978 1 8511 2816 7

(For Scotland) *Practical Fire Safety Guidance For Factories And Storage Premises* [www.firelawscotland.org/v26276.html?pContentID=244](http://www.firelawscotland.org/v26276.html?pContentID=244)

*Safe use and handling of flammable liquids* HSG140 HSE Books 1996 ISBN 978 0 7176 0967 3 [www.hse.gov.uk/pubns/books/hsg140.htm](http://www.hse.gov.uk/pubns/books/hsg140.htm)



*The storage of flammable liquids in containers* HSG51 (Second edition)  
HSE Books 1998 ISBN 978 0 7176 1471 4  
[www.hse.gov.uk/pubns/books/hsg51.htm](http://www.hse.gov.uk/pubns/books/hsg51.htm)

*The storage of flammable liquids in tanks* HSG176 HSE Books 1998  
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*Safe handling of combustible dusts: Precautions against explosions* HSG103  
(Second edition) HSE Books 2003 ISBN 978 0 7176 2726 4  
[www.hse.gov.uk/pubns/books/hsg103.htm](http://www.hse.gov.uk/pubns/books/hsg103.htm)

*Designing and operating safe chemical reaction processes* HSG143 HSE Books  
2000 ISBN 978 0 7176 1051 8 [www.hse.gov.uk/pubns/books/hsg143.htm](http://www.hse.gov.uk/pubns/books/hsg143.htm)

*Safe use and storage of cellular plastics* HSG92 HSE Books 1996  
ISBN 978 0 7176 1115 7 [www.hse.gov.uk/pubns/books/hsg92.htm](http://www.hse.gov.uk/pubns/books/hsg92.htm)

*Checklist for the assessment of safety standards at operator owned sites*  
UKLPG UIS006 [www.uklpg.org/uploads/DOC4D42E68445DED.pdf](http://www.uklpg.org/uploads/DOC4D42E68445DED.pdf)

*Electrical installations associated with bulk LPG installations*  
UKLPG UIS008 [www.uklpg.org/uploads/DOC4D42E71B42230.pdf](http://www.uklpg.org/uploads/DOC4D42E71B42230.pdf)

*Safe use of propane and butane cylinders, appliances and equipment*  
UKLPG UIS028 [www.uklpg.org/uploads/DOC4F0D692796907.pdf](http://www.uklpg.org/uploads/DOC4F0D692796907.pdf)

*DSEAR Risk Assessment 2008* BCGA Guidance note GN13  
[www.bcg.co.uk/publications/GN13.html](http://www.bcg.co.uk/publications/GN13.html)

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(They are also available from bookshops.)  
Statutory Instruments can be viewed free of charge at [www.legislation.gov.uk/](http://www.legislation.gov.uk/).

## **Further information**

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This guidance is issued by the Health and Safety Executive. Following the guidance is not compulsory, unless specifically stated, and you are free to take other action. But if you do follow the guidance you will normally be doing enough to comply with the law. Health and safety inspectors seek to secure compliance with the law and may refer to this guidance.

This leaflet is available at: [www.hse.gov.uk/pubns/indg370.htm](http://www.hse.gov.uk/pubns/indg370.htm).

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