

# Explosives Regulations 2014

## Safety provisions

### Guidance on Regulations



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This publication is for anyone who has duties under the safety provisions of the Explosives Regulations 2014 (ER2014) (SI 2014/1638).

It is particularly relevant to dutyholders such as employers, private individuals and other people manufacturing explosives, storing larger quantities of explosives or storing explosives that present higher hazards or greater risks of initiation.

This publication provides overarching technical guidance that will help dutyholders to comply with the safety provisions in the Regulations. It also identifies detailed topic-based and specialist guidance and provides background information that supports subsector guidance published elsewhere.

It also contains material relevant to enforcing authorities such as local authority trading standards officers, the police, fire and rescue services and other emergency services. This publication may also be of interest to other government or regulatory agencies and waste disposal operators.

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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.

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## Introduction

### Who is this publication for?

- 1 This publication is for anyone who has duties under the safety provisions of the Explosives Regulations 2014 (ER2014) (SI 2014/1638).
- 2 It is particularly relevant to dutyholders such as employers, private individuals and other people manufacturing explosives, storing larger quantities of explosives or storing explosives that present higher hazards or greater risks of initiation.
- 3 This publication provides overarching technical guidance that will help dutyholders to comply with the safety provisions in the Regulations. It also identifies detailed topic-based and specialist guidance and provides background information that supports subsector guidance, see paragraph 8.
- 4 It also contains material relevant to enforcing authorities such as local authority trading standards officers, the police, fire and rescue services and other emergency services. This publication may also be of interest to other government or regulatory agencies and waste disposal operators.

### What is this publication about?

- 5 This publication provides overarching guidance on how the safety provisions of the Regulations should be met.
- 6 Following the guidance will enable you to comply with the safety provisions of ER2014.
- 7 This document also provides guidance on the application and scope of the Regulations and on some wider areas which are relevant to ER2014. These wider areas are included as they help support compliance with the safety provisions.

Throughout this guidance you will see statements in boxes. The statements identify successful outcomes of the application of appropriate safety measures to explosives operations. Dutyholders can use the statements to challenge themselves on the effectiveness of the safety precautions that they have implemented.

### Subsector guidance

- 8 There is subsector guidance that complements this document. Links to subsector guidance can found at [www.hse.gov.uk/explosives/new-regs-subsector.htm](http://www.hse.gov.uk/explosives/new-regs-subsector.htm).
- 9 Dutyholders such as employers, private individuals and other people manufacturing explosives, storing larger quantities of explosives or storing explosives that present higher hazards or greater risks of initiation should use the relevant subsector guidance to supplement the guidance in this document.

10 Dutyholders working in other subsectors should use this document to support or to provide background to published subsector guidance.

### **Other health and safety legislation that applies to explosives operations**

11 There are other general health and safety regulations which apply to explosives operations. This publication gives additional guidance where there are particular issues which need to be considered, for example, in selecting work or personal protective equipment or in vacating an explosives site.

### **Application and the scope of the Regulations**

12 Regulations 2 and 3 of ER2014 identify how the Regulations apply to explosives operations. This section provides information and guidance on how the scope of the Regulations applies to the safety provisions.

#### ***Explosives for work, personal and recreational use***

13 ER2014 applies to explosives operations whether they are for work or non-work purposes. They therefore apply to anyone storing explosives for personal recreational use, or to voluntary clubs or societies storing explosives (examples include storage for firework displays, bonfire processions or re-enactment events).

#### ***Transport***

14 ER2014 does apply to the transport of explosives on site. This includes movement on public roads between different buildings on the same site.

15 ER2014 does not apply to explosives that are being transported by road, rail, air or water provided that the explosives are not kept in one place for longer than 24 hours.

16 Explosives that are being transported will be treated as being in storage when they are, or are to be, kept at any place for more than 24 hours.

17 Dutyholders who keep explosives that are being transported as part of the supply chain should ensure that any explosives whose onward journey cannot take place are stored safely and lawfully.

#### ***Application offshore***

18 ER2014 applies to certain activities in the UK territorial sea adjacent to Great Britain (for example, coastal construction activities which extend into the territorial sea and the construction, operation and demolition of wind farms).

19 ER2014 does not apply to ships at sea or ships moored within harbour areas (see the Dangerous Substances in Harbour Areas Regulations 1987 (SI 1987/37)). Outside the territorial sea ER2014 will only apply within designated areas on the UK Continental Shelf.

20 Regulations 6, 7, 9, 10, 12–18, 20, 23 and 26–30 of ER2014 do not apply to offshore installations as defined by regulation 3 of the Offshore Installations and Pipeline Works (Management and Administration) Regulations 1995 (SI 1995/738).

#### ***Explosives in use***

21 The safety provisions of ER2014 do not generally apply to explosives that are in use. However, the nature of some activities on sites licensed by the Health and Safety Executive (HSE) and the Office for Nuclear Regulation (ONR) means that



there may be constraints on these activities in the licence where they interact with the manufacture or storage of explosives.

22 All unused explosives must be returned to a suitable store at the end of each day. However, there may be circumstances, such as complex demolitions, blasting operations, or large fireworks displays, when explosives are left overnight in the shothole or attached to the structure to be demolished or rigged as part of a display. Similarly the investigation of a misfire may require explosives to be left in situ until they can be safely removed or disposed of. The operator should make arrangements for supervision of the explosives to ensure their safety and security.

23 While the operations are continuing, these explosives would be regarded as being in use. Were the operations to cease, or be suspended for any length of time, the explosives could be regarded as no longer in use and therefore subject to the 'safety provisions' of ER2014. In the final instance it would be for a court to decide, as a matter of fact, whether in the specific circumstances the explosives were, or were not, in use.

### **Hazard type**

#### ***The role of hazard type***

24 Hazard type (HT) is central to both the safety provisions and the licensing elements of the Regulations.

25 Hazard type defines and describes the nature of the hazard arising from an explosive in manufacture and storage conditions.

#### ***Definition of 'hazard type' and its relationship to hazard division***

26 Definitions of the hazard types are given in regulation 2 of ER2014:

- *Hazard Type 1: '...an explosive which, as a result of, or as a result of any effect of, the conditions of its storage or process of manufacture, has a mass explosion hazard'* (a mass explosion can be one in which the entire body of explosives explodes as one; where a substantial proportion of the explosives present could explode in such a way that the practical hazard should be assessed by assuming simultaneous explosion of all of the explosives present; or one which is associated with a serious blast hazard);
- *Hazard Type 2: '...an explosive which, as a result of, or as a result of any effect of, the conditions of its storage or process of manufacture, has a serious projectile hazard but does not have a mass explosion hazard'* (where a fragment hazard arises solely as a consequence of the building or structure in which the explosives are located, breaking up, the explosives would normally be treated as Hazard Type 1);
- *Hazard Type 3: '...an explosive which, as a result of, or as a result of any effect of, the conditions of its storage or process of manufacture, has a fire hazard and either a minor blast hazard or a minor projectile hazard, or both, but does not have a mass explosion hazard'* (ie those explosives which give rise to considerable radiant heat or which burn to produce a minor blast or projection hazard);
- *Hazard Type 4: '...an explosive which, as a result of, or as a result of any effect of, the conditions of its storage or process of manufacture, has a fire hazard or slight explosion hazard, or both, with only local effect'* (ie those explosives which present only a relatively low explosives hazard in the event of ignition or initiation, where no significant blast or projection of fragments of appreciable size or range is expected).

27 Hazard type represents the potential behaviour of the explosives in the form in which they are manufactured or stored. This means that explosives do not have

inherent hazard types that can be automatically ascribed without consideration. Hazard type will be dependent on:

- the quantity of explosives;
- the types of explosives;
- the loading density;
- packaging (if any) or containment;
- the presence of barriers or other controls that will prevent rapid communication of an event between explosives;
- orientation;
- how an event involving the explosives might progress or degrade any controls.

28 How explosives of different hazard type can affect their surroundings can also depend on the orientation of any packaging, additional confinement or building that they are in.

29 The hazard type of packaged explosives may not correspond to the UN/ADR hazard division classification for transport – although in the majority of cases the hazard type of packaged explosives will correspond to the hazard division.

30 Hazard division is the classification assigned (along with a 4-digit UN Number) by a competent authority for an explosive as packaged for transport according to the requirements of the UN scheme. Hazard types share similar criteria for describing behaviours (blast, fragmentation etc) as hazard divisions but represent the hazards posed in manufacture and storage rather than when an explosive has been packaged for transport.

#### *Determination of hazard type*

31 Some explosives kept under particular circumstances are not normally considered in terms of hazard type for the purposes of regulation 26 of ER2014. These explosives include desensitised explosives and those listed in the exceptions to the application of regulation 27.

32 For those explosives being kept as packaged for carriage, and that have been classified, there will generally be a direct correlation between the UN hazard division (HD) assigned them on classification for transport and the hazard type (HT) they should be allocated for storage, ie:

- UN HD 1.1 = HT 1
- UN HD 1.2 = HT 2
- UN HD 1.3 = HT 3
- UN HD 1.4 = HT 4

33 Explosives that have been assigned on classification the UN HD 1.5 and 1.6 will need to be considered in detail and on a case-by-case basis before a hazard type can be allocated.

34 If explosives are kept other than in their classified packaging, it cannot be assumed that the hazard they present remains the same. The nature of packaging (or lack of it), and the quantity and arrangement in storage can have a significant effect on the hazard presented in non-transport situations. The hazards presented by explosives should be assessed throughout the course of their manufacture, storage and handling to ensure that the correct hazard type is used under all conditions.

35 This assessment may require tests and trials to be undertaken to determine how an explosive behaves in particular circumstances, and the hazard type may vary as conditions change. For example:

- Propellants classified as UN HD 1.3 would, under normal circumstances, be regarded as HT 3. However, under specific circumstances these propellants can be HT 1. Such circumstances include confinement during processing (especially at elevated pressure and/or temperature), and exceeding the critical diameter and bed depth of the material. Examples of where these circumstances may occur are:
  - within an extrusion press (where the key considerations are critical diameter, confinement, pressure and, with certain pressing operations, elevated temperature); and
  - within a hopper or pipework in a cartridge-filling operation (where the key considerations are propellant depth and confinement).
- Some detonators classified as UN HD 1.4 for transport can also present an HT 1 hazard when outside their packaging and stored together.
- An explosion in a box where a large number (thousands) of percussion caps are kept loose will result in the explosion of the majority of the caps in the box (HT 1). However, if the same caps are kept in small boxes or in trays where they are separated from one another, the initiation of one cap will not result in the initiation of the rest of them (HT 4).
- Black powder classified as UN HD 1.1, would when:
  - stored in large quantities or metal tins be regarded as HT 1;
  - unconfined and in quantities of a few grammes be generally regarded as HT 4;
  - stored in accordance with Appendix 7 of this guidance be regarded as HT 3.

## Terminology

36 Further information on various terms used in the Regulations and in this document can be found in the Glossary.

## Safety requirements

Explosives operations are subject to robust controls to maintain safety standards.

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### General principles of safety in explosives operations

37 High standards of safety need to be in place before explosive operations start and they should remain in place – and be effective – for as long as the explosive operations continue. It is generally difficult or impossible to regain control of an event involving explosives once control has been lost. The safety provisions of ER2014 provide the regulatory framework for identifying and implementing these standards of safety and are based on generally recognised principles of safe operation in the sector.

38 There are ten general principles underpinning the safety provisions of ER2014. These principles should form part of the arrangements and working practices of anyone undertaking explosives operations.

- People undertaking explosives operations should be competent to carry out their particular roles.
- The particular hazards associated with the explosives should be understood.
- The sources of energy that could cause the explosives to initiate should be identified.
- Appropriate safety measures should be part of a planned and proportionate system of work to control all sources of energy that could cause an initiation.
- Particular care should be taken where an activity involves the application of energy to an explosive to ensure that this is controlled.
- So far as reasonably practicable, the quantity of explosives, extent and duration of exposure to the hazard should be minimised.
- The number of people exposed to the hazard should be limited to the minimum necessary for the activity in hand.
- Precautions should be in place to prevent an explosives event from escalating if an initiation does take place.
- Precautions should be in place to protect people if an initiation does occur.
- Robust systems should be in place to make sure that the necessary precautions are in place and remain effective.

39 Applying these principles should result in arrangements and safe systems of work which ensure that:

- suitably qualified and experienced people are engaged in all elements of the explosives operations;
- the properties of any explosives being manufactured or stored are known and/or understood;
- the hazards presented by the explosives under the conditions of their manufacture or storage will have been identified and assessed;

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- reasonably practicable steps are taken to segregate activities involving explosives from activities that do not involve explosives;
- wherever reasonably practicable, sensitive explosives are desensitised during processing or storage;
- explosives are not introduced into multi-stage processes until as late as possible;
- the amounts of explosive present in production and packing areas are limited to that needed for the work in hand;
- people are not exposed to explosives hazards unnecessarily;
- people in close proximity to explosives areas are provided with an appropriate level of protection from harm;
- changes in processes and procedures are not made until checks have been made to see that all the control measures remain appropriate.

## Regulatory framework

40 The safety provisions in ER2014 comprise four whole regulations and some elements of a fifth regulation.

41 The four whole regulations are:

- **Regulation 26** requires anyone manufacturing or storing explosives to take appropriate measures:
  - to prevent fire or explosions;
  - to limit the extent of fire or explosion including measures to prevent the spreading of fires and the communication of explosions from one location to another; and
  - to protect people from the effects of fire or explosion.
- **Regulation 27** requires people storing explosives to maintain separation distances, identifies the circumstances in which separation distances do not need to be applied, and identifies how separation distances are applied to certain sites that are granted a licence by HSE or ONR.
- **Regulation 28** requires anyone discarding or disposing of explosives, or who is decontaminating explosive-contaminated items, to ensure, so far as reasonably practicable, that they are undertaking those activities safely.
- **Regulation 29** prohibits the manufacture and storage and import of pyrotechnics containing sulphur and/or phosphorus mixed with chlorates without the approval of HSE.

42 **Regulation 13** relates to the grant of licences but also includes safety provisions. It allows:

- HSE and ONR to prescribe separation distances at most of the sites they license as an alternative to the 'fixed rules' approach required by regulation 27;
- HSE and ONR to prescribe certain activities that will be subject to the provisions of the licence at most of the sites they license to take account of potential interactions between those activities and the manufacture and/or storage of explosives that takes place at that site;
- all licensing authorities to reinforce the requirements of regulation 26 as they relate to the sale of pyrotechnic articles at a site which is licensed for the storage of explosives.

## Fire and explosion measures

### Regulation 26 Fire and explosion measures

#### Regulation 26

(1) Any person who manufactures or stores explosives must take appropriate measures –

- (a) to prevent fire or explosion;
- (b) to limit the extent of fire or explosion including measures to prevent the spreading of fires and the communication of explosions from one location to another; and
- (c) to protect persons from the effects of fire or explosion.

(2) For the purposes of paragraph (1), the reference to the manufacture or storage of explosives is to be deemed to include a reference to any handling, on-site transport and testing of explosives which is associated with that manufacture or storage.

(3) In this regulation, “fire or explosion” means unplanned fire or explosion at the site of manufacture or storage.

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#### Safety measures

During manufacture and storage, appropriate measures are taken to:

- prevent an unplanned fire or explosion;
- limit the extent of fires or explosions;
- prevent fires spreading;
- stop explosions communicating from one place to another; and
- protect people from the effects of a fire or explosion.

43 The appropriate safety measures will depend on the nature of the operations and the explosives. Regulation 26 requires safety measures to be taken for:

- preventing fires and explosions by controlling sources of energy that could initiate a fire or an explosion (‘sources of initiation’) and the circumstances that could bring an initiation about;
- limiting the extent of a fire or explosion. This involves taking steps to prevent fires spreading or explosions communicating, and limiting the amount of explosives involved;
- protecting people in the event of an explosion. This will involve:
  - considering the number of people who might be affected by an explosives event;
  - having emergency procedures in place;
  - taking steps to ensure people can quickly escape in the event of a fire; and
  - making provision to protect them from the effects of a blast or other explosion effect.

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44 An unplanned fire or explosion is:

- a fire or explosion on the site that the person manufacturing or storing the explosives did not intend to happen;
- an intended fire or explosion that exceeded its expected extent or severity, ie was larger or had more extensive effects than was intended.

45 Safety measures will often be straightforward to identify and to implement. For example, in a store holding a smaller quantity of HT 4 articles:

- to prevent a fire or an explosion: exclude sources of ignition such as naked flames and heaters;
- to limit the extent of the fire or explosion: keep the articles away from stocks of flammable substances;
- to protect people from the effects of fire or explosion: ensure that the building can be effectively evacuated and that information on the building's contents could be provided to the emergency services.

46 Safety measures must continue to be effective whenever explosives are present. This means that, as part of those measures, anyone manufacturing or storing explosives will need to understand how their appropriate measures can fail and have suitable arrangements in place to ensure their preventative and protective measures remain effective.

47 The safety measures must be identified and implemented before any new or changed explosives operation begins.

48 Employers must consult all their employees (either directly or via safety representatives), in good time, on health and safety matters. Issues employees must be consulted on include:

- risks arising from their work;
- proposals to manage and/or control these risks;
- the best ways of providing information and training.

Employers can ask employees and their representatives what they think the hazards are, as they may notice things that are not obvious and may have some good, practical ideas on how to control the risks.

49 Where dutyholders share workplaces (whether on a temporary or permanent basis), they need to co-operate with each other to comply with their respective obligations under ER2014.

**Identify safety measures**

Safety measures to:

- prevent unplanned fires and explosion;
- prevent the spread of fire and the communication of an explosion; and
- protect people from the effects of a fire and explosion;

are identified using a structured approach.

50 To identify and evaluate hazards, assess risks, and implement appropriate safety measures, the following should be considered for each stage of the explosives operation:

- how a fire and explosion could occur;

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- how to prevent it spreading or communicating; and
- how to protect people.

51 Appendix 1 provides further guidance on how hazards can be identified and evaluated, how to assess explosives risks and how the safety measures should be identified.

**Risk assessment**

52 Employers and the self-employed who comply with the risk assessment requirements of:

- the Management of Health and Safety at Work Regulations 1999 (SI 1999/3242) (the Management Regulations);
- the Dangerous Substances and Explosive Atmospheres Regulations 2002 (SI 2002/2776) (DSEAR);
- fire safety legislation; and
- (where appropriate) the Control of Major Accident Hazards Regulations 1999 (SI 1999/743) (COMAH);

will have taken the steps necessary to identify the appropriate measures they are required to take under regulation 26(1) of ER2014.

53 Regulation 3 of the Management Regulations requires all employers and self-employed people to assess the risks to workers and any other people who may be affected by their work or business. This is to enable them to identify the sensible and proportionate measures they need to take to control the risks.

54 Regulation 5 of DSEAR requires a risk assessment to be carried out to identify whether dangerous substances are present at the site and the risks they present. DSEAR applies to all hazards arising from both the manufacture and storage of explosives and from the other dangerous substances on site. This includes, for example, substances not in use, or those in storage awaiting use.

55 Regulation 5(3) of COMAH requires operators to have a safety management system in place that will identify and evaluate major hazards. It also requires the adoption and implementation of procedures for systematically identifying major hazards arising from normal and abnormal operation and the assessment of their likelihood and severity.

56 Fire safety legislation requires responsible persons to make a suitable and sufficient assessment of the risks to which relevant people are exposed. This is to identify the general fire precautions that need to be taken to comply with the requirements and prohibitions imposed by fire safety legislation.

**Management arrangements**

Appropriate safety measures are in place. Roles and responsibilities for implementing and maintaining them are specified and understood.

57 Arrangements should be in place to manage explosives operations. These arrangements should address the responsibilities for:

- identifying;
- implementing; and
- maintaining;

the safety measures.



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26

Appendix 2 contains detailed guidance on management arrangements for explosives operations.

58 Employers and the self-employed will generally identify and implement management arrangements as a consequence of their duties under regulation 5 of the Management Regulations.

59 Employers will also have duties as a responsible person under fire safety legislation.

60 Operators of establishments subject to COMAH will also have a duty to manage any explosives operations as part of their safety management system.

### Cross-cutting safety measures

Cross-cutting safety measures (ie measures that address more than one duty) are implemented to ensure the safe manufacture and storage of explosives.

61 Some safety measures are particularly important because they reduce the risk of an explosion being initiated and limit the consequences in the event of an initiation. These safety measures are:

- appropriate training and competence;
- safe systems of work and working practices;
- high standards of housekeeping;
- providing and maintaining appropriate mounds and traverses;
- effective stock management;
- segregating explosives presenting different likelihoods of initiation (or different hazard types);
- segregating explosives operations from other activities;
- safely transporting explosives on site.

### Competence

People manufacturing or storing explosives are competent to carry out activities under normal conditions. They understand the hazards and risks which may arise and the actions to take in abnormal or emergency situations.

62 Competent people understand how a fire and explosion can occur and know what to do to prevent it. They understand how it can be stopped from spreading or communicating to other explosives and know what to do to protect people including themselves. Having an appropriate level of competence allows everyone involved in explosives operations, including directors, managers, workers and contractors, to recognise the hazards and risks in operational activities and then apply the right safety measures to control and manage those hazards and risks.

63 To be competent an organisation or individual must have a combination of training, skills, experience and knowledge and the ability to apply those to perform a task safely. Factors such as attitude and physical ability and behaviours can also affect someone's competence.

64 Competence develops over time. Individuals develop their competence through a mix of initial training, on-the-job learning, instruction, assessment and formal qualification. In the early stages of training and experience, people should be

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closely supervised. As competence develops, the need for direct supervision can be reduced.

65 Dutyholders should have systems in place to assess and identify training and competency needs. They should also follow up where training needs are identified or competency needs to be developed. The extent and formality of these systems depends on factors such as the outcomes of the hazard identification and evaluation (see paragraphs 50–51 and Appendix 1 for further guidance), the complexity of the explosives operation, the size of the organisation, and the rate of turnover of the people involved in the operation. Competence should be reviewed at periodic intervals and when there have been significant changes such as:

- changes in operation, including the manufacture of new articles or the storage of different explosives;
- the introduction of new facilities or equipment;
- the use of new substances;
- changes in staff or other people involved in the explosives operation;
- changes in recognised industry practice;
- changes in the regulatory framework.

66 Dutyholders should ensure that everyone involved in or providing support to explosives operations:

- understands the nature of the risks and hazards that may arise out of the explosives operations;
- can identify that the appropriate measures to be taken have been implemented before they start an explosives operation;
- know what:
  - abnormal and hazardous conditions may arise;
  - the indications are that an abnormal or hazardous condition may have arisen;
  - action to take in the event of an indication of an abnormal or hazardous condition or a non-compliance being detected;
- know what housekeeping and hygiene procedures need to be followed;
- correctly use appropriate work equipment;
- know what site rules (if any) apply to the explosives operation;
- understand when personal protective equipment is required and be able to use it; and
- know what action to take in the event of an emergency.

67 Certain people are likely to require more extensive competence (including a deeper understanding of the properties and behaviours of explosives) and/or training. These people should include those with responsibility for:

- hazard identification and evaluation, assessment of risk and the design and specification of safety measures including the selection of personal protective equipment;
- the design and specification of products and processes;
- the design, selection and/or specification of facilities, plant and work equipment and the preparation and specification of maintenance schedules; management and supervision;
- installation and maintenance of work equipment and plant;
- monitoring the ongoing effectiveness of the appropriate measures; and
- quality assurance and quality control of materials.

68 It may sometimes be necessary to use external contractors, for example where there is a need for particular expertise, or where there is a discrete task to

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perform. The dutyholder should confirm that the contractors are competent and have received the necessary training.

69 There are several sector-based approaches that can help in developing and judging competence. These include:

- membership of a relevant professional body;
- membership of a relevant trade association or trade body;
- membership of a relevant technical forum;
- membership of a relevant representative association or society;
- assessments made or qualifications developed against a recognised standard such as National Occupational Standards;
- relevant accredited training courses;
- implementing a formal management system or framework to a recognised standard.

### Safe systems of work and working practices

Explosives operations and activities are carried out to agreed procedures.

70 Procedures should cover the way that explosives operations are undertaken. They also include the way that other activities are undertaken in explosives areas where these activities could act as a source of ignition for explosives or other flammable materials.

71 Employers and the self-employed should implement a safe system of work developed from a suitable and sufficient risk assessment but the working practices of all dutyholders should include measures to prevent fire and explosion developed from an identification and evaluation of the explosives hazards.

72 Developing the procedures for undertaking an explosives operation will normally include consideration of:

- the activity and where it is to be carried out;
- the sequence of the tasks needed to complete the activity and how they will be done;
- the outcomes of the hazard identification and evaluation and the assessment of risks;
- the skills and competencies required to deal with the hazards and risks;
- the precautions necessary to prevent a fire and explosion, to stop a fire spreading and an explosion communicating, and to protect people from the effects of a fire or explosion;
- recognised and generally accepted safety procedures covering known hazards;
- how the explosives operation will be segregated from other activities and any controls necessary to maintain that segregation;
- the tools and equipment (including personal protective equipment) to be used;
- how to minimise both explosives waste and other waste that could act as a source of ignition for explosives and how that waste will be managed prior to disposal;
- what state or condition the explosives area and plant or equipment will be left in at the end of the activity.

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## Housekeeping

High standards of housekeeping are maintained to:

- provide control over sources of initiation;
- prevent fires and explosions;
- reduce the likelihood of a fire spreading or an explosion communicating; and
- reduce the risks of people becoming trapped or harmed if a fire or explosion occurs.

73 The areas where explosives operations take place should be kept clean of:

- any loose explosive powder that may have leaked from containers or articles or has been generated during a process;
- other waste materials (including any fine flammable particulates);
- grit or other contamination.

74 Explosive powders, flammable fines from packaging, and grit or other contamination can increase the likelihood of initiation of a fire or explosion. Explosive powders, flammable fines or packaging can also allow a small initial event to spread or communicate to other explosives or combustible materials that are present.

75 Explosives, tools, equipment and empty packaging that are not immediately required for the explosives operation at hand should be effectively segregated from the explosives activity so that they do not:

- present an increased risk of an unplanned explosion;
- provide a 'stepping stone' that would allow a fire to spread or an explosion to communicate;
- present an obstacle to people escaping the explosives area;
- present an enhanced secondary fragment hazard that could harm people.

76 Explosives areas, buildings and workstations should be designed and/or laid out so that that it is easy to identify when high standards of housekeeping are not being maintained, and so they are straightforward to keep clean and tidy.

77 Maintaining high standards of housekeeping also means that:

- all materials (including tools and equipment etc) not necessary for the explosives operation should be kept out of the explosives area or building;
- the construction and surface finish of explosives facilities should enable ease of housekeeping;
- all materials (including tools and equipment etc) that are necessary for the explosives operation can be identified and should be kept in an appropriate location when they are not in use;
- quantities of explosive waste should be kept to a minimum and that explosive waste and other dangerous materials are not allowed to build up in sinks, drains etc;
- the quantity of flammable and combustible material in explosives areas should be kept to the minimum necessary for safely and effectively undertaking the explosives operation;
- escape routes should be identified and kept clear;
- a system for regular cleaning and disposal should be established.

## Mounds, traverses and barriers

Mounds, traverses and other barriers are used to prevent or limit the spread of fires or the communication of an explosion and to protect people.

78 A mound or traverse is a barrier that will intercept fragments and debris caused by an explosion in a building or store. Doors can also fulfil a role as an effective barrier to the communication of a minor event.

79 In the event of explosion, mounds and traverses serve two purposes:

- to protect explosives stored in nearby buildings from initiation by fragments; and
- to reduce the risks to people including the inhabitants of nearby occupied buildings from fragments and debris.

80 Mounds and traverses are not generally considered to provide a high level of protection from blast overpressure or radiant heat (unless any fireball is contained within the mound). They will normally only reduce the area that is at risk from projected debris when they significantly exceed the height of any stack of explosives or the structure within which those explosives are contained.

81 Natural ground features and water barriers may be used for this purpose, but the most common forms are artificial earth mounds, reinforced concrete walls or containers filled with earth.

82 The height, thickness, shape, separation from the store and materials used for a mound should be appropriate to the explosives operations, amount and hazard type of explosives. Detailed guidance on the specification and construction of a suitable mound or traverse can be found in Chapter 7 of the MoD publication JSP 482.<sup>1</sup>

83 Where mounds are intended to:

- protect people from the effects of an explosion – they should generally be built to at least the height of the eaves of the building and be a minimum of 1 m thick at the top;
- prevent the communication of an explosion – they should comply with the requirements of the '2 degree rule' or the '600 mm rule' (see Glossary);
- fulfil both of the above functions – they should meet the requirements for the taller, larger, or thicker mound or the greater distance from the building.

84 Ensure that the materials used to construct mounds do not exacerbate the debris/fragment problem. Mounds should therefore be stable and made of a suitable material, which will generally comprise sand, or clay or earth. There should be no rocks or stones greater than 75 mm in diameter in a sand, clay or earth mound and the rocks should make up no more than 5% of the total weight.

85 Mounds will deteriorate over time. For example, if a sloping mound is used (single or double slope), the slope must be sufficient to ensure the mound material is stable. It is useful to stabilise mounds by planting with grass or other suitable, well-maintained vegetation.

86 Doors (and other barriers such as mesh screens over windows or in front of entrances) can often be effective in preventing a minor event escalating or an explosive event in one building communicating to explosives in another, and in protecting people during the initial stages of an explosive event.

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87 Doors to storage buildings should be kept closed unless immediate access is required to the buildings' contents.

88 Where the doors to buildings being used for explosives operations face each other, or are arranged so that an event in one building could communicate to another via the door, the door to only one building should be open at any one time even when more than one building is in use.

### Stock management

Dutyholders know the type and quantity of all explosives present on site and their locations.

89 Dutyholders should have a suitable stock management system to ensure that:

- incompatible explosives are not stored together;
- explosives whose safety can decrease as they age can be managed;
- appropriate information is available in an emergency.

90 A suitable stock management system will also enable dutyholders to:

- ensure that any licence limits (or relevant exceptions) are not breached;
- ensure that they comply with any duty to maintain a record of 'relevant explosives' and 'civil explosives' required by regulations 35 and 36 of ER2014;
- ensure that they can identify and report the losses of any 'relevant explosives' as required by regulation 37 of ER2014.

91 In its simplest form a stock management system will involve:

- knowing what stock is present in a facility;
- rotating stock to ensure that the oldest stock is used first;
- checking the position, height and stability of stacks, condition of packaging etc;
- checking to ensure that the stock is in good condition or remains within any recommended shelf life; and
- managing damaged stock and/or packaging or stock that is beyond its recommended shelf life.

92 These objectives can be achieved by:

- recording all movements of explosives in and out of the store or other explosives facility so there is always an up-to-date record of the amount and type of explosive present. It is recommended that duplicate records are kept in a safe place;
- ensuring that the oldest stock of explosives is easily accessible and is used first and/or conducting routine surveillance on explosives to ensure that they remain safe to store;
- stacking explosives boxes, packages or other containers in a stable manner, laid flat and with the top side up;
- avoiding over-stacking as this can result in pressure deformation of packaging, spilling and exposure of the contents, damage to articles and possible deterioration of the explosive; and
- leaving a sufficient gap between stacks and walls to allow air to circulate freely (and any lightning protection to be effective).

## Segregating explosives presenting different likelihoods of initiation

Explosives that have significantly different likelihoods of initiation are segregated from one another.

93 Explosives that have significantly different likelihoods of initiation (ie sensitivities) can present an additional risk if stored together. Segregating them may reduce the potential for fire or an explosion to spread, and reduce the extent and severity of any likely event.

94 Segregation should be achieved by:

- separating the most sensitive substances or articles from less sensitive explosives so that in the event of accidental initiation they do not act as an initiator for less sensitive explosives. For example:
  - detonators should be kept in a separate compartment (or annex) from other explosives (eg blasting explosives) to prevent initiation (detonation) of the secondary explosives in case of fire and/or the accidental initiation of the detonators;
  - igniters should be kept separately from other explosives to prevent fire from accidentally initiated igniters spreading to other explosives;
  - pyrotechnic substances should be separated from explosive and pyrotechnic articles to prevent fire from the unintended ignition of those substances initiating the articles;
- keeping explosives, other than those which are still in the course of being processed, in packaging designed for their transport;
- only removing explosives from their packaging in an appropriate place;
- keeping separate from bulk holdings of explosives any explosive substances or articles which present an increased risk or hazard, for example:
  - explosives presenting a risk from water activation;
  - explosives containing highly flammable, toxic or pyrophoric substances;
  - explosives whose behaviour is uncertain due to deterioration;
  - samples or other materials made as part of research and development and which have not been fully characterised;
  - waste explosives (whose behaviour may be uncertain);
- segregating explosives being tested from other explosives operations;
- segregating the disposal of explosives from other explosives operations.

## Segregating explosives operations from other activities

Explosives operations are segregated from activities that do not include explosives.

95 Segregating explosives operations from activities that do not include explosives can ensure that:

- materials involved in other activities do not aggravate the effects of an explosive event;
- people on site who are not engaged in the explosives activities are appropriately protected should a fire or explosion occur;
- the likelihood of the non-explosive activity acting as a source of initiation is reduced.

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96 Segregation of explosives operations from other activities should be achieved by:

- not storing explosives with other hazardous goods (eg flammable liquids and solids, reactive substances);
- storing explosives in a separate area from other goods (eg food stuffs, combustible materials);
- so far as reasonably practicable, preparing non-explosives components for explosive articles separately from explosives operations;
- preparing packaging for use with explosives separately from explosives operations.

### Safely transporting explosives on site

Particular care is taken when transporting explosives on site and only appropriate methods are used.

97 Particular care needs to be taken when explosives are being transported on site because:

- transporting explosives brings them into close proximity with sources of energy that can cause them to initiate or ignite;
- an event involving explosives in transport can act as an initiating event for explosives elsewhere on the site or act as a stepping stone between different quantities of explosives because normal segregation arrangements may not be met;
- an event involving explosives in transport may obstruct an escape route.

98 The methods of transport and the location of transport routes on site should be considered as part of the hazard identification and evaluation and assessment of explosives risks.

99 Take care to avoid situations in transport which could cause impact, such as explosives being dropped (or objects dropping onto explosives), collisions or striking (for example, accidental collision between a forklift truck and explosives). This is particularly important where the explosive is exposed and is not contained in a finished article or package, box or other container.

100 The principle of separating sensitive explosive articles and substances from less sensitive bulk items (for example, not carrying detonators with explosives) should be observed for the transport of explosives on site. In general, avoid mixed loads of different types of explosives or of explosives and non-explosive materials on one vehicle. Explosives that are being carried on vehicles should be protected from the elements and from contamination that could increase their sensitivity or reduce their reliability.

101 Take care loading and unloading explosive articles and substances onto any vehicle. Loads should be secured where appropriate.

102 Workplaces should be organised in such a way that pedestrians and vehicles can circulate in a safe manner. Additional traffic measures such as designated:

- site entrances for vehicles carrying explosives;
- routes for pedestrians and vehicles carrying explosives; and
- loading and unloading areas for explosives;



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should be considered as part of the hazard identification and evaluation. The transport of explosives on site should be segregated from other activities to minimise, so far as reasonably practicable, the number of people who might be affected by an explosive event.

103 Park vehicles loaded with explosive articles and substances away from explosives buildings that they are not servicing, or from other dangerous goods, to avoid communicating an explosion to or from the building or dangerous goods. Vehicles loaded with explosives that are parked near to the building they are servicing should only be at that location as long as is necessary for their loading or unloading to be safely completed. This will reduce the likelihood of a fire spreading or an explosion communicating to other explosives or other dangerous goods.

### Preventing fires and explosions (Regulation 26(1)(a))

Safety measures are in place to prevent the accidental initiation of explosives.

104 Keep sources of ignition away from the explosives or other flammable materials on site. The presence of explosives (including explosive vapours and dusts) should be controlled, especially in areas of activity, for example, places where work is done or where people or other traffic move around regularly.

105 The following sections give guidance on how the main sources of ignition can be controlled and the general principles that can be followed to prevent fire and explosion. They are structured around the general circumstances of the storage and manufacture of explosives, the most common sources of ignition, and general precautions to prevent fire and explosion.

### General precautions

Explosives operations only occur in an appropriate place, using appropriate tools and equipment and following an appropriate process.

106 Explosives operations should only be undertaken in a suitable place and within the scope of any licence or other permission. The suitability of the location will depend on the quantity and type of explosives and on the planned activity.

107 The precautions are covered in detail in paragraphs 110–173. In summary they include ensuring that any place of manufacture, processing facility, store, storage area, container or cupboard is:

- suitably weatherproof;
- designed to ensure that explosives do not come into contact with substances with which they are incompatible;
- protected by a lightning conductor, where appropriate;
- not used for other activities at the same time that explosives are being manufactured, processed or kept, eg a store should only be used to keep explosives and the tools or implements necessary for the safe keeping of those explosives; and
- kept clean, with steps taken to prevent grit entering unpackaged explosives.

108 Tools and equipment should be suitable for the particular conditions of the explosives operation and authorised for use in that operation.

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109 Equipment and processes should be designed or chosen to prevent ignition and should:

- follow a hierarchy of controls, ie elimination, substitution, reduction, engineering and finally personal protection;
- use controls which fail to safety wherever reasonably practicable;
- take into account both normal and abnormal operating conditions, including machinery breakdown or failure, maintenance and decontamination;
- ensure that while equipment is suitable for use in explosives work it does not aggravate other risks or hazards;
- ensure that the equipment can be thoroughly cleaned, avoiding the uncontrolled build-up of waste explosives and ensuring that there is minimal possibility of material remaining in corners and crevices.

### Protecting explosives from sources of ignition

Explosives are protected from those sources of ignition that could cause them to initiate and are kept in a suitable closed container or in suitable packaging, whenever it would be reasonably practicable to do so.

110 Suitable precautions must be taken to exclude possible sources of ignition from explosives.

111 The most common sources of ignition are:

- naked lights and flames;
- heat and temperature;
- electricity (including static electricity and electromagnetic energy);
- sparks from mechanical or frictional contact between metal surfaces;
- impact and friction;
- pressure; and
- chemical incompatibility between certain substances.

112 The sources of ignition which need to be controlled will depend on the site, the activities being undertaken and the outcomes of the hazard identification and evaluation.

113 Examples of how some of these sources of ignition can act as initiating events include:

- flames or sparks when inappropriate tools are used for process or maintenance activities;
- a consequence of the ignition of flammable gases, vapours and explosive dusts;
- heating when explosives are stored too close to sources of heat such as incandescent light bulbs or when dusts collect on or in powered equipment and mechanical handling aids;
- heating when aged explosives begin to decompose or explosives are mixed with incompatible materials in waste;
- electricity from lightning strikes;
- the discharge of a charge of static electricity that has built up on a person wearing inappropriate clothing;
- nipping of fuses due to metal-to-metal contact during cutting;
- friction when inserting fuse or fuseheads into, or removing fuseheads from, sensitive exposed composition;
- impact or friction when sensitive explosives are dropped or inappropriately handled;

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- a combination of impact and friction when explosives are dropped onto an edge, spike or spigot.

***Naked lights and flames***

Robust systems are in place to prevent the introduction of naked lights and flames into explosives areas.

114 Generally any equipment or article that could introduce a naked light or flame should not be brought into an explosives area. This means that matches, lighters and smokers' materials should be forbidden from explosives areas unless specifically required for the activity, eg testing and disposal

115 If it is necessary to use a naked light or flame in an explosive area, for example as part of a maintenance activity, any explosives should be removed from the area. Alternatively, precautions should be taken to completely segregate the explosives or any other flammable materials from the naked light or flame so that it cannot act as a source of ignition.

116 If it is necessary to use flammable materials in an explosive operation they should only be present in the minimum quantity that is sufficient to allow the activity to be undertaken safely and appropriate precautions must be in place to prevent their ignition.

117 Where it is necessary to use flammable materials in maintenance work, they should only be taken into the explosives area for immediate use and removed once the task has been completed.

***Heat and temperature***

Potential sources of heat energy and high temperature are identified and kept to the minimum necessary for the safe operation of an explosives area.

118 Ensure that explosives which are sensitive to heat do not come into unintentional contact with hot surfaces, or exposure to direct sunlight and other strong sources of illumination. Where contact is intentional (for example during processing or during inspection) the temperature and period of exposure must be controlled to prevent unwanted initiation. Similar considerations apply where gases, vapours, mists and dusts capable of forming a flammable atmosphere may be present in an explosives area.

119 Heating devices with exposed elements such as electric fan heaters and gas-powered or other similar convection heaters should not be used in explosives areas. Oil- or water-filled electrically powered portable radiators can be used where fixed heating systems that use, for example, hot water or steam are not available.

120 Potential sources of heat energy and high temperatures (such as electric motors and internal combustion engines, plant or equipment that could generate high temperatures by frictional heating) should also be identified and inspected at appropriate intervals to ensure that they are (and remain) appropriate for use in an explosives area.

121 Site (or guard) radiators and pipes to prevent physical contact with explosives. The maximum temperature of all radiators and heating pipes should be limited either by specification or by the use of suitable thermal cut-outs. It is also recommended to fit heating units with tamper-proof controls and an indication to show when they are energised. Radiators sited in dusty areas should be cleaned regularly.

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122 Further information on maximum surface temperatures for manual handling equipment and heating systems and manual handling equipment can be found in Sections 13 and 14 of the CBI-EIG publication *Guidance for electrical installation and equipment within explosive manufacturing facilities including fireworks*.<sup>2</sup>

123 Both low and high temperatures can also change how susceptible some explosives are to other sources of initiation. For example, nitroglycerine-based explosives can become very sensitive to impact when they freeze and can start to dangerously decompose if they are stored for too long at high temperature. Where the properties of explosives are affected by temperature, ensure that they are maintained at a suitable temperature. Generating information that will help identify the effect of heat and temperature on an explosive is a normal part of the product development process and can be obtained from the manufacturer's or supplier's material safety data sheets or product safety data sheets.

**Electrical, electrostatic and electromagnetic energy**

Sources of electrical energy are identified and are kept to the minimum necessary for the safe operation of an explosives area.

124 The presence of electrical energy (including electrostatic or electromagnetic energy) brings with it a risk of a failure in the electrical installation. This can cause a fire, a spark initiating a fire or an explosion, or an electrical discharge or electromagnetic radiation setting off an igniter, detonator or other fuse head.

125 The particular precautions necessary to prevent fires or explosions will vary greatly. They will depend on the activity, the explosives involved, any other substances that may be present during manufacture and/or storage and the design and layout of any building or other place used for the explosives operation. The presence of electrical energy in and around explosives buildings and other explosives areas must be kept to the minimum necessary for the safe operation of the facility.

126 Further guidance on protecting explosives from electrical, electrostatic and electromagnetic energy can be found in Appendix 3.

**Mechanical sparks**

Potential sources of mechanical sparks, including those that could arise from equipment failure, are identified and kept to the minimum necessary for the safe operation of an explosives area.

127 Mechanical sparks generally arise from sudden or violent contact between hard surfaces. This can include metal-to-metal contact and contact between metal objects and hard surfaces such as stone or concrete. Controlling sources of mechanical sparks is particularly important where explosive substances are exposed and where explosives are being processed.

128 Where it is reasonably practicable, the metal and other surfaces in explosives areas that have the potential to generate mechanical sparks should be replaced with, or covered by, a durable and chemically compatible non-metallic material. When selecting the material, consider both the electrostatic precautions required for the application and the material's durability and flammability.

129 It is not always practicable to cover the metal surfaces of tools and equipment. In these situations, the design, selection, inspection and maintenance of the equipment must ensure that either:

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- adequate clearances are achieved between moving and static parts of equipment; or
- durable and chemically compatible, non-ferrous metals or non-metallic materials are used at the interface between moving and static parts of the equipment.

130 If clearances are relied upon to prevent the generation of mechanical sparks, control measures should be in place to prevent objects becoming accidentally lodged in the clearance.

131 Explosives should only be manipulated with tools that do not create sparks. Non-sparking materials include bronze, wood, bone and plastics as well as some steel alloys. The electrostatic risks associated with plastics should be addressed in the selection of non-sparking tools. Non-sparking tools should be used in operations where there are exposed explosives or where equipment has not been decontaminated, such as in-process adjustments, maintenance operations, or when dismantling plant and equipment.

132 Ferrous and other hand tools capable of producing mechanical sparks (including scissors) should only be used where they do not present a significant risk of initiation and precautions have been taken to avoid metal-to-metal contact. For example, the use of a steel blade to cut plastic igniter cord on a wooden (rather than a metal) surface.

133 Where it is necessary to use tools and equipment such as angle grinders or other power tools in an explosives area, for example during a maintenance activity, any explosives should be removed from the area or precautions should be taken to completely segregate the explosives or any other flammable materials from any sparks that the tools and equipment may produce so that the equipment cannot act as a source of ignition.

**Impact and friction**

Potential sources of impact and friction are identified and kept to the minimum necessary for the safe operation of an explosives area.

134 All explosives are sensitive to impact and friction to a greater or lesser extent. Initiating explosives and pyrotechnic compositions tend to be more sensitive than ammonium nitrate-based explosives or military high explosives. All explosives require protection from impact and friction, but more care is needed for those that are more sensitive.

135 Impacts and friction can arise from both the intended and unintended application of physical force. Physical force can be applied in many ways and in an explosives context this will generally include:

- dropping;
- nipping;
- penetrating;
- pinching;
- pressing;
- rubbing;
- sliding;
- striking;
- squeezing.

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136 Preventative measures are intended to either reduce the likelihood of explosives being subject to physical force or to limit that force so it will not be large enough or delivered in a way that will cause explosives or other flammable substances to initiate. These preventative measures should include:

- selecting and maintaining fit-for-purpose tools, plant and equipment;
- minimising the height at which explosives are handled or stored to reduce the force of impact should they be dropped;
- not sliding explosives that are sensitive to friction, or packages containing such, along the ground or other surface;
- laying out workspaces, walkways, passageways and other traffic routes so that the risks of objects being dropped onto, knocking or penetrating explosives are as low as reasonably practicable;
- only keeping or working on explosives in a designated location;
- keeping explosives in appropriate packaging such as a transport carton whenever it is practicable to do so;
- designing and selecting the materials for hinges and lids of containers to minimise the risk of impact and friction during opening and closing;
- ensuring that hinges, container lids and doors do not become contaminated with explosives that are sensitive to impact or friction;
- appropriately cleaning, lubricating and maintaining hinges and bearings;
- ensuring that people follow a safe system of work, work calmly and without unnecessary or inappropriate haste;
- maintaining high standards of housekeeping so that grit and other sensitising agents are not introduced into explosives;
- maintaining internal roads, pathways, walkways, steps and landings in a good condition, free from potholes and tripping hazards.

137 Precautions should also take account of the potential for articles and containers holding substances to be damaged if they fall, are dropped, overturned or penetrated. Damage to an article or a container could result in sensitive explosives being exposed to further sources of ignition.

**Pressure**

Sources of pressure are identified and kept to the minimum necessary for the safe operation of an explosives area.

138 Pressure, either above a certain level or rapidly applied, can act as a source of initiation during manufacturing operations and additional guidance on this topic can be found in subsector guidance.

139 Pressure can also change the behaviour of explosives. For example, an explosive that might only burn gently in the open can burn rapidly, deflagrate or detonate when subject to pressure arising from confinement. This means that cracks, fissures, holes and voids where explosives can accumulate should be identified and closed or designed out of equipment and the workplace. If it is not reasonably practicable to do this, they should be subject to routine inspection and cleaning.

140 In most circumstances the preventative measures used to protect explosives from impact and friction will protect explosives from the effects of excessive pressure.

**Chemical incompatibility**

Chemicals and materials incompatible with the explosives used or with each other are identified and either kept to the minimum necessary for the safe operation of the explosives facility or completely segregated from the explosives.

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141 Incompatible substances and/or mixtures can produce significant chemical reactions. These can either generate sufficient heat to cause explosives or other flammable materials to ignite or can produce by-products that are sensitive to sources of ignition.

142 The potential implications of mixing incompatible materials should always be considered by a competent person and the chemical compatibility of proprietary materials (such as paints, varnishes, adhesives, elastomers and lubricants) will need to be assessed before they are used or kept in direct contact with explosive substances. Be aware that manufacturers of such proprietary materials may alter their product composition and reassessment should be undertaken as appropriate.

143 Some of the principal 'internal' incompatibilities, where care needs to be taken to prevent unintended contact, occur with:

- picric acid and metal (particularly copper, lead and zinc);
- chlorates with, in particular, metals, acids, sulphur and phosphorus;
- azides and ammonium nitrate with copper and copper alloys.

144 Some of the principal 'external' incompatibilities, where care needs to be taken to prevent unintended contact, occur with:

- metal powders and water which can generate heat and flammable gases;
- strong acids and flammable materials which can start fires;
- rusty tools and equipment and aluminium surfaces which can produce unintended sparks from thermite reactions.

145 This is not an exhaustive list of incompatible substances. Further information about substances incompatible with explosive substances and proprietary explosive articles may be obtained from manufacturers, suppliers, product data sheets and from relevant subsector guidance.

**Maintenance systems**

The safety measures are properly maintained.

146 Maintenance systems should include:

- identifying the safety measures and any safety-critical systems (including procedures and management arrangements), plant and equipment;
- record keeping;
- planning and prioritisation of maintenance work;
- either planned preventative maintenance or risk-based inspection and maintenance;
- inspection of the safety measures by a competent person at regular specified intervals; and
- reporting and acting on faults with systems, plant, equipment and relevant site infrastructure.

147 In safety-critical applications, inspection and maintenance of equipment may need to be more frequent than manufacturers' recommendations. This may include a daily, or more frequent, pre-use visual inspection of equipment. Only replacement parts from the manufacturer or approved supplier should be used with safety-critical equipment.

148 The maintenance regime should include periodic inspections of explosives areas. Inspections should include checking safety-critical factors such as:



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- the condition of the roof and walls or other built structures to ensure that they remain stable and provide adequate weather protection;
- the condition of any earthing system and the arrangements to avoid static build-up;
- the condition of the floor, in particular to see that slip or trip hazards are avoided, that there are no cracks where explosives could accumulate and that conducting floors are effective;
- the condition of the internal surfaces, particularly to ensure there are no areas of exposed iron, steel, rust, detachable grit etc which could present a source of ignition;
- standards of housekeeping are appropriate;
- vegetation and other flammable materials within the explosives area or which could effect it are subject to appropriate control;
- the ongoing effectiveness of mounds, traverses and other barriers.

149 Maintenance activities often introduce sources of ignition into explosives buildings and areas, so should generally be subject to a high level of control, for example through a permit-to-work system. Control measures should include arrangements for ensuring the competence, control and supervision of those preparing for and undertaking maintenance activities and for those returning a facility to use, and that only appropriate equipment necessary for the maintenance activity is taken into the explosives area or building.

150 Modifications or adjustments to plant and equipment that do not introduce additional sources of ignition or increase the likelihood of an explosive event may be undertaken provided they are authorised by a competent person and are covered by specific work instructions.

151 Maintenance work may involve the use of contractors. Ensure that they, and their employees, fully understand and follow safety procedures and only use appropriate tools and equipment.

152 Equipment that introduces a source of ignition to an explosives area or building should not be used for maintenance activities unless the source of ignition is segregated from explosives. Generally it will be reasonably practicable to remove explosives from a building or area where maintenance activities are to be undertaken. Similarly, and where reasonably practicable to do so, plant or equipment requiring maintenance should be removed from the explosives building or area so that it can be worked on in a safe place.

153 Before maintenance activities take place, the area being worked in, and any equipment that may contain or be contaminated with explosives or other flammable substances, must be thoroughly cleaned. Any equipment that is to be moved so that it can be worked on should also be thoroughly cleaned before it is moved. Equipment that has been cleaned should be examined by a competent person to ensure that it is either safe to work on or so that additional safety controls can be implemented where the equipment remains contaminated with explosives or other flammable materials.



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**Measures to limit the extent of a fire or explosion  
(Regulation 26(1)(b))**

Appropriate steps are taken to:

- limit the size of an explosion or fire that may occur;
- stop fires spreading; and
- limit the size of an explosive event and the area that the event affects.

154 Limiting the severity of a fire or explosion will involve:

- managing stocks of explosive to limit the amount of explosives to that necessary for the explosives operation;
- keeping explosives away from flammable or combustible materials which could fuel a fire or which could be projected as burning firebrands from an explosion;
- taking appropriate steps to ensure that the explosives behave as expected and present the hazard considered in the hazard identification and analysis;
- taking reasonably practicable measures to prevent, contain, or safely vent blast and release other explosive effects.

155 The measures taken to limit the severity of a fire or explosion will comprise those relevant preventative and protective measures identified in 'Cross-cutting safety precautions' (paragraphs 61–103). They will also involve emergency arrangements. Appendix 4 provides further information on emergency arrangements.

156 The key measures to limit the extent of a fire and explosion are to:

- separate storage buildings from production buildings and areas where explosives are packed or processed;
- segregate higher-risk explosives from lower-risk explosives;
- where reasonably practicable, undertaking explosives operations in a way that will either contain the effects of a fire or explosion, minimise the severity of the event or direct or mitigate them in such a way that the likelihood of a fire spreading or an explosion communicating is minimised. For example:
  - containing small arms ammunition filling equipment within an enclosure;
  - storing black powder and similar explosives in such a way that they present a HT 3 or HT 4 hazard rather than an HT 1 or HT 2 hazard;
  - keeping lower hazard fireworks, pyrotechnic articles and small arms ammunition in buildings and containers that will either fully contain the effects of an explosive event or will reduce the rate at which one spreads;
  - fitting vent panels to plant, equipment and buildings that allow an explosive event to vent to a safe place and/or which reduces the likelihood of a fire transitioning to a deflagration or detonation;
  - using physical barriers, including walls, screens, sand and water barriers, to prevent communication and unitise explosives hazards within an explosives facility;
  - installing drencher and sprinkler systems in explosives facilities where they can be expected to be effective in preventing a fire spreading without introducing unacceptable consequential risks;
  - using a jig, fixture or other tooling designed to prevent the initiation of the explosives being processed communicated to other articles awaiting processing or just processed;
- ensuring that explosives are not left where they can act as a 'stepping stone' to the communication of fire or explosion;

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- controlling combustibles in and around explosives areas, such as waste, unused packaging, vegetation that could fuel the spread of a fire, or flammable materials that are generated during grounds maintenance such as grass cuttings etc;
- implementing the general fire precautions expected by relevant fire safety legislation where they would not adversely affect explosives safety.

157 Further guidance can be found in subsector guides and in the CBI-EIG report *Use of structural justification to underpin HSE explosives licence*.<sup>3</sup>

### **Protecting people from the effects of fire or explosion (Regulation 26(1)(c))**

Measures are in place to protect people in the event of a fire or explosion.

158 Steps to protect people in the event of a fire or explosion will generally require:

- the number of people in explosives areas to be controlled and limited to those necessary to undertake, manage and monitor the explosives operation;
- reasonably practicable engineering controls to be implemented where they will protect people from the effects of a fire or explosion;
- providing personal protective equipment where it would be appropriate to do so;
- establishing emergency procedures and implementing process and general fire precautions.

159 Some engineering controls will be delivered or maintained by implementing the relevant preventative and protective measures identified in 'Cross-cutting safety precautions' (paragraphs 61–103).

#### **Limiting the numbers of people in explosives areas**

The number of people in explosives areas is kept to the minimum needed to safely carry out and to safely support the explosives operations.

160 Ensure that the number of people present in an explosive area is controlled and that explosives operations are segregated from non-explosives operations. Depending on the nature of the explosives activity, degree of hazard and the potential risks to people, controls might include:

- physical controls that only allow access to explosives areas to authorised people;
- providing instructions to people engaged in the explosives operations and to visitors;
- supervising people engaged in the explosives operations and visitors;
- placing signs and notices on doors or at other appropriate places indicating who is authorised to be present and the maximum number of people permitted in the area at any one time;
- minimising the number of visitors at any one time in an explosives building or explosives area;
- ceasing operations when visitors or unauthorised people are present.

#### **Engineering controls**

Engineering controls to protect people from the effects of a fire or an explosion are identified on a case-by-case basis.

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161 The reasonably practicable engineering controls that can be implemented to protect people from the effects of a fire or an explosion will depend on the hazard and risks presented by the explosives present on a site, the activities that are being undertaken, and where people are required to be present to safely and effectively undertake the explosives operations. In many instances this means that controls will need to be identified on a case-by-case basis. Depending on the nature of the activity engineering controls could include:

- mounds, traverses and barriers;
- containment structures that will either completely or partially contain the effects of an explosive event;
- fitting vent panels to plant, equipment and buildings that allow an explosive event to vent to a safe place and/or which reduce the likelihood of a fire transitioning to a deflagration or detonation;
- sprinkler and drencher systems;
- the use of control rooms remote from the explosives activity;
- safety screens on equipment or at individual work stations.

162 Where engineering controls are implemented they should be subject to inspections to ensure that they will remain effective when they are called upon.

**Provision of personal protective equipment**

Personal protective equipment is used as a last line of protection. It is not solely relied upon when people can be protected by engineering controls.

163 Personal protective equipment can protect individuals by supplementing engineering controls or by supplementing procedural controls where engineering controls are not reasonably practicable. Further information on the regulatory framework surrounding the selection and use of personal protective equipment can be found in *Personal protective equipment at work. Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations (L25)*.<sup>4</sup>

164 The hazards presented by explosives often mean that the effectiveness of personal protective equipment can only be identified by:

- a systematic identification of the hazards;
- a systematic identification of the parts of the body likely to be effected by those hazards;
- realistic testing and/or robust modelling based around the circumstances of the explosives operation;
- an assessment of the effect any personal protective equipment identified would have on the likelihood of an explosive event occurring.

165 Careful consideration should be given to whether an explosives operation is acceptable where personal protective equipment is being relied upon as a control, where the likelihood of an event is significant and where the consequences are likely to be anything other than trivial. Some personal protective equipment designed to protect against certain hazards, such as substantial shock or blast effects or to protect certain areas of the body such as the hands, may not be appropriate because it increases the likelihood of an explosive event to an intolerable level.

166 Ensure that personal protective clothing does not act as a mechanism for transferring incompatible materials from one place on an explosives site to explosives on another part of that site.

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167 The nature of explosives events means that even where personal protective equipment has been identified as not being required, clothing that is likely to aggravate the effects of a fire or an explosion should not be worn.

168 Any visitors to an explosives area or an explosives operation should be appropriately dressed and provided with appropriate personal protective equipment.

169 Further information on the types of personal protective equipment that can be considered for particular activities can be found in relevant subsector guidance.

**Emergency procedures**

Effective emergency procedures are in place.

170 Emergency procedures must clearly set out what dutyholders, employees and others should do and should not do in an emergency. The procedures should normally be written down to allow them to be communicated to others consistently. Information on the procedures must be provided to all employees and to others involved in the site's activities. This does not necessarily require extensive documentation. For example, where a site has a single small store the emergency procedures might consist of evacuating the area around the store and calling the fire and rescue service. In this case the documentation might simply involve a written notice displayed prominently where all staff will see it.

171 Emergency procedures on an explosives site should cover:

- what constitutes an emergency;
- what to do in the event of an emergency;
- fire precautions relevant to the emergency procedures;
- fire detection and warning systems;
- means of escape and evacuation;
- providing information to the emergency services;
- what to do when the emergency is over;
- how the recovery phase will be managed.

Further guidance on these topics can be found in Appendix 4.

172 Dutyholders must have emergency procedures in place to deliver the requirements of the Management Regulations and the Dangerous Substances and Explosives Atmospheres Regulations. Certain sites where very large quantities of hazardous substances, including explosives, are present are also subject to the requirements of COMAH. COMAH contains requirements for the preparation of on-site and off-site emergency plans which should address how people would be protected from the effects of a fire or explosion.

173 Responsible persons are also required to identify and establish emergency arrangements under fire safety legislation. The general fire precautions taken to comply with fire safety legislation will usually be the same as the steps taken to protect people from the effects of fires and explosions on an explosives site.

## Separation distances (Regulations 27 and 13(6))

### Regulation 27 Separation distances

#### Regulation 27

(1) Subject to paragraphs (2) and (3), every person who stores explosives at a site must ensure that the relevant separation distance prescribed by Schedule 5 is maintained between a store and a building or other place to which that Schedule applies.

(2) Paragraph (1) does not apply to —

- (a) desensitised explosives; or
- (b) explosives which are stored under a licence granted by the Executive or the ONR in cases —
  - (i) where the assent of the local authority was required pursuant to regulation 13(3); or
  - (ii) where that assent was not required by virtue of regulation 13(4)(c), (d), (e), (f) or (g).

(3) Paragraph (1) does not apply to the storage of explosives where the total quantity of explosives stored at a site, excluding, in the case of sub-paragraphs (c) and (e), any amount of small arms ammunition, does not exceed —

- (a) 100 grams;
- (b) a combined total of 5 kilograms of shooters' powder and model rocket motors;
- (c) 30 kilograms of shooters' powder and 300 grams of percussion caps;
- (d) 200 detonators and —
  - (i) 5 kilograms of water-based explosive and detonating cord; or
  - (ii) 5 kilograms of water-based explosive or detonating cord; or
- (e) in the case of explosives kept by a police force —
  - (i) 16 kilograms of stun grenades; and
  - (ii) 4 kilograms of explosives kept for operational purposes other than the purpose referred to in paragraph (iii) but including ordnance disposal and the training of dogs for the detection of explosives; or
  - (iii) 30 kilograms of explosives kept solely for the purpose of gaining entry to premises; or
  - (iv) 30 kilograms of explosives kept solely for the purposes of ordnance disposal;

and the explosives are stored in a safe and suitable place with all due precautions for public safety.

(4) In this regulation —

- (a) "model rocket motors" means explosive articles which are —
  - (i) assigned in accordance with the United Nations Recommendations the U.N. no. 0186, 0272, 0349, 0351 or 0471;

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- (ii) *intended to be used for the propulsion of model rockets or similar articles; and*
  - (iii) *in respect of each individual explosive article, contain no more than 1 kilogram of explosive; and*
- (b) *“stun grenades” means pyrotechnic articles designed to confuse, disorientate or distract a person which are assigned in accordance with the United Nations Recommendations the U.N. no. 0431 or 0432.*

Separation distances are met.

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**Application**

174 The tables of separation distances given in Schedule 5 (reproduced in Appendix 5) apply to all stores other than:

- stores holding small quantities of explosive, ie 100 g or less;
- stores holding 5 kg or less of a combination of shooters’ powder and model rocket motors (see Appendix 7 for further guidance on the storage of shooters’ powders);
- stores holding 30 kg of shooters’ powder or less and/or up to 300 g of percussion caps, subject to certain conditions (see Appendix 7 for further guidance on the storage of shooters’ powder). Where these explosives are being kept with small arms ammunition any separation distance required due to the presence of small arms ammunition will continue to apply;
- stores holding up to 200 detonators and 5 kg of water-based explosive and detonating cord; or 5 kg of water-based explosive or detonating cord, subject to certain conditions (see Appendix 7 for further guidance);
- stores used by the police to keep no more than 4 kg of explosives for use for operational purposes including the training of dogs used for the detection of explosives or up to 30 kg of explosives kept for ordnance disposal or explosive means of entry and associated activities. Where these explosives are being kept with small arms ammunition any separation distance required due to the presence of small arms ammunition will continue to apply;
- stores, other than those where HSE or ONR have granted a licence under regulation 13(6), where the only explosives being kept are desensitised explosives;
- stores licensed by HSE or ONR where the local authority has given its assent to the grant of the licence or where, in certain circumstances assent was not required for the grant of the licence; and
- stores at sites controlled by the Ministry of Defence. Stores controlled by contractors on establishments owned or controlled by the Ministry of Defence are not exempt from the separation distance requirements of ER2014.

175 These distances also apply to the storage of explosives even when a licence is not required and to stores operated by organisations which are exempt from the licensing requirements. This includes any stores operated by local authorities and police forces not detailed above.

176 Regulation 27 imposes a continuing duty on the person storing the explosives. If there is development which means that required separation distances cannot be maintained then the dutyholder must reduce the quantity of explosives held or even, in extreme circumstances, relocate the store (with the agreement of their licensing authority). In some cases the dutyholder may also take other measures such as mounding or unitising the hazard by using several smaller stores. The dutyholder might also implement arrangements that would reduce the hazard

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associated with the explosives or opt to keep explosives with a hazard type requiring smaller separation distances.

177 The existence of separation distance requirements does not, in itself, prevent development near to explosives stores. It is the responsibility of the dutyholder to take the necessary steps to ensure that they continue to comply with the requirements. Where development does take place, the dutyholder would need to consider the actions needed to ensure continued compliance and where the storage takes place on a licensed site, the dutyholder should contact the licensing authority and inform them of the change in circumstances at the earliest opportunity.

178 The distances apply between the explosive store and a range of protected places including occupied buildings. These include distance requirements for public traffic routes and public places.

### **Buildings that are not normally occupied**

179 There are no requirements to maintain separation distances between stores and uninhabited buildings. However, people storing explosives should bear in mind that such buildings could be reoccupied or redeveloped in the future at which point the relevant requirements would apply and the applicable separation distances would need to be reviewed.

180 Certain buildings which could endanger an explosives building (for example, a high-voltage electrical generating plant) will not normally be inhabited. The requirements of regulation 26 mean that dutyholders will need to take account of the risks posed by such buildings in deciding where it might be appropriate to locate their stores.

181 Further information on the types of building that HSE would generally consider to be unoccupied can be found at [www.hse.gov.uk/explosives/licensing](http://www.hse.gov.uk/explosives/licensing).

### **Mounds and traverses**

182 Schedule 5 to ER2014 uses the terms 'mounded' and 'unmounded' stores. It also defines 'mounded' as meaning surrounded by suitable mounds. Further information on what comprises a suitable mound can be found at 'Mounds, traverses and barriers' (paragraphs 78–88) and in subsector guidance.

### **Application of separation distances and regulation 13(6)**

183 Paragraph 2 of regulation 27 creates two possible routes for applying separation distances at HSE and ONR licensed sites:

- a licence may be granted where the separation distances specified in Schedule 5 would apply, ie HSE or ONR would license on the same basis as local licensing authorities. HSE would normally only license on a 'fixed rules' basis at a mine or in a harbour area or when the requirements of Schedule 1 5(b) can be met; and
- where the quantity of explosives is greater than 2000 kg, where regulation 13(4)(c) to (g) applies, or where HSE or ONR uses its discretion to vary the separation distance requirements, HSE or ONR may grant a licence that includes conditions specifying the separation distances that are to be met.



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184 Regulation 13(6) also allows HSE and ONR to apply separation distances to licences that they grant which only relate to the manufacture of explosives.

185 When they grant licences, HSE and ONR will normally follow the distances given in Schedule 5 of ER2014.

186 HSE and ONR will normally follow the same approach to the aggregation hazard types and quantities of explosives required by Schedule 5. HSE and ONR may follow an alternative approach where it has been shown to provide an appropriate level of safety.

187 HSE and ONR have the discretion to vary the separation distances. HSE and ONR would normally only use their discretion to depart from the separation distances specified in Schedule 5 (or from distances interpolated from these tables and the mathematical formulae which support them) if other risk and hazard reduction and mitigation measures are taken which would ensure an equivalent level of safety. These measures would be presented to HSE or ONR as a technical justification and included as conditions in any licence. Examples of mitigation which might be considered include, but are not restricted to:

- mounds or other traverses or features designed to intercept flying debris from a fire or explosion;
- building structures sufficient to contain the effects of a fire or explosion;
- building orientation and construction which directs effects away from adjacent buildings and other protected places;
- reducing the unit risk from a building containing explosives by means of suitable internal partitions ('compartmentalisation'); and
- common fire detection/alarm systems when combined with effective mitigatory measures.

188 The suitability of any measure to justify the use of reduced separation distances will depend on site-specific circumstances, for example the types and quantities of explosives present in a building. The licence applicant will need to demonstrate that the proposed safety measures are suitable for the site and the other circumstances.

189 HSE and ONR may also vary separation distances where an existing HSE or ONR licensed site is divided into two independently-operated and licensed sites, for example following sale or subletting of part of the site. Normally HSE and ONR would expect the external separation distances to apply between buildings on the two sites, but have the discretion to accept shorter distances (including, if appropriate, a distance equivalent to the existing internal separation distances) where additional or existing safety measures that would provide an equivalent level of safety to those provided by external separation distances are in place.



## Discarding, disposal and decontamination

### Regulation 28 Discarding or disposing of explosives and decontamination of explosive-contaminated items

#### Regulation 28

(1) Any person who discards or disposes of explosives or explosive-contaminated items must ensure, so far as is reasonably practicable, that they are discarded, or disposed of safely.

(2) Any person who decontaminates explosive-contaminated items must ensure, so far as is reasonably practicable, that they are decontaminated safely.

Explosives and explosive-contaminated items are disposed of or discarded safely.

Explosive-contaminated items are safely decontaminated.

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#### Discarding and disposal of explosives

Explosives are not discarded as general or household waste.

190 The discard, disposal and destruction of explosives is a high-hazard activity. A failure to dispose of or discard explosives safely is one of the main causes of events and injuries in explosives work. Explosives events can happen because of:

- a failure to recognise that explosives requiring disposal are accumulating in manufacturing, process or storage areas;
- casual attitudes when dealing with the discard or disposal of explosives, often arising out of a lack of competence or a failure to properly supervise, inspect or audit the activity;
- people not appreciating the properties and behaviour of explosives under certain conditions (explosives that have been discarded or require disposal may be unusually sensitive due to changes in rheology and morphology, deterioration, contamination and inadequate stabilisation);
- ill-considered systems of work or no basic safety precautions, often arising out of a failure to identify and evaluate the hazards or a failure to follow prescribed procedures.

191 The disposal of explosives will usually be a high-risk activity. This means that any person planning to dispose of explosives should consider the following and determine whether there are safe, reasonably practicable alternatives to destroying the explosives:

- Are the explosives safe to transport and use as is?
- Would the explosives be safe to transport and use if reworked?
- If disposal is being considered because the explosives have failed to meet a

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prescribed quality standard, can the explosives be used legally in an environment where that failure to meet the quality standard will not have a materially detrimental impact on safety, health or the environment?

- If disposal is being considered because the explosives have become life-expired or time-expired, can the explosives be re-lived or re-qualified?
- Is the nature of the explosive such that particular specialist competence and/or equipment will be required for the safe disposal of the explosives and is this competence and/or equipment available?
- Is there a recognised method or scheme in place for the disposal of the particular explosive? For example schemes are in place for the disposal of time-expired flares and other lifesaving pyrotechnics.
- Has the manufacturer produced instructions on how the explosives can be disposed of?

192 Waste explosives should be disposed of in a designated area and with facilities appropriate to the type and quantity of explosives to be destroyed. A safe system of work must be in place, and the people involved in disposal of explosives should be competent in the roles that they will undertake.

**Disposal methods**

193 The five main methods for safe disposal or destruction of explosives are:

- functioning in the design mode;
- burning;
- detonation;
- dissolution or dilution; and
- chemical destruction (including bioremediation).

194 Sea dumping and burial are not suitable methods for disposal and are not generally considered as being safe ways to discard explosives. They will not in general destroy the explosives or render them harmless.

195 Explosives should be disposed of by the most suitable method. Identification of the most suitable disposal method needs to consider the nature of the explosive and its hazards, and any hazards associated with the disposal method or created during the disposal process. The nature and position of any disposal site should also be considered as part of the identification of the most suitable method.

**Functioning in the design mode**

196 Where the explosives requiring disposal are safe to transport and use then methods such as disposal by functioning in the design mode should be considered.

197 Disposal of an explosive by functioning it in its design mode has the advantage that the performance during use of an explosive substance or article is predictable and will have been well characterised.

198 The safe and legal sale or transfer to another person of explosives that are safe to transport and use should also be considered before destruction is chosen as the disposal method.

**Burning**

199 When burning explosives, the risk of explosion and the generation of any thermal effects must be taken into account, and measures taken to minimise the risk and to protect against the effects of an explosive event. The general principle is to only burn small quantities at any one time while avoiding excessive transport movements. Items and debris which might be propelled from the fire when burned must be suitably contained without confining the explosive.

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200 Incompatible explosives must not be burned together. If there is any doubt about compatibility of explosives they should be burned separately.

*Detonation*

201 While disposal by detonation is relatively simple, it is essential to use a suitable site large enough to contain the effects of detonation. This method is most appropriate in 'use' situations, for example at quarries or other sites where blasting is performed. After detonation, the site needs to be checked for unconsumed explosives. Clear procedures are essential for checking whether all explosives have been fired, and anyone involved in this activity must clearly understand the steps to take in the event of misfires.

*Dissolution or dilution*

202 Some explosives can be prepared for destruction by a compatible solvent or diluent. Other explosives can be desensitised by a compatible solvent or diluent and the resulting waste can then be disposed of by burning. For example, most powdery pyrotechnic compositions contain a water-soluble component, which means that their explosive properties can be destroyed by immersion in sufficient quantities of water for an appropriate time. To control the consequential hazards associated with dissolution and dilution, it is generally accepted practice that any water-insoluble solids should be filtered from the resulting liquor and destroyed by burning.

203 The consequential hazards generally associated with dissolution and dilution are:

- solvent evaporating to produce a flammable vapour (the use of any flammable solvents in the disposal or destruction process should be controlled);
- solvent evaporating and regenerating the original explosive;
- solvent reacting with the explosive to produce a flammable gas such as hydrogen;
- solvent reacting with the explosive to produce an uncontrolled exothermic reaction. Some such reactions can further result in the ignition of the explosives, and components thereof (eg sodium and water), and any flammable gas produced;
- the production of solutions that pose a greater risk to health or the environment than the original explosive.

*Desensitisation and chemical destruction*

204 Chemical destruction is normally only relevant to the decontamination of plant or spillages where 'on-the-spot' destruction of small amounts of explosives is required. This method may be appropriate for very sensitive explosives which are too dangerous to transport for disposal in other ways.

205 Any secondary waste from chemical destruction should be assumed to present an explosives hazard, and be dealt with accordingly.

206 Bioremediation, which chemically changes or destroys explosives, is also possible. Bioremediation of explosives and explosives waste is a specialist topic and should not normally be considered unless a detailed and extensive hazard identification and evaluation and assessment of the explosives risks, supported by relevant small-scale testing, has been considered.

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**Disposal of explosive articles**

207 The method of disposal for explosive articles will depend on the nature of the particular device. The hazards and risks arising from each method need to be considered before deciding on the appropriate one to use.

208 Disposal can sometimes be safely achieved simply by exploding the article under controlled conditions at a suitable location. Alternatively, destruction of small articles may be possible in an armoured furnace. Disassembly or breakdown of articles is likely to introduce significant explosives risks and should only be considered as a last resort. Disassembly is an act of manufacture and must also be carried out in compliance with the regulatory requirements relating to manufacture.

**Decontamination of explosive plant and equipment**

Particular care should be taken when dismantling plant and equipment.

209 Decontamination methods will depend on the type of explosives (or explosives articles) and the nature of the buildings, plant or equipment involved. Hazards should be identified and evaluated before starting decontamination work.

210 Particular care should be taken when dismantling a contaminated plant. Undue force should not be used. If remote disassembly is not possible, workers should be supplied with appropriate clothing and equipment to protect them from localised detonation or other explosive effects.

211 If the equipment appears to be clean it must not be assumed that it is free from explosives until it has undergone some form of proving. It should be assumed that an explosion may occur at every stage of the proving process and the operation conducted accordingly. 'Hand flaming' must never be attempted, ie using a hand-held blowtorch to ensure that any explosives residues have been burned off an explosives-contaminated article.

**Hazard identification, hazard evaluation and risk assessment**

212 Consider what measures are required to dispose of or discard explosives safely or to decontaminate explosives plant and equipment. This will require the hazards associated with the explosives, the activity and the environment to be identified and evaluated. The guidance contained in paragraphs 50–51 and in Appendix 1 applies to the disposal and discard of explosives and to the decontamination of explosives plant and equipment.

213 Employers and the self-employed will generally identify and implement the controls to ensure that a disposal or decontamination activity is safe as an outcome of their risk assessment process. If they are the operator of an establishment subject to the provisions of the COMAH Regulations this will be carried out as part of the implementation of a safety management system.

**Vacating an explosives site**

Vacated explosives sites are left in a safe state.

214 Any person who vacates an explosives site should ensure that any explosives that are present, as well as any equipment, plant, or any other explosive-

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contaminated items, are either safely removed, disposed of, decontaminated, or lawfully transferred to the person who will be in control of the site.

215 In addition to their duties under regulation 28 of ER2014, an employer or self-employed person storing or manufacturing explosives has a duty under section 3 of the Health and Safety at Work etc Act 1974 to ensure, so far as reasonably practicable, that their activities do not create risks for people other than those in their employment. This applies to risks which might arise from the presence of explosives at the site after it has been vacated. This means that all explosives buildings and sites should be cleared of explosives before they are vacated.

216 Depending on the nature, use, size and history of the site it may be necessary to seek the advice of a specialist contractor. This is to ensure that all places where explosives may be present on the site are identified, assessed and, where necessary, decontaminated.

## Prohibitions concerning manufacture, storage and importation of certain explosives

### Regulation 29 Prohibitions concerning manufacture, storage and importation of certain explosives

#### Regulation 29

(1) Subject to paragraph (2), no pyrotechnic substance which consists of —

- (a) sulphur; or
- (b) phosphorus,

*mixed with chlorate of potassium or other chlorates or pyrotechnic article which contains any such mixture may be manufactured, stored or imported into the United Kingdom without the approval of the Executive.*

(2) In determining whether to approve for the purposes of paragraph (1), the Executive must take into account —

- (a) the risk of the mixture spontaneously combusting; and
- (b) the potential for the mixture to become sensitive to ignition by friction or impact.

(3) A contravention of paragraph (1) concerning importation is punishable only under the 1974 Act.

Only approved pyrotechnics substances and articles containing sulphur and/or phosphorus mixed with chlorates are manufactured, stored and imported.

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217 Pyrotechnic mixtures of sulphur and/or phosphorus with chlorates are not only liable to spontaneous ignition, but also tend to become exceedingly sensitive to ignition by friction or impact over time. These behaviours generally result from the presence of acidic and/or potentially acidic species in the sulphur and phosphorus and can be controlled by the use of appropriate stabilisers.

218 Anyone wishing to manufacture, import or store any pyrotechnic article or pyrotechnic substance containing these mixtures must apply to HSE for the article or substance to be approved.

219 HSE will make its decision on whether or not to approve a pyrotechnic article or a pyrotechnic substance containing a mixture of sulphur and/or phosphorus with chlorates on a case-by-case basis. In making its determination it will take account of the evidence provided by the dutyholder that shows that:

- the likelihood of the mixture spontaneously combusting and the hazards presented by the pyrotechnic substance or article are tolerable;
- the potential for the mixture to become sensitive to ignition by friction or impact over time is subject to appropriate controls.

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For further information on the information that HSE would expect to see in support of an application for the approval of a pyrotechnic substance or article containing a mixture of sulphur and/or phosphorus and chlorate, please contact the HSE Explosives Inspectorate: [explosive.enquiries@hse.gsi.gov.uk](mailto:explosive.enquiries@hse.gsi.gov.uk).

## Appendix 1 Hazard identification and evaluation and the assessment of explosives risks

### Identification and evaluation of explosives hazards

1 A systematic identification and evaluation of explosives hazards should consider:

- What fire and explosion hazards are associated with the properties of the explosive substances and articles stored, handled or produced?
- How can a fire or explosion occur in both normal and abnormal conditions?
- What measures could be implemented to prevent the fire or explosion occurring?
- Which of those measures would it be appropriate to implement in the circumstances of the explosives operation?
- How could a fire or explosion spread?
- What measures could be implemented to stop a fire or explosion spreading or acting as an initiating event for other explosives?
- Which of those measures would it be appropriate to implement in the circumstances of the explosives operation?
- Who might be harmed by a fire or an explosion and how could a fire or explosion harm people?
- What measures could be taken to protect people from that harm if a fire or explosion were to occur?
- Which of the measures should be implemented in the circumstances of the explosives operation?
- How should the appropriate measures be implemented?
- How should the continuing effectiveness of the appropriate measures be ensured?

### Fire and explosion hazards

2 The major hazards associated with explosives operations are fire and explosion. The potential for harm of any fire or explosion will often depend on the type of explosives and can include:

- blast and shock effects, including effects on building structures and glazing;
- fireballs and projected firebrands;
- flying fragments arising from an article itself or secondary fragments arising from the break-up of its immediate surroundings such as packaging or a building;
- projected effects such as propelled rockets and other pyrotechnic effects.

3 Each of these effects can, depending on its severity, cause harm to people, damage to the surroundings, initiate other explosives or cause fires to spread. The hazard type of the explosives will generally identify the predominant effects.

4 Consider whether the type of explosives operation and the sources of energy it involves might result in the explosive behaving in a different way from that which



might initially be expected. The behaviour of an explosive or substance in bulk storage, or in production conditions, might also differ from the intended effect or the behaviour 'in use' or in laboratory conditions. For example, explosives which might normally simply deflagrate could, under confinement, produce a mass explosion.

5 In certain circumstances there will also be secondary hazards such as the release of toxic or flammable substances.

## How can a fire or explosion start?

### *Properties of explosives and sources of ignition*

6 Determining how a fire and explosion can start will involve considering:

- the properties of the explosive, its sensitiveness to different sources of energy;
- the properties of any other flammable materials, their sensitiveness to different sources of energy and the nature of any tasks involving them;
- sources of ignition and how they could start a fire or initiate an explosion.

7 These steps may need to be reconsidered along with the initially identified controls to decide whether the likelihood of a fire and explosion has been reduced sufficiently to appropriately manage the explosives risks or whether any additional controls are required.

8 Depending on the type of explosive, potentially any application of energy might initiate an explosion. Sources of initiation to consider include:

- naked lights and flames;
- heat and temperature;
- electricity (including static electricity and electromagnetic energy);
- sparks from mechanical or frictional contact between metal surfaces;
- impact and friction;
- pressure; and
- chemical incompatibility between certain substances.

9 Consider how sources of energy can combine to increase the likelihood of an initiation, for example friction and impact combining when an explosive is dropped onto an edge, spike or spigot.

10 Other issues that can, depending on the explosive, affect sensitiveness to initiation and the likelihood of an event include:

- contamination of the explosive with grit etc either as a part of an on-site activity or as a consequence of the contamination of raw materials;
- contact with water;
- reduction of chemical and thermal stability over the life of the explosive;
- loss of a desensitising agent.

11 The likelihood of a fire or explosion will also be affected by:

- any intrinsic properties of the explosive that can affect the likelihood of an explosion, for example critical diameter or critical bed depth;
- the sensitivity of the explosives under ambient and process conditions to various stimuli, ie heat, flame, impact, friction, shock or electricity. For processing operations involving explosive substances and compositions, knowledge of their sensitiveness to these stimuli is essential to identify control

- measures, for example the level of protection against static electricity required;
- the potential for failure of safety instrumented systems, eg a cooling system leading to loss of control of an exothermic reaction;
- the potential for a fire or explosion originating in non-explosive but hazardous materials used in explosives processing, for example flammable solvents or strong oxidising agents.

12 Similarly degradation, decomposition and self-heating reactions which might not present a risk of initiation in laboratory quantities could result in an unsafe condition when explosives are manufactured or kept in larger quantities.

### **Higher-risk operations**

13 The evaluation and assessment should also identify whether there are any operations that present higher risks. Examples of activities where historical information suggests they are likely to present a greater likelihood of a fire or explosion include:

- maintenance work involving 'hot work' in or around explosives buildings or on explosives equipment;
- pumping operations;
- work involving handling particularly sensitive explosive compositions;
- contractor activities;
- breakdown of explosives articles.

### **Other potential hazards**

14 The evaluation and assessment should not simply address the risk factors that might arise in normal operations. It also needs to consider conditions under which the hazard might change and address risk factors that might arise during reasonably foreseeable circumstances. These may, depending on the circumstances, include:

- spread of fires from neighbouring properties and buildings;
- operator error or other inadvertent deviations from operating procedures;
- the potential for segregation arrangements to fail so that fuels and oxidisers inadvertently mix to produce an explosive or energetic mixture;
- equipment malfunction;
- the introduction of foreign material or inappropriate tools and equipment;
- ageing causing protective materials such as coatings to degrade or deteriorate;
- loss of containment of the explosives from a process or their removal from their expected packaging;
- effects of interruptions/breaks (whether planned or unplanned);
- service failures (such as loss of power supplies or water).

### **Associated activities**

15 Dutyholders should also consider how an initiation could occur during any associated activities such as:

- transport and movement of explosives and other hazardous substances around the site;
- disposal and decommissioning of explosives and explosive-contaminated equipment;
- ancillary activities such as cleaning, testing and quality control;
- movements in and out of storage, manufacturing and process facilities; and
- maintenance of buildings, grounds and equipment.

## How could a fire or explosion spread?

16 The major hazards associated with explosives also mean that it is often very easy for a fire to spread or an explosion to communicate.

17 Implementation of appropriate controls and compliance with the separation distance requirements of regulation 27 or the requirements of a licence issued by HSE or ONR should mean that explosion effects will not lead to the instantaneous communication of a fire or explosion to other explosives.

18 During the evaluation and assessment, consider what additional steps can be taken to prevent a fire spreading and identify any 'stepping stones' that could allow a fire to spread or an explosion to communicate more rapidly than expected. For example, the hazard identification and evaluation might identify that rules and arrangements are necessary to ensure that doors to buildings are kept closed, that firebreaks are maintained around explosives areas or that explosives being moved around or off site are not left outside licensed areas.

## How could a fire or explosion harm people?

19 As well as considering the immediate effects of an explosives event, you should consider the impact of a fire or explosion on people's ability to escape to a safe place.

20 The evaluation and assessment should consider members of staff or other people normally present on the site but, depending on the circumstances, it should consider hazards to:

- the public – either on site or off site;
- workers at other neighbouring premises;
- visitors and contractors working on site;
- the emergency services.

21 Appropriate controls and compliance with the separation distance requirements of regulation 27 or the requirements of a licence issued by either HSE or ONR should mean that explosion effects will not lead to intolerable levels of risk to people from an explosive event during the manufacture or storage of explosives.

## What measures should be implemented?

22 This document provides information on the safety measures to consider and put into operation where appropriate. Implementing these measures comprises three consecutive steps, ie:

- reducing the hazard;
- controlling the likelihood of an event or its frequency;
- where the risk of a fire or explosion cannot be eliminated, putting protective and mitigating measures in place.

23 The nature of some explosive operations is such that they are generally accepted as presenting such a risk to the people who might undertake them that they should either not be undertaken or should be conducted remotely.

### **Maintaining effective safety measures**

24 Measures are only likely to be effective if they are:

- communicated to people undertaking or responsible for an activity;
- monitored for continuing effectiveness;
- subject to periodic review and revision.

### **Monitoring for continuing effectiveness**

25 The safety measures will only be effective if they are in place and operating.

26 Resources should be committed to implement systems which ensure that:

- the identified measures remain in place; and
- processes and procedures are being followed.

## **Providing information about the explosives hazards**

27 The main findings of the identification and evaluation of the explosives hazards, the assessment of the explosives risks and the measures to be taken should be made available to workers and/or their representatives and to other people involved in the explosives activity. The way this information is provided will depend on the nature of the hazards, the likelihood of their being realised and the appropriate measures that need to be implemented. This may vary from oral communication to individual instruction and training, supported by information in writing.

## **Review and revision**

28 Review is a routine part of any quality management system. The identification and evaluation of the hazards, the assessment of the explosives risks and the appropriate measures implemented should be reviewed where, for example:

- there is any significant change to the activity or the environment in which it takes place, including new or modified machines, new personnel, new substances or substances manufactured to a different specification, and new or revised procedures;
- when processes or products are restarted after a long gap – because circumstances may have changed, and personnel may no longer be familiar with the product or process.

## **Approaches to hazard identification etc in explosives operations**

29 Detailed examples of how this process can be undertaken, what a systematic identification and evaluation of explosives hazards and assessment of explosives risks might look like in a particular subsector, what controls might be implemented and how their continuing effectiveness can be ensured can be found in the 'Further reading' section of this guidance.

30 For more complex operations including chemical processing, operations controlled by programmable logic control, or other tasks that are safety critical, the application of systematic tools should be considered and where appropriate they should be used as part of the hazard identification and evaluation process and as a part of the assessment of explosives risks. These tools include:

- hazard and operability studies (HAZOPS);
- failure mode and effects analysis (FMEA);
- failure mode, effects and criticality analysis (FMECA);
- consequence analysis and fault tree/event tree analysis techniques (FTA/ETA);
- human reliability assessment.

## Appendix 2 Management arrangements for explosives operations

### Extent of the arrangements

1 The management arrangements for explosives operations should be integrated into the management system for all other aspects of activities carried out at the site.

2 Management arrangements for explosives operations should include arrangements for and allocation of roles and responsibilities (where relevant) for:

- assessing (and reviewing) the competence and training needs for staff, contractors or others involved in the site's explosives activities and making arrangements for any necessary training;
- identifying and evaluating the explosives hazards and assessing the explosives risks on the site and their periodic review;
- providing information to employees, contractors or others involved in the operation of the site;
- ensuring co-ordination and co-operation with all users of the site – whether tenants or different operating arms of the same company;
- ensuring that people on the site are properly supervised and demonstrate appropriate behaviours;
- ensuring compliance with any licence conditions;
- the design, layout and construction of the establishment and initiating any changes to it;
- the selection and specification of work equipment (including personal protective equipment), plant and materials;
- the operation of formal systems of work – including permits-to-work on certain activities – and arrangements for the control of access to danger areas;
- planning, prioritisation, and carrying out maintenance work, together with inspection and testing alarm and firefighting systems and keeping records;
- ensuring co-ordination and co-operation with contractors;
- control and supervision of contractors' staff;
- emergency planning and the provision of relevant information to the emergency services;
- the reporting and investigating accidents and 'near misses' and any necessary follow-up action.

3 A manager, member of staff or other person may undertake more than one of these roles. Equally on larger sites there may be more than one person with responsibility for a particular area of work.

### Consultation with employees and others

4 The workforce and other dutyholders on an explosives site should be involved in the site's safe operation. Involvement of the workforce and other dutyholders can make a significant contribution to creating and maintaining a safe and healthy working environment and an effective health and safety culture. In turn, this can benefit business by reducing accidents and incidences of work-related ill health.

5 Employers are required by law to consult their employees on health and safety matters. The Safety Representatives and Safety Committees Regulations 1977 (SI 1977/500) provide for safety representatives to be appointed by trade unions that are recognised in the workplace. Safety representatives appointed under those Regulations by recognised trade unions must be consulted by employers.

6 Employees who are not covered by such representatives must, under the Health and Safety (Consultation with Employees) Regulations 1996 (SI 1996/1513) be consulted either directly or indirectly, through elected representatives.

7 Where people working with explosives, or otherwise allowed to be present on the explosives site, are not the employees of the dutyholder, proper consultation will contribute to the identification and continued implementation of the appropriate measures.

### Employee responsibilities

8 Section 7 of the Health and Safety at Work etc Act 1974 (the HSW Act) requires all employees to take reasonable care of their own health and safety and of the health and safety of others who may be affected by what they do at work. Section 7 also places a duty on employees to co-operate with their employer to comply with statutory duties for health and safety.

9 Regulation 14 of the Management Regulations places specific duties on employees to:

- use all machinery, equipment, dangerous substances or other equipment provided by their employer correctly, in accordance with any training and safety instructions they have received; and
- inform their employer (or anyone appointed by them to assist with health and safety) without delay of any work situation which might present a serious and imminent danger.

10 Employees should also notify any shortcomings in the appropriate measures and the health and safety arrangements, even when no immediate danger exists, so that any necessary remedial action may be taken. The duties placed on employees under the Management Regulations do not reduce the responsibility of the employer to comply with duties under those Regulations and other relevant statutory provisions.

11 Systems should also be in place to allow people on an explosives site who are not employees to report any shortcomings in the appropriate measures and the health and safety arrangements, even when no immediate danger exists, so that any necessary remedial action may be taken.

### Safety precautions and actions

12 Staff, contractors and anyone else working at or visiting a site storing or manufacturing explosives should be provided with sufficient information to ensure that the appropriate measures can be properly implemented. This information should include, where relevant:

- workplace rules including, for example, rules on the carrying/use of mobile phones and other radio-communications or wireless devices;
- limits on the quantity of explosives and numbers of people permitted in

- explosives buildings;
- types of tools and equipment permitted for use in explosives buildings and explosives areas;
- incompatible materials, substances etc that must be kept away from explosives or explosive substances;
- the location of controlled areas;
- the use of personal protective equipment;
- procedures to be followed in the event of an emergency; and
- other health and safety systems as relevant (in particular the use of permit-to-work or other systems where maintenance work is to be carried out).

13 Signs and notices are not the only way to communicate safety information – they should not be seen as a substitute for the provision of appropriate training, instruction and supervision.

### Workplace rules

14 Workplace rules are one of the ways in which the appropriate measures required by regulation 26 of ER2014 can be delivered. They allow information on safety precautions and expected behaviours to be communicated to people undertaking activities on an explosives site.

15 Workplace rules are expected industry practice at manufacturing and larger storage sites. They may also be required at smaller storage sites where there is a high level of interaction between explosive or non-explosives activities; where any management arrangements are extensive or complex; or where the explosives present a substantial hazard.

16 The workplace rules will depend on the hazards identified at the workplace, local conditions etc. Examples include:

- smoking and smoking materials should be prohibited in explosives areas. The possession of matches and other sources of ignition should also be prohibited unless expressly authorised. The rules must be clear about where such prohibitions apply, and where, if at all, smoking is permitted in non-explosives areas;
- the introduction of alcohol or any illegal drug into any explosives building or explosives area should be prohibited;
- working while under the influence of alcohol or any drug which might impair concentration should be prohibited;
- admitting any person who appears to be intoxicated into any explosives building or explosives area should be prohibited;
- the areas where mobile phones, pagers and other devices that are capable of wireless communication or which are fitted with their own power source can be used without permission should be identified;
- restrictions on any other articles or substances which may not be taken into explosives areas or which may only be permitted at particular locations within the explosives area (for example jewellery, food and drink) should be listed;
- restrictions on where changes of clothing can or should take place should be listed;
- places on site that can only be entered with expressed permission of an authorised or responsible person should be identified.

17 Where appropriate, the workplace rules should require workers, visitors and contractors to co-operate with any reasonable request to a search for articles which might provide a source of ignition or contamination that could increase the risk of such.



## Appendix 3 Electrical safety in explosives operations

### Electrical equipment and installations

- 1 Electrical equipment and installations within any explosives area should be confined to that equipment which is essential to the operation of the facility. Where it is necessary to install electrical equipment, it should conform to the relevant standards and must be designed and constructed to prevent it becoming a source of ignition.
- 2 Any electrical installation or equipment should be appropriate for use with the type and form of the explosives and other dangerous substances which are or which can be expected to be present and which could directly or indirectly interact with the electrical installation or equipment to initiate a fire or explosion.
- 3 For facilities that would be expected to attract a separation distance, overhead power lines and telephone wires should not, whenever possible, cross over, or terminate on, an explosives building or area, nor should underground cables pass under them. Overhead lines leading to the building or area, should, wherever possible, terminate away from it with the final connection made underground, fitted with appropriate surge protection. Where new cables are laid they should be protected against mechanical damage.
- 4 Conductors, generating plant, or high-voltage transformers and switchgear must be located at a suitable distance away from explosives facilities. Switchgear and distribution boards should not be sited inside a room containing explosives.
- 5 Sockets should only be provided when absolutely necessary, and must be appropriate to the area that they are in.

### Portable electrical equipment

- 6 Before any portable electrical equipment is used in an explosives facility its potential as a source of ignition should be considered and assessed. This assessment must consider the potential presence of explosives dusts, flammable or explosive atmospheres; the potential for any electrical spark from the motor or during use; and their consequences with respect to fire or explosion. It must also consider other ways the equipment could act as a source of ignition during use (for example, surface temperature, frictional heating or other modes of failure that would cause overheating) and maintaining suitable separation from explosives.
- 7 The use for maintenance of either mains- or battery-powered electrical equipment in an explosives building may be permitted once the building has been cleared of all explosives or, where the building is divided into rooms which can be isolated from one another, where the room has been cleared of all explosives and is isolated from the rest of the building. In other cases, if it is not feasible to clear the whole building then a decision will need to be made on whether it is safe to

undertake the activity and suitable arrangements must be made to isolate the area where the work is being carried out.

8 The equipment must be suitable for the environment. Suitability will include, where appropriate, the means to prevent dusts, mists or vapours entering the equipment.

9 Electrical equipment used for maintenance should never be left unattended when connected to the supply.

## Electromagnetic energy

### *Mechanisms of initiation*

10 Electromagnetic energy emitted from radio transmitters and other devices such as mobile phones, beepers, pagers, transmitters and electrical cables can be collected by pipework or other metal structures acting as aerials. The energy can be released when the 'aerial system' is broken. Explosives sensitive to this type of energy include electro-explosive devices (EEDs) and explosive articles that contain EEDs.

### *Precautions*

11 Where EEDs are present and it is reasonably practicable to do so, suitable fixed communication systems should be provided to eliminate the need for portable communications devices. Where the use of such equipment is unavoidable, the potential for initiating any EEDs present will need to be assessed. A margin of at least 12 decibels (dB) below the 'no fire hazard' threshold of the most sensitive device present should be maintained. As part of planning for emergencies, the police, fire and emergency services will need to be informed if explosives sensitive to radio energy are, or may be, present so that they may make a similar assessment of their radio communications equipment.

## Electrostatics

### *Mechanisms of initiation*

12 Electrostatic charges are commonly generated by contact electrification, when two dissimilar materials are brought together then separated. Other mechanisms which generate separated charge include charging by induction and charge transfer. Electrostatic charges can be produced by physical activity (eg walking, moving machinery, processing materials) and it can take only a few, brief brushing movements for an isolated conductor to reach several thousand volts, eg a person leaving a car seat or removing an article of clothing.

13 Separated electrostatic charges quickly combine either directly or via the earth unless they are prevented from doing so. The main ways in which separated charges are retained are:

- on a conductor insulated from other conductors and from earth by a non-conductor; and
- on a non-conductor by virtue of the resistance of the material itself.

14 The spark discharge of accumulated electrostatic charges can initiate a fire or explosion. The electrostatic energy required to cause ignition varies with the type of explosive and its physical state. In general, primary explosives and EEDs are much more sensitive than propellants or high explosives, while pyrotechnics exhibit a wide range of sensitivity. The level of the precautions required will depend on the

explosive and should be considered as part of the hazard identification and evaluation.

### **Precautions**

15 The electrostatic charge on people handling electrostatic discharge (ESD)-sensitive explosive substances and articles must be limited. Accumulation of charge is dependent on a number of variables including the clothing being worn but can be controlled by the use of appropriate clothing, conductive/antistatic shoes, appropriate flooring and the correct humidity.

16 The precautions required depend upon the sensitivity of the explosives. An antistatic regime is required when materials with ignition energies of 1 millijoule (mJ) and above are present. A conductive regime is required where materials with ignition energies of less than 1 mJ are present.

17 There are three broad degrees of precaution, usually referred to as:

- first degree – appropriate for comparatively insensitive explosives. It requires the avoidance of exposed, isolated conductors and earthing of all large conducting objects (such as fixed plant and equipment) usually via a buildings protective earth conductor;
- intermediate – appropriate for sensitive explosives. It requires the first-degree precautions plus additional antistatic measures to reduce the possibility of accumulation and retention of an electrostatic charge capable of igniting or initiating the explosives substances or articles; and
- second degree – appropriate for very sensitive explosives. It requires first-degree precautions plus conducting measures to prevent accumulation and retention of an electrostatic charge capable of igniting or initiating the explosive substances or articles.

18 First-degree precautions are appropriate for comparatively insensitive explosives (those with a minimum ESD for initiation greater than 450 mJ) or those where it can be shown that the nature of the process will not result in sufficient electrostatic charge being accumulated to cause the initiation of the explosives.

19 Intermediate precautions are required for sensitive explosives (those with a minimum ESD energy for initiation greater than 1 mJ and up to and including 450 mJ). In addition to first-degree precautions, specific measures include:

- using antistatic materials and effective earthing for all equipment, work benches, chairs, boxes or other containers and other movable or portable items;
- strictly controlling high-resistivity materials such as plastics, rubber and glass. Where it is necessary to use these materials (and they could accumulate and retain a static charge) they should either not have a surface area greater than 75 cm<sup>2</sup> or a suitable and sufficient assessment should have been undertaken which demonstrates that the high-resistivity materials in use do not have the capability of producing a spark with sufficient energy to initiate the explosives;
- providing conductive floors in accordance with a relevant standard with a resistance from surface to earth of between 50 kilo ohm (k $\Omega$ ) and 2 mega ohms (M $\Omega$ );
- providing appropriate antistatic footwear in accordance with a relevant standard;
- maintaining the relative humidity at a level at which electrostatic charges capable of initiation or igniting the explosives article or substances will not accumulate, usually equal to or greater than 40%. Where the process requires the relative humidity to be less than 40% alternative measures must be in place to ensure that an electrostatic initiation does not occur;

- providing suitable external work clothing which is not liable to generate or retain electrostatic charge. Clothing should not be put on or removed in the presence of any explosives substances or articles; and
- if the use of wrist or ankle straps is specified as part of the required antistatic precautions, then they should be of a quick-release type and comply with a relevant standard. The end-to-end resistance, including the strap, cabling and termination contact, should be between 900 k $\Omega$  and 35 M $\Omega$ . Connections for straps should be dedicated for each working area and should be readily accessible.

20 Second-degree precautions are required when dealing with very sensitive explosives (those with an ESD ignition or initiation energy up to and including 1 mJ). In addition to first-degree precautions, specific measures include:

- using conducting materials and effective earthing for all equipment, work benches, chairs, boxes or other containers and other movable or portable items;
- avoiding high-resistivity materials such as plastics, rubber and glass;
- providing conducting floors in accordance with a relevant standard (with a resistance from surface to the building protective earth of less than 50 k $\Omega$ );
- providing conducting footwear in accordance with a relevant standard;
- installing personal resistance monitors at every entrance;
- when handling compositions having ignition energies of less than 100 micro Joules (0.1 mJ), the use of personal resistance monitors at individual workstations is recommended so that workers can regularly check if they have accumulated an electrical charge as they move between tasks; and
- maintaining the relative humidity of the atmosphere at 65% or more. Where the process requires the relative humidity to be less than 65% alternative measures must be in place to ensure that an electrostatic initiation does not occur.

21 In addition to wearing suitable external work clothing (as described for intermediate precautions), people working with very sensitive explosives will also need to ensure that clothing worn underneath external clothing is not liable to generate electrostatic charge.

22 Where gloves have been identified as a part of the appropriate personal protective equipment for a task that requires precautions to be taken to prevent the accumulation and discharge of electrostatic energy, those gloves should be conductive. Where it is not practicable or appropriate to use conductive gloves the process should be reviewed to determine:

- whether the task can be redesigned or conducted with alternative preventative and protective measures that would allow the use of gloves that are not conducting;
- whether the task can be redesigned or conducted with alternative preventative and protective measures that would allow the task to be undertaken without the use of gloves.

### **Checking and maintenance of antistatic and conducting precautions**

23 Where explosives have been identified as being susceptible to initiation by electrostatic energy and people are required to wear conducting footwear and low-resistivity clothing, they should be given training in the care of such clothing in accordance with the manufacturer's recommendations.

24 Where resistance monitors are used, clear operating instructions should be provided and the continued accuracy of the monitors checked.

25 Dutyholders should assess how frequently conducting and antistatic precautions should be checked to ensure they remain effective, for example straps should be inspected daily or immediately before use, whereas other parts of the system may only require weekly or monthly checking. Suppliers' or manufacturers' instructions on maintenance should be adhered to.

26 Wherever antistatic or conducting precautions are being taken, people working in the areas must be protected from electric shock. In areas where conducting regimes exist, mains electrical systems should be protected by residual current devices (RCDs) which comply with an appropriate standard. Any fixed or portable electrical equipment should be double insulated or have not less than two independent protective earth connections.

27 Follow manufacturers' advice on the cleaning, polishing and maintenance of antistatic or conducting floors and worktops, as incorrect techniques can adversely affect the conducting properties of the floors negating their properties as a preventive measure.

28 As the use of such flooring increases the risk of electrocution, additional care should be exercised with maintenance and other work on electrical equipment.

## Lightning protection

29 Suitable lightning protection should be installed in explosives stores except where the store:

- is temporary (for example, for no more than a few weeks on a seasonal basis) and holding HT 4 pyrotechnic articles;
- is used to keep less than 75 kg of HT 4 explosives;
- is used to keep less than 25 kg of HT 3 explosives;
- is used to keep no more than 100 g of HT 1 or HT 2 explosives;
- contains only HT 4 small arms ammunition;
- is made by excavation and is thereby inherently protected from lightning; or
- is exempted under the terms of a licence issued by HSE or ONR;
- is within domestic premises, is not otherwise exempt and is being used for the storage of explosives in accordance with regulation 27(3).

30 Suitable lightning protection should be installed in manufacturing and processing facilities that cannot be emptied of explosives upon the approach of a thunderstorm.

31 Lightning protection will need to be based on the requirements set out in an appropriate relevant standard. The method of protection will depend on the nature of the area to be protected and includes the use of a suspended air termination network at an adequate height above the area to be protected and/or any vertical conductors. All metallic reinforcement, crane and railway rails which enter explosives buildings must be bonded to the nearest point of the lightning protection system.

32 Inspections and tests should be conducted at intervals recommended by a competent person that will ensure the continuing effectiveness of the system. Where earth resistance is expected to vary during the year tests should be conducted at intervals that will allow any seasonal earth resistance to be assessed, eg every 11 months.

33 All main structural metalwork in and on the explosive building (including the lightning and anti-static protection systems), should be connected to a common

system of earthing and equipotential bonding. Metallic enclosures of electrical switchgear, motors, starters and other electrical appliances must be suitably earthed. Metallic cable sheaths or armouring, metal projections through walls (pipes, rails etc) should be suitably bonded to the lightning protection system. Provision should be made to allow access to the earth electrodes for testing purposes.

34 Steel-framed structures with metallic cladding may be regarded as self-protecting provided the individual earth resistance of each stanchion, in a stand-alone condition, does not exceed 10 ohms. The metallic cladding should be bonded to the structure by suitable metal fixings and electrically bonded with straps of the same cross-sectional area as the main down conductor, and at least 50 mm<sup>2</sup>. Where these conditions cannot be met, a ring conductor, bonded to each stanchion and with earth electrodes at each end of the structure, should be provided.

35 Steel ISO or similar containers used for the storage of explosives can be regarded as self-protecting provided that:

- the walls are lined with wood (or other appropriate lining) or the explosives are kept at least 150 mm away from the container's walls;
- the panels and doors are electrically bonded with straps of a cross section of at least 50 mm<sup>2</sup>;
- two earthing points connected to earth rods are provided at opposite corners; and
- resistance from the top of the container to earth is less than 10 ohms.

## Appendix 4 Emergency procedures

### Information and arrangements

1 People present on explosives sites should know what to do in the event of an emergency. They should be given clear guidance on:

- situations or circumstances when work must stop (for example in the event of fire, equipment malfunction, loss of containment or in other cases which could lead to accidental initiation);
- what escape routes to take to leave quickly and safely;
- a safe place(s) where people should assemble after evacuation;
- what information should be provided to the emergency services; and
- who will tell people if and when it is safe to return to the site or to work.

2 Arrangements should also be in place to assist particular groups of people such as members of the public or other visitors on site (who may be unfamiliar with the workplace and the risks presented by dangerous substances that are present), or disabled people. The guidance will draw on the hazard identification and evaluation and identify the actions to be taken in different emergency scenarios.

3 Dutyholders should carry out exercises to familiarise employees and others routinely present on site with the procedures and to test their effectiveness. Procedures must be reviewed if test results suggest it is necessary to do so.

4 Many people with duties under ER2014 will also have duties under the requirements of fire safety legislation. Compliance with the duties imposed by fire safety legislation will, in general, result in the development and implementation of appropriate measures for handling fires on an explosives site.

### Fire precautions

5 The fire precautions required will depend on the complexity of the site, the type of explosives and other material being kept, the processes being conducted and the results of both the hazard identification and evaluation and any risk assessment required to comply with the Management Regulations, DSEAR or fire safety legislation.

6 Many of the appropriate preventative and protective measures taken to comply with the requirements of regulation 26 of ER2014 will also comprise 'general' fire precautions required by fire safety legislation.

7 In general the fire precautions associated with the emergency procedures will consist of ensuring that the explosives are not present anywhere where in the event of a fire they would endanger or prevent someone from using the escape routes, and that they are kept well away from flammable and other hazardous substances.

Common fire prevention and precaution principles to consider in the design of the workplace and systems of work include:

- removing any features that would assist the rapid development of a fire;
- locating manufacturing and process operations or storage away from escape routes. Explosives should also be kept away from vertical openings which might spread smoke or fire through buildings (in some cases openings may be specifically designed to vent heat and flame away from escape routes etc);
- high standards of housekeeping;
- effective maintenance;
- regular testing and examination of the means of escape, firefighting equipment and fire warning systems; and
- record keeping.

8 When considering fire precautions, assess the particular fire hazards that may arise from the process or activity being carried out, as these may vary from one situation to another. This includes:

- ensuring that escape is not prevented by toxic fume, flame or radiant heat in areas where there are potential leakage and ignition sources;
- identifying the places people need to go during normal plant operation or maintenance and the means provided to allow them to escape these places in an emergency; and
- considering potential hazards arising from the form of construction and materials used for the structure and finish of the building. For example, unprotected openings in walls and vertical shafts may help the spread of smoke and therefore hinder escape, and unsuitable lining surfaces of walls and ceilings (such as fibre boards and some gloss paints) and the use of sandwich panels can lead to the rapid spread of flame.

## Fire detection and warning systems

9 There must be a means of raising the alarm in case of fire. It may also be appropriate to install a fire detection system linked to a general alarm, eg where processes are left unattended, where a fire may start unnoticed or where occupants in a building may not be aware of fire developing in another part of the building.

10 The fire warning system and detection system should be suitable for the site and will vary depending on the operation or process being carried out and should be appropriate to the level of risk presented. For example, these may range from the installation of automatic detection in a shop storing a small quantity of fireworks, to the use of detectors linked to automatic water drench systems in certain manufacturing processes.

11 Where an automated warning system is required, workers must also be able to activate the alarm manually in the event of an emergency.

12 The type of any system and the coverage required (including the siting of any detectors, call points, sounders and alarm-actuating points) will vary depending on the size of the site and the size, number, construction and use of the buildings on the site. Where a responsible person has duties under fire safety legislation, the type and coverage of the systems required will be determined by fire risk assessment and any installation should comply with the requirements of any relevant standard.



## Means of escape and evacuation

### Layout of buildings

13 All explosives buildings and areas should be designed to allow people to escape and reach a place of total safety quickly. A place of total safety is one that is well away from the fire and where people can subsequently disperse. To reach a place of total safety it may be necessary to provide a protected route or reasonable place of safety having a fire-resisting structure with not less than 30 minutes protection. As a general rule, the greater the risk people are exposed to, the shorter the escape route should be. Travel distances from any point to a place of reasonable safety should not exceed the distances in Table 2 of the *Fire safety legislation guide*<sup>5</sup> or the table below (which references the hazard expected in fire safety guidance) where relevant.

**Table 1 Recommended escape route distances**

| Buildings, rooms and areas where explosives are processed or stored  | More than one escape route | Dead ends where exit is substantially in one direction         |
|--|----------------------------|--|
| Process areas for fireworks, pyrotechnic and primary compounds<br><i>(no equivalent fire safety legislation category)</i>  | 6 m                        | 4 m<br>No explosive should be present between person and exit  |
| Process areas for secondary explosives and propellant<br><i>(Special fire hazard – industrial)</i>   | 18 m                       | 9 m<br>No explosive should be present between person and exit  |
| Process areas for secondary explosives and propellant<br><i>(Higher fire risk area – industrial)</i>   | 25 m                       | 12 m<br>No explosive should be present between person and exit |
| Assembly and packaging of explosives items and the storage of explosive components not in their transport packaging<br><i>(Higher fire risk area – industrial)</i> | 25 m                       | 12 m<br>No explosive should be present between person and exit |
| Stores<br><i>(Normal fire risk area – industrial)</i>  | 45 m                       | 25 m   |

14 Special fire hazard areas are similar to those given in note 2 to Table 2 of the *Fire safety legislation guide*. For the explosives industry this would include any process involving explosives which may result in a rapidly developing fire. Examples of where this could occur include:

- any procedure where energy is being inputted into the explosive;
- machining;
- casting;
- blending;
- cutting;
- decanting propellant.

15 In addition to the circumstances defined in the *Fire safety legislation guide*, for the explosives sector 'higher risk' travel distances should normally be applied to buildings where work is taking place on explosive items or components, eg assembly or packaging. Also included within this category are processes which will not result in a rapidly developing fire.

16 In the event of fire, the hazards may include explosion, smoke and hot toxic gases, as well as flames, and the danger is exacerbated by the speed at which these may spread through a building.

17 Exit doors (other than those in domestic premises) should open outwards, be easily pushed open and be accessible without the use of a key, card or code while the building is occupied. Exit doors should never be blocked or obstructed. There should be a flat area of at least 1 m immediately around the outside of the exit door. All escape routes and exits must be clearly marked and identifiable.

18 Fire alarm-actuating devices should normally be situated at the exit(s) from the building and should preferably be capable of immediate activation (for example not a break-glass type). Call points should be positioned in safe locations away from moving machinery and dangerous substances or on escape routes at a safe distance.

19 There are relevant standards that provide recommendations for the planning, design, installation, commissioning and maintenance of fire-detection and alarm systems in buildings other than dwellings. Due consideration should be given to the design of electrical and electronic equipment installed for fire detection and warning purposes to ensure that it is appropriate for the explosives activities that take place in the areas where it is installed.

### **Escape routes**

20 Where there is risk of blast or fireball or projected effects from articles such as fireworks, plans and arrangements for escape and evacuation must take into account the fact that workers escaping from a building may still be in immediate danger from blast and fragments thrown by the exploding building or from a fireball or any other projected effects.

21 Issues which will need to be taken into account include:

- escape routes. These should be clearly marked and appropriately lit. Consider constructing 'dog legs', installing barriers that can trap fragments and projected effects, and pressure relief areas to divert blast pressure away from those escaping a building; and
- the location of muster areas. These should be clearly identified. Fire blankets and other fire and first-aid equipment should be available at or readily accessible from these areas.

22 Evacuation plans and procedures will need to take into account the possibility that in the event of a fire in one building, people in other buildings both on and off the site may be at less risk if they stay indoors.

### **Firefighting arrangements**

23 Dutyholders should have procedures to be followed in the event of a fire or explosion on an explosives site. They should include in what circumstances they would or would not attempt to fight a fire.

24 The priority in the event of a fire will be to evacuate people to a place of safety. Anyone detecting a fire involving explosives should evacuate the area immediately and raise the alarm. This is because explosives contain their own oxygen and experience indicates that it can be very difficult to predict how quickly a fire will develop or spread.

25 Dutyholders' firefighting action should generally be limited to preventing a small fire growing and protecting escape routes.

26 In general, people responding to a fire should withdraw to a safe distance if the fire should spread to a building known to contain explosives or other similarly hazardous materials. If there is any doubt about the nature or location of the explosives involved, the fire should not be fought and all personnel should evacuate to a safe distance. Fires that have spread to buildings or areas holding HT 1, HT 2 or HT 3 explosives should not be fought unless measures have already been put in place that will allow the fire to be fought remotely or from a place that is known to provide appropriate protection from the potential explosives hazards.

27 Any training and information should emphasise that:

- people on site tackle fires only when it is safe to do so and only after receiving appropriate training in the use of the firefighting equipment; and
- fighting large fires is dangerous and that people should only tackle small fires and not those that have gained a firm hold or involve explosives.

28 The training and information will also need to cover:

- the number, type and location of firefighting equipment stored in the premises and elsewhere; and
- the type(s) and location of fire warning systems.

29 Appropriately trained on-site personnel may use firefighting equipment to prevent external fires reaching stocks of explosives **but only when they can do so without endangering themselves or others**. People should not put themselves or others at risk by attempting to fight fires unless this is necessary to protect escape routes, or unless fires are small enough to be brought under control easily. The fire and rescue service should be called immediately any fire is discovered. Fires may develop quickly, are often difficult to extinguish and any delay in calling the fire and rescue service may prove critical.

30 Where there is a competent on-site firefighting team, the team may fight larger fires that do not pose an immediate threat to the explosives. These activities will generally be limited to preventing the fire spreading to buildings or areas containing explosives, or to fighting secondary fires after an explosion.

31 Avoid the potential danger from prolonged attempts at firefighting. Firefighting must not continue when the means of escape of those fighting the fire are threatened. Having left the vicinity of a fire, people should not return to fight it.

32 If there is any danger that the fire will affect any explosives present, those fighting the fire must evacuate the area immediately.

### **Firefighting equipment**

33 When carrying out the hazard identification and evaluation, and any required fire risk assessment, consider whether equipment should be provided for fighting fires to protect people. This should only be at an early stage to assist with escape and evacuation.

34 In a fire, pyrotechnic articles and other explosives can ignite readily, burn rapidly, have great potential for fire spread and often produce large volumes of smoke. Emergency plans should consider whether firefighting is necessary to safeguard personal escape, or to safeguard others. If it is not needed for this purpose then it may be appropriate to exclude firefighting altogether, thus avoiding exposure to unnecessary risk and ensuring that people's first response is to evacuate and raise the alarm rather than attempting to fight a fire.

35 The only firefighting equipment usually required in explosives buildings is equipment for fighting small fires in areas where explosives are not present, such as administration or welfare areas (offices, toilets etc) and connecting corridors. These will ensure that small fires that do not involve explosives can be dealt with quickly and effectively.

36 Firefighting equipment should not be provided in areas where it could significantly increase the likelihood of, or could aggravate, an explosives event. First-aid firefighting equipment should not be provided in explosives stores where its use to prevent or minimise material loss would be at the expense of safety.

37 Consider providing automatic water sprinklers or drenchers where they would not significantly increase the likelihood of, or aggravate, an explosives event. For example, at an automated manufacturing/loading facility which is attended, and where the quantities of pyrotechnic or propellant material being processed would present a significant risk to people.

38 Where firefighting equipment is provided as part of the overall fire risk assessment in places storing small quantities of lower hazard explosives such as HT 4 fireworks, HT 4 pyrotechnic articles or small arms ammunition, it may be used to safeguard personal escape, or to maintain protection while others escape. One 9 litre water extinguisher or a 3 kg dry powder extinguisher may be suitable for firefighting of this type as they are simple to use, do not pose major incompatibility issues and have limited duration. These should not be supplemented by additional extinguishers as this may encourage those fighting the fire to stay longer than it is safe to do so.

39 Relevant recognised standards are available that relate to firefighting equipment. Where it is provided, it must conform to a relevant standard.

40 Explosive materials contain their own source of oxygen and small portable fire extinguishers are unlikely to be effective in reducing the fire. Large volumes of water from fire sprinkler or drencher systems may have more effect. When attempting to extinguish any fire, the choice of firefighting medium is most important and suitable training must be provided to ensure the correct choice.

### **Liaison with fire and rescue services**

41 Information on the buildings and other places on site where explosives are or are likely to be present, and the explosives that are likely to be involved in an emergency, should be prepared in advance and be provided to the fire and rescue service in the event of a fire or other emergency. This will allow the fire and rescue service to plan an appropriate response to any emergency on site.

42 Dutyholders who have a licence to manufacture and/or store explosives granted under the provisions of ER2014 and dutyholders who do not require a licence but may be routinely keeping significant quantities of explosives should contact the fire and rescue service, who may wish to undertake familiarisation visits

to explosives sites. During those contacts the fire and rescue service should be informed what the normal manning arrangements for the site are.

43 A competent person should be appointed to advise the fire and rescue service in the event of an incident. On arrival the fire and rescue service should whenever practicable be told where the fire is located, the types and quantities of the explosives that are involved in the fire and that are elsewhere on site, and the hazards that the explosives present. The fire and rescue service should also be advised of the presence and location of other dangerous substances.

44 Much of the initial information that the fire and rescue service will require can be provided by way of:

- a copy of any licence granted under the provisions of ER2014;
- a site plan showing:
  - where explosives are or are likely to be present;
  - where other dangerous substances are or are likely to be present;
  - assembly areas or other places where people have been instructed to take refuge as part of the site's emergency procedures;
- a copy of any relevant stock records.

45 Where a site is not permanently manned the dutyholder should have arrangements in place for the competent person to be contacted by the fire and rescue service or other emergency services.

### Re-entry and resumption of work

46 Re-entry after an incident, and the resumption of work, should only be permitted when directed by a competent person appointed by the site operator. Where there has been a major incident involving the call-out of the fire and rescue service, entry to the premises should be prohibited until the fire and rescue service has given the all-clear.

47 Any work involving potentially hazardous situations after an incident (for example dealing with smouldering explosives, opening vessels or sealed work equipment) should only be undertaken under the supervision and direction of a competent person and with due consideration of any investigation into the circumstances of the incident that may need to take place by regulatory bodies and the site operator. Learning why something happened will help make sure it does not happen again.

48 Before explosives activities are restarted the hazard identification and evaluation and any associated risk assessments should be reviewed to determine whether there are any additional appropriate measures that should be taken to:

- prevent a fire or explosion;
- limit the extent of a fire or explosion;
- protect people.

## APPENDIX 5 Annotated separation distance tables

1 Tables 1–11 are reproduced from Schedule 5 of ER2014. They have been annotated to make their day-to-day use easier.

### How to use the tables

2 The tables in Schedule 5 show in Column 1 two figures in each row for the quantity of explosives (for example 25–50 kg). The effect of Schedule 5.1(4) is that this means, in this example, more than 25 kg and no more than 50 kg.

3 Class A distances should be used for bridleways, footpaths, footways and waterways used by more than 20 people in any 24-hour period. Class A distances should also be used for a road used by more than 20 and no more than 500 vehicles every 24 hours.

4 Class B distances should be used for docks, jetties, piers, railway lines, reservoirs, river walls and runways. Class B distances should also be used for a road used by more than 500 and no more than 10 000 vehicles every 24 hours.

5 Class C distances should be used for places of public resort. Places of public resort are places other than buildings where more than 100 people are present or are likely to be present on at least a weekly basis. Class C distances should also be used for a road used by more than 10 000 vehicles every 24 hours.

6 Class D distances should be used for buildings that are normally occupied (ie where people are, or are likely to be, present either all the time or from time to time), and include all dwellings (including mobile homes and caravans), shops, government and public buildings, churches, colleges, schools, hospitals, theatres, cinemas or other buildings (such as sports stadiums) where the public assemble. Class D distances should also be used for buildings or other facilities used for the bulk storage of dangerous goods and for buildings that are not on the same explosives site but which are used for the manufacture, processing or storage of explosives.

7 Class E distances should be used for any vulnerable buildings. The vulnerable building distances for Hazard Type 3 or 4 explosives are the same as those for other buildings.

8 Class F distances should be used for buildings within the explosives site, other than:

- buildings occupied by a person other than the licensee (in which case Class D distances should be used);
- vulnerable buildings (in which case Class E should be used);
- buildings normally occupied by more than 20 people (in which case Class D should be used); or

- buildings used for the bulk storage of dangerous goods other than goods which are explosives (in which case Class D should be used).

9 Class G distances should be used for buildings or other places within the explosives site that are used for the storage of explosives (also known as 'magazine-to-magazine distance').

10 Class H distances should be used for buildings or other places within the explosives site that are used for the manufacture or processing of explosives (also known as 'process building distances').

### Measuring distances

11 Distances are measured from the outside edge of the building or place where explosives are stored to the nearest point of the building or place to which the separation distance applies. The distance should be measured in the horizontal plane. Distances are measured along a straight line without regard to mounds or traverses or earth cover.

### Determining the separation zone

12 Where there is more than one store on a site the separation zone is a composite of separation distances around the individual stores.

### Deciding the hazard type (HT) and quantity to use when more than one HT is present

13 Where more than one type of explosive is kept, the limit for the most energetic explosive will apply. For example, if HT 1 explosives are kept with HT 4 then HT 1 distances will apply. The quantity will be determined by adding the net mass of the HT 1 explosives to the net mass of the HT 4 explosives. This process is called aggregation. For example:

$$50 \text{ kg HT 1} + 300 \text{ kg HT 3} = 350 \text{ kg HT 1}$$

$$1000 \text{ kg HT 1} + 50 \text{ kg HT 2} + 10\,000 \text{ kg HT 3} + 20\,000 \text{ kg HT 4} = 31\,050 \text{ kg HT 1}$$

### Deciding the quantity to use when there is more than one store on site

14 Where stores on a site are separated from each other by a distance less than the specified Class G distances, the quantity of explosives in the stores will be added together (ie aggregated) for the purposes of determining what net mass in Column 1 should be used.

### Deciding which table to use in areas of low population density

15 In certain cases, the supplementary tables in Schedule 5 specify distances for low population density areas. These tables specify the maximum number of houses (or other dwellings such as flats) which may be in a specified area around the store at which the low population density distances may be applied to dwellings.

16 An illustration showing how to work out whether the low-density distance can be applied is given in Appendix 6.

17 In most such areas it will be immediately clear that the area is low population density. Where it is necessary to make a count of the number of inhabited buildings, the electoral register will be a source of data on the number of households in residential areas.

18 There is a continuing duty on the person storing explosives to comply with the requirements in cases where subsequent development means that the number of dwellings in the reference zone exceeds the threshold at which the low-density distance applies.

**Table 1** Hazard Type 1 explosive in a brick-built mounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 0.1–25                      | 33  | 50                                    | 100  | 100                         | 100                                   | 50                                  | 9                                | 18   |
| 25–30                       | 33  | 50                                    | 100  | 100                         | 100                                   | 50                                  | 9                                | 18   |
| 30–40                       | 34  | 51                                    | 103  | 103                         | 103                                   | 51                                  | 9                                | 18   |
| 40–50                       | 35  | 53                                    | 106  | 106                         | 106                                   | 53                                  | 9                                | 18   |
| 50–60                       | 37  | 55                                    | 110  | 110                         | 110                                   | 55                                  | 10                               | 22   |
| 60–70                       | 37  | 56                                    | 111  | 114                         | 114                                   | 57                                  | 10                               | 22   |
| 70–80                       | 38  | 57                                    | 113  | 118                         | 118                                   | 59                                  | 11                               | 22   |
| 80–90                       | 38  | 58                                    | 115  | 121                         | 121                                   | 61                                  | 11                               | 22   |
| 90–100                      | 39  | 59                                    | 118  | 125                         | 125                                   | 63                                  | 11                               | 22   |
| 100–150                     | 43  | 64                                    | 128  | 142                         | 142                                   | 71                                  | 13                               | 27   |
| 150–200                     | 46  | 70                                    | 139  | 156                         | 156                                   | 78                                  | 14                               | 27   |
| 200–250                     | 50  | 75                                    | 150  | 169                         | 169                                   | 85                                  | 16                               | 30   |
| 250–300                     | 54  | 80                                    | 161  | 170                         | 170                                   | 85                                  | 16                               | 30   |
| 300–350                     | 57  | 86                                    | 172  | 172                         | 172                                   | 86                                  | 18                               | 33   |
| 350–400                     | 61  | 91                                    | 183  | 183                         | 183                                   | 92                                  | 18                               | 33   |
| 400–450                     | 64  | 97                                    | 193  | 193                         | 193                                   | 97                                  | 19                               | 36   |
| 450–500                     | 68  | 102                                   | 204  | 204                         | 204                                   | 102                                 | 19                               | 36   |
| 500–550                     | 68  | 102                                   | 204  | 204                         | 204                                   | 102                                 | 24                               | 56   |
| 550–600                     | 68  | 102                                   | 204  | 204                         | 216                                   | 102                                 | 24                               | 56   |
| 600–650                     | 68  | 102                                   | 204  | 227                         | 227                                   | 113                                 | 24                               | 56   |
| 650–700                     | 68  | 102                                   | 204  | 231                         | 238                                   | 116                                 | 24                               | 56   |
| 700–750                     | 68  | 102                                   | 204  | 235                         | 249                                   | 118                                 | 24                               | 56   |
| 750–800                     | 68  | 102                                   | 204  | 238                         | 260                                   | 119                                 | 24                               | 56   |
| 800–850                     | 68  | 102                                   | 204  | 242                         | 270                                   | 121                                 | 24                               | 56   |
| 850–900                     | 68  | 102                                   | 204  | 245                         | 280                                   | 123                                 | 24                               | 56   |
| 900–950                     | 68  | 102                                   | 204  | 248                         | 290                                   | 124                                 | 24                               | 56   |
| 950–1000                    | 68  | 102                                   | 204  | 250                         | 300                                   | 125                                 | 24                               | 56   |



**Table 1** Hazard Type 1 explosive in a brick-built mounded store (continued)

| Column 1       | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|----------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
|                | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 1000–1100      | 68  | 102   | 204   | 255                         | 319                                      | 128                                    | 30                                  | 85  |
| 1100–1200      | 68  | 102   | 204   | 259                         | 337                                      | 130                                    | 30                                  | 85  |
| 1200–1300      | 68  | 102   | 204   | 263                         | 354                                      | 132                                    | 30                                  | 85  |
| 1300–1400      | 68  | 102   | 204   | 266                         | 370                                      | 133                                    | 30                                  | 85  |
| 1400–1500      | 68  | 102   | 204   | 269                         | 386                                      | 135                                    | 30                                  | 85  |
| 1500–1600      | 68  | 102   | 204   | 272                         | 402                                      | 136                                    | 30                                  | 85  |
| 1600–1700      | 69  | 104   | 208   | 274                         | 416                                      | 137                                    | 30                                  | 85  |
| 1700–1800      | 72  | 108   | 215   | 277                         | 431                                      | 139                                    | 30                                  | 85  |
| 1800–1900      | 74  | 111   | 222   | 279                         | 444                                      | 140                                    | 30                                  | 85  |
| 1900–2000      | 76  | 114   | 229   | 281                         | 458                                      | 141                                    | 30                                  | 85  |
| 2000–3000      | 95  | 143   | 285   | 285                         | 570                                      | 143                                    | 35                                  | 106   |
| 3000–4000      | 109   | 164   | 328   | 328                         | 656                                      | 164                                    | 38                                  | 122   |
| 4000–5000      | 121   | 181   | 362   | 362                         | 724                                      | 181                                    | 41                                  | 134   |
| 5000–10 000    | 158   | 237   | 475   | 475                         | 950                                      | 237                                    | 52                                  | 176   |
| 10 000–15 000  | 183   | 274   | 548   | 548                         | 1097                                     | 274                                    | 59                                  | 204   |
| 15 000–20 000  | 202   | 303   | 606   | 606                         | 1211                                     | 303                                    | 65                                  | 225   |
| 20 000–25 000  | 218   | 327   | 653   | 653                         | 1306                                     | 327                                    | 70                                  | 243   |
| 25 000–30 000  | 232   | 347   | 695   | 695                         | 1389                                     | 347                                    | 75                                  | 258   |
| 30 000–40 000  | 255   | 383   | 765   | 765                         | 1531                                     | 384                                    | 82                                  | 275   |
| 40 000–50 000  | 275   | 412   | 825   | 825                         | 1649                                     | 412                                    | 88                                  | 295   |
| 50 000–60 000  | 292   | 438   | 877   | 877                         | 1753                                     | 438                                    | 94                                  | 315   |
| 60 000–70 000  | 308   | 461   | 923   | 923                         | 1846                                     | 461                                    | 99                                  | 345   |
| 70 000–80 000  | 322   | 482   | 965   | 965                         | 1930                                     | 482                                    | 103                                 | 345   |
| 80 000–90 000  | 335   | 502   | 1004  | 1004                        | 2007                                     | 502                                    | 108                                 | 375   |
| 90 000–100 000 | 347   | 520   | 1040  | 1040                        | 2079                                     | 520                                    | 111                                 | 375   |

**Supplementary Table 1A** Hazard Type 1 explosive in a brick-built mounded store – reduced distances for areas of low population density

| Column 1                    | Column 2                  | Column 3  | Column 4  |
|-----------------------------|---------------------------|---|---|
| Quantity of explosives (kg) | Reference zone radius (m) | Maximum number of dwellings in the reference zone | Reduced distances to dwellings if the maximum number of dwellings in the reference zone is not exceeded (m) |
| 0.1–60                      | No reduced distances*     |   |   |
| 60–70                       | 222                       | 61  | 111   |
| 70–80                       | 227                       | 63  | 113   |
| 80–90                       | 231                       | 66  | 115   |
| 90–100                      | 235                       | 68  | 118   |
| 100–150                     | 257                       | 81  | 128   |
| 150–200                     | 279                       | 96  | 139   |
| 200–250                     | 300                       | 128   | 150   |
| 250–600                     | No reduced distances*     |   |   |
| 600–1600                    | 408                       | 206   | 204   |
| 1600–1700                   | 416                       | 214   | 208   |
| 1700–1800                   | 431                       | 229   | 215   |
| 1800–1900                   | 444                       | 244   | 222   |
| 1900–2000                   | 458                       | 259   | 229   |

\* The hazard profile means that there are no reduced distances for quantities of explosives between these values. The distances given in Table 1 for the relevant quantity should be used.

**Table 2** Hazard Type 1 explosives in a brick-built unrounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|-----------------------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 0.1–25                      | 47  | 70  | 141   | 141                         | 141                                      | 70                                     | 141                                 | 141   |
| 25–30                       | 48  | 72  | 144   | 144                         | 144                                      | 72                                     | 144                                 | 144   |
| 30–40                       | 50  | 76  | 151   | 151                         | 151                                      | 76                                     | 151                                 | 151   |
| 40–50                       | 53  | 80  | 159   | 159                         | 159                                      | 80                                     | 159                                 | 159   |
| 50–60                       | 56  | 84  | 168   | 168                         | 168                                      | 84                                     | 168                                 | 168   |
| 60–70                       | 59  | 88  | 176   | 176                         | 176                                      | 88                                     | 176                                 | 176   |
| 70–80                       | 61  | 92  | 184   | 184                         | 184                                      | 92                                     | 184                                 | 184   |
| 80–90                       | 64  | 96  | 191   | 191                         | 191                                      | 96                                     | 191                                 | 191   |
| 90–100                      | 66  | 99  | 199   | 199                         | 199                                      | 99                                     | 199                                 | 199   |
| 100–150                     | 77  | 115   | 230   | 230                         | 230                                      | 115                                    | 230                                 | 230   |
| 150–200                     | 85  | 128   | 256   | 256                         | 256                                      | 128                                    | 256                                 | 256   |
| 200–250                     | 92  | 138   | 276   | 276                         | 276                                      | 138                                    | 276                                 | 276   |
| 250–300                     | 98  | 147   | 293   | 293                         | 293                                      | 147                                    | 293                                 | 293   |
| 300–350                     | 103   | 154   | 308   | 308                         | 308                                      | 154                                    | 308                                 | 308   |
| 350–400                     | 107   | 160   | 320   | 320                         | 320                                      | 160                                    | 320                                 | 320   |
| 400–450                     | 110   | 165   | 331   | 331                         | 331                                      | 165                                    | 331                                 | 331   |
| 450–500                     | 113   | 170   | 340   | 340                         | 340                                      | 170                                    | 340                                 | 340   |
| 500–550                     | 116   | 174   | 348   | 348                         | 348                                      | 174                                    | 348                                 | 348   |
| 550–600                     | 118   | 178   | 355   | 355                         | 355                                      | 178                                    | 355                                 | 355   |
| 600–650                     | 120   | 181   | 361   | 361                         | 361                                      | 181                                    | 361                                 | 361   |
| 650–700                     | 122   | 184   | 367   | 367                         | 367                                      | 184                                    | 367                                 | 367   |
| 700–750                     | 124   | 186   | 372   | 372                         | 372                                      | 186                                    | 372                                 | 372   |
| 750–800                     | 126   | 189   | 377   | 377                         | 377                                      | 189                                    | 377                                 | 377   |
| 800–850                     | 127   | 191   | 381   | 381                         | 381                                      | 191                                    | 381                                 | 381   |
| 850–900                     | 128   | 193   | 385   | 385                         | 385                                      | 193                                    | 385                                 | 385   |
| 900–950                     | 130   | 194   | 389   | 389                         | 389                                      | 194                                    | 389                                 | 389   |
| 950–1000                    | 131   | 196   | 392   | 392                         | 392                                      | 196                                    | 392                                 | 392   |
| 1000–1100                   | 133   | 199   | 398   | 398                         | 398                                      | 199                                    | 398                                 | 398   |
| 1100–1200                   | 134   | 202   | 403   | 403                         | 403                                      | 202                                    | 403                                 | 403   |
| 1200–1300                   | 136   | 204   | 408   | 408                         | 408                                      | 204                                    | 408                                 | 408   |
| 1300–1400                   | 137   | 206   | 412   | 412                         | 412                                      | 206                                    | 412                                 | 412   |
| 1400–1500                   | 138   | 208   | 415   | 415                         | 415                                      | 208                                    | 415                                 | 415   |

**Table 2** Hazard Type 1 explosives in a brick-built unrounded store (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1500–1600                   | 139   | 209                                   | 418  | 418                         | 418                                   | 209                                 | 418                              | 418  |
| 1600–1700                   | 140   | 211                                   | 421  | 421                         | 421                                   | 211                                 | 421                              | 421  |
| 1700–1800                   | 141   | 212                                   | 424  | 424                         | 431                                   | 212                                 | 424                              | 424  |
| 1800–1900                   | 142   | 213                                   | 426  | 426                         | 444                                   | 213                                 | 426                              | 426  |
| 1900–2000                   | 143   | 214                                   | 428  | 428                         | 458                                   | 214                                 | 428                              | 428  |
| 2000–3000                   | 147   | 221                                   | 442  | 442                         | 570                                   | 221                                 | 442                              | 442  |
| 3000–4000                   | 150   | 225                                   | 449  | 449                         | 656                                   | 225                                 | 449                              | 449  |
| 4000–5000                   | 151   | 227                                   | 454  | 454                         | 724                                   | 227                                 | 454                              | 454  |
| 5000–10 000                 | 167   | 251                                   | 502  | 502                         | 950                                   | 251                                 | 502                              | 502  |
| 10 000–15 000               | 185   | 277                                   | 554  | 554                         | 1097                                  | 277                                 | 554                              | 554  |
| 15 000–20 000               | 202   | 303                                   | 606  | 606                         | 1211                                  | 303                                 | 606                              | 606  |
| 20 000–25 000               | 218   | 327                                   | 653  | 653                         | 1306                                  | 327                                 | 653                              | 653  |
| 25 000–30 000               | 232   | 347                                   | 695  | 695                         | 1389                                  | 347                                 | 695                              | 695  |
| 30 000–40 000               | 255   | 383                                   | 765  | 765                         | 1531                                  | 383                                 | 765                              | 765  |
| 40 000–50 000               | 275   | 412                                   | 825  | 825                         | 1649                                  | 412                                 | 825                              | 825  |
| 50 000–60 000               | 292   | 438                                   | 877  | 877                         | 1753                                  | 438                                 | 877                              | 877  |
| 60 000–70 000               | 308   | 461                                   | 923  | 923                         | 1846                                  | 461                                 | 923                              | 923  |
| 70 000–80 000               | 322   | 482                                   | 965  | 965                         | 1930                                  | 482                                 | 965                              | 965  |
| 80 000–90 000               | 335   | 502                                   | 1004   | 1004                        | 2007                                  | 502                                 | 1004                             | 1004   |
| 90 000–100 000              | 347   | 520                                   | 1040   | 1040                        | 2079                                  | 520                                 | 1040                             | 1040   |

**Table 3** Hazard Type 1 explosive in a metal-built mounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|-----------------------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 0.1–10                      | 7   | 10  | 21  | 23                          | 40                                       | 12                                     | 9                                   | 18  |
| 10–20                       | 9   | 13  | 26  | 29                          | 42                                       | 15                                     | 9                                   | 18  |
| 20–30                       | 10  | 15  | 30  | 33                          | 44                                       | 17                                     | 9                                   | 18  |
| 30–40                       | 11  | 16  | 33  | 37                          | 46                                       | 18                                     | 9                                   | 18  |
| 40–50                       | 12  | 18  | 35  | 40                          | 48                                       | 20                                     | 9                                   | 18  |
| 50–60                       | 13  | 19  | 38  | 42                          | 48                                       | 21                                     | 10                                  | 22  |
| 60–70                       | 13  | 20  | 40  | 44                          | 52                                       | 22                                     | 10                                  | 22  |
| 70–80                       | 14  | 20  | 41  | 46                          | 57                                       | 23                                     | 11                                  | 22  |
| 80–90                       | 14  | 21  | 42  | 47                          | 61                                       | 24                                     | 11                                  | 22  |
| 90–100                      | 14  | 21  | 43  | 48                          | 66                                       | 24                                     | 11                                  | 22  |
| 100–150                     | 16  | 24  | 49  | 55                          | 86                                       | 28                                     | 13                                  | 27  |
| 150–200                     | 18  | 27  | 54  | 62                          | 104                                      | 31                                     | 14                                  | 27  |
| 200–250                     | 20  | 30  | 60  | 69                          | 121                                      | 35                                     | 16                                  | 30  |
| 250–300                     | 23  | 34  | 68  | 76                          | 136                                      | 38                                     | 16                                  | 30  |
| 300–350                     | 25  | 38  | 76  | 83                          | 151                                      | 44                                     | 18                                  | 33  |
| 350–400                     | 28  | 41  | 83  | 90                          | 165                                      | 45                                     | 18                                  | 33  |
| 400–450                     | 30  | 45  | 89  | 97                          | 178                                      | 49                                     | 19                                  | 36  |
| 450–500                     | 32  | 48  | 96  | 102                         | 191                                      | 51                                     | 19                                  | 36  |
| 500–550                     | 34  | 51  | 102   | 107                         | 204                                      | 54                                     | 24                                  | 56  |
| 550–600                     | 36  | 54  | 108   | 111                         | 216                                      | 56                                     | 24                                  | 56  |
| 600–650                     | 38  | 57  | 114   | 116                         | 227                                      | 58                                     | 24                                  | 56  |
| 650–700                     | 40  | 60  | 119   | 121                         | 238                                      | 61                                     | 24                                  | 56  |
| 700–750                     | 42  | 62  | 125   | 126                         | 249                                      | 63                                     | 24                                  | 56  |
| 750–800                     | 43  | 65  | 130   | 131                         | 260                                      | 66                                     | 24                                  | 56  |
| 800–850                     | 45  | 68  | 135   | 136                         | 270                                      | 68                                     | 24                                  | 56  |
| 850–900                     | 47  | 70  | 140   | 140                         | 280                                      | 70                                     | 24                                  | 56  |
| 900–950                     | 48  | 73  | 145   | 145                         | 290                                      | 73                                     | 24                                  | 56  |
| 950–1000                    | 50  | 75  | 150   | 150                         | 300                                      | 75                                     | 24                                  | 56  |
| 1000–1100                   | 53  | 80  | 159   | 159                         | 319                                      | 80                                     | 30                                  | 85  |
| 1100–1200                   | 56  | 84  | 168   | 168                         | 337                                      | 84                                     | 30                                  | 85  |
| 1200–1300                   | 59  | 88  | 177   | 177                         | 354                                      | 89                                     | 30                                  | 85  |
| 1300–1400                   | 62  | 93  | 185   | 185                         | 370                                      | 93                                     | 30                                  | 85  |

**Table 3** Hazard Type 1 explosive in a metal-built mounded store (continued)

| Column 1<br>Quantity of explosives (kg) | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|---|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
|   | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1400–1500                               | 64  | 97                                    | 193  | 193                         | 386                                   | 97                                  | 30                               | 85   |
| 1500–1600                               | 67  | 100                                   | 201  | 201                         | 402                                   | 101                                 | 30                               | 85   |
| 1600–1700                               | 69  | 104                                   | 208  | 208                         | 416                                   | 104                                 | 30                               | 85   |
| 1700–1800                               | 72  | 108                                   | 215  | 215                         | 431                                   | 108                                 | 30                               | 85   |
| 1800–1900                               | 74  | 111                                   | 222  | 222                         | 444                                   | 111                                 | 30                               | 85   |
| 1900–2000                               | 76  | 114                                   | 229  | 229                         | 458                                   | 115                                 | 30                               | 85   |
| 2000–3000                               | 95  | 143                                   | 285  | 285                         | 570                                   | 143                                 | 35                               | 106  |
| 3000–4000                               | 109   | 164                                   | 328  | 328                         | 656                                   | 164                                 | 38                               | 122  |
| 4000–5000                               | 121   | 181                                   | 362  | 362                         | 724                                   | 181                                 | 41                               | 134  |
| 5000–10 000                             | 158   | 237                                   | 475  | 475                         | 950                                   | 238                                 | 52                               | 176  |
| 10 000–15 000                           | 183   | 274                                   | 548  | 548                         | 1097                                  | 274                                 | 59                               | 204  |
| 15 000–20 000                           | 202   | 303                                   | 606  | 606                         | 1211                                  | 303                                 | 65                               | 225  |
| 20 000–25 000                           | 218   | 327                                   | 653  | 653                         | 1306                                  | 327                                 | 70                               | 243  |
| 25 000–30 000                           | 232   | 347                                   | 695  | 695                         | 1389                                  | 348                                 | 75                               | 258  |
| 30 000–40 000                           | 255   | 383                                   | 765  | 765                         | 1531                                  | 383                                 | 82                               | 275  |
| 40 000–50 000                           | 275   | 412                                   | 825  | 825                         | 1649                                  | 412                                 | 88                               | 295  |
| 50 000–60 000                           | 292   | 438                                   | 877  | 877                         | 1753                                  | 438                                 | 94                               | 315  |
| 60 000–70 000                           | 308   | 461                                   | 923  | 923                         | 1846                                  | 461                                 | 99                               | 345  |
| 70 000–80 000                           | 322   | 482                                   | 965  | 965                         | 1930                                  | 482                                 | 103                              | 345  |
| 80 000–90 000                           | 335   | 502                                   | 1004   | 1004                        | 2007                                  | 502                                 | 108                              | 375  |
| 90 000–100 000                          | 347   | 520                                   | 1040   | 1040                        | 2079                                  | 520                                 | 111                              | 375  |

**Supplementary Table 3A** Hazard Type 1 explosive in a metal-built mounded store – reduced distances for areas of low population density

| Column 1                    | Column 2                  | Column 3  | Column 4  |
|-----------------------------|---------------------------|---|---|
| Quantity of explosives (kg) | Reference zone radius (m) | Maximum number of dwellings in the reference zone | Reduced distances to dwellings if the maximum number of dwellings in the reference zone is not exceeded (m) |
| 0.1–10                      | 41                        | 2   | 21  |
| 10–20                       | 52                        | 3   | 26  |
| 20–30                       | 60                        | 4   | 30  |
| 30–40                       | 66                        | 5   | 33  |
| 40–50                       | 71                        | 6   | 35  |
| 50–60                       | 75                        | 7   | 38  |
| 60–70                       | 79                        | 8   | 40  |
| 70–80                       | 81                        | 8   | 41  |
| 80–90                       | 83                        | 8   | 42  |
| 90–100                      | 86                        | 9   | 43  |
| 100–150                     | 97                        | 12  | 49  |
| 150–200                     | 109                       | 14  | 54  |
| 200–250                     | 121                       | 18  | 60  |
| 250–300                     | 136                       | 23  | 68  |
| 300–350                     | 151                       | 28  | 76  |
| 350–400                     | 165                       | 34  | 83  |
| 400–450                     | 178                       | 39  | 89  |
| 450–500                     | 191                       | 45  | 96  |
| 500–550                     | 204                       | 51  | 102   |
| 550–600                     | 216                       | 57  | 108   |
| 600–650                     | 227                       | 63  | 114   |
| 650–700                     | 238                       | 70  | 119   |
| 700–750                     | 249                       | 77  | 125   |
| 750–800                     | 260                       | 83  | 130   |
| 800–850                     | 270                       | 90  | 135   |

**Table 4** Hazard Type 1 explosive in a metal-built unrounded store with no detonator annex attached

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 0.1–10                      | 8   | 11                                    | 23   | 30                          | 40                                    | 15                                  | 30                               | 30   |
| 10–20                       | 10  | 14                                    | 29   | 35                          | 42                                    | 18                                  | 35                               | 35   |
| 20–30                       | 11  | 16                                    | 33   | 39                          | 44                                    | 20                                  | 39                               | 39   |
| 30–40                       | 12  | 18                                    | 36   | 42                          | 46                                    | 21                                  | 42                               | 42   |
| 40–50                       | 13  | 19                                    | 38   | 44                          | 48                                    | 22                                  | 44                               | 44   |
| 50–60                       | 13  | 20                                    | 40   | 46                          | 48                                    | 23                                  | 46                               | 46   |
| 60–70                       | 14  | 21                                    | 42   | 48                          | 52                                    | 24                                  | 48                               | 48   |
| 70–80                       | 14  | 22                                    | 43   | 50                          | 57                                    | 25                                  | 50                               | 50   |
| 80–90                       | 15  | 22                                    | 44   | 52                          | 61                                    | 26                                  | 52                               | 52   |
| 90–100                      | 15  | 23                                    | 45   | 55                          | 66                                    | 28                                  | 55                               | 55   |
| 100–150                     | 17  | 25                                    | 50   | 66                          | 86                                    | 33                                  | 66                               | 66   |
| 150–200                     | 18  | 28                                    | 55   | 78                          | 104                                   | 39                                  | 78                               | 78   |
| 200–250                     | 20  | 30                                    | 60   | 89                          | 121                                   | 45                                  | 89                               | 89   |
| 250–300                     | 23  | 34                                    | 68   | 101                         | 136                                   | 51                                  | 101                              | 101  |
| 300–350                     | 25  | 38                                    | 76   | 112                         | 151                                   | 56                                  | 112                              | 112  |
| 350–400                     | 28  | 41                                    | 83   | 124                         | 165                                   | 62                                  | 124                              | 124  |
| 400–450                     | 30  | 45                                    | 89   | 135                         | 178                                   | 68                                  | 135                              | 135  |
| 450–500                     | 32  | 48                                    | 96   | 138                         | 191                                   | 69                                  | 138                              | 138  |
| 500–550                     | 34  | 51                                    | 102  | 141                         | 204                                   | 71                                  | 141                              | 141  |
| 550–600                     | 36  | 54                                    | 108  | 144                         | 216                                   | 72                                  | 144                              | 144  |
| 600–650                     | 38  | 57                                    | 114  | 147                         | 227                                   | 74                                  | 147                              | 147  |
| 650–700                     | 40  | 60                                    | 119  | 150                         | 238                                   | 75                                  | 150                              | 150  |
| 700–750                     | 42  | 62                                    | 125  | 153                         | 249                                   | 77                                  | 153                              | 153  |
| 750–800                     | 43  | 65                                    | 130  | 156                         | 260                                   | 78                                  | 156                              | 156  |
| 800–850                     | 45  | 68                                    | 135  | 159                         | 270                                   | 80                                  | 159                              | 159  |
| 850–900                     | 47  | 70                                    | 140  | 162                         | 280                                   | 81                                  | 162                              | 162  |
| 900–950                     | 48  | 73                                    | 145  | 165                         | 290                                   | 83                                  | 165                              | 165  |
| 950–1000                    | 50  | 75                                    | 150  | 168                         | 300                                   | 84                                  | 168                              | 168  |
| 1000–1100                   | 53  | 80                                    | 159  | 175                         | 319                                   | 88                                  | 175                              | 175  |
| 1100–1200                   | 56  | 84                                    | 168  | 181                         | 337                                   | 91                                  | 181                              | 181  |
| 1200–1300                   | 59  | 88                                    | 177  | 187                         | 354                                   | 94                                  | 187                              | 187  |
| 1300–1400                   | 62  | 93                                    | 185  | 193                         | 370                                   | 97                                  | 193                              | 193  |



**Table 4** Hazard Type 1 explosive in a metal-built unrounded store with no detonator annex attached (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1400–1500                   | 64  | 97                                    | 193  | 199                         | 386                                   | 100                                 | 199                              | 199  |
| 1500–1600                   | 67  | 100                                   | 201  | 205                         | 402                                   | 103                                 | 205                              | 205  |
| 1600–1700                   | 69  | 104                                   | 208  | 211                         | 416                                   | 106                                 | 211                              | 211  |
| 1700–1800                   | 72  | 108                                   | 215  | 217                         | 431                                   | 108                                 | 217                              | 217  |
| 1800–1900                   | 74  | 111                                   | 222  | 223                         | 444                                   | 111                                 | 223                              | 223  |
| 1900–2000                   | 76  | 114                                   | 229  | 229                         | 458                                   | 114                                 | 229                              | 229  |
| 2000–3000                   | 95  | 143                                   | 285  | 285                         | 570                                   | 143                                 | 285                              | 285  |
| 3000–4000                   | 109   | 164                                   | 328  | 328                         | 656                                   | 164                                 | 328                              | 328  |
| 4000–5000                   | 121   | 181                                   | 362  | 362                         | 724                                   | 181                                 | 362                              | 362  |
| 5000–10 000                 | 158   | 237                                   | 475  | 475                         | 950                                   | 237                                 | 475                              | 475  |
| 10 000–15 000               | 183   | 274                                   | 548  | 548                         | 1097                                  | 274                                 | 548                              | 548  |
| 15 000–20 000               | 202   | 303                                   | 606  | 606                         | 1211                                  | 303                                 | 606                              | 606  |
| 20 000–25 000               | 218   | 327                                   | 653  | 653                         | 1306                                  | 653                                 | 653                              | 653  |
| 25 000–30 000               | 232   | 347                                   | 695  | 695                         | 1389                                  | 347                                 | 695                              | 695  |
| 30 000–40 000               | 255   | 383                                   | 765  | 765                         | 1531                                  | 383                                 | 765                              | 765  |
| 40 000–50 000               | 275   | 412                                   | 825  | 825                         | 1649                                  | 412                                 | 825                              | 825  |
| 50 000–60 000               | 292   | 438                                   | 877  | 877                         | 1753                                  | 438                                 | 877                              | 877  |
| 60 000–70 000               | 308   | 461                                   | 923  | 923                         | 1846                                  | 461                                 | 923                              | 923  |
| 70 000–80 000               | 322   | 482                                   | 965  | 965                         | 1930                                  | 482                                 | 965                              | 965  |
| 80 000–90 000               | 335   | 502                                   | 1004   | 1004                        | 2007                                  | 502                                 | 1004                             | 1004   |
| 90 000–100 000              | 347   | 520                                   | 1040   | 1040                        | 2079                                  | 520                                 | 1040                             | 1040   |

**Supplementary Table 4A** Hazard Type 1 explosive in a metal-built unrounded store with no detonator annex attached – reduced distances for areas of low population density

| Column 1                    | Column 2                  | Column 3  | Column 4  |
|-----------------------------|---------------------------|---|---|
| Quantity of explosives (kg) | Reference zone radius (m) | Maximum number of dwellings in the reference zone | Reduced distances to dwellings if the maximum number of dwellings in the reference zone is not exceeded (m) |
| 0.1–10                      | 46                        | 3   | 23  |
| 10–20                       | 57                        | 4   | 29  |
| 20–30                       | 65                        | 5   | 33  |
| 30–40                       | 71                        | 6   | 36  |
| 40–50                       | 76                        | 7   | 38  |
| 50–60                       | 80                        | 8   | 40  |
| 60–70                       | 84                        | 9   | 42  |
| 70–80                       | 87                        | 9   | 43  |
| 80–90                       | 89                        | 10  | 44  |
| 90–100                      | 91                        | 10  | 45  |
| 100–150                     | 100                       | 12  | 50  |
| 150–200                     | 110                       | 15  | 55  |
| 200–250                     | 121                       | 18  | 60  |
| 250–300                     | 136                       | 23  | 68  |
| 300–350                     | 151                       | 28  | 76  |
| 350–400                     | 165                       | 34  | 83  |
| 400–450                     | 178                       | 39  | 89  |
| 450–500                     | 191                       | 45  | 96  |
| 500–550                     | 204                       | 51  | 102   |
| 550–600                     | 216                       | 57  | 108   |
| 600–650                     | 227                       | 64  | 114   |
| 650–700                     | 238                       | 70  | 119   |
| 700–750                     | 249                       | 77  | 125   |
| 750–800                     | 260                       | 84  | 130   |
| 800–850                     | 270                       | 90  | 135   |
| 850–900                     | 280                       | 97  | 140   |
| 900–950                     | 290                       | 104   | 145   |
| 950–1000                    | 300                       | 111   | 150   |
| 1000–1100                   | 319                       | 125   | 159   |

**Table 5** Hazard Type 1 explosive in a metal-built unrounded store with a detonator annex attached

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 0.1–10                      | 10  | 16                                    | 31   | 48                          | 48                                    | 24                                  | 48                               | 48   |
| 10–20                       | 12  | 18                                    | 36   | 50                          | 50                                    | 25                                  | 50                               | 50   |
| 20–30                       | 13  | 19                                    | 38   | 52                          | 52                                    | 26                                  | 52                               | 52   |
| 30–40                       | 14  | 21                                    | 41   | 54                          | 54                                    | 27                                  | 54                               | 54   |
| 40–50                       | 14  | 22                                    | 43   | 56                          | 56                                    | 28                                  | 56                               | 56   |
| 50–60                       | 15  | 22                                    | 45   | 58                          | 58                                    | 29                                  | 58                               | 58   |
| 60–70                       | 16  | 24                                    | 47   | 60                          | 60                                    | 30                                  | 60                               | 60   |
| 70–80                       | 16  | 25                                    | 49   | 63                          | 63                                    | 32                                  | 63                               | 63   |
| 80–90                       | 17  | 26                                    | 51   | 70                          | 70                                    | 35                                  | 70                               | 70   |
| 90–100                      | 18  | 27                                    | 53   | 77                          | 77                                    | 39                                  | 77                               | 77   |
| 100–150                     | 21  | 32                                    | 63   | 110                         | 110                                   | 55                                  | 110                              | 110  |
| 150–200                     | 25  | 37                                    | 74   | 143                         | 143                                   | 72                                  | 143                              | 143  |
| 200–250                     | 28  | 42                                    | 84   | 176                         | 176                                   | 88                                  | 176                              | 176  |
| 250–300                     | 31  | 47                                    | 94   | 209                         | 209                                   | 105                                 | 209                              | 209  |
| 300–350                     | 35  | 52                                    | 104  | 242                         | 242                                   | 121                                 | 242                              | 242  |
| 350–400                     | 38  | 57                                    | 115  | 275                         | 275                                   | 138                                 | 275                              | 275  |
| 400–450                     | 42  | 62                                    | 125  | 308                         | 308                                   | 154                                 | 308                              | 308  |
| 450–500                     | 43  | 64                                    | 128  | 309                         | 309                                   | 155                                 | 309                              | 309  |
| 500–550                     | 44  | 66                                    | 132  | 310                         | 310                                   | 155                                 | 310                              | 310  |
| 550–600                     | 45  | 68                                    | 135  | 311                         | 311                                   | 156                                 | 311                              | 311  |
| 600–650                     | 46  | 69                                    | 138  | 311                         | 311                                   | 156                                 | 311                              | 311  |
| 650–700                     | 47  | 71                                    | 142  | 312                         | 312                                   | 156                                 | 312                              | 312  |
| 700–750                     | 48  | 73                                    | 145  | 313                         | 313                                   | 157                                 | 313                              | 313  |
| 750–800                     | 49  | 74                                    | 148  | 314                         | 314                                   | 157                                 | 314                              | 314  |
| 800–850                     | 51  | 76                                    | 152  | 315                         | 315                                   | 158                                 | 315                              | 315  |
| 850–900                     | 52  | 78                                    | 155  | 316                         | 316                                   | 158                                 | 316                              | 316  |
| 900–950                     | 53  | 79                                    | 159  | 317                         | 317                                   | 159                                 | 317                              | 317  |
| 950–1000                    | 54  | 81                                    | 162  | 318                         | 318                                   | 159                                 | 318                              | 318  |
| 1000–1100                   | 56  | 84                                    | 169  | 319                         | 319                                   | 160                                 | 319                              | 319  |
| 1100–1200                   | 58  | 88                                    | 175  | 321                         | 337                                   | 161                                 | 321                              | 321  |
| 1200–1300                   | 61  | 91                                    | 182  | 323                         | 354                                   | 162                                 | 323                              | 323  |
| 1300–1400                   | 63  | 94                                    | 189  | 325                         | 370                                   | 163                                 | 325                              | 325  |

**Table 5** Hazard Type 1 explosive in a metal-built unrounded store with a detonator annex attached (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1400–1500                   | 65  | 98                                    | 195  | 326                         | 386                                   | 163                                 | 326                              | 326  |
| 1500–1600                   | 67  | 101                                   | 202  | 328                         | 402                                   | 164                                 | 328                              | 328  |
| 1600–1700                   | 70  | 104                                   | 209  | 330                         | 416                                   | 165                                 | 330                              | 330  |
| 1700–1800                   | 72  | 108                                   | 215  | 332                         | 431                                   | 166                                 | 332                              | 332  |
| 1800–1900                   | 74  | 111                                   | 222  | 333                         | 444                                   | 167                                 | 333                              | 333  |
| 1900–2000                   | 76  | 114                                   | 229  | 335                         | 458                                   | 168                                 | 335                              | 335  |
| 2000–3000                   | 95  | 143                                   | 285  | 353                         | 570                                   | 177                                 | 353                              | 353  |
| 3000–4000                   | 109   | 164                                   | 328  | 370                         | 656                                   | 185                                 | 370                              | 370  |
| 4000–5000                   | 121   | 181                                   | 362  | 388                         | 724                                   | 194                                 | 388                              | 388  |
| 5000–10 000                 | 158   | 237                                   | 475  | 475                         | 950                                   | 237                                 | 475                              | 475  |
| 10 000–15 000               | 183   | 274                                   | 548  | 548                         | 1097                                  | 274                                 | 548                              | 548  |
| 15 000–20 000               | 202   | 303                                   | 606  | 606                         | 1211                                  | 303                                 | 606                              | 606  |
| 20 000–25 000               | 218   | 327                                   | 653  | 653                         | 1306                                  | 327                                 | 653                              | 653  |
| 25 000–30 000               | 232   | 347                                   | 695  | 695                         | 1389                                  | 347                                 | 695                              | 695  |
| 30 000–40 000               | 255   | 383                                   | 765  | 765                         | 1531                                  | 383                                 | 765                              | 765  |
| 40 000–50 000               | 275   | 412                                   | 825  | 825                         | 1649                                  | 412                                 | 825                              | 825  |
| 50 000–60 000               | 292   | 438                                   | 877  | 877                         | 1753                                  | 438                                 | 877                              | 877  |
| 60 000–70 000               | 308   | 461                                   | 923  | 923                         | 1846                                  | 461                                 | 923                              | 923  |
| 70 000–80 000               | 322   | 482                                   | 965  | 965                         | 1930                                  | 482                                 | 965                              | 965  |
| 80 000–90 000               | 335   | 502                                   | 1004   | 1004                        | 2007                                  | 502                                 | 1004                             | 1004   |
| 90 000–100 000              | 347   | 520                                   | 1040   | 1040                        | 2079                                  | 520                                 | 1040                             | 1040   |

**Supplementary Table 5A** Hazard Type 1 explosive in a metal-built unmounted store with a detonator annex attached – reduced distances for areas of low population density

| Column 1                    | Column 2                  | Column 3  | Column 4  |
|-----------------------------|---------------------------|---|---|
| Quantity of explosives (kg) | Reference zone radius (m) | Maximum number of dwellings in the reference zone | Reduced distances to dwellings if the maximum number of dwellings in the reference zone is not exceeded (m) |
| 0.1–10                      | 62                        | 5   | 31  |
| 10–20                       | 71                        | 6   | 36  |
| 20–30                       | 77                        | 7   | 38  |
| 30–40                       | 82                        | 8   | 41  |
| 40–50                       | 86                        | 9   | 43  |
| 50–60                       | 90                        | 10  | 45  |
| 60–70                       | 94                        | 11  | 47  |
| 70–80                       | 98                        | 12  | 49  |
| 80–90                       | 102                       | 13  | 51  |
| 90–100                      | 106                       | 14  | 53  |
| 100–150                     | 127                       | 20  | 63  |
| 150–200                     | 147                       | 27  | 74  |
| 200–250                     | 168                       | 35  | 84  |
| 250–300                     | 188                       | 44  | 94  |
| 300–350                     | 209                       | 54  | 104   |
| 350–400                     | 229                       | 65  | 115   |
| 400–450                     | 250                       | 77  | 125   |
| 450–500                     | 257                       | 81  | 128   |
| 500–550                     | 263                       | 85  | 132   |
| 550–600                     | 270                       | 90  | 135   |
| 600–650                     | 277                       | 95  | 138   |
| 650–700                     | 284                       | 99  | 142   |
| 700–750                     | 290                       | 104   | 145   |
| 750–800                     | 297                       | 109   | 148   |
| 800–850                     | 304                       | 114   | 152   |
| 850–900                     | 310                       | 119   | 155   |
| 900–950                     | 317                       | 124   | 159   |
| 950–1000                    | 324                       | 129   | 162   |
| 1000–1100                   | 337                       | 140   | 169   |
| 1100–1200                   | 351                       | 152   | 175   |
| 1200–1300                   | 364                       | 163   | 182   |

**Supplementary Table 5A** Hazard Type 1 explosive in a metal-built unrounded store with a detonator annex attached – reduced distances for areas of low population density (continued)

| Column 1                    | Column 2                  | Column 3  | Column 4  |
|-----------------------------|---------------------------|---|---|
| Quantity of explosives (kg) | Reference zone radius (m) | Maximum number of dwellings in the reference zone | Reduced distances to dwellings if the maximum number of dwellings in the reference zone is not exceeded (m) |
| 1300–1400                   | 377                       | 176   | 189   |
| 1400–1500                   | 391                       | 188   | 195   |
| 1500–1600                   | 404                       | 202   | 202   |
| 1600–1700                   | 418                       | 215   | 209   |
| 1700–1800                   | 431                       | 229   | 215   |
| 1800–1900                   | 444                       | 244   | 222   |
| 1900–2000                   | 458                       | 259   | 229   |
| 2000–3000                   | 570                       | 401   | 285   |
| 3000–4000                   | 656                       | 530   | 328   |
| 4000–5000                   | 724                       | 647   | 362   |

**Table 6** Hazard Type 2 explosive, some or all items being of more than 0.7 kg net mass in a mounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 0.1–25                      | 20  | 30                                    | 60   | 60                          | 120                                   | 30                                  | 9                                | 32   |
| 25–30                       | 20  | 30                                    | 60   | 60                          | 120                                   | 30                                  | 9                                | 32   |
| 30–40                       | 25  | 37                                    | 74   | 74                          | 148                                   | 37                                  | 9                                | 32   |
| 40–50                       | 29  | 44                                    | 88   | 88                          | 176                                   | 44                                  | 9                                | 32   |
| 50–60                       | 33  | 49                                    | 99   | 99                          | 198                                   | 49                                  | 9                                | 46   |
| 60–70                       | 36  | 54                                    | 108  | 108                         | 216                                   | 54                                  | 9                                | 46   |
| 70–80                       | 39  | 58                                    | 116  | 116                         | 232                                   | 58                                  | 9                                | 46   |
| 80–90                       | 41  | 61                                    | 123  | 123                         | 246                                   | 61                                  | 9                                | 46   |
| 90–100                      | 43  | 64                                    | 129  | 129                         | 258                                   | 64                                  | 9                                | 46   |
| 100–150                     | 51  | 76                                    | 152  | 152                         | 304                                   | 76                                  | 9                                | 61   |
| 150–200                     | 56  | 84                                    | 168  | 168                         | 336                                   | 84                                  | 9                                | 61   |
| 200–250                     | 60  | 91                                    | 181  | 181                         | 362                                   | 91                                  | 9                                | 69   |
| 250–300                     | 64  | 96                                    | 191  | 191                         | 382                                   | 96                                  | 9                                | 69   |
| 300–350                     | 67  | 100                                   | 200  | 200                         | 400                                   | 100                                 | 10                               | 75   |
| 350–400                     | 69  | 104                                   | 207  | 207                         | 414                                   | 104                                 | 10                               | 75   |
| 400–450                     | 71  | 107                                   | 213  | 213                         | 426                                   | 107                                 | 10                               | 79   |
| 450–500                     | 73  | 110                                   | 219  | 219                         | 438                                   | 110                                 | 10                               | 79   |
| 500–550                     | 75  | 112                                   | 224  | 224                         | 448                                   | 112                                 | 10                               | 92   |
| 550–600                     | 76  | 115                                   | 229  | 229                         | 458                                   | 115                                 | 10                               | 92   |
| 600–650                     | 78  | 117                                   | 233  | 233                         | 466                                   | 117                                 | 10                               | 92   |
| 650–700                     | 79  | 119                                   | 237  | 237                         | 474                                   | 119                                 | 10                               | 92   |
| 700–750                     | 80  | 120                                   | 241  | 241                         | 482                                   | 120                                 | 10                               | 92   |
| 750–800                     | 81  | 122                                   | 244  | 244                         | 488                                   | 122                                 | 10                               | 92   |
| 800–850                     | 83  | 124                                   | 248  | 248                         | 496                                   | 124                                 | 10                               | 92   |
| 850–900                     | 84  | 125                                   | 251  | 251                         | 502                                   | 125                                 | 10                               | 92   |
| 900–950                     | 84  | 127                                   | 253  | 253                         | 506                                   | 127                                 | 10                               | 92   |
| 950–1000                    | 85  | 128                                   | 256  | 256                         | 512                                   | 128                                 | 10                               | 92   |
| 1000–1100                   | 87  | 131                                   | 261  | 261                         | 522                                   | 131                                 | 11                               | 105  |
| 1100–1200                   | 89  | 133                                   | 266  | 266                         | 532                                   | 133                                 | 11                               | 105  |
| 1200–1300                   | 90  | 135                                   | 270  | 270                         | 540                                   | 135                                 | 11                               | 105  |
| 1300–1400                   | 91  | 137                                   | 274  | 274                         | 548                                   | 137                                 | 11                               | 105  |
| 1400–1500                   | 92  | 139                                   | 277  | 277                         | 554                                   | 139                                 | 11                               | 105  |

**Table 6** Hazard Type 2 explosive, some or all items being of more than 0.7 kg net mass in a mounded store (continued)

| Column 1       | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|----------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
|                | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 1500–1600      | 93  | 140   | 280   | 280                         | 560                                      | 140                                    | 11                                  | 105   |
| 1600–1700      | 95  | 142   | 284   | 284                         | 568                                      | 142                                    | 11                                  | 105   |
| 1700–1800      | 95  | 143   | 286   | 286                         | 572                                      | 143                                    | 11                                  | 105   |
| 1800–1900      | 96  | 145   | 289   | 289                         | 578                                      | 145                                    | 11                                  | 105   |
| 1900–2000      | 97  | 146   | 292   | 292                         | 584                                      | 146                                    | 11                                  | 105   |
| 2000–3000      | 104   | 156   | 312   | 312                         | 624                                      | 156                                    | 12                                  | 112   |
| 3000–4000      | 109   | 163   | 326   | 326                         | 652                                      | 163                                    | 13                                  | 117   |
| 4000–5000      | 112   | 168   | 337   | 337                         | 674                                      | 168                                    | 14                                  | 121   |
| 5000–10 000    | 123   | 185   | 370   | 370                         | 740                                      | 185                                    | 17                                  | 133   |
| 10 000–15 000  | 129   | 194   | 388   | 388                         | 776                                      | 194                                    | 20                                  | 140   |
| 15 000–20 000  | 134   | 201   | 401   | 401                         | 802                                      | 201                                    | 22                                  | 144   |
| 20 000–25 000  | 137   | 206   | 411   | 411                         | 822                                      | 206                                    | 24                                  | 148   |
| 25 000–30 000  | 140   | 210   | 419   | 419                         | 838                                      | 210                                    | 26                                  | 151   |
| 30 000–40 000  | 144   | 216   | 431   | 431                         | 862                                      | 216                                    | 29                                  | 156   |
| 40 000–50 000  | 147   | 220   | 441   | 441                         | 882                                      | 220                                    | 32                                  | 159   |
| 50 000–60 000  | 150   | 224   | 449   | 449                         | 898                                      | 224                                    | 35                                  | 162   |
| 60 000–70 000  | 152   | 227   | 455   | 455                         | 910                                      | 227                                    | 36                                  | 166   |
| 70 000–80 000  | 153   | 230   | 460   | 460                         | 920                                      | 230                                    | 38                                  | 166   |
| 80 000–90 000  | 155   | 233   | 465   | 465                         | 930                                      | 233                                    | 39                                  | 170   |
| 90 000–100 000 | 157   | 235   | 470   | 470                         | 940                                      | 235                                    | 40                                  | 170   |



**Table 7** Hazard Type 2 explosive, some or all items being of more than 0.7 kg net mass in an unrounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|-----------------------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 0.1–25                      | 20  | 30  | 60  | 60                          | 120                                      | 30                                     | 60                                  | 60  |
| 25–30                       | 20  | 30  | 60  | 60                          | 120                                      | 30                                     | 60                                  | 60  |
| 30–40                       | 25  | 37  | 74  | 74                          | 148                                      | 37                                     | 74                                  | 74  |
| 40–50                       | 29  | 44  | 88  | 88                          | 176                                      | 44                                     | 88                                  | 88  |
| 50–60                       | 33  | 49  | 99  | 99                          | 198                                      | 49                                     | 99                                  | 99  |
| 60–70                       | 36  | 54  | 108   | 108                         | 216                                      | 54                                     | 108                                 | 108   |
| 70–80                       | 39  | 58  | 116   | 116                         | 232                                      | 58                                     | 116                                 | 116   |
| 80–90                       | 41  | 61  | 123   | 123                         | 246                                      | 61                                     | 123                                 | 123   |
| 90–100                      | 43  | 64  | 129   | 129                         | 258                                      | 64                                     | 129                                 | 129   |
| 100–150                     | 51  | 76  | 152   | 152                         | 304                                      | 76                                     | 152                                 | 152   |
| 150–200                     | 56  | 84  | 168   | 168                         | 336                                      | 84                                     | 168                                 | 168   |
| 200–250                     | 60  | 91  | 181   | 181                         | 362                                      | 91                                     | 181                                 | 181   |
| 250–300                     | 64  | 96  | 191   | 191                         | 382                                      | 96                                     | 191                                 | 191   |
| 300–350                     | 67  | 100   | 200   | 200                         | 400                                      | 100                                    | 200                                 | 200   |
| 350–400                     | 69  | 104   | 207   | 207                         | 414                                      | 104                                    | 207                                 | 207   |
| 400–450                     | 71  | 107   | 213   | 213                         | 426                                      | 107                                    | 213                                 | 213   |
| 450–500                     | 73  | 110   | 219   | 219                         | 438                                      | 110                                    | 219                                 | 219   |
| 500–550                     | 75  | 112   | 224   | 224                         | 448                                      | 112                                    | 224                                 | 224   |
| 550–600                     | 76  | 115   | 229   | 229                         | 458                                      | 115                                    | 229                                 | 229   |
| 600–650                     | 78  | 117   | 233   | 233                         | 466                                      | 117                                    | 233                                 | 233   |
| 650–700                     | 79  | 119   | 237   | 237                         | 474                                      | 119                                    | 237                                 | 237   |
| 700–750                     | 80  | 120   | 241   | 241                         | 482                                      | 120                                    | 241                                 | 241   |
| 750–800                     | 81  | 122   | 244   | 244                         | 488                                      | 122                                    | 244                                 | 244   |
| 800–850                     | 83  | 124   | 248   | 248                         | 496                                      | 124                                    | 248                                 | 248   |
| 850–900                     | 84  | 125   | 251   | 251                         | 502                                      | 125                                    | 251                                 | 251   |
| 900–950                     | 84  | 127   | 253   | 253                         | 506                                      | 127                                    | 253                                 | 253   |
| 950–1000                    | 85  | 128   | 256   | 256                         | 512                                      | 128                                    | 256                                 | 256   |
| 1000–1100                   | 87  | 131   | 261   | 261                         | 522                                      | 131                                    | 261                                 | 261   |
| 1100–1200                   | 89  | 133   | 266   | 266                         | 532                                      | 133                                    | 266                                 | 266   |
| 1200–1300                   | 90  | 135   | 270   | 270                         | 540                                      | 135                                    | 270                                 | 270   |
| 1300–1400                   | 91  | 137   | 274   | 274                         | 548                                      | 137                                    | 274                                 | 274   |
| 1400–1500                   | 92  | 139   | 277   | 277                         | 554                                      | 139                                    | 277                                 | 277   |

**Table 7** Hazard Type 2 explosive, some or all items being of more than 0.7 kg net mass in an unrounded store (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1500–1600                   | 93  | 140                                   | 280  | 280                         | 560                                   | 140                                 | 280                              | 280  |
| 1600–1700                   | 95  | 142                                   | 284  | 284                         | 568                                   | 142                                 | 284                              | 284  |
| 1700–1800                   | 95  | 143                                   | 286  | 286                         | 572                                   | 143                                 | 286                              | 286  |
| 1800–1900                   | 96  | 145                                   | 289  | 289                         | 578                                   | 145                                 | 289                              | 289  |
| 1900–2000                   | 97  | 146                                   | 292  | 292                         | 584                                   | 146                                 | 292                              | 292  |
| 2000–3000                   | 104   | 156                                   | 312  | 312                         | 624                                   | 156                                 | 312                              | 312  |
| 3000–4000                   | 109   | 163                                   | 326  | 326                         | 652                                   | 163                                 | 326                              | 326  |
| 4000–5000                   | 112   | 168                                   | 337  | 337                         | 674                                   | 168                                 | 337                              | 337  |
| 5000–10 000                 | 123   | 185                                   | 370  | 370                         | 740                                   | 185                                 | 370                              | 370  |
| 10 000–15 000               | 129   | 194                                   | 388  | 388                         | 776                                   | 194                                 | 388                              | 388  |
| 15 000–20 000               | 134   | 201                                   | 401  | 401                         | 802                                   | 201                                 | 401                              | 401  |
| 20 000–25 000               | 137   | 206                                   | 411  | 411                         | 822                                   | 206                                 | 411                              | 411  |
| 25 000–30 000               | 140   | 210                                   | 419  | 419                         | 838                                   | 210                                 | 419                              | 419  |
| 30 000–40 000               | 144   | 216                                   | 431  | 431                         | 862                                   | 216                                 | 431                              | 431  |
| 40 000–50 000               | 147   | 220                                   | 441  | 441                         | 882                                   | 220                                 | 441                              | 441  |
| 50 000–60 000               | 150   | 224                                   | 449  | 449                         | 898                                   | 224                                 | 449                              | 449  |
| 60 000–70 000               | 152   | 227                                   | 455  | 455                         | 910                                   | 227                                 | 455                              | 455  |
| 70 000–80 000               | 153   | 230                                   | 460  | 460                         | 920                                   | 230                                 | 460                              | 460  |
| 80 000–90 000               | 155   | 233                                   | 465  | 465                         | 930                                   | 233                                 | 465                              | 465  |
| 90 000–100 000              | 157   | 235                                   | 470  | 470                         | 940                                   | 235                                 | 470                              | 470  |

**Table 8** Hazard Type 2 explosive every item being of 0.7 kg net mass or less in a mounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 0.1–25                      | 12  | 18                                    | 37   | 37                          | 74                                    | 18                                  | 9                                | 15   |
| 25–30                       | 13  | 19                                    | 38   | 38                          | 76                                    | 19                                  | 9                                | 15   |
| 30–40                       | 14  | 20                                    | 41   | 41                          | 82                                    | 20                                  | 9                                | 15   |
| 40–50                       | 14  | 22                                    | 43   | 43                          | 86                                    | 22                                  | 9                                | 15   |
| 50–60                       | 15  | 22                                    | 45   | 45                          | 90                                    | 22                                  | 9                                | 18   |
| 60–70                       | 16  | 23                                    | 47   | 47                          | 94                                    | 23                                  | 9                                | 18   |
| 70–80                       | 16  | 24                                    | 48   | 48                          | 96                                    | 24                                  | 9                                | 18   |
| 80–90                       | 16  | 25                                    | 49   | 49                          | 98                                    | 25                                  | 9                                | 18   |
| 90–100                      | 17  | 25                                    | 51   | 51                          | 102                                   | 25                                  | 9                                | 18   |
| 100–150                     | 19  | 28                                    | 56   | 56                          | 112                                   | 28                                  | 9                                | 22   |
| 150–200                     | 20  | 30                                    | 60   | 60                          | 120                                   | 30                                  | 9                                | 22   |
| 200–250                     | 21  | 32                                    | 63   | 63                          | 126                                   | 32                                  | 9                                | 24   |
| 250–300                     | 22  | 33                                    | 66   | 66                          | 132                                   | 33                                  | 9                                | 24   |
| 300–350                     | 23  | 34                                    | 68   | 68                          | 136                                   | 34                                  | 10                               | 25   |
| 350–400                     | 24  | 35                                    | 71   | 71                          | 142                                   | 35                                  | 10                               | 25   |
| 400–450                     | 24  | 36                                    | 73   | 73                          | 146                                   | 36                                  | 10                               | 27   |
| 450–500                     | 25  | 37                                    | 74   | 74                          | 148                                   | 37                                  | 10                               | 27   |
| 500–550                     | 25  | 38                                    | 76   | 76                          | 152                                   | 38                                  | 10                               | 31   |
| 550–600                     | 26  | 39                                    | 78   | 78                          | 156                                   | 39                                  | 10                               | 31   |
| 600–650                     | 26  | 39                                    | 79   | 79                          | 158                                   | 39                                  | 10                               | 31   |
| 650–700                     | 27  | 40                                    | 80   | 80                          | 160                                   | 40                                  | 10                               | 31   |
| 700–750                     | 27  | 41                                    | 82   | 82                          | 164                                   | 41                                  | 10                               | 31   |
| 750–800                     | 28  | 41                                    | 83   | 83                          | 166                                   | 41                                  | 10                               | 31   |
| 800–850                     | 28  | 42                                    | 84   | 84                          | 168                                   | 42                                  | 10                               | 31   |
| 850–900                     | 28  | 43                                    | 85   | 85                          | 170                                   | 43                                  | 10                               | 31   |
| 900–950                     | 29  | 43                                    | 86   | 86                          | 172                                   | 43                                  | 10                               | 31   |
| 950–1000                    | 29  | 44                                    | 87   | 87                          | 174                                   | 44                                  | 10                               | 31   |
| 1000–1100                   | 30  | 44                                    | 89   | 89                          | 178                                   | 44                                  | 11                               | 36   |
| 1100–1200                   | 30  | 45                                    | 91   | 91                          | 182                                   | 45                                  | 11                               | 36   |
| 1200–1300                   | 31  | 46                                    | 92   | 92                          | 184                                   | 46                                  | 11                               | 36   |
| 1300–1400                   | 31  | 47                                    | 94   | 94                          | 188                                   | 47                                  | 11                               | 36   |
| 1400–1500                   | 32  | 48                                    | 95   | 95                          | 190                                   | 48                                  | 11                               | 36   |

**Table 8** Hazard Type 2 explosive every item being of 0.7 kg net mass or less in a mounded store (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1500–1600                   | 32  | 48                                    | 97   | 97                          | 194                                   | 48                                  | 11                               | 36   |
| 1600–1700                   | 33  | 49                                    | 98   | 98                          | 196                                   | 49                                  | 11                               | 36   |
| 1700–1800                   | 33  | 50                                    | 99   | 99                          | 198                                   | 50                                  | 11                               | 36   |
| 1800–1900                   | 33  | 50                                    | 100  | 100                         | 200                                   | 50                                  | 11                               | 36   |
| 1900–2000                   | 34  | 51                                    | 101  | 101                         | 202                                   | 51                                  | 11                               | 36   |
| 2000–3000                   | 37  | 55                                    | 110  | 110                         | 220                                   | 55                                  | 12                               | 40   |
| 3000–4000                   | 39  | 59                                    | 117  | 117                         | 234                                   | 59                                  | 13                               | 42   |
| 4000–5000                   | 41  | 61                                    | 122  | 122                         | 244                                   | 61                                  | 14                               | 44   |
| 5000–10 000                 | 47  | 70                                    | 140  | 140                         | 280                                   | 70                                  | 17                               | 50   |
| 10 000–15 000               | 50  | 76                                    | 151  | 151                         | 302                                   | 76                                  | 20                               | 54   |
| 15 000–20 000               | 53  | 80                                    | 159  | 159                         | 318                                   | 80                                  | 22                               | 57   |
| 20 000–25 000               | 55  | 83                                    | 166  | 166                         | 332                                   | 83                                  | 24                               | 60   |
| 25 000–30 000               | 57  | 86                                    | 171  | 171                         | 342                                   | 86                                  | 26                               | 62   |
| 30 000–40 000               | 60  | 90                                    | 180  | 180                         | 360                                   | 90                                  | 29                               | 66   |
| 40 000–50 000               | 62  | 94                                    | 187  | 187                         | 377                                   | 94                                  | 32                               | 68   |
| 50 000–60 000               | 64  | 97                                    | 193  | 193                         | 386                                   | 97                                  | 35                               | 70   |
| 60 000–70 000               | 66  | 99                                    | 198  | 198                         | 396                                   | 99                                  | 36                               | 74   |
| 70 000–80 000               | 67  | 101                                   | 202  | 202                         | 404                                   | 101                                 | 38                               | 74   |
| 80 000–90 000               | 69  | 103                                   | 206  | 206                         | 412                                   | 103                                 | 39                               | 76   |
| 90 000–100 000              | 70  | 105                                   | 210  | 210                         | 420                                   | 105                                 | 40                               | 76   |

**Table 9** Hazard Type 2 explosive every item being of 0.7 kg net mass or less in an unrounded store

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 0.1–25                      | 12  | 18                                    | 37   | 37                          | 74                                    | 18                                  | 37                               | 37   |
| 25–30                       | 13  | 19                                    | 38   | 38                          | 76                                    | 19                                  | 38                               | 38   |
| 30–40                       | 14  | 20                                    | 41   | 41                          | 82                                    | 20                                  | 41                               | 41   |
| 40–50                       | 14  | 22                                    | 43   | 43                          | 86                                    | 22                                  | 43                               | 43   |
| 50–60                       | 15  | 22                                    | 45   | 45                          | 90                                    | 22                                  | 45                               | 45   |
| 60–70                       | 16  | 23                                    | 47   | 47                          | 94                                    | 23                                  | 47                               | 47   |
| 70–80                       | 16  | 24                                    | 48   | 48                          | 96                                    | 24                                  | 48                               | 48   |
| 80–90                       | 16  | 25                                    | 49   | 49                          | 98                                    | 25                                  | 49                               | 49   |
| 90–100                      | 17  | 25                                    | 51   | 51                          | 102                                   | 25                                  | 51                               | 51   |
| 100–150                     | 19  | 28                                    | 56   | 56                          | 112                                   | 28                                  | 56                               | 56   |
| 150–200                     | 20  | 30                                    | 60   | 60                          | 120                                   | 30                                  | 60                               | 60   |
| 200–250                     | 21  | 32                                    | 63   | 63                          | 126                                   | 32                                  | 63                               | 63   |
| 250–300                     | 22  | 33                                    | 66   | 66                          | 132                                   | 33                                  | 66                               | 66   |
| 300–350                     | 23  | 34                                    | 68   | 68                          | 136                                   | 34                                  | 68                               | 68   |
| 350–400                     | 24  | 35                                    | 71   | 71                          | 142                                   | 35                                  | 71                               | 71   |
| 400–450                     | 24  | 36                                    | 73   | 73                          | 146                                   | 36                                  | 73                               | 73   |
| 450–500                     | 25  | 37                                    | 74   | 74                          | 148                                   | 37                                  | 74                               | 74   |
| 500–550                     | 25  | 38                                    | 76   | 76                          | 152                                   | 38                                  | 76                               | 76   |
| 550–600                     | 26  | 39                                    | 78   | 78                          | 156                                   | 39                                  | 78                               | 78   |
| 600–650                     | 26  | 39                                    | 79   | 79                          | 158                                   | 39                                  | 79                               | 79   |
| 650–700                     | 27  | 40                                    | 80   | 80                          | 160                                   | 40                                  | 80                               | 80   |
| 700–750                     | 27  | 41                                    | 82   | 82                          | 164                                   | 41                                  | 82                               | 82   |
| 750–800                     | 28  | 41                                    | 83   | 83                          | 166                                   | 41                                  | 83                               | 83   |
| 800–850                     | 28  | 42                                    | 84   | 84                          | 168                                   | 42                                  | 84                               | 84   |
| 850–900                     | 28  | 43                                    | 85   | 85                          | 170                                   | 43                                  | 85                               | 85   |
| 900–950                     | 29  | 43                                    | 86   | 86                          | 172                                   | 43                                  | 86                               | 86   |
| 950–1000                    | 29  | 44                                    | 87   | 87                          | 174                                   | 44                                  | 87                               | 87   |
| 1000–1100                   | 30  | 44                                    | 89   | 89                          | 178                                   | 44                                  | 89                               | 89   |
| 1100–1200                   | 30  | 45                                    | 91   | 91                          | 182                                   | 45                                  | 91                               | 91   |
| 1200–1300                   | 31  | 46                                    | 92   | 92                          | 184                                   | 46                                  | 92                               | 92   |
| 1300–1400                   | 31  | 47                                    | 94   | 94                          | 188                                   | 47                                  | 94                               | 94   |
| 1400–1500                   | 32  | 48                                    | 95   | 95                          | 190                                   | 48                                  | 95                               | 95   |

**Table 9** Hazard Type 2 explosive every item being of 0.7 kg net mass or less in an unrounded store (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1500–1600                   | 32  | 48                                    | 97   | 97                          | 194                                   | 48                                  | 97                               | 97   |
| 1600–1700                   | 33  | 49                                    | 98   | 98                          | 196                                   | 49                                  | 98                               | 98   |
| 1700–1800                   | 33  | 50                                    | 99   | 99                          | 198                                   | 50                                  | 99                               | 99   |
| 1800–1900                   | 33  | 50                                    | 100  | 100                         | 200                                   | 50                                  | 100                              | 100  |
| 1900–2000                   | 34  | 51                                    | 101  | 101                         | 202                                   | 51                                  | 101                              | 101  |
| 2000–3000                   | 37  | 55                                    | 110  | 110                         | 220                                   | 55                                  | 110                              | 110  |
| 3000–4000                   | 39  | 59                                    | 117  | 117                         | 234                                   | 59                                  | 117                              | 117  |
| 4000–5000                   | 41  | 61                                    | 122  | 122                         | 244                                   | 61                                  | 122                              | 122  |
| 5000–10 000                 | 47  | 70                                    | 140  | 140                         | 280                                   | 70                                  | 140                              | 140  |
| 10 000–15 000               | 50  | 76                                    | 151  | 151                         | 302                                   | 76                                  | 151                              | 151  |
| 15 000–20 000               | 53  | 80                                    | 159  | 159                         | 318                                   | 80                                  | 159                              | 159  |
| 20 000–25 000               | 55  | 83                                    | 166  | 166                         | 332                                   | 83                                  | 166                              | 166  |
| 25 000–30 000               | 57  | 86                                    | 171  | 171                         | 342                                   | 86                                  | 171                              | 171  |
| 30 000–40 000               | 60  | 90                                    | 180  | 180                         | 360                                   | 90                                  | 180                              | 180  |
| 40 000–50 000               | 62  | 94                                    | 187  | 187                         | 377                                   | 94                                  | 187                              | 187  |
| 50 000–60 000               | 64  | 97                                    | 193  | 193                         | 386                                   | 97                                  | 193                              | 193  |
| 60 000–70 000               | 66  | 99                                    | 198  | 198                         | 396                                   | 99                                  | 198                              | 198  |
| 70 000–80 000               | 67  | 101                                   | 202  | 202                         | 404                                   | 101                                 | 202                              | 202  |
| 80 000–90 000               | 69  | 103                                   | 206  | 206                         | 412                                   | 103                                 | 206                              | 206  |
| 90 000–100 000              | 70  | 105                                   | 210  | 210                         | 420                                   | 105                                 | 210                              | 210  |

**Table 10** Hazard Type 3 explosive

| Column 1                    | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|-----------------------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 0.1–25                      | 0   | 0   | 0   | 0                           | 0  | 0                                      | 9                                   | 12  |
| 25–30                       | 7   | 10  | 20  | 20                          | 20                                       | 10                                     | 9                                   | 12  |
| 30–40                       | 7   | 11  | 22  | 22                          | 22                                       | 11                                     | 9                                   | 12  |
| 40–50                       | 8   | 12  | 23  | 23                          | 23                                       | 12                                     | 9                                   | 12  |
| 50–60                       | 8   | 12  | 25  | 25                          | 25                                       | 12                                     | 9                                   | 15  |
| 60–70                       | 9   | 13  | 26  | 26                          | 26                                       | 13                                     | 9                                   | 15  |
| 70–80                       | 9   | 14  | 27  | 27                          | 27                                       | 14                                     | 9                                   | 15  |
| 80–90                       | 9   | 14  | 28  | 28                          | 28                                       | 14                                     | 9                                   | 15  |
| 90–100                      | 10  | 15  | 29  | 29                          | 29                                       | 15                                     | 9                                   | 15  |
| 100–150                     | 11  | 17  | 34  | 34                          | 34                                       | 17                                     | 9                                   | 18  |
| 150–200                     | 12  | 19  | 37  | 37                          | 37                                       | 19                                     | 9                                   | 18  |
| 200–250                     | 13  | 20  | 40  | 40                          | 40                                       | 20                                     | 10                                  | 21  |
| 250–300                     | 14  | 21  | 43  | 43                          | 43                                       | 21                                     | 10                                  | 21  |
| 300–350                     | 15  | 22  | 45  | 45                          | 45                                       | 22                                     | 11                                  | 23  |
| 350–400                     | 16  | 23  | 47  | 47                          | 47                                       | 23                                     | 11                                  | 23  |
| 400–450                     | 16  | 24  | 49  | 49                          | 49                                       | 24                                     | 12                                  | 25  |
| 450–500                     | 17  | 25  | 50  | 50                          | 50                                       | 25                                     | 12                                  | 25  |
| 500–550                     | 17  | 26  | 52  | 52                          | 52                                       | 26                                     | 14                                  | 32  |
| 550–600                     | 18  | 27  | 54  | 54                          | 54                                       | 27                                     | 14                                  | 32  |
| 600–650                     | 18  | 28  | 55  | 55                          | 55                                       | 28                                     | 14                                  | 32  |
| 650–700                     | 19  | 28  | 56  | 56                          | 56                                       | 28                                     | 14                                  | 32  |
| 700–750                     | 19  | 29  | 58  | 58                          | 58                                       | 29                                     | 14                                  | 32  |
| 750–800                     | 20  | 29  | 59  | 59                          | 59                                       | 29                                     | 14                                  | 32  |
| 800–850                     | 20  | 30  | 60  | 60                          | 60                                       | 30                                     | 14                                  | 32  |
| 850–900                     | 20  | 31  | 61  | 61                          | 61                                       | 31                                     | 14                                  | 32  |
| 900–950                     | 21  | 31  | 62  | 62                          | 62                                       | 31                                     | 14                                  | 32  |
| 950–1000                    | 21  | 32  | 64  | 64                          | 64                                       | 32                                     | 14                                  | 32  |
| 1000–1100                   | 22  | 33  | 66  | 66                          | 66                                       | 33                                     | 17                                  | 40  |
| 1100–1200                   | 22  | 34  | 67  | 67                          | 67                                       | 34                                     | 17                                  | 40  |
| 1200–1300                   | 23  | 35  | 69  | 69                          | 69                                       | 35                                     | 17                                  | 40  |
| 1300–1400                   | 24  | 36  | 71  | 71                          | 71                                       | 36                                     | 17                                  | 40  |
| 1400–1500                   | 24  | 36  | 73  | 73                          | 73                                       | 36                                     | 17                                  | 40  |

**Table 10** Hazard Type 3 explosive (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 1500–1600                   | 25  | 37                                    | 74   | 74                          | 74                                    | 37                                  | 17                               | 40   |
| 1600–1700                   | 25  | 38                                    | 76   | 76                          | 76                                    | 38                                  | 17                               | 40   |
| 1700–1800                   | 26  | 39                                    | 77   | 77                          | 77                                    | 39                                  | 17                               | 40   |
| 1800–1900                   | 26  | 39                                    | 79   | 79                          | 79                                    | 39                                  | 17                               | 40   |
| 1900–2000                   | 27  | 40                                    | 80   | 80                          | 80                                    | 40                                  | 17                               | 40   |
| 2000–3000                   | 31  | 46                                    | 92   | 92                          | 92                                    | 46                                  | 19                               | 46   |
| 3000–4000                   | 34  | 50                                    | 101  | 101                         | 101                                   | 50                                  | 20                               | 50   |
| 4000–5000                   | 36  | 54                                    | 109  | 109                         | 109                                   | 54                                  | 22                               | 54   |
| 5000–10 000                 | 46  | 68                                    | 137  | 137                         | 137                                   | 68                                  | 28                               | 68   |
| 10 000–15 000               | 52  | 78                                    | 157  | 157                         | 157                                   | 78                                  | 33                               | 78   |
| 15 000–20 000               | 57  | 86                                    | 172  | 172                         | 172                                   | 86                                  | 37                               | 86   |
| 20 000–25 000               | 62  | 93                                    | 186  | 186                         | 186                                   | 93                                  | 41                               | 93   |
| 25 000–30 000               | 66  | 99                                    | 197  | 197                         | 197                                   | 99                                  | 44                               | 98   |
| 30 000–40 000               | 72  | 109                                   | 217  | 217                         | 217                                   | 109                                 | 47                               | 110  |
| 40 000–50 000               | 78  | 117                                   | 234  | 234                         | 234                                   | 117                                 | 50                               | 120  |
| 50 000–60 000               | 83  | 124                                   | 249  | 249                         | 249                                   | 124                                 | 54                               | 130  |
| 60 000–70 000               | 87  | 131                                   | 262  | 262                         | 262                                   | 131                                 | 58                               | 140  |
| 70 000–80 000               | 91  | 137                                   | 274  | 274                         | 274                                   | 137                                 | 63                               | 140  |
| 80 000–90 000               | 95  | 142                                   | 285  | 285                         | 285                                   | 142                                 | 67                               | 150  |
| 90 000–100 000              | 98  | 147                                   | 295  | 295                         | 295                                   | 147                                 | 70                               | 150  |



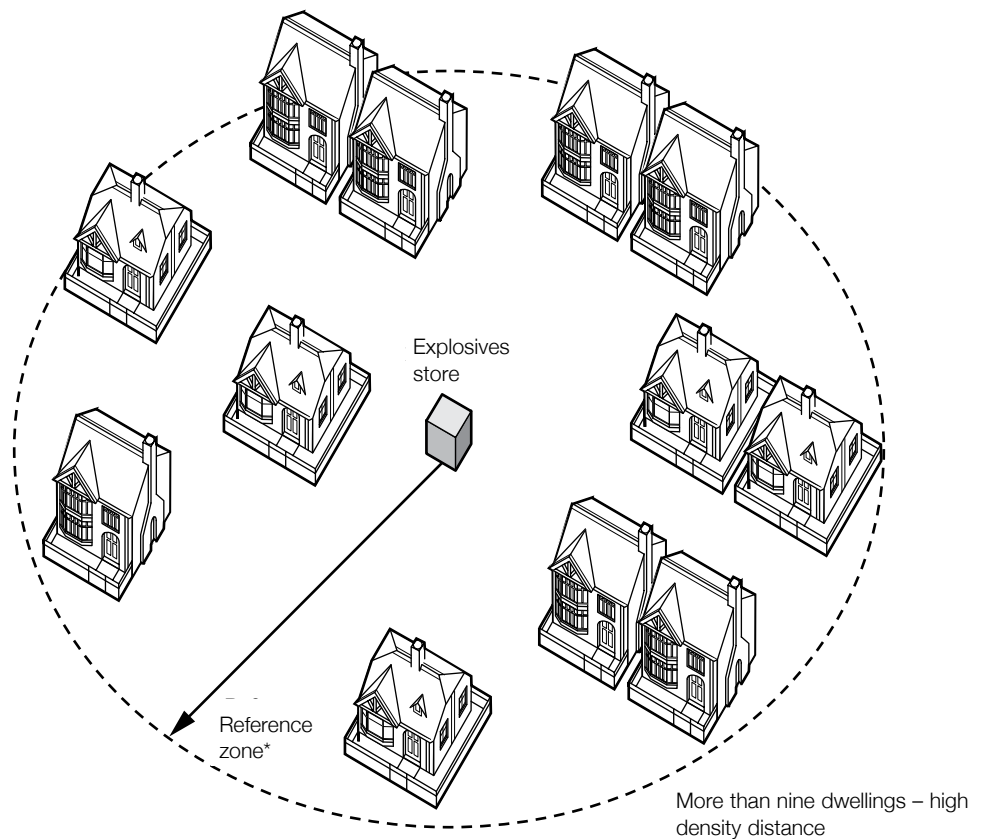
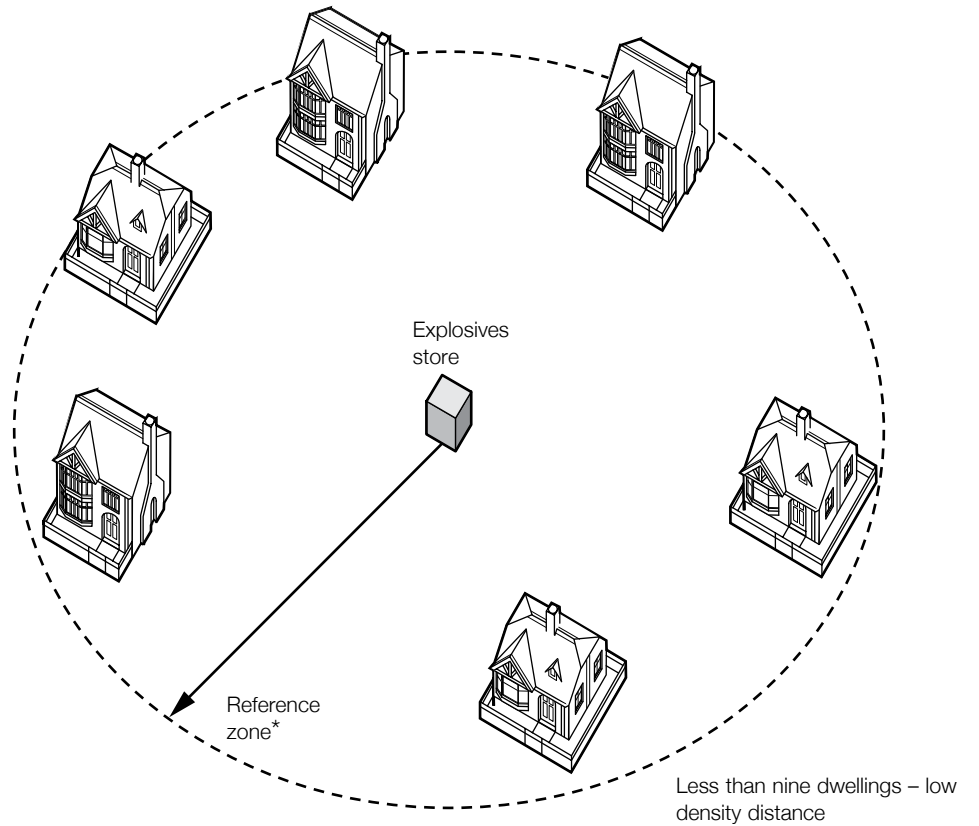
**Table 11** Hazard Type 4 explosive

| Column 1                    | Distance in metres to protected works and/or buildings of |   |   |                             |  |  |                                     |   |
|-----------------------------|---|---|---|-----------------------------|--|--|-------------------------------------|---|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath,<br>lightly<br>used<br>road    | <b>Class B</b><br>Minor<br>road,<br>railway | <b>Class C</b><br>Major<br>road, place<br>of public<br>resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable<br>building | <b>Class F</b><br>On-site<br>buildings | <b>Class G</b><br>On-site<br>stores | <b>Class H</b><br>On-site<br>manufacture<br>and<br>processing |
| 0.1–250                     | 0   | 0   | 0   | 0                           | 0  | 0                                      | 9                                   | 11  |
| 250–300                     | 1   | 1   | 1   | 1                           | 1  | 1                                      | 9                                   | 11  |
| 300–340                     | 1   | 1   | 2   | 2                           | 2  | 1                                      | 9                                   | 11  |
| 340–370                     | 1   | 2   | 3   | 3                           | 3  | 2                                      | 9                                   | 11  |
| 370–400                     | 1   | 2   | 4   | 4                           | 4  | 2                                      | 9                                   | 11  |
| 400–450                     | 2   | 3   | 5   | 5                           | 5  | 3                                      | 9                                   | 11  |
| 450–500                     | 2   | 3   | 6   | 6                           | 6  | 3                                      | 9                                   | 11  |
| 500–550                     | 2   | 4   | 7   | 7                           | 7  | 4                                      | 9                                   | 12  |
| 550–650                     | 3   | 5   | 9   | 9                           | 9  | 5                                      | 9                                   | 12  |
| 650–700                     | 3   | 5   | 10  | 10                          | 10                                       | 5                                      | 9                                   | 12  |
| 700–750                     | 4   | 6   | 11  | 11                          | 11                                       | 6                                      | 9                                   | 12  |
| 750–800                     | 4   | 6   | 12  | 12                          | 12                                       | 6                                      | 9                                   | 12  |
| 800–900                     | 4   | 7   | 13  | 13                          | 13                                       | 7                                      | 9                                   | 12  |
| 900–950                     | 5   | 7   | 14  | 14                          | 14                                       | 7                                      | 9                                   | 12  |
| 950–1000                    | 5   | 8   | 15  | 15                          | 15                                       | 8                                      | 9                                   | 12  |
| 1000–1100                   | 5   | 8   | 16  | 16                          | 16                                       | 8                                      | 12                                  | 19  |
| 1100–1150                   | 6   | 9   | 17  | 17                          | 17                                       | 9                                      | 12                                  | 19  |
| 1150–1200                   | 6   | 9   | 18  | 18                          | 18                                       | 9                                      | 12                                  | 19  |
| 1200–1300                   | 6   | 10  | 19  | 19                          | 19                                       | 10                                     | 12                                  | 19  |
| 1300–1350                   | 7   | 10  | 20  | 20                          | 20                                       | 10                                     | 12                                  | 19  |
| 1350–1400                   | 7   | 11  | 21  | 21                          | 21                                       | 11                                     | 12                                  | 19  |
| 1400–1450                   | 7   | 11  | 22  | 22                          | 22                                       | 11                                     | 12                                  | 19  |
| 1450–1550                   | 8   | 12  | 23  | 23                          | 23                                       | 12                                     | 12                                  | 19  |
| 1550–1600                   | 8   | 12  | 24  | 24                          | 24                                       | 12                                     | 12                                  | 19  |
| 1600–1650                   | 8   | 13  | 25  | 25                          | 25                                       | 13                                     | 12                                  | 19  |
| 1650–1700                   | 9   | 13  | 26  | 26                          | 26                                       | 13                                     | 12                                  | 19  |
| 1700–1800                   | 9   | 14  | 27  | 27                          | 27                                       | 14                                     | 12                                  | 19  |
| 1800–1850                   | 9   | 14  | 28  | 28                          | 28                                       | 14                                     | 12                                  | 19  |
| 1850–1900                   | 10  | 15  | 29  | 29                          | 29                                       | 15                                     | 12                                  | 19  |
| 1900–2000                   | 10  | 15  | 30  | 30                          | 30                                       | 15                                     | 12                                  | 19  |
| 2000–3000                   | 13  | 20  | 40  | 40                          | 40                                       | 20                                     | 14                                  | 23  |
| 3000–4000                   | 13  | 20  | 40  | 40                          | 40                                       | 20                                     | 16                                  | 24  |

**Table 11** Hazard Type 4 explosive (continued)

| Column 1                    | Distance in metres to protected works and/or buildings of |                                       |  |                             |                                       |                                     |                                  |  |
|-----------------------------|---|---------------------------------------|--|-----------------------------|---------------------------------------|-------------------------------------|----------------------------------|--|
| Quantity of explosives (kg) | <b>Class A</b><br>Footpath, lightly used road             | <b>Class B</b><br>Minor road, railway | <b>Class C</b><br>Major road, place of public resort | <b>Class D</b><br>Buildings | <b>Class E</b><br>Vulnerable building | <b>Class F</b><br>On-site buildings | <b>Class G</b><br>On-site stores | <b>Class H</b><br>On-site manufacture and processing |
| 4000–5000                   | 15  | 23                                    | 45   | 45                          | 45                                    | 23                                  | 17                               | 25   |
| 5000–10 000                 | 17  | 26                                    | 51   | 51                          | 51                                    | 26                                  | 22                               | 27   |
| 10 000–15 000               | 18  | 27                                    | 54   | 54                          | 54                                    | 27                                  | 24                               | 27   |
| 15 000–20 000               | 18  | 28                                    | 56   | 56                          | 56                                    | 28                                  | 25                               | 27   |
| 20 000–25 000               | 19  | 29                                    | 57   | 57                          | 57                                    | 29                                  | 26                               | 27   |
| 25 000–30 000               | 20  | 30                                    | 59   | 59                          | 59                                    | 30                                  | 27                               | 27   |
| 30 000–40 000               | 20  | 30                                    | 60   | 60                          | 60                                    | 30                                  | 27                               | 27   |
| 40 000–50 000               | 20  | 31                                    | 61   | 61                          | 61                                    | 31                                  | 27                               | 27   |
| 50 000–60 000               | 20  | 31                                    | 61   | 61                          | 61                                    | 31                                  | 27                               | 27   |
| 60 000–70 000               | 21  | 31                                    | 62   | 62                          | 62                                    | 31                                  | 27                               | 27   |
| 70 000–80 000               | 21  | 32                                    | 63   | 63                          | 63                                    | 32                                  | 27                               | 27   |
| 80 000–90 000               | 21  | 32                                    | 63   | 63                          | 63                                    | 32                                  | 27                               | 27   |
| 90 000–100 000              | 21  | 32                                    | 64   | 64                          | 64                                    | 32                                  | 27                               | 27   |

## Appendix 6 Guidance on density distance: Working out whether high- or low-density distances apply



\* Reference zone is twice the low-density distance

## Appendix 7 Storing small quantities of shooters' powder, water-based explosives, detonators and detonating cord

1 Regulation 27(3)(b), (c) and (d) disapplies separation distance requirements for keeping small quantities of shooters' powder, water-based explosives and detonating cord. The following sections describe the conditions that should be met to qualify for the disapplication. These conditions apply at all premises including domestic premises.

### Shooters' powder

2 Shooters' powder includes both black powder and smokeless powder.

3 The powder should be kept in containers with no more than 1 kg of powder per container. The containers should be constructed in such a way that, in the event of a fire they do not provide additional containment that will either increase the explosive force of any deflagration or cause smokeless powder to detonate. Normally plastic/polythene or paper/cloth containers should be used. Metal containers with a screw cap or a push-in lid must not be used.

4 Although shooters' powders are generally not very sensitive to ignition by electrostatic discharge, homeloaders or others who decant the contents of plastic containers should take care to reduce the risk of static electricity build-up. Advice on precautions may be sought from the manufacturer.

5 The containers of powder should be kept in a box constructed of plywood with a minimum thickness of 18 mm and a maximum thickness of 24 mm.

6 Where the box holds more than one container, each individual container should be separated by a 6 mm wooden partition that is securely fixed to the outer walls of the box. Each compartment should allow 30% additional height between the top of the container and the inside of the lid.

7 There should be a good seal to prevent a flame path between the lid of the box and the interior. An intumescent strip should be fitted around the edges of the lid to give a good seal or alternatively, a stepped lid or internal second lid should be fitted.

8 The box should be constructed so that there is no exposed metal on the inside. Internal nuts should be covered by a glued wooden liner not less than 6 mm.

9 Figure 1 shows a box that would meet the requirements set out in the previous paragraphs.

**Figure 1** Storage of shooters' powder. Note intumescent strip on box lid



10 Boxes constructed in line with the findings presented in HSE research report RR991<sup>6</sup> can be used for the storage of between 1 and 25 (5 x 5) containers without being type tested. They are expected to provide at least eight minutes of fire protection to a box that is involved in a major conflagration.

11 The box should not be located:

- under or near any means of access or escape, for example under stairs;
- in the same room as flammable liquids; or
- in areas where there are risks of fire.

12 Metal boxes, including ammunition boxes, are not suitable and must not be used. This is because while metal is fire resistant it also transmits heat very well, and because the metal container adds additional containment that significantly increases the explosive power of the powder.

13 Similarly a box constructed from plywood must not be kept in any form of metal box, drawer or cupboard.

### **Storage of water-based explosives**

14 Regulation 27(3)(d) allows the storage of small quantities of water- and ammonium nitrate-based explosives assigned to UN No 0241 without the need to maintain separation distances providing certain conditions are met. These conditions can be met by:

- using a store that has been designed and constructed to ensure that there is no additional containment in the event of an explosion – for example by fitting an outward-opening door that would be capable of effectively venting pressure in the event of an explosion;
- the store should be constructed of lightweight fire-retardant materials such as thermalite block;
- the store should be located inside a building (such as an integral or separate garage or outhouse) but not inside a dwelling;

- the store should be located at floor level on a concrete (or similar) floor; and
- flammables (for example, petrol, LPG, paint and white spirit) should either be sufficiently segregated from the explosives that they will not act as a source of ignition or, where this is not possible, should not be kept in the same room as the explosives.

15 Where the store is located in a garage, any vehicles should be removed. All wood, plastic and paper should also be removed.

## Detonators and detonating cord

16 Regulation 27(3)(d) allows the keeping of small quantities of detonators and detonating cord without the need to maintain separation distances providing certain conditions are met.

17 The conditions can be met for detonators by:

- storing detonators in a separate compartment from other explosives; or
- only storing detonators:
  - that have been classified for transport in UN Hazard Division 1.4B or 1.4S and keeping them in their original inner and outer transport packaging; and
  - in a manner that will prevent the communication of an explosive event between detonators.

18 Storing detonators in a manner that will prevent the communication of an explosive event will involve using packaging that provides a physical barrier that stops the detonation of any one detonator spreading to the rest of the case. Two of the principal media currently used to prevent the communication of an explosive event in transport are blocks of medium density fibreboard (MDF) or flame-suppressed PVC. The individual detonators are placed in holes in the block. The dimensions of these holes and their spacing will depend on the detonators that are being stored.

19 Where the block has been approved by a competent authority for use in the transport of that type of detonator, it will normally be acceptable for use in storage. Where the block is constructed for use in storage then the depth of the holes should be sufficient to cover the explosive charge: generally they will be at least 27 mm deep. The holes should be at least 20 mm apart and the block should have been subjected to appropriate type testing.

20 The conditions can be met for detonating cord by:

- cutting the detonating cord up into lengths of up to 5 m;
- carefully taping the cut ends of the detonating cord to prevent the escape of any composition;
- loosely coiling the detonating cord in such a way as to avoid cracking or splitting;
- separating individual coils of detonating cord by a physical barrier that will prevent the detonation of one length of cord from spreading to adjoining lengths of cord.

21 Physical barriers that can be used to separate coils of detonating cord can be made from plywood or plasterboard. The thickness of the plywood or plaster board will depend on the type and performance of the detonating cord and it is likely that type testing will be required to identify whether or not the plywood or plaster board provides an appropriate barrier to propagation in the storage conformation.

22 Detonating cord should not be kept in bulk reels – unless the manufacturer has manufactured the reels to meet the requirements of UN Hazard Division 1.4 and the detonating cord is kept as packaged for transport.

## Glossary

**2 degree rule** a generally accepted approach to the design of mounds and traverses intended to prevent the sympathetic initiation of explosives elsewhere by high-velocity fragments. The 'rule' requires the subtended angle between a stack of explosives and the top of a mound or traverse to exceed 2 degrees. More information can be found in Chapter 7 of JSP482.

**600 mm rule** a generally accepted approach to the design of mounds and traverses intended to prevent the sympathetic initiation of explosives elsewhere by high-velocity fragments. The 'rule' requires the top of the mound or traverse to be at least 600 mm above the height of the stack of explosives. More information can be found in Chapter 7 of JSP482.

**antistatic regime** the arrangements that are in place to limit the accumulation of a static charge and to ensure that any discharge of an accumulated charge is safe.

**black powder** is the explosive substance assigned in accordance with the United Nations Recommendations the UN no 0027 or 0028

**civil explosive** an explosive which has been or would be classified in accordance with the UN Recommendations as falling within Class 1 but it does not include:

- ammunition the acquisition of which is regulated or prohibited by virtue of the Firearms Act 1968 to 1997;
- any explosive which it is shown is intended for the lawful use by the armed forces or the police of any country;
- a pyrotechnic article; and
- an explosive which is used immediately at the place of manufacture.

**communication** the process of an ignition, burn, deflagration, detonation or other explosive event progressing to adjacent or nearby explosives.

**competent authority** an authority or other body designated as such in member states that are contracting parties to the European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). A list of competent authorities can be found on the United Nations website [www.unece.org](http://www.unece.org).

**conductive regime** the arrangements in place to prevent the generation of static electricity and its accumulation.

**cross-cutting safety precaution** an appropriate measure that addresses more than one duty.

**deflagration** exothermic chemical decomposition of a material in which the reaction front advances into the unreacted material at less than the speed of sound.



**detonation** a chemical reaction that progresses through an explosive at a rate exceeding the speed of sound in the reaction zone.

**dwelling** for the purposes of regulation 27 and Schedule 5 a 'dwelling' includes an individual flat within a block of flats.

**explosion** a violent reaction of an explosives substance or article with the potential to cause harm or damage to its surroundings by either shock, overpressure, thermal effects or projected effects and fragments.

**explosive** includes explosive articles, explosive substances and desensitised explosives. Explosives are defined according to their properties and by the criteria in the United Nations Recommendations on the Transport of Dangerous Goods as revised or reissued from time to time. Pyrotechnic substances are considered to be explosives for the purposes of the Regulations along with pyrotechnic articles that would, if classified for transport, fall within UN Class 1 or be too dangerous to transport because of their explosive properties. However, this does not mean that a substance or an article has to have been subject to formal classification procedures before it is considered to be an explosive.

The interpretation of 'explosive' in the Regulations contains an important qualification intended to exempt short-lived, explosive, chemical intermediates that are produced but then further chemically modified as part of the same manufacturing process. If the process:

- does not chemically alter the substance so that it can no longer be considered to be an explosive;
- involves the retention of the explosive substance for a significant period of time; or
- involves the isolation of an explosive chemical (including any explosive by-product);

then it will be subject to the Regulations even if the explosive is added to a diluting medium to desensitise it.

**explosive substance** an explosive substance can be a single substance or a mixture of substances. The definition contains two important qualifications:

- the definition of explosive substance excludes gases and mixtures of gases; and
- the explosion effect must be created by a reaction in the substance or preparation in itself (or in the case of a pyrotechnic effect, by a self-sustaining reaction).

This does not therefore include a secondary reaction which involves substances or preparations which were not part of the original explosive substance.

**explosives area** any area, which may be outdoors or within a building, where explosives are stored, manufactured, disposed of or otherwise processed.

**explosives building** any building in which explosives are stored, manufactured, or otherwise processed.

**explosives operations** any activity involving explosives that is subject to the requirements of the Regulations. It will include manufacture, storage, disposal, discard, and decontamination, on site transport and may include explosives processing that does not constitute manufacture and on certain sites, use.

**fire safety legislation** the Regulatory Reform (Fire Safety) Order 2005 (SI 2005/1541) and its equivalent in Scotland, the Fire (Scotland) Act 2005 (asp 5).

**flammable fines** small particles of flammable materials. They are generally much easier to ignite than the bulk material because they have a much higher specific surface area. Flammable fines can be generated when packaging materials, such as wood or cardboard, are moved into or out of buildings and rub against walls, doors or equipment.

**initiation** the act of causing an explosive material to ignite, burn, deflagrate, detonate or otherwise explode.

**ISO container** a steel freight container specially designed to facilitate the transport of goods, designed and constructed to a relevant standard, and used for the storage of explosives.

**manufacture** the interpretation in the Regulations specifies certain activities that are regarded as manufacture. However, manufacture is not limited to these activities but would include any activity where the process undertaken changes the nature of the substance or article. This includes processes where explosive substances or explosives are made or assembled, or unmade or disassembled (for example, manufacture of gunpowder, filling or fusing of fireworks, assembling fireworks displays from components, breaking down jet perforating guns, removing fuses from artillery shells and filling shotgun cartridges and other cartridges for small arms).

The activities covered by ER2014 include the manufacture of explosives and intermediate products for on-site mixing and storage.

There are a number of processes that are not considered to be 'manufacture' for the purposes of the Regulations. These can include:

- packing or repacking explosives or explosive articles;
- breaking down explosives stored in bulk into smaller storage containers;
- labelling explosives or explosive articles;
- testing and proofing explosives or explosives articles; and
- using explosives articles as components to make a product which is not classified as an explosive (for example, the preparation of an explosive actuator into a fire drencher system, fitting airbags to vehicles, fitting ejector seats and other pyrotechnic articles to aircraft).

Where these activities alone are undertaken then there is no requirement to hold a licence under regulation 6. However, such activities fall within the scope of the Regulations as a whole and of the safety requirements set out in regulations 26–29.

**net mass** the terms 'net explosive content' and 'net explosive quantity' are commonly used in the industry to refer to the weight of the explosive contained within an article (ie less packaging, casings etc but including explosives in fuses and propelling charges etc). Although these terms are commonly understood to refer to mass there is scope for differing interpretations of 'content' and 'quantity' in that these could be taken to refer to volume. The term 'net mass' is used for the sole reason of avoiding any scope for confusion or misinterpretation.

**normal shipboard activities** includes:

- the construction, reconstruction or conversion of a ship outside, but not inside, Great Britain; and
- the repair of a ship except repairs carried out in dry dock.

**offshore** the belt of sea over which the UK exercises sovereign jurisdiction and any area designated under:

- section 1(7) of the Continental Shelf Act 1964;
- section 1(5) of the Energy Act 2008;
- a 'renewable energy zone' designated by section 84(4) of the Energy Act 2004.

**person** the term 'person' is used in a number of the Regulations. 'Person' can be an individual and it includes a body of persons corporate or unincorporate.

**place of reasonable safety** in a non-explosives building the meaning of place of reasonable safety is the definition in the *Fire safety legislation guide*:

*'a place within a building or structure where, for a limited period of time, people will have some protection from the effects of fire and smoke. This place, usually a corridor or stairway, will normally have a minimum of 30-minutes fire resistance and allow people to continue their escape to a place of total safety.'*

For buildings containing explosives, it should be either an exit from a building (including its mound where present) or a place within the building where, for a limited period of time, people will have some protection from the effects of fire, smoke and radiated heat. This place must have suitable fire resistance to allow people to continue their escape to a place of total safety.

**place of total safety** in a non-explosives building the meaning of place of total safety is the definition in the *Fire safety legislation guide*:

*'a place, away from the premises, in which people are at no immediate danger from the effects of the fire.'*

For buildings containing explosives, in addition to the above, it includes a place away from the building in which people are at no immediate danger from the effects of the fire or potential explosion.

For explosive sites, the place of total safety is not the same as the 'minimum hazard zones' identified within the operational guidance for the fire and rescue service.

**propagation** the process of burning, deflagration, detonation or other explosive effect progressing through the mass of material in a container or stack.

**pyrotechnic articles** articles that contain explosives substances or an explosive mixture of substances designed to produce heat, light, sound, gas or smoke or a combination of such effects through self-sustained exothermic chemical reactions. They include fireworks plus other items such as flares, smoke signals and flash cartridges. Pyrotechnic articles will also include all such articles that have been characterised as such by a notified body under the provisions of Directive 2007/23/EC, pyrotechnic articles that are equipment falling within the scope of Directive 96/98/EC and percussion caps intended specifically for toys falling within the scope of Council Directive 2009/48/EC. Pyrotechnic articles will also include those articles that have identified as such by Directive 2004/57/EC.

**pyrotechnic substance** an explosive substance of a kind designed to produce heat, light, sound, gas, or smoke or a combination of any of these, as a result of non-detonative, self-sustaining, exothermic chemical reactions.

**reasonably practicable** balancing the level of risk against the measures needed to control the real risk in terms of money, time or trouble. However, you do not need to take action if it would be grossly disproportionate to the level of risk. See [www.hse.gov.uk/risk/expert.htm](http://www.hse.gov.uk/risk/expert.htm).

**relevant explosive** an explosive for which an 'explosives certificate' is required under regulation 5 of ER2014 for acquiring or keeping that explosive, or would be required if it were not being acquired or kept by a person or organisation exempted by regulation 3(7). In relation to regulations 35 (records) and 37 (reporting loss) of ER2014 it also includes:

- ammunition the acquisition of which is regulated or prohibited by virtue of the Firearms Act 1968 to 1997; and
- smokeless powder;

even though, in the case of smokeless powder, an explosives certificate is not always required for their acquisition or keeping.

Explosives listed in Schedule 2 (other than smokeless powder as noted above) and pyrotechnic articles (apart from those listed in Schedule 3) are **not** relevant explosives.

**relevant standard** a code of practice or other standard linked to legislation (CEN, BS EN, ANSI, BS, IEC, ISO) or a published and commonly known industry-produced standard of performance, providing specific standards relevant to an explosives operation, activity or facility.

A relevant standard will be a document established by consensus and approved by a recognised body that provides for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.

A relevant standard will be based on consolidated results of science, technology and experience.

**separation zone** area around a site which falls within a separation distance.

**site** 'site' is defined as 'the whole area under the control of the same person'. In most instances it will be the same as the area of the establishment at which the explosives operations take place, although in some cases the extent of the area under control of that person will be much greater than the area within which the explosives operations take place. For the purposes of the ER2014 the whole area includes:

- all places adjoining each other; and
- two or more areas separated only by a:
  - road;
  - railway;
  - inland waterway.

See [www.hse.gov.uk](http://www.hse.gov.uk) for more detailed guidance on the application of the Regulations to sites that are shared by different people and between a parent company and its subsidiaries (or between subsidiaries).

**storage** includes all possession, keeping or holding other than when the explosives are actually undergoing manufacture, are in use or are being transported (see paragraph 16 for further information on storage and transport).

**storage area** any area where explosives are stored either on a short- or long-term basis.

**vulnerable building** a building or structure that is particularly vulnerable to blast effects or which is built in a way that makes it unlikely to provide the level of protection to people from fragment effects normally expected from a building. The Regulations define vulnerable buildings as:

- buildings of more than three storeys above ground or 12 m in height constructed with continuous non-load bearing curtain walling with individual glazed or frangible panels larger than 1.5 m<sup>2</sup> and extending over more than 50% or 120 m<sup>2</sup> of the surface of any elevation;
- buildings of more than three storeys above ground or 12 m in height with solid walls and individual glass panes or frangible panels larger than 1.5 m<sup>2</sup> and extending over at least 50% of any elevation;
- buildings of more than 400 m<sup>2</sup> plan area with continuous or individual glazing panes larger than 1.5 m<sup>2</sup> extending over at least 50% or 120 m<sup>2</sup> of the plan area; or
- any other structure that, in consequence of an event such as an explosion, may be susceptible to disproportionate damage such as progressive collapse.

## References and further reading

### References

- 1 *Ministry of Defence explosives regulations* JSP 482 MOD 2013  
[www.gov.uk/government/publications/jsp-482-mod-explosives-regulations](http://www.gov.uk/government/publications/jsp-482-mod-explosives-regulations)
- 2 *Guidance for electrical installation and equipment within explosive manufacturing facilities including fireworks* Confederation of British Industry 2009  
[www.eig.org.uk](http://www.eig.org.uk)
- 3 *Use of structural justification to underpin HSE explosives licence* Specialised Industry Report Confederation of British Industry 2011 [www.eig.org.uk](http://www.eig.org.uk)
- 4 *Personal Protective Equipment at Work (Second edition). Personal Protective Equipment at Work Regulations 1992 (as amended). Guidance on Regulations L25 (Second edition)* HSE Books 2005 ISBN 978 0 7176 6139 8  
[www.hse.gov.uk/pubns/books/l25.htm](http://www.hse.gov.uk/pubns/books/l25.htm)
- 5 *Fire safety legislation guide*  
[www.gov.uk/government/collections/fire-safety-law-and-guidance-documents-for-business](http://www.gov.uk/government/collections/fire-safety-law-and-guidance-documents-for-business)
- 6 *Response of small-scale blackpowder storage in partitioned wooden boxes to external fire* RR991 HSE 2013 [www.hse.gov.uk/research/rrhtm/rr991.htm](http://www.hse.gov.uk/research/rrhtm/rr991.htm)

### Further reading

#### ***Hazard identification and evaluation and the assessment of risk***

General information on risk assessment can be found at  
[www.hse.gov.uk/risk/index.htm](http://www.hse.gov.uk/risk/index.htm)

More information describing approaches to the identification and evaluation of explosives hazards and the assessment of risks associated with explosives operations can be found in:

*Risk assessment for explosives including fireworks: A practical approach to risk assessment which is relevant to small companies including wholesale and retail organizations involved in the storage, distribution and supply of explosives including fireworks operations* Confederation of British Industry 2012 [www.eig.org.uk](http://www.eig.org.uk)

*Fireworks in shops: Retailers' risk assessment checklist* HSE 2010 [www.hse.gov.uk/pubns/indg407ch.pdf](http://www.hse.gov.uk/pubns/indg407ch.pdf)

*Protective measures: A guide on measures other than personal protective equipment to protect people in explosives working areas* Confederation of British Industry 2003 ISBN 0 85201 572 0 [www.eig.org.uk](http://www.eig.org.uk)

### **Managing safety**

More information on establishing effective management arrangements can be found in the following references:

See the *Health and safety toolbox* website for more information on multi-occupancy workplaces [www.hse.gov.uk/toolbox/index.htm](http://www.hse.gov.uk/toolbox/index.htm)

*Dangerous substances and explosive atmospheres. Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance L138* (Second edition) HSE Books 2013 ISBN 978 0 7176 6616 4 [www.hse.gov.uk/pubns/books/l138.htm](http://www.hse.gov.uk/pubns/books/l138.htm)

*The health and safety toolbox: How to control risks at work* HSG268 HSE Books 2013 ISBN 978 0 7176 6447 4 [www.hse.gov.uk/pubns/books/hsg268.htm](http://www.hse.gov.uk/pubns/books/hsg268.htm)

*Managing for health and safety* website [www.hse.gov.uk/managing/](http://www.hse.gov.uk/managing/)

*Managing for health and safety* HSG65 (Third edition) HSE Books 2013 ISBN 978 0 7176 6456 6 [www.hse.gov.uk/pubns/books/hsg65.htm](http://www.hse.gov.uk/pubns/books/hsg65.htm)

### **Worker involvement**

See the *Worker involvement* website for more information on consulting employees [www.hse.gov.uk/involvement](http://www.hse.gov.uk/involvement)

### **Leadership**

Leadership is particularly important in organisations that manage major hazards such as explosives. More information on leadership in health and safety can be found at [www.hse.gov.uk/leadership](http://www.hse.gov.uk/leadership)

### **Training and competence**

For general advice on health and safety training, see *Health and safety training: A brief guide for employers* Leaflet INDG345(rev1) HSE Books 2012 [www.hse.gov.uk/pubns/indg345.htm](http://www.hse.gov.uk/pubns/indg345.htm)

To find competence-related guidance for a specific industry, task or working environment including National Occupational Standards and Sector Skills Councils, see [www.hse.gov.uk/competence/industry-specific-competence.htm](http://www.hse.gov.uk/competence/industry-specific-competence.htm)

For detailed information on assessing the effectiveness of competence in major hazards industries, see:

*Inspection of Competence Management Systems at COMAH Establishments* (Operational Delivery Guide) COMAH Competent Authority [www.hse.gov.uk/comah/guidance/inspection-competence-management-systems.pdf](http://www.hse.gov.uk/comah/guidance/inspection-competence-management-systems.pdf)

### **Controlling maintenance and permits-to-work**

Further information on controlling maintenance activities and permits-to-work can be found at:

Isolation and permits-to-work [www.hse.gov.uk/safemaintenance/permits.htm](http://www.hse.gov.uk/safemaintenance/permits.htm)

*Guidance on permit-to-work systems: A guide for the petroleum, chemical and allied industries* HSG250 HSE Books 2005 ISBN 978 0 7176 2943 5 [www.hse.gov.uk/pubns/books/hsg250.htm](http://www.hse.gov.uk/pubns/books/hsg250.htm)

### **Managing contractors**

*Using contractors: A brief guide* Leaflet INDG368(rev1) HSE Books 2013  
[www.hse.gov.uk/pubns/indg368.htm](http://www.hse.gov.uk/pubns/indg368.htm)

*Managing contractors: A guide for employers* HSG159 (Second edition) HSE Books 2011 ISBN 978 0 7176 6436 8 [www.hse.gov.uk/pubns/books/hsg159.htm](http://www.hse.gov.uk/pubns/books/hsg159.htm)

### **Topic-based guidance**

Further information on a wide range of explosives safety-related topics can be found at [www.eig.org.uk](http://www.eig.org.uk)

Further information on the control of electrical, electrostatic and electromagnetic hazards and the hazards arising out of surface temperatures of equipment can be found in:

*Guidance for electrical installation and equipment within explosives manufacturing and storage facilities including fireworks* Confederation of British Industry 2009 ISBN 978 0 85201 722 7 [www.eig.org.uk](http://www.eig.org.uk)

Information about the location of cellular radio transmitters is available from the Office of Communications (Ofcom) at [www.sitfinder.radio.gov.uk](http://www.sitfinder.radio.gov.uk)

Further information on protecting people from the effects of explosive events can be found in:

*Protective measures: A guide on measures other than personal protective equipment to protect people in explosives working areas* Confederation of British Industry 2003 ISBN 0 85201 572 0 [www.eig.org.uk](http://www.eig.org.uk)

*Requirements for remote explosives manufacturing facilities* Confederation of British Industry 2005 [www.eig.org.uk](http://www.eig.org.uk)

### **PPE**

For guidance on the effectiveness, selection and use of personal protective equipment for use in explosives operations see:

*Review of Standards for thermal protection PPE in the Explosives Industry* June 2013 RR1002 HSE Books 2014  
<http://www.hse.gov.uk/research/rrhtm/rr1002.htm>

*Guidance on Personal Protective Equipment (PPE) for Explosives Operations* Confederation of British Industry 2014 [www.eig.org.uk](http://www.eig.org.uk)

### **Fire safety**

Fire safety [www.hse.gov.uk/toolbox/fire.htm](http://www.hse.gov.uk/toolbox/fire.htm)

*Guidance on Fire Precautions at Explosives Sites Licensed by the Health & Safety Executive: Fire Precautions at Licensed Explosives Sites* Confederation of British Industry 2013 [www.eig.org.uk](http://www.eig.org.uk)

### **Planning for emergencies**

Emergency procedures [www.hse.gov.uk/toolbox/managing/emergency.htm](http://www.hse.gov.uk/toolbox/managing/emergency.htm)

*Emergency planning for major accidents: Control of Major Accident Hazards Regulations 1999* HSG191 HSE Books 1999 ISBN 978 0 7176 1695 4  
[www.hse.gov.uk/pubns/books/hsg191.htm](http://www.hse.gov.uk/pubns/books/hsg191.htm)



### ***Separation distances***

For further information on how HSE applies separation distances to the sites it licences see:

*Use of structural justification to underpin HSE explosives licence* Specialised Industry Report Confederation of British Industry 2011 [www.eig.org.uk](http://www.eig.org.uk)

*Guidance on occupied buildings on licensed explosives sites* Confederation of British Industry 2013 [www.eig.org.uk](http://www.eig.org.uk)

### ***Disposal***

Further information on the safe disposal of explosives and explosives-contaminated items can be found in:

*Guidance for the Safe Management of the Disposal of Explosives* Confederation of British Industry 2007 [www.eig.org.uk](http://www.eig.org.uk)

*The Safe Disposal of Damaged Fireworks* Fireworks Enforcement Liaison Group, Chief Fire Officers Association 2009 [www.cfoa.org.uk/11893](http://www.cfoa.org.uk/11893)

### ***Decontamination and vacating an explosives site***

*Management Guidance for the Safe Decommissioning of Explosives Sites: A guide to the safe decommissioning of Explosives Sites, the relevant legislation, and the techniques used for decontamination* Confederation of British Industry 2003

### ***Application of health and safety legislation offshore***

*Application of health and safety law offshore: Guidance on the legislative changes introduced by the Health and Safety at Work etc Act 1974 (Application outside Great Britain) Order 2013* Offshore Information Sheet 1/2013 [www.hse.gov.uk/offshore/legislative-changes.pdf](http://www.hse.gov.uk/offshore/legislative-changes.pdf)

## Further information

For information about health and safety, or to report inconsistencies or inaccuracies in this guidance, visit [www.hse.gov.uk/](http://www.hse.gov.uk/). You can view HSE guidance online and order priced publications from the website. HSE priced publications are also available from bookshops.

This guidance can be found online at: [www.hse.gov.uk/pubns/books/l150.htm](http://www.hse.gov.uk/pubns/books/l150.htm).

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