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Fire protection of laboratories

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CONTENTS

SCOPE

These recommendations are applicable to all laboratories. Losses caused by fire, explosion, ingress of water, intruders and consequential losses are considered in addition to life safety. Health hazards and the reactions of chemicals, biohazards and radioactive materials are not considered in this document.

This publication provides recommendations for fire safety in laboratories of all sizes from small rooms to multi-million-pound facilities. The guidance is directed to property protection and business continuity, as well as the protection of life.

The recommendations are of a general nature and are aimed principally at the 'responsible person' for fire safety in the laboratory (as defined in the Regulatory Reform (Fire Safety) Order 2005 and the equivalent legislation applying in Scotland and Northern Ireland (refs 1 to 4)). The majority of laboratories will be used for quality control, research and development, or experimental studies in a particular branch of science or engineering. Others may be specialist facilities, such as pathological, animal, electronic, hydraulic, radioactive, biological or mechanical laboratories. The recommendations also apply to teaching facilities in hospitals, schools and colleges where large numbers of relatively inexperienced people may undertake a range of experiments under supervision.

Because of the wide application of these recommendations they are written to enable general application and further specific guidance should be referred to for additional information regarding chemicals, equipment or processes being employed. This is particularly important in those areas where radioactive or pathogenic materials may be handled.

SYNOPSIS

These recommendations are intended to be of a general nature to assist when planning the construction, formulating the fire safety strategy and managing the fire protection of laboratories in all scientific and engineering disciplines.

DEFINITIONS

Classification of hazardous areas

(This classification refers to areas in which open processes are carried out; areas in which closed processes are undertaken should be subject to a risk assessment in accordance with BS EN 60079-10: 2003 (ref. 5).)

Zone 0: An area in which an explosive gas atmosphere is present continuously or for long periods.

Zone 1: An area in which an explosive gas atmosphere is likely to occur in normal operation.

Zone 2: An area in which an explosive gas atmosphere is not likely to occur in normal operation and, if it does occur, will persist for a short period only.

Compartment walls

A wall conforming to the requirements for compartment walls contained in the FPA **Design guide: Fire protection of buildings: Core document: Compartmentation** (ref. 6). Such walls shall be constructed of non-combustible materials and have a fire resistance of not less than 120 minutes.

Compartment floors

A floor conforming to the requirements for compartment floors contained in **Design guide: Fire protection of buildings: Core document: Compartmentation** (ref. 6). Such floors shall be constructed of non-combustible materials and have a fire-resistance of not less than 120 minutes.

Fire doors and shutters

A door or shutter conforming to the FPA **Design guide: Fire protection of buildings: Protection of openings and service penetrations from fire** (ref. 7). Such doors and shutters shall be capable of achieving at least 120-minutes' fire resistance with respect to integrity.

Fire resistance

The ability of an element of building construction to withstand exposure to a standard time/temperature and pressure regime (refs 8 to 10) without loss of its fire separating function, load-bearing function, or both for a given time.

Flammable liquid

A liquid as defined for highly flammable liquid (see below) but with a flashpoint up to 55ºC.

Highly flammable liquid

The definition of a 'highly flammable liquid' in the Fire Certificates (Special Premises) Regulations 1976 has been amended in the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 (ref. 11) as follows:

'Highly Flammable Liquid' means any liquid, liquid solution, emulsion or suspension, other than aqueous ammonia, liquefied flammable gas, and liquefied petroleum gas which:

(a) when tested in accordance with Part A.9 of the Annex to the Directive has a flashpoint of less than 32ºC…;

(b) when tested at 50ºC using the procedure referred to in Appendix B to the 'Approved requirements and test methods for the classification and packaging of dangerous goods for carriage' [ref. 12] with a heating time of 60 seconds supports combustion…'

Non-combustible

A non-combustible material is one which satisfies the requirements for non-combustibility when tested in accordance with BS 476-4: 1970 (ref. 13) or BS EN ISO 1182 (ref. 14).

Oxidising substances

Substances that react with other materials, either at room temperature or with the application of heat, to cause a type of chemical reaction often involving the bonding of oxygen atoms. Oxidation reactions may be exothermic, proceeding sufficiently vigorously to cause explosions. Oxidising materials, however, are not necessarily themselves combustible.

Organic peroxides

Substances that contain carbon, hydrogen and oxygen may be considered derivatives of hydrogen peroxide. Organic peroxides are thermally unstable substances which may exhibit exothermic decomposition. Organic peroxides tend to:

- be liable to explosive decomposition;
- burn rapidly;
- be sensitive to impact or friction; and
- react dangerously with other substances.

INTRODUCTION

Although laboratories differ widely in their construction and application, two general types of laboratory are encountered:

- physical laboratories are used for testing the size, shape, weight, strength, corrosion resistance and other physical and mechanical qualities of materials subject to wear and tear. In general these tend to present fewer fire hazards than:
- chemical, pharmaceutical and bio-science laboratories where qualitative and quantitative analyses are undertaken to determine the composition of a material or product.

Generally, the hazards encountered in laboratories are low to moderate because of the relatively small quantities of materials being involved. However, some facilities may present serious fire hazards from:

- excessive quantities of flammable or reactive chemicals;
- uncontrolled ignition sources; and
- inadequate procedures or equipment for handling hazardous materials.

There is often a need for controlled conditions to achieve precise measurements and these can assist in reducing the hazards.

As well as the life risk associated with fires and explosions in laboratories, many of these facilities will contain sophisticated equipment of high asset value and damage to these may have a significant impact on the continuing smooth running of the business operations of the organisation concerned or even those in neighbouring premises. In order to maintain business continuity, it is vital that in all laboratories an appropriate fire safety strategy is developed and adopted with staff receiving detailed instruction in the actions that they should take in an emergency.

Incidents are thus measured not only in the direct material loss of the building and contents, but also in the loss of business earnings and productive time. The replacement value of the building and its contents must be taken into account when considering measures necessary to address the fire risk assessment and not only the time necessary to construct or find new premises but the time necessary to duplicate research or production that has been carried out in order to replace lost samples and essential data that will be needed before any new work can be undertaken.

A significant fire loss can seriously undermine international collaboration on projects and have an impact on marketing and hence the income to be derived from new products. A loss may also affect customers' or potential future research partners' perception of the organisation and not accurately reflect their technical and other achievements.

In addition to the time necessary to rebuild and re-equip the facility, regulatory revalidation associated with the reinstatement of some processes can delay the resumption of normal operations for months or years, depending on the regulatory body and process requirements. The likelihood of an incident occurring must therefore be minimised and if a fire does occur the quicker it is under control, the more likely it is that disruption to business will be minimised and normal operations will recover.

The general fire precautions should be the subject of a fire risk assessment by a 'responsible person' in compliance with the Regulatory Reform (Fire Safety) Order 2005 or equivalent legislation in Scotland and Northern Ireland (refs 1-4). Where chemicals are present, an assessment may also need to be undertaken in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref. 11).

This legislation requires any workplace where a dangerous substance is either present or liable to be present to be subject to a suitable assessment of the risks and an action plan necessary to eliminate or reduce the fire hazards to be formulated. Where an explosive atmosphere may occur, the workplace must be classified into zones based on the frequency and duration of the explosive atmosphere and the zones checked by a competent person. This should be undertaken in accordance with BS EN 60079-10: 2003: **Electrical apparatus for explosive gas atmospheres: Classification of hazardous atmospheres** (ref. 5).

The fire risk assessment should be subject to periodic review but should always be reviewed at the planning stage of a new research project.

Other relevant legislation such as the Control of Substances Hazardous to Health Regulations 2002 (as amended) (COSHH Regulations, ref. 15) and the Ionising Radiation Regulations 1999 made under the Health and Safety at Work etc Act 1974 (refs 16 and 17) should be noted, in addition to various environmental requirements (refs 18 to 23).

RECOMMENDATIONS

1. Construction

1.1 Buildings should comply with the FPA **Design guide: Fire protection of buildings: Essential principles** (ref. 24) in addition to Approved Document B to the Building Regulations 2000 (ref. 25), and should incorporate compartment walls and floors where appropriate. Consideration should be given to fire-resistant construction, compartmentation, protected stairways and lifts, and the absence of combustible linings.

1.2 During the planning stage an outline assessment of the work to be undertaken should consider the type and number of potential hazards that may be present, the replacement value of the equipment and the area or location in relation to surrounding occupancies. Property protection and business continuity considerations may indicate that increased protection should be provided in some, or all, areas of the premises.

1.3 Where the fire risk assessment identifies especially hazardous tests or experiments, these should only be undertaken in separate, specially designed laboratories, preferably detached from the main laboratory or facility building. Where detached accommodation is not available, compartment walls providing at least 120-minutes' fire resistance should be constructed between the high-risk areas and other parts of the premises and there should be no doorways providing direct access between these areas.

1.4 All laboratory/prep room areas should be separated by a compartment wall from:

- process plant;
- storage areas;
- areas used for the storage of highly flammable and flammable liquids;
- gas cylinder stores;
- stores of radioactive materials;
- stores of biological samples (including pathogens); and
- areas used for the storage of combustible waste materials.

1.5 Fire-rated glazing should be used in glazed screens; in all cases, these should be compatible with the fire compartmentation of the building. Glazing onto escape routes should be minimised to avoid radiated heat compromising the route and to eliminate fragments of glass causing a hazard in the event of an explosion.

1.6 Structural steelwork should be fire-protected to provide 120-minutes' fire resistance to prevent, in the event of a fire, premature collapse of main building elements.

1.7 Small individual rooms such as offices within laboratories should be of non-combustible construction; any prefabricated panels incorporated into the structure must have non-combustible cores. These rooms should be located so that, as far as possible, there is a route from the room to a final exit from the laboratory that does not pass through a high fire hazard area.

1.8 The travel distance for means of escape should be subject to a suitable and sufficient risk assessment but wherever possible travel should always be available in more than one direction. Exits that lead directly to a place of safety (that is, outside of the building) are the preferred option.

1.9 Multiple means of escape must be considered where a high explosion hazard exists or where a fume cupboard or extraction hood is located adjacent to an escape door, or where a gas cylinder or flammable liquid is in use in there.

1.10 Emergency escape lighting in accordance with BS 5266-1 (ref. 26) shall be installed on all escape routes and in areas where high hazard processes are being undertaken. All escape routes shall be adequately signed.

1.11 Where the fire risk is assessed as being of a 'low' or 'normal' level (such as where simple quality assurance tests are carried out or mechanical properties of materials are being investigated) the requirements for the building construction may be reduced from that indicated in paragraph 1.3 with the agreement of the local building authority and the insurer of the premises.

1.12 Similarly, a reduced level of protection may be acceptable in areas fitted with a fixed fire suppression system, such as an automatic sprinkler installation or a total gas flooding system. In the case of sprinklers, this will only be the case where water pressures and flow rates are suitable, following a risk assessment and the approval of the local authority and the insurer of the premises. Sprinkler installations should be installed and maintained in compliance with the **LPC Rules for automatic sprinkler installations incorporating BS EN 12845** (ref. 27).

1.13 Internal and external glazing of laboratories where explosion hazards may be present is a potential threat to personnel. These features should thus be minimised and the glazing specified with care.

2. Services and equipment

2.1 Electrical

2.1.1 An assessment of work areas and storage areas should be carried out and appropriate 'zones' assigned in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 and BS EN 60079-10 (refs 11 and 5).

2.1.2 All electrical installations should conform to BS 7671: **Requirements for electrical installations** (ref. 28)**.**

2.1.3 All electrical circuits in laboratories should be protected by residual current devices.

2.1.4 A sufficient number of switched sockets should be provided at required locations to avoid the need for extension leads. Power-on indicator lights should be provided on sockets and provision should be made for emergency shutdown of power in laboratories where high hazard processes are being carried out.

2.1.5 The use of a portable multi-outlet socket block should only be permitted if the device is equipped with its own residual current device. Care should be taken to ensure that the maximum current capacity of the plug fitted to the device is not exceeded.

2.1.6 Electrical wiring should be certified as suitable for use within the zone in which a flammable liquid or gas is being stored or processed (ref. 5) as determined by a risk assessment.

2.1.7 All items of electrical equipment, such as fridges, stirrers and vacuum pumps, must be suitable for use in the zone in which they are to be located. Care must be taken when moving equipment from zone to zone.

2.1.8 Portable electrical equipment must be inspected periodically in compliance with the provisions of the Electricity at Work Regulations 1989 (ref. 29) and the guidance in HSG 107 (ref. 30).

2.1.9 Electrical installations and fixed equipment should be tested and inspected periodically in compliance with BS 7671 (ref. 28). All electrical installations and maintenance should also comply with BS EN 60079-14 (ref. 31).

2.1.10 Electrical services passing through compartment walls and compartment floors should be protected in accordance with the FPA Design guide: **Fire protection of buildings: Protection of openings and service penetrations from fire** (ref. 7).

2.2 Space heating and air conditioning

2.2.1 No type of portable space heater is considered suitable in a laboratory environment due to the possible tripping, overturning, and ignition hazards it presents.

2.2.2 Any ducted air-handling system serving the laboratory facility should be a self-contained system kept entirely separate from other air-handling systems serving the remainder of the building. This is to reduce hazards from both incoming and outgoing contamination and fire spread.

2.2.3 Separate heating, ventilation and air conditioning systems should be installed in laboratory fire compartments that house high value or business critical equipment.

2.2.4 Fresh-air intakes and outlets should be carefully sited to avoid ingress of undesirable contaminants into the

laboratory or the release of noxious materials into the atmosphere outside.

2.2.5 Ducting should:

- be of non-combustible construction;
- be plastic lined where corrosion resistance is required;
- have limited directional changes;
- take as short a route as possible; and
- be arranged so that vapours cannot condense and collect at low points in the ductwork.

2.2.6 Exhaust air should pass through an efficient filter system, especially where infectious, toxic or radioactive materials could be discharged.

2.2.7 Ducts passing through compartment walls and floors should be fitted with automatic fire dampers to maintain the fire separation. Dampers should operate automatically by means of a fusible link, or preferably by smoke detectors if circumstances are appropriate.

2.2.8 Where an automatic fire detection system is to be used in an area where there are fume cupboards or in an air-conditioned environment, the air-movement characteristics need careful study to ensure that the detector configuration will operate efficiently with the air-handling systems both on and off. In a similar manner, care must also be taken when installing automatic fire detection in category III laboratories (clean rooms and other areas where positive pressure is maintained).

2.2.9 The effects of air movement resulting from the use of fume cupboards and similar equipment should also be assessed to ensure that effective operation of heating and ventilation systems are not compromised.

2.2.10 All systems and ducts should be installed and maintained in accordance with BS 9999: 2008: **Code of practice for fire safety in the design, management and use of buildings.**

2.2.11 All laboratories where constant hazardous or toxic atmospheres exist (including microbiological laboratories) should have a negative pressure to ensure that this does not leak into the rest of the building. The need for pressure differentials to be provided in other laboratories should be determined by a risk assessment.

2.3 Fume cupboards (including glove boxes)

2.3.1 Fume cupboards should be constructed from fire-resistive materials suitable for their intended application. Material selection should reflect the most aggressive environment likely to be encountered during the lifetime of the fume cupboard, and should be non-combustible wherever practicable.

2.3.2 Fume cupboards and glove boxes operated in series should be provided with separate ducting and fire separation between adjacent units.

2.3.3 In order to protect the environment, fume cupboards should not be regarded as convenient extraction routes for waste toxic or flammable gases or vapours. The design of the equipment should cater for the removal of these by appropriate means such as scrubbing or chemical absorption.

2.3.4 Fume cupboards should not be used as storage places for flammable substances, oxidising agents or other chemicals.

2.3.5 It should be recognised that there is likely to be an ignition risk with the introduction of some portable electric equipment that is not designed to be used in a fume cupboard environment. It must be ensured that all electrical equipment is suitable for the hazard zone in which it is to be used (ref. 5).

2.3.6 Exhaust fan motors should not be located within ducting. Their controls should be located outside the fume cupboard together with the controls for gases and other services unless they are appropriate for use in the hazard zone.

2.3.7 Airflow indicators should be installed. If not, procedures should be in place to ensure inspections of fan units (and in particular the drive belts) are performed regularly and the face velocities are measured to demonstrate that the cupboard is fit for purpose.

2.3.8 All fume cupboards and glove boxes should be serviced and maintained, to include face velocity and containment requirements, in accordance with BS EN 14175 (ref. 33) and the manufacturer's instructions.

2.4 Hot plates, ovens, furnaces, and heating equipment

2.4.1 Space heating equipment should not be installed in or adjacent to areas where flammable liquids are handled.

2.4.2 Free-standing equipment should be placed on heat-resistant surfaces. Built-in equipment should have appropriate insulation and ventilation.

2.4.3 Ovens and furnaces should be fitted with overriding non-automatically resetting thermal cut-out devices, in addition to normal thermostats. This is particularly important where the oven or furnace is left operating unattended.

2.4.4 Solvent distillation utilising portable heating mantels and similar equipment should not be left unattended.

2.4.5 Wherever possible, hot surfaces should not be present in the vicinity of hazardous materials such as hydraulic fluids.

2.4.6 Whenever a laboratory is left unattended, all heated equipment should be checked to ensure that it has not been left on. If it is required that such equipment be left operating, suitable fire protection measures, such as an automatic fire suppression system, should be provided for the area.

2.5 High-value equipment

2.5.1 High-value equipment, such as computers, spectrometers, electron microscopes and similar equipment which could easily be damaged by liquids, should be protected from water or chemical spillages occurring on the floor above. While the provision of non-combustible canopies may assist, it is better to re-route water and heating pipes around the room perimeter if possible. Welded joints, as opposed to compression fittings, should be used in all plumbing. Caution should be exercised where false ceilings are installed as pipework is often hidden from view. Alternatively, the floor over the equipment should be made impervious to liquids.

2.5.2 Electronic data processing equipment should be installed in accordance with RC3: **Loss prevention in electronic equipment installations, Part 1: Fire prevention** (ref. 34). These recommendations may also be applicable in respect of high-value laboratory equipment other than electronic data processing equipment.

3. Flammable gases and liquids

3.1 Piped services

3.1.1 Liquids and gases should be delivered from cylinders or bulk tanks, preferably at a safe location outside the building via permanently installed hard metal piping. Quick-acting isolation valves linked to the automatic fire detection system should be installed both at the point of supply and delivery.

3.1.2 Supply and discharge terminals must be clearly and permanently marked at each end and along the pipe run to identify the liquid or gas carried.

3.1.3 Pipelines should be colour-coded throughout their length to comply with BS 1710 (ref. 35). Pipelines should be clearly marked to show the direction of flow of the contents.

3.1.4 Pipelines should take the shortest practical route and be located and adequately supported well clear of heat sources, electric cables, and other services or areas where mechanical damage is possible.

3.1.5 Pipework passing through compartment walls and compartment floors should be protected strictly in accordance with the design guide for the fire protection of buildings (ref. 7).

3.1.6 Further advice on the transportation of highly flammable and flammable liquids in enclosed systems set out in RC20: Part 1 (ref. 36) should be observed.

3.1.7 All pipes, tanks and other metalwork of installations used to store, convey or dispense flammable liquids and gases should be bonded and earthed.

3.2 Gas cylinders

3.2.1 Where liquefied petroleum gas is involved, RC8: **Recommendations for the storage, use and handling of common industrial gases in cylinders including LPG** (ref. 37) should be followed.

3.2.2 Cylinders containing flammable gas should preferably be stored in a secure compound in the open air to enable natural ventilation to disperse any small leaks. If this is not practicable, the cylinders should be in a separate designated building or in a designated storage place within a building provided with suitable high and low level ventilation. Designated buildings and storage places should comply with RC8 (ref. 37).

3.2.3 The total quantity of flammable gases in a laboratory should be kept to the minimum needed for effective operations. Where it is unavoidable to have cylinders containing flammable gases or oxygen inside the laboratory the cylinders must be secured in a vertical position, preferably within a cabinet providing at least 60-minutes' fire resistance. Appropriate hazard warning signs should be displayed prominently on the cabinet.

3.2.4 Acetylene cylinders should not be permitted in a laboratory area. The cylinders should be located in a purpose-built store outside the building with the gas being piped in. Where acetylene is required in an area remote from a gas cylinder store, a cylinder may be secured in a suitable fire compartment designed for this purpose. The cylinder should be conspicuous when entering the area and should not be located in a cabinet. Appropriate hazard warning signs should be displayed in the entrance to the compartment.

3.2.5 The storage area or storage building for gas cylinders should be at least 4m from other buildings and ignition sources. Gas leakage detectors (such as for hydrogen) should be installed in cylinder stores with the alarm monitored in the security control room.

3.2.6 Smoking and naked lights should be prohibited in all flammable gas storage areas and buildings. Permanent warning notices should be prominently displayed at these sites.

3.2.7 Different types of gases should be segregated from each other, particularly flammable gases and oxidising gases. Empty cylinders should not be kept with full cylinders. Gas cylinders should be protected from direct sunlight.

3.2.8 Areas where pyrophoric gases are to be stored or used should be subject to a specific fire risk assessment. The gas should be transported in concentric pipework and a water mist or sprinkler system should be installed to protect the workplace.

3.2.9 Regulators, pipes and pressure valves appropriate to the type of gas to be used should be fitted.

3.2.10 Grease or oil must not be allowed to come into contact with cylinders, their valves or associated equipment. **This is particularly important with cylinders containing oxygen as this gas will react dangerously with grease or oil.**

3.2.11 Where there is the possibility of a gas supply at a higher pressure feeding back into a lower pressure system, suitable back-pressure valves should be installed.

3.2.12 Gas supply valves should be closed when a supply is not required.

3.2.13 Staff should be trained in the moving, connection and disconnection of gas cylinders. This should include instruction in the hazards associated with the processes, for example, the reason why oxygen cylinder couplings should not have threads greased.

3.3 Highly flammable and flammable liquids

3.3.1 The quantity of highly flammable and flammable liquids in laboratories and elsewhere on site should be subject to a risk assessment and kept to a minimum.

3.3.2 Such liquids should be stored in purpose-built cabinets or bins providing at least 30-minutes' fire resistance and having integral spillage trays. Cabinets must be clearly marked with hazard warning signs. Ducting to vented cabinets should be of non-combustible construction with a plastic lining.

3.3.3 The maximum size of any container of highly flammable liquid on a bench should not exceed 500ml.

3.3.4 Highly flammable liquids should, wherever practicable, be carried in approved safety containers. If glass containers are necessary for corrosion resistance or to maintain the purity of a liquid, their capacity should not exceed 4.54 litres (1 gallon) and they should be contained in protective carrying containers.

3.3.5 Only refrigerators designed or modified for the storage of flammable liquids are suitable for the purpose. The storage of volatile, flammable liquids in refrigerators from which

the interior light has not been removed has led to serious explosions and thus these appliances should not be used in a laboratory environment (see section 3.3.1).

3.3.6 Bulk supplies should preferably be kept in a separate, non-combustible, suitably marked building; in all cases storage should be in accordance with the principles set out in RC 20: Part 1 (ref. 36).

3.3.7 Whenever possible, experiments using flammable liquids should be carried out in a fume cupboard and on a metal tray to retain the contents of the apparatus should it fracture.

3.3.8 Highly flammable and flammable liquids should not be stored near hazardous materials such as oxidising agents, organic peroxides, strong reducing agents, and strong acids.

3.3.9 A supply of non-combustible absorbent material should be kept immediately available to deal with any spillages of flammable liquid. Staff should be instructed in the use of this material and its safe disposal.

3.3.10 Further guidance for the use, handling and storage of flammable liquids is set out in RC 20: Part 1 and 2 (refs 36 and 38).

3.4 Hazardous chemicals

3.4.1 Adequate attention should be paid to fire and explosion hazards which might arise from the non-compatibility of some chemicals should they become mixed following an accident or breakage.

3.4.2 Compliance with the Control of Substances Hazardous to Health Regulations 2002 (ref. 15) is essential.

3.4.3 Tritium is a radioactive isotope of hydrogen with a half life of over 12 years that poses particular hazard if released and absorbed into the structure of the building. In this case controlled demolition of all or parts of the building may be necessary. Tritium should be kept in a proprietary container and refrigerated.

4. Fire safety management

4.1 General provisions

4.1.1 The laboratory should be the subject of a fire risk assessment in compliance with the Regulatory Reform (Fire Safety) Order 2005 (or equivalent legislation in Scotland and Northern Ireland) (refs 1–4). Where chemicals are present, an assessment may also need to be undertaken in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref. 11).

4.1.2 A complete list and the material safety data sheets of all substances stored or in use on the site should be kept available at all times in accordance with COSHH Regulations (ref. 15).

4.1.3 The premises should be kept clean and tidy and only the minimum daily requirements of hazardous chemicals or goods should be present in the laboratory itself. Bulk stocks should be kept outside or in properly designed storerooms.

4.1.4 When an experiment or research project is finished, the apparatus should be dismantled, cleaned and inspected and the components returned to store or disposed of safely. Similarly, the products of the experiment and any surplus chemicals should be suitably stored or disposed of at this time.

4.1.5 Service ducts or enclosures should be kept clean and not be used for storage or other purposes. The doors should be kept closed and locked and be labelled to this effect.

4.1.6 The shelf life of chemicals and samples should be checked regularly; the interval depending on the ageing qualities of the materials. Any found to be out of date should be disposed of safely. Specialist advice should be sought from the Health and Safety Executive in respect of any substance found or prepared which may be unstable or highly reactive due to their age or conditions of storage.

4.1.7 All plant and equipment should be operated and maintained in accordance with manufacturers' instructions. Records of service history should be kept. Regular and frequent inspections should be made to ensure that all equipment is in safe working order.

4.1.8 A safety committee should be established, particularly in research laboratories, to oversee working practices and to vet any new projects before work starts. It should meet regularly and report to a senior manager with budgetary control for health and safety matters.

4.1.9 For hazardous operations, a written permit-to-work system should be established and strictly implemented to ensure that both the operator and the management are fully aware of the risks and the safeguards to be adopted. Only trained personnel should be allowed to undertake such work, and they must be provided with suitable protective clothing and equipment.

4.1.10 Hazardous experimental work involving pilot plant should be carried out in a special area separated from the remainder of the laboratory by walls constructed entirely of brickwork, masonry or concrete having at least 120-minutes' fire resistance. Any openings should be fitted with self-closing fire doors with 120-minutes' fire resistance; such doors to have been tested and approved by an independent third-party approvals organisation. No doors should connect these areas directly to other parts of the building; all doors should open directly to the outside to minimise contamination by toxic, radioactive or biological materials. Where necessary, suitable provisions should be made to vent an explosion.

4.1.11 There should be an annual audit of the laboratory to ensure that:

- fire and health and safety measures are in place and are used and followed;
- all staff in the area are trained and familiar with the standard operating procedures; and
- all the equipment is in place and maintained as required.

4.2 Waste disposal

4.2.1 The provisions of the Hazardous Waste (England and Wales) Regulations 2005 and associated legislation for England, Wales, Scotland and Northern Ireland (refs 18–22) must be observed.

4.2.2 Waste flammable liquids must not be disposed of via the drains. They should be collected in suitable closed containers and stored in a safe place outside the laboratory pending regular removal from the premises by a specialist waste disposal company. When storing waste liquids caution should be exercised to avoid mixing non-compatible materials.

4.2.3 Other combustible waste materials (for example, filter papers, wiping cloths, and residues) should be deposited in non-combustible lidded receptacles of limited size. Waste should be removed from the laboratory daily and stored outside in locked containers. External waste storage should be at least 10m from buildings and plant.

4.2.4 Waste, unsaturated oils and other reactive materials that may be subject to self-heating should be stored separately in metal containers (with metal lids) at least 10m from the buildings to await disposal.

4.2.5 Waste materials should not be allowed to accumulate; they should be regularly removed from the site.

4.2.6 As cleaners often work in isolation and may not be aware of the possible dangers in a laboratory, it is necessary to give them special training and instruction.

4.3 Welding and other hot-work processes

4.3.1 These processes should only be carried out after written approval by the laboratory manager or the safety adviser, who should stipulate when and how the work shall be carried out.

4.3.2 Arrangements should be subject to a written permit-to-work system in accordance with RC7: **Recommendations for hot work** (ref. 39).

4.4 Overnight use

4.4.1 In some laboratories equipment or processes may be required to operate overnight and unattended.

- Where a routine occurrence and circumstances allow, these should be housed in an area separated from the remainder of the building by brickwork, masonry or concrete walls having at least 120-minutes' fire resistance. Any openings in these walls should be fitted with self-closing fire doors with 120-minutes' fire resistance; such doors to have been tested and approved by an independent third-party approvals organisation.
- Where a small area of a large laboratory is to be used on occasion overnight for an unattended experiment, it should be subject to a risk assessment and the production of documented emergency procedures. Copies of these procedures should be given to the security staff and be posted on the door to the laboratory. The procedures should include the actions to be taken in the event of fire, spillage or leakage of water. Firefighting media suitable for use and details of any personal protective equipment to be worn should also be included.

4.4.2 The installation of an automatic fire detection and alarm system and/or an automatic fire suppression installation should be considered as part of the fire risk assessment undertaken during the planning stage of the project

4.4.3 Equipment left on overnight and unattended should be recorded on a permit to work system.

4.5 Smoking, eating and drinking

4.5.1 Smoking should be prohibited in all external storage areas. This is particularly important where toxic, flammable and corrosive liquids and gases and high-value equipment are present. Appropriate notices should be prominently displayed.

4.5.2 Where a smoking shelter is provided it must be:

- outside the building;
- subject to a specific fire risk assessment;
- constructed of non-combustible materials;
- where practicable, sited at least 10m away from any building or structure, including gas cylinder and flammable liquid stores;
- provided with suitable metal ashtrays and a separate metal waste bin with a fitted metal lid; and
- provided with a suitable fire extinguisher.

4.5.3 The immediate area around the shelter and the shelter itself should be kept clear of combustible materials including windblown debris and vegetation.

4.5.4 Raised, slatted floors or decking should not be used and concealed or semi-open spaces should be sealed to ensure combustible debris cannot accumulate beneath the shelter.

4.5.5 The use of combustible curtains, canopies and drapes to protect smokers from the elements must be avoided.

4.5.6 In no circumstances should the shelter be sited near:

- windows;
- ventilation intakes or extracts;
- entrances and exits from the premises;
- hazardous materials;
- waste storage containers (such as skips or bins); or
- beneath a canopy or low slung eaves.

4.5.7 Areas where smoking is allowed but no shelter is provided must be free of combustible materials and be equipped with firefighting equipment, metal ashtrays and a separate metal waste bin with a fitted metal lid.

4.5.8 A 'no smoking' policy must be established in outside areas where fire hazards exist. Such areas may include refuse and storage areas containing combustible materials, flammable liquids (including refuelling supplies), gas cylinders, foam plastics, fibreboard and timber. 'NO SMOKING' notices must be displayed prominently in these areas.

4.6 Water Damage

4.6.1 Buildings should be maintained in good repair and gutters and downpipes cleaned out at least once a year. Roofs need to be checked annually to ensure that they are

watertight and that roof coverings are securely fixed in place. Flat felt roofs have a limited life span (usually about 10 years) and need to be checked carefully for splits or blisters in the felt covering, particularly at or close to joints. Where they show signs of wear, it is better to replace them rather than risk water ingress at a later stage.

4.6.2 Water pipes, drains and similar services should be routed so as to be well away from, and not pass directly over, sensitive, costly or business critical equipment.

4.6.3 Computers and other high-value equipment should not be located in basements or places where they could be affected by flooding. Where this is unavoidable the equipment should be installed above floor level and a small pit or sump with an electric pump should be considered. (See also paragraph 3.5.1.)

4.6.4 Tank and cistern overflows should discharge to safe places. With chiller systems, the drip tray must be of sufficient capacity and provided with a drain hole large enough not to become blocked.

4.6.5 Freezing should be avoided by setting central heating controls to maintain a minimum temperature of 4ºC inside the premises. Where this is not possible and in outside areas trace heating and lagging will be necessary.

4.6.6 All vulnerable reactants, products and other stored materials should be kept off the floors on shelving, racks, pallets, or dunnage.

5. Fire protection

5.1 Portable fire extinguishers should be installed in accordance with BS 5306-8 (ref. 40) and serviced and maintained in compliance with BS 5306-3 (ref. 41). Where flammable liquids are in use, no person should have to travel more than 20m in order to reach an extinguisher.

5.2 Rooms containing high-value computer, diagnostic, test or analytical equipment should be provided with a fixed gas fire suppression system triggered by smoke detectors configured for coincidence connection. The suppression system should be installed and maintained according to the installer's instructions. The automatic fire detection and alarm systems installed in these areas should comply with BS 6266 (ref. 42). Insurers normally require the gas fire suppression system to meet the requirements of LPS 1230 (ref. 43).

5.3 Glove boxes and similar enclosures where access is difficult, and/or where flammable or highly flammable materials are handled, should be provided with a fixed extinguishing system. Systems designed for in-cabinet protection of electronic equipment may be considered for these areas (ref. 44). (Oxygen-enriched or pressurised chambers require special consideration.)

5.4 Where a fixed fire suppression system is installed, means should be provided to shut down any exhaust or ventilation systems and to seal any openings before any gas is discharged. Operation of the system should also result in automatic shut down of gases and supply of reactants to the equipment (other than cooling systems).

5.5 For larger laboratories, consideration should be given to the installation of automatic sprinkler installations and automatic fire detection and alarm systems in accordance with the **LPC Rules for automatic sprinkler installations incorporating BS EN 12845 and BS 5839-1** (refs 27 and 45 respectively). Care should be taken not to install a water extinguishing system where the chemicals stored are liable to react with the firefighting water.

5.6 All employees should be given basic fire training covering at least the following:

- actions to take in an emergency;
- how to raise the alarm;
- how to call the fire brigade;
- how to shut down hazardous processes in an emergency; and
- how to escape in a safe manner.

Selected staff should receive:

- additional training so as to be able to act as fire wardens;
- practical instruction in the use of the fire extinguishers; and
- training in clearing spillages of hazardous materials.

6. Security

6.1 The threat of deliberate fire raising is an important element of the fire risk assessment undertaken for the premises in compliance with the Regulatory Reform (Fire Safety) Order 2005 (ref. 1) and should receive serious attention.

6.2 Site security against intruders should be compatible with:

- the values at risk;
- the nature of the contents (including information media and data accrued from long research projects);
- the location of the laboratory;
- the history of crime in the area;
- the post loss history of the site; and
- the nature of the work undertaken (whether it is likely, for example, to arouse hostile reaction from organised groups or people).

6.3 Intruder alarms should be installed and maintained to BS EN 50131 (ref. 46) or other recognised international standard under contract by an installer who is registered with the National Security Inspectorate (NSI) or the Security Systems and Alarms Inspection Board (SSAIB), and who is acceptable to the police authority. The installation should meet insurers' requirements, and needs to be designed specifically for each location.

6.4 On larger sites, security staff should be employed outside of working hours to check all parts of the site. Where a contractor is to be engaged, a check should be made that the security company is reputable and experienced and approved by an independent inspection body such as the National Security Inspectorate (NSI).

6.5 Clocking points, or similar means of recording the patrols, should be provided. Where a single security person is present, arrangements should be such that cross checks are made every hour with another site to confirm that all is well.

6.6 Security lighting and the provision of closed-circuit television should be considered as important elements of the security strategy. CCTV systems should be installed by an NSI or SSAIB approved installer.

6.7 Security staff should be made aware of any experiments or production processes taking place outside working hours so that special checks may be made to ensure that everything is in order. Security personnel should have instructions on what to do in an emergency. Otherwise, they should ensure during their patrols that all services are suitably isolated and that all doors and windows are secure.

6.8 Laboratory access should be restricted to named persons only, and barred to others by means of suitable controls such as keying, proximity or magnetic card readers and so on.

6.9 At all entry points, suitable warning notices should be posted to warn of flammable, toxic, radioactive, laser or other hazards.

7. Contingency planning

7.1 The guidance set out in **Business resilience: A guide to protecting your business** published by the FPA (ref. 47) and BS 25999: **Business continuity management** (ref. 48) should be adopted.

7.2 Where work carried out in the laboratory is a business critical operation or involves toxic, biohazard or radiological materials, a crisis management plan should be devised and comprehensively tested on a regular basis. Following the exercises, the plans should be amended as necessary to ensure that appropriate staff can be made available to provide advice to the emergency services and assist their colleagues to ensure that business operations return to normal expeditiously and in a controlled and safe manner.

7.3 Fire-resisting safes, data safes and fire-resisting cabinets are adequate to protect data on a short-term basis while waiting for 'backing up' to main files. But they should not be seen as a substitute for a regime of frequent and more substantive 'backing up' of data files and the secure storage of the information off site in another building or safe location away from the laboratory.

7.4 Samples necessary for historical records, trial evaluations and so on should be kept in a purpose-built store room having at least 120-minutes' fire resistance and/or stored off site.

7.5 Location of essential gas and water stop valves, main switches, drainage gullies, manholes and so on should be known to all staff who may have to operate these in an emergency, and to the public fire brigade on their familiarisation visits.

7.6 The locations of shut-off points for services, stop valves for sprinkler systems and other control systems for emergency installations should be indicated on a plan of the site provided for the fire brigade. These plans are best located at the entrance to the facility adjacent to the fire alarm indicator and control panel. The locations of fire hydrants on or near the site should also be marked on these plans.

7.7 A 'salvage team' should be established to plan and implement effective responses to a range of possible incidents. They should be able to identify key equipment or contents that will require special or early treatment, decide on what emergency equipment should be purchased or hired to minimise the damage, and set up the necessary programme for future training and exercises. If damage is likely to spread beyond the site, joint assistance schemes should be set up in liaison with neighbouring companies and local authorities.

7.8 A management team should be set up to look into aspects of recovery from a major fire or explosion. They should investigate, at least the following:

- replacement times for buildings, equipment, and contents;
- whether alternatives are available more quickly and, if so, at what cost;
- whether help can be obtained from other laboratories; and
- the effect on production, turnover or research programmes.

The team should then devise ways to reduce the impact of a major loss. Such schemes should be regularly updated and, if possible, a tabletop exercise should be carried out.

8. Checklist

8.1	Construction	Yes	No	N/A	Action required	Due date	Sign on completion
8.1.1	Does the building comply with the FPA **Design guide: Essential principles in addition to Approved Document B to the Building Regulations 2000**, and incorporate compartment walls and floors where appropriate? (1.1)						
8.1.2	During the planning stage was an outline assessment of the work to be undertaken made, considering the type and number of potential hazards that may be present, the replacement value of the equipment and the area or location in relation to surrounding occupancies? (1.2)						
8.1.3	Where the fire risk assessment identifies especially hazardous tests or experiments, are these only undertaken in separate, specially designed laboratories, preferably detached from the main laboratory or facility building? (1.3)						
8.1.4	Are all laboratory/prep room areas separated by a compartment wall from high fire hazard areas? (1.4)						
8.1.5	Is fire-rated glazing compatible with the fire compartmentation of the building used in glazed screens? (1.5)						
8.1.6	Is structural steelwork fire-protected to provide 120-minutes' fire resistance so as to prevent premature collapse of main building elements in the event of a fire? (1.6)						
8.1.7	Are small individual rooms such as offices within laboratories of non-combustible construction and located so that there is a route from the room to a final exit from the laboratory that does not pass through a high fire hazard area? (1.7)						
8.1.8	Is travel from the laboratory available in more than one direction from all parts of the laboratory? (Ideally, with exits that lead directly to a place of safety.) (1.8)						
8.1.9	Are multiple means of escape available where a high explosion hazard exists, where a fume cupboard or extraction hood is located adjacent to an escape door, or where a gas cylinder or flammable liquid is in use? (1.9)						
8.1.10	Is emergency escape lighting in accordance with BS 5266-1 installed on all escape routes and in areas where high hazard processes are being undertaken and are all escape routes adequately signed? (1.10)						
8.1.11	Where the fire risk is assessed as being of a 'low' or 'normal' level, have the local building authority and the insurer of the premises indicated their agreement to any requirements for the building construction to be reduced from that indicated in paragraph 2.3? (1.11)						
8.1.12	Have areas where there is a reduced level of protection been fitted with a fixed fire suppression system, such as an automatic sprinkler installation or a total gas flooding system, following a suitable risk assessment and the approval of the local authority and the insurer of the premises? (1.12)						
8.1.13	Have areas of internal and external glazing of laboratories where explosion hazards may be present been minimised and the glazing specified with care? (1.13)						

8.2 Services and equipment	Yes	No	N/A	Action required	Due date	Sign on completion
8.2.1 Electrical						
8.2.1.1 Has an assessment of work areas and storage areas been carried out and appropriate 'zones' assigned in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 and BS EN 60079-10? (2.1.1)						
8.2.1.2 Do all electrical installations conform to the current edition of the BS 7671? (2.1.2)						
8.2.1.3 Are all electrical circuits in laboratories protected by residual current devices? (2.1.3)						
8.2.1.4 Have a sufficient number of switched sockets been provided at required locations with power-on indicator lights provided on sockets and provision for emergency shutdown of power where high hazard processes are being carried out? (2.1.4)						
8.2.1.5 Is the use of a portable multi-outlet socket block only permitted if the device is equipped with its own residual current device? (2.1.5)						
8.2.1.6 Has the electrical wiring been certified as suitable for use within the zone in which a flammable liquid or gas is being stored or processed as determined by a risk assessment? (2.1.6)						
8.2.1.7 Are all items of electrical equipment, such as fridges, stirrers and vacuum pumps, suitable for use in the zone in which they are located? (2.1.7)						
8.2.1.8 Is portable electrical equipment inspected periodically in compliance with the provisions of the Electricity at Work Regulations 1989 and the guidance in HSG 107? (2.1.8)						
8.2.1.9 Are electrical installations and fixed equipment tested and inspected periodically in compliance with BS 7671 and is maintenance in compliance with BS EN 60079-14? (2.1.9)						
8.2.1.10 Are electrical services passing through compartment walls and compartment floors protected in accordance with the FPA ***Design guide: Fire protection of buildings: Protection of openings and service penetrations from fire***? (2.1.10)						
8.2.2 Space heating and air conditioning						
8.2.2.1 Is the laboratory free of portable heaters? (2.2.1)						
8.2.2.2 Is any ducted air-handling system serving the laboratory facility a self-contained system kept entirely separate from other air-handling systems serving the remainder of the building? (2.2.2)						
8.2.2.3 Are separate heating, ventilation and air conditioning systems installed in laboratory fire compartments that house high value or business critical equipment? (2.2.3)						

	Yes	No	N/A	Action required	Due date	Sign on completion
8.2.2.4 Are fresh-air intakes and outlets carefully sited to avoid ingress of undesirable contaminants into the laboratory or the release of noxious materials into the atmosphere outside? (2.2.4)						
8.2.2.5 Is ducting of non-combustible construction, designed to have limited directional changes, take as short a route as possible and arranged so that vapours cannot condense and collect at low points in the ductwork? (2.2.5)						
8.2.2.6 Does exhaust air pass through an efficient filter system, especially where infectious, toxic or radioactive materials could be discharged? (2.2.6)						
8.2.2.7 Where ducts pass through compartment walls and floors are they fitted with suitable automatic fire dampers to maintain the fire separation? (2.2.7)						
8.2.2.8 Where an automatic fire detection system is used in an area where there are fume cupboards or in an air-conditioned environment, have the air-movement characteristics been carefully studied to ensure that the detector configuration will operate efficiently with the air-handling systems both on and off? (2.2.8)						
8.2.2.9 Have the effects of air movement resulting from the use of fume cupboards and similar equipment been assessed to ensure that effective operation of heating and ventilation systems are not compromised? (2.2.9)						
8.2.2.10 Are all ventilation and air conditioning systems and ducts installed and maintained in accordance with BS 5588-9? (2.2.10)						
8.2.2.11 Do all laboratories where constant hazardous or toxic atmospheres exist (including microbiological laboratories) should have a negative pressure to ensure that this does not leak into the rest of the building? (2.2.11)						
8.2.3 Fume cupboards (including glove boxes)						
8.2.3.1 Are fume cupboards constructed from material suitable for their intended application and non-combustible wherever practicable? (2.3.1)						
8.2.3.2 Are fume cupboards and glove boxes that are operated in series provided with separate ducting and fire separation between adjacent units? (2.3.2)						
8.2.3.3 In order to protect the environment, does the design of the equipment cater for the removal of waste toxic or flammable gases or vapours by appropriate means such as scrubbing or chemical absorption? (2.3.3)						
8.2.3.4 Are fume cupboards free of stored flammable substances, oxidising agents and other chemicals? (2.3.4)						
8.2.3.5 Is electrical equipment suitable for the hazard zone in which it is to be used? (2.3.5)						
8.2.3.6 Are the controls for exhaust fan motors located outside the fume cupboard together with the controls for gases and other services (unless they are appropriate for use in the hazard zone)? (2.3.6)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.2.3.7	Are airflow indicators installed? If not, are procedures in place to ensure inspections of fan units and drive belts are performed regularly and the face velocities are measured to demonstrate that the cupboard is fit for purpose? (2.3.7)						
8.2.3.8	Are all fume cupboards and glove boxes serviced and maintained, to include face velocity and containment requirements, in accordance with BS EN 14175 and the manufacturer's instructions? (2.3.8)						
8.2.4	***Hot plates, ovens, furnaces and heating equipment***						
8.2.4.1	Are areas where flammable liquids are handled free of heating equipment? (2.4.1)						
8.2.4.2	Is free-standing equipment placed on heat-resistant surfaces, and does built-in equipment have appropriate insulation and ventilation? (2.4.2)						
8.2.4.3	Are ovens and furnaces fitted with overriding non-automatically re-setting thermal cut-out devices in addition to normal thermostats? (2.4.3)						
8.2.4.4	Is solvent distillation utilising portable heating mantels and similar equipment always attended? (2.4.4)						
8.2.4.5	Are hot surfaces remote from hazardous materials, such as hydraulic fluids? (2.4.5)						
8.2.4.6	When a laboratory is left unattended, is all heating equipment checked to ensure that it is not left on? Or, if it is to be left operating, are suitable fire protection measures in place? (2.4.6)						
8.2.5	***High-value equipment***						
8.2.5.1	Are water and heating pipes routed around the room perimeter and are welded joints used in all plumbing? Alternatively, has the floor over the equipment been made impervious to liquids? (2.5.1)						
8.2.5.2	Has electronic data processing equipment been installed in accordance with **RC3: Loss prevention in electronic equipment installations, Part 1: Fire prevention**? (2.5.2)						
8.3	**Flammable gases and liquids**						
8.3.1	***Piped services***						
8.3.1.1	Are flammable liquids and gases that are delivered from cylinders or bulk tanks located safely outside the building via permanently installed hard metal piping with quick-acting isolation valves linked to the automatic fire detection system installed both at the point of supply and delivery? (3.1.1)						
8.3.1.2	Are supply and discharge terminals clearly and permanently marked at each end and along the pipe run to identify the liquid or gas carried? (3.1.2)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.3.1.3	Are pipelines colour-coded throughout their length to comply with the BS 1710 and clearly marked to show the direction of flow of the contents? (3.1.3)						
8.3.1.4	Do pipelines take the shortest practical route and are they located and adequately supported well clear of heat sources, electric cables, and other services or areas where mechanical damage is possible? (3.1.4)						
8.3.1.5	Is pipework passing through compartment walls and compartment floors protected in accordance with the design guide for the fire protection of buildings? (3.1.5)						
8.3.1.6	Is the advice on the transportation of highly flammable and flammable liquids in enclosed systems set out in RC20: Part 1 observed? (3.1.6)						
8.3.1.7	Are all pipes, tanks and other metallic elements of installations that are used to store, convey or dispense flammable liquids and gases bonded and earthed? (3.1.7)						
8.3.2	***Gas cylinders***						
8.3.2.1	Where liquefied petroleum gas is involved, is the advice in RC8: ***Recommendations for the storage, use and handling of common industrial gases in cylinders including LPG*** followed? (3.2.1)						
8.3.2.2	Are cylinders containing flammable gas stored in a secure compound in the open air to enable natural ventilation to disperse any small leaks? If this is not practicable, are the cylinders in a separate designated building or in a designated storage place within a building provided with suitable high and low level ventilation? (3.2.2)						
8.3.2.3	Is the total quantity of flammable gases in a laboratory kept to the minimum needed for effective operations? Where it is unavoidable to have cylinders containing flammable gases or oxygen inside the laboratory, are the cylinders secured in a vertical position, preferably within a cabinet providing at least 60-minutes' fire resistance with appropriate hazard warning signs displayed prominently? (3.2.3)						
8.3.2.4	Has the use of acetylene been minimised with the cylinders safely stored outside the building or in a separate fire compartment? (3.2.4)						
8.3.2.5	Is the storage area or storage building for gas cylinders at least 4m from other buildings and ignition sources? Are gas leakage detectors installed in cylinder stores with the alarm(s) monitored in the security control room? (3.2.5)						
8.3.2.6	Are smoking and naked lights prohibited in all flammable gas storage areas and buildings, with permanent warning notices prominently displayed? (3.2.6)						
8.3.2.7	Are different types of gases segregated from each other, particularly flammable gases and oxidising gases? And are empty cylinders kept segregated from full cylinders with all cylinders being protected from direct sunlight? (3.2.7)						

	Yes	No	N/A	Action required	Due date	Sign on completion
8.3.2.8 Are areas where pyrophoric gases stored subject to a specific fire risk assessment? And is the gas transported in concentric pipework with a water mist or sprinkler system installed to protect the workplace? (3.2.8)						
8.3.2.9 Are regulators, pipes and pressure valves fitted appropriate to the type of gas to be used? (3.2.9)						
8.3.2.10 Have measures been taken to ensure that grease or oil does not come into contact with cylinders, their valves or associated equipment? (This is particularly important with cylinders containing oxygen as this gas will react dangerously with grease or oil.) (3.2.10)						
8.3.2.11 Where there is the possibility of a gas supply at a higher pressure feeding back into a lower pressure system, have suitable back-pressure valves been installed? (3.2.11)						
8.3.2.12 Are gas supply valves closed when a supply is not required? (3.2.12)						
8.3.2.13 Are staff trained in the moving, connection and disconnection of gas cylinders, including instruction in the hazards associated with the processes? (3.2.13)						
8.3.3 Highly flammable and flammable liquids						
8.3.3.1 Is the quantity of highly flammable and flammable liquids in laboratories and elsewhere on site subject to a risk assessment and kept to a minimum? (3.3.1)						
8.3.3.2 Are flammable liquids stored in purpose-built cabinets or bins providing at least 30-minutes' fire resistance and having integral spillage trays? And are cabinets clearly marked with hazard warning signs and ducting to vented cabinets made of non-combustible construction with a plastic lining? (3.3.2)						
8.3.3.3 Is the maximum size of any container of highly flammable liquid on a bench not in excess of 500ml? (3.3.3)						
8.3.3.4 Are highly flammable liquids carried in approved safety containers? Or if glass containers are necessary for corrosion resistance or to maintain the purity of a liquid, does their capacity not exceed 4.54 litres with the vessels being held in protective carrying containers? (3.3.4)						
8.3.3.5 Are only refrigerators designed or modified for the storage of flammable liquids used for this purpose? (3.3.5)						
8.3.3.6 Are bulk supplies kept in a separate, non-combustible, suitably marked building and in accordance with the principles set out in RC 20: Part 1? (3.3.6)						
8.3.3.7 Are experiments using flammable liquids carried out in a fume cupboard and on a metal tray to retain the contents of the apparatus should it fracture? (3.3.7)						
8.3.3.8 Are highly flammable and flammable liquids stored separately from hazardous materials such as oxidising agents, organic peroxides, strong reducing agents, and strong acids? (3.3.8)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.3.3.9	Is a supply of non-combustible absorbent material kept immediately available to deal with any spillages of flammable liquid? Have staff been instructed in the use of this material and its safe disposal? (3.3.10)						
8.3.4	***Hazardous chemicals***						
8.3.4.1	Has adequate attention been paid to fire and explosion hazards which might arise from the non-compatibility of some chemicals should they become mixed following an accident or breakage? (3.4.1)						
8.3.4.2	Have the requirements of the Control of Substances Hazardous to Health Regulations 2002 been observed? (3.4.2)						
8.3.4.3	Is tritium kept in a proprietary container and refrigerated? (3.4.3)						
8.4	**Fire safety management**						
8.4.1	***General provisions***						
8.4.1.1	Have assessments been carried out in compliance with the Regulatory Reform (Fire Safety) Order 2005 (or equivalent legislation in Scotland and Northern Ireland) and where chemicals are present, in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR)? (4.1.1)						
8.4.1.2	Has a complete list been draw up and the material safety data sheets of all substances that are stored or in use on the site kept available at all times in accordance with COSHH Regulations? (4.1.2)						
8.4.1.3	Are the premises kept clean and tidy with only the minimum daily requirements of hazardous chemicals or goods present in the laboratory itself? (4.1.3)						
8.4.1.4	When an experiment or research project is finished, is the apparatus dismantled, cleaned and inspected and the components returned to store or disposed of safely? And are the products of the experiment and any surplus chemicals suitably stored or disposed of at this time? (4.1.4)						
8.4.1.5	Are service ducts or enclosures kept clean and not used for storage or other purposes? Are the doors to these enclosures kept closed and locked and labelled to this effect? (4.1.5)						
8.4.1.6	Is the shelf life of chemicals and samples checked regularly; the interval depending on the ageing qualities of the materials; and any found to be out of date disposed of safely? (4.1.6)						
8.4.1.7	Is all plant and equipment operated and maintained in accordance with manufacturers' instructions? (4.1.7)						
8.4.1.8	Has a safety committee been established to oversee working practices and to vet any new projects before work starts? (4.1.8)						
8.4.1.9	For hazardous operations, has a written permit-to-work system been established and is it strictly implemented to ensure that both the operator and the management are fully aware of the risks and the safeguards to be adopted? (4.1.9)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.4.1.10	Is hazardous experimental work involving pilot plant carried out in a special area separated from the remainder of the laboratory by walls constructed entirely of brickwork, masonry or concrete having at least 120-minutes' fire resistance with any openings fitted with self-closing fire doors with 120-minutes' fire resistance? Have such doors been tested and approved by an independent third-party approvals organisation? In addition, where necessary, have suitable provisions been made to vent an explosion? (4.1.10)						
8.4.1.11	Is an annual audit of the laboratory carried out to ensure that: • fire and health and safety measures are in place and are used and followed?; • all staff in the area are trained and familiar with the standard operating procedures?; and • all the equipment is in place and maintained as required? (4.1.11)						
8.4.2	***Waste disposal***						
8.4.2.1	Are the provisions of the Hazardous Waste (England and Wales) Regulations 2005 and associated legislation for England, Wales, Scotland and Northern Ireland observed? (4.2.1)						
8.4.2.2	Are arrangements in place to ensure that waste flammable liquids are not disposed of via the drains? And when storing waste liquids, is caution exercised to avoid mixing non-compatible materials? (4.2.2)						
8.4.2.3	Are other combustible waste materials removed from the laboratory daily and deposited in non-combustible lidded receptacles stored in locked containers outside, at least 10m from buildings and plant? (4.2.3)						
8.4.2.4	Are waste, unsaturated oils and other reactive materials that may be subject to self-heating stored separately in metal containers with metal lids located at least 10m from the buildings to await disposal? (4.2.4)						
8.4.2.5	Are waste materials regularly removed from the site so as not to accumulate? (4.2.5)						
8.4.2.6	Are cleaners given special training and instruction so as to make them aware of the possible dangers in a laboratory? (4.2.6)						
8.4.3	***Welding and other hot work processes***						
8.4.3.1	Are these processes only carried out after written approval by the laboratory manager or the safety adviser, who stipulates when and how the work shall be carried out? (4.3.1)						
8.4.3.2	Are arrangements subject to a written permit-to-work system in accordance with RC7: **Recommendations for hot work?** (4.3.2)						

	Yes	No	N/A	Action required	Due date	Sign on completion
8.4.4 Overnight use						
8.4.4.1 Where equipment or processes may be required to operate overnight and be left unattended are they carried out in a suitable area separated from the remainder of the building? In the event of a small section of the laboratory being used, has it been subject to a fire risk assessment specific to this purpose? (4.4.1)						
8.4.4.2 Has the installation of an automatic fire detection and alarm system and/or an automatic fire suppression installation been considered as part of the fire risk assessment undertaken during the planning stage of the project? (4.4.2)						
8.4.4.3. Is equipment left on and unattended overnight recorded on a permit to work system? (4.4.3)						
8.4.5 Smoking, eating and drinking						
8.4.5.1 Is smoking prohibited in all external storage areas with appropriate notices being prominently displayed? (4.5.1)						
8.4.5.2 Where a smoking shelter is provided, is it outside the building, subject to a specific fire risk assessment, constructed of non-combustible materials, sited at least 10m away from any building or structure and provided with suitable metal ashtrays, a separate metal waste bin with a fitted metal lid and a suitable fire extinguisher? (4.5.2)						
8.4.5.3 Is the immediate area around the shelter and the shelter itself kept clear of combustible materials including windblown debris and vegetation? (4.5.3)						
8.4.5.4 Is there a solid floor to the shelter so that combustible debris cannot accumulate beneath? (4.5.4)						
8.4.5.5 Is the use of combustible curtains, canopies and drapes to protect smokers from the elements avoided? (4.5.5)						
8.4.5.6 Is the shelter sited away from windows, ventilation intakes or extracts, entrances and exits from the premises, hazardous materials, waste storage containers and not beneath a canopy or low slung eaves? (4.5.6)						
8.4.5.7 Are areas where smoking is allowed but no shelter is provided free of combustible materials and equipped with fire fighting equipment, metal ash trays and a separate metal waste bin with a fitted metal lid? (4.5.7)						
8.4.5.8 Has a ‘no smoking’ policy been established in outside areas where fire hazards exist? (4.5.8)						
8.4.6 Water damage						
8.4.6.1 Are buildings maintained in good repair, gutters and downpipes cleaned out at least once a year and roofs checked annually? (4.6.1)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.4.6.2	Are water pipes, drains and similar services routed so as to be well away from, and not pass directly over, sensitive, costly or business critical equipment? (4.6.2)						
8.4.6.3	Are computers and other items of high-value equipment located away from basements or places where they could be affected by flooding? If this is unavoidable, is the equipment installed above floor level? (4.6.3)						
8.4.6.4	Do tank and cistern overflows discharge to safe places? Are the drip trays of chiller systems of sufficient capacity and provided with a drain hole large enough not to become blocked? (4.6.4)						
8.4.6.5	Is freezing avoided by setting central heating controls to maintain a minimum temperature of 4°C inside the premises? Where this is not possible and in outside areas, is trace heating and lagging installed where necessary? (4.6.5)						
8.4.6.6	Are all vulnerable reactants, products and other stored materials kept off the floors on shelving, racks, pallets, or dunnage? (4.6.6)						
8.5	**Fire protection**						
8.5.1	Are portable fire extinguishers installed in accordance with BS 5306-8 and serviced and maintained in compliance with BS 5306-3; and where flammable liquids are in use does no person have to travel more than 20m in order to reach an extinguisher? (5.1)						
8.5.2	Are rooms containing high-value computer, diagnostic, test or analytical equipment provided with a fixed gas fire suppression system triggered by smoke detectors configured for coincidence connection? Is the suppression system installed and maintained according to the installer's instructions? (5.2)						
8.5.3	Are glove boxes and similar enclosures where access is difficult and/or where flammable or highly flammable materials are handled, provided with a fixed extinguishing system? (5.3)						
8.5.4	Where a fixed fire suppression system is installed, are means provided to shut down any exhaust or ventilation systems and seal any openings before any gas is discharged? Does operation of the system also result in automatic shut down of gases and supply of reactants to the equipment (other than cooling systems)? (5.4)						
8.5.5	Has consideration been given to the installation of automatic sprinkler installations and automatic fire detection and alarm systems in larger laboratories in accordance with the LPC Rules for automatic sprinkler installations incorporating BS EN 12845 and BS 5839-1 respectively? (5.5)						
8.5.6	Have all employees been given basic fire training and have selected staff received additional training as appropriate to their roles? (5.6)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.6	**Security**						
8.6.1	Has the threat of deliberate fire raising been given serious attention when undertaking the fire risk assessment in compliance with the Regulatory Reform (Fire Safety) Order 2005? (6.1)						
8.6.2	Is the site security against intruders compatible with the values at risk, the nature of the contents, the location of the laboratory, the history of crime in the area, the post loss history of the site and the nature of the work undertaken? (6.2)						
8.6.3	Are intruder alarms installed and maintained to BS EN 50131 or other recognised international standard under contract by an installer who is registered with the National Security Inspectorate (NSI) or the Security Systems and Alarms Inspection Board (SSAIB), and who is acceptable to the police authority? Does the installation meet insurers' requirements? Is it designed specifically for each location? (6.3.)						
8.6.4	On larger sites, are security staff employed outside of working hours to check all parts of the site? Where a contractor is to be engaged, has a check been made that the security company is reputable and experienced and approved by an independent inspection body such as the NSI? (6.4)						
8.6.5	Are clocking points, or similar means of recording the patrols, provided? (6.5)						
8.6.6	Have security lighting and the provision of closed-circuit television been considered as important elements of the security strategy? (6.6)						
8.6.7	Have security staff been made aware of any experiments or production processes taking place outside working hours so that special checks may be made to ensure that everything is in order? (6.7)						
8.6.8	Is laboratory access restricted to named persons only, and barred to others by means of suitable controls such as keying, proximity or magnetic card readers? (6.8)						
8.6.9	Are suitable warning notices posted to warn of flammable, toxic, radioactive, laser or other hazards at all entry points? (6.9)						
8.7	**Contingency planning**						
8.7.1	Has the guidance set out in **Business resilience: A guide to protecting your business** published by the FPA and BS 25999: **Business continuity management** been adopted? (7.1)						
8.7.2	Where work carried out in the laboratory is a business critical operation or involves toxic, biohazard or radiological materials, has a crisis management plan been devised and comprehensively tested on a regular basis? (7.2)						

		Yes	No	N/A	Action required	Due date	Sign on completion
8.7.3	Fire-resisting safes, data safes and fire-resisting cabinets are adequate to protect data on a short-term basis while waiting for 'backing up' to main files, but has a regime of frequent and more substantive 'backing up' of data files and the secure storage of the information been established off site in another building or safe location away from the laboratory? (7.3)						
8.7.4	Are samples necessary for historical records, trial evaluations and so on kept in a purpose-built store room having at least 120-minutes' fire resistance and / or stored off site at a separate location? (7.4)						
8.7.5	Is the location of essential gas and water stop valves, main switches, drainage gullies, manholes and so on known to all staff who may have to operate these in an emergency, and to the public fire brigade on their familiarisation visits? (7.5)						
8.7.6	Are the locations of shut off points for services, stop valves for sprinkler systems and other control systems for emergency installations indicated on a plan of the site provided for the fire brigade? And are these plans located at the entrance to the facility adjacent to the fire alarm indicator and control panel? (7.6)						
8.7.7	Has a 'salvage team' been established to plan and implement effective responses to a range of possible incidents? (7.7)						
8.7.8	Has a management team been set up to look into aspects of recovery from a major fire or explosion? (7.8)						

Address		Signature/ Name		Date	

Annex A: Incompatible chemicals

The table below is an indicative list of chemicals that should be stored and handled so as not to come into contact. In must be emphasised that the list is not complete, and the omission of a chemical or chemicals from the list does not indicate any degree of compatibility.

Chemical	**Incompatibility**
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetone	Concentrated nitric and sulphuric acid mixtures
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Alkali and alkaline earth metals (lithium, sodium, potassium)	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens, powdered metals (such as aluminium or magnesium)
Ammonia (anhydrous)	Mercury (for example in manometers), chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrates, sulphur, finely divided organic or combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenical materials	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidising agents
Carbon tetrachloride	Sodium, chlorates, ammonium salts, acids, powdered metals, sulphur, finely divided organic or combustible materials
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metals, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulphide
Chromic acid and chromium	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromatic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens
Fluorine	Isolate from everything
Hydrocarbons such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, alcohols, acetone, organic materials, aniline, nitromethane, combustible materials
Hydrogen sulphide	Fuming nitric acid, oxidising gases

Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Sulphuric acid
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gases, copper, brass, any heavy metals
Nitrites	Potassium or sodium cyanide.
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, greases, hydrogen, flammable: liquids, solids and gases
Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or mineral), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Phosphorus pentoxide	Water
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulphuric and other acids
Potassium perchlorate	(see sulphuric and other acids also chlorates)
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulphuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium Chlorate	Acids, ammonium salts, oxidisable materials, sulphur
Sodium nitrite	Ammonium nitrate and other ammonium salts
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulphide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulphides	Acids
Sulphuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing agents
Water	Acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, chromic acid, phosphorous oxychloride, phosphorous pentachloride, phosphorous pentoxide, sulphuric acid, sulphur trioxide

Source: Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Research Council, Washington DC, 1995.

Annex B: Storage of solid and liquid chemicals

Material	Storage conditions	Examples
Flammable liquids	Store in flammable liquid storage cabinet, grounded if metal Separate from oxidising materials	Acetone Ethanol Glacial acetic acid
Non-flammable liquids	Store in cabinet (can be stored with flammable liquids) Separate from oxidising materials	Carbon tetrachloride Ethylene glycol
Acids	Store in cabinet of non-combustible material Separate from oxidising acids, organic acids and mineral acids Use plastic bins to provide separate areas in the same cabinet Separate perchloric acid from all other acids using ceramic, glass or clay bins Separate from alkalis, cyanides, and sulphides	Nitric acid Hydrochloric acid Sulphuric acid
Alkalis	Store in cabinet, dry area Separate from acids	Ammonium hydroxide Sodium hydroxide Potassium hydroxide
Water reactive chemicals	Store in cabinet, dry location Separate from aqueous solutions	Sodium Potassium Lithium
Oxidising agents	Store in cabinet of non-combustible material Separate from flammable and combustible materials	Sodium hypochlorite Benzoyl peroxide Potassium permanganate
Non-volatile, non-reactive solids	Store in cabinets or open shelves with edge guards	Agar Sodium chloride Sodium bicarbonate

Source: Based on information published by the University of Waterloo, Ontario.

REFERENCES

1. Regulatory Reform (Fire Safety) Order 2005, SI 2005 No 1541, The Stationery Office.
2. The Fire (Scotland) Act 2005, asp 5, The Stationery Office.
3. Fire Safety (Scotland) Regulations 2006, Scottish SI 2006 No 456, The Stationery Office.
4. Fire and Rescue Services (Northern Ireland) Order 2006, SI 2006 No 1254 (NI9), The Stationery Office.
5. BS EN 60079-10: 2003: **Electrical apparatus for explosive gas atmospheres:** Classification of hazardous atmospheres, British Standards Institution.
6. **Design guide: Fire protection of buildings: Core document: Compartmentation,** 2008, Fire Protection Association.
7. **Design Guide: Fire protection of buildings: Protection of openings and service penetrations from fire,** 2005, Fire Protection Association.
8. BS 476-20: 1987: **Method for determination of the fire resistance of elements of construction (general principles),** British Standards Institution.
9. BS 476-21: 1987: **Methods for determining of the fire resistance of loadbearing elements of construction**, British Standards Institution.
10. BS 476-22: 1987: **Methods for determination of the fire resistance of non-loadbearing elements of construction**, British Standards Institution.
11. Dangerous Substances and Explosive Atmospheres Regulations 2002, The Stationery Office.
12. **Approved Requirements and Test Methods for the Classification and Packaging of Dangerous Goods for Carriage,** L88, Health and Safety Executive, 1996.
13. BS 476-4: 1970 (1984): **Fire tests on building materials and structures: Non-combustibility test for materials**, British Standards Institution.
14. BS EN ISO 1182: 2002: **Reaction to fire tests for building products. Non-combustibility test**, British Standards Institution.
15. The Control of Substances Hazardous to Health Regulations 2002, SI 2002 No 2677, (as amended), The Stationery Office.
16. Ionising Radiation Regulations 1999, SI 1999 No 3232, The Stationery Office.
17. Health and Safety at Work etc Act 1974, The Stationery Office.
18. The Hazardous Waste (England and Wales) Regulations 2005, SI 2005 No 894, The Stationery Office.
19. The List of Wastes (England) Regulations 2005, SI 2005 No 895, The Stationery Office.
20. The List of Wastes (Wales) Regulations 2005, WSI 2005 No 1820 (W.148), The Stationery Office.
21. The Special Waste Amendment (Scotland) Regulations 2004, SSI 2004 No 204, The Stationery Office.
22. The Hazardous Waste Regulations (Northern Ireland) 2005, SR 2005 No 300, The Stationery Office.
23. The Landfill (England and Wales) Regulations 2002, SI 2002/1559, The Stationery Office.
24. **Design guide for the fire protection of buildings: Essential principles**, 2007, Fire Protection Association.
25. The Building Regulations 2000: Approved Document B: Fire Safety, 2006 Edition, Communities and Local Government.
26. BS 5266-1: 2005: **Emergency lighting: Code of practice for the emergency lighting of premises**, British Standards Institution.
27. **LPC Rules for automatic sprinkler installations incorporating BS EN 12845**, Fire Protection Association, 2003.
28. BS 7671: 2008: **Requirements for electrical installations**, British Standards Institution.
29. Electricity at Work Regulations 1989, SI 1989 No 635, The Stationery Office.
30. HSG107 Maintaining portable and transportable electrical equipment, 2004, Health and Safety Executive.
31. BS EN 60079-14: 2003: **Electrical apparatus for explosive gas atmospheres**. **Electrical installations in hazardous areas (other than mines),** British Standards Institution.
32. BS 9999: 2008: **Code of practice for fire safety in the design, management and use of buildings,** British Standards Institution.
33. BS EN 14175: **Fume cupboards** (various parts), British Standards Institution.
34. RC3: **Loss prevention in electronic equipment installations, Part 1: Fire prevention**, 2003, FPA.
35. BS 1710: 1984: **Specification for the identification of pipelines and services**, British Standards Institution.
36. RC20: **Recommendations for fire safety in the storage and use of highly flammable and flammable liquids: Part 1 General principles**, 2006, Fire Protection Association.
37. RC8: **Recommendations for the storage, use and handling of common industrial gases in cylinders including LPG**, 2005, Fire Protection Association.
38. RC20: **Recommendations for fire safety in the storage and use of highly flammable and flammable liquids: Part 2: Storage in drums, cans and other containers other than external fixed tanks**, 2007, Fire Protection Association.
39. RC7: **Recommendations for hot work**, 2007, Fire Protection Association.
40. BS 5306-8: 2000: **Fire extinguishing installations and equipment on premises. Selection and installation of portable fire extinguishers: Code of practice**, British Standards Institution.
41. BS 5306-3: 2000: **Fire extinguishing installations and equipment on premises. Code of practice for the inspection and maintenance of portable fire extinguishers**. British Standards Institution.
42. BS 6266: 2002: **Code of practice for fire protection for electronic equipment installations**, British Standards Institution.

43. LPS 1230: **Requirements for fire testing of fixed gaseous fire extinguishing systems, Issue 1-1 2005**, Loss Prevention Certification Board.

44. RC3: **Loss prevention in electronic equipment installations, Part 5: In-cabinet fire protection systems, 2005**, Fire Protection Association.

45. BS 5839-1: 2002: **Fire detection and alarm systems for buildings. Code of practice for system design, installation, commissioning and maintenance**, British Standards Institution.

46. BS EN 50131: **Alarm systems. Intrusions systems. General requirements (various sections)**, British Standards Institution.

47. **Business reliance: A guide to protecting your business and its people**, 2005, Fire Protection Association.

48. **BS 25999: Business continuity management (various parts)**, British Standards Institution.

FURTHER READING

1. **Safe practices in chemical laboratories**, Royal Society of Chemistry, 1989.

2. **Firecode: Fire safety in the NHS, Health Technical Memorandum 05-03: Operational provisions: Part G: Laboratories on hospital premises**, The Stationery Office.

3. **NFPA 704: Standard System for the Identification of the Hazards of Materials for Emergency Response**, National Fire Protection Association, Quincy, Massachusetts, USA.

4. **Maintenance, examination and testing of local exhaust ventilation HSG54**, second edition 1998, HSE Books.

5. **Dangerous properties of industrial materials**, N Irving Sax, Richard J Lewis, 10th Edition 1999, Van Nostrand Reinhold.

6. BS EN 14470: **Fire safety storage cabinets: Part 1: Safety storage cabinets for flammable liquids**: 2004, British Standards Institution.

7. BS EN 14470: **Fire safety storage cabinets: Part 2: Safety cabinets for pressurised gas cylinders**, 2006, British Standards Institution.

8. **Fire protection handbook**, 2003, National Fire Protection Association, Quincy, Massachusetts, USA.

9. NFPA 45: **Fire protection for laboratories using chemicals**, 2004, National Fire Protection Association, Quincy, Massachusetts, USA.

10. NFPA 99: **Standard for healthcare facilities, including laboratories in health-related industries**, 2002, National Fire Protection Association, Quincy, Massachusetts, USA.

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