

# RC55: Recommendations for fire safety in the storage, handling and use of flammable and highly flammable liquids



## Symbols used in this guide



Good  
practice



Bad  
practice



Discussion  
topic



Frequently asked  
question

## Acknowledgements

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# Summary of Key Points

<b>Comply with fire safety legislation</b>	<ul style="list-style-type: none"><li>• In addition to a fire risk assessment undertaken in compliance with national fire safety legislation an assessment should also be undertaken by a competent person in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR).</li></ul>
<b>Protect business continuity</b>	<ul style="list-style-type: none"><li>• All businesses should take steps to maintain the continuity of their operations by making and rehearsing a suitable emergency plan.</li></ul>
<b>Provide suitable training for staff</b>	<ul style="list-style-type: none"><li>• All staff should be familiar with the hazards associated with the flammable liquids in use, the necessary precautions and the actions to be followed in the event of fire or spillage.</li></ul>
<b>Identify hazard zones</b>	<ul style="list-style-type: none"><li>• The DSEAR assessment should include identifying hazard zones in the workplace</li></ul>
<b>Plan the fire risk assessment</b>	<ul style="list-style-type: none"><li>• The 'VICES' acronym is a key element of fire safety with flammable liquids and should be followed when carrying out the assessment</li></ul>
<b>Ventilation</b>	<ul style="list-style-type: none"><li>• Ensure there is sufficient ventilation at high and low level to keep the concentration of the liquid's vapour below its lower explosive limit</li></ul>
<b>Ignition</b>	<ul style="list-style-type: none"><li>• Take care to identify all potential ignition sources in the workplace, including:<ul style="list-style-type: none"><li>- Heating and hot surfaces</li><li>- Contractors' operations</li><li>- Electrical equipment and installations</li><li>- Sources of static electricity</li><li>- Lift trucks</li><li>- Deliberate fire setting</li></ul></li></ul>
<b>Containment</b>	<ul style="list-style-type: none"><li>• Provide catchment areas in case of leaks and spillages in order to retain leakage, guard against the risk of pollution and contain a possible flowing liquid fire.</li><li>• Remember that containers that appear to be empty may contain residual vapour and can be extremely hazardous.</li></ul>
<b>Exchange</b>	<ul style="list-style-type: none"><li>• Priority should be given to eliminating flammable and highly flammable liquids from the workplace wherever possible.</li></ul>
<b>Separation</b>	<ul style="list-style-type: none"><li>• Limit quantities of flammable liquids stored in the working area to the minimum volumes required for the day or period of work.</li></ul>
<b>Ensure that hazard zones are observed</b>	<ul style="list-style-type: none"><li>• All electrical equipment and vehicles should be suitable for the hazard zone in which they are to be used.</li></ul>
<b>Electrical</b>	<ul style="list-style-type: none"><li>• Ensure that portable appliances are PAT tested and the installation is inspected periodically in accordance with the requirements of BS 7671.</li></ul>
<b>Fire protection</b>	<ul style="list-style-type: none"><li>• Fire protection measures for areas where flammable and highly flammable liquids are stored, handled or used should be proportionate to the risk and be based on the findings of the assessments carried out in compliance with fire safety legislation and DSEAR.</li></ul>

# 1 Synopsis

These recommendations provide practical guidance regarding the storage, handling and use of small volumes of highly flammable and flammable liquids in the workplace.

In addition to utilising the Dangerous Substances and Explosive Atmosphere Regulations 'VICES' acronym, the guidance gives introductory advice regarding electrical equipment for use in hazard zones, the transportation of flammable liquids in closed systems and best practice with storage in tanks.

# 2 Scope

These recommendations present measures relating to fire safety in the storage, handling and use of highly flammable and flammable liquids (which may include solvents, adhesives, resins etc) having a flashpoint of up to 55°C. Some of these liquids may also present other types of hazards, for example, to health, but health and safety issues other than those relating to fire safety are outside the scope of this document. Issues that arise with the bulk handling of flammable and highly flammable liquids at bulk storage tank farms, depots, refineries, petrochemical plants or large chemical works are also outside the scope of this document.

The guidance presented here does not apply to the use or storage of Liquefied Petroleum Gas (LPG), oil fired heating installations or paint spraying, for which more specific guidance is available in RISCAuthority recommendations RC8, RC9, RC 31 and RC32 (refs 1-4). Further information regarding the selection of electrical and non-electrical equipment for use in atmospheres containing flammable and explosive gases is set out in RC30 (ref 5).

This advice is not intended to apply to the storage of flammable and highly flammable liquids in drums, cans and containers or external fixed tanks, for which further information is provided in RC56 and RC57 respectively (refs 6 and 7).

Legislation other than the Regulatory Reform (Fire Safety) Order 2005 and equivalent legislation in Scotland and Northern Ireland (refs 8-12) and the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref 13) may impose requirements additional to the provisions contained in this document (see, for example, refs 14-18). Due regard should also be given to other regulations that may have an impact on environmental protection.

Flammable atmospheres created by the presence of combustible dusts in the air present a serious hazard similar to that posed by vapours of flammable liquids but are outside the scope of this document. (For further information see RISCAuthority recommendations RC12 (ref 19)).

# 3 Definitions

## **Auto-ignition temperature**

The minimum temperature at which a material will ignite spontaneously without the presence of a source of ignition.

## **Bund**

A secondary enclosure to retain spills and leakage from tanks or containers to prevent contamination and spread of fire.

## **Classification of hazardous areas (BS EN 60079-10-1) (ref 20)**

(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.)

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, is likely to do so only infrequently and will exist for a short period only.

#### Competent

Someone with sufficient training and experience or knowledge and other qualities to enable them properly to implement the relevant measures.

#### Explosive limits (BS EN 60079-10-1) (ref 20)

Lower explosive limit (LEL): The concentration of flammable gas or vapour in air, below which the gas atmosphere is not explosive.

Upper explosive limit (UEL): The concentration of flammable gas or vapour in air, above which the gas atmosphere is not explosive.

#### Flammable liquid

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

#### Flashpoint (BS EN 60079-10-1) (ref 20)

The lowest liquid temperature at which, under certain standardised conditions, a liquid gives off vapours in a quantity such as to be capable of forming an ignitable vapour/air mixture.

#### Highly flammable liquid (DSEAR 2002) (ref 13)

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 (ref 21) has a flashpoint of less than 32°C; and
- (b) when tested at 50°C 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' with a heating time of 60 seconds supports combustion.



- Each flammable and highly flammable liquid should be considered in turn and possible non-combustible or aqueous based alternatives considered for application.
- Waste flammable liquids should not be mixed and should be kept in clearly marked, closed, waste disposal tanks.

## 4 Introduction

Flammable and highly flammable liquids fall within the definition of a 'dangerous substance' as referred to in the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref 13).

Where a dangerous substance is either present or liable to be present at the workplace, a suitable assessment of the risks likely to arise should be conducted in accordance with DSEAR and action taken to eliminate or reduce the hazard. 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.

The flashpoint is the property that is conventionally used to classify and indicate the flammability of liquids. Those with flashpoints below or close to ambient temperatures are more hazardous than those with flashpoints at temperatures unlikely to be reached in the workplace.

Two main dangers need to be recognised:

- the danger of explosion, when flammable vapour/air mixtures fall within their explosive limits;
- the danger of fire, which may involve the flow of burning liquid over a wide area, or the rupture or explosion of unvented or inadequately vented containers.

All flammable liquids, regardless of flashpoint, will contribute greatly to the severity and spread of fire. Physical properties, the auto-ignition temperature, explosive limits, specific gravity, vapour density and vapour pressure will need to be considered when specifying risk control

measures. Changes of state of a material when heated and the effect of gravity inducing a flow of liquids and vapours also require serious consideration.

The intensity of a fire or its rate of growth may be increased if incompatible materials, such as organic peroxides (ref 40), are stored adjacent to flammable liquids. Alternatively, a fire may grow and involve dangerous substances which are themselves not combustible (see Health and Safety booklet HSG 71, ref 22).

These recommendations apply to all flammable and highly flammable liquids although under certain conditions some of the requirements, where liquids with high flashpoints are concerned, may be relaxed. The extent of hazard reduction and management will be one of the outcomes of the specific risk assessment conducted in terms of DSEAR and the general fire risk assessment carried out in compliance with fire safety legislation.

To comply with the requirements of DSEAR, the management of flammable and highly flammable liquids should be subject to a risk assessment undertaken by a competent person. When considering such an assessment it should be remembered that the control measures that may be appropriate in the case of an open process, where flammable vapours are exposed to the atmosphere, may be very different from those which should be observed in an area where a process in which such substances are handled in pipelines and closed containers is undertaken.

The risk assessment undertaken in compliance with DSEAR, like fire risk assessments of the workplace undertaken in accordance with fire safety legislation, is a continual and evolving process; it should be reviewed periodically and when there are changes in the:

- equipment being used;
- flammable liquid storage area;
- staffing arrangements;
- materials being used in the process;
- operating procedures;
- operating parameters and control measures that are observed;
- management of the process;
- size of the operation; or
- process times involved.

The risk assessment should also be reviewed following an incident or near miss.

Specialist advice should be sought where materials, such as organic peroxides and monomers, are in use that present not only flammability, but also other special hazards.

The main causes of fire involving flammable liquids, which should be borne in mind when carrying out the risk assessment, include:

- lack of awareness: incorrect/improper installation or use of equipment; hazardous situations not being recognised; or people being ignorant of the hazards associated with flammable liquids;
- lack of training in the handling of flammable liquids;
- lack of maintenance: where no problem areas are apparent (such as in the case of a closed process) and it is felt that the cost of regular maintenance is not justified;
- misuse: poor management procedures where a person engages in an unsuitable or prohibited practice (for example, smoking) with total disregard for safety regulations;
- carelessness: where an existing problem is recognised but ignored;
- improper design: possibly by a person not qualified to do so and ignoring relevant legislation and/or standards;
- static electricity: where movement of flammable liquid in the handling process may lead to a build up of charge;
- absence of good housekeeping: where areas are not kept free from other combustible materials; and

- lack of management of ‘empty’ containers: for example, where containers used in large scale operations have been decommissioned but subsequently inadvertent steam injection has raised the temperature inside a container high enough to reach the auto-ignition temperature of the residual deposits. In addition to DSEAR, the requirements of the Control of Pollution (Oil Storage) (England) Regulations 2001 (ref 18) should be observed, particularly those relating to the provision of bunds around storage tanks.

#### Changes in legislation

In 2015 a number of amendments to current legislation affecting the control and management of flammable liquids will come into operation. In particular:

- From 1 June 2015 European Regulation (EC) No 1272/2008: Classification, labelling and packaging of substances and mixtures (already known as the ‘CLP Regulations’) will replace the Chemicals (Hazard Information and Packaging for Supply) Regulations 2009.

## 5 Recommendations

### 5.1 Compliance with fire safety legislation

- 5.1.1 A suitable and sufficient fire risk assessment should be undertaken for all premises to which the Regulatory Reform (Fire Safety) Order 2005 (or equivalent legislation in Scotland and Northern Ireland) applies (refs 8-12).
- 5.1.2 As well as the staff handling and using flammable liquids, the assessment should consider staff remote from the process area who may be affected by smoke and heat in the event of a fire. Where large volumes of flammable liquids are stored, handled or in use the implications for other people in the neighbourhood should also be addressed. In business critical areas the implications for property protection and business continuity, as well as life safety, should also feature prominently in the assessment.
- 5.1.3 An assessment should be undertaken in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref 13). In common with the fire risk assessment, this should be undertaken by a competent person; it should identify any hazard zones in the workplace.
- 5.1.4 Risk assessments should be the subject of periodic review, including at the time when any changes to the process, the substances involved, the method of storing or handling the substances or the treatment of waste solvents are being considered.
- 5.1.5 The response by fire and rescue services to 999/112 calls and signals routed via fire alarm monitoring organisations varies widely throughout the UK, and differs from day to night-time. Fire safety managers should refer to the relevant fire and rescue service to make themselves aware of the levels of response in the areas in which their premises are located and consider this information when undertaking and reviewing their fire risk assessments.

### 5.2 Business continuity

Even a small fire can have a disproportionate effect on a business if it occurs in a critical area. The use of solvents is hazardous and must be carefully managed to avoid unnecessary disruption to the efficient functioning of the business.

- 5.2.1 In commercial premises where processes routinely involve the use of solvents, the fire hazards and thus the threat to the business are increased if the processes are allowed to continue unattended. If it is intended that equipment is to be left operating without staff in attendance then a specific risk assessment for the process should be undertaken and appropriate control measures introduced. Further information

regarding unattended processes is set out in RISCAuthority recommendations RC42 (ref 23).

- 5.2.2 All businesses should take steps to maintain the continuity of their operations by making a suitable emergency plan. Guidance for this is set out in *Business resilience: A guide to protecting your business and its people* (ref 24). The emergency plan should address the implications of a fire, flood or other perceived disaster on all facets of the business model. It should indicate the lines of communication that should be followed and the contact details for specialist assistance, providers of alternative accommodation and suppliers of replacement equipment.
- 5.2.3 Tabletop exercises should be held periodically to test the effectiveness and suitability of the emergency plans.
- 5.2.4 Consideration may be given to applying commercially available computer programs, such as the ROBUST software (Resilient Business Software Toolkit) that is available free of charge (ref 25), or similar product, to develop and check the adequacy of the plan.



- Processes involving flammable liquids should not be allowed to continue unattended without a specific risk assessment for the process having been undertaken and appropriate control measures introduced.
- Excess or waste flammable liquids must not be allowed to enter drains.



**Figure 1: Flammable liquid storage cupboard below a fume hood**

### 5.3 Fire safety management

- 5.3.1 At the outset, attention should be given to eliminating flammable and highly flammable liquids from the workplace wherever possible. Serious consideration should be given to the need for the use of such liquids in the process and the possibility of replacing them with non-flammable liquids as alternatives, or at least with solvents having a flashpoint above 55°C.
- 5.3.2 The workforce should be made aware of the presence and use of flammable liquids, and the hazards involved within the buildings in which they are working.
- 5.3.3 Staff should be trained in good practice relating to the opening, handling and disposal of containers (for example, containers should be opened correctly rather than punctured).
- 5.3.4 All staff should be familiar with the hazards associated with the product(s) used, the necessary precautions and the action to be followed in the event of fire or spillage. These include how to:
  - raise the alarm;
  - ensure all staff evacuate the workplace;
  - call the fire and rescue service;
  - attack the fire if it is safe to do so;
  - contain spillage and dispose of contaminated materials safely; and
  - ventilate the area concerned (open windows, doors and other openings intended for this purpose to increase ventilation).
- 5.3.5 Staff should be made aware of the hazards of deliberate fire raising, which may be carried out by colleagues as well as by intruders (ref 37).
- 5.3.6 Flammable liquids and nominally 'empty' containers should not be accessible to intruders; suitable security measures should be in place.
- 5.3.7 Containers should be labelled in accordance with BS EN ISO 7010 (see ref 26).
- 5.3.8 Installed or portable electrical equipment, including electric lighting should be appropriate for the zone (assessed according to BS EN 60079-10-1) (ref 20) in which it is to be used. In areas where unenclosed liquids are being used and zones have not been defined, measures should be taken as would be appropriate when considering the whole area as an area of highest hazard (ie zone 0).

## FAQ

- Should 'empty' flammable liquid containers be treated differently from those that are full or partially full?
- What does VICES mean?

### 5.4 VICES

- 5.4.1 The HSE guidance in booklet HS(G)51 (ref 27) suggests the use of the acronym VICES to help apply five basic principles which ensure that any flammable or highly flammable liquid that is necessary in the workplace is used and stored with appropriate care.
- 5.4.2 Suitable staff training should be in place to ensure all personnel are aware of the hazards in the workplace and apply VICES to ensure a safer working environment for all.
- 5.4.3 The acronym may be explained as follows:

#### V Ventilation (see section 5)

- Is there sufficient ventilation to keep the concentration of the liquid's vapour below its lower explosive limit?

#### I Ignition (see section 6)

- Have all possible ignition sources been removed?
- Is the electrical equipment used in this area suited to the risk category?

#### C Containment (see section 7)

- Are the liquids stored in suitable containers?
- In the event of a spill will they be contained?
- Is it possible to prevent spillages from spreading?
- Are bunds or catchment trays present where required?
- Are 'empty' containers properly managed?

#### E Exchange (see section 8)

- Although the fourth heading of the acronym, this asks the basic question can the flammable substances can be eliminated from the workplace?
- Can the substance be replaced by a less flammable one?

#### S Separation (see section 9)

- Is the storage of liquids separated from other stored materials?
- Are incompatible materials suitably separated?
- Are physical barriers (examples might be walls, doors, cabinets and bins) present as required?

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### 5.5 Ventilation

- 5.5.1 Adequate ventilation should be provided by natural or mechanical means to prevent the concentration of vapour accumulating to within the relevant explosive limits of the most hazardous solvent likely to be present. The degree of ventilation required will depend on the flashpoint of the liquid, the quantities in use, the location of the work and the type of process and will normally be determined by reference to the COSHH assessment (see ref 15).
- 5.5.2 Flammable liquid stores should be at or above ground level unless sufficient mechanical ventilation is provided.
- 5.5.3 Ventilation openings should be provided at low and high level, direct from the storage area to the outside, to prevent the accumulation of flammable vapour. Care should be taken to prevent drums and other items from obstructing the openings. Natural ventilation may be achieved by the use of air-bricks.

- 5.5.4 Mechanical ventilation may be used, providing at least six air changes per hour. Extract must be at low level and the inlet at high level, positioned so as to provide cross-flow. Duct openings should not allow fire spread. Fan motors should not be positioned within ductwork, and should be suitable for the hazard zone. All mechanical ventilation installations shall comply with BS 5925 (ref 28).
- 5.5.5 Where mechanical ventilation is installed the location of the exhaust outlet should be subject to a risk assessment in compliance with DSEAR. In most cases it should be adequate if the ventilation ductwork is terminated at least 3m above ground level and the same distance from building openings (including the eaves of buildings), boundaries, natural hazards such as drains and sources of ignition.
- 5.5.6 Ducting should:
- be of non-combustible construction;
  - take as short a route as possible;
  - have as few directional changes as possible;
  - be arranged so that vapours cannot condense and collect at low points in the ductwork; and
  - be routed to a safe place in the open air.
- 5.5.7 No fire dampers should be fitted in extract ducts for flammable vapours.
- 5.5.8 Where flammable or highly flammable liquids are stored and mechanical ventilation cannot be provided, explosion relief should be provided according to the findings of a risk assessment. In such a case, a lightweight roof or relief panels in the walls would serve to vent an explosion, provided that they release the pressure to a safe place so as not to cause injury or damage to property.
- 5.5.9 The discharge of a dangerous substance into the atmosphere may have an environmental impact and thus expert advice should be sought where necessary.
- 5.5.10 Safe procedures must be followed for the cleaning of tanks and vessels, particularly where a change of use or type of content is proposed (see HSE Guidance Note CS15, ref 29).



- Even a small fire can have a disproportionate effect on a business if it occurs in a critical area.
- What possible potential sources of ignition may have been forgotten in my fire risk assessment?

## 5.6 Ignition

- 5.6.1 One of the major objectives of any fire risk assessment is to identify potential sources of ignition in the workplace. These will include flames, sparks, hot surfaces, hot work, electrical fire hazards and areas of movement that may lead to the generation of heat by friction or the build up of static charges. All potential sources of ignition should be maintained well below the auto-ignition temperature of the most hazardous solvent in the area.
- 5.6.2 Assessment of the lightning risk should be undertaken in accordance with BS EN 62305 (ref 30) and the requirements of RISCAuthority recommendations RC35 (ref 31). In the petrochemical industry a specific strategy is used that is outside the scope of this document. Particular consideration is warranted for buildings and tanks in the open containing flammable liquids.
- 5.6.3 Smoking must be prohibited in all areas where flammable liquids are used or stored and suitable notices should be prominently displayed. Care should be taken when identifying locations for smoking areas. Further information regarding designated smoking areas is set out in RISCAuthority recommendations RC51 (ref 32).
- 5.6.4 All necessary maintenance or contractors' work in areas where flammable or highly flammable liquids are in use should be carried out according to a Method Statement (provided by the contractor or the site occupier as necessary) and under a 'Permit to Work' system. Special precautions are necessary when work may generate heat or sparks and strict safety procedures must be followed in respect of any work involving plant or equipment containing, or used for the handling of flammable liquids (see RISCAuthority recommendations RC7 (ref 33). The measurement of

vapour concentrations might be required in areas where the liquids cannot be safely removed or where it is suspected that high concentrations still exist, to ensure that the concentration is below the product's lower explosive limit.

- 5.6.5 Where possible, cold cutting should be used as an alternative to hot work and the equipment should be removed to a safe environment, such as a workshop, for the work to be conducted.

#### **Heating**

- 5.6.6 Heating must be suitable for the hazard zone in which the highly flammable or flammable liquids are being stored or used.
- 5.6.7 Where a heating system providing ducted warm air or supplying hot water or steam to pipes and radiators is in use the system should incorporate a heat exchanger so as to prevent flammable vapours from coming into contact with an ignition source. Any furnace or heat exchanger should be segregated and located either outside the hazard zone or in a separate building of brick or concrete construction with a self-closing door to each opening. Combustion products should be exhausted to the open, clear of windows or other openings of the hazard zone. Hot water or steam should circulate at a temperature not exceeding 120°C.
- 5.6.8 Electrical heaters should be of the low temperature flameproof type, certificated for the use in the relevant hazard zone. The temperature of the external surface of such heaters should not exceed 120°C.
- 5.6.9 Electrical underfloor or ceiling heating should have heating elements totally embedded in concrete or employ air ducts to circulate hot air within the floor or ceiling.
- 5.6.10 Heating installations and equipment should be maintained according to the manufacturer's instructions.

#### **Static electricity**

- 5.6.11 The potential hazard of ignition due to a build-up of static electricity should be assessed and precautions taken to eliminate it. (See ref 34).
- 5.6.12 All plant and equipment used for handling highly flammable liquids must be electrically bonded and earthed (see ref 34); non-static tools should also be used. Consideration should be given to any additional measures necessary to prevent the build up and uncontrolled discharge of static electricity. Bonding and earthing should be subject to an annual continuity test.
- 5.6.13 Trolleys, pump trucks and other wheeled devices should incorporate a conductive assembly, including tyres.
- 5.6.14 Where high concentrations of vapours are present the use of synthetic clothing and non-conducting shoes should be avoided to prevent a build-up of static electricity and possible discharge.
- 5.6.15 Where decanting takes place into a container with a small opening, a funnel should be used. Where a hose is used it should be ensured that the hose is of a conducting type.
- 5.6.16 Filling lines should terminate as close as possible to the bottom of tanks/containers to reduce the likelihood of a static build-up and discharge.
- 5.6.17 Safety drum transfer pumps incorporating controlled flow dispensing valves, flame arresters, self-closing lids and suitable earth bonding arrangements should be used for transferring large volumes of liquids. Small volumes of highly flammable liquids should be handled using safety dispensing cans. Drip trays should be provided.

#### **Fork-lift trucks**

- 5.6.18 Only lift trucks certificated for use in the relevant hazard zone should be used (see HSE Guidance HSG 113, ref 35).
- 5.6.19 Gangways in areas where flammable and highly flammable liquids are stored should be sufficiently wide to permit safe manoeuvring of trucks.
- 5.6.20 Battery powered trucks should not be charged within a zone in which a hazardous atmosphere may be present.

- 5.6.21 Gas cylinders of LPG fuelled trucks should not be changed in areas where highly flammable or flammable liquids are stored or used.
- 5.6.22 Further guidance on the safe use of lift trucks can be found in RISCAuthority, recommendations RC11 (ref 36).

#### Arson prevention

- 5.6.23 Vigilance should be maintained against deliberate fire setting at all times as a fire involving a flammable liquid will ignite easily and spread very rapidly.
- 5.6.24 Storage of flammable liquids should be permitted in the open only where there are adequate security precautions against arson and vandalism. Precautionary measures should be considered depending on the character of the neighbourhood and the quantity and nature of the flammable liquids stored. (See RISCAuthority recommendations RC48 (ref 37) and the FPA book *The prevention and control of arson* (ref 38).)

### 5.7 Containment

- 5.7.1 Topographical features of the premises and surrounding area should be taken into account when considering the choice of locations for the storage or use of flammable liquids. In all cases the implications of undulations should be considered in relation to a possible release of the materials that are being handled or stored. The potential consequences of fire water run-off should also be taken into account. (See HSE Guidance Note EH 70, ref 39.)
- 5.7.2 Safe catchment areas need to be provided to retain leakage, guard against the risk of pollution and contain a possible flowing liquid fire:
- catchment areas, or bunds, must have a capacity of not less than 110% of the capacity of the largest container in the bund or 25% of their aggregate storage capacity, whichever is greater;
  - the base and walls of the bund must be impermeable to oil and water;
  - the base and walls must not be penetrated by any drain pipe, valve or opening;
  - if any fill or draw off pipe passes through the base or wall of the bund the junction between the pipe and the base or wall must be adequately sealed to prevent the escape of oil or water;
  - tanks and bunds must be positioned or suitably protected so as to minimise the risk of damage by impact as far as practicable.
- 5.7.3 Adequate drainage facilities should be provided to a suitable container or a safe place. Discharge to main drains should not be permitted. Care should also be taken to prevent dense flammable vapours from entering drains.
- 5.7.4 Flammable and highly flammable liquids should not be stored or handled in areas that are liable to flooding.
- 5.7.5 Operating procedures should ensure that before transfer operations commence, a check is made to confirm that the liquid or solvent being delivered is of the correct type and that the quantity can be accommodated within the vessel.
- 5.7.6 Automatic shut-offs incorporating overfill alarms should be fitted to all enclosed vessels and to all vessels supplied by piped services, as a precaution against overfilling.
- 5.7.7 Containers should not be punctured to open them.
- 5.7.8 Where there is tank storage within a building, consideration should be given to providing an emergency dump facility.
- 5.7.9 It is desirable to provide a means of spill control, such as floor dishing or ramped sills, at door openings between compartments. Large containers may be stored on bunded pallets while in use.



**Figure 2: IBC container on bunded pallet**

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- 5.7.10 Spillages can happen at any time. An assessment should be made of the possible location and size of spillage or leakage and an action plan drawn up to include the availability of appropriate non-combustible absorbent materials and tools to deal with any incident. Staff should be trained in their use.
- 5.7.11 Containers which appear to be empty may contain residual vapour and can be extremely hazardous. They should be kept securely closed and treated in the same way as full containers.

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## 5.8 Exchange

- 5.8.1 Exchange refers to the primary need to ensure that flammable and highly flammable liquids are eliminated from the workplace if at all possible. Each such liquid should be considered in turn and possible non-combustible or aqueous based alternatives be considered. (A successful example of the practical application of this principle is to be found in the printing industry, where flammable blanket wash has largely been replaced by suitable water-based alternatives.)

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## 5.9 Separation

- 5.9.1 Wherever flammable liquids are stored or used, a list of the substances present should be maintained, along with details of their quantities and location (see COSHH Regulations, ref 15). The list should be kept in a place where it is readily available for use by the fire and rescue service on their arrival, such as a gatehouse.
- 5.9.2 Flammable liquids should not be stored with oxidising agents or flammable gases. Oxidising agents or other products incompatible with flammable liquids should be stored in separate areas. Further advice regarding these substances is set out in RISC Authority recommendations RC43 (ref 40).

**Figure 3: Detached flammable liquid store**



- 5.9.3 If practicable, the processing or handling of flammable liquids should be carried out in a detached building or, where this is not practical, in a compartment providing at least two hours fire resistance. (See *LPC Design Guide for the Fire Protection of Buildings 2000*, ref 41.)
- 5.9.4 Where flammable liquids are handled or stored, attention should be paid to the provision of physical barriers, such as bunds, as well as suitably designed compartment walls, floors and doorways, to restrict the flow of a large spillage.
- 5.9.5 High standards of housekeeping should be maintained to prevent the accumulation of rubbish, particularly combustible materials, in the vicinity of flammable and highly flammable liquids:

- any waste materials, contaminated cleaning rags etc, should be stored in clearly marked metal bins with metal lids and removed to a safe external area, ideally at least 10m from any buildings, at the end of each shift or working day.
  - waste flammable liquids should not be mixed and should be kept in clearly marked, closed, waste disposal tanks. The storage of waste flammable liquids should be to the same high safety standard as for virgin flammable liquids.
  - waste materials must not be disposed of by burning.
  - waste flammable liquids should be disposed of carefully on-site, or where necessary be removed from the site for further treatment by licensed waste contractors.
- 5.9.6 Quantities of flammable liquids stored in a working area should be kept to a minimum and be subject to a process risk assessment. In all cases the volumes should not exceed the requirements for the day or period of work. The risk assessment must ensure that less than 50litres of highly flammable liquid or 250litres of flammable liquid are stored in the working area at any time.
- 5.9.7 Solvents in the work area but not in use should be kept in closed containers and stored in suitable cabinets or bins.
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## **5.10 Electrical equipment for flammable atmospheres**

- 5.10.1 An assessment of the work areas and storage areas should be carried out and appropriate 'zones' assigned in accordance with the DSEAR 2002 and BS EN 60079-10-1 (refs 13 and 20).
- 5.10.2 Where flammable or highly flammable liquids are present, although control measures are taken to minimise their uncontrolled release as far as is reasonably practicable, there will always remain the possibility of an explosive/flammable atmosphere occurring. In the hazard zones identified in the DSEAR assessment all sources of ignition, including those associated with electrical sparks or hot surfaces of electrical apparatus, should be excluded or protected.
- 5.10.3 Should it be necessary to use electrical apparatus or install wiring in hazardous areas it is imperative that it is suitable for use in a flammable atmosphere. Expert advice may need to be sought for this assessment, because enclosed processes may produce different zoning risk assessments from when the same flammable liquids are in use in open areas. In the former case they have a reduced exposure probability. Certified explosion-protected electrical apparatus and cabling appropriate for the relevant zones should then be selected. All electrical equipment used in these areas shall comply with BS EN 60079-10-1 (ref 20) or equivalent. (Also see RISC Authority recommendations RC30, ref 5.)
- 5.10.4 A plan identifying hazard zones should be prepared. This should be displayed prominently in order to inform staff, contractors and visitors so as to ensure that no unauthorised activities take place in these areas.
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## **5.11 Transportation in enclosed systems**

- 5.11.1 In piped systems flammable liquids should be supplied by metered pumps and not be gravity fed.
- 5.11.2 Pumps should be appropriately rated for the zone in which they are installed (see 10.1 and 10.3).
- 5.11.3 Pipes should normally be of steel or stainless steel or be approved by recognised standards. They should be clearly labelled and/or colour coded (ref 42), marked with arrows to indicate the direction of flow and with any additional marking to indicate a hazard as necessary. The marking should especially be done near to the most

hazardous points such as joints or valves. The emergency cut off valves should also be clearly signed.

- 5.11.4 The imposed loads should be taken into account when pipes are buried and appropriate measures, including installing on a bed of compacted material and covering suitably, should be taken to protect such pipes. Two or more levels of pipes in a single trench should be separated vertically by at least 150mm of well compacted backfill.
- 5.11.5 Similarly, loads should be considered when designing support systems for pipelines above ground level.
- 5.11.6 Pipework systems should be electrically bonded and earthed (see ref 34).
- 5.11.7 Quick-action shut-off valves should be provided at the dispensing point, to guard against spillage.
- 5.11.8 In addition to local shut-off valves, to ensure that under fire conditions supplies are isolated in the most effective manner, emergency stops should be provided to turn off pumps and to close valves installed at the most remote point, ideally at the source of the supplies.
- 5.11.9 Consideration should be given to interlocking the emergency stops to operate automatically in the event of any alarm arising from the operation of manual or automatic fire alarm systems and sprinklers. In addition, the pumps should be isolated and the remotely located valves closed out of working hours.
- 5.11.10 No pipe carrying flammable or highly flammable liquid should pass through any ducting or hazardous areas such as transformer rooms where it could be exposed to excessive heat or corrosion.
- 5.11.11 Pipe runs should be kept as short as possible with directional changes kept to a minimum.
- 5.11.12 Flexible pipes can be used in areas of vibration. These should be designed so that the possibility of the diameter of the pipe being restricted by kinking or a similar process is avoided. Flexible pipes should be kept as short as possible and should be electrically bonded and pressure tested annually.
- 5.11.13 Where practicable, welded joints are preferred over flanges to reduce the possibility of leaks. Where welding is not practical, pipes should be flanged, threaded or mechanically attached so that the mechanical strength of the joint will not be impaired if exposed to fire.
- 5.11.14 Piping systems used for transporting flammable or highly flammable liquids should be maintained liquid tight. Pipework that leaks constitutes a hazard and should be emptied of liquid and repaired in a suitable manner.

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## **5.12 Transportation other than in closed systems**

- 5.12.1 Wherever large quantities of flammable or highly flammable liquids have to be routinely handled, consideration should be given to transporting the material via a pipeline.
- 5.12.3 Small quantities of flammable and highly flammable liquids should always be transported in safety containers; open containers should never be permitted to be used for this purpose.
- 5.12.3 Large volumes of flammable and highly flammable liquids should be transported in drums or tanks designed for this purpose. Containers should be of robust construction so as to resist damage during transit. The containers should be suitably labelled and handled with care, especially when loading and unloading from vehicles.
- 5.12.4 Where very large volumes of flammable and highly flammable liquids are in use or transit a Dangerous Goods Safety Advisor should be engaged to provide competent advice in compliance with the ADR Regulations (ref 43).

- 5.12.5 Further guidance regarding the storage of flammable and highly flammable liquids in drums, cans and other containers is set out in RISCAuthority recommendations RC56 (ref 6).
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### **5.13 Tanks**

- 5.13.1 Any tank heating equipment should be fitted with a duplicate thermostat and high temperature limit device. The high temperature limit device should prevent the temperature of the liquid exceeding a temperature of 10°C below its boiling point. There should be a regular testing programme for the thermostats and temperature limit devices, with the results being recorded.
- 5.13.2 Any vessel containing internal heating elements should be fitted with a duplicate low-liquid-level alarm and cut-out to prevent the elements being exposed to the atmosphere. Provision should be made for isolation of the system in the event of an emergency.
- 5.13.3 Vent pipes from storage tanks should be designed to release vapours so as to allow them to disperse safely; this should be subject to a risk assessment in compliance with DSEAR. Normally, a discharge height of 0.3m above the top of the tank or at least 3m above ground level should be sufficient but there may be a need to increase this height to achieve effective and safe vapour dispersion. Vent outlets should be located so that vapours are discharged upwards or horizontally away from adjacent walls and clear of eaves and other obstructions.
- 5.13.4 All tanks and vessels should be clearly and boldly marked in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996 (ref 17) or other applicable legislation as listed in Schedule 5 of DSEAR.
- 5.13.5 Further guidance regarding the storage of flammable liquids in external fixed tanks is set out in RISCAuthority recommendations RC57 (ref 7).
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### **5.14 Fire protection**

- 5.14.1 Fire protection measures for areas where flammable and highly flammable liquids are stored, handled or used should be proportionate to the risk and be based on the findings of the fire risk assessments carried out in compliance with fire safety legislation and DSEAR (refs 8-13).
- 5.14.2 Where flammable liquids are used or stored, appropriate portable fire extinguishers, approved and certificated by an independent, third-party certification body, should be installed and maintained in accordance with British Standard BS 5306: Parts 3 and 8 (see refs 44 and 45).
- 5.14.3 As part of the fire risk assessment, consideration should be given to installing a fixed fire suppression system proportionate to the risk, such as sprinklers with foam additives. This will be particularly relevant for very hazardous plant or processes that are critical to the wellbeing of the business. When installing such a system the guidance set out in Technical Bulletin TB214 should be followed in addition to that in BS EN 12845 (refs 46 and 47).
- 5.14.4 Consideration should also be given to installing an automatic fire detection and alarm system in accordance with BS 5839: Part 1 (ref 48).
- 5.14.5 During the design stage of the fire protection systems for hazard zones, it should be borne in mind that they should be intrinsically safe and appropriate for the zone, temperature and other relevant parameters of the environment in which they will be installed.

## 6. Checklist

Compliance with fire safety legislation (section 1)						
6.1		Yes	No	N/A	Action required	Due date Sign on completion
6.1.1	Has a suitable and sufficient fire risk assessment been undertaken for all premises to which the Regulatory Reform (Fire Safety) Order 2005 (or equivalent legislation in Scotland and Northern Ireland) applies? (5.1.1)					
6.1.2	Does the assessment consider staff remote from the process area who may be affected by smoke and heat in the event of a fire? (5.1.2)					
6.1.3	In business critical areas, do the implications for property protection and business continuity, as well as life safety, feature prominently in the assessment? (5.1.2)					
6.1.4	Has an assessment been undertaken in accordance with the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) that identifies hazard zones in the workplace? (5.1.3)					
6.1.5	Are the risk assessments the subject of periodic review, including at the time when any changes to the process, the substances involved, the method of storing or handling the substances or the treatment of waste solvents are being considered? (5.1.4)					
6.1.6	Has reference been made to the relevant fire and rescue service to become aware of the levels of response in the areas in which the premises are located? (5.1.5)					
Business continuity (section 2)						
6.2						
6.2.1	If it is intended that equipment is to be left operating without staff in attendance then has a specific risk assessment for the process been undertaken and appropriate control measures introduced? (5.2.1)					
6.2.2	Have steps been taken to maintain the continuity of operations by making a suitable emergency plan? (5.2.2)					
6.2.4	Does the emergency plan indicate the lines of communication that should be followed and the contact details for specialist assistance, providers of alternative accommodation and suppliers of replacement equipment? (5.2.2)					
6.2.5	Are table top exercises held periodically to test the effectiveness and suitability of the emergency plans? (5.2.3)					
6.2.6	Is consideration given to applying commercially available computer programmes, such as the ROBUST software (Resilient Business Software Toolkit) or a similar product, to develop and check the adequacy of the plan? (5.2.4)					
Fire safety management (section 3)						
6.3						
6.3.1	Is attention given at the outset to eliminating flammable and highly flammable liquids from the workplace wherever possible? (5.3.1)					
6.3.2	Is the workforce made aware of the presence and use of flammable liquids, and the hazards involved within the buildings in which they are working? (5.3.2)					

		Yes	No	N/A	Action required	Due date	Sign on completion
6.3.3	Are staff trained in good practice relating to the opening, handling and disposal of containers? (5.3.3)						
6.3.4	Are all staff familiar with the hazards associated with the product(s) used, the necessary precautions and the action to be followed in the event of fire or spillage? (5.3.4)						
6.3.5	Are staff made aware of the hazards of deliberate fire raising, which may be carried out by colleagues as well as by intruders? (5.3.5)						
6.3.6	Is access to flammable liquids and nominally 'empty' containers denied to intruders? (5.3.6)						
6.3.7	Are containers labelled in accordance with BS EN ISO 7010? (5.3.7)						
6.3.8	Is installed or portable electrical equipment, including electric lighting, appropriate for the hazard zone in which it is to be used? (5.3.9)						
<b>6.4 VICES (section 4)</b>							
6.4.1	Has the HSE guidance in booklet HS(G)51, which suggests the use of the acronym VICES, been used to help apply five basic principles which ensure that any flammable or highly flammable liquid that is necessary in the workplace is used and stored with appropriate care? (5.4.1)						
6.4.2	Is suitable staff training in place to ensure all personnel are aware of the hazards in the workplace and apply VICES to ensure a safer working environment for all? (5.4.2)						
6.4.3	Ventilation: Is there sufficient ventilation to keep the concentration of the liquid's vapour below its lower explosive limit? (5.4.3)						
6.4.4	Ignition: Have all possible ignition sources been removed and is the electrical equipment used in this area suited to the risk category? (5.4.3)						
6.4.5	Containment: (5.4.4) <ul style="list-style-type: none"> <li>• Are the liquids stored in suitable containers?</li> <li>• In the event of a spill will they be contained?</li> <li>• Is it possible to prevent spillages from spreading?</li> <li>• Are bunds or catchment trays present where required?</li> <li>• Are 'empty' containers properly managed?</li> </ul>						
6.4.6	Exchange: Can the flammable substances can be eliminated from the workplace or be replaced by less flammable ones? (5.4.5)						
6.4.7	Separation: Are flammable liquids stored apart from other stored materials and are physical barriers present as required? (5.4.6)						
<b>6.5 Ventilation (section 5)</b>							
6.5.1	Is adequate ventilation provided by natural or mechanical means to prevent concentrations of vapour accumulating to within the relevant explosive limits of the most hazardous solvent likely to be present? (5.5.1)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.5.2	Are flammable liquid stores located at or above ground level unless sufficient mechanical ventilation is provided? (5.5.2)						
6.5.3	Are adequate ventilation openings provided at low and high level, direct from the storage area to the outside to prevent accumulations of flammable vapour? (5.5.3)						
6.5.4	If mechanical ventilation is used, does it provide at least six air changes per hour with extract at low level and inlets at high level, positioned so as to provide cross-flow? (5.5.4)						
6.5.5	Where mechanical ventilation is installed, is the location of the exhaust outlet subject to a risk assessment in compliance with DSEAR? (5.5.5)						
6.5.6	Is ventilation ductwork terminated at least 3m above ground level and the same distance from building openings (including the eaves of buildings), boundaries, natural hazards such as drains and sources of ignition? (5.5.5)						
6.5.7	Is ducting of non-combustible construction, taking as short a route as possible, with as few directional changes as possible and arranged so that vapours cannot condense and collect at low points in the ductwork? (5.5.7)						
6.5.8	Is ductwork for extracting flammable vapours free of dampers? (5.5.7)						
6.5.9	Where flammable or highly flammable liquids are stored and mechanical ventilation cannot be provided, is explosion relief provided according to the findings of a risk assessment? (5.5.8)						
6.5.10	Is expert advice sought if necessary where the discharge of a dangerous substance into the atmosphere may have an environmental impact? (5.5.9)						
6.5.11	Are safe procedures followed for the cleaning of tanks and vessels, particularly where a change of use or type of content is proposed? (5.5.10)						
<b>6.6</b>	<b>Ignition (section 6)</b>						
6.6.1	Have all potential sources of ignition in the workplace been identified in the fire risk assessment? (5.6.1)						
6.6.2	Has an assessment of the lightning risk been undertaken in accordance with BS EN 62305 and RISC Authority recommendations RC35? (5.6.2)						
6.6.3	Is smoking prohibited in all areas where flammable liquids are used or stored with suitable notices being prominently displayed? (5.6.3)						
6.6.4	Is all necessary maintenance or contractors' work in areas where flammable or highly flammable liquids are in use carried out according to a Method Statement and under a 'Permit to Work' system? (5.6.4)						
6.6.5	Is cold cutting used where possible as an alternative to hot work if equipment cannot be removed to a safe environment, such as a workshop, for the work to be conducted? (5.6.5)						
6.6.6	Is the heating installation suitable for the hazard zone in which the highly flammable or flammable liquids are being stored or used? (5.6.6)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.6.7	Where a heating system providing ducted warm air or supplying hot water or steam to pipes and radiators is in use, does the system incorporate a heat exchanger so as to prevent flammable vapours from coming into contact with an ignition source? Does hot water or steam circulate at a temperature not exceeding 120°C? (5.6.7)						
6.6.8	Are electrical heaters of the low temperature flameproof type, certificated for the use in the relevant hazard zone, with the temperature of the external surface of such heaters not exceeding 120°C? (5.6.8)						
6.6.9	Does electrical underfloor or ceiling heating have heating elements totally embedded in concrete or employ air ducts to circulate hot air within the floor or ceiling? (5.6.9)						
6.6.10	Are heating installations and equipment maintained according to the manufacturer's instruction? (5.6.10)						
6.6.11	Has the potential hazard of ignition due to a build-up of static electricity been assessed and precautions taken to eliminate it? (5.6.11)						
6.6.12	Has all plant and equipment used for handling highly flammable liquids been electrically bonded and earthed, with the bonding and earthing being subject to an annual continuity test? (5.6.12)						
6.6.13	Do trolleys, pump trucks and other wheeled devices incorporate a conductive assembly, including tyres? (5.6.13)						
6.6.14	Where high concentrations of vapours are present, is the use of synthetic clothing and non-conducting shoes avoided to prevent a build-up of static electricity and possible discharge? (5.6.14)						
6.6.15	Where decanting takes place into a container with a small opening, is a funnel used (or where a hose is used is it of a conducting type)? (5.6.15)						
6.6.16	Do filling lines terminate as close as possible to the bottom of tanks/containers to reduce the likelihood of static build-up and discharge? (5.6.16)						
6.6.17	Are safety drum transfer pumps incorporating controlled flow dispensing valves, flame arresters, self-closing lids and suitable earth bonding arrangements used for transferring large volumes of liquids? (5.6.17)						
6.6.18	Are only lift trucks certificated for use in the relevant hazard zone in use in these areas? (5.6.18)						
6.6.19	Are gangways in areas where flammable and highly flammable liquids stored sufficiently wide to permit safe manoeuvring of trucks? (5.6.19)						
6.6.20	Are battery powered trucks charged away from a zone in which a hazardous atmosphere may be present? (5.6.20)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.6.21	Are gas cylinders of LPG fuelled trucks changed away from areas where highly flammable or flammable liquids are stored or used? (5.6.21)						
<b>6.7</b>	<b>Containment (section 7)</b>						
6.7.1	Are topographical features of the premises and surrounding area taken into account when considering the choice of locations for the storage or use of flammable liquids? (5.7.1)						
6.7.2	Are safe catchment areas provided to retain leakage, guard against the risk of pollution and contain a possible flowing liquid fire? (5.7.2)						
6.7.3	Are adequate drainage facilities provided to a suitable container or a safe place? (5.7.3)						
6.7.4	Are flammable and highly flammable liquids be stored and handled in areas that are not liable to flooding? (5.7.4)						
6.7.5	Do operating procedures ensure that before transfer operations commence, a check is made to confirm that the liquid or solvent being delivered is of the correct type and that the quantity can be accommodated within the vessel? (5.7.5)						
6.7.6	Are automatic shut-offs incorporating overfill alarms fitted to all enclosed vessels and to all vessels supplied by piped services as a precaution against overfilling? (5.7.6)						
6.7.7	Have staff been trained not to puncture containers as a means of opening them? (5.7.7)						
6.7.8	Where there is tank storage within a building, has consideration been given to providing an emergency dump facility? (5.7.8)						
6.7.9	Is floor dishing or ramped access used as a means to control spillages at door openings between compartments? (5.7.9)						
6.7.10	Are large containers stored on bunded pallets while in use? (5.7.9)						
6.7.11	Has an assessment been made of the possible location and size of spillage or leakage and an action plan drawn up to include the availability of appropriate non-combustible absorbent materials and tools to deal with any incident? (5.7.10)						
6.7.12	Are containers which appear to be empty kept securely closed and treated in the same way as full containers? (5.7.11)						
<b>6.8</b>	<b>Exchange (section 8)</b>						
6.8.1	Is each flammable and highly flammable liquid considered in turn and possible non-combustible or aqueous based alternatives considered? (5.8.1)						
<b>6.9</b>	<b>Separation (section 9)</b>						
6.9.1	Wherever flammable liquids are stored or used, is a list of the quantities and locations of substances present maintained in a place where it is readily available for use by the fire and rescue service? (5.9.1)						
6.9.2	Is care taken not to store flammable liquids with oxidising agents or flammable gases? (5.9.2)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.9.3	Where practicable, is the processing or handling of flammable liquids carried out in a detached building? (5.9.3)						
6.9.4	Where flammable liquids are handled or stored, is attention paid to the provision of physical barriers, such as bunds, as well as suitably designed compartment walls, floors and doorways, to restrict the flow of a large spillage? (5.9.4)						
6.9.5	Are high standards of housekeeping maintained to prevent the accumulation of rubbish, particularly combustible materials, in the vicinity of flammable and highly flammable liquids? (5.9.5)						
6.9.6	Are the quantities of flammable liquids stored in a working area kept to a minimum and subject to a process risk assessment? (5.9.6)						
6.9.7	Are solvents in the work area that are not in use kept in closed containers and stored in suitable cabinets or bins? (5.9.7)						
<b>6.10</b>	<b>Electrical equipment for flammable atmospheres (section 10)</b>						
6.10.1	Has an assessment of the work areas and storage areas been carried out and appropriate 'zones' assigned in accordance with DSEAR? (5.10.1)						
6.10.2	In the hazard zones identified in the DSEAR assessment, are all sources of ignition, including those associated with electrical sparks or hot surfaces of electrical apparatus, excluded or protected? (5.10.2)						
6.10.3	Has certified explosion-protected electrical apparatus and cabling been selected for use in hazard zones? (5.10.3)						
6.10.4	Has a hazard zone plan been prepared and displayed prominently in order to inform staff, contractors and visitors of the zones so as to ensure that no unauthorised activities take place in these areas? (5.10.4)						
<b>6.11</b>	<b>Transportation in enclosed systems (section 11)</b>						
6.11.1	In piped systems, are flammable liquids supplied by metered pumps rather than being gravity fed? (5.11.1)						
6.11.2	Are pumps appropriately rated for the zone in which they are installed? (5.11.2)						
6.11.3	Are pipes constructed of steel or stainless steel or approved by recognised standards; are they clearly labelled and/or colour coded and marked with arrows to indicate the direction of flow? (5.11.3)						
6.11.4	Are the imposed loads taken into account when pipes are buried and appropriate measures, including installing on a bed of compacted material and covering suitably, taken to protect such pipes? (5.11.4)						
6.11.5	Are loads considered when designing support systems for pipelines above ground level? (5.11.5)						
6.11.6	Are pipework systems electrically bonded and earthed? (5.11.6)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.11.7	Are quick-action shut-off valves, provided at the dispensing point, to guard against spillage? (5.11.7)						
6.11.8	In addition to local shut-off valves are emergency stops provided to turn off pumps and close valves installed at the most remote point, ideally at the source of the supplies? (5.11.8)						
6.11.9	Has consideration been given to interlocking the emergency stops to operate automatically in the event of any alarm arising from the operation of manual or automatic fire alarm systems and sprinklers? (5.11.9)						
6.11.10	Has it been ensured that no pipe carrying flammable or highly flammable liquid passes through any ducting or hazardous areas such as transformer rooms where it could be exposed to excessive heat or corrosion? (5.11.10)						
6.11.11	Are pipe runs kept as short as possible with directional changes kept to a minimum? (5.11.11)						
6.11.12	Where flexible pipes have been used in areas of vibration, are these designed so that the possibility of the diameter of the pipe being restricted by kinking or a similar process is avoided? (5.11.12)						
6.11.13	Where practicable, are welded joints, rather than flanges, installed to reduce the possibility of leaks? (5.11.13)						
6.11.14	Are piping systems used for transporting flammable or highly flammable liquids maintained liquid tight? (5.11.14)						
<b>6.12</b>	<b>Transportation other than in closed systems (section 12)</b>						
6.12.1	Wherever large quantities of flammable or highly flammable liquids have to be routinely handled, has consideration been given to transporting the material via a pipeline? (5.12.1)						
6.12.2	Are small quantities of flammable and highly flammable liquids always transported in safety containers? (5.12.2)						
6.12.3	Are large volumes of flammable and highly flammable liquids transported in drums or tanks designed for this purpose? (5.12.3)						
6.12.4	Where very large volumes of flammable and highly flammable liquids are in use or transit, has a Dangerous Goods Safety Advisor been engaged to provide competent advice in compliance with the ADR Regulations? (5.12.4)						
<b>6.13</b>	<b>Tanks (section 13)</b>						
6.13.1	Is tank heating equipment fitted with a duplicate thermostat and high temperature limit device? (5.13.1)						
6.13.2	Is any vessel containing internal heating elements fitted with a duplicate low-liquid-level alarm and cut-out to prevent the elements being exposed to the atmosphere, with provision being made for isolation of the system in the event of an emergency? (5.13.2)						
6.13.3	Are vent pipes from storage tanks designed to release vapours so as to allow them to disperse safely? (5.13.3)						

		Yes	No	N/A	Action required	Due date	Sign on completion
6.13.4	Are all tanks and vessels clearly and boldly marked in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996 or other applicable legislation as listed in Schedule 5 of DSEAR? (5.13.4)						
<b>6.14</b>	<b>Fire protection (section 14)</b>						
6.14.1	Are the fire protection measures for areas where flammable and highly flammable liquids are stored, handled or used proportionate to the risk and based on the findings of the fire risk assessments carried out in compliance with fire safety legislation and DSEAR? (5.14.1)						
6.14.2	Where flammable liquids are used or stored, are appropriate portable fire extinguishers, approved and certificated by an independent, third-party certification body, installed and maintained in accordance with BS 5306: Parts 3 and 8? (5.14.2)						
6.14.3	As part of the fire risk assessment, has consideration been given to installing a fixed fire suppression system proportionate to the risk, such as sprinklers with foam additives? (5.14.3)						
6.14.4	Has consideration been given to installing an automatic fire detection and alarm system in accordance with BS 5839: Part 1? (5.14.4)						
6.14.5	During the design stage of the fire protection systems for hazard zones, was it borne in mind that they should be intrinsically safe and appropriate for the zone, temperature and other relevant parameters of the environment in which they will be installed? (5.14.5)						

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3. RC31: *Recommendations for fire safety in automotive refinishing and paint spraying processes*, 2008, Fire Protection Association.
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5. RC30: *Recommendations for the selection of electrical and non-electrical equipment for use in atmospheres containing flammable and explosive gases or atmospheres*, 2005, Fire Protection Association.
6. RC56: *Recommendations for fire safety in the storage and use of highly flammable and flammable liquids: Storage in containers other than external fixed tanks*, 2014, Fire Protection Association.
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9. The Fire (Scotland) Act 2005, asp 5, The Stationery Office.
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11. Fire and Rescue Services (Northern Ireland) Order 2006, SI 2006 No 1254 (NI9), The Stationery Office.
12. Fire Safety Regulations (Northern Ireland) 2010, SI 2010 No 325 (NI), The Stationery Office.
13. Dangerous Substances and Explosive Atmospheres Regulations (DSEAR), 2002, SI 2002 No 2776, The Stationery Office.
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20. BS EN 60079-10-1:2009, *Explosive atmospheres. Classification of areas. Explosive gas atmospheres*, British Standards Institution.
21. Directive 1992/69/EEC, *Classification, packaging and labelling of dangerous substances*, The Stationery Office.
22. HSG71: *Chemical warehousing: The storage of packaged dangerous substances*, 2009, Health and Safety Executive.
23. RC42: *Recommendations for fire safety of unattended processes*, 2011, Fire Protection Association.
24. Business resilience: A guide to protecting your business and its people, 2005, Fire Protection Association.

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26. BS EN ISO 7010: 2012: *Graphical symbols. Safety colours and safety signs*. Registered safety signs. British Standards Institution.
27. HSG 51: *Storage of flammable liquids in containers*, 1998, Health and Safety Executive.
28. BS 5925: 1991: *Code of practice for ventilation principles and designing for natural ventilation*, British Standards Institution.
29. CS15: *The cleaning and gas freeing of tanks containing flammable residues*, 1985, Health and Safety Executive.
30. BS EN 62305: *Protection against lightning* (several parts), British Standards Institution.
31. RC35: *Protection of buildings against lightning strike*, 2013, Fire Protection Association.
32. RC51: *Recommendations regarding smoking at work*, 2013, Fire Protection Association.
33. RC7: *Recommendations for hot work*, 2012, Fire Protection Association.
34. BS 7430: 2011: *Code of practice for protective earthing of electrical installations*, British Standards Institution.
35. HSG 113: *Lift trucks in potentially flammable atmospheres*, 1996 Health and Safety Executive.
36. RC11: *Recommendations for fire safety in the use of lift trucks*, 2014, Fire Protection Association.
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38. *The Prevention and Control of Arson*, Adair Lewis, 2012 Fire Protection Association.
39. EH 70: *The control of firewater run-off from CIMAH sites to prevent environmental damage*, 1995, Health and Safety Executive.
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42. BS 1710: 1984: *Specification for identification of pipelines and services*, British Standards Institution.
43. ADR: *European Agreement Concerning the International Carriage of Dangerous Goods by Road*, 2013, United Nations.
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45. BS 5306-8: 2012: *Fire extinguishing installations and equipment on premises. Selection and positioning of portable fire extinguishers. Code of practice*, British Standards Institution.
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47. British Standard/European Standard 12845: 2003: *Fixed firefighting systems. Automatic sprinkler systems. Design, installation and maintenance*, British Standards Institution.
48. BS 5839-1: 2013: *Fire detection and fire alarm systems for buildings. Code of practice for design, installation, commissioning and maintenance of systems in non-domestic premises*, British Standards Institution.

#### Further reading

- L138: *Dangerous substances and explosive atmospheres regulations 2002, Approved Code of Practice and Guidance*, 2013, Health and Safety Executive.

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