

Recommendations



for fire safety in
the storage and
use of highly
flammable and
flammable liquids

Part 2: Storage in drums,
cans and containers other
than external fixed tanks

RC20



InFiReS

LOSS PREVENTION RECOMMENDATIONS

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SCOPE

These recommendations present measures relevant to fire safety in the storage of highly flammable and flammable liquids in drums, cans and containers other than in external fixed tanks. Such liquids (which may include solvents, adhesives, resins etc) may have flashpoints of up to 55°C. Some of these liquids may represent other types of hazards – for example, to health – but such hazards are not discussed in this document.

The document does not apply to the use or storage of liquefied petroleum gas (LPG), aerosol products or spraying, for which more specific guidance is available (see refs 1 to 5). Pressurised containers are also outside the scope of these Recommendations.

Legislation may impose requirements additional to the provisions contained in this document. Due regard should also be given to considerations of environmental protection. (See refs 6 to 10.)

These Recommendations are part of a suite of documents and should be read in conjunction with RC20 Parts 1 and 3 (refs 11 and 12).

The guidance set out here should be taken into consideration when risk assessments are carried out in compliance with the Regulatory Reform (Fire Safety) Order 2005 and equivalent legislation in Scotland and Northern Ireland (refs 13 to 16) and the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002 (ref. 17).

SYNOPSIS

These Recommendations give advice on the storage of flammable and highly flammable liquids in industry. Information includes the design of bunds for external storage, internal flammable liquid stores and flammable liquid cupboards for the workplace.

Detailed guidance includes advice on ventilation, the heating of stores, the selection of electrical equipment and provisions for the safe use of lift trucks.

DEFINITIONS

Auto-ignition temperature

The minimum temperature at which a material will ignite spontaneously under specified test conditions.

Classification of hazardous areas (BS EN 60079-10: 2003) (ref. 18)

(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.

Explosive limits (BS EN 60079-10: 2003)

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: 2003)

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

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. 17) 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 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' [ref. 3] with a heating time of 60 seconds supports combustion...'



INTRODUCTION

Flammable and highly flammable liquids fall within the definition of 'dangerous substance' as referred to in the Dangerous Substances and Explosive Atmospheres Regulations 2002 (DSEAR) (ref. 17).

As a result of this legislation, 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 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 close to ambient temperatures are obviously more hazardous than those with flashpoints at temperatures unlikely to be reached in the workplace.

Two main dangers need to be recognised:

- (a) the danger of explosion, when flammable vapour/air mixtures fall within their explosive limits; and
- (b) 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 oxygen enrichment or depletion of the atmosphere, 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, are stored adjacent to flammable liquids. In addition, a fire may grow and involve dangerous substances which are themselves not combustible (see Health and Safety booklet HSG71: *Chemical warehousing. The storage of packaged dangerous substances* (ref. 19)).

These recommendations apply to all flammable and highly flammable liquids. Under certain conditions some of these requirements, where liquids with higher 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 the Regulatory Reform (Fire Safety) Order 2005 (ref. 13).

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 is not a once in a lifetime approach. It should be reviewed periodically, and also following an incident or near-miss and when there are changes in:

- the equipment being used;
- the materials being used in the process;
- the operating procedures;
- the operating parameters and control measures that are observed;
- the management of the process;
- the size of the operation; and
- the 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;
- blatant 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 appropriate waste management, for example of 'empty' containers: 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 should be observed, particularly those relating to the provision of bunds (ref. 10).

RECOMMENDATIONS

1. General considerations

- 1.1 At the outset, attention should always 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-combustible liquids as alternatives – or at least with those having a flashpoint above 55°C.
- 1.2 The HSE guidance in booklet HSG51 (ref. 20) suggests the use of the acronym VICES to help apply five basic principles which ensure that any flammable or highly flammable liquid that is irreplaceable is used and stored with appropriate care.

The acronym may be explained as follows:

V Ventilation (see section 2)

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

I Ignition (see section 3)

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

C Containment (see section 4)

- 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 5)

- Can flammable substances be eliminated?
- Can the substance be replaced by a less flammable one?

S Separation (see section 6)

- 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?

1.3 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.

2. Ventilation

2.1 Low-level and high-level ventilation direct to the open air should be provided in a storage building or compartment to prevent the accumulation of flammable vapour. This may be achieved by the use of air-bricks. The vent area should comprise at least 2.5% of the combined area of the roof (ceiling) and walls. Care should be taken to prevent drums obstructing the openings.

2.2 Alternatively, mechanical ventilation may be used, to provide at least six air changes per hour. Extract must be at low level, 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. 21) and the location of the exhaust outlet should be subject to a risk assessment in compliance with DSEAR.

2.3 Where mechanical ventilation is installed, the exhaust ducting should:

- be of non-combustible construction;
- have limited directional changes and take as short a route 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.

2.4 To enable adequate ventilation where storage is in the open air, sites selected for this purpose should not be in hollows or other areas below surrounding ground level where released flammable vapours may accumulate.

2.5 Open air storage areas should be away from buildings and structures that may prevent an adequate flow of air for ventilation.

Explosion relief

2.6 In buildings or compartments where highly flammable liquids are stored, at least 10% of the combined area of the roof (ceiling) and walls

should have openings and/or construction capable of providing explosion relief direct to a safe place in the open.

3. Ignition

- 3.1 One of the major objectives of any fire risk assessment is to identify potential sources of ignition in the workplace. These will include flames, hot surfaces and areas of movement that may lead to the generation of heat by friction or the build up of static charges. All sources of ignition should be eliminated and temperatures maintained well below the auto-ignition temperature of the liquid. (Also refer to RC 20-1 (ref. 11)).
- 3.2 Smoking must be prohibited in all areas where flammable liquids are used or stored and appropriate notices prominently displayed.
- 3.3 The risk assessments undertaken for open air storage areas should also seek to mitigate the hazards associated with motor vehicles being introduced into the proximity.

Heating

- 3.4 The use of sealed hot water radiators is preferred for heating; the presence of flames and electrically heated elements must be avoided.
- 3.5 Heating must be suitable for the zone in which the work is being carried out (see Definitions section of this document).
- 3.6 Areas used for the storage and use of highly flammable and flammable liquids may be heated by the following:
- 3.6.1 A heating system providing ducted warm air or supplying hot water or steam to pipes and radiators. The system should incorporate a heat exchanger so as to prevent flammable vapours from coming into contact with an ignition source.
- 3.6.2 Any furnace or heat exchanger should be segregated and located either outside the 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 zone in which the highly flammable or flammable liquids are being stored or processed.
- 3.6.3 Hot water or steam should circulate at a temperature not exceeding 120°C.
- 3.6.4 Electrical heaters of the low temperature flameproof type, certificated for use within the zone. The temperature of the external surface of such heaters should not exceed 120°C.
- 3.6.5 Electrical underfloor or ceiling heating with heating elements totally embedded in concrete.

Electrical equipment

- 3.7 Electrical equipment and wiring should be certified as suitable for use within the zone in which the flammable liquid is being stored or processed (see ref. 18), as determined by a risk assessment. They should also comply with the provisions of the Electricity at Work Regulations 1989 (ref. 22). All electrical installations and maintenance thereof should comply with BS EN 60079-14 (ref. 23).
- 3.8 Alternatively, electrical wiring and equipment should be located outside the building in which the flammable liquids are being stored or handled.

Static electricity

- 3.9 The potential hazard of ignition due to a build-up of static electricity should be assessed and precautions taken to eliminate it (see ref. 24).
- 3.10 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.
- 3.11 All plant and equipment used for handling highly flammable liquids must be electrically bonded and earthed (see ref. 24); 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.
- 3.12 Where decanting takes place into a container with a smaller opening, a long-necked funnel should be used. Where a hose is used it should be ensured that the hose is of a conducting type.
- 3.13 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.
- 3.14 (a) Safety drum transfer pumps incorporating controlled flow dispensing valves, flame arresters, self-closing lids and suitable earth bonding arrangements should be used for transferring larger volumes of liquids. Drip trays should be provided.
- (b) Smaller volumes of highly flammable liquids should be handled using safety dispensing cans.

Filling

- 3.15 A filling pipe, if used, should terminate as close as possible to the bottom of the tank to prevent the build-up and discharge of static electricity.
- 3.16 Copper earthing strips around the perimeter of the room may be needed to facilitate the discharge of static electricity.

Lift trucks

- 3.17 Only lift trucks certified to the appropriate electrical zoning standard should be used (see HSE Guidance HSG113 (ref. 25)).
- 3.18 Gangways should be sufficiently wide to permit safe manoeuvring of trucks.
- 3.19 Suitably positioned barrier rails should be considered to minimise the risk of impact damage.
- 3.20 Battery powered trucks should not be charged within a zone in which a hazardous atmosphere may be present.
- 3.21 The gas cylinders of LPG fuelled trucks should not be changed in areas where highly flammable or flammable liquids are stored or used.
- 3.22 Further guidance on the use of fork lift trucks can be found in RC11: *Recommendations for the use of fork-lift trucks* (ref. 26).

Protection from direct sunlight

- 3.23 For very low flashpoint or unstable liquids (or in the exceptional circumstances of less than 5% vapour space being provided in drums), consideration should be given to shielding the containers from direct sunlight. This may be accomplished by providing an open-sided canopy of non-combustible material.

Arson prevention

- 3.24 Storage of flammable liquids should be permitted in the open only where there are adequate security precautions against arson and vandalism. Precautionary measures which should be considered depend upon the nature of the neighbourhood and the quantity and nature of the flammable liquids stored. (See the FPA book, *The Prevention and Control of Arson* (ref. 27).)
- 3.25 The storage area and its immediate surroundings should be kept free from combustible materials, including waste, weeds and dried vegetation.

4. Containment

Bunding

- 4.1 Safe catchment areas need to be provided to contain a possible flowing liquid fire and to guard against the risk of pollution. These catchment areas, or bunds, should:
 - incorporate an impervious sill or low bund, at least 150mm high, and must have a capacity of not less than 110% of the contents 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 and be treated with a proprietary sealing product where necessary to maintain this property;
- 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;
- provision needs to be made for the drainage of rain water from the bund area. To avoid pollution, however, rain water should not be allowed to enter surface water drains.
- where the bund is deeper than 300mm it is recommended that mechanical ventilation be provided; and
- tanks and bunds must be positioned so as to minimise the risk of damage by impact as far as practicable.

- 4.2 Only liquid products should be stored in the bund area and it should be kept free from any combustible materials. The bund may take the form of a ramped sill at the entrance to allow wheeled access for the safe handling of products.

- 4.3 All drums should be accessible to enable leakages to be easily identified and to minimise the amount of handling needed to remove any specific container.

- 4.4 Drums in bunds should be stored off the ground on non-combustible stillage to limit corrosion.

Dispensing

- 4.5 Storage containers shall be suitable for the product stored. They should be robust, with tight-fitting lids to resist spillage. Where small containers of about 2.5 litres are used, they should be fitted with a carrying handle or be conveyed in suitable carriers. Glass should not be used for containers with a volume greater than 2.5 litres.

- 4.6 Flammable liquids should be conveyed in suitable proprietary safety containers.

- 4.7 Dispensing from drums should be by means of a safety transfer pump or valve incorporating quick-action release and built-in flame arrester.

- 4.8 Upending of drums should be minimised and when necessary be carried out using proprietary drum handling equipment.

Spillage

- 4.9 Where possible, drums and large containers not stored in bunds or banded stores should be stored on pallets which incorporate sumps to



Figure 1: Drums stored on a pallet incorporating a sump

retain any leakage. The sumps should be emptied and cleaned following any leaks.

- 4.10 Appropriate quantities of suitable materials should be available to retain and absorb spillages. Staff should be trained in the safe use and disposal of these materials.

5. Exchange

- 5.1 Although it is the fourth letter of the acronym 'VICES', 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 alternatives be considered. (A successful example of the practical application of this principle is to be found in several industries where flammable white spirit-based paints have been replaced with water-based alternatives.)

6. Separation

External storage in drums

- 6.1 Wherever possible, drums and other containers for flammable liquids should be stored in a designated safe position in the open air. When selecting a location for outdoor storage, cognisance should be taken of:
- the fall of ground in relation to residential areas and exposed risks in the event of a large spillage;
 - access to and around the site;
 - drainage systems;
 - available water supplies;
 - population densities around the site;
 - the location of boreholes, aquifers or artesian wells within 500m of the site; and

- the exposure to impact damage from vehicular movements.

- 6.2 External storage areas should be clearly marked 'Highly flammable liquids' or 'Flammable liquids' as appropriate.
- 6.3 The distance between any point on the perimeter of the drum storage area and any boundary fence, adjacent building or toxic or corrosive chemicals should not be less than the distances specified in paragraph 6.12 below.

Internal storage

- 6.4 Where it is not practicable to store flammable liquids in the open air owing to limitations of space or for reasons of security, small volumes suitable for the immediate work period may be kept in the workplace but larger quantities should be kept in suitable storage buildings.
- 6.5 Flammable liquids should be stored in suitable containers such as tanks and drums. These should be kept closed and stored on pallets with sumps or on suitable fixed shelving. Where they have to be kept on the floor, appropriate physical protection should be provided.
- 6.6 Small containers of flammable liquids kept in the workplace should be stored in a purpose-built flammable liquid cabinet. Quantities of flammable liquids held in any 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 shift being worked.
- 6.7 Cupboards designed for the storage of flammable liquids should:
- be constructed of non-combustible materials;
 - have trays at each level to limit the spread of liquid should a spillage occur;
 - have a sill at the lowest level to prevent spilled liquid leaking from the cupboard;



Figure 2: Small containers in the workplace should be stored in a purpose-built flammable liquid cabinet



Figure 3: An industrial bulk container

- be conspicuously signed to indicate the nature of their contents; and
 - not contain incompatible materials that may react together if contamination, leakage or spillage occurs.
- 6.8 Drums should preferably not be stacked. Where this is impracticable, they should be stacked to a height not exceeding 2m (for example, not more than 2 × 205 litres drums high stored vertically). If greater storage is necessary the drums should be stacked on drum racks, to a height of 5m maximum, subject to a risk assessment.
- 6.9 Industrial bulk containers (IBCs) should preferably be made of metal and again not be stacked. Where this is unavoidable the manufacturer should be consulted and the storage be subject to a risk assessment. IBC containers should not be stacked more than two high (ie one on top of another).
- 6.10 Drums, IBC and similar containers should be stored with aisles, with a minimum width of 1.5m, for inspection and with no dead ends to hamper the escape of personnel.
- 6.11 Mixing and other processes involving the use of flammable liquids should not be undertaken in storage areas.

Purpose-built or dedicated stores

- 6.12 Storage buildings should preferably be detached and may include proprietary stores. Unless of fire-resisting construction, storage buildings should be located not less than 4m from any boundary fence or adjacent buildings for quantities <100,000 litres; and 7.5m for quantities >100,000 litres. Storage should not be above ground level or on the roof unless the local authority approves a suitable non-combustible store with additional requirements for drainage and ventilation.

- 6.13 The storage buildings should be single storey and of non-combustible construction. Where the storage building is closer to other buildings or to the site boundary than the required distances cited above, then its walls, including the walls of any internal compartments, should have the fire resistance ratings specified in Table 1. Doors should be kept securely locked when not in use. Doors should be fitted with automatic self-closers. All doors/means of escape should be unlocked and unobstructed when the building is occupied.
- 6.14 Only limited amounts of combustible packaging should be permitted to be kept in the store.
- 6.15 There should be a minimum of two exits, the travel distance to either of which should be minimised and subject to the findings of the fire risk assessment for the area.

A storage compartment within a building

- 6.16 If it is not possible to store flammable liquids in a detached building, storage may be permitted in a designated compartment within a building. To facilitate ventilation, at least one wall of the compartment should be an external wall.
- 6.17 The storage compartment should preferably be within a single-storey part of the building. Where it is only possible to provide storage in a multi-storey building it should be at ground level. In each case, there should be compartment walls and floors separating the storage area from the rest of the building and those walls and floors should have the levels of fire resistance shown in Table 1.
- 6.18 External walls of an internal storage area which are closer to other buildings than specified in 6.12 should have a fire resistance rating of 120 minutes.
- 6.19 There should preferably be no direct access to the internal store from the building in which it is located. All doorways from the designated storage compartment should lead to the open, unless fire-resisting separation is provided to the standard laid down in Table 1.

Bulk storage tanks

- 6.20 Bulk storage tanks should not be sited within buildings but where there is no practicable alternative they should be within a compartment which meets the criteria set out above.
- 6.21 Any supplementary tanks should also be segregated from working areas by walls or partitions of not less than 120 minutes' fire resistance. Such tanks should be fitted with an

Table 1: Stores for drums, cans and small containers

This table is compiled in accordance with model construction requirements for petroleum spirit can and drum stores (ref. 20), and assumes storage heights not exceeding 2m. Higher storage will require increased fire resistance.

Minimum quantity (litres)	Fire resistance (minutes)	Floor loading (litres/m ²)
<i>(a) Separate structure, maximum floor loading 300 litres/m²</i>		
500	30	300 max
2 500	60	300 max
100 000	120	300 max
500 000	240	300 max
<i>(b) Part of another structure</i>		
250	30	50
1 250	60	100
5 000	120	200
100 000	240	200

overflow pipe capable of returning flammable liquid to the bulk storage tank or to a safe location in the event of overfilling.

- 6.22 Tanks within buildings should generally comply with the third part of this set of recommendations, RC20: Part 3: *Storage in external fixed tanks* (ref. 12).

Fire walls

- 6.23 Where fire walls are erected between container storage and buildings or boundaries, then the safety distances in 6.12 can be reduced, subject to a fire risk assessment, provided the wall is at least 2m high, offers 30 minutes' fire resistance and extends a suitable distance beyond the sides of the storage area. Where the fire wall forms part of the building there should be no storage against this wall, unless there are no openings or fire escapes above it.

Prohibited goods

- 6.24 Flammable liquid store rooms should not be used for any other purpose and particularly not for the storage of compressed gases or toxic, corrosive or oxidising substances.

Empty containers

- 6.25 Empty containers may still contain significant traces of liquid and/or flammable vapours. All empty containers should be:
- kept closed;
 - removed from the workplace on a regular basis;
 - stored as for full containers; and
 - labelled as being empty or be segregated from full containers.
- 6.26 Prolonged storage of empty containers should be avoided.

- 6.27 Empty containers should be disposed of safely.

7. Fire safety management

Identification

- 7.1 The storage location should be clearly identified by an appropriate pictogram and signs stating 'Highly flammable liquid' or 'Flammable liquid' depending upon the flashpoints of the products being stored. All containers should be clearly marked to indicate their contents.
- 7.2 For quantities greater than 25 tonnes, the storage location needs to be marked in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996 (ref. 9). On certain sites where more dangerous substances are stored, signs in accordance with the Dangerous Substances (Notification and Marking of Sites) Regulations 1990 (ref. 28) should be displayed.
- 7.3 Individual containers will be marked as required to identify their contents in accordance with the Chemicals (Hazard Information and Packaging for Supply) Regulations 2002 (ref. 8) as amended and the Carriage of Dangerous Goods (Classification, Packaging and Labelling) and Use of Transportable Pressure Receptacles Regulations 1996 (ref. 29).
- 7.4 Where appropriate, competent authorities should be notified and emergency action plans prepared in compliance with the Control of Major Accident Hazards (COMAH) Regulations 1999 (as amended) (ref. 30).

Training and supervision

- 7.5 All staff members should be trained in:
- the hazards associated with the processes being carried out on the premises;
 - precautions in the use and handling of flammable liquids;

- action in the event of spillage or fire; and
 - emergency procedures as required by the Regulatory Reform (Fire Safety) Order 2005 (ref. 13).
- 7.6 No hot work is to be performed unless a permit to work has been issued under a hot work permit scheme.

8. Fire protection

- 8.1 All storage facilities are to be fitted with at least a manually operated fire alarm system that will sound and be audible in all areas of the storage facility above the background noises (assuming a minimum noise of 65dB(A)), in accordance with BS 5839-1 (ref. 31).
- 8.2 In zoned hazardous areas, it may be necessary for fire detection systems and communications systems to be intrinsically safe and appropriate for the zone, temperature and other relevant parameters.

Automatic sprinkler system

- 8.3 Consideration should be given to installing a sprinkler installation. Such a system should be provided where the requirement of safety distances and/or storage heights cannot be met or when so required by a risk assessment. An automatic sprinkler system could permit an increase in storage heights or reduce safety distances provided the requirements of the *LPC Rules for Automatic Sprinkler Installations incorporating BS EN 12845* are satisfied and adhered to (ref. 32).

Portable firefighting equipment

- 8.4 The requirements for portable firefighting equipment will depend on the quantities of flammable liquids stored, any associated hazards and the position of the storage facility.
- 8.5 Appropriate portable fire extinguishers, approved and certificated by an independent, third-party certification body, should be provided in accordance with BS 5306-8 (ref. 33).
- 8.6 Consideration should be given to the provision of access for fire brigade personnel and their equipment. Unobstructed access should also be available to hydrants, monitors or fixed installations relevant to the site.

9. Checklist		Yes	No	N/A	Action required	Due date	Sign on completion
9.1	Fire risk assessment						
9.1.1	Have suitable and sufficient risk assessments been undertaken in compliance with the Regulatory Reform (Fire Safety) Order 2005 (or the equivalent legislation in Scotland and Northern Ireland)?						
9.1.2	Has an assessment been undertaken in compliance with the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) 2002?						
9.1.3	Is there a policy for these assessments to be reviewed periodically?						
9.2	Ventilation						
9.2.1	Is low-level and high-level ventilation provided direct to the open air from a storage building or compartment to prevent the accumulation of flammable vapour?						
9.2.2	If the answer to the previous question is no, is mechanical ventilation used to provide at least six air changes per hour?						
9.2.3	Are storage sites in the open air selected for this purpose and not located in hollows or other areas below surrounding ground level?						
9.2.4	Are open air storage areas away from buildings and structures that may prevent an adequate flow of air for ventilation?						
9.2.5	In buildings or compartments where highly flammable liquids are stored, does at least 10% of the combined area of the roof (ceiling) and walls consist of openings and/or construction capable of providing explosion relief direct to a safe place in the open?						
9.3	Ignition						
9.3.1	Are all sources of ignition eliminated from the storage area and temperatures maintained well below the auto-ignition temperature of the liquids stored?						

	Yes	No	N/A	Action required	Due date	Sign on completion
9.3.2				Is smoking prohibited in all areas where flammable liquids are used or stored?		
9.3.3				Do the risk assessments undertaken for open air storage areas seek to mitigate the hazards associated with motor vehicles being introduced into the proximity?		
9.3.4				Is heating provided by the use of sealed hot water radiators?		
9.3.5				Is electrical equipment and wiring certified as suitable for use within the zone in which the flammable liquid is being stored or processed?		
9.3.6				Has the potential hazard of ignition due to a build-up of static electricity been assessed and precautions taken to eliminate it?		
9.3.7				Are only lift trucks certified to the appropriate electrical zoning standard in use?		
9.3.8				Are battery-powered trucks charged outside the zone in which a hazardous atmosphere may be present?		
9.3.9				Are containers of very low flashpoint or unstable liquids shielded from direct sunlight?		
9.3.10				Is the storage of flammable liquids only permitted in the open where there are adequate security precautions against arson and vandalism?		
9.4				Containment		
9.4.1				Are catchment areas provided to contain a possible flowing liquid fire and to guard against the risk of pollution?		
9.4.2				Are only liquid products stored in the bund area, with the area being kept free from any combustible materials?		

	Yes	No	N/A	Action required	Due date	Sign on completion
9.4.3 Are all drums accessible to enable leakages to be easily identified and to minimise the amount of handling needed to remove any specific container?						
9.4.4 Are drums in bunds stored off the ground on non-combustible stillage to limit corrosion?						
9.4.5 Are storage containers suitable for the products stored?						
9.4.6 Are flammable liquids conveyed in suitable proprietary safety containers?						
9.4.7 Is dispensing from drums by means of a safety transfer pump or valve incorporating quick-action release and built-in flame arrester?						
9.4.8 Are drums and large containers which are not located in bunds or bunded stores stored on pallets which incorporate sumps to retain any leakage?						
9.4.9 Are appropriate quantities of suitable materials available to retain and absorb spillages with staff trained in their safe use?						
9.5 Exchange						
9.5.1 Has each such liquid been considered in turn and possible non-combustible or aqueous alternatives been considered?						
9.6 Separation						
9.6.1 Are drums and other containers for flammable liquids stored in a designated safe position in the open air?						
9.6.2 Are external storage areas clearly marked 'Highly flammable liquids' or 'Flammable liquids' as appropriate?						
9.6.3 Are flammable liquids stored in suitable containers such as tanks and drums?						

	Yes	No	N/A	Action required	Due date	Sign on completion
9.6.4 Are small quantities in the workplace stored in a purpose-built flammable liquid cabinet?						
9.6.5 Is stacking avoided in the storage of drums and IBC containers?						
9.6.6 Are mixing and other processes involving the use of flammable liquids undertaken away from storage areas?						
9.6.7 Are detached buildings and proprietary stores selected for the storage of flammable liquids?						
9.6.8 Where fire walls are erected between container storage and buildings or boundaries are the walls at least 2m high, offering 30 minutes' fire resistance and extending a suitable distance beyond the sides of the storage area?						
9.6.9 Are the flammable liquid stores used exclusively for this purpose and free of compressed gases, toxic, corrosive or oxidising substances?						
9.6.10 Is the prolonged storage of empty containers avoided?						
9.7 Fire safety management						
9.7.1 Are the storage locations clearly identified by appropriate pictograms and signs?						
9.7.2 Are individual containers marked as required to identify their contents?						
9.7.3 Where appropriate are competent authorities notified and emergency action plans prepared in compliance with the Control of Major Accident Hazards (COMAH) Regulations 1999 (as amended)?						
9.7.4 Do all staff members receive suitable training in the use, handling and safe disposal of flammable liquids?						

	Yes	No	N/A	Action required	Due date	Sign on completion
9.7.5						
9.8						
9.8.1						
9.8.2						
9.8.3						
9.8.4						
9.8.5						
Signature						
				Name	Date	

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RC20

for fire safety in
the storage and
use of highly
flammable and
flammable liquids

Part 2: Storage in drums,
cans and containers other
than external fixed tanks

Recommendations



InFiReS