

A Guide to the Safe Storage of Hazardous Materials

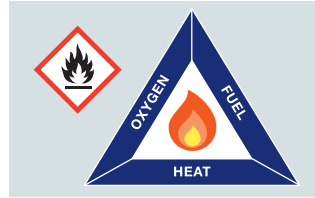


- Understand the dangers associated with storing flammable materials and how to reduce the risks with safe internal and external storage
- Develop a logical approach to preventing fires through good housekeeping, product segregation, correct storage and ventilation
- Easy to follow guidance on current legislation including DSEAR 2002, HSG51, HSG71, HSG140 and EN14470-1
- Links to support materials and technical support

What's the Problem?

Flammable hazardous materials are substances that can ignite easily and burn rapidly. They can be commonly found for example, at most construction sites, factories, laboratories and educational establishments.

For a fire to occur, there are three elements that must come together at the same time and in the right proportions, fuel, heat (ignition source) and oxygen. Remove any of the elements and the fire cannot start or will extinguish.



The “fire triangle” is commonly used as a model to understand how a fire starts and how it can be prevented:

- **Fuel:** Fuels are flammable or combustible materials and are commonly liquids, gases, or solids.
- **Heat:** These are ignition sources and can include an open flame, sparks or chemical reaction.
- **Oxygen:** The most common source of oxygen is air, but oxygen can also come from chemicals oxidizers.

DSEAR Definition of Hazardous Materials

- Any flammable, highly flammable, extremely flammable liquid, gas, oxidiser or explosive material
- A substance or preparation which because of its properties, the way it is used or its presence in the workplace, can create a risk
- Any dust, whether in the form of solid particle or fibrous materials or otherwise, which can form an explosive mixture and is not defined under CHIP or GHS-CLP. Many products - organic, synthetic or natural - have the ability to create explosive properties
- All substances corrosive to metals. For example, Hydrochloric or Sulphuric Acid, whilst not flammable have the ability to generate Hydrogen gas
- All pressurised gas systems including pressure systems and not just commercial cylinders

What you should do?

You must develop work procedures for the use and storage of flammable materials and ensure workers are trained in these procedures. Because of the potential fire hazard, you will also need to have additional procedures in place to deal with fires and spills.

Work procedures should address:

- Storage
- Disposal
- Transfer
- Spill clean up
- Dispensing
- Incompatible materials
- Use and maintenance of engineering controls used in the workplace (such as ventilation)
- Required personal protective equipment for handling flammable products
- Fire protection and prevention

Backbone of current United Kingdom Legislation

The most relevant regulation and guidance advice you should familiarise yourself with is:

- DSEAR 2002 - The Dangerous Substances & Explosives Atmosphere Regulations
- Approved Code of Practice and guidance - Practical advice on how to comply with the Dangerous Substances and Explosive Atmospheres Regulations
- Controlling fire and explosion risks in the workplace - A brief guide to the Dangerous Substances and Explosive Atmospheres Regulations
- HSG71 - Chemical warehousing - The storage of packaged dangerous substances
- HSG51 - Storage of flammable liquids in containers

- HSG140 - Safe use and handling of flammable liquids
- COSHH - Control of Substances Hazardous to Health

United Kingdom Legislation explained

- **DSEAR 2002:** The Dangerous Substances & Explosives Atmosphere Regulations 2002 requires, by law, employers working with flammable liquids to take all reasonable precautions to eliminate the danger at its source. Where possible, flammable liquids should be substituted with safer materials, but where not possible, every effort must be made to control the substance to protect personnel, property and the environment.
- **Health and Safety at Work Act 1974:** This is the primary piece of legislation covering occupational health and safety in Great Britain.
- **HSG51:** The storage of flammable liquids in containers. This publication is aimed at anyone who has responsibility for the storage of dangerous substances, regardless of the size of storage facility. It sets out control measures aimed at eliminating or reducing risks to people at work or otherwise from the storage of packaged dangerous goods. It reflects good practice for the design of new storage facilities (and where reasonably practicable, to existing sites) and applies to transit or distribution warehouses, open-air storage compounds, and facilities associated with a chemical production site or end user.
- **HSG140:** This guidance is for those responsible for the safe use and handling of flammable liquids in all general work activities, small-scale chemical processing and spraying processes. It explains the fire and explosion hazards associated with flammable liquids and will help you determine how to control the risks in your workplace.
- **BS EN14470 parts 1 & 2:** Part 1 covers a European standard giving performance requirements for fire safety cabinets to be used for the storage of flammable liquids in laboratories; and Part 2 provides performance requirements for fire safety cabinets used for storing pressurised gas cylinders.
- **HSG71:** Focuses on the classification of hazardous materials and the relationships of those materials with each other. Particular focus is given to general recommendations for the separation or segregation of different classes of dangerous substances, including flammable liquids. This is essential practice to prevent reaction between incompatible product types possibly having extremely severe consequences to human life and property. (See Table 2 from HSG51 below)

	CLASS	1	2	3	4	5	6	8
Chemical Segregation By Chemical Group.								
Explosive			Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregate Form
Compressed gases		2.1 Flammable 	2.2 Non Toxic Non flammable 	2.3 Toxic 				
		Segregate Form	Keep Apart	Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregate Form
		Segregate Form	Keep Apart	Keep Apart	Segregation may not be necessary	Segregation may not be necessary	Segregation may not be necessary	Segregation may not be necessary
		Segregate Form	Segregate Form or Keep Apart	Segregate Form	Keep Apart	Segregate Form	Segregate Form	Segregation may not be necessary
Flammable liquids		4.1 Readily combustible 	4.1.1 Spontaneously combustible 	4.3 Dangerous when wet 				
		Segregate Form	Segregate Form	Segregation may not be necessary	Keep Apart	Segregate Form	Segregate Form	Segregation may not be necessary
		Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregation may not be necessary
		Segregate Form	Segregate Form	Segregation may not be necessary	Keep Apart	Keep Apart	Keep Apart	Segregation may not be necessary
Oxidising substances		5.1 Oxidising substance 	5.2 Organic peroxide 					
		Segregate Form	Segregate Form	Segregation may not be necessary	Segregate Form	Segregate Form	Segregate Form	Segregation may not be necessary
		Segregate Form	ISOLATE	Segregate Form	Segregate Form	Segregate Form	Segregate Form	Segregation may not be necessary
Toxic								
		Segregate Form	Keep Apart	Segregation may not be necessary	Keep Apart	Keep Apart	Keep Apart	Segregation may not be necessary
Corrosive								
		Segregate Form	Keep Apart	Keep Apart	Segregation may not be necessary	Keep Apart	Keep Apart	Segregation may not be necessary

Segregation may not be necessary Segregation may not be necessary, but consult suppliers about requirements for individual substances. In particular, note that some types of chemicals within the same class, particularly Class 8 corrosives, may react violently, generate a lot of heat if mixed or evolve toxic fumes

Segregate Form These combinations should not be kept in the same building compartment or outdoor storage compound. Compartment walls should be impermeable, of at least 30 minutes fire resistance and sufficiently durable to withstand normal wear and tear. Brick or concrete construction is recommended. An alternative is to provide separate outdoor storage compartments with an adequate space between them.

Keep Apart

Separate packages by at least 3 m in the storeroom or storage area outdoors. Materials in non-combustible packaging that are not dangerous substances and that present a low fire standard of separation should be regarded as a minimum between substances known to react together readily, if that reaction would increase the danger of an escalating incident.

Segregate Form or Keep Apart

The lower standard refers to the outside storage of gas cylinders. Where non-liquefied flammable gases are concerned, the 3 m separation distance may be reduced to 1 m.

ISOLATE

This is used for organic peroxides, for which dedicated buildings are recommended. Alternatively, some peroxides may be stored outside in fire-resisting secure cabinets. In either case, adequate separation from other buildings and boundaries is required.

Where do we start in the process of storage?

- Establish the quantities and range of hazardous materials at your location, identify risks such as ignition sources, fire and explosion
- Identify where the hazardous materials are currently stored and define control measures to eliminate risk
- Have plans and procedures in place to deal with incidents, accidents and emergencies
- Understand who is involved in the procurement process and whether there may be fluctuations in the volumes required and any potential impact on storage requirements
- Understand how products are delivered to the process area and what if any risks are involved
- What does the waste stream consist of and what volumes of waste may need to be considered for storage
- Constantly review your stock requirements and see if they can be reduced
- Audit all stock to ensure there aren't out of date products in the system
- Ensure all employees are properly informed about and trained to control the risks from dangerous substances
- Where elimination of risk is not possible, arrangements for the safe storage of hazardous materials has to be made - measures of which are defined in DSEAR

The importance of Safety Data Sheets (SDS)

- SDS are your best source of information on hazardous materials especially for the compatibility of each material to another
- SDS must be accessible at all times to all staff; so they understand and are aware of the hazards associated with the materials they come into contact with
- SDS are essential for many aspects of hazardous materials including toxicity, co-located storage, accidental release, firefighting measure and first aid

Where are we now?

With specific regard to the storage of flammable liquids; regulations state that:

Fire resisting storerooms and fire resisting workrooms should provide a minimum of 30 minutes fire resistance in respect of integrity, insulation and where applicable; load bearing capacity. The exception to this is when the storeroom or workroom are within a building that also contains residential accommodation, in which case the partition between the two should provide a minimum of 60 minutes fire resistance to comply with UK legislation.

Fire resisting cupboards and bins should provide a minimum of 30 minutes fire resistance in respect of integrity, except where provision is made for explosion relief and/or ventilation to comply with UK legislation.

It should be noted that there are a number of more demanding standards and design specifications which refer to the fire performance of the complete cabinet structure, including:

- BS EN 14470-1:2004 ,Fire safety storage cabinets – Part 1: Safety storage cabinets for flammable liquids
- Factory Mutual, Underwriters Laboratories and ANSI/NFPA 30 standards



Where standards go beyond the minimum requirements of UK legislation, it is to be emphasized that their implementation in the UK is not a legal requirement. However, for quantities in excess of the recommended maxima employers/duty holders may find cabinets with enhanced fire performance help in making their risk assessment demonstration.

We strongly recommend that you consult with your insurance provider to ensure what you are doing complies with the terms of your insurance policy. Your local authority fire brigade is also worth talking too as they can have valuable insight that could save you time and money going forward.

Fire Integrity - A Definition (HSG51)

Performance requirements do not specify an absolute test for safety storage cabinets or bins themselves, rather they relate to nominal construction principles. These are:

- Materials used to build the sides, top, bottom, door(s) and lid are capable of providing the required fire resistance i.e. 30 minutes integrity, and reaction to fire



- Joints between the sides, top, bottom of storage cabinets and bins should be free from openings or gaps
- Lid/doors should be close fitting against the frame of the cabinet/bin supports and fastenings should be of a material with a melting point greater than 750°C

However, it is extremely important to note that the above does not specify an absolute test or standard for the storage cabinet or bin itself, rather it relates to nominal construction principles.

It should be noted that there are a number of more demanding standards and design specifications which companies can use for an improved approach to safety, such as EN14470.

Storage of Flammable Materials - Internal

Your cabinets should:

- Minimise the fire risks associated with storing flammable substances and protect the contents in the event of fire. Ideally you will use a cabinet with a known (tested) minimum length of time (fire rating)
- Minimise the amount of vapour released into the working environment
- Ensure the retention of accidental spillages within the cabinet
- Provide sufficient evacuation time for all personnel
- Reduce the risk of explosion through greater temperature protection to provide fire fighters with adequate time to deal with an incident and minimise site damage

Storage of Flammable Materials - External

Many facilities require large volumes of flammable materials to be typically held on the premises. At these sites, flammable materials may be stored in large containers - 200L drums or 1000L IBC's (Intermediate Bulk Containers) are most common. One of the most effective control measures when working with bulk flammables is to remove them from the workplace and into a safer, external storage location.

Particular note should be taken to adequately separate flammable liquids from:

- Site boundaries
- Occupied buildings
- Process areas
- Fixed ignition sources
- Incompatible materials

The recommended minimum separation distances (HSG51) shown below are widely accepted industry practice. Although these distances may not provide complete fire protection to prevent other parts of the premises from being affected by a fire in the storage area, or prevent fire causing damage beyond the boundary, they should provide time to implement emergency procedures and enable people to evacuate to a place of safety.

Quantity Stored (L)	Distance (M)
Up to 1,000	2
1,000 to 100,000	4
Above 100,000	7.5



Where these separation distances cannot be realised, additional protective measures, may be used to justify a reduction in the minimum separation distances.

In practice, such protective measures include the use of storage units with:

- Fire rated construction - 60 mins is the minimum legal requirement; enhanced version typically offer 90 and 120 mins of Fire Integrity & Fire Resistance.
- Legally compliant bunds to retain leaks and spills which are capable of withstanding fire.
- Fire rated doors fitted with intumescent seals.
- Suitable ventilation (fitted with intumescent seals) to remove possible accumulation of flammable vapours (natural or forced, dependant on application).
- Temperature control to properly manage product stability.
- Explosion relief panels as appropriate.

In the event of an incident the objective is to ensure that people can safely escape from the working area and in this context, the purpose of storing dangerous substances in the appropriate storage unit is to provide a physical barrier to delay the involvement of the stored liquids in a fire and provide sufficient time for people's safe evacuation and the immediate implementation of emergency procedures.

It's important not to overlook any aspect associated with the safe handling of flammable liquids such as static discharge during filling/decanting, combustion due to excessive heat build-up, potential ignition sources such as a spark from a tool or electrical component and pressure build-up in a container.

Points to consider:

Is there good natural air movement in and around where the flammable substances are stored and used?

If not you may have to consider mechanical air changes. Good ventilation will mean that any vapours given off from a spill, leak, or release will be rapidly dispersed.

Have all the obvious ignition sources been removed from the storage and handling areas?

You need to think outside the box as an ignition source can be very varied; sparks from electrical equipment, welding or cutting tools, hot surfaces, open flames, static charge etc. An explosion can even be caused by the simple action of decanting a flammable liquid from one container to another if they have not been earthed.

Are your flammable substances kept in the correct type of storage unit?

Check the distance from the unit or proposed site of the unit to occupied buildings, boundaries, process units, flammable liquid storage tanks and or sources of ignition.

Does it need to be fire rated?

If you can't achieve the separation distance relevant to the volume of liquid you are storing you will need to use a fire rated unit.

If there is a spill will it be contained and prevented from spreading?

Consider what will happen if the liquid spills out with the bunded storage unit

Can you replace a flammable substance for a less flammable one, or can you eliminate it from the process completely?

Processes and products evolve, check with your supplier to see if they have alternatives, including a non-flammable one; and/or research the possibility of redesigning your process to make it safer.

Are your flammable substances stored and used in a different area to other substances & processes?

By separating them you will lessen the risk of an incident and improve workplace safety.

Flammable liquids should be stored separately from other dangerous substances that may enhance the risk of fire or compromise the integrity of the storage unit, for example; energetic substances, oxidizers and corrosive materials. Sometimes these other dangerous substances may be flammable liquids in their own right or held in a flammable liquid. However, it is still inappropriate to store these in the same cabinets or bins with other flammable liquids.

This Guidance has been produced by the British Safety Industry Federation's Spills Containment and Control Group to help ensure that employers and users are properly informed on how to store hazardous materials and manage the inherent risks that they pose. All documentation referred to in this Guidance can be accessed at www.bsif.co.uk

Useful Links:

DSEAR 2002: <http://www.bsif.co.uk/wp-content/uploads/2019/05/DSEAR-2002.pdf>

ACOP: <https://www.hse.gov.uk/legislation/legal-status.htm>

A brief guide to the DSEAR: <https://www.bsif.co.uk/wp-content/uploads/2020/02/Guide-to-DSEAR.pdf>

HSG51: <http://www.bsif.co.uk/wp-content/uploads/2019/05/hsg51.pdf>

HSG71: <http://www.bsif.co.uk/wp-content/uploads/2019/05/hsg71.pdf>

HSG140: <https://www.bsif.co.uk/wp-content/uploads/2020/02/hsg140.pdf>

COSHH: <https://www.bsif.co.uk/wp-content/uploads/2020/02/COSHH.pdf>



TOP TIPS

There are three main ways to prevent fires:

1

Limit the amounts of flammable and combustible materials

- Keep only what you need on-site
- At work locations, the recommended maximum quantities that may be stored in cabinets and bins are: No more than 50 litres for extremely, highly flammable and those flammable liquids with a flashpoint below the maximum ambient temperature of the workroom / working area. No more than 250 litres for other flammable liquids with a higher flashpoint of up to 60°C. These quantities are intended to be viewed as recommended maxima representing industry safe practice, rather than absolute limits. There is some flexibility, where for example the design of modern buildings and the pattern of work can make it difficult to work within these limits, e.g. in large or openplan workrooms/working areas. Where the employer proposes to store quantities in excess of the recommended maxima, a robust justification should be recorded.

2

Provide proper ventilation to ensure flammable vapours do not accumulate

- Install properly designed ventilation in the storage area
- Ensure that processes that use or make flammable materials do not vent back in the work site
- Ensure that equipment, such as spray booths, where flammable materials are used, are vented outside of the building, and away from air intakes
- Ventilation systems must be properly maintained and comply with regulations

3

Control ignition sources

- Ground and bond all work and ignition-proof equipment
- Ensure that there is no smoking in work areas where flammable materials are stored or used
- Never store flammable materials near hot equipment or open flames
- Use intrinsically safe and non-sparking tools. It is important that the employer assesses the work site and identifies potential fire hazards. This will allow the employer to identify the best ways to control these hazards.

British Safety Industry Federation (BSiF) is the UK's leading trade body within the safety industry. We have members including manufacturers, distributors, test houses, certification bodies, safety professionals and service providers.

Our aim is to provide support and guidance on a wide range of occupational safety issues. Click on the top menu to find out more about our members' products and services as well as the latest BSiF news, events and initiatives.