



**Chemical Safety**

**Module 4**

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Health & Safety  
**Essentials**

Registered charity number 207890

# Storage of dangerous substances in the laboratory

You are required to eliminate or reduce the risk of harm to persons from events such as fire, explosions, thermal run-away and release of chemicals and this is a requirement for considerations to be made for adequate storage arrangements. Therefore, it is good practice to conduct a risk assessment for the storage of flammable materials.

Procedures should be in place for receipt of chemical goods, and you should check paperwork to ensure that the material is identified properly and has the correct labelling and that the safety data sheet is available.

If you cannot identify the substance or it is not as expected, or the packaging is damaged, then it should be removed to a safe place and segregated.

The receipt procedure should include asking questions such as: what is the hazard of the material, where should it be stored and how, and include a segregation policy for materials. Think about discarded packaging, where and how materials are stacked (i.e. if this is against walls, they should be fire retardant), look at the properties of materials e.g. free flowing powder spills if stored high can increase fire spread.

Careful consideration should be made of storage condition requirements, and this should include ignition potential, protection from heat, sunlight, moisture and anything that would escalate an incident.

<b>E.g. Interactions of</b>	<b>acids with hypochlorites</b>	<b>could liberate chlorine</b>
	<b>acids with cyanides</b>	<b>could liberate hydrogen cyanide</b>
	<b>acids with alkalis</b>	<b>generates heat</b>
	<b>acids with sulphides</b>	<b>generates hydrogen sulphide</b>

You will find the requirements for safe storage listed on the suppliers **Safety Data Sheet (SDS)**, and it will give advice on special storage conditions, temperature limitations, and sensitivity to impact.

Remember, unstable substances may form during chemical storage, or prolonged storage, and appropriate measures need to be taken to prevent this happening e.g. certain ethers, alcohols and aldehydes can form peroxides that can detonate during distillation. For this reason bottles of substances prone to peroxidation shouldn't be kept for long periods once they have been opened.

Some substances are inherently unstable, and can detonate under certain conditions of temperature and pressure e.g. **acetylene, carbon disulphide**, and substances prone to auto-polymerisation.

Some substances can detonate as a result of friction or heat e.g. **organic peroxides** or contamination e.g. mixtures of perchloric acid.

Flammable, pyrophoric or combustible solids are often encountered in labs and they include **alkali metals, metallic hydrides, organometallic compounds, phosphorous** and **sulphur**.

Storage racks should be stable, inspected and maintained, with procedures for loading and a maximum working load. Whilst taking into account manual handling issues, they should be stacked systematically from the bottom up, by hazard and property.

## Flammable liquids

Flammable liquids are actually liquids that generate enough flammable vapour to flash or sustain a fire but this depends upon the amount of vapour mixed with air. If there is not enough or too much fuel vapour, the fire or explosion cannot occur.

The minimum concentration of fuel in air is called the lower explosive limit (LEL) and the maximum is the upper explosive limit (UEL).



In normal use, it is the LEL that is important as leaks and spills need to be diluted by good workplace ventilation to avoid the immediate risk of ignition and fire. Generally, organic solvent vapours are denser than air and will fall to the lowest point and pass across benches and floors without being noticed. The consequence is that an ignition source quite some distance away presents a risk of a fire starting.

**In general there are a number of principles that should be followed for flammable materials:**

- **substitute for a less flammable material if possible**
- **minimise quantities as far as possible**
- **store flammable materials in correctly designed fire resisting stores**
- **ideally locate stores in a separate building in order to minimise the impact if a fire occurs**
- **storage areas should be clearly marked with their contents and flammability**
- **you should have stock rotation, so that materials are kept for the minimum time and in minimum quantities (look at deliveries on a regular basis, in smaller volume containers)**
- **make arrangements for restricting access to materials to those competent to handle them, who are trained to deal with any spillages and proper disposal of wastes (not down the drains)**
- **ensure all materials are labelled correctly and stored simply and logically, and segregated as required from incompatible materials**
- **ideally you should not dispense flammable materials in store rooms**
- **have control of sources of ignition, and combustible materials**

## Flammable liquid storage

Flammable liquid stores are usually separated from other buildings by several metres and have a number of design features which improve the integrity of the store. Common to all stores is the provision of a bund or other enclosed base such that any leaks or spillages remain inside the store. These can take the form of racking with lipped shelving or a tanked base inside a building. In all cases, the volume of the bund must not be compromised by storing containers at such a level that they take up the containment volume.

**If you can store flammable materials in an outside store, this is preferable.**

In principle you should limit the storage of flammable liquids in a work area or laboratory and the best practice guidance gives less than 50L of highly flammable materials, and less than 250L of flammable materials. The amount will vary according to factors such as the size of the room. It is good practice to conduct a risk assessment for storage of flammable materials in the work-area.

**Storage of small quantities of flammable liquids** - The risk is reduced if flammable liquids are stored in quantities of not more than 500mls nominal capacity, because of the extent of accidental spillage. Containers should be kept tightly sealed, and if used on the bench placed in a spill tray.

**Storage of Cylinders, flammable gases and piped gases** - should be stored in an upright position, so leaks are vaporised and dispersed in air. They should be secured to prevent toppling over. Most cylinders will explode if exposed to intense heat. Acetylene in particular can explode without warning if dropped or struck forcibly. Gases are not odourised, and some are lighter than air, however some are heavier, and this should be taken into consideration if there is a release. Temporary connections that are flexible, rubber or plastic hose types can perish or unsuitable connection methods or attack from materials such as propane, butane, solvents or corrosive substances can also cause failure. Equipment could fail due to overpressure, or gas taps be knocked open inadvertently.



A release of gas or flammable material into an enclosed space such as a refrigerator, oven or drain may result in an explosion and not a fire. You should ensure that purpose built units for storage of chemicals are used, not domestic appliances.

<b>Aerosol cans</b>	<b>should not be overheated, and should be stored in small quantities inside a mesh/well ventilated container.</b>
<b>Oxidising and organic peroxides</b>	<b>can cause very rapid run-away exothermic fire/oxidation reactions with materials not normally considered combustible.</b>
<b>Toxic materials</b>	<b>the risk is related to failure of containment, and an acute risk to health from exposure and in fire from the resulting toxic fumes and smoke.</b>
<b>Corrosives</b>	<b>It should not be assumed that all corrosives could be stored together; they can also react with storage racks, metals and packaging materials.</b>
<b>Miscellaneous dangerous substances</b>	<b>such as asbestos, PCB's lithium batteries, all need specialist advice from the supplier on storage and handling.</b>

## Learning assessment 3

Fill in the blanks in the following sentences:

1. Interactions of acids with hypochlorites could liberate \_\_\_\_\_.
2. Interactions of acids with \_\_\_\_\_ could liberate hydrogen cyanide.
3. Interactions of acids with alkalis generate \_\_\_\_\_.
4. Interactions of acids with sulphides generate \_\_\_\_\_.
5. You will find information on chemical hazards on the \_\_\_\_\_.
6. Mixtures of flammable vapours will only burn if the fuel concentration lies within certain limits. The minimum concentration of fuel in air is called the \_\_\_\_\_ and the maximum is the \_\_\_\_\_.
7. \_\_\_\_\_ - should not be overheated, and should be stored in small quantities inside a mesh/well ventilated container.
8. Oxidising and organic \_\_\_\_\_ can cause very rapid run-away exothermic fire/oxidation reactions with materials not normally considered combustible.

