

Chemical storage guidance

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2. Scope

This document provides guidance on the safe storage of hazardous chemicals within the University to ensure both the health and safety of staff, students and other individuals who may be affected by the storage of hazardous substances within the University and compliance with current regulatory requirements.

The guidance is appropriate for all individuals who may handle or are responsible for the use and storage of hazardous substances. It applies to all areas where such substances may be stored including delivery stores, laboratories, workshops, site services cleaning cupboards and external compounds.

Hazardous substances are defined as any substance classified as hazardous by the following regulations:

- EC regulation 1272/2008 Classification, labelling and Packaging of Substances and Mixtures.
- The Carriage of Dangerous Goods and Use of Transportable Pressure Equipment Regulations 2004
- Highly Flammable Liquids and Liquefied Petroleum gases Regulations 1972
- The Control of Substances Hazardous to Health Regulations 2005 (as amended)
- Dangerous Substances and Explosive atmospheres Regulations 2002

The guidance does not include advice on the storage of compressed gas cylinders or cryogenic gases.

3. Responsibilities

The responsibilities of Heads of Schools/Services, line managers and designated responsible persons are detailed within the University's Hazardous Chemical Management Policy, section 9 (<http://www.bristol.ac.uk/safety/media/po/chem-coshh.po.pdf>).

In summary, Heads of Schools/Services must ensure that arrangements are in place to assess and manage the risks posed by the storage of hazardous chemicals within their School/Service and ensure appropriate security measures are in place to prevent unauthorised access to regulated substances. As part of the School/Service safety management system, Heads of School/Service must monitor the effectiveness of these arrangements and ensure action is taken to resolve problems where there is evidence to indicate chemical storage measures are unsatisfactory. If a Schools/Service has a centralised chemical store, the Head of School/Service must appoint a named responsible person to manage the facility. The responsible person must ensure a risk assessment of the store has been carried out, measures in place to prevent exposure to the risks identified, appropriate hazard warning signs and emergency provisions are in place.

Line managers are responsible for ensuring all hazardous chemical storage for which they are responsible has been assessed with regards the risks posed by the chemicals stored, the assessment should consider the type of storage that is required, the impact should a fire occur and whether the location presents any increased risk to the health and safety of persons working within or near to the storage area. Suitable control measures must be implemented to prevent or reduce the risks identified by the risk assessment. Line managers must ensure that specific storage arrangements for substances that are potentially unstable or may degrade during prolonged storage are identified and put in place. This must include establishing designated shelf lives for these substances, ensuring a robust system for stock control and a suitable, documented inspection regime is in place.

Staff and students must comply with the safety and security measures that apply to the storage of hazardous chemicals within their workplace and report any defects in equipment, personal protective equipment and chemical storage facilities.

4. General Chemical Storage Principles

Applying some general principles can help ensure hazardous chemicals are stored in a safe manner. It is good practice to limit the amounts purchased to that required for foreseeable work and to minimise the quantities stored. The disposal of unused chemicals can cost significantly more than any perceived savings made when buying in bulk quantities that are unlikely to be used.

It is advisable to segregate incompatible chemicals and separate substances where possible according to their hazard classification.

Exposure to heat or direct sunlight may lead to the deterioration of containers as well as degradation of the contents, therefore containers should be stored away from direct sunlight or heat sources.

Storage should include measures to prevent or mitigate spills, leaks or breakages such as:

- Using secondary containment to contain spills or leaks. Containment should account for 110% the volume of the largest container e.g. if the largest container holds 1L then containment should hold at least 1.1L. For some substances such as oils and solvents this is a legal requirement.
- Consider appropriate storage positions - avoid storing bottles on the floor where they may be damaged or knocked over. Locate large containers on lower shelves and avoid stacking containers on top of each other.
- Where there is a need to store decanted solutions, ensure the containers are appropriate for the chemicals they are to contain and are well sealed. Do not overfill containers and allow enough free head space to account for any expansion of the contents and prevent over pressurising of the container.

- Use appropriate carriers or trolleys to transfer items between storage and point of use.

The safe management of hazardous chemicals includes providing appropriate information to users about the hazards posed by these substances. Therefore container labels should be intact and clearly indicate the nature of the chemical hazard. Safety data sheets contain relevant information regarding safe use, precautionary measures to take and suitable storage recommendations; these should be kept up to date and made readily available to users. It is prudent to rotate stocks to ensure oldest containers are used and removed from the store first and prevent stockpiling of old containers.

5. Hazard Classification and signage for stores.

5.1 Chemical Hazard Information

Information about the hazards posed by chemical materials is available from a number of sources including:

- **Safety Data Sheets:** suppliers are required by law to provide up to date hazard information for their products which have been classified as hazardous to supply. Safety data sheets must include information about the properties of a substance, the hazards posed, handling, storage, disposal and transport instructions and emergency information including exposure control measures.
- **Container labels:** Suppliers must label a substance according to the Classification, Labelling and Packaging Regulation EC 1272/2008. Container labels should contain the supplier contact information, the approved or trade name of the substance, the nominal quantity supplied and all relevant hazard statements, pictograms, signal words and precautionary statements.
- **Trade and supplier websites**
- **European Chemical Agency (ECHA) Classification and labelling online inventory** (<http://echa.europa.eu/information-on-chemicals/cl-inventory>).

5.2 Hazard Warning Signs

Work areas and dedicated chemical stores should display signs to indicate the nature of the hazard present. Signs should conform to the requirements of the Health and Safety (Signs & Signals) Regulations 1996 or the relevant Classification, Labelling and Packaging Regulation pictogram. To avoid confusion, where several different chemical hazards are present a general warning sign or signage indicating

the primary chemical hazard may be used.

5.2.1 General warning.



General warning of a hazard.

5.2.2 Flammable Materials



Highly Flammable liquids (flash point <math>< 32^{\circ}\text{C}</math>)

Flammable Liquids with flash point of 32°C - 55°C



Highly Flammable Solids (readily catch fire after brief contact with a source of ignition)

5.2.3 Explosive substances



Substances manufactured and supplied for use as explosives

Substances classified under the UN Dangerous Goods List as explosive.



Substances which may explode under the effect of flame or are sensitive to shocks or friction.

5.2.4 Oxidising substances



Substances that give rise to exothermic reaction in contact with other substances and may cause or enhance the combustion of other materials.



5.2.5 Corrosive substances



Acidic Substances

Alkaline and related substances

Caustic substances



Substances which may damage or destroy other materials including living tissue, metals and organic compounds.

5.2.6 Toxic substances



Substances which if inhaled, ingested or absorbed through the skin may cause serious adverse health effects.

5.2.7 Harmful or irritant substances



Substances which if inhaled, ingested or in contact with skin may cause adverse health effects.

Substances which may cause reversible damage to biological tissue

There is no specific yellow warning sign for these substances, an appropriate alternative from those listed or the CLP red diamond pictogram may be used.

5.2.8 Cryogenic liquids



Liquids with normal boiling point below -90°C , which are gases at normal working temperature and pressure.

5.2.9 Potentially explosive atmosphere



Area contains a mixture of air and one or more dangerous substances in the form of a gas, vapour, mist or dust in which, after

ignition has occurred, combustion spreads to the entire unburned mixture.

6. Chemical incompatibility and instability

6.1 Chemical incompatibility

A wide variety of chemicals react dangerously when mixed with certain other substances. Significant incompatibilities are described on the supplier's safety data sheet therefore these should be consulted when carrying out a chemical risk assessment and planning the most appropriate storage conditions for a chemical. Further information regarding specific chemical incompatibility is available in **Bretherick's Handbook of Reactive Chemical Hazards, Academic Press**.

<http://www.sciencedirect.com/science/book/9780123725639>

To avoid accidental mixing of incompatible chemicals, substance should be stored in securely closed containers which are specifically designed for the purpose and clearly labelled. Corrosive Liquids are best stored in corrosion resistant secondary containment cabinets, trays or containers that can retain spills. It is good practice to separate chemicals according to their hazard class and segregate away from incompatible chemicals by using storage cabinets, secondary containment or distance.

In general:

	Flammable liquids	Inorganic acids	Organic acids	Alkalis & bases	Oxidising chemicals
Flammable liquids		X		X	X
Inorganic acids	X		X	X	
Organic acids		X		X	X

Alkalis & bases	X	X	X		
Oxidising chemicals	X		X		

6.2 Energetic and air/water reactive chemicals

Potentially unstable chemicals will have special storage considerations and may have a designated shelf life after which they have the potential to become unsafe e.g. some ethers can form explosive peroxides when stored for prolonged periods. These details will be outlined within the supplier's safety data sheet. Where these substances are stored a suitable chemical risk assessment must be completed and include appropriate measures to reduce the risk of these substances becoming unsafe. The risk assessment should inform the development of a safe system of work for managing the storage of these substances.

Measures for managing these types of substances may include:

- Avoid storing energetic and reactive substances in areas of elevated temperatures and away from direct sunlight.
- Consider limiting the amount of these substances purchased to the minimum quantity required for foreseeable work within the designated shelf life.
- Ensure containers are clearly labelled with the date of receipt, opening and use by date.
- Substances that must be kept wetted or in a desensitised form to ensure stability may decompose exothermically if they are allowed to dry out. These substances should be regularly inspected for signs of drying (e.g. around bottle stoppers and caps and within the bottle) and the checks documented. Any leaks or spills should be dealt with immediately.
- Substances that require an inhibitor or stabiliser to prevent contact with air should be regularly checked to ensure the quantity of inhibitor does not fall below an effective level.
- Some common solvents are peroxide forming substances e.g. Methyl-tert-Butyl ether. These should be stored in airtight containers, in a dark, cool, dry place. Where appropriate the container head space may be purged with an inert gas. The contents should be periodically tested for the presence of peroxides – disposable kits are available from most laboratory suppliers (e.g. Quantofix or Merckoquant strips). These substances should be disposed of at the end of their designated shelf life. Examples of these solvents and guidance on managing them safely is available from:

<http://www.sigmaaldrich.com/chemistry/solvents/learning-center/peroxide-formation.html>

7. Types of store.

7.1 General work bench storage

It is advisable to limit bench reagent bottles to the minimum required for the day's work, however flammable solvents should be limited to 500ml or less and be kept away from ignition sources.

Low hazard chemicals may be stored on dedicated shelving within the work area and containers should be clearly labelled with the contents, user and hazard. This type of storage is best reserved for working stocks of reagents rather than as a substitute for dedicated chemical storage areas.

7.2 Flammable cabinets.

A limit of 50 litres highly flammable/flammable substances may be kept in an operational room within appropriate flammable cabinets. These cabinets must be of metal design and provide 30 minutes fire resistance. Ideally, newly purchased cabinets should conform to *BS EN 14470-1:2004 Safety storage cabinets for flammable liquids*. In order to contain spills and breakages, the cabinets should be equipped with corrosion resistant trays or lipped shelves. Old cabinets that have become significantly corroded and rusty should be replaced.

The impact of large volumes of flammable solvents within a work room in the event of a fire must be considered, therefore cabinets should be positioned away from doors and fire evacuation routes to ensure people can evacuate safely. The presence of flammable storage should be indicated on room hazard plans and recorded in the building fire risk assessment.

7.3 Acid storage within laboratories and workshops

Strong acids should be stored in a well ventilated space to prevent the build-up of corrosive vapours, if storing within a lab or workshop consider using a suitable acid resistant cabinet. Storage shelves should be acid resistant and be capable of containing spills – secondary containment should be used where reasonably practicable. It is not good practice to store acids on high level shelves.

7.4 Cold storage

Refrigerators used for the controlled temperature storage of chemicals must be dedicated and clearly labelled for that purpose and never used to store food or beverages. If there is a need to store flammable materials the refrigerator must be intrinsically safe (of non-sparking design) to prevent ignition of the contents and clearly labelled as such. It is important that refrigerators used for chemical storage are PAT tested regularly in accordance with University portable appliance testing guidance <http://www.bristol.ac.uk/safety/media/gn/pat-gn.pdf> .

7.5 Workshop storage

Workshops are not suitable for the bulk storage of large amounts of hazardous materials, rather the quantity of products stored should be kept to a minimum. Any toxic chemicals should be kept in a secure lockable cabinet or cupboard.

Flammable solvents should not be stored in close proximity to sources of ignition such as:

- open flames such as burners, heaters, glass blowing/cutting/welding torches
- Grinding wheels
- Electric heaters or heating guns (these must be switched off at the wall socket when not in use).
- Electrical tools and equipment
- Sources of static electricity.

The total quantity of flammable solvent kept on workbenches should be less than 500ml and constitute those substances used for the day's work. In accordance with HSE guidance, larger quantities of flammable solvents can be stored in an appropriate flammables cabinet, the total amount should not exceed 50litres.

7.6 External bulk stores

Dedicated stores must be risk assessed and the appropriate control measures implemented to prevent or reduce the risks posed by the storage of the hazardous substances they contain. General precautionary measures should consider:

- Ensuring the store has a suitable form of spill control, either be constructed with a low bund or impervious sill or ensure containers are stored on appropriate banded pallets that are capable of holding 110% of the largest container
- Secure access against unauthorised entry.
- Suitable location away from drains and fire evacuation routes. Stores of flammable liquids should be separated from site boundaries and other plant and occupied buildings to protect against the impact of a fire outside the area that

could spread to the stores and also guard against a fire within the store that may affect the safety of people within the vicinity. Where reasonably practicable external stores containing up to 1000 litres of flammable liquids should be sited 2m away from other buildings, plant and boundaries. If this is not possible then containers should be protected by a fire resistant construction e.g. fire wall which offers 30 minutes fire resistance.

- Adequate ventilation to prevent accumulation of fumes and vapours, this may be either natural or mechanical ventilation depending on the substances and quantities stored.
- Stores should be safely accessible to those that need to use them, suitable lighting and access for trolleys and handling of large containers should be considered.
- If stores contain bulk stores of flammable or highly flammable liquids or gases, the storage area must be assessed with respect to the Dangerous Substance and Explosive Atmosphere Regulations and classified under the appropriate DSEAR zone. Sources of ignition must be prohibited and all electrical and light fittings be intrinsically safe and compliant with the Dangerous Substance and Explosive Atmosphere Regulation (DSEAR) requirements. Further guidance can be found on HSE's website: <http://www.hse.gov.uk/pUbns/priced/hsg51.pdf>
- Stores should be equipped with suitable emergency response equipment including an appropriate spill kit, eye wash and fire extinguisher.

7.7 Waste storage

Waste should be stored according to the same principles as all chemical storage, however waste containers must be clearly labelled as waste and the relevant hazard information displayed. Where practicable, chemical waste should be separated from other chemical stocks.

Avoid stockpiling chemical waste and arrange regular collection by the University Waste contractor, chemical waste must be booked for collection through the Sustainability Waste manager.

http://www.bristol.ac.uk/environment/waste/chemical_%20waste/

8. Ventilation

Storage areas must be well ventilated to prevent the accumulation of fumes and vapours with ventilation providing approximately 5 air changes per hour recommended. If door or wall grilles are employed to provide passive ventilation, these should be fitted with intumescent seals where there is a fire risk or the area is used to store flammable substances

Where there is the potential for accumulation of dense vapours or gases, low level ventilation is recommended.

Mechanical ventilation systems must be maintained in an efficient working order and good repair in accordance with manufacturer's guidelines.

9. Monitoring

Where there is a serious risk to health resulting from an accumulated airborne concentration of a hazardous substance, monitors and alarm systems should be considered to alert people of dangerous conditions e.g. low oxygen alarms are recommended in areas where cryogenic liquids are stored and pose a risk of oxygen depletion.

10. Inspection

Chemical storage areas should be inspected regularly and at least 6 monthly, when significant changes are made or more often if storage poses a particularly high hazard. The inspection should be documented to indicate any further actions that may be required and account for

- General housekeeping standards within the store.
- The condition of the structure and fittings within the store.
- The condition of chemical containers. Containers that are showing signs of corrosion, damage or deteriorated labels should be disposed of.
- Signs of deterioration of the materials stored e.g.
 - Cloudy liquids that were originally clear.
 - Darkening or changes in colour.
 - Caking of anhydrous materials which may indicate uptake of water.
 - Presence of solids in liquids or liquids in solids.
 - Pressure build up in containers.
 - Reaction with water.

Unwanted or expired chemicals must be removed and safely disposed of.

11. Emergency arrangements

11.1 Fire

The location of dedicated chemical stores should be recorded in the building fire risk assessment and brought to the attention of the facilities manager. The position of these stores should be marked up on floor plans contained within the building fire

manual. These areas should be assessed to identify the risk and impact of a fire within these areas. The assessment can be used to determine the appropriate provision of fire prevention and detection systems needed.

11.2 First aid

First aid kits including eyewashes should be readily accessible from chemical storage facilities. Where special provisions are required as a result of the use of particularly hazardous materials e.g. hydrofluoric acid, phenol or cyanide, these should be available within the store.

The requirement for and accessibility to emergency showers should be determined by risk assessment.

11.3 Spills

Appropriate spill kits should be readily available and include drain protection to prevent spills entering the drainage system. Spill kits should be appropriate to the quantities of substances stored and include

- Absorbent material for dealing with liquids (e.g. absorbent pads, pillows, socks and universal absorbent granules).
- Chemical neutralisers where necessary.
- Dust pan and brush.
- Plastic bags for containing contaminated materials.
- Suitable PPE (e.g. nitrile/rubber gloves, eye protection, disposable apron or coveralls).
- Other specialist equipment as determined by the storage risk assessment.

It is important to ensure that anyone dealing with a chemical spill knows how to respond appropriately therefore local spill procedures and arrangements should be provided and staff trained in managing a chemical spill. Safety and Health Services offer a Laboratory Chemical Spill training course which is bookable through the University Staff Development website.

12. Appendix One - Regulated substances

High risk, regulated substances must be kept in areas subject to secure storage with access limited to authorised users. This includes:

- Poisons
- Class 1 Explosives and class 4 desensitised explosive substances
- Controlled drugs
- Drug precursor substances (DPS) (Schedule 1)
- Chemical Weapons Convention Substances (Schedule 1 and 2).

12.1 Additional regulatory requirements for controlled drugs and drug precursors.

- The storage and use of Schedule 1 drug precursors and controlled drugs must be documented by a standard operating procedure which outlines the measures governing the storage, handling, authorised users, recording of use and stock checking.
- Storage facilities must meet the requirements of the Misuse of Drugs (Safe Custody) Regulations 1973 (as amended).
- Controlled drugs and precursors must be stored in a locked safe, cabinet or store that is constructed and maintained to prevent unauthorised access. Construction must meet the requirements of Schedule 2 to the Misuse of Drugs (Safe Custody) Regulations 1973.
- In general, safes and cabinets should be constructed of sheet steel at least 2-3mm thick and have a robust locking mechanism.
- Safes and cabinets must be fixed securely to a wall or floor via internal bolts as outlined in Schedule 2 to the Misuse of Drugs (Safe Custody) Regulations 1973.
- Stores must not be labelled in any way that would indicate the presence of controlled drugs or drug precursor substances.
- Home Office guidance recommends storage areas be protected by an intruder detection system or equivalent measure for identifying unauthorised access.
- Combination locks or controlled swipe card access is recommended to avoid additional security arrangements for storing keys.
- Where combination locks are employed, the combination should be made known only to authorised persons and must not be shared with other individuals. The combination should be changed regularly (6 monthly periods are recommended).
- Where stores are accessed via keys the following measures must be taken:
 - Keys must be kept in a separate safe or key box.
 - Access must be to a limited number of authorised responsible persons and be documented through a sign in & out procedure.
 - Key boxes and safes must be constructed from 3mm sheet steel and be

- fixed by internal bolts to a solid wall.
- It is not good practice to keep keys in a locked desk drawer or other office furniture.
- Any loss or theft must be reported immediately to all the following:
 - Head of School/Service,
 - Security Services
 - Safety and Health Services.

12.2 Additional regulatory requirements for explosive substances.

- The storage of explosive substances is subject to strict regulatory controls and quantity limits. Anyone wishing to acquire and hold these substances must inform the University Chemical Safety Adviser and their Head of School/Service to ensure all regulatory duties and licence requirements are met.
- Quantities of explosive substances must be kept below any licence limits and within a licenced storage area.
- Stores must conform to the requirements of the Explosives Regulations 2014 and HSE guidance for security and safety provisions (HSE Books L150 and L151).
- Access to stores must be restricted to authorised users only and have a suitable method for raising an alarm in the event unauthorised access is attempted.
- Where stores are secured by key access, the keys must be held securely by a named responsible person or within a locked cabinet secured by combination lock or similar.
- Key cabinets must be bolted to the fabric of the building.
- Storage must meet separation distances as outlined in the Explosive Regulations 2014, as appropriate to the explosive hazard class and quantities held.
- Storage areas must be risk assessed and measures to prevent fire or explosion identified and implemented. This must comprise measures to exclude sources of ignition, segregation from flammable materials and incompatible substances, protection against impact or friction, mechanical sparks, electrical and electrostatic energy.
- Records of substances acquired and held must be maintained, records should indicate the identification of individual items, quantity held, location and the person responsible. Records must be kept for 3 years from when the substance is used or disposed of.
- Stocks must be subject to strict stock management to ensure licence limits are not breached, records held are accurate and any losses can be identified and reported.
- Any loss or theft must be reported immediately to all the following:
 - Head of School/Service,
 - Security Services
 - Safety and Health Services.

12.3 Biocides/pesticides/fertilisers

- Pesticides and biocides must be approved for storage and use in the UK, container labels should display an appropriate MAFF/MAPP or HSE approval number. Lists of approved products are available from the Chemicals Regulation Directorate:

<http://www.pesticides.gov.uk/guidance/industries/pesticides/topics/pesticide-approvals/Approvals-for-Pesticides-in-the-UK>

- Stores must be designed to contain spills and leaks, constructed to provide dry storage, be adequately ventilated and fire resistant.
- Where quantities allow, purpose built storage bins/chests/cabinets should be used.
- Substances must be stored in their original containers with the approved labels intact.
- Stores must be secured to prevent theft and unauthorised access.
- Pesticides and biocides must be stored away from combustible materials, stores of hay and straw, fertilisers, gas cylinders and sources of ignition.
- Pesticides/biocides/fertilisers must not be stored near drains, watercourses, wells or areas that may be liable to flooding.
- An appropriate spill containment kit should be readily accessible and contain appropriate drain protection to prevent spills entering the drainage system.
- Regular stock checks should be carried out and any unexplained losses or theft reported to Head of School/Service, Security Services and Safety & Health Services.