

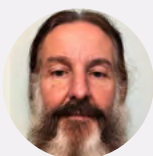
# Laboratory Safety

National Laboratory Safety Webinar

WEBINAR WHITEPAPER JUNE 2022

**Speaker: Richard Greenwood**

---



**Richard Greenwood**

Consults in workplace chemical hazards and safety.  
Accredited Member of the  
Australasian Institute of  
Dangerous Goods Consultants





## Index

	Page
Introduction	3
Laboratory Safety and Chemical Storage	4
The Advising Consultant	4
Opening Remarks – Richard Greenwood	4
Chemical Segregation in Workplace Regulation	4
Flammable Liquids	5
Ignition sources	6
Corrosive Substances	8
Questions	9
Westlab Chemicals	12
Westlab Products for Chemical Storage	13



The everyday activities in a laboratory are many and varied. Labelling, diluting, pipetting, weighing, pouring, and mixing, loading the autosampler, heating, and cooling.

In the bustle, it is extremely easy, day after day, to overlook potential safety hazards such as the correct storage of chemicals and even to short circuit safety procedures. This can lead to drifting into bad habits or overlooking sound laboratory design with eventually unhappy and often dire consequences.

Constant refreshing on the subject of 'laboratory safety' is wise and unbelievably valuable. This online seminar series does just that. In this paper, the ideas discussed in the first online seminar on Chemical Storage in Laboratories are presented to enhance evaluation of your own laboratory environment and design and practises.



## Laboratory Safety and Chemical Storage

When considering good practice and design in laboratories, regulations and recommendations are often obscure and couched in technical language. Often difficult to interpret, they may need further clarification from consultants and experts that have built up a wealth of experience in applying the regulations practically.

This discussion presents some of the key drivers that underlie regulatory requirements and in the light of these insights will aid in making it easier to plan laboratories and practices: correctly, safely, and pragmatically.

## The Advising Consultant

Consulting Specialist Richard Greenwood from RG Chemical Safety outlines the discussion in this paper.

Richard has a reputation for practical, clear, and concise interpretation of the requirements around chemical storage in the laboratories and workspaces. He has worked in chemical safety and hazard classification for over 25 years. This includes time spent on the interpretation and compliance with Health and Safety and Dangerous Goods regulations in industries ranging from research and training laboratories to large scale chemical manufacturing plants. He is experienced in expert consultancy, especially in the Globally Harmonized System (GHS) and is also deeply familiar with hazardous chemicals and dangerous goods transport and storage regulations. He commenced an interpretation of the Globally Harmonized System of chemical classification and labelling in 2002.

Richard has been called upon to work as a hazardous chemical consultant and to provide interpretation of complex regulatory requirements to meet industry product movement timescales. Of special note is his contribution to public comment on the development of work, health, and safety transnationally; including identifying changes in the final regulations that lead to industry confusion and a range of unintended consequences.

He has been recognised for this work by Safe Work Australia, and in 2012 was asked to comment on the Industry Review. To seal his competence in this area he was awarded with the program delivery in 2013 and 2014.

## Opening Remarks – Richard Greenwood

I want to stress that while I consult to industry and transport, I also have a long history of association with laboratories - school laboratories and research laboratories. I do aim to have a pragmatic approach in these situations, and I find that in my experience, this is particularly important when dealing with laboratories. Typically, laboratories hold smaller quantities of dangerous and hazardous products than general workplaces, and that presents specific issues.

There are some standard means of addressing those issues such as the use of storage cabinets. These issues are not always well understood, and sometimes the solutions are poorly applied. My specific intention here is to discuss some of the issues that have arisen in my experience.

## Chemical Segregation in Workplace Regulation

Even when dealing with relatively small quantities of chemicals compared to commercial manufacturing places, these chemicals are frequently highly hazardous, so therefore, clear segregation becomes critical. This is so, despite the quantities being small and the space available for storage being quite limited. That requirement to segregate chemicals in the workplace, typically has primary reference to spill containment and not generally to storage. Storage however is upstream from spill containment and so becomes significantly important. In fact, in any storage environment, once an incident occurs and there is a spill or some release of a chemical, this regulation will necessarily come into play anyway.

Workplace responsibility is about ensuring that in those cases chemicals that could come together will not react dangerously. The actual terminology is about chemicals not being compatible, and the definition of compatibility is incredibly consistent across all Australian legislation regardless of whether it is talking about the GHS or dangerous goods.

### Chemical Segregation in Workplace Regulation

Requirement to segregate spill containment of chemicals which are not compatible:

“compatible, for 2 or more substances, mixtures or items, means that the substances, mixtures or items do not react together to cause a fire, explosion, harmful reaction or evolution of flammable, toxic or corrosive vapour.”

WHS, Victorian and WA Dangerous Goods Storage Regulations



The wording “the compatibility of two or more substances, mixtures, or items,” means that these substances and mixtures or items do not react together to cause a fire explosion, harmful reaction, or the evolution of flammable toxic or corrosive vapor. The flammable toxic or corrosive vapour could be from the materials themselves or from the harmful reaction that may occur.

These regulations are fairly clear. However, the difficulty is that if nothing can be identified as a specific breach of regulations regarding storage, there is a vague area that can be problematic. The wording “harmful reaction” is not defined, and consequently that can become a matter of interpretation. This can be a difficulty in one specific problem area with dangerous goods or hazardous chemicals. [Addressed later]

Over the last 40 years there has been a long-standing culture of discussion in Australia concerning the most immediate issues around dangerous goods. But for states outside of Victoria and WA and when dealing with Work, Health and Safety, the terminology can be quite different - and to some extent broader. A lot of these immediate issues are at least covered under Dangerous Goods. For this reason, we cannot just refer to Hazardous chemicals as a lot of the issues are governed by Dangerous Goods regulations. Cabinets, for example, according to Australian standards are to be labelled with the Dangerous Goods diamond logo and not an equivalent GHS pictogram. This is so, even though they are not at placarding levels under any sort of legislation for the typical contents that you can fit into a cabinet.

#### In summary then:

- Even with small quantities of chemical, segregation is important as storage affects spill containment
- Workplace responsibility amounts to preventing the reaction of incompatible substances.
- The definition of “harmful reaction” is a bit ambiguous and is open to interpretation
- When applying regulations regarding Hazardous Chemicals we must also consider Dangerous Goods regulations.
- Dangerous Goods definitions consider Goods transportation, not specifically storage.

## Flammable Liquids

Flammable Liquids are at the entry level where further consideration should be given to storage. This is also an area where Dangerous Goods Regulations are perhaps a little misleading in that it is not the liquid that is the problem.

Flammable liquids are flammable liquids because they produce sufficient vapour that will burn and can be ignited which can lead to a fire under the defined conditions of concern in the workplace. In fact, some of those conditions are a lot hotter than we generally encounter in the smaller laboratory however the concept that is being followed is still there at the smaller scale.



The GHS does this better than the DGS because the hazard statements associated with these chemicals and the labels includes the words “highly flammable liquids and vapours” when dealing with, for example, ethanol or acetone. This focusses the attention on the fact that you are not only dealing with the danger from the liquids but the vapours as well.

The vapours from flammable liquids are heavier than air and often significantly so, and so in a slow and gentle release they tend to stay low near the floor. But if you are working at bench height, that means they will tend to spread out at bench level. There is one exception. Methanol is the only material that is actually a liquid, and where the vapour is of similar density to air and will therefore easily spread out. But for everything else (for example ethanol, which can be 1 1/2 times as dense as air) density keeps increasing for other common solvents. Since it is the vapours that are the concern, ventilation of storage and/or the tight sealing of containers are the primary method of controlling vapours. The ventilation must disperse the vapours if they are released.

That is not the only approach though. Another approach is to surround the chemicals with a container which will trap the vapours.

Flash point is the temperature is where there is sufficient vapour for the vapour to burn. The warmer the liquid becomes, the more vapour it will produce. Depending on the way it burns and the amount of energy that the combustion produces, there is a certain percentage of vapour in air that will burn and continue burning thereby sustaining combustion. That is typically around a few percent for most liquids and should be seriously considered when devising storage techniques.

The flash point is the temperature at which the saturated vapour pressure meets that minimum amount that can burn continually. At any temperature warmer than that, there will be greater vapour and more fuel for the fire. The flashpoints vary a lot; ethanol is about 12 degrees, acetone is about minus 6, petrol is about minus 40, and xylene is about 27.

Depending on which flammable liquid is being used, storage environments may be around above or below flashpoint. In cold weather ethanol becomes a little sluggish to burn so if the liquid is below 12 degrees it will actually have to be warmed to produce enough vapour to ignite.

Vapour is going to come out of any open container or if the vapour pressure builds up enough it will break its way out of the container any way it can. The significance of a spill like this is that a greater surface area means faster vapour release and a faster spreading vapour cloud. There will be a bigger volume of vapour produced, and more chance of hitting an ignition source which will lead to a fire. While flashpoints are often discussed, as well as lower flammable limits and lower explosive limits; solvent vapours typically also have health effects to some degree, and these may pose serious health concerns quite a lot lower temperature than the incidence of a fire.

Whilst monitoring is good, it is not just about the LEL (Lower Exposure Limit) but also involves the ‘Exposure standards’ where large quantities of hazardous material are also a concern.





### In summary then:

- Flammable Liquids in themselves are not the problem, it is the vapours that they produce that are.
- The CHS handles this area of regulation better than the GHS.
- Vapours of liquids are heavier than air and apart from methanol present a danger low down.
- Tight sealing of containers is the primary method of controlling vapours
- A second method is to store containers in a sealed cabinet to trap the vapours
- At flashpoint, the ambient temperature ensures there is sufficient vapour loading to sustain a fire. This is initiated by an ignition source.
- Storage environments are above the flashpoint of some chemicals and below the flashpoint of others.

## Ignition sources

The concern here is downstream from the fact that there is a vapour present. Vapours do not ignite on their own, but when there is a perfect mix of vapours in the air. It only needs individual molecules to begin the reaction, so the amount of energy required to start that reaction is tiny. It is not bulk material that is being heated to elevate the temperature but just a tiny number of molecules to get the combustion process going. Sparks and hot work will contribute to ignition, and basically any non-electrically safe equipment will be an ignition source. Frequently, there is a time delay while the vapour, works its way into the equipment where the live components are that will cause the ignition.

Over time I have noticed in stores and laboratories that the growth and spread of electronic equipment in the location is the main contributor to ignition sources. Electronic equipment used to be placed in special places and special rooms, but this is no longer the case as it is not possible anymore due to lack of space and the increase in this sort of equipment. To maintain this awareness, one must think carefully about where equipment sits in relation to storage and where flammable vapours may be produced. The key means to controlling this is store chemicals in cabinets, but it must be the correct cabinetry for storing flammable liquids. There is a specific method of construction that is advised in relevant Australian standards, and while this is not the only way to build a safe flammable liquids cabinet, it is the most recognised way of doing so.

European standards exist which offer different ideas on how to achieve a safety and performance standard in the workplace, these ideas look at how long the enclosure will last in a fire, but we do not have these numbers for Australian made Cabinets. Australian storage cabinets do have key requirements and features that provide safety. The first main feature is designs that allow for containment of liquid spills and vapours, such as a spill bund under the bottom shelf.

The second is the ability to fit larger bottles onto the shelf. In the effort to avoid lying them down, the bottom shelf is sometimes removed to use the bund space to fit the bottles, but the issue is you have removed the bund space that is designed to catch the spills. Though you may have sufficient space to contain a spill you do not have the FULL space, and this is important as the cabinet is design for a certain volume of contents.

Another key feature of the Australia design is to keep vapours down, but the most common complaint when working with a flammable liquid cabinet in Australia is they are required to have self-closing and latching doors. This can be clumsy and annoying whilst it poses its own safety concerns, bumping the person putting flammable or poisonous liquids away. The main purpose of the design is however to ensure the doors will always close (no-one can forget to close them) and any vapour dispersion will be largely contained within the cabinet.

The shelf above the bund should have drainage holes only and should not be wide open. The idea is that the entire cabinet will fill with saturated vapour pressure after any spill or be released once the container is opened within. But if there is a spill and it is below the bund, after the initial release of vapour, further release will be slowed as it will not be coming from a fully open area, but the hazardous vapour will slowly diffuse out of perforated holes.

There is an option with the cabinet design to include ventilation. The cabinet has low and high bung holes which have a very specific purpose. If the purpose of the cabinet is to keep vapours in, then obviously the bung holes should be blocked. If the cabinet is going to be ventilated, then the ventilation should be a mechanical form of ventilation that activates whenever the store is in use. It may be unnecessary to have it switched on the entire time, but it should have been on for some time before the door is opened, thus removing the vapour if there has been a spill before the doors are opened.

The other key component of the design is fire protection, at present no standard exists defining how long the fire protection provided should last, but the cabinets are a robust non-combustible construction which is fire resistant and the idea is to allow for an initial response to an external fire and if that is not possible then enough time escape and the evacuation of a work area and time for the fire brigade to bring in their better resources for dealing with the fire before the flammable liquids add fuel to the fire. Most fires in workplaces do not actually start with the flammable liquids, even in those places where a lot of flammable liquids are used.

When a fire does involve flammable liquids, it is usually spectacular. The fire usually starts somewhere else, the environment warms up and the flammable liquids are heated and consequently there is a build-up of pressure. Then there is some release of that vapour and when it ignites, the fire grows very quickly. What, at one point, was a slow growing fire consuming general combustible material, can then rapidly escalates to a dangerous fire once dangerous goods are involved. To try and ensure that flammable liquids cabinets are not the source of the fire, we should take precautions that they are not situated near any ignition sources, or if that is not possible, they need to be ventilated.



The intention here with the design is that if there is a spill or release within the cabinet that has not been noted or has not been dealt with, then the person who opens the cabinet has sufficient training to recognise the increased hazard and respond immediately. Their initial response may be to shut the door and release as little vapour as possible while they give the problem some thought. The question might be "Why is there a vapour in there when we have been ventilating the cabinet?" and it may be too that the cabinet is right next to the fridge - definitely an ignition source! So, the cabinet is full of vapour and since it is usually denser than air will spread slowly at ground level - primarily with a slow diffusion upwards. If you can smell it at bench top height the amount at ground level will be remarkably high. If there is obvious air movement from a fan or aircon duct, then the situation may be different. So, the vapour will most probably be spreading low from the open cabinet.

The officially accepted 'hazardous area' sufficient for vapour to be ignited is three metres laterally and one metre above. From my experience, it is the lateral distance that is much more significant, as the amount that spreads upwards will be far slower and lower. At one metre above it is likely not to be very much at all, if there is an under-bench cabinet, it is the potential ignition sources below the bench that will be the primary concern.

Permanently sited electronic equipment installed directly next to flammable liquids contained in unventilated cabinets can cause potential hazards, for example: refrigerators, dishwashers, and ventilators. Even refrigerators rated for flammable liquids can be a risk, as the inside of the refrigerator is rated for that but not necessarily the exterior. This means situating a cabinet next to it is not a clever idea.

Since we all have a duty of care responsibility under the regulations, safety considerations such as seal designs, present and trained personnel in response methods and care taken in locating storage are all key items that should be in place. It is necessary that everybody is aware of the hazards they may be associated with in the general workplace, particularly laboratory technicians in school laboratories where flammable liquids are used.

Extraction ventilation may be installed if it is not possible to meet satisfactory separation of ignition sources. Usually, you would fit this source to the lower bung. You do not ventilate a cabinet by just removing the bungs, if you do you have compromised all the safety provided by the cabinet. An outside vent must be installed if the bung is removed. Connection can be made to an outside high vent but if that does not have something active in it, it will not effectively remove the vapours and if the wind is not blowing it will not be doing much either so you would have to respond to it as if it was an unventilated cabinet. If you have connected it up with a whirly bird, and you open the door and get hit with a burst of noticeable vapour, you are best to shut the doors and go round switching off and removing ignition sources before you do the clean-up.

When undertaking the clean-up, first remove the bottom shelf, insert absorbent packs, close cabinet doors while the liquid is absorbing, and remove the absorbed material into a container that can be reliably sealed. These precautions avoid the creation of further flammable waste and vapours. Essentially the waste still has the same hazards but has been safely contained.

**In summary then:**

## Ignition sources

- Vapours do not ignite on their own. Ignition is provided by an ignition source.
- Ignition sources only need to provide a small amount of energy to start a fire in a vapour laden atmosphere.
- Air might be laden with vapour for quite some time before ignition occurs.
- Electronic equipment is now prolific in the modern laboratory, so there is no shortage of ignition sources
- The proximity of these sources to possible vapours from flammable liquids is the key thing to manage.
- Australian standards prescribe the most recognised specifications for a Chemical Storage cabinet.
- These specialised cabinets provide an effective solution for isolating vapours from ignition sources.
- The 'hazardous area' for vapour ignition is 3 metres laterally and one metre vertically above the floor.
- Extraction ventilation may be installed if it is not possible to meet satisfactory separation of ignition sources

## Cabinets

- These are designed with a bund below the bottom shelf to catch spills.
- The bottom shelf should not be removed to fit larger bottles as this will compromise the bund.
- Reduction of vapour in the atmosphere is prevented by self-closing doors and ventilation extraction from the cabinet.
- The cabinet casing is fire resistant being made from non-combustible materials.
- The cabinet is not indestructible but buys time for the fire brigade to get to the chemical sources before ignition may occur.
- Training is needed so that personnel know what to do when a vapour is detected in the cabinet.
- Cabinets should not be situated next to refrigerators, dishwashers, or ventilators. This holds true even if the appliances are rated for flammable liquids.
- When cleaning cabinets handling the waste with precaution is essential because it is still hazardous.



## Corrosive Substances

Corrosives too are a key area of concern, as they are designed to cause severe damage to metals and are categorised as a dangerous good. A substance like this that causes extreme damage to the skin will damage the eyes a lot faster as skin has dead material on its surface, but eyes are live tissue. So, body contact issues are of high priority here.

### Key considerations then are:

- personal protective equipment, particularly for eyes
- first response in first aid with eyewash and showers
- equipment maintenance issues – gear should be checked, inspected, and replaced, including storage racking that may have been affected by corrosives.
- possible reactions with metals that produce flammable hydrogen gas,
- and any materials that may substantially increase in reactivity.
- Dangerous Goods and the GHS only have the one corrosive symbol, which indicates that the damage caused by acids and alkalis are similar. The actual symbol does not indicate which corrosives may alkalize, and which ones may react to produce heat. They do not clarify clearly under the Dangerous Goods system what defines a corrosive but uses the same picture to make sure that all recognise and deduce the same controls and responses.

So, in the case of acids, bases, and alkalis, they are often identified as reactive and therefore require segregation.

A good question relating to the situation in a school laboratory is “When is the segregation justified?”

A pragmatic approach to this is “When is there a real hazard?” Not just whether the substance is on a list of corrosive chemicals and is therefore dangerous.

There is no doubt that between concentrated and strong acids and concentrated and strong bases there is a reaction that will produce dangerous quantities of heat.

In large scale production areas these can cause horrific explosions producing pressure and causing failures of equipment and many times cause personal injury. Even in a small-scale situation this justification exists. That is well recognised in standards and in the Dangerous Goods system of classification.

When the Dangerous Goods protocol insists on labelled segregation for concentrated strong acids and concentrated strong alkalis it is considering how to safely transport these chemicals, and actually uses those terms. This I believe is the intention.

However, in a laboratory area, particularly in a school laboratory, the labelling has been applied downwards and away from those levels. This is the key factor for labelling concentrated and strong materials. I would contend there is no general justification for segregation of dilute solutions although there are some exceptions. In the case of simple diluted solutions of acids and alkalis, there is no real need to segregate them, because should they mix, they will automatically neutralise. This is a known result where basically the materials will finish more safely than when they started off. Therefore, why should they be segregated in order to prevent that reaction?

### In summary then:

- Corrosive substances cause immediate damage to eyes and damage over time to skin.
- PPE, first response stations and equipment maintenance are key to managing this hazard
- Reaction with metals should be considered in locating and storing these substances.
- Signage implies that acids and alkalis are equally dangerous but does not differentiate between heat producing and alkalising substances
- A pragmatic approach to the acid/alkali interaction and whether segregation is necessary is to consider the question “When is there a real hazard?”
- Dangerous Goods protocol for concentrated acids mainly considers the aspect of transportation.
- There is no general justification for segregation of dilute solutions although there are some exceptions
- For lower (2 molar) concentrations calculating the temperature elevation caused by the reaction assists in deciding whether segregation is necessary or not. In most instances it is not necessary.
- isolation is high in the hierarchy of standard controls to be applied





## Questions.

### How diluted and how much heat are we talking about?

These amounts can be calculated. If there are two molar hydrochloric acid and two molar sodium hydroxide, these are relatively strong solutions for schools, school laboratories and even many working laboratories. They may have been made up from concentrated materials, and I am certainly recommending segregation for these. I am not saying that two molar hydrochloric acid can go in any way with concentrated sodium hydroxide, but, at these levels when mixed, how much hotter can they actually get?

### What is the actual worst case?

When calculated it cannot be more than a certain number of degrees, and according to my calculations the heat is less than 14 degrees. In production quantities and production sealed equipment this could still be a problem. But out in the open and in open mixing situations it can go from 25 degrees, (which is pretty warm for solutions in a workplace) to about body heat, which is warm, but not dangerously so. I would say that this is not a harmful reaction, and even if it gets on the hands, gloves should be worn, it should not be dangerous or create a risk of thermal burns. Therefore, it is not something that requires segregation under the regulations, but the context should be considered here. I am not talking about either of these being a more concentrated solution, rather about the mixture at this level. There are some exceptions: cyanides with dilute acids, reactive metals, and dilute acids. Bleach solutions or poor chlorines and dilute acids are problems because of the reactivity or toxicity of the other components. So, there will be cases where segregation may still be required say between, a corrosive bleach solution and a dilute acid.

Here we are talking about the general mineral ones, which I do not see as justified under the regulations. The expectation in many cases would be that alkaline must be segregated for oxidizing agents. The crucial issues are the broad range of reactivity they have which do cause problems in laboratories as they age. On occasion, they also cause problems in laboratories in waste streams as that result arises in the controlled mixing of materials.

That should be planned for as the other key issue with oxidizers is basically the various families of chemicals that are oxidizers. These are permanganates, perchlorates, and nitrates. As hypochlorites, they are all highly reactive and may react with one another, so this is even more complex than just a simple acid alkali case for corrosives. There are incompatible materials with oxidizing agents as well.

**A key question I am often asked is: We've been told that our oxidizers have to be 5 metres away from our flammable liquids. We have them in cabinets, but we can only get the cabinets 3 metres apart and we have been told this is a nonconformance.**

I cannot stress highly enough that isolation is high in the hierarchy of standard controls to be applied. It may be provided by sufficient distance to ensure that a materials spill cannot come into bodily contact, and considering it is a liquid, which direction it will drain in or via a suitably designed storage device. When buying and using a cabinet, cabinets made with incompatible materials could be adjacent. Even though the cabinet is isolated, access and any spills have to be managed accordingly. The response should be conducted in such a way that there is no possibility that the unaffected material will be released, have no bodily contact and the space is locked down until the incident has been dealt with. There is no inherent reason why a cabinet that is sufficiently segregated cannot contain alkali's even where they are concentrated.

Regarding questions about hydrogen peroxide, this is probably the most problematic of the oxidisers. Most of the other oxidizers are held in a series of solids, which are much safer to deal with than reactive materials. Typically, they are only reactive once they dissolve, so there's very little surface area contact to react with. Hydrogen peroxide as a liquid is corrosive and oxidizing. Dangerous Goods recognises that as oxidising down to 8%. The poison schedule states that it can be as high as 12% - for example in hair care products. At around 20% it ceases being treated it as corrosive, but I strongly suspect that it can potentially do permanent damage, as it is oxidising and highly reactive.

### If you do not have cabinets, what do you do with it?

Start looking at isolating, not necessarily by 5 metres but with sufficient distance or sufficient controls where you can be comfortable that a spill is not going to spread.

This applies to oxidizers as well, or if hydrogen peroxide is the only significant oxidizer you may have, put it elsewhere away from combustible material, or store it in a tub. Secure a lid on the tub to keep dust and other materials out as it is notorious for breaking down quite violently and reacts with contaminant materials.

Specifically, less than or equal to 15% is still quite significantly reactive and recognized as an oxidizing material at that level. Those levels should be treated the same way as 35% hydrogen peroxide, which at that level is definitely corrosive. It is significantly more hazardous and more of an issue than a 15% solution. Storing it in a fridge will increase its life, but the usual concern with fridges is that they are generally not electrically safe, so it is advisable to not to put flammable liquids in there. Although that is not an issue with hydrogen peroxide, as it is not going to produce anything that will burn, rather it will produce something that will encourage burning.



The same rules apply in containing spills, isolating, and considering other materials in the spill, particularly regarding any combustible material. When storing a tub use a lid to ensure that nothing falls in. This could be a problem if the hydrogen peroxide gets bumped and spills where the main concern is reaction. For people with north facing windows, this is the chemical that is probably going to be the concern, it is the one with the most temperature sensitivity, so it's a good idea to store it in a fridge.

There is a concern when storing chemicals in fridges to keep the vapour shown, which is reasonable unless there is a power blackout. When a fridge turns back on, it is full of vapour and potentially there could be a fire. Hydrogen peroxide at 35% should be treated as other dangerous goods and be stored somewhere away from other chemicals.

For instance, calcium carbide produces a settling gas in large volumes which is more than saturated vapour pressure and should be kept away from flammable liquid stores. If there was a concern about ethanol bottles being in a fridge along with the hydrogen peroxide, it could be managed, but there would have to be a process in place for storage, e.g., housed in separate tubs at the same level so there is no chance of mixing.

There is a similar question about 70% nitric acid because it is an oxidiser at 70% and above 65%. In fact, it is an oxidiser from the Dangerous Goods point of view. Below 65%, there is still exists significant additional reactivity, as in only being a corrosive. Nitric acid is one of the common acids, and it is the fastest one to eat through skin.

### What about the light switches?

A light switch is still an ignition source even when using a flammable liquids cabinet. It has to be either more than 3 metres away or more than 1 metre above the top of the cabinet. A primary concern in the store is not the light itself, but items at ground level which are usually fridges and dishwashers.

This whitepaper is one of a series of webinars on safety, so there will be further safety topics in the future. We also have a gift voucher for our clients to go online and use the code for orders. Orders of \$100 or more receive a \$30 as a thank you discount for attending today's webinar. Westlab would like to thank everyone for attending, and we look forward to future tenants at these webinars.

### When should I use the storage cabinet when there is a suitable table in the laboratory storage standard?

If you store high quantities, or have them in your working areas, then you should have cabinets available for storage. You should have everything except what you are actually working with at the time in the cabinet. Flammable liquids are the quantity that you are likely to hit first, as well as combustible liquids. Proper guidance advises that a table should not be used for storage.

To justify the purchase of the storage cabinet and to convince people internally that one is required, results show that they are highly effective when broadly applied. Alternatives to storage cabinets to consider, such as storage tubs or trays do not actually improve safety, especially when cleaning spills. Do not put anything that is not suitable in there and do not use a tub or even a tray if it is under circumstances where access is difficult. By doing this you can create an additional hazard, and the likelihood of spilling or dropping a bottle when trying to access it from a deep tub, particularly when it is in the back with some other compatible materials storage on shelves is likely. I suggest that any corrosive or irritant materials should not be stored at or above head height.

Good practice is key to safety precautions.







## Westlab Chemicals

Westlab has released a chemical range that includes the labelling and the packaging of chemicals.

After an Australia wide survey on preferred cabinet requirements, with lab staff, lab techs and lab managers, results showed that labelling was the most desired feature in cabinet supply. By using a colour coding system, at a glance you can see what class the chemical is, and how that ties in with dangerous goods labelling.

Visit this link for more information on the Range of Storage Cabinets:

<https://www.westlab.com.au/catalogsearch/result?q=storage%20Cabinets>

## Discover the Westlab Chemical Range

Discover the wide range of chemicals designed for lab techs



## Chemical Storage Cabinets from Westlab

Dangerous Goods storage is available in three different ranges:

1. A Metal Range
2. A non-metal Range.
3. Another non-metal Range especially for Corrosives.



Modulab 4-in-10 Metal Cabinet



Modulab Non-Metal Cabinet



PolyChem Corrosive Cabinet

### Mod-U-Lab 4-in-1

This cabinet can be used to store any class of chemical. Westlab actually supplies this cabinet with all the relevant labelling, and then it is again labelled on-site according to your storage requirements. In this range we have five varied sizes, starting with a 30-litre cabinet, 60 litre, 100 litre, 160 litre and the big 250 litre.

### Modular nonmetal cabinet

This modular non-metal cabinet is solely used for Class 9, or corrosive chemicals. These cabinets are made from a high-density polyethylene which gives good longevity when storing chemicals. Nothing in these cabinets can corrode, as it is completely made from polyethylene. None of the hinge pins, or clips are going to corrode, and it offers an excellent lifespan.

### The newest range is the Polychem range.

The Westlab Polychem range is Westlab's newest cabinet. This is used as a non-metal cabinet and is made from high density polyethylene.

How does this cabinet differ from the others?

Traditional, flat shelving has been removed and replaced with grapnels tubs, which is a fully injection moulded propylene tub. Once again it is chemical resistant and works as a small spill tray, and able to contain a small amount. This cabinet has a fully banded bottom, so if anything does spill over the edge of those tubs it gets caught in the bottom.

Acknowledgments to Richard Greenwood for his contribution to this White Paper.





## Disclaimer

This document is a technical whitepaper setting out the current and future developments of Westlab Pty. Ltd ("Westlab"). The Whitepaper does not constitute an offer to sell, a solicitation of an offer to buy any of the products, services or tokens that are mentioned in this document. Westlab does not perform Initial Coin Offering (also known as Initial Token Offering or Token Sale) and this paper is for information purposes only and is not a statement of future intent. Unless expressly specified otherwise, the products and innovations set out in this paper are currently under development and are not currently in deployment. Westlab makes no warranties or representations as to the successful development or implementation of such technologies and innovations, or achievement of any other activities noted in the paper, and disclaims any warranties implied by law or otherwise, to the extent permitted by law. No person is entitled to rely on the contents of this paper or any inferences drawn from it, including in relation to any interactions with Westlab or the technologies mentioned in this paper. Westlab disclaims all liability for any loss or damage of whatsoever kind (whether foreseeable or not) which may arise from any person acting on any information and opinions relating to Westlab or the Westlab Platform contained in this paper or any information which is made available in connection with any further enquiries, notwithstanding any negligence, default or lack of care. The information contained in this publication is derived from data obtained from sources believed by Westlab to be reliable and is given in good faith, but no warranties or guarantees, representations are made by Westlab with regard to the accuracy, completeness or suitability of the information presented. It should not be relied upon, and shall not confer rights or remedies upon, you or any of your employees, creditors, holders of securities or other equity holders or any other person. Any opinions expressed reflect the current judgment of the authors of this paper and do not necessarily represent the opinion of Westlab. The opinions reflected herein may change without notice and the opinions do not necessarily correspond to the opinions of Westlab. Westlab does not have an obligation to amend, modify or update this paper or to otherwise notify a reader or recipient thereof in the event that any matter stated herein, or any opinion, projection, forecast or estimate set forth herein, changes or subsequently becomes inaccurate. Westlab, its directors, employees, contractors and representatives do not have any responsibility or liability to any person or recipient (whether by reason

of negligence, negligent misstatement or otherwise) arising from any statement, opinion or information, expressed or implied, arising out of, contained in or derived from or omission from this paper. Neither Westlab nor its advisors has independently verified any of the information, including the forecasts, prospects and projections contained in this paper. Each recipient is to rely solely on its own knowledge, investigation, judgment and assessment of the matters which are the subject of this report and any information which is made available in connection with any further enquiries and to satisfy itself as to the accuracy and completeness of such matters. Whilst every effort is made to ensure that statements of facts made in this paper are accurate, all estimates, projections, forecasts, prospects, expressions of opinion and other subjective judgments contained in this paper are based on assumptions considered to be reasonable as of the date of the document in which they are contained and must not be construed as a representation that the matters referred to therein will occur. Any plans, projections or forecasts mentioned in this paper may not be achieved due to multiple risk factors including without limitation defects in technology developments, legal or regulatory exposure, market volatility, sector volatility, corporate actions, or the unavailability of complete and accurate information. Westlab may provide hyperlinks to websites of entities mentioned in this paper, however the inclusion of a link does not imply that Westlab endorses, recommends or approves any material on the linked page or accessible from it. Such linked websites are accessed entirely at your own risk. Westlab does not accept responsibility whatsoever for any such material, nor for consequences of its use. This paper is not directed to, or intended for distribution to or use by, any person or entity who is a citizen or resident of or located in any state, country or other jurisdiction where such distribution, publication, availability or use would be contrary to law or regulation. This paper may not be redistributed, reproduced or passed on to any other person or published, in part or in whole, for any purpose, without the prior, written consent of Westlab. The manner of distributing this paper may be restricted by law or regulation in certain countries. Persons into whose possession this paper may come are required to inform themselves about and to observe such restrictions. By accessing this paper, a recipient hereof agrees to be bound by the foregoing limitations. Planned features may change based on the competitive landscape and go-to-market strategy.

# National Lab Safety Webinar

22 June 2022



## Chemical Storage Checklist

Follow this easy checklist to ensure your chemicals are stored safely.

- ☐ Considering equipment at floor level and below the level of the top of the cabinet, are flammable liquids cabinets situated within 3m of a powerpoint, light switch or active electrical equipment?

---

- ☐ Do you use flammable liquids on benchtops, within 3m of benchtop equipment?

---

- ☐ Does your storage of oxidizing agents ensure that spills of different families of oxidiser will remain separate??

---

- ☐ If you have limited space for segregated storage of corrosives, have you prioritised segregation of concentrated forms?

---

- ☐ Have you made an action list of items that need attention to enhance the safety arrangements in your laboratory?

---

## Webinar Q&A

### Find the answers to the questions asked at Laboratory Safety Webinar

Is there a limit to how many flammable cabinets you can have in a confined space? We have 2 that are side by side in a very small chemical storage room, but it is ventilated by a wall fan

AS1940 guidance limits to 850L on ground floors, per 250m<sup>3</sup> total floor space.

Is a light switch in the storeroom considered an ignition source when chemicals are also in a Flammables cabinet?

Yes.

Are Hot Plates considered an ignition source?

They will be an ignition source – the thermostat will switch power on and off. Just being a hot surface is sufficient for some flammable vapours.

Is proximity to an ignition source the only deciding factor for ventilation a flammables cabinet? Are there other factors that mean you should install ventilation from the bung?

ASNZS 2243.10 (no longer current): "If ventilation is an essential risk control measure (such as could be the case for volatile, extremely toxic or corrosive substances), the cabinet shall be vented to the external atmosphere."

What temperature should our chemical storeroom be kept at? What is the highest humidity that is acceptable in a chemical storeroom?

Some chemicals may require storage below a specific temperature, typically 30°C but potentially lower. This should be indicated on the SDS. Examples are chemicals that break down, such as peroxides. The humidity should not be a problem with properly sealed containers, but I accept that in practice there may be slow absorption of moisture that may render some chemicals unusable. It can also promote corrosion of fittings and shelving. I don't know of specific guidance in either temperature or humidity.

How detrimental is it for a chemical storeroom to have a north facing window (along one whole side)? Should it be boarded/blocked off in order to extinguish exposure to sunlight?

Not many common lab chemicals are light sensitive – hydrogen peroxide and silver salts are the main ones I can think of. Heating in summer is probably the more important issue. I personally love natural light in workspaces, so if it can be shaded with slats or a veranda to limit direct light and heating that should be enough.

#### OFFICES

##### Australia

1800 358 101  
sales.au@westlab.com  
www.westlab.com.au

##### Canada

1 877 822 1455  
sales.ca@westlab.com  
www.westlab.com

##### New Zealand

09 972 7682  
sales.nz@westlab.com  
www.westlab.co.nz

##### United States

646 568 5391  
sales.us@westlab.com  
www.westlab.com

## Webinar Q&A (cont.)

### What is the formula to calculate temperature change?

I calculate it this way:

50mL 2M NaOH (0.1mol) and 50mL 2M HCl (0.1mol) generates -57.9kJ mol<sup>-1</sup> energy, so releases 5.79kJ in 100mL water from 0.1mol reacting. 4.184 kJ will heat 1kg of water by 1°C, so this amount will heat 100mL by 13.8°C. This temperature increase is independent of scale, and is the maximum temperature possible for these

### Where and what is the best place and way to store 70% Nitric Acid in a chemical storeroom safely? (We don't have a small separated corrosive cabinet.)

All oxidisers are problematic for storage, due to the wide range of potential harmful reactions. 70% nitric acid is compatible with mineral acids such as sulfuric acid and hydrochloric acid, but not compatible with organic acids such as acetic acid. It is also not compatible with a number of other oxidisers, such as hypochlorites.

If it is possible to eliminate organic acids from your acid cabinet, I would say that is the best place. The organic acids can be stored elsewhere, particularly where they are also flammable liquids. It is always difficult to be 100% definitive here, because certain chemicals may have specific reactivity that makes this unsuitable.

### Where should Calcium carbide be stored?

Protection from moisture and humidity are the primary issues. It is a solid, so a casual spill is less of a concern. I'm not certain about heat sensitivity of it, but given its properties, I'd recommend in a tub so it can be sealed.

### Where should 35% hydrogen peroxide and bromine water be stored?

Hydrogen peroxide should be in an oxidisers cabinet and kept dark and cool.

If necessary, it should be kept with containment separate to other oxidisers in the cabinet, with the containment covered so that no contaminating material can fall into where a spill may occur.

Bromine water acts as an oxidiser in organic reactions but does not classify as one for Dangerous Goods or GHS purposes due to the high water content. It is corrosive, and generally quite reactive with the option of producing corrosive and toxic gases which is the main hazard. Keep cool and sealed. My apologies, my usual sources are drawing a blank on this one for further details and advice, including whether it should be isolated from acids or alkalis.

### Another curly one, how should Glacial Acetic acid (flam & corrosive) be stored?

It is compatible with acids other than oxidising acids such as concentrated nitric acid, but also generally compatible with flammable liquids. If you have either an Acid cabinet or flammable liquids cabinet, put it there so long as an acid cabinet does not include oxidising acids. Note that if you have to store it with flammable liquids, inspect the inside of the cabinet every six months for any sign of corrosion to components.

#### OFFICES

##### Australia

1800 358 101  
sales.au@westlab.com  
www.westlab.com.au

##### Canada

1 877 822 1455  
sales.ca@westlab.com  
www.westlab.com

##### New Zealand

09 972 7682  
sales.nz@westlab.com  
www.westlab.co.nz

##### United States

646 568 5391  
sales.us@westlab.com  
www.westlab.com



## Webinar Q&A (cont.)

Should corrosive solids be stored in a cabinet also, or only corrosive liquids? If so, can the solids be stored in the same cabinet on a shelf some way above the liquids?

Corrosive solids are certainly less of an immediate issue than corrosive liquids, but in order to protect them from interaction with incompatible materials (they are in their most concentrated form, after all), then on a shelf above compatible corrosive liquids is the recommendation – obviously it is critical to isolate acids from alkalis here.

What is the safest way to store the lower concentrations of Hydrogen Peroxide  $H_2O_2$ , (15% and lower)? Some say it can be stored in a fridge that is only used for scientific materials (no food or drink) others say it belongs with the 35% Hydrogen Peroxide  $H_2O_2$ . Who's right?

It depends on what else is in the fridge.  $H_2O_2$  reacts with a broad range of other materials, not just flammable or combustible liquids.

Should hydrogen peroxide be stored in a fridge?

General advice is to store cool. Though the material is considered stable at normal temperatures, it loses activity over time, and this will happen more quickly at higher temperatures. Unless contaminated, it will not decompose dangerously if stored out of direct sunlight and not heated.

Are you suggesting we shouldn't keep isopropyl alcohol (used in DNA experiment) in a fridge, perhaps only to cool it in a fridge short term prior to using for an experiment?

Isopropyl alcohol and ethanol are okay in fridges while they are working, as they will be well below the flash point. The problem can arise in an extended power outage, where the contents of the fridge come up to room temperature. If the pressure build-up causes a vapour release, particularly if it pops the top off the container, then you may have sufficient vapour inside to ignite when the power comes back on. Even under these circumstances, this is a rare combination of events, but it is possible and so technically you have stored a flammable liquid exposed to an ignition source. Remember though, that if you don't have a flammable liquid cabinet, or your cabinet is within 3m of an ignition source, the fridge is NO WORSE for these liquids. This argument does not apply to lower flash point materials such as acetone, where the flash point is  $-20^{\circ}C$ , and there is always enough vapour to be ignited.

Do you have a suggestion on how and where to store an Iodine solution and in its solid form since it sublimates and defaces labels over time?

Ideally the containers should be sealed so this does not occur. I don't know another way of preventing it.

Is glacial acetic acid to be stored in an acid cabinet as some tables say it is not to be treated as an acid?

Answered previously – not compatible with all acids. Generally compatible with flammable liquids, but vapours may affect cabinet construction.

### OFFICES

#### Australia

1800 358 101  
sales.au@westlab.com  
www.westlab.com.au

#### Canada

1 877 822 1455  
sales.ca@westlab.com  
www.westlab.com

#### New Zealand

09 972 7682  
sales.nz@westlab.com  
www.westlab.co.nz

#### United States

646 568 5391  
sales.us@westlab.com  
www.westlab.com

## Webinar Q&A (cont.)

### How would you recommend storing Sodium lumps?

While it is a Dangerous Goods 4.1 and can be stored in a cabinet is not intended for storage with a Dangerous Goods 4.3 material. Sodium metal is reducing rather than oxidising, so is not likely to react dangerously with most flammable solids.

Use-by/shelf-life details of chemicals are not on their label or in their SDS. Some manufacturers offer a recommended shelf life after requesting it. It's hard to know how long a chemical can be kept for, for use in secondary school laboratories. Some chemicals become unsafe and some lose their potency. What guide can you offer on this?

Reactive chemicals such as peroxides, in particular, may lose activity over time. Most mineral salts are entirely stable for years, though they may be hygroscopic.

### Does ChemWatch have access to the SDS for Westlab's chemical range?

Via the ChemWatch site, you can access the Westlab SDSs - search by name or product code.

### What is the maximum flammable liquid volume that can be stored in cabinets in school laboratory?

If storing the liquid in a working laboratory rather than a storeroom, previous guidance was 250L/kg total Dangerous Goods within a 10m radius. This could all be flammable liquids if there were no other Dangerous Goods present. This seems excessive. Do not exceed the capacity of cabinets, and don't remove bottom shelving to fit more in.

#### OFFICES

##### Australia

1800 358 101  
sales.au@westlab.com  
www.westlab.com.au

##### Canada

1 877 822 1455  
sales.ca@westlab.com  
www.westlab.com

##### New Zealand

09 972 7682  
sales.nz@westlab.com  
www.westlab.co.nz

##### United States

646 568 5391  
sales.us@westlab.com  
www.westlab.com