SAFETY REGULATIONS IN RESEARCH LABORATORIES

Text approved February 23rd 1999 in the Chemistry Executive Commission, and modified in the **** Executive C.

These safety regulations constitute a **minimum set of recommendations and obligations** that must be understood and fulfilled by everybody working in the department's laboratories.

The research director is the safety officer directly responsible for everyone working in his care; he or she must inform them of these norms and must also obtain agreement for his/her monitoring by means of the signing of a form that will be available from the department secretary's office.

It should be noted that **legal regulations referring to laboratory accidents involve teaching staff to a great extent, and these are not exempted from their responsibility by simply advising students on the execution of safety regulations, but must make use of their authority to ensure that rules are respected.** (Law 31/95, BOE of November of 1995, 10 p. 32590)

Contents

A) LABORATORY USAGE

Safety elements

Before beginning work in the laboratory, it is necessary to familiarize oneself with its safety elements. The research director, or the person he or she delegates, will demonstrate how these work and will explain the exact localization of:

Personal

* ***fire extinguishers, fire blankets, safety showers and eyewash fountains***
* ***gas masks and different kinds of filters*** that must obviously be appropriate for each particular need
* **facial protection shields** for transferring acids or of any other corrosive substance
* ***standardized laboratory safety glasses***

Building

* ***exits***, whether they be emergency exits or not, for evacuation in case of fire or any other incident.
* ***fume hoods***: they are the appropriate place for all hazardous operations where toxic or inflammable vapors are given off. They should never be used as a place to store products.
* ***risk laboratories on the 5th floor***: they are obligatory for all operations that involve toxic, inflammable or explosive gases.
* ***electrical plugs*** must be in perfect condition. If any damage is observed, it must be reported immediately so it can be repaired
* ***safety cabinets*** (fireproof and specific)
* ***sprinklers:*** automatic extinguishers

Never work alone in the lab.

Workspace conditions
Workspaces must always be kept clean and tidy, without books or coats, bags, excess of reagent packs, unnecessary equipment, superfluous objects or spilled chemical products (these must be cleaned up immediately).

Behavior in the laboratory
Behavior must be correct: no joking, running, playing, or screaming. If you listen to music, it must be at a low volume to avoid annoying others and to ensure that acoustic alarms can be heard correctly.

Handling of chemical products
Chemical products can be hazardous due to their toxic, corrosive, inflammable or explosive attributes, and must be handled with the greatest care. You can find all necessary information in the reagent Material Safety Data sheets:

Internet information: ***http://www.mtas.es/insht/ipcsnspn/spanish.htm***
Suppliers' websites

Pictograms indicate the kind of risks associated with the substance they contain. In addition, chemical product catalogs provide information about the dangers associated with each compound and give advice on how to handle them. The most frequent is the well-known use of the letters ***R (risk indicators) and S (safety advice***) which can usually be found in the opening pages of chemistry catalogs (See Aldrich, Panreac, Sigma, Fluka, etc). Clearly, one must be able to understand the meaning of the pictograms and to interpret the R and S letters.

Avoid inhaling vapors from chemical products and always work in ventilation hoods when you handle toxic, irritating, corrosive or lacrimogenous products. The use of the 5th floor risk labs for any operation involving toxic, inflammable and explosive gases ***is obligatory***.

Avoid contact of chemical products with the skin, especially those that are toxic and corrosive; in these cases the use of disposable gloves is highly recommended.

Always use special equipment to pipette liquids (never do so directly with the mouth).

When finishing any work or operation, arrange materials and used reagents so that they do not build up outside of their specific storage areas. Make sure to disconnect instruments, running water, gases, etc.

B) PERSONAL PROTECTION

Eyes
The use of standardized safety glasses is obligatory whenever you are in the lab.

Do not wear contact lenses. In the event of an accident, chemical products can splash into the eyes or their vapors can quickly get behind lenses and injure the eyes before the lenses can be removed. Do not use un-standardized prescription glasses as safety glasses.

Due to the direct risk of squirting or splashing when transferring acids, alkalis or cryogenic liquids, you must use a standardized facial protection shield to cover the whole face.

Dress

The wearing of a lab coat (100% cotton) is obligatory; regardless of the care taken in working, chemical product splashes are unavoidable.

The main advantage of the lab coat is that it is easy to take off, thereby providing clear protection against splashes and spills. For this reason, lab coats - as with any other type of specific laboratory wear - must be fitted with front buttons, and coats should always be worn buttoned up to prevent them from getting caught on laboratory structures and material.

It is advisable not to wear miniskirts, short pants or stockings (these are made of synthetic fibers and can adhere to the skin when they come into contact with certain chemical products; sandals or open shoes should also be avoided, and long loose hair must be kept in a ponytail.

Also to be avoided are the wearing of high heels (they don't allow running in the event of a fire), watches, bracelets, rings and any other type of jewelry (solvent and toxic products can get between these articles and the skin; they can get caught on protruding objects, causing containers to spill and preventing escape in the event of danger).

Gloves
They are a great help if the wearer knows how to use them correctly. You must check:

* before each use, that they are free of punctures or tears: using punctured gloves is more dangerous than not wearing gloves, since the toxic or abrasive substance concentrates between the skin and the gloves
* that you use ones that are not permeable to a toxic product or are abrasive (these would be completely useless). The permeability of gloves to certain substances depends on the material they are made of: rubber gloves normally provide good protection against organic acids and acceptable protection against bases and inorganic acids (except nitric acid); in spite of this, they are attacked by aromatic and chlorinated hydrocarbons and are not advisable for working with carbon sulfide. They must be washed and removed when leaving the laboratory, answering the telephone or writing, in order to avoid any respective contamination.
* that the appropriate gloves are used to carry out particular operations: cryogenic, metallic, etc

Hygiene rules
* ***Do not eat or drink in the laboratory*****,** because foods and drinks can be contaminated with chemical products
* Wash your hands after performing an experiment and also before leaving the laboratory.
* The wearing of lab coats in the cafeteria or in any other place where foods are eaten is not allowed.
**** Smoking is not permitted in any of the chemistry department facilities***, whether they be teaching or research laboratories, hallways, accesses to plants, W.C., etc., in both C7 (odd and even, any floor) and C5 (3^{rd} and 4^{th} floor) blocks.

C) PREVENTION ROUTINES

Do not store large quantities of solvent in laboratories; those that are indispensable must be kept the in fireproof cabinets. Do not place solvents with low ignition temperatures near to stoves, ovens

or heating plates. Products that can ignite in contact with water (for example, sodium) must be handled with extreme caution.

Heating plates are highly recommended instead of Bunsen burners; if it is not possible to use the former, you must be sure there is no solvent or inflammable products nearby.

Electrical wires must be very well insulated; ***plugs*** must be protected from splashes and water filtrations; ***electrical instruments*** must be connected to ground; mechanical shaker ***motors*** should made spark-free or, if this cannot be done, they must be moved away from refluxes and any other inflammable vapors.

Laboratories, safety cabinets and cold storage rooms (3rd and 0 floor) ***must*** be thoroughly checked and cleaned out at least once a year (to remove out of date products, etc), and this should preferably be done on a twice-yearly basis (July and December). It is also recommended to check the operational condition of drains, including the one in floor of the laboratory.

D) PREVENTION OF ACCIDENTS

Glassware
It is obvious that the glassware is hazardous because it can break and cause cuts. In addition, if it breaks during the course of a reaction, chemical products can overflow or spurt outwards.

Never use glassware that is in a bad condition; broken glass must be kept in special containers. Glass parts in any assembly must be held tightly but without being under tension.

Transport
Whether of gases or chemical substances, transport is a risky operation in itself, and must therefore be carried out with great caution. As a general rule, elevators should not be used. If their use cannot be avoided, chemical products/cylinders and people should travel separately.

Chemical products
The moving of large quantities of (many) products at the same time should be avoided. They must never be carried close to the body. The use of trolleys is recommended, with side protection to prevent products from falling.

Gas cylinders
Transport is to be carried out using special trolleys with safety fixing points on the top third section. These trolleys must be in perfect condition, and if any defect is detected, they must be taken out of service immediately and repaired.

Liquefied, compressed and dissolved gases
Gas cylinders must always be kept in their special storage area (on the roof of C7 research building), from where they will only be taken when they need to be used; and to where they are to be returned immediately, once their use is over. Stored cylinders, even empty ones, must have their cap or protective device fitted and have the valve closed. The mobile caps protecting the valve must stay screwed onto the cylinder until the moment of using.

Before using a liquefied or dissolved gas cylinder, you must ensure that it is in the vertical position and held firmly with chains. Cylinders can be fixed or portable, and chains must be installed obligatorily in all laboratories where gas cylinders are used, in the place where they are most likely to be used.

If valves are difficult to open or close or are rusty, consult the supplier for instructions ; ***never use lubricant products.***

Connections to pipes, regulators and to any other instruments must always be in very good condition and tightly sealed to prevent leaks. Any ***rubber piping*** used must be in good condition.

Whenever necessary, the risk laboratories on the 5th floor are to be used for any work that involves toxic, inflammable or explosive gases.

Liquefied gases (liquid nitrogen)
At atmospheric pressure, liquefied gases generally boil off to produce very low temperatures (nitrogen: -196ºC). Direct contact with cryogenic liquids can cause serious freezing or frostbite, with splashes to the eyes being particularly serious. If the affected part is the skin, it takes on a waxy appearance (pale yellowish color), although often without being painful. Defrosting however causes very strong pain, swellings, reddening and the risk of infections.

When containers at room temperature are filled, boiling is initially very quick and energetic, and liquefied gas may easily splash onto face and hands, and therefore ***the following precautions must be taken***:

- ***wearing of cryogenic insulated gloves*** (made of a dry material that does not grow stiff or break easily at low temperatures). They must be loose enough to be taken off quickly in the event of cryogenic liquid penetrating. Glove cuffs must be specially designed to prevent the liquid from penetrating easily.
- the wearing of a ***facial protection shield*** (standardized safety glasses are an incomplete protection).

A liter of liquid nitrogen produces 690 liters of gassy nitrogen at 15ºC. Appropriate ventilation is therefore necessary in places where liquefied gases are handled in open containers. Nitrogen is harmless, but if the oxygen content falls below 15% due to displacement by the nitrogen, suffocation can occur.

Transport must be undertaken in suitable small and covered cryogenic containers.

Hazardous operations
* reflux and distillations/reactions (nothing is to be heated up when covered)
* use of vacuum lines
* use of autoclaves
* handling of liquid nitrogen
* solvent distillations, anhydrations, etc

Storage
The ***bunker*** is the appropriate place to store large quantities of products, and these must always be properly laid out.

If, due to lack of space in the bunker, certain quantities of compounds must be stored in the laboratories, the following rules must be respected:

* all products, without exception, must be properly marked and labeled; nobody should use a product from a container that is not properly labeled
* appreciable quantities of solvent (around 20 liters) can be kept in ***safety cabinets***; it is very hazardous to store different drums of solvent in the same room

* corrosive substances must not be placed above eye level, whether it be in cabinets or on shelves and laboratory work benches
* in principle, chemical wastes have their own storage area (the bunker***). In laboratories,*** those substances that react violently when coming into contact with each other (for example, derived chlorinated and ammonia derivatives; oxidizers and reducers in general), or that give off toxic gases (for example, acids and cyanides) ***must be placed separated in suitable and labeled containers***. The frequency of chemical waste collection must be at least once a month.

Cold storage room (3rd floor)
The cold storage room is used for storing products whose composition demands this type of storage. ***Cleaning out is*** **obligatory** at least once a year and preferably twice yearly (in July and December).

Products must be tightly sealed in numbered and marked containers; in each laboratory there should be a list indicating the contents of each container (the cold storage room must not therefore contain any products not in their containers, above all if they are toxic or have an unpleasant odor). If this norm is followed strictly, there is no reason for vapors to be given off by products inside the cold storage room.

The following procedure must be carried out when depositing a product in or removing a product from the cold storage room:

* Consult in each laboratory the list of the container in which the product is to be deposited or from which it is to be removed. Meanwhile, press the cold storage room purge button. This will cause the red light on the door to light up.
* When the red light has switched off , the door may be opened to take out or deposit the closed container and then the door must be immediately closed again. In this way, there is no reason for the cold storage room to be open more than 30 seconds.
* Take the closed container to a fume hood, where it can be opened to take out or to arrange the product. Having finished, close the container again.
* If on concluding this operation more than 2 minutes have passed since the cold storage room was opened, it will be necessary to activate the purge system again and wait until red light switches off; if less than 2 minutes have passed, the cold storage room can be opened and the container returned without activating the system.
* It is necessary to make sure that at the end of the operation both the container and the refrigerator door are perfectly closed. To return the container once again to its place, the cold storage room does not need to be open for more than 20 seconds.

This regulation indicates that ***it is completely forbidden***
* to have products out of their containers in the cold storage room
* to enter the cold storage room without the purge cycle system being completed (light off)
* to open containers inside the cold storage room

Refrigerators (0 floor)
Basic instructions to be followed are the same as those in the previous point, except for the fact that there is no purge system.

Mechanical risks (vacuum pumps)
All equipment moving parts must be sufficiently protected. The risk of collapse or implosion is inherent to all systems working “in a vacuum”, In order to reduce the danger of glass shards flying out in the event of an implosion taking place, containers with a volume greater than 1 liter must be well protected with a metallic shield, or by wrapping them with resistant tapes, by plastic-coating them or by taking other appropriate measures.

D) PROCEDURES IN CASE OF ACCIDENT

Telephone Nos. ***2525*** ***campus security***
1800/1900 ***campus dispensary***

The PNA principle ***Protect yourself***
Notify others
Aid the possible victims

Safety information regarding products used must be available at all times in order to inform medical personnel

FIRE

A) In the laboratory

Evacuate even though the fire is not important. Notify all co-workers without spreading panic, and always keep calm.

Minor fires

If the fire is small and restricted to a small area:
* put it out using an ***appropriate fire extinguisher*** (CO_2 , metals or powder), using sand, or by covering the fire with a suitably sized container to suffocate it
* remove chemical products around fire
* never use water to put out a fire caused by a burning solvent

Major fires

* isolate the fire
* use the appropriate fire extinguishers (CO , metals or powder)
* evacuate the building if you cannot control the fire quickly (in extreme situations, automatic extinguishers (sprinklers) will activate

B) On the body

If you set yourself alight

- call for help immediately;
- stretch out on the floor and roll about to put out the flames
- do not run or try to reach the safety shower unless it is very near to you (running can fan flames)

If someone else catches fire

- cover the victim up with a fire blanket,
- take them to the safety shower if it is close or roll them about on the floor.
- ***never spray them directly with a fire extinguisher without protecting the face***.
- do not attempt to remove pieces of clothing that are stuck to skin: cut them with scissors.

When the fire is out, keep the patient lying down, ensure that he/she does not catch cold and **request medical assistance**

Fire must always be fought from a position that allows you an eventual escape route, and avoiding inhaling the gases and powder generated. If a recently started fire cannot be quickly controlled, it is advisable to run away from it.

It is the responsibility of all concerned to help anyone who is burning.

BURNS

Small burns caused by **hot material**, water baths, heating plates or heating blankets, etc. must be treated by bathing the affected area with cold water for 10-15 minutes.

In the case of burns caused by **chemical products**, in addition to the above instructions, you must search for information on their toxicity and act accordingly (going directly to the clinic with the information provided by the ***safety data sheets*** for the products handled). ***Whenever there is inflammation or reddening you must go to the doctor.***

If burns have been produced by **cold and freezing**

* never try to remove clothing that has stuck to skin by freezing, since this may produce substantial injuries
* never apply direct heat to the victim. The patient should be transferred to a warm place (approx. 22º C)
* request qualified medical assistance. If this is not possible, take the patient to a hospital as soon as possible. *Meanwhile*, the following should be borne in mind:

* Loosen clothes. Tight clothing can hinder blood circulation in the affected parts.
* Sprinkle injured areas lightly with tepid water. ***BE CAREFUL***! Contact with hot water (over 42º C) or with any other form of heat is hazardous.
* Protect affected parts by covering them with dry and sterile gauze, but without compressing, to avoid cutting off the blood circulation.
* Immobilize the area around the wound.

INJURIES

In the form of cuts
Cuts caused by a glassware breakage are a common laboratory risk. Cuts must be thoroughly cleaned under running water for at least 10 minutes or so.

* If they are small and the bleeding stops quickly, they must be cleaned with soap and water and wrapped with a bandage or appropriate dressing;
* If they are large and the bleeding does not stop, ***immediate medical assistance must be sought.*** In this case it is very important to specify which compound or mixture has entered in contact with the wound

Eyes (corrosive substances)
Here, the time factor (less than 10 seconds) is essential: the sooner the eye is washed, the lesser will be the damage produced.

* It is necessary to ***clean both eyes***, with plenty of running water for at least 15 minutes in an eyewash fountain. The eyes should be kept open with help of the fingers to help the water to flow under the eyelids
* ***Never direct the high-pressure water from a tap straight onto the eye***, since this could injure it.
* ***Always seek medical assistance***, although the injury may seem small.

Skin (corrosive substances)
* Any chemical product coming into contact with the skin ***must be cleaned off immediately with plenty of running water, for at least 15 minutes***. Safety showers installed in laboratories should be used in those cases where the affected area is large or there is not enough room for cleaning in the sink.

* ***Remove all contaminated clothing*** from the affected person ***as soon possible*****,** doing so under the shower. Cut and rip off clothing in cases where pullovers or shirts need to be taken off, in order to avoid eye contamination.

- ***Go quickly to the nearest hospital emergency room*** ***and inform them in detail of the nature of the toxic product***, making sure that health personnel understand you correctly. (An accident with hydrochloric acid needs treating in a completely different way from one with hydrofluoric acid, despite de fact that both are halogen group hydracids)

CORROSION

Acids
- Quickly cut or rip off clothing soaked in acid.
- Clean the affected area with plenty of running water and
- ***go to hospital immediately***

As purely informative advice: neutralize the acidity with sodium hydrogenocarbonate for 15-20 minutes; remove the excess of paste that has formed on the wound, dry it and apply an oily calcareous liniment or another similar product.

Alkalis
- clean with enough running water and
- ***go to hospital immediately***

As purely informative advice: wash with a 1% acetic acid solution *for 15-20 minutes)*; dry and apply a tannic acid ointment.

INGESTION OF CHEMICAL PRODUCTS

Before instigating any specific procedure, request medical assistance and do not leave the victim alone

If the patient is unconscious, put him or her in and inclined position, with the head to one side, and take out the tongue; if the patient is conscious, rest him or her against a wall and cover with a blanket to keep warm.

- ***Do not administer alcoholic drinks*** (alcohol increases the absorption of most toxic substances)
- ***Do not provoke vomiting if*** the ingested product is corrosive

Be prepared to give artificial mouth to mouth respiration

INHALATION OF CHEMICAL PRODUCTS

* ***Try to identify the toxic vapor and wear the appropriate kind of gas mask*** during the time needed to rescue the accident victim. If you do not have the correct one to hand, hold your breath as long as possible-

* Take to the affected person immediately to a well-ventilated place with fresh air. ***Seek medical assistance as quickly as you can.***

* If you observe first symptoms of breathing difficulties, begin the artificial mouth to mouth respiration (pure oxygen must only be administered by qualified personnel), and continue until a doctor indicates otherwise.

ELECTRIC SHOCK

* ***Switch off the current*** if the victim is in contact. Great care must be taken to ensure that the person trying to help is not electrocuted.
* In the event of **circulatory shock**, ***a doctor must be called immediately*** and the victim kept still and comfortable. ***No type of stimulant must be given.***

EMERGENCY ACTION

Phase 1/ Alarm

- Leave the laboratory and await instructions.

Phase 2/Evacuation plan

- ***Cut off electricity and gas by pressing the laboratory's red emergency stop button***. Apparatus that cannot be left without current should be connected to the SAI
- ***Do not cut off the water***
- ***Leave the building by following the instructions given by authorized personal***

Accident reporting

After an accident a report must always be made by filling out the relevant form (plant pharmacy) and handing it in to the department secretary's office. If it has been a serious accident, a report must be made by the head of laboratory research.