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MANUAL DE SEGURIDAD Y BUENAS PRÁCTICAS EN EL LABORATORIO

LABORATORY SAFETY AND BEST PRACTICE HANDBOOK

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Date: 23 July 2021	Date: 10 Sept. 2021	Date: 22 Sept. 2021

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Laboratory Safety and Best Practice Handbook

Drawn up by the *Unidad de Prevención de Riesgos Laborales* [Health and Safety Unit] of the University of Leon (September 2021)

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1. AIMS OF THE SAFETY HANDBOOK

The teaching and research activities carried out in the University of Leon's laboratories may on occasion involve possible exposure to risks. Their potential seriousness depends on the type of work being done, and on the protection and prevention measures put in place in each case.

Laboratory work, including research tasks undertaken by temporary staff, doctoral students, researchers, postdoctoral students and so forth, is appropriately structured. There are chains of responsibilities clearly defined and established in the Health and Safety Plan of ULE. This was referred to the Health and Safety Committee on 27 May 2019, approved by the Governing Body on 16 July 2019 and published on the ULE webpage.

This Handbook addresses the guidelines set down to ensure work performed in ULE's laboratories is safe and healthy. It takes into consideration, primarily, current legislation on workplace risk prevention, the environment and waste management.

It is aimed at **academic teaching** and **research staff** (ATRS), including under this heading **research interns** and **doctoral students**, who are beginning to carry out laboratory experiments. Likewise, all **professional, administrative, support** and **service staff** (PASS) having anything to do with laboratory work should be aware of its contents. In particular, all **researchers responsible for projects** and all **scientific and technical research interns** starting work at ULE should read and familiarize themselves with this Handbook.

Furthermore, the attached acceptance document (Appendix 1), confirming they have read and understood it should be signed and dated, and kept appropriately filed by the Lead Researcher, the Course Co-ordinator or other person accountable.

2. UNIVERSITY LABORATORIES

ULE has a number of different types of laboratory. The potential risks that might arise in them are directly linked to the activities carried out, and the materials and equipment used in them.

Among the various laboratories existing in the University of Leon, on the **Leon Campus** there are those for:

- Analysis and Experimentation, Organic and Inorganic Chemistry, Analytic Chemistry, Applied Chemical Engineering, Physical Chemistry, Physics, Food Technology Biochemistry, Pharmaceutical Technology, Microbiology**,** Parasitology, Medical Microbiology, Epidemiology, Virology.
- Radioactive Isotopes, Ecology, Physics, Electronic, Signal and Communications Theory, Biology, Zoology, Physical Anthropology, Botany, Genetics, Ecology, Cellular Biology, Molecular Biology, Plant Physiology, Medicine**,** Physiology, Medical Specialities, Surgery, Anatomy, Pharmacology, Animal Experimentation, Geology, Architecture, Robotics and Automation.

Further, there are Biology, Microbiology and Medicine Institutes on the Leon Campus:

- IBIOMED: Institute for Biomedicine
- INBIOMIC: Institute for Molecular Biology, Genomics and Proteomics
- INDEGSAL: Institute for Cattle Development and Animal Health

On the **Ponferrada Campus** there are laboratories for:
Physiology, Medicine and Surgery, Microbiology, Biochemistry, Toxicology and Pharmacology, Anatomy, Heat Technology, Ecology, Genetics, Microbiological Control, Geology, Topography, Photography, Basic Operations, Chemistry, Milk and Wine Production, Crop Science and Technology, Botany, Physics, Forestry, Zoology, Robotics, Motors and Machinery, Forest Conservation, Community Health, Physiotherapy, Muscle and Joint Assessment, Forest Mensuration, Quality Control, Electrical Engineering.

The operation of all these laboratories must follow the standards laid down for the activities carried out in them.

3. TYPES OF RISK

In accordance with current health and safety legislation on the prevention of workplace risks, certain terms are defined as below.

· PREVENTION – the whole set of activities or measure adopted or envisaged for all phases in the activity of an enterprise that are aimed at avoiding or decreasing hazards arising from work.

· WORKPLACE RISKS – the possibility a worker might suffer from a given sort of harm arising from work. In rating a risk in terms of seriousness, the probability of harm occurring and its severity are considered jointly.

· HARM ARISING FROM WORK – any disease, pathology or lesion occasioned by or during work.

· SERIOUS IMMINENT WORKPLACE RISK – any hazard that it is reasonable to see as likely to occur in the immediate future and to involve serious harm to the health of workers.

In the case of exposure to agents liable to cause severe negative effects on staff health, there is assumed to be a grave and imminent risk when it is reasonable to see as likely the occurrence in the immediate future of exposure to the agents in question, from which critical damage to health could arise, even when this would not become immediately obvious.

· Processes, activities, operations, equipment or products are seen as POTENTIALLY DANGEROUS when they are such as to pose risks to the health and safety of staff involved with them if no specific preventive measures are in place.

· WORK EQUIPMENT – any machine, apparatus, tool or installation used for work purposes.

· WORKING CONDITIONS – any features of work that might have a significant influence in triggering risks to workers' health and safety. Under this heading the following are

specifically included:

- The general characteristics of the buildings, installations, equipment, materials and tools and the like that constitute or are present in the workplace.
- The nature of the physical, chemical and biological agents present in the work context, with their corresponding intensities, concentrations or levels of presence.
- Any procedures for the use of the agents mentioned above that might have an influence in causing the sorts of risk listed.
- Any other characteristics of work undertaken, including those linked to organization and ordering, that might have an impact on the magnitude of the risks to which workers are exposed.

· PERSONAL PROTECTIVE EQUIPMENT – any equipment intended to be worn or held by staff so as to protect them from one or more risks that might threaten their safety or health in their work, together with any supplementary or accessory items used for this purpose.

Ratings for risks are in terms of their seriousness. The probability of harm occurring and its severity are taken into consideration jointly.

Taking the definitions given as a basis, it is possible to distinguish several categories.

a) **SAFETY Risks** proper are those with the potential to cause workplace accidents, these being any bodily injury suddenly suffered by workers while carrying out their work.
b) **OCCUPATIONAL HYGIENE Risks** are those which could potentially trigger occupational diseases, seen as a slow and gradual deterioration of the health of workers caused by exposure to given risks linked to the working environment.
c) **Risks in the fields of ERGONOMICS** and **APPLIED PSYCHOSOCIOLOGY** are those related to the suitability of the work station for an individual, considering questions of repetitive movements, stress, dissatisfaction, and similar physical, social and psychological matters.

This Handbook concentrates essentially on those risks that are capable of triggering possible occupational diseases. This means that it pays virtually no attention to potential risks in the safety, ergonomics and applied psycho-sociology categories.

RISKS LINKED TO THE WORKING ENVIRONMENT

The term risks linked to the working environment refers to all the factors arising in the carrying out of work activities that may affect workers' health through effects on their surroundings.

The various different hazards to which staff may be exposed in their workplaces can be classified on the basis of the type of agent causing them. Specifically, these agents can be grouped in the light of their nature into several classes.

• Physical Agents.

A. Risks arising from physical agents

A.1. Mechanical: Noise, potentially leading to occupational deafness, and vibrations, affecting the hand and arm subsystems, or the whole body.

A.2. Heat: These can be an outcome of high or low temperatures, involving situations

arising from extremes of heat or cold. They may also be a question of comfort or discomfort, linked to the ergonomics of the ambient temperature.

A.3. Electromagnetic:

a) Possible exposures to ionizing radiations. From the point of view of health and safety, all that is done is to identify the risk, with the Nuclear Safety Board determining its scale, and the relevant preventive and protection measures to be taken in each case.

b) Possible exposures to non-ionizing radiations: ultraviolet, visible, infrared, and so forth.

• Chemical Agents.

B. Risks arising from possible exposure to chemicals: particulate matter (dust or fibres); acids or alkalis (corrosive agents); solvents (volatile agents); carcinogens, mutagens, or substances deleterious for reproduction and fertility; heavy metals and the like.

• Biological Agents.

C. Risks that ensue from possible exposure to biological entities. Biological agents are split into four groups (numbered 1, 2, 3 and 4) as a function of the potential seriousness of any disease they may cause in humans, of the availability of one or more forms of treatment, of prophylaxis, or of both, and their capacity to cause a pandemic. Group 4 includes biological agents capable of causing very serious or lethal diseases, for which there are no adequate treatments or prophylactic measures and which have the capacity to set loose a pandemic.

3.1 Physical Risks:

A.1. Mechanical

Noise

Noise is the term used when a set of sounds becomes annoying or unpleasant. It is thus a subjective concept: one and the same sound may be perceived as useful, pleasant or annoying according to who is hearing it and at what time. However, when the level of sound is very high, even if some people may actually enjoy it, it can constitute a danger to health. Health and safety legislation sets reference values in order to prevent hearing loss (occupational deafness) differentiating between peak levels, which must never be exceeded at any moment during exposure, and weighted daily equivalent levels, established from the viewpoint of working days of eight hours and working weeks of forty.

Vibrations:

Legislation sets the benchmark values for vibration affecting the arms and hands, and the whole body, distinguishing between situations that are acceptable, those that involve risks, and those that cannot be allowed. It establishes appropriate measures for monitoring, control and prevention. The two effects that occur most often and have been widely studied are Raynaud's Syndrome or "white finger", in the case of vibrations affecting arms or hands, and possible lesions to the neck or back, in the case of whole body vibrations.

A.2. Temperature

Heat is the only "contaminant" that can be generated by the human body itself, so that it has natural defence mechanisms. Human beings need to maintain an internal temperature of approximately 37ºC ± 1ºC to live, possessing physical and physiological means of achieving this. Risks for workers' health begin when the environmental conditions go beyond the capacity of these self-defence mechanisms. They arise from the physical requirements for tasks being carried out, clothing, and external conditions such as ambient temperature, relative humidity, wind speed, and so forth.

Cold:

Working at very low temperatures or using materials stored under these conditions, for instance, work in, or access to cold stores, which are generally kept at around -20ºC,
Other operations with hazards from cold would be handling samples, substances, or both, stored in ultra-low temperature freezer chests, normally kept at -80ºC, activities using liquid nitrogen, and the like.
In general terms, work done in cold stores involves a certain minimum exposure time, necessary to enter the installation and remove the item required. The principal risk is that fingers might become stuck to a frozen container or surface. Activities involving materials stored at -80ºC involve this same risk, but in addition there is a danger from splashes of ultra-cold fluids, for example, liquid nitrogen, and of possible asphyxia through displacement of atmospheric oxygen.
Work entailing possible exposure to low temperatures from inclement weather is generally best undertaken using appropriate clothing and accessories.

Heat:

Some work is undertaken in a context of great heat, using materials exposed, or equipment functioning, at very high temperatures. Two examples would be activities involving muffle furnaces, which generally operate at 800ºC or even more, or kilns, that usually function with temperatures of 90ºC to 100ºC.
As a rule, work requiring the use of a crucible in a muffle furnace, or of glassware in a kiln, as also other heating processes, involves minimum times. It is necessary to proceed in accordance with guidelines and stipulations for this activity. Normally these make obligatory the use of specific collective or personal protective equipment. The chief risks arise from possible emanations of gases or vapours, splashes, scalds and burns.
In the case of activities possibly involving exposure to high temperatures caused by the weather, it is essential to undertake acclimatization, to ensure adequate hydration (including replacement of the mineral salts lost in sweat), to use skin protection when there is direct exposure to solar radiation, and to wear a cap, hat or similar headgear.

A.3. Electromagnetic

One form of transmission of energy is through the radiation of electromagnetic waves. These waves are of types differing one from another in accordance with the amount of energy they can transmit, this depending on their frequency.

Ionizing Radiations:

These are the most energetic, having such a quantity of energy that they are able to interact with matter, giving rise to particles with an electric charge, known as ions. Ionizing radiation may be electromagnetic, like X and gamma rays. It may also be particulate, with the emission of components of atoms, as in the case of alpha and beta particles. Exposure to ionizing radiation may cause very serious and irreversible harm to health, among other things by causing cancer.
As indicated above, health and safety units identify the risk. However, it is the Nuclear Safety Board, or firms authorized by it in each Autonomous Region of Spain, that is the official body in charge of assessing it. It also is responsible for stipulating any specific training required, for inspections, health monitoring, and appropriate preventive and protective measures to be adopted in each instance, in conformity with current legislation, covering equipment for radiological diagnosis, radioactive installations and similar.

Non-Ionizing Radiation:

Non-ionizing radiations can produce effects of various sorts on the human organism, depending on the frequency band in question.
Laser radiation can be extremely dangerous, since it projects a huge amount of energy onto a very small surface.
Ultraviolet (U.V.) radiation can cause skin trouble (reddening and even burning), or conjunctivitis if the eyes are exposed.
Visible light gives rise to other problems, which are less serious but more frequent. These problems relate to lighting and generally are considered from the viewpoint of ergonomics and psycho-sociology. The commonest occur in relation to the type of illumination present and the visibility requirements for the type of task to be performed. There is particular Influence from contrast, lighting level, glare and other factors, for example, when computers are being used.
Infrared radiation reaching the eye can damage the retina or cause opacity of the lens. It can sometimes also affect the skin because of the heat it transmits.
Microwaves are especially dangerous because of their effects on health derived from their considerable heating capacity, their action being enhanced when they impinge on water molecules forming a part of plant or animal tissues.
Radio-frequency (R.F.) electromagnetic waves can also affect certain bodily tissues by heating them.

3.2 Chemical Risks:

What is a Chemical Risk?

Chemical risks are those arising from contact, whether direct, through handling or inhalation, or otherwise, with substances.
Spanish Royal Decree 374/2001, of 6 April 2001, relates to the protection of the health and safety of workers against the risks linked to chemical agents during their work. It defines these agents as any element or chemical compound, whether in itself or in a mixture, in its natural state or as produced, used or dispensed during workplace activity.

From a practical viewpoint, health and safety should assess chemical risks by considering the potential toxicity of substances, their concentration, the length of exposure, and the personal characteristics of each individual. Taking all these into consideration, it is clear that one and the same chemical may cause a workplace accident (for example, in the event of splashes or a sudden emission of gases or vapours at high concentration), or a potential occupational disease (for instance, when workers are exposed to a given concentration of a chemical in the atmosphere they breathe for long periods of exposure). Hence, chemical risk can be associated with any activity involving handling of chemicals (including particulate matter in suspension, such as fibres, which can have very high toxicity, dust, gases, vapours, and similar).

Chemical Agents and Health (Prevention of Occupational Diseases)

Inhalation of chemicals can cause poisoning. This is defined as the set of symptoms and clinical signs arising from the action of a toxic substance. The degree of poisoning from a chemical agent depends on a range of factors. These include the toxicity of the substance, its concentration in the surroundings, the length of exposure and the biological state of the individual affected, for example pregnancy or breastfeeding, immunodeficiencies and so forth).

A toxic substance has to go through various metabolic processes in the organism for it to be appropriate to speak of poisoning. These are explained by the acronym **ADAME**:

Absorption
Distribution (or transport)
Accumulation (or location)
Metabolization (biotransformation)
Elimination

Direct detection of a chemical or its metabolites in the blood, or in urine or exhaled air during the final process of elimination of the substance or its metabolites constitute the only practical procedures permitting confirmation whether or not there has been exposure to a toxic chemical. At the present day, there are forty-six substances whose metabolites can be measured in biological samples of blood, urine and exhaled air. From time to time, the Spanish National Institute for Health and Safety in the Workplace updates and publishes guidelines for permissible limits for exposure to chemicals.

Signage and Labelling

Globally Harmonized System of Classification and Labelling of Chemicals (G.H.S.)

Labels are a basic obligatory source of information identifying a given chemical and the risks associated with handling it.

All labels must include the following data:

Pictograms, to a maximum of two.

Correspondence between Older (orange) and Newer (red and white) Pictograms

The letter codes indicate which former category or categories the newer pictograms cover.

 C – Corrosive  T – Toxic  Xa – Harmful Xi – Irritant	 E – Explosive  F – Flammable  O - Oxidizing	 N – Harmful to the environment
 **C**  **T, X**  **C, X**  **T, X**	 **E, O**  **O**  **F**  *new category*	 **N**
Health Hazards	Physical and Chemical Hazards	Environmental Hazards

Safety Signage and Labelling

GLOBALLY HARMONIZED SYSTEM (GHS)
CLASSIFICATION AND LABELLING OF CHEMICALS

The Globally Harmonized System is intended to provide information related to the effects that can be caused by the use of chemicals.

1. Physical Hazards

Pictogram	Meaning
	Combustible substances. Extremely flammable or flammable gases or aerosols. Highly flammable or flammable liquids and vapours. Flammable solids.
	Oxidizing gases and solids. Oxidizers may cause or intensify fire. Strong oxidizers may cause fire or explosion.
	Explosives: unstable, mass explosion hazard, severe projection hazard, fire, blast or projection hazard, may mass explode in fire.
	Compressed gases. Gas under pressure may explode if heated. Refrigerated gas may cause cryogenic burns or injury.

2. Health Hazards

Pictogram	Meaning
	Substances seriously harmful to health. Cause one or more of: respiratory or skin sensitization, germ cell mutagenicity, carcinogenicity, reproductive toxicity, specific target organ toxicity (single or repeated exposure), or aspiration hazard.
	Harmful and irritant substances. May cause respiratory irritation. May cause drowsiness or dizziness. May cause an allergic skin reaction. Cause serious eye irritation. Cause skin irritation. Harmful if swallowed. Harmful in contact with skin. Harmful if inhaled. Harmful for public health and the environment by destroying ozone in the upper atmosphere.

	Corrosive substances and mixtures. May corrode metals. Cause severe skin burns and eye damage.
	Poisonous substances. Fatal, acutely toxic, or toxic if ingested, inhaled or absorbed through the skin.

3. Danger for the Environment

Pictogram	Meaning
	Environmentally harmful substances. Toxic or very toxic to aquatic life, with long-lasting effects.

HAZARD INDICATIONS: "H STATEMENTS"

Structure of Hazard Indications

Hazard Statement		
H[azard]	**First Digit**	**Last Two Digits**
	Group Number **2 = Physical Hazard** **3 = Health Hazard** **4 = Environmental Hazard**	**Sequence Number** **01, 02, 03, …**

H200 – Physical Hazard Indications	
H200	Unstable explosive
H201	Explosive; mass explosion hazard
H202	Explosive; severe projection hazard
H203	Explosive; fire, blast or projection hazard
H204	Fire or projection hazard
H205	May mass explode in fire
H220	Extremely flammable gas
H221	Flammable gas
H222	Extremely flammable aerosol
H223	Flammable aerosol
H224	Extremely flammable liquid and vapour

H225	Highly flammable liquid and vapour
H226	Flammable liquid and vapour
H228	Combustible liquid
H240	Heating may cause an explosion
H241	Heating may cause a fire or explosion
H242	Heating may cause a fire
H250	Catches fire spontaneously if exposed to air
H251	Self-heating; may catch fire
H252	Self-heating in large quantities; may catch fire
H260	In contact with water releases flammable gases which may ignite spontaneously
H261	In contact with water releases flammable gas
H270	May cause or intensify fire; oxidizer
H271	May cause fire or explosion; strong oxidizer
H272	May intensify fire; oxidizer
H280	Contains gas under pressure; may explode if heated
H281	Contains refrigerated gas; may cause cryogenic burns or injury
H290	May be corrosive to metals
H300 – Health Hazard Indications	
H300	Fatal if swallowed
H301	Toxic if swallowed
H302	Harmful if swallowed
H304	May be fatal if swallowed and enters airways
H310	Fatal in contact with skin
H311	Toxic in contact with skin
H312	Harmful in contact with skin
H314	Causes severe skin burns and eye damage
H315	Causes skin irritation
H317	May cause an allergic skin reaction
H318	Causes serious eye damage
H319	Causes serious eye irritation
H330	Fatal if inhaled
H331	Toxic if inhaled
H332	Harmful if inhaled
H334	May cause allergy or asthma symptoms or breathing difficulties if inhaled
H335	May cause respiratory irritation

H336	May cause drowsiness or dizziness
H340	May cause genetic defects
H341	Suspected of causing genetic defects
H350	May cause cancer
H351	Suspected of causing cancer
H350i	May cause cancer through inhalation.
H360	May damage fertility or the unborn child.
H360F	May damage fertility
H360D	May damage the unborn child

H360Fd	May damage fertility. Suspected of damaging the unborn child
H360Df	May damage the unborn child. Suspected of damaging fertility.
H360FD	May damage fertility. May damage the unborn child.
H361	Suspected of damaging fertility or the unborn child
H361d	Suspected of damaging the unborn child
H361f	Suspected of damaging fertility
H361fd	Suspected of damaging fertility. Suspected of damaging the unborn child.
H362	May cause harm to breast-fed children
H370	Causes damage to organs
H371	May cause damage to organs
H372	Causes damage to organs through prolonged or repeated exposure
H373	May cause damage to organs through prolonged or repeated exposure
H400 – Environmental Hazard Indications	
H400	Very toxic to aquatic life
H410	Very toxic to aquatic life with long-lasting effects
H411	Toxic to aquatic life with long-lasting effects
H412	Harmful to aquatic life with long-lasting effects
H413	May cause long-lasting harmful effects to aquatic life
H420	Harms public health and the environment by destroying ozone in the upper atmosphere
Supplementary Hazard Information (valid only in EU countries)	
Physical Properties	
EUH001	Explosive when dry
EUH006	Explosive with or without contact with air.
EUH014	Reacts violently with water
EUH018	In use may form flammable/explosive vapour-air mixture.
EUH019	May form explosive peroxides
EUH044	Risk of explosion if heated under confinement
Health Properties	
EUH029	Contact with water liberates toxic gas
EUH031	Contact with acids liberates toxic gas
EUH032	Contact with acids liberates very toxic gas
EUH066	Repeated exposure may cause skin dryness or cracking
EUH070	Toxic by eye contact
EUH071	Corrosive to the respiratory tract
Environmental Properties	
EUH059	Hazardous to the ozone layer.
Further information or Details Required on the Labels of Certain Substances and Mixtures	

EUH201	Contains lead. Should not be used on surfaces liable to be chewed or sucked by children.
EUH201A	Warning! Contains lead.
EUH202	Cyanoacrylate. Danger. Bonds skin and eyes in seconds. Keep out of the reach of children.
EUH203	Contains chromium (VI). May produce an allergic reaction.
EUH204	Contains isocyanates. May produce an allergic reaction.
EUH205	Contains epoxy constituents. May produce an allergic reaction.
EUH206	Warning! Do not use together with other products. May release dangerous gases (chlorine).
EUH207	Warning! Contains cadmium. Dangerous fumes are formed during use. See information supplied by the manufacturer. Comply with the safety instructions.
EUH208	Contains <*name of sensitising substance*>. May produce an allergic reaction.
EUH209	Can become highly flammable in use.
EUH209A	Can become flammable in use.
EUH210	Safety data sheet available on request.
EUH401	To avoid risks to human health and the environment, comply with the instructions for use.

PRECAUTIONARY ADVICE: "P STATEMENTS"

Structure of Precautionary Advice Statements:

Precautionary Advice Statement		
P[recaution]	First Digit	Last Two Digits
	Group Number 1 = General 2 = Prevention 3 = Response 4 = Storage 5 = Disposal	Sequence Number 01, 02, 03, …

P100 – General Precautionary Statements	
P101	If medical advice is needed, have product container or label at hand.
P102	Keep out of reach of children.
P103	Read label before use.
P200 – Preventive Precautionary Statements	
P201	Obtain special instructions before use.
P202	Do not handle until all safety precautions have been read and understood.
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P211	Do not spray on an open flame or other ignition source.
P220	Keep/Store away from clothing/… /combustible materials.
P221	Take precautions to avoid mixing with combustibles.
P222	Do not allow contact with air.

P223	Do not allow contact with water.
P230	Keep wetted with <… > (Manufacturer or supplier to specify incompatibilities).
P231	Handle under inert gas.
P232	Protect from moisture.
P233	Keep container tightly closed.
P234	Keep only in original container.
P235	Keep cool.
P240	Ground/bond container and receiving equipment.
P241	Use explosion-proof electrical/ventilating/lighting/… /equipment. (Manufacturer or supplier to specify details)
P242	Use only non-sparking tools.
P243	Take precautionary measures against static discharge.
P244	Keep valves and fittings free from oil and grease.
P250	Do not subject to grinding/shock/… /friction. (Manufacturer or supplier to specify limits)
P251	Do not pierce or burn, even after use.
P260	Do not breathe dust/fumes/gas/mist/vapours/spray (Manufacturer or supplier to specify conditions applicable)
P261	Avoid breathing dust/fumes/gas/mist/vapours/spray (Manufacturer or supplier to specify conditions applicable)
P262	Do not get in eyes, on skin, or on clothing.
P263	Avoid contact during pregnancy/while nursing.
P264	Wash <…> thoroughly after handling. (Manufacturer or supplier to specify details of washing)
P270	Do not eat, drink or smoke when using this product.
P271	Use only outdoors or in a well-ventilated area.
P272	Contaminated work clothing should not be allowed out of the workplace.
P273	Avoid release to the environment.
P280	Wear protective gloves/protective clothing/eye protection/face protection. (Manufacturer or supplier to specify type).
P281	Use obligatory personal protective equipment
P282	Wear cold insulating gloves/face shield/eye protection.
P283	Wear fire/flame resistant/retardant clothing.
P284	Wear respiratory protection (manufacturer or supplier to specify type).
P285	In case of inadequate ventilation, wear respiratory protection (Manufacturer or supplier to specify type).
P231 + P232	Handle under inert gas. Protect from moisture
P235 + P410	Keep cool. Protect from sunlight
P300 – Response Precautionary Statements	
P301	IF SWALLOWED:
P302	IF ON SKIN:
P303	IF ON SKIN (or hair):
P304	IF INHALED:
P305	IF IN EYES:
P306	IF ON CLOTHING:
P307	If exposed

P308	If exposed or concerned
P309	If exposed or unwell
P310	Immediately call a POISON CENTRE/doctor/…
P311	Call a POISON CENTRE/ doctor/…
P312	Call a POISON CENTRE/ doctor/… /if you feel unwell.
P313	Get medical advice/attention.
P314	Get medical advice/attention if you feel unwell.
P315	Get immediate medical advice/attention.
P320	Specific treatment is urgent (see … on this label).
P321	Specific treatment needed (see … on this label).
P322	Specific measures required (see first aid instructions on this label).
P330	Rinse mouth.
P331	Do NOT induce vomiting.
P332	If skin irritation occurs:
P333	If skin irritation or a rash occurs:
P334	Immerse in cool water/wrap in wet bandages.
P335	Brush off loose particles from skin.
P336	Thaw frosted parts with lukewarm water. Do not rub affected areas.
P337	If eye irritation persists:
P338	Remove contact lenses if present and easy to do. Continue rinsing.
P340	Remove person to fresh air and keep comfortable for breathing.
P341	In case of breathing difficulties, remove person to fresh air and keep comfortable for breathing
P342	If experiencing respiratory symptoms:
P350	Wash gently with plenty of soap and water
P351	Rinse cautiously with water for several minutes.
P352	Wash with plenty of water/…
P353	Rinse skin with water/shower.
P360	Immediately rinse contaminated clothing and skin with plenty of water before removing clothes.
P361	Immediately take off all contaminated clothing.
P362	Take off contaminated clothing.
P363	Wash contaminated clothing before reuse.
P370	In case of fire:
P371	In case of major fire and large quantities:
P372	Explosion risk in case of fire.
P373	DO NOT fight fire when fire reaches explosives.
P374	Fight fire with normal precautions from a reasonable distance.
P375	Fight fire remotely due to the risk of explosion.
P376	Stop leak if safe to do so.
P377	Leaking gas fire – do not extinguish unless leak can be stopped safely.
P378	Use … to extinguish. (Manufacturer or supplier to specify, particularly if water can exacerbate the fire)
P380	Evacuate area.
P381	Eliminate all ignition sources if safe to do so.
P390	Mop up spillage so it does not damage other materials

P391	Collect spillage
P301 + P310	IF SWALLOWED: Immediately call a POISON CENTRE/doctor/…
P301 + P312	IF SWALLOWED: Call a POISON CENTRE/doctor/… /if you feel unwell.
P301+ P330 + P331	IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P302 + P334	IF ON SKIN: Immerse in cool water/wrap in wet bandages.
P302 + P350	IF ON SKIN: Wash with plenty of soap and water
P302 + P352	IF ON SKIN: Wash with plenty of water
P303+ P361 + P353	IF ON SKIN (or hair): Immediately take off all contaminated clothing. Rinse skin with water/shower.
P304 + P340	IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P304 + P341	IF INHALED: In case of breathing difficulties, remove person to fresh air and keep comfortable for breathing
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do. Continue rinsing.
P306 + P360	IF ON CLOTHING: Immediately rinse contaminated clothing and skin with plenty of water before removing clothes.
P307 + P311	If exposed: Call a POISON CENTRE/ doctor/…
P308 + P313	If exposed or concerned: Get medical advice/attention.
P309 + P311	If exposed or unwell: Call a POISON CENTRE/ doctor/…
P332 + P313	If skin irritation occurs: Get medical advice/attention.
P333 + P313	If skin irritation or a rash occurs: Get medical advice/attention.
P335 + P334	Brush off loose particles from skin. Immerse in cool water/wrap in wet bandages.
P337 + P313	If eye irritation persists: Get medical advice/attention.
P342 + P311	If experiencing respiratory symptoms: Call a POISON CENTRE/ doctor/…
P370 + P376	In case of fire: Stop leak if safe to do so.
P370 + P378	In case of fire: Use <…> to extinguish. (Manufacturer or supplier to specify appropriate means, particularly if water can exacerbate the fire)
P370 + P380	In case of fire: Evacuate area.
P370 + P380 + P375	In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.
P371 + P380 + P375	In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.
P400 – Storage Precautionary Statements	
P401	Store … (in conformity with local, regional, national or international standards as specified)
P402	Store in a dry place.
P403	Store in a well ventilated place. [When product is volatile and generates a hazardous atmosphere]
P404	Store in a closed container.
P405	Store locked up.
P406	Store in a corrosive resistant/… container with a resistant inner liner.
P407	Maintain air gap between stacks/pallets.
P410	Protect from sunlight.

P411	Store at temperatures not exceeding … °C/… °F. (Manufacturer or supplier to specify temperature)
P412	Do not expose to temperatures exceeding 50 °C / 122 °F.
P413	Store bulk masses greater than … kg/… lbs at temperatures not exceeding … °C/… °F. (Manufacturer or supplier to specify details)
P420	Store away from other materials.
P422	Store contents under <…> (Manufacturer or supplier to specify the liquid or inert gas needed).
P402 + P404	Store in a dry place. Store in a closed container.
P403 + P233	Store in a well ventilated place. Keep container tightly closed. (Specifically if the product is volatile and may give rise to a dangerous atmosphere).
P403 + P235	Store in a well ventilated place. Keep cool.
P410 + P403	Protect from sunlight. Store in a well-ventilated place.
P410 + P412	Protect from sunlight. Do not expose to temperatures exceeding 50°C / 122°F.
P411 + P235	Store at temperatures not exceeding … °C/… °F. Keep cool. (Manufacturer or supplier to specify temperature)
P500 – Disposal Precautionary Statement	
P501	Dispose of contents/container to … [… in accordance with local / regional / national / international regulations (to be specified)].

Safety Data Sheets (SDS). These are documents rounding out the information provided by labels and describing the characteristics of different chemicals, so that a professional user handling a given substance will have information about the hazards associated with it.

In accordance with current legislation on the topic, it is obligatory for SDSs to be provided to the professional user with the first delivery of a product, or to be available on the manufacturer's webpage. SDSs provide details of the nature, composition, and other features of substances and of their hazards, but in addition give further data such as how to manage waste remaining from its use, first aid, threshold values, and physical, chemical, and toxicological information.

IT SHOULD BE REMEMBERED THAT:

- These sheets should be handed over by the manufacturer or distributor to purchasers, or alternatively be available on the relevant webpage.
- Before any chemical is used, its SDS should be read, and the instructions given should be followed.

Handling Chemicals

Handling substances implies gaining an acquaintance with the hazards they might pose.

In general, among others, operations possibly involving dangers would be:

♦ Occasionally, and exclusively in a few institutes and laboratories, certain chemicals may be made.

♦ Use of chemicals in general

♦ Repackaging
♦ Storage
♦ Loading and unloading operations
♦ Transport
♦ Disposal

Any of these operations requires attention to be paid to the compatibilities between different substances. Handling, transfer, storage, transport, and even disposal, of them all depend on this factor.

IT SHOULD BE REMEMBERED THAT:

- **Collective protection equipment**, such as fume extractor hoods, localized extraction, or both, should always be used. As far as is possible, **fume extractors** should be employed in all operations involving the handling of substances that are highly toxic, carcinogenic, teratogenic, mutagenic, toxic for fertility and reproduction, poisonous for the environment, allergenic, or any combination of these. Likewise, they should be used in activities that produce vapours or imply the handling of volatile substances.
- All work should be done with **mechanical extraction and air renewal** systems **activated**.
- If the use of collective protection equipment is not enough, when certain operations must be performed outside the fume hood, and if there are leaks or spills, localized extraction systems should be utilized. If these, in turn, are not sufficient, use should be made of **personal protective equipment (PPE)** appropriate for the operation being carried out and the chemicals involved. **PPE is obtained and issued by the person responsible for the laboratory in general, or for research project, course being taught, or other activity, with technical advice from the ULE Health and Safety Unit and any similar outside service, in accordance with the standards applicable in each case.**
- Substances must be stored in the **zones specially designated** for the purpose. Bulk supplies may be stored in shared areas intended for this purpose, with the intention of minimizing the quantities of chemicals in the actual workplace.

Table of Incompatibilities

When chemicals are to be put in storage, and when any operation involving chemicals is being carried out, account must be taken of the table of incompatibilities between substances:

SUMMARY CHART OF STORAGE INCOMPATIBILITIES FOR HAZARDOUS WASTE					
					

	+	-	-	-	+
	-	+	-	-	-
	-	-	+	-	-
	-	-	-	+	○
	+	-	+	○	+
+ = May be stored together ○ = May be stored together only if specific preventive measures are taken - = Should not be stored together					

	E	O	F	T	C	N	**Table of Incompatibilities**
E	Yes	No	No	No	No	No	E = Explosive
O	No	Yes	No	No	No	2	O = Oxidizing
F	No	No	Yes	No	1	No	F = Flammable
T	No	No	No	Yes	Yes	Yes	T = Toxic
C	No	No	1	Yes	Yes	Yes	C = Corrosive
N	No	2	Yes	Yes	Yes	Yes	N = Harmful to the environment
1 = May be stored together if in secure containers							
2 = May be stored together if special measures are taken							
The letters used in the Table correspond to those associated with pictograms assigned to chemicals as a function of the hazards they pose.							

General Hazard Sign

	• There should be **signage** in the work area whenever the substances utilized are highly toxic. In this case, the **general warning sign**, the sign corresponding to the activity being performed (for instance the use of radioactive isotopes), or both, should be employed.

Absorption and Neutralization Procedures

The chart given below summarizes a range of **procedures for absorption and neutralization of chemicals** and families of substances. In general, if consultation of the safety data sheet does not indicate a specific method, the recommendation would be to use an adsorbent or absorbent of proven efficacy (activated charcoal, vermiculite, aqueous or organic solutions, and so forth), thereafter applying the procedure for destruction or disposal as waste that is recommended. **Neutralization should be undertaken directly in those instances in which its effectiveness is guaranteed**, although always keeping in mind the possibility of the generation of toxic or inflammable gases and fumes.

Examples of Procedures for Neutralizing or Absorbing Spillages of Chemicals

Substance or Family of Substances	Procedure
Acid, hydrofluoric	Solution of calcium hydroxide or calcium carbonate.
Acids, inorganic	See general procedure.
Acids, organic	Sodium bicarbonate.
Aldehydes	Sodium bisulphite solution in abundance.
Alkaline sulphides	Sodium bisulphite solution in great abundance and soapy water with sodium bisulphite.
Alkaloids	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Amides, alkaline	Ammonium chloride in abundance.
Amines, alicyclic	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Amines, aliphatic	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Amines, aromatic	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Azo derivatives	10% solution of ammonium cerium nitrate.
Bases, inorganic	See general procedure.
Bases, pyrimidine	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Borohydrides	Cold water in abundance.
Calcium carbide	Remove with dry vermiculite.
Carbamates	Sodium hydroxide solution 5M.
Carbon sulphide	Sodium bisulphite solution in great abundance and soapy water with sodium bisulphite.
Cyanides	Sodium hypochlorite solution. pH should be kept in the basic region (> 7).
Di-isocyanates	Cold methanol.

Dimethyl and diethyl sulphate	Sodium hydroxide solution 5M.
Ethanol amines	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Ethidium bromide	Activated charcoal, Amberlite XAD-16, or lactophenol blue dye.
Fluorides	Calcium chloride solution.
Formaldehyde	Sodium hypochlorite solution.
Halides, inorganic	Sodium bicarbonate and sodium hydroxide solution in abundance.
Halides, organic	Sodium hydroxide solution 10%.
Halides, organic acid	Sodium bicarbonate.
Hydrazine (hydrate)	Sodium hypochlorite solution.
Hydrides	Remove with organic solvents. Do not use water or alcohols.
Hydrogen peroxide	Vermiculite in abundance.
Hydroperoxides	Vermiculite in abundance.
Ketones	Sodium bisulphite solution in abundance. See also general procedure for flammables.
Lithium	Water in abundance.
Mercury	See specific procedure.
Metal carbonyls	Remove with water, endeavouring to maintain neutral pH value.
Methyl chlorosilanes	Cold water in abundance.
Organic acid anhydrides	Sodium bicarbonate.
Organic sulphur compounds	Sodium bisulphite solution in great abundance and soapy water with sodium bisulphite.
Organometallic compounds	Remove with organic solvents. Do not use water or alcohols.
Osmium tetroxide	Ammonium hydroxide solution at pH 10.
Peracids	Vermiculite in great abundance.
Peranhydrides	Vermiculite in great abundance.
Peresters	Vermiculite in great abundance.
Peroxides	Vermiculite in great abundance.
Phosphorus, white and phosphides	Copper sulphate solution, followed by neutralization with sodium bicarbonate or hypochlorite.
Polyamines	Sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Potassium	Butanol or tertiary butanol in great abundance.
Propidium iodide	Activated charcoal, Amberlite XAD-16, or lactophenol blue dye.
Rubidium	Butanol or tertiary butanol in great abundance.
Silane	Dilute solution of copper sulphate.
Sodium	Methanol in great abundance.
Solutions of heavy metals and derivatives	Form insoluble derivatives, or gather up and precipitate immediately.
Substituted hydrazines	Sodium hypochlorite solution, sodium bisulphate, dilute sulphuric acid (pH 5 to 6), or sulphamic acid.
Thioethers	Sodium bisulphite solution in great abundance and soapy water with sodium bisulphite.
Thiols	Sodium bisulphite solution in great abundance and soapy water with sodium bisulphite.

Examples of Procedures for Neutralizing or Absorbing Spillages of Chemicals

3.3 BIOLOGICAL RISKS

What is a Biological Risk?

Spanish Royal Decree 664/97 explains and defines as follows:

a) Biological Agents: micro-organisms, including genetically modified, cell cultures and human internal parasites, liable to cause any type of infection, allergy or toxicity.

b) Micro-organism: any microbiological entity, whether cellular or not, capable of reproducing itself or transferring genetic material.

c) Cell Culture: the result of growing *in vitro* cells obtained from multicellular organisms.

In view of the above, at the very least it is necessary to include bacteria, viruses, parasites and fungi. Additionally, the category extends to derivatives of animals such as hair, fur, claws, secretions and so forth, and derivatives of plants, such as pollen, spores, and the like.

Use or handling of a biological agent may constitute the principal purpose of some laboratory work. Hence, two clearly differentiated situations should be taken into account:

- Activities in which **the biological agent is intentionally handled.**
- Activities which **do not involve a deliberate intention to handle a biological agent, but in which one or more may be present.**

In general, there are certain activities in which it is necessary to keep in mind the possibility of exposure biological agents:

1. Work in food-production facilities.
2. Work on farms.
3. Activities in which there is contact with animals or plants, or with products of animal or plant origin.
4. Work in healthcare facilities, including isolation and pathological anatomy services.
5. Work in clinical, veterinary, diagnostic and research laboratories, excluding microbiological diagnosis laboratories.
6. Work in waste disposal facilities.
7. Work in sewage treatment installations.

Biological Agents and Health

When contact with a given biological agent produces undesirable effects on human health, these are differentiated as **infection, allergy** or **toxicity**.

The classification provided in Spanish Royal Decree 664/97 of 12 May 1997 on the protection of workers against risks related to exposure to biological agents in their job permits an initial identification of micro-organisms according to the dangers they pose. Four levels are established on the basis of the characteristics mentioned below.

Article 3 of Royal Decree 664/97. Classification of Biological Agents

For the purposes of the Royal Decree, biological agents are classified as falling into one of four groups as a function of the risk of infection:

• Group 1 Biological Agents: Unlikely to cause illness in humans.

• Group 2 Biological Agents: Capable of causing disease in humans and of constituting a hazard for staff, but unlikely to spread to a community at large, and for which there is generally an efficacious prophylaxis or treatment.

• Group 3 Biological Agents: Able to trigger serious illness in humans, representing a

grave danger for workers, with the risk of spreading to a whole community, but for which there are normally effective prophylactic or therapeutic means.
• Group 4 Biological Agents: Causing serious illness in humans and entailing grave dangers for staff, highly likely to spread to a community at large, and for which there is generally no effective prophylaxis or treatment.

Risk Elimination and Reduction:
If assessment makes plain a risk to staff health, exposure to this should be avoided, or, if this is not possible, reduced to the lowest level feasible. For this purpose, a range of measures should be considered, including actions relating to the source of contamination, to its means of diffusion, and to the workers concerned.

Relating to the **source of contamination**:
A source of contamination is seen both as the biological agent involved and the task or process that may set it free. Among preventive measures acting at this level the following may be mentioned:

- Replacement of biological agents that may pose a risk to staff health with alternatives that are non-hazardous or less hazardous, if the nature of the activity so permits.
- Establishment of working procedures and use of technical measures that avoid or minimize the release of biological agents into the workplace.
- Use of containment areas in processes producing bio-aerosols or splashes.
- Collection, storage and disposal of hazardous bio-waste in standardized containers.
- Safe means of handling and transport of biological agents within the workplace.

Relating to the **means of diffusion:**
If the release of a biological agent cannot be avoided, steps should be taken to limit both its presence in the workplace and any escape into the surroundings.

- Having work surfaces, floors and walls that are waterproof and resistant to disinfectants.
- Having an appropriate ventilation system.
- Establishing programmes to control vectors, such as insects or rodents.
- Drawing up appropriate protocols for cleaning and disinfection.
- Making available eyewash and skin antiseptics in the working area.
- Placing suitable signage to indicate biological hazards.
- Arranging for separate lockers for work clothes and street clothing.

Relating to **staff members:**

- Adequate training and information on potential risks.
- Precautions to be taken to prevent exposure to these hazards.
- Guidelines on hygiene.
- Appropriate training and information on the uses, cleaning and employment of personal protective equipment, with special emphasis on how to put it on, and particularly on how to take it off after use.

- Measures to be adopted in case of incidents, to prevent accidents, and to deal with accidental leaks or spills.

The training mentioned should be provided when an individual first starts work and when new risks arise, and should be repeated periodically if needed. Furthermore, it should be pointed out that it is obligatory for the person responsible for a laboratory to expand training and information in specific cases, so there is a requirement for drawing up written instructions to indicate what should be done in the following circumstances:

1. If there is a serious accident or incident involving the handling of a biological agent.
2. Whenever an agent in Group 4 is to be manipulated. The Health and Safety Unit of ULE recommends the establishment of Standard Operating Procedures (SOPs) for the handling of any type of biological agent, especially those transmissible through inhalation.

Handling Biological Agents

The laying down of suitable operating procedures and the use of appropriate technical measures to avoid or minimize the formation of bio-aerosols during the manipulation of samples is crucial in reducing possible exposure to biological agents.

IT SHOULD BE REMEMBERED THAT:

Samples should be taken with extreme **care**, using the right **accessories** (needles, syringes, test tubes, dishes, racks, and so forth) and appropriate **PPE** (gloves, masks, safety goggles and the like).

An **unknown sample** is a **potentially dangerous sample**. Lab coat and gloves must be used. Goggles or face screens will be required if there is any potential for exposure to splashes or squirting body fluids.

Every sample must always be carried in a **container with an adjustable lid and seal** preventing any possible escape of fluids.

If test tubes burst during **centrifuging**, the lid of the centrifuge must not be opened for **at least five minutes**. Thereafter, all equipment, materials and work surfaces are to be disinfected with a product of proven effectiveness.

Single-use **syringes** and **needles** are to be disposed of in **special containers**.

It is crucial for all laboratories to have **specific places for reception and initial handling of samples**. For this purpose, laboratories must possess **biological safety cabinets** suited to the type of samples with which they deal. Such cabinets must follow an appropriate maintenance programme, including periodic filter replacement. Similarly, there should be **protocols** describing the way and place in which various sorts of sample are to be handled.

FURTHERMORE, IT SHOULD ALSO BE REMEMBERED THAT:

When **samples arrive from outside** the laboratory, the sender should be asked to send them in a manner complying with the relevant **safety standards**. Likewise, **reception of samples should take into account the dangerousness of the biological agents they may contain**.

With a view to handling samples in accordance with the type of biological agent concerned and the safety group to which it belongs, appropriate **containment barriers**

will be use to **avoid the dispersion of dangerous bio-aerosols.**

4. PROTECTIVE MATERIALS FOR LABORATORIES

4.1. COLLECTIVE PROTECTIVE EQUIPMENT

Extractor Hoods

Extractor hoods capture, contain and expel emissions generated by dangerous chemicals. They protect against squirting and splashes and facilitate clean air renewal. The purpose of a gas extractor hood is to prevent the escape of contaminating gases, fumes, or both, into the laboratory. This is achieved by sucking any gases, fumes or vapours out of the area within the hood so that they cannot expand out into the laboratory, forcing them through a suitable filter (generally activated charcoal) that traps them, and blowing the remaining air, now free of them, to the outside.

The capacity of a hood to provide adequate protection depends on a range of factors:
• Control of airspeed at the hood entrance.
• Air movement and flow trajectories in the laboratory, this being directly related to the siting of the hood within the laboratory.
• The effect of the presence of the operator on flow trajectory at the hood entrance.
• Turbulence inside the hood. This is also related to the siting of the hood, movements of staff past the hood, items of equipment present inside it, and so forth.

Recommendations for the Use of Extractor Hoods:

• Gas extractor hoods should be checked periodically in accordance with the instructions given by the manufacturer, installer, or both. Their filters should also be replaced at the intervals laid down by the latter.

• The operator should work at a distance of at least 15cm from the hood frame.
• Gases should be directed from the spouts towards the inner wall of the hood, or, even better, towards its ceiling.
• Hoods should not be used for storing chemicals. The work surface must be kept spick and span.
• Care should be taken in situations requiring the front sash window of the hood to be lowered so as to achieve a minimum acceptable inward airspeed.
• Extractor hoods should always be maintained in good working order. The operator should never be able to detect any strong odour coming from the material located inside. If this occurs, the extractor function should immediately be checked.

Biological Safety Cabinets (BSCs)

These are designed to provide protection to personnel, the environment and material being handled (preserving sterile conditions) when appropriate practices and procedures are employed.
The use high-efficiency particulate absorbing filters at entry or exit points, or both. **They should not be confused with other laminar flow devices**, such as culture hoods, in which air is usually drawn out of the interior to the outside, hence entering into direct contact with the operator or user. Such culture hoods **should not be utilized** at any time for handling infectious, toxic, irritating or allergenic materials.

Types of BSC

Class I: Ventilated cabinets providing personal and environmental protection, with air drawn in past the operator. The air released to the exterior goes through a high-efficiency particulate-absorbing (HEPA) filter intended to protect the environment from discharges of pathogenic agents. These are suitable for working with agents posing a moderate risk, when containment is needed but **NOT** protection for materials (a sterile environment is not ensured).
Class II: Ventilated cabinets protecting personnel, materials and the environment. They are fitted with high-efficiency filters for absorbing particles both at entry and at exit points. They are used with low- to moderate-risk agents, and sometimes with very small quantities of toxic substances. Two main subtypes of Class II cabinets are recognized: Class II A and Class II B. The difference lies in the percentage of air they recycle.
Class III: Totally enclosed, leak-proof cabinets kept at below atmospheric pressure. They have a HEPA filter at the air entry port and two further such filters, in series, at the exit port. Access to the interior is obtained through rubber gauntlets fitted to the cabinet itself.

Recommendations for the Use of BSCs

• In general, these would be similar to those laid down for extractor hoods. They should be checked periodically in conformity with the manufacturer's or installer's instructions, and their filters replaced at the stipulated intervals.
• Before use, the work surface should be washed off with 70% alcohol or any other disinfectant suitable for the agent involved. All necessary utensils should be washed before putting them into the BSC.
• **NO** objects should be placed in front of the air entry port.

· The air exit grille should **NOT** be blocked.
• Clean utensils should be kept separate from dirty, these latter being placed farther away from the operator, with clean items closer.
• It is advisable to put a small tray or similar container inside to hold sharp objects, used pipettes, and so forth. No used material should be thrown away outside the BSC.
• Spills inside the BSC should be cleaned up immediately. At least ten minutes should be allowed to elapse from the end of this cleaning before work is resumed, the cabinet being kept in operation throughout.
• When work has been completed, all materials should be collected up, and all interior surfaces washed off with 70% alcohol or any other disinfectant suitable for the items concerned.
• Before leaving the laboratory, users should take off lab coats, gloves and any other personal protective material, and wash hands thoroughly.

4.2. SELECTION AND USE OF PPE

What is PPE?
Spanish Royal Decree 773/97 of 30 May 1997, which makes provisions for minimum health and safety arrangements relating to the utilization by workers of personal protective equipment (PPE), explains that this is any item intended to be worn or held by workers so as to protect them from one or more risks to their safety or their health in the workplace, as also any supplementary objects or accessories given over to this purpose.

Requirements for PPE
The conditions to be fulfilled to allow sales, and the essential health and safety features, of PPE were laid down in Spanish Royal Decree 1047/92 and subsequent modifications. This regulates the selling and free movement of personal protective equipment. It establishes an obligation for all prototypes for PPE to undergo an **EU type examination** conducted by an officially recognized Control Body, guaranteeing the effectiveness of the equipment in accordance with current standards.
Of particular note is the obligation for manufacturers to provide an information pamphlet with every piece of equipment, a very useful document for the process of selection and utilization. It must contain information on all the characteristics of the item, for example, instructions and limitations for use, maintenance, cleaning, updates, expiry dates and so forth. It is a requirement for the document to be written in the language of the user, and its contents must be perfectly clear.
The minimum requirements for choosing and using PPE are set out in Spanish Royal Decree 773/97.

Choosing PPE
The need to use personal protective equipment in a laboratory arises from the possibility of leaks, spills or sudden accidental exposure, and also from cases in which the collective protection systems installed are not enough to guarantee adequate safeguards

for those users present. This may be because there are residual hazards, or because it is impossible to utilize an adequate collective protection system. In such cases there should be an assessment of the risks affecting the laboratory as a whole. Particular attention should be paid to the various agents in use, whether physical, chemical, or biological, or any combination of these, how they are handled, the instruments utilized, the technology applied, and every activity or operation performed, evaluating all aspects that might constitute risk factors.

The employment of one or more pieces of PPE against a single risk, or against more than one, may bring with it certain drawbacks. Thus, when selecting suitable PPE, account should be taken not only of the level of safety needed, but also of comfort and convenience. Those working in the laboratory and their representatives (Health and Safety Officers) should be consulted on this point.

Use and Maintenance

To ensure correct use of any PPE acquired, before it is brought into utilization, standard operating procedures should be drawn up, implementing and expanding existing arrangements for purchasing, maintaining and managing PPE, as shown on the ULE website. Such SOPs should clearly and specifically address the following aspects:

- ✓ Zones or types of operation in which it should be employed
- ✓ Instructions for correct use
- ✓ Limitations on use, if any
- ✓ Instructions for storage, cleaning and conservation
- ✓ Expiry dates for pieces of PPE or their components

A programme should be put in place for managing personal protective equipment in the laboratory, including the following details, among others:

1. Keeping a minimum basic stock of all PPE.
2. Providing training and information relative to PPE, suitable for all users of the laboratory. This will require instructional and informational activities to familiarize them with all the different sorts of equipment available, whether or not for personal use, indicating when it is obligatory to use them, giving recommendations, and specifying how they are to be maintained.
3. Making certain that all laboratory users are aware of, and have a written document indicating, the quantities and types of equipment available in the laboratory, as well as the specific items issued to them personally. The situations and operations in which it is obligatory to employ this equipment, conditions for its use and maintenance, and the places where it is stored should also be stated.
4. Ensuring equipment is signed for on issue, with written instructions for use provided when necessary.

The Table below describes some of the operations and activities most frequently performed in a laboratory and the risks associated with them.

Table 1. Common Activities and Associated Risks

Operations and Activities	Hazards [Note 1]	Suitable PPE
Handling		

➢ Solvents and volatile chemicals ➢ Apparatus at high temperatures ➢ Syringes, glassware and capillary columns ➢ Pressurized bottles ➢ Substances at high and low temperatures ➢ Using vacuums	➢ Inhaling organic fumes ➢ Skin and respiratory irritation ➢ Splashes and spills ➢ Burns ➢ Fire ➢ Cuts and stabs ➢ Biological contamination	➢ Goggles ➢ Gloves ➢ Masks ➢ Face shields
Handling [Note 2] ➢ Biological materials ➢ Biological fluids ➢ Experimental animals	➢ Cuts and stabs ➢ Scratches and bites ➢ Inhalation of bio-aerosol ➢ Skin contact	➢ Gloves ➢ Masks ➢ Face shields
Handling ➢ Items with specific risks	➢ Exposure to carcinogens, mutagens, or items harmful for reproduction and fertility ➢ Exposure to radionuclides [Note 3] ➢ Exposure to asbestos and other fibres	➢ Goggles ➢ Gloves impermeable to biological fluids ➢ Gloves resistant to cuts and punctures ➢ Masks ➢ Face shields
Storage and transfer	➢ Fire ➢ Spills ➢ Splashes	➢ Stand-alone equipment [Note 4] ➢ Goggles ➢ Gloves ➢ Aprons ➢ Masks
Note 1. Careful assessment of the hazards associated with the various operations undertaken and the manipulation of substances necessary in the laboratory allows the selection of appropriate Personal Protective Equipment (PPE), including how to use it, its distribution and its maintenance. Note 2. In this context there is a need to distinguish what is necessary to protect the material, normally because it requires to be kept sterile, and what is needed to protect the workers involved. Note 3. These must be in conformity with the specific standards imposed. Note 4. Such equipment may be considered for general use in the laboratory in case of emergencies or evacuations.		

4.3. TYPES OF PPE MOST OFTEN USED IN LABORATORIES

The following sections offer advice and practical criteria for the PPE most frequently needed in university laboratories. They do not cover other forms of PPE normally employed in laboratories where there may be risks of other types, for example, electrical. These may require the use of specific types of gloves, insulated workbenches, seats or rods, helmets or ear protectors, and so forth.

Gloves

The **purpose** of this piece of equipment is to prevent contact with, and penetration of, the skin by biological agents, or by toxic, corrosive or irritant substances, especially in the case of the hands, which are the part of the body most likely to come into contact with chemical or biological materials. The risk of impregnation of clothing should not be forgotten, and can be prevented by wearing bib aprons or tabards, which are considered to be PPE. It should be remembered that work clothes, such as lab coats, uniforms or scrubs, are NOT seen as PPE, and for given tasks there may be other pieces of personal protective equipment more suited to the hazard characteristics of the chemical or biological agent being handled. In the case of direct contact with a chemical, a substance or a biological agent, the protective items or work clothes, or both, should be washed immediately.

Practical Suggestions of Interest Relating to Use:

- The skin is in itself a good protection against external attack. Hence, special attention must be paid to suitable hygiene for the hands, using soap and water or antiseptics appropriate for skin. Moreover, particular care should be taken with those areas of the skin that might be damaged or impaired through cuts, jabs, scratches, abrasions and the like. Some operations must be strictly prohibited if there is any wound to the skin.
- When it comes to choosing protective gloves, consideration must be given, on the one hand, to sensitivity of touch and the ability to grasp items, and on the other, the need for the greatest possible protection. The *manufacturer's information leaflet* should be taken into account. Such information pamphlets contain useful data referring to storage, use, cleaning, maintenance, disinfection, accessories, spare parts, classes of protection, expiry dates, an explanation of types, and so forth.
- Protective gloves must be the right size. If gloves are too tight, this may, for instance, impair their insulating properties or restrict circulation. If they are too loose, this will restrict the sense of touch and limit the ability to grasp objects adequately.
- Safety gloves are made of different materials, polyvinyl chloride (PVC), polyvinyl alcohol (PVA), nitrile, latex, neoprene, and others, as a function of the risk against which they are intended to protect. For laboratory use, apart from the necessary mechanical resistance to tearing and perforation, it is crucial for them to be impermeable to a range of chemicals, to offer adequate protection against possible biological risks, against the dangers of burning or freezing, against electricity, and the like. Hence, when choosing safety gloves it is necessary to know their suitability as a function of the potential hazards against which they are to protect. To this end, the relevant certificate that must be

provided by the supplier will be required. Table 2, by way of example, indicates the chemical resistance of various types of gloves.

Table 2. Resistance of Gloves to Chemicals

Chemical	Composition of Gloves					
	Latex	Neoprene	Nitrile	Butyl	PVC	PVA
ACIDS, INORGANIC						
Chromic acid	B	F	F	G	G	B
Hydrochloric acid 18%	G	E	G	G	E	B
Hydrofluoric acid 48%	G	E	G	G	G	B
Nitric acid 70%	B	G	P	G	F	B
Phosphoric acid	G	E	G	G	G	B
Red fuming nitric acid	NC	P	P	NC	P	B
Sulphuric acid 95%	E	E	F	G	F	B
White fuming nitric acid	NC	P	P	NC	P	B
ACIDS, ORGANIC						
Acetic acid	E	E	G	G	G	B
Formic acid	E	E	F	G	E	P
ALCOHOLS						
Butanol	E	E	G	G	G	F
Ethanol	E	E	G	G	G	F
Methanol	E	E	G	G	G	F
ALDEHYDES						
Acetaldehyde	G	E	G	G	G	F
Benzaldehyde	F	F	F	G	F	G
Formaldehyde	E	E	G	G	G	P
AMINES						
Aniline	F	F	G	G	G	F
Diethylamine	F	G	E	NC	F	F
Hydrazine	G	F	G	NC	G	B
CAUSTIC SUBSTANCES						
Ammonium hydroxide	E	E	G	G	E	B
Sodium hydroxide 50%	E	E	G	G	G	B
SOLVENTS, ACETONE						
Acetone	E	G	P	G	P	F
Methyl ethyl ketone	E	G	F	G	B	E
Methyl isobutyl ketone	E	G	F	G	F	G
SOLVENTS, AROMATIC						
Benzene	B	P	G	NC	P	E
Coal tar distillates	B	F	G	NC	F	E
Styrene	B	F	G	NC	P	E
Toluene	B	B	E	B	G	E
Xylene	B	P	G	F	B	E
SOLVENTS, CHLORINATED						
Chloromethane	F	G	G	NC	B	E
Hexachloro-ethane	B	B	G	B	B	E
Tetrachloromethane	B	F	G	B	F	E
Trichloro-ethylene	B	G	G	NC	B	E
Trichloromethane	B	G	G	F	B	E
SOLVENTS, PETROLEUM DERIVED						

Hexane	B	F	E	NC	F	E
Paraffin	B	G	E	B	F	E
Pentane	F	G	E	B	B	E
SOLVENTS, VARIOUS						
Acrylonitrile	G	G	F	G	P	E
Bromo-ethane	F	G	G	NC	B	E
Ethyl acetate	P	G	G	G	B	P
Propyl acetate	G	G	G	G	P	G
White spirit	F	G	G	NC	E	E
VARIOUS SUBSTANCES						
Animal fats	E	G	G	NC	G	E
Carbon disulphide	B	F	G	B	F	E
Cutting oil	P	E	G	B	G	F
Electrolytes	E	E	G	P	E	B
Epoxy resins	E	E	G	G	E	E
Ethylene glycol	E	E	G	G	G	G
Glycerine	E	G	G	G	E	F
Hydrogen peroxide 50%	G	G	G	G	F	P
Paint stripper	F	G	G	NC	B	G
Printing ink	G	E	E	NC	P	E
Toluene di-isocyanate	G	F	G	NC	B	G
Trinitrotoluene	G	G	G	G	E	E
Turpentine	B	G	E	B	G	
Wood varnish (tung oil)	B	G	G	NC	F	E
E = Excellent; G = Good; F = Fair; P = Poor; B = Bad; NC = Not Checked						

Face and Eye Protection

In a laboratory there can be splashes of chemicals or the impact of objects against the face or eyes, either of the person directly involved in a task, or of others present. For this reason, protection for the face and eyes must be seen as of great importance and should be used at all appropriate times within the laboratory.

Table 3. Laboratory Work Requiring Eye Protection

ACTIVITIES	OPERATIONS
➢ Glassware with low internal pressure ➢ Cryogenic materials ➢ Glassware with high internal pressure ➢ Explosives ➢ Caustic, irritant or corrosive substances ➢ Biological matter posing health risks ➢ Radioactive materials ➢ Ultraviolet light ➢ Toxic chemicals ➢ Carcinogenic substances ➢ Flammable materials ➢ Laser light	➢ Melting ➢ Drilling ➢ Grinding ➢ Filing ➢ Sawing

Protective items available fall into two large groups as a function of the area protected:

If they cover only the eyes, they are classed as **goggles**.

If in addition to the eyes, they cover part or all of the face and possibly other sections of the head, they are termed **screens**.

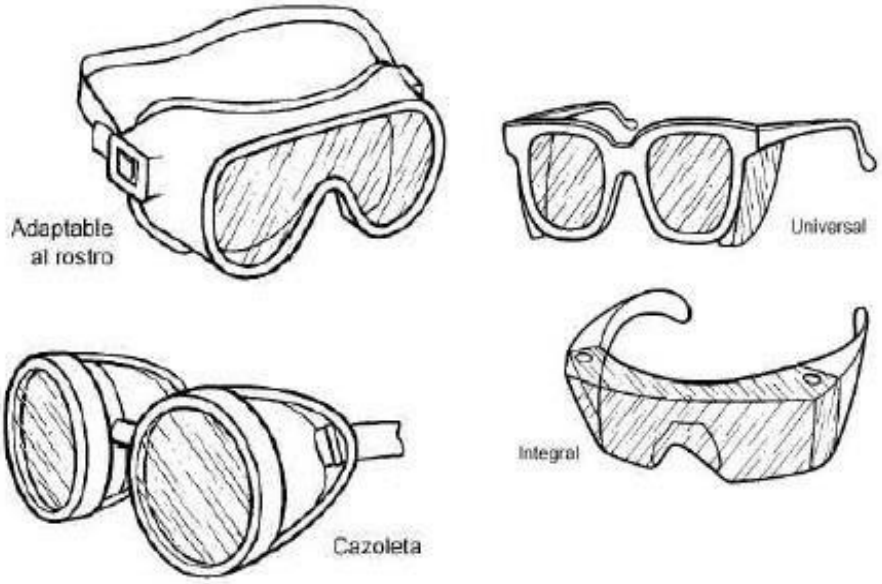
Choice, Use and Maintenance:

1. When choosing eye and face protection, the *manufacturer's information leaflet* should be consulted. This pamphlet should contain all data of use with reference to storage, use, cleaning, maintenance, disinfection, accessories, spare parts, classes of protection, expiry date, an explanation of types, and other details.
2. Selection of eye protectors should be on the basis of the potential risk against which the user is to be protected. This may be infrared radiation, ultraviolet radiation, welding, chemical or biological splashes, or particles of material, for instance arising from cutting with a circular saw, or other hazards. In the specific case of laser radiation it is preferable to contact a supplier of proven competence in this field, in view of the complexity of choices.
3. Loss or downgrading of visibility through eyepieces, viewers and the like, may be a source of risk in most instances. For that reason, ensuring that this does not occur is crucial. To achieve this, such elements must be cleaned on a daily basis, always in accordance with the instructions provided by the manufacturer or distributer.
4. So as to avoid skin diseases, protective items must be periodically disinfected, and particularly every time that they are passed on from one user to another, always in conformity with the indications given by manufacturers so that the treatment used does not affect the characteristics and performance of the various elements involved.
5. Before use of any protective item, it should be inspected visually, so as to check it is in good condition. If any element is damaged or badly worn, it should be replaced. If that is not possible, the whole piece of equipment should be taken out of use. Indicators of excessive wear would include yellowing of eyepieces, surface scratches on lenses, cracks and the like.
6. To ensure proper conservation, equipment should be kept clean and dry in its corresponding case whenever not in use. If items are briefly removed, care must be taken not place them with the eyepiece lenses downwards, so as to avoid scratching.

<u>Goggles</u>

Safety goggles should offer good protection to the front and sides. In the light of the type of frame they may be divided into groups:

1. General-purpose goggles. The eyepieces are fixed to a frame with struts known as temples, and side protection may or may not be present. They may be called eyeglass goggles.
2. Goggles with a separate cup-like eyepiece for each eye.
3. Goggles fitting to the face, with a single large lens or eyepiece.
4. Wraparound fitted goggles. They enclose the eye socket region and seal against the face. They can be used when corrective spectacles are worn, and so are sometimes called "over eyeglass" goggles.



Face-fitting General-purpose
Cup eyepiece Wrap-around

Screens

Various types of protective screen may be distinguished:

1. *Face Screen*. This device protects the eyes and covers all or part of the face.
2. *Hand Screen*. This is a face screen that is held in the hand, rather than worn.
3. *Wraparound Face Screen*. This type protects not just the eyes but also the face, throat and neck. It is worn either directly strapped to the head or attached to a safety helmet.
4. *Mounted Face Screen*. Such a device protects the eyes and face, being supported by a frame similar to what is used for eyeglasses, rather than being fixed to a headband or helmet.

Corrective and Contact Lenses

Individuals with sight defects requiring the use of **corrective lenses** should choose one of the following types:

• Safety goggles whose protective eyepieces are also graduated lenses.

• Goggles protecting the eyes that can be worn over eyeglasses without affecting their fit.

Nevertheless, current legislation on the matter does NOT obliges any business to supply safety goggles with individually graduated corrective lenses, so the commonest options are “over eyeglass” goggles or screens.

Anyone needing to wear **contact lenses** during laboratory work should be aware of certain potential hazards:

• It is practically impossible to remove contact lenses if a chemical has spilled or splashed into the eyes.

• Contact lenses interfere with procedures for emergency eye rinsing.

• Contact lenses can trap or catch fumes and solids against the eye.
• If chemicals enter the eye and the person affected is unconscious, personnel providing first aid will not know that the victim wears contact lenses. Hence, the use of contact lenses in a laboratory should be carefully weighed up, and in general, the use of contact lenses in any operation involving a potential splashing hazard is inadvisable.

Respiratory Protection

Equipment for protecting an individual's respiratory tract is used to try to avoid the entry of contaminants into the body via that route. Technically, such equipment may be classified as **dependent** or **independent of the surroundings.**

Recommendations

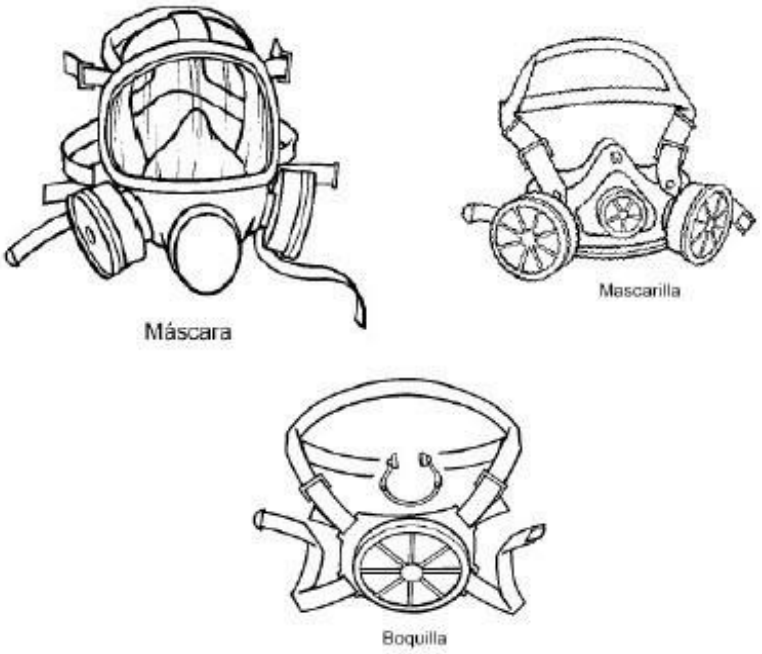
• When selecting respiratory protection equipment, it is advisable to take account of the *manufacturer's information leaflet*. This informative document should contain all data of interest referring to storage, use, cleaning, maintenance, disinfection, accessories, spare parts, classes of protection, expiry date, an explanation of models, and other details. In choosing equipment the following factors must be taken into account:
• Technical aspects: equipment must be chosen to match appropriately the potential risks faced.
• Ergonomic aspects: from among the pieces of equipment that fulfil technical requirements, the item chosen should be the one best adapted to the personal characteristics of the user. Users or their representatives should take a hand in making this decision. The most crucial features with which apparatus should comply in this regard are:

1. Least reduction feasible in sight and hearing capacities.
2. Lowest possible weight.
3. Head straps with an easy adjustment system for normal working conditions.
4. The parts of the face seal that touch the user's face should be of soft material.
5. The face seal should not be made of any substance causing skin irritation.
6. Correctly fitting filter of reduced size, preferably blocking the field of vision only minimally.
7. Equipment should interfere as little as possible with the user's breathing.
8. The equipment should have a pleasant smell, or, better still, no smell at all.

1. Equipment Dependent on Surrounding Air

These are pieces of kit using ambient air by purifying it, in other words holding back or transforming any contaminants present in it so that it can be breathed. They cannot be used when the air is lacking in oxygen, when the concentrations of contaminants are very great, when they are highly toxic substances, or when there is some risk of a malfunction not being detected.

They consist of two clearly differentiated parts: the ***face seal*** and the ***filter.***
The **face seal** is designed to create a hermetically sealed space around the respiratory tract, such that the only route into it is via the filter. There are three types of mask or respirator: *full-face, half-face* and *mouthpiece* or *mouth-bit*.



Full-face Half-face
Mouthpiece / Mouth-bit

Filters are designed to purify air and eliminate pollutants. They are classified as falling into three large groups, according to whether they protect against: *partículates* and *aerosols, gases* and *fumes*, or *particles, gases* and *fumes.*

Against Particulates and Aerosols

The filtering material is made up of a network of plastic fibres that hold back contaminants to a greater or lesser degree. These are Type P filters and they are divided into three classes, on the basis of their filtering capacity:

- **P-1**: Low-efficiency filters
- **P-2**: Medium-efficiency filters
- **P-3**: High-efficiency filters

Against Gases and Fumes

The filtering substance is activated charcoal, given different treatments in accordance with the contaminant to be removed. The following types of filter are distinguished on the basis of the substances they combat:

- **A** Organic gases and vapours with a boiling point over 65ºC
- **AX** Organic gases and vapours with a boiling point below 65ºC
- **B** Inorganic gases and vapours

• **E** Sulphur dioxide and acidic gases and vapours
• **K** Ammonia and organic ammonia derivatives
• **SX** Special purpose, for given gases and vapours

There are also multiple filters against gases and vapours, combining two or more of the groups listed above, excluding SX filters. They fulfil all the requirements of the separate categories combined. All these types of filter, other than AX and SX, are classified by capacity into three groups:
• Class **1**: Low-capacity filters
• Class **2**: Medium-capacity filters
• Class **3**: High-capacity filters

This implies that if a respirator has been designed for use with two filters, both have to be of identical capacity and format.

Against Particulates, Gases and Vapours
These are termed filter combinations. The filtering portion adds together a grouping of the simple filters mentioned above. Particular instances of this class are the special filters protecting against:
•Type **NO-P3**: Nitrogen oxides
•Type **Hg-P3**: Mercury

Table 4. Type, Class, Colour and Details of Filters

TYPE	CLASS	COLOUR	SPECIAL DETAILS
A	1, 2, or 3	Brown	
AX	---	Brown	Not reusable
B	1, 2, or 3	Grey	
E	1, 2, or 3	Yellow	
K	1, 2, or 3	Green	
P	1, 2, or 3	White	
SX	---	Purple	Must specify against which chemicals and maximum concentrations the filter offers protection
NO-P3	---	Blue and White	Not reusable
Hg-P3	---	Red and White	Maximum length of use 50 hours

Markings All filters must carry at least the following specifications as markings:
• Identification of manufacturer, supplier or importer.
• Number and date of the standard matched.
• The letters CE together with the number of the Control Body that performed the most recent quality check on production.
• Type, class, colour code and special details in accordance with Table 4.
• The indication “See manufacturer’s information”.
• Expiry year and month.

• Storage conditions.
• For combination filters, the direction of airflow within the filter, whenever there could be any doubt about connecting it.

Facemask
This is a particular kind of respiratory protection that brings together in a single inseparable structure both the face seal and the filter. Such masks are not suitable for protection from gases, fumes or vapours, but they are adequate for protecting against solid particles and aerosols.

2. Equipment Independent of Surrounding Air
This equipment is characterized by the fact that the air breathed by the user does not come from the workplace. It can be divided into partly or fully ***stand-alone***.

• **Partly Stand-alone Equipment** utilizes air drawn from outside the workplace, uncontaminated and transported through tubing or taken from pressurized containers that are not portable.
• **Fully Stand-Alone Equipment** has an air-supply system carried by the user. Use of such a self-contained apparatus is indicated in cases in which the air is unbreathable and independent free movement is required.

PPE for Biological Hazards
A special mention must be made of equipment intended to protect against biological risks. The following points are of note:
• There is a strong tendency to confuse equipment designed to avoid contamination of sterile materials (protecting a product) with items intended to protect the user. In the presence of a biological hazard a protocol for PPE use should be established that ensures effective protection against it, combined with whatever may be needed to maintain aseptic conditions for materials or samples.
• With regard to protection for the skin, it is wise to take full account of the *manufacturer's information leaflet*. This informative pamphlet or booklet is supposed to contain all data of interest referring to storage, use, cleaning, maintenance, disinfection, accessories, spare parts, classes of protection, expiry date, an explanation of models and makings, and other details. At times, in view of the relative size of the biological agent and of pores in the gloves employed, it may be necessary to use two, or even three, pairs of

gloves one over the other. Where there is any risk of splashes, face screens are needed.
• Protection against the inhalation of bio-aerosols entails the utilization of respiratory protective equipment with HEPA (High-Efficiency Particulate-Absorbing) filters capable of holding back micro-organisms and thus sterilizing the air breathed through them. At times it may also be advisable to use P3 filters.
Finally, it should be stressed that in this instance training is very important, with particular emphasis to be laid on the correct fitting of PPE before use, and the right way to take PPE off when finished with.

Hearing Protection

Acoustic protection equipment comprises items for individual use intended to reduce the level of sound heard by a person located in a noisy area. In general, it is advisable to wear such equipment when the weighted daily equivalent dB(A) level greater than 80 decibels.
Areas affected by excessive noise should have signage to that effect, indicating the need for hearing protection, and appropriate equipment should be to hand. Among the various types of hearing protectors may be included:

Earplugs

Headphones or earmuffs

Foot Protection

Protective footwear is designed to guard against injuries caused by corrosive substances, the falling of heavy items, treading on objects, electric shock, or slipping on wet floors. Footwear made of canvas and similar materials, like tennis shoes, absorbs liquids easily. If a chemical spills onto a shoe of this kind, it must be taken off immediately. It is preferable to wear shoes fully covering and protecting the feet. In a laboratory it is not appropriate to wear sandals, openwork clogs, high heels or any footwear exposing the foot. A large range of specialist laboratory shoes is available nowadays.

5. WORK CLOTHING

Work clothes do NOT constitute Personal Protective Equipment. Nevertheless, all work clothing, such as lab coats, uniforms, scrubs and similar, must fulfil certain minimum criteria as a function of what is expected of it. The work clothes most often used in

laboratories include ***lab coats***, ***aprons*** and, in some specific parts of the university, ***surgical scrubs***, and other specialist items**.**

Laboratory Coats

Lab coats are designed to give some protection to clothing and skin from chemicals that might spill or splash. They should always be worn fully buttoned up and they should reach to the knee. There are various types offering different degrees of protection:

• **Cotton**: this offers some protection against flying objects, sharp corners and serrated edges, as well as being a good fire retardant.
• **Wool**: this offers protection against splashes and powdered materials, and to some extent against limited quantities of acid and small flames.
• **Synthetic Fibres**: these can give protection against sparks, and infrared or ultraviolet radiation. However, lab coats made of synthetic fibres can worsen the adverse effects of some laboratory hazards. In particular, various synthetic fibres melt when in contact with flames. The molten material can cause skin blistering and burns, and emit irritant fumes.
• **Refractory and Aluminized Fabrics**: these protect against heat radiation.

Aprons

An apron provides an alternative to a lab coat. Aprons are generally made of plastic or rubber to offer protection against corrosive and irritant chemicals. Aprons should be worn over garments covering the arms and body. There are certain kinds of apron that are considered PPE, for example, those used for welding or to protect from ionizing radiations. In these cases, the regulations for PPE apply.

6. EMERGENCY EQUIPMENT

Definition
These are aid items to be used in the case of emergencies, when there are discharges,

splashes, spills, leaks, and so forth. This equipment must be kept in good condition and accessible. In other words, if must not be hidden by panels, clothing or other objects, so that it can be brought into play with the requisite speed. In all cases it should be correctly signposted.

Emergency Equipment Most Commonly Found in Laboratories

Laboratories usually have available a range of items for use in an emergency. The commonest are listed below. They should always have correct signage.

- Eyewash stations
- Safety showers

Firefighting equipment:

- Fire alarm control panels
- Alarm buttons
- Sirens
- Extinguishers
- Fire hose installations
- Hydrants
- Sprinklers
- Fire blankets
- Sand or other specific firefighting substances

Equipment Signage

			
Fire Hose Reel	Fire Extinguisher	Emergency Safety Shower	Emergency Eyewash Station

Eyewash Stations

These are systems intended to permit rapid, effective decontamination of the eyes and essentially comprise two spouts or sprinklers able to supply a jet of drinking water for flushing the eyes or face, a sink with an appropriate drain fixed to the floor or the wall and a tap activated by the foot using a pedal or the elbow using a lever. The jet coming from the spouts should be at a low pressure so as not to cause needless harm or pain. The water should be of potable quality and it is preferable for it to be lukewarm in temperature. Eyewash stations should be easily accessible and clearly signed, and located at a short distances from the work positions in the laboratory, so that a person

suffering an accident can reach one with eyes shut, since injuries to the eyes are usually accompanied by temporary blindness. Moreover, they should be in close proximity to safety showers, because accidents affecting the eyes often also involve the skin, and in this way both eyes and body can be washed in sequence.

Recommendations for Use

• *Contact lenses should be removed as soon as possible* to enable the eyes to be flushed, eliminating any dangerous chemical. In any case, it is not advisable to use contact lenses in a laboratory.
• The water should not *directly drench the eyeball, but be directed at the bridge of the nose*. In this way, the flushing of the eyes is much more effective, removing any chemical. A forceful flow of water can actually carry particles into the eyes.
• The eyelids should be pulled back so as to ensure the area underneath them is adequately flushed.
• Washing should proceed from the nose towards the ears. This will avoid entry of any chemical into the unaffected eye if only one is involved.
• The eyes and eyelids should be drenched for at least fifteen minutes.
• After flushing, it is appropriate the cover both eyes with clean, sterile gauze or a similar bandage.
• The eyewash station should be given periodical maintenance checks.
• The eyewash station should be given a full inspection every six months.
• Fixed eyewash jets should be fitted with protective covers to avoid any accumulation of contaminants from the air.

Safety Showers

These are the commonest emergency system for cases of splashes or spatter causing a risk of chemical burns. They also can be used if clothes catch fire, although in this case they should be used after employment of a fire blanket, if one is available.

Characteristics of Safety Showers

• Such a shower should supply a **flow** of water sufficient to soak the user completely in a very short time.

• The **water** supplied should be **potable**, and should not be cold, but rather lukewarm, preferably between **20°C** and **35°C**. The purpose would be to avoid the risk involved in chilling a burnt patient in a state of shock, and since unwillingness to stay for any length of time under a flow of icy water would might lead to insufficient elimination of the contaminant because of only brief use of the shower. Similarly, it is advisable for there to be a suitable **drain**, as this makes maintenance much easier.

• The **shower head** should have a diameter sufficient to drench the user totally (20 cm), with large holes preventing it from becoming blocked by chalk deposits. The distance from the floor to the shower head should be such as to permit the user to stand erect, say 2.0 to 2.3 metres. The separation between the wall and the shower head should be large enough to allow the presence of two people if necessary, so not less than 60 cm.

• The **operating stopcock** should be rapid-action, so that conventional taps should not be used. The operating control or button should be easy to reach. The best types are those having a triangular handle linked to the system by a solid bar, better than a chain. Foot operation via a pedal is not normally used, because of the chance of inadvertently stepping on it and setting off the system by accident, not to mention the possibility of tripping over such a pedal. There is an exception in the form of systems actuated by stepping up onto a platform.

• The **main stopcock** for the installation should be located in a place not accessible to people working nearby, the aim being to avoid permanent shutting off of the water supply to avoid inconvenience from leaks or other faults. Any such anomalies should be reported and repaired immediately. Hence, the main stopcock will be closed exclusively when repairs are being undertaken.

• It is useful to have a **sound or light alarm** set off whenever the shower is brought into use. This allows other people present to become aware there is a problem, and thus come to the rescue. Normal showers installed in changing rooms or washrooms can also perform some of the functions of safety showers, especially in smaller laboratories. They can be handy when there are small burns or splashes on clothes, since they are out of sight and hence permit a person affected to take off clothing without any inhibitions.

Fire Safety Equipment:
All firefighting materials are coloured red, except the fire alarm control panel. The same is true of signage for this equipment.

Fire Alarm Panels
These panels are intended to alert all those in a laboratory to danger from fire. Everyone in ULE must be familiar with their precise locations and functioning, so as to be able to cancel false alarms.

Alarm Buttons
These are push switches that can be used to set off an alarm.

Bells or Sirens
These may be set off automatically by the fire alarm control panel, or may be manually operated by pressing a button.

Extinguishers
At times, when it is not feasible to control a small fire occurring in a laboratory with fire blankets or damp cloths, by reason of its location, characteristics, persistence or extent, it becomes necessary to have recourse to fire extinguishers. These are devices containing an extinguishing agent or substance that can be directed against the fire through the action of internal pressure. Since there are different kinds of fire, classified as affecting solids, liquids, gases or metals, in each instance the appropriate extinguishing agent needs to be chosen and located close to the place where a fire of a given type is likely to be involved. The range available includes water jet, mist or spray, general-purpose or specialist dry powder, foam, or carbon dioxide, or even special extinguishing agents specific to a given use, because particular chemicals are needed in certain contexts, for example, some alkalis react violently with water and water-containing mixes

Table 5. Classes of Fire and Appropriate Extinguishers

Class of Fire		Extinguishing Agents							
		Water	Foam	Powder		Carbon dioxide	Special Powders	Mode of Action	Notes
Identifying Symbol	Combustible Material		AFFF	$KHCO_3$	ABC				
	Paper, cardboard, wood, cloth, and similar combustible solids	YES	YES	NO	YES	NO	NO	Cooling, interruption of chain reaction, smothering (denial of oxygen)	
	Naphtha, petrol, paint, oil and similar flammable liquids	NO	YES	YES	YES	YES	NO	Interruption of chain reaction, smothering	Do not use water jets. Water mist can be used
	Butane, propane and other flammable gases	NO	NO	YES	YES	YES	NO		
	Electrical equipment and installations	NO	NO	YES	YES	YES	NO	Interruption of chain reaction, smothering	Do not use water or foam, as they are good electrical conductors
	Flammable metals, such as magnesium, sodium, and the like	NO	NO	NO	NO	NO	YES	Heat absorption, smothering	Do not use conventional extinguishers. Special device required for each type of metal

Notes:

1. The Spanish system of classification shown is similar to the A, B, C, D, K system used in the U.S.A., and is ***NOT*** compatible with the British and Irish system of A (solids), B (liquids), C (gases), D (metals), Ϟ (electrical), F (cooking fats and oils). Similarly, the green, red, blue and yellow colour codes for classes of fire used here are ***NOT*** related to the British and Irish extinguisher colour band code: Red (water), Cream (foam), Blue (dry powders), Black (carbon dioxide), Yellow (wet powders), Green (obsolete, was used for halon).
2. ABC = Mono-ammonium Phosphate; AFFF = Aqueous Film-Forming Foam; $KHCO_3$ = Potassium Bicarbonate

Basics of Fire Extinguisher Use ("PASS")

P[ull]
A[im]
S[queeze]
S[weep]

Pull: With the extinguisher on the ground, place hand on the top of the cylinder and pull the pin, breaking the anti-tamper seal. This releases the trigger handle and allows the unit to be activated.
Aim: The horn or hose should be pointed at the base of the flames.
Squeeze*:* The handle should be squeezed to release the extinguishing agent.
Sweep: The horn or hose should be swept from side to side at the base of the fire. The extinguisher should be emptied onto the flames.

Safety Precautions
Never get too close to a fire.
Never allow a fire to get between you and the exit of the room.
Never enter an unknown area to put out a fire, especially in a chemical laboratory.
Report the fire to the relevant person or body if necessary.

Fire Hose Reels
After appropriate training, anybody can use these, not just professional firefighters.


Semi-Rigid


Flexible

Hydrants
These are exclusively for use by the fire brigade.

Wall-Mounted

Pillar Type

Sprinklers

These are brought into action automatically by the fire alarm control panel.

Fire Blankets

Such blankets allow effective action against small fires, especially if clothes catch fire, as an alternative to safety showers. Use of a fire blanket may in some cases avoid the need for the person on fire to move or be moved, which helps to limit the effects and extension of the flames. The use of fire blankets to put out flames is intended for speedy action. An alternative to a fire blanket would be clothing or cloths that are not easily ignited or have been dampened, for instance, a cotton lab coat.

Sand or Other Substances for Extinguishing Fires

These are intended for quick, straightforward extinction of small fires that may occur in a laboratory. These materials should be stored in easily handled containers, suitably labelled. They should be used in accordance with the type of fire, following specific instructions provided.

7. OBLIGATORY RULES FOR LABORATORIES

7.1 Generic Rules

New arrivals should be informed immediately about work rules, the safety and emergency plan for the laboratory, and the specific hazard characteristics of the substances, installations and usual operations performed there. This rule extends also to visiting researchers and temporary contract personnel of all types, including cleaning and safety staff. The following are a series of recommendations that should be systematically followed in a laboratory.

Personal Habits and Clothing:

- No activity should be carried out without prior authorization and appropriate supervision.
- It is preferable never to work alone. When substances that are carcinogens, teratogens, toxic for reproduction, or biological agents in Groups 3 and 4 are involved, all work must be fully supervised.
- Lab coats should always be worn, completely buttoned up, together with whatever personal protective equipment is required for the type of work being undertaken.
- Long hair should always be tied back, not left loose. Bracelets, pendants, necklaces, garments with wide or “kimono” sleeves, tops with hoods, scarves, neckties, and similar items must not be worn.
- Suitable footwear must be used, not sandals or other types of shoe leaving parts of the foot bare. It is advisable to wear long trousers, and in general to choose clothing that prevents substances which might fall or be spilt from getting into shoes or coming into contact with the skin of legs and feet.
- Hands must be washed after handling biological samples, microbiological cultures, animals, on taking off gloves (see recommendations on the use of gloves) and always on leaving the laboratory.

- Lab coats, gloves and other PPES or laboratory clothing must be taken off before proceeding to areas outside the laboratory. Laboratory coats should NEVER be worn if going to a canteen or cafeteria.
- All materials not related to the work in hand must be removed from the working zone.
- Smoking, eating and drinking are forbidden in laboratories, as are other actions that involve a risk of ingesting or coming into contact with toxic or pathogenic substances, for instance, chewing gum, putting on make-up, inserting or removing contact lenses and so forth. In general, hand-eye and hand-mouth contact should be avoided while in the laboratory and until hands can be washed on exit.
- Contact of chemicals, micro-organisms, laboratory material, and so on, with mouth, skin and eyes should be avoided.
- It is advisable to use and store flammable substances in the smallest quantities feasible.
- Food and drink should NOT be kept in laboratory refrigerators.
- Laboratory glassware should never be used to hold food or drinks, nor should chemicals be stored in food or drink containers.
- Guests should not be received, nor meetings held in a laboratory. Other rooms are more appropriate for such activities.
- It is preferable to separate teaching from research activities. If it is necessary to use some item of equipment for a class, it is not appropriate for unsupervised students or large groups of people to access specialist laboratories.
- Working in or visiting a laboratory may entail risk for pregnant women and immunocompromised or particularly sensitive individuals. These conditions should be reported and information provided about the hazards involved in any specific activity carried out in a laboratory.
- Contact lenses should not be worn.

Work Habits:

- It is appropriate to document all activities carried out in a laboratory and any incidents occurring (laboratory logbook).
- Work should be performed in an orderly, clean, unhurried fashion.
- Work surfaces should be kept clean, neat and tidy, free of substances, books, and material not needed for the activity being undertaken.
- Such surfaces should be cleaned before and after any work is performed. The cleaning procedure will depend on the type of activity and the substances used. If there has been any spillage, this must be dealt with appropriately and in conformity with safety guidelines.
- Equipment should never be used by people unfamiliar with its operation.
- When a piece of work is finished, care should be taken to ensure the disconnection of equipment supplies, such as water, air pressure, electric power, gas for burners and any other gases.
- PPE suitable for each given task should be used.
- Moving around the laboratory should be done cautiously, so as not to interrupt others

working there.

- Pipettes should not be operated with the mouth. A propipette, transfer pipette or pipetting syringe should be used instead.
- If the activity requires this, extractor hoods should used to the fullest extent possible.
- Extractor hoods are collective protection devices and should not be used to store substances.
- The Safety Data Sheets for the reagents that need to be used should be requested or supplied, as applicable.
- Container labels should be read and the safety data sheets for substances consulted before they are used for the first time.
- At the very least users must be familiar with the Hazard and Precaution Statements for the substances to be utilized (included on the packaging label) or their equivalents, the former Risk and Safety Statements.
- Work materials should be transported safely, using trays, trolleys, test-tube racks, holders and so forth. Laboratory notebooks should never be used as a tray. Reagents and solutions should never be carried in open containers.
- When a task or operation is finished, materials, reagents, equipment, and so on should be collected up, avoiding unnecessary clutter.
- If bottle tops, flask stoppers, taps and other similar items become jammed, they should never be forced with the bare hand. Suitable protective wear should be used when unjamming (gloves, goggles, shields, and the like).
- Unknown substances should never be mixed, unless there is a clear and specific reason for doing so.
- Reagents should be put back in their place after use, keeping the quantities in the work station to a minimum.
- When flammable substances are to be heated, flameless heat sources should be used, for example hot plates, sand baths, and similar.
- When test tubes are being heated, the mouth of the tube should not be pointed towards people or equipment.
- Bunsen burners should be turned off whenever not in use.
- Once chemicals have been taken out of their jars, they should not be put back into them.
- The use of needles and other sharp objects should be strictly limited to operations in which they are essential.
- The handling of bio-hazardous agents requires special precautions. Care should be taken to avoid forming aerosols, specific guidelines for the use of pipettes should be followed, and biological safety cabinets are likely to be needed for exclusive use with certain materials.

Containers:

- Containers should be filled to at most 80% of their capacity, so as to avoid splashes and spills. Whenever possible, transfer of contents relying on gravity should be avoided.
- Containers with unknown contents should not be removed.

***Labelling*:**

- If a laboratory requires special precautions, for instance, because it works with infectious agents, or substances posing a specific risk, this should be indicated by appropriate signage at the entrance.
- Suitable labels should be attached to all flasks and other receptacles into which a chemical has been transferred or in which mixtures have been prepared. The label should identify the contents and the owner's name, and carry hazard information reproducing the original labelling.

***Handling of Glassware*:**

- Glass tubes should never be roughly handled.
- Any broken glassware should be placed in a bin specifically for glass, not in an ordinary waste basket.
- Glassware that has cracks or chips should not be used.
- Test tubes should be picked up with tongs. Hot glass looks no different from cold.
- The temperature of any containers that have been subjected to heat should be checked.

Specific Rules for Microbiology or Pathogen Laboratories:

The following recommendations are specific to laboratories working with micro-organisms (viruses, bacteria, fungi and the like), especially if they are pathogens.

- Contaminated samples should not be removed from the laboratory.
- Micro-organisms should always be dealt with near a flame source.
- Care should be taken to avoid generating aerosols containing micro-organisms, as they can easily be inhaled.
- Suitable PPE should be used when ultraviolet radiation is being employed.
- In the case of pathogenic micro-organisms, scrupulous care must be taken to maintain an appropriate level of containment.
- When a task is completed, the organisms are to be inactivated or disposed of as biological waste in the appropriate clearly identified bins, as applicable.

General Waste-Disposal Rules:

- Direct contact with waste should be avoided by using PPE.
- As far as possible, material should be used that can easily be decontaminated without causing additional risks for, or damage to, the environment.
- Standard practice should be for a single person NOT to handle waste alone and unaided.
- Liquid waste should not be placed in containers of more than 25 litres in capacity, so as to facilitate handling and avoid unnecessary risks.
- Transport of containers holding 25 litres or more should be carried out using trolleys to avoid risks. This would extend to any container weighing more than 3 kilos if it has to be moved over a distance of more than 10 metres.
- Waste should be poured into containers in a slow, controlled manner. The operation must be halted if any abnormal occurrence is observed. If any large quantity of liquid is to be transferred, a hand pump should be used. If an electric pump is employed it should be explosion-proof.

- Containers should be kept closed when not in use.
- Waste containers should be set on the floor until removed definitively, so as to prevent them from falling or toppling.
- Containers must not be allowed to block passageways or placed in a location where people might trip over them.

7.2 Good Practice in Laboratories

As indicated above, the carrying out of the different activities that may be undertaken in the laboratories at ULE may generate and thus cause exposure to a range of environmental hazards. The following are various good practices allowing these risks to be reduced.

Good Practice in Resource Use:

1. Equipment and Appliances:

- Equipment should be chosen to have the fewest negative effects on the environment. For instance, refrigerants should not be harmful to the ozone layer, machinery should have a low consumption of energy and water, and emit little noise or vibration, equipment should give off only low levels of radiation, and so forth.
- Mains power supply adapters should be used so that batteries are not needed.
- Equipment should be chosen to have a long useful life and to require the smallest feasible consumption of non-renewables and of energy to produce it.

2. Materials and Products:

- There should be awareness of ecological symbols and brands. Among these would be environmental certificates issued by the Spanish Standards Agency (AENOR), the German *Blaue Engel Siegel* [Blue Angel Seal], Forestry Stewardship Council (FSC) Certification, the *Distintiu de garantia de qualitat ambiental* [Emblem Guaranteeing Environmental Quality] issued by the regional authorities of Catalonia in Spain, the European Union Ecolabel (E.U. flower), Nordic Swan Ecolabel, and others.
- As far as possible, materials and products with such certifications should be chosen, as they guarantee proper environmental management.
- Users should suggest or purchase, according to their mandate, rechargeable or less harmful batteries (not using mercury, cadmium, or other similar substances).
- As far as is feasible, products should be sought that come in containers made of recycled or biodegradable materials, able to be re-used or at least returned to suppliers.
- Purchases should be of products with the minimum of packaging, and in containers of a size allowing reduction in the generation of waste containers.
- Aerosol products should be avoided. Spray bottles and atomizers are equally effective and less harmful for the environment.

3. Disinfecting and Cleaning Products:

- There should be awareness of relevant pictograms and H and P Statements.
- There should be awareness of applicable Safety Data Sheets.
- Checks should be carried out that all products are correctly labelled with clear handling instructions (safety and environmental protection, storage requirements, expiry dates, actions in the case of poisoning, and so forth).
- Chemicals, as also disinfection and cleaning products, should be chosen from those least aggressive to the environment (biodegradable detergents not containing phosphates or chlorine; non-corrosive cleaners, products not containing chromium, and so on).

4. Water:

- Water should not be left running unnecessarily. By turning off taps, the wasting of water can be avoided.
- As far as possible, pressure, diffuser and timer devices should be fitted to taps to reduce water consumption.
- The water supply should be checked to detect any leaks and to avoid excessive consumption of water caused by drips, burst pipes and other escapes of water.

5. Paper:

- Recycled paper, not chlorine bleached, should be chosen.

6. Energy:

- Equipment should not be left on standby, and transformers and chargers should not be left connected, unless this is essential for some reason. Multi-socket power strips should be fitted with switches to ensure that all items of apparatus are turned off completely.
- When items are being heated, recipients suited to the size of the heating plate should be used, and covered with a lid when feasible. If the heating plate is electrical, it can be switched off a few minutes before the end of heating, so as to take advantage of residual heat.
- When refrigerators, kilns and ovens are used, doors must be fully closed. Unnecessary opening of doors should be avoided. Items that are still hot should be allowed to cool before being put into a refrigerator.
- Whenever possible, the fullest advantage should be taken of natural light, for example by painting walls in light colours or white.
- Timers and motion sensors should be fitted to lights in corridors, toilets and other intermittently used spaces. Low-consumption bulbs should be used.
- Heating and cooling system thermostats should be set to the temperature really needed in each case.

Product Storage:

- The quantities and volumes of hazardous products in the workplace should be kept to a minimum.
- Products and materials should be stored on the basis of compatibility, quantity and frequency of use.

- Care should be taken to ensure items in store can be fully and easily identified.
- All containers must be hermetically sealed and appropriately labelled, especially the most toxic or dangerous.
- Lists of materials and products stored should be kept up to date, and stocks managed, so as to avoid items going beyond their expiry dates.

Using Products:

- Good laboratory practice should be known and applied.
- Among officially recognized methods and techniques, preference should go to those involving the fewest risks and offering the least harm to the environment (less toxic and hazardous, consuming less energy or water, and so on).
- Instructions for the use of products should be read carefully and followed.
- Care should be taken when handling reagents, chemicals and samples, so as to avoid errors that would require repetitions of procedures, and hence increase waste.
- There should be full awareness of the dangerousness of any products used and of the hazards they can pose for the health and safety of people, and for the environment.
- Users should know how to identify and apply, where appropriate, the health, safety and environmental regulations applicable to the packaging, labelling, storage, use, transport, and disposal of substances and chemical preparations.
- Products should be used up entirely, so that containers are completely empty, avoiding pollution.
- Materials and containers should be reused as far as possible.

Laboratory Equipment and Instruments:

- Equipment should be carefully calibrated in order to avoid errors and repetitions of procedures, which entail increased waste.
- Equipment should be kept in action only for the minimum time needed so as to avoid emissions of heat, noise, vibration, radiation, and so forth, and to prevent unnecessary energy consumption.
- The risks of environmental pollution arising from any incorrect use of chemicals, instruments and equipment in the laboratory should be identified.

Waste Management:

- Suitable bins or containers should be installed for depositing each type of waste on the basis of requirements for managing it.
- Items containing re-used materials, such as recycled plastics and paper, should be employed where feasible.
- Products whose packaging offers good possibilities for recycling should be used for preference.
- Different waste products should be correctly separated.
- The guidelines laid down for waste that is dealt with by special collection services should be followed.
- Whenever possible, the containers in which products are delivered should be re-used to package the hazardous wastes generated from them.

Discharges and Dumping:

There is a prohibition on discharges into public sewers of:

- Materials hindering the proper functioning or the maintenance of sewers.
- Combustible, flammable, explosive, irritant, corrosive, or toxic solids, liquids or gases, radioactive substances, heavy metals and the like.
- Harmful micro-organisms or potentially reactive residues of them.

Reductions in Discharges and Dumping can be achieved by:

- Carrying out processes carefully so as to avoid errors and repetitions.
- Establishing measures against spillages, hence circumventing the need for cleaning.
- Choosing cleaning agents allowing reductions in pollution from material dumped or discharged, both in volume and in hazardousness.
- Collecting up material for dumping and separating it appropriately, undertaking pre-treatment before dumping, or handing it over to authorized waste management enterprises.

As far as possible, there should be an attempt to **reduce** emissions of:

- Volatile organic compounds (VOCs). This can be achieved by keeping solvent containers closed and by making use of extractor hoods appropriately checked and fitted with adequate filters.
- Chlorofluorocarbon compounds (CFCs). Use of these is very limited nowadays, but they can still be found in some older refrigeration devices. Such equipment must be carefully maintained and disposed of correctly when it becomes redundant, in order to avoid the escape of CFCs into the atmosphere. These might still be present in aerosols and similar products, in which case they should be withdrawn appropriately. Certain laboratory products may comprise or contain CFCs.
- Noise and vibration. As far as possible, use should be made of equipment and devices emitting less noise and vibration. These should be turned off or disconnected when not in use.

Special Precautions for Practicals and Experiments with Animals

- Vaccination protocols as laid down by the Health Monitoring Section of the Health and Safety Unit must be observed.
- It is advisable to wear single-use lab coats when clothing might be dirtied by bodily fluids, blood, excreta or secretions. The other clothes worn during these activities should be washed frequently, preferably separated from any other clothing that is not used for work.
- Any drops of blood spilt should be cleaned up rapidly with a disinfectant, for instance bleach.
- Samples of blood and other biological material should be sent in appropriately marked double-walled containers, hermetically sealed and insulated from their surroundings.
- To avoid stab injuries, needles should not be re-inserted into the original

protective cover before being deposited as waste in the special container provided for sharps. Unless the syringe must be re-used for some reason, it is advisable to dispose of it together with the needle, rather than trying to remove this.

Specific Precautions for Pressurized Gas Cylinders

- Whenever possible, a special area will be set aside, separate from laboratories, for cylinders of pressurized gases, keeping full apart from empty, and with both the cylinders and the associated tubing carefully labelled. Only those cylinders actually connected to equipment are to remain in the laboratory.
- Cylinders should be kept in a vertical position and should be anchored to vertical walls.
- Cylinder change-over will be in accordance with the general distribution system established.
- If it does not prove possible to turn the tap of a pressurized gas cylinder, use should NEVER be made of grease, oil or similar substances. The relevant supplier should be informed and called in to remedy the problem.
- If one is not already in existence, a maintenance programme should be set up for manometers, connectors and tubing, to be carried out by specialist technicians.

8. STANDARD OPERATING PROCEDURES (SOPs)

Standard operating procedures are documents describing the specific sequence of operations and methods that should be applied in the laboratory for any given purpose. An SOP defines an operation uniquely, outlining the steps that must be followed in the same way whenever this operation is carried out in the laboratory.

SOPs are associated with the availability of a quality manual, and are generally used in laboratories offering services or manufacturing products for outsiders. It is advisable to draw up and establish SOPs for all laboratories, whether they are for teaching practical classes or for research. At times, it may be particularly appropriate to apply SOPs in research laboratories:

- To cover routine or highly standardized activities. Many procedures virtually never change, or alternatively it may be of interest to make certain they are always performed in a very specific way. In such cases, setting up an SOP may aid in fixing the procedures.
- To regulate the offering of any type of service available to outsiders, even if this is not the main activity of the laboratory. The use of SOPs contributes to ensuring repeatability of activities and increases client confidence. Laboratories utilizing SOPs will have fewer difficulties if ever they engage in implementing quality policies.
- To promote the following of good practice in the laboratory. SOPs are very detailed documents, which need to address aspects relating to safety, waste management, good practice, and other similar matters. Drawing up SOPs may help in identifying problems and in encouraging good practice in the laboratory.

SOPs require a descriptive title and must be correctly identified. They should be compiled by those members of the laboratory who best know the procedure being described. Their usual structure is:

- Introduction: This text is optional.
- Aim: The purpose of the SOP should be clearly described.
- Field of Application: This section establishes the area to which the operating procedure applies.
- References: There should be an entry for every document that is related to, or used in, drawing up the SOP (standards, quality manuals, other SOPs, and so on.).
- Definitions: Whenever necessary, definitions should be provided for uncommon terms or expressions appearing in the procedure.
- Responsibilities: It can be useful to explain who is responsible for bringing in the SOP and the person or group of people who must carry out the activities listed in it.
- Procedure: A detailed description should be given of how to perform the actions necessary for the aims of the procedure.
- Appendices: When necessary, tables, graphs, illustrations and so forth may be included.

SOPs also require approval by the person responsible for the laboratory, as also by the quality controller if one exists. Finally, every SOP must have the following identification information on its front cover:

- Title of SOP.
- Identification Code.
- Version of SOP.
- Total number of pages.
- Name and signature of the compiler or compilers.
- Name and position of the person approving it, with date of approval.
- Name and position of the person confirming quality control, with date.

Employing SOPs entails creating a system to verify compliance, set the frequency of revisions and check them, and so forth. Moreover, care must be taken to ensure that SOPs are available in the places to which they apply, and that users know where to find them.

9. MANAGEMENT OF HAZARDOUS WASTE IN ULE AND ITS LABORATORIES

https://servicios.unileon.es/servicios-universitarios-generales/gestion-de-residuos/

Wastes generated at the University may be divided into four large groupings:

- Similar to general household waste

- Biological / Health
- Chemical
- Radioactive

9.1. Waste Similar to General Household Refuse

These present no risk to health or the environment. This group includes waste from kitchens, cafeterias and dining facilities, material from administrative activities, bulky waste, furniture, rubble from building works, and inert items. In Spain, the local authorities of administrative areas with more than 5,000 population are responsible for collecting such refuse.

Certain materials are picked up selectively to encourage waste separation for recycling: glass, paper and cardboard, used batteries, and scrap metal, among others.

Inert waste comprises those non-hazardous items that do not undergo any significant physical, chemical or biological transformations. Inert materials are not soluble or burnable, and they do not react physically, chemically, or in any other way. They are not biodegradable, and they do not negatively affect other materials with which they come into contact in any fashion that might lead to environmental pollution or harm to human health. Total leaching from these wastes, their contaminant content and the eco-toxicity of leachate should all be insignificant, and in particular they should not involve any risk to the quality of water, whether surface, underground, or both.

9.2. Biological / Health Waste

In accordance with Decree 204/1994 on Managing Sanitary Waste promulgated by the Regional Government of Castile and Leon on 15 September 1994, sanitary waste is to be classified into four groups:

- GROUP I: Waste treatable as general household refuse
- GROUP II: Non-specific sanitary waste
- GROUP III: Special or biohazardous sanitary waste
- GROUP IV: Waste regulated by specific norms or standards

Biological waste similar to sanitary waste is included in this classification.

9.2.1. Group I: Waste Treatable as General Household Refuse

This is waste matter that is generated in health establishments or laboratories, but is not specific to their activities. Hence, it presents no special management requirements.

9.2.2. Group II: Non-Specific Sanitary Waste

Waste of this type is generated by some clinical activity, but, not having been in contact with patients or biological liquids that might transmit the infectious diseases listed in Table I, it does not present any danger.

The group includes: dressings, bandages, cotton wool, compresses or gauze with remnants of blood, secretions, or excretions, remnants of plaster casts, clothing, and materials derived from analyses, treatments or minor surgical operations, and any other similar activity not being included in Group III.

List of Infectious Diseases

Cholera	Tularaemia
Viral Haemorrhagic Fever	Typhoid Fever

Brucellosis	Leprosy
Diphtheria	Anthrax
Meningitis	Paratyphoid A, B and C
Encephalitis	Plague
Query Fever	Poliomyelitis
Glanders	Bacterial Dysentery
Active Tuberculosis	Rabies
Viral Hepatitis	AIDS

9.2.3. Group III: Special or Biohazardous Sanitary Waste

Waste of this type requires the taking of preventive measures while handling, collecting, storing, transporting, treating and disposing of it, as it presents risks for workers, for public health or for the environment.

It may be further subdivided into the following classes:

1. Infectious waste, able to transmit one or more of the infectious diseases listed in Table I.
2. Anatomical waste, except for items covered by Decree 2263/1974 on the Regulation of Funeral Undertakers promulgated on 20 July 1974.
3. Blood and blood derivatives in liquid form.
4. Needles and sharps.
5. Attenuated live virus vaccines.

9.2.4. Group IV: Waste Regulated by Specific Norms or Standards

Management of such waste is governed by special hygiene and environmental requirements, both within and outside the location where it is generated.

In the specific case of carcasses of experimental animals, to the extent that ULE facilities are affected, they follow recently enacted European standards on this point, Regulation (EC) 1774/2002 of the European Parliament and Council, promulgated on 3 October 2002 laying down laying down health rules concerning animal by-products not intended for human consumption.

9.3. Chemical Waste

Chemical waste in laboratories comprises substances or preparations which almost always present certain characteristics of toxicity or hazardousness. Incorrect identification and storage of such waste may constitute a further risk, over and above those entailed by laboratory activities. Management of this chemical waste at the University of Leon is based on the European rules in Directive 91/689/EEC and Decision 94/904/EC, and on national and regional legislation on the topic. Some substances have specific legislation about them, for instance, chemicals that are carcinogenic agents.

In accordance with Spanish Law 22/2011 on contaminated residues and soils, enacted on 28 July 2011, all items in the list approved in Decision 94/904/EC are to be considered hazardous waste, as are all recipients and containers that have held them, together with any further substances classed as dangerous by European Community norms and those specified by the Spanish Government in conformity with European standards or in international agreements to which Spain is a subscriber.

Good working conditions in a laboratory ought to involve a programme or **"Plan for Waste**

Management" achieving appropriate protection for health and the environment. This should form a part of the general organization of the laboratory.
Likewise, for both safety and financial reasons, there is a need to look into the possibilities for minimizing waste. An attempt should be made to reuse or recycle products whenever feasible, as also to optimize stock control so as to avoid generating waste, checking for items that have exceeded their "use by" dates or are no longer used or required (setting up an exchange system for the latter).
Among **chemical waste** the following are included:

- **Products used or generated in the laboratory**
- **Reagents beyond their expiry date**
- **Reagents still usable, but no longer of use**
- **Primary standard solutions or substances**
- **Solvents**
- **Solutions**
- **Photographic developer and fixer liquids**

Normally such waste arises in

- **Haematology laboratories,**
- **Pathological anatomy laboratories,**
- **Immunology laboratories,**
- **Genetics laboratories,**
- **Serology laboratories,**
- **Microbiology laboratories,**
- **Biochemical laboratories,**
- **Accident and emergency laboratories,**
- **Radiology sections**

All of these require differentiated patterns of management, to be specified in accordance with the necessities of each case. Managing such waste appropriately is needed, not only with the aim of improving working conditions, but also because it constitutes a key element in the application of quality and environmental control in a laboratory. Moreover, it is, in addition, one of the requirements for the application of good laboratory practices (GLP).
Because of the problems to which this waste may give rise, meetings should be organized between those responsible for management and services, and supervisors so as to explain *in situ* what is proposed and what work guidelines should be followed. These should be ratified by departments before the management system is put into operation.
Chemicals that may be disposed of down the drain without prior treatment should be listed on posters, after authorization for this disposal has been requested and obtained from the relevant local government office.
REGULATION (EC) 1272/2008 OF THE EUROPEAN PARLIAMENT AND COUNCIL ("CLP")
"CLP" embodies new European rules on the **C**lassification, **L**abelling and **P**ackaging of substances and mixtures.
This legal norm introduced into the territory of the European Union new arrangements for classifying and labelling chemicals, based on the United Nations Globally Harmonized System (GHS). Hazard classes define the nature of any physical risk to human health or the environment posed by substances or mixtures thereof.

Physical Hazards		Health Hazards		Environmental Hazards	
Classes	Categories	Classes	Categories	Classes	Categories

Explosives		7[a]	Acute toxicity	4	Hazardous to the aquatic environment	5[g]
Flammable	Gases	2	Skin damage or irritation	2[d]	Hazardous to the ozone layer	1
	Liquids	3	Serious eye injuries or irritation	2		
	Solids	2	Respiratory or skin sensitivity	2		
	Aerosols	2	Mutagenicity	2[e]		
Oxidizing	Gases	1	Carcinogenicity	2[e]		
	Liquids	3	Toxicity for reproduction or breastfeeding	3[f]		
	Solids	3	Specific toxicity, single exposure	3		
Pressurized Gases		4[b]	Specific toxicity, multiple exposures	2		
Spontaneous Reaction		7	Dangerous if inhaled	1		
Self-igniting	Liquids	1				
	Solids	1				
Spontaneous heating		2				
Emitting flammable gases in contact with water		3				
Organic peroxides		7[c]				
Corrosive to metals		1				

Notes:
a. Unstable explosives and six subdivisions (1.1 to 1.6).
b. Compressed, liquefied, refrigerated liquefied, and dissolved.
c. Types A, B, C, D, E, F, and G.
d. 1 (A, B, and C) and 2.
e. 1 (A and B) and 2.
f. 1 (A and B), 2, and specific for breastfeeding.
g. Acute effects (1) and chronic effects (4).

Table 6. Classes and Categories of Hazard

European Union Regulations on Chemicals. Fundamentals of the CLP Rules

The table above and the details in this section are in accordance with the guidelines and explanations given in the Spanish Technical Prevention Notice NTP 878. Chemical waste requires compliance with special preventive measures, because it poses risks to health or the environment. Hence, particular care must be taken when handling such wastes, and above all when identifying and packaging them after they have been used, ready for disposal. This is because incorrect labelling may add a further hazard to the dangers already entailed by the activities of laboratories.

These substances are classified as falling into the following groups on the basis of their chemical and physical properties:

- Group I: Halogenated or chlorinated solvents
- Group II: Unhalogenated or unchlorinated solvents
- Group III: Aqueous solutions
- Group IV: Acids
- Group V: Oils
- Group VI: Solids
- Group VII: Special Wastes

Group I: Halogenated or Chlorinated Solvents

This category covers organic liquids containing more than 2% of any halogen and a chlorine content greater than 1%. Examples of these would be dichloromethane, chloroform, carbon tetrachloride (tetrachloromethane), tetrachloroethene, and bromoform. They are substances with diverse toxicological characteristics, and specific effects on health. This group also includes mixtures of halogenated and unhalogenated solvents, whenever the halogen content of the mix is greater than 2%.

Group II: Unhalogenated or Unchlorinated Solvents

Organic liquids containing less than 2% of halogens or a chlorine content under 1% are classified under this heading. Such substances are flammable and toxic, and among them may be mentioned the following groupings, with examples:

- Alcohols: methanol, ethanol, isopropyl alcohol
- Aldehydes: formaldehye, acetaldehyde
- Amides: dimethylformamide
- Amines: dimethylamine, aniline, pyridine
- Ketones: acetone, cyclohexanone
- Esters: ethyl acetate, ethyl formate
- Glycols: ethylene glycol, mono-ethylene glycol
- Aliphatic hydrocarbons: pentane, hexane, cyclohexane
- Aromatic hydrocarbons: toluene, ortho-xylene

Care should be taken not to mix solvents that are immiscible, since separation into different phases makes later treatment difficult. Obviously, this is even more the case for those that react with each other.

Group III: Aqueous Solutions

This group covers solutions in water of organic and inorganic substances. The resulting group is very large, so that it is necessary to establish divisions and subdivisions, as indicated below. Such subdivisions are needed either to avoid incompatibility reactions, or because of the requirements imposed by later treatment:

1. Inorganic aqueous solutions, with examples of each type:
    - Alkaline aqueous solutions: sodium hydroxide, potassium hydroxide.
    - Acid aqueous solutions of heavy metals: nickel, silver, cadmium, selenium, photographic fixing fluids.
    - Acid aqueous solutions not containing heavy metals (under 10% by volume of acid).
    - Aqueous solutions of hexavalent chromium.
    - Other inorganic aqueous solutions: photographic developing fluids, sulphates, phosphates, chlorides.
2. Organic aqueous solutions and those with a high chemical oxygen demand, again with examples:
    - Aqueous solutions of dyestuffs: methyl orange, phenolphthalein.
    - Organic fixing solutions: formaldehyde, phenol, glutaraldehyde.
    - Mixtures of water with solvents: chromatography eluents, methanol-water mix.

Group IV: Acids

This group comprises inorganic acids and concentrated aqueous solutions thereof (over 10% by volume). It should be kept in mind that mixing them, as a function of the composition and concentration of the solutions, may produce dangerous chemical

reactions with the release of toxic gases and increased temperatures. To avoid such a risk, before mixing concentrated acids in the same container, tests should be carried out with small quantities. If no reaction is observed, mixing is acceptable. If there is a reaction, the acids should be kept separate for disposal.

Group V: Oils

This group incorporates mineral oils, for example, left over from machinery maintenance operations, or from heating oil baths.

Group VI: Solids

Both inorganic and organic chemicals that are solids are classified in this group. However, this group does not include pure reagents beyond their "use by" date that are in a solid state, as these fall in Group VII). Several subgroups are established within this classification of solids:

- Organic solids: Chemicals organic in nature, or contaminated with organic chemicals, for example, activated carbon or silica gel impregnated with organic solvents.
- Inorganic solids: Solid inorganic chemicals, for instance, salts of heavy metals.
- Contaminated single-use materials: This subgroup covers items contaminated with chemicals. The subgroups may be further subdivided, classifying items by their nature and their contaminants, in accordance with the guidelines established by the authorized waste management enterprise, including glassware, gloves, filter papers, rags, and other materials. Broken glassware contaminated with chemicals, such as pipettes, test-tubes, beakers and other laboratory material in general, poses risks linked both the intrinsically hazardous nature of the chemicals contaminating them and also the possibility of hazards arising through the skin, due to cuts or stab wounds. This kind of glassware should not be placed in the conventional glass waste container, among other reasons, because it should not be subjected to the normal compaction procedure. An appropriate bin specifically for these items should be used for disposal.

None of these items should be mixed one with another.

Group VII: Special Wastes

This group encompasses chemicals, whether solids or liquids, which are highly dangerous and should not thus be included within any of the other groups. It also covers pure reagents that are out of date or expired. All these items should not be mixed one with another or with waste from any other group. Examples include:

- Strongly oxidizing substances, such as peroxides.
- Spontaneously igniting or highly flammable, for instance, metallic powdered magnesium.
- Highly reactive substances, (examples being fuming acids), acid chlorides (such as acetyl chloride), alkaline metals (like sodium and potassium), hydrides (for instance sodium borohydride or lithium hydride), compounds with active halogens (like benzyl bromide), polymerizable compounds (such as isocyanates or epoxy resins), peroxidizable compounds (for example, ethers), residues of reactions (likely to be unknown substances).
- Highly toxic chemicals (benzene, osmium tetroxide, chromium mixtures, cyanides, sulphides, mercury, asbestos, and so forth.).

- Unidentified substances and those that are unlabelled.

In general, hazardous chemical wastes should be separated on the basis of their physical and chemical properties:

- Liquids
  - Organic
    - Halogenated
    - Unhalogenated
    - Water with a high chemical oxygen demand
    - Oils
  - Inorganic
    - Acids
    - Bases
    - Salts, etcetera.
- Solids
  - Organic
    - Halogenated
    - Unhalogenated
  - Inorganic
    - Metals
    - Sulphates
    - Carbonates, etcetera.

Any mixing of substances that renders management more difficult, for example, through the formation of distinct immiscible phases should be avoided. Even chemicals that belong to one and the same group, should be separated into different containers if any chemical may react with another.

Particular attention must be paid to ensuring that peroxides are kept carefully separate from burnable, flammable, oxidizing and corrosive substances.

9.4. Radioactive Waste

All wastes of a radioactive nature should be treated and signalled appropriately, in compliance with the requirements established by Spanish Royal Decree 783/2001 of 6 July 2001, approving regulations for health protection against ionizing radiations. These procedures must be followed until the materials can be handed over to the authorized disposal manager, currently the *Empresa Nacional de Residuos Radiactivos, S.A* (ENRESA), the Spanish National Corporation for Radioactive Waste.

Even though these are waste materials, the Globally Harmonized System of descriptions (as outlines in Section 3.2 on Chemical Risks) **still applies**

.

ALL WASTES MUST BE CORRECTLY LABELLED

The University of Leon has standardized labels which indicate the following:

The four-digit harmonized system (UN) number	Description of waste
	The six-digit European Waste Catalogue (EWC) number, together with code numbers indicating hazard type (H), activity (A) and process (B) generating the waste, reason for management (Q),

<table>
<tr><td rowspan="5">Hazard pictograms (up to two) from those established by the Classification, Labelling and Packaging Regulation (EC) 1272/2008</td><td colspan="2">types of waste (L, P, S and G), waste management operations (D and R), and particular constituents of the waste (C)</td></tr>
<tr><td colspan="2">Details of the source generating the waste, including full address and post code
QR code</td></tr>
<tr><td>Date</td><td rowspan="2">Consignee, with full address, post code and telephone number</td></tr>
<tr><td>Type of hazard</td></tr>
</table>

It is particularly important for the labels to have full details of the name, address and telephone number of the generator of the waste, with the date or dates on which it was packaged (the start and finish of packing or filling) They should also have complete indications of the risks posed by the waste.
Moreover, the rules lay down that the **label with the pictogram or pictograms should be firmly affixed to the container**. Furthermore, any previous indications on the container must be removed so that no out-of-date or erroneous details are present that could give rise to confusion if the new label becomes detached, for example.

The **minimum** label size permissible is 10cm × 10cm.

10. ACTION IN CASE OF FIRE

The **minimum basic equipment and infrastructure requirements for protection against fires** are the following:

- Signed escape routes and indications of the number of exits
- Fire resistant building materials
- Fire-fighting equipment such as extinguishers, hose reels, dry risers, alarm and detection systems, proper signage and similar.

The **Fire Protection Plan** for each building sets out the material and human resources available and the actions that will be taken in case of fire emergency.

The general guidelines from the building evacuation plan should be followed.
It is the responsibility of everyone connected with ULE to ensure that all fire-fighting equipment remains clearly visible at all times, and that no obstacle is ever placed on an evacuation route.

On detecting a fire:

♦ If it is controllable, use should be made of extinction equipment located nearby, provided that there are persons familiar with it and that no danger is posed by this intervention.

♦ If it is NOT controllable, the emergency should be signalled by using the alarm buttons, and the area should be evacuated, closing all doors and windows on leaving, provided the size of the fire permits this action to be taken. Finally, all those present should collaborate in evacuating the building and its environs and head for the fire assembly point.

***If trapped by fire*:**

♦ Close all doors between you and the fire. Block any gaps around the doors with cloths or mats. Dampen them if water is available.

♦ Look for a room with an outside window. If possible, open it slightly.

♦ When moving around, go on all fours, because in general smoke is less dense than air and rises above it, although there are a few exceptions.

♦ Use a wet cloth to cover the nose and mouth when breathing, so as to avoid inhaling smoke.

♦ If the smoke is so dense that it impedes visibility, leading to disorientation, move to an outer wall and follow it along. It does not matter whether you go to the right or to the left, because sooner or later you will reach an exit.

11. ACTION IN CASE OF ACCIDENT

https://www.unileon.es/intranet/prevencion/informes/procedimiento_aatt.pdf

The general approach taken to accidents should be, in this order:

P – PROTECT
I – INFORM
H – HELP

Burns

- Rinse with abundant cold water for ten to fifteen minutes.
- Consult a doctor immediately.

Cuts

- If it is a minor cut, rinse with abundant running water for at least ten minutes.
- Disinfect the area with antiseptic from the first aid kit.
- Let the injury dry in the air or cover it with a sterile bandage.
- If it is a large cut in, or close to, a dangerous area, call a doctor immediately. Attempt to control haemorrhaging through pressure. Do NOT extract foreign bodies. Avoid movement, and, if feasible, place a dressing or damp gauze on the injury.

Accidental Spills on the Skin

- Rinse at once with abundant running water.
- After this drenching, remove contaminated clothing as soon as possible.
- Safety showers should be used in those instances where the affected zone of the body

is extensive.

Splashes on Skin and in Eyes
- Rinse with abundant running water. The emergency eyewash station should be used if the splash has gone into an eye.
- Do not attempt to neutralize.
- Consult a doctor immediately.

Action if chemicals are swallowed
- Call the poisons information service, trying to have available at the very least the label of the product, its safety data sheet, or both.
- Do not induce vomiting if the substance ingested is corrosive.
- When victims are unconscious, they should be laid on one side, with the head tilted back and sideways, and an attempt should be made to ensure the tongue falls forward, opening the airway. When victims are conscious, they should be propped up in a semi-recumbent position. In both cases, they should be covered with a blanket to keep them warm.

Action in the Case of Inhalation of Chemicals
- If the toxic substance is a gas, put on the appropriate type of gas mask before going to the aid of the person affected.
- The person affected should immediately be taken out into a zone with fresh air.
- A doctor should be consulted immediately. Try to take all available information about the gases, vapours from a toxic substance, or both, that have been inhaled.

Action in the Case of Contamination with Biological Material
- Consult a doctor immediately. Try to take all available information about the biological agent or agents to which there has been exposure.
- Follow the preventive treatment prescribed (prophylaxis, vaccination, and the like)

Action in the Case of Gas Leaks:
Leaks of flammable gas not accompanied by flames:
♦ If possible, the supply of gas should be interrupted by closing the shut-off valve.
♦ Do not use naked lights or electric equipment. Lighting should not be turned off or on, even if it is night-time or the area is in darkness.
♦ If the leak cannot be eliminated, the spreading of gas should be prevented, and people should not be permitted to the zone affected.

Leaks of flammable gas accompanied by fire:
If a fire takes place, all gas cylinders exposed to heat may explode, with the resultant danger of the scattering of parts of the cylinder, associated items, nearby objects, and the gas it contains.
♦ If possible, close the shut-off valve.
♦ Alert the Fire Brigade.
♦ Even if the fire is extinguished, there are still risks.
♦ Any gas cylinders affected by the fire should not be touched.
♦ If no risk is involved, remove the greatest possible number of cylinders that have not

been affected.

12. HEALTH MONITORING

The **Health Monitoring Programme,** both for individuals and for groups, offered by the Health and Safety Unit will be followed, in accordance with legislation on health and safety in the workplace. Personnel from the Health Monitoring Section will familiarize themselves with the conditions, procedures and potential risks existing in laboratories. The Health and Safety Unit may at any time put forward suggestions through the Health Monitoring Section for individualized protection measures, and maintain personal medical records. Finally, certain personal circumstances must be notified to the Health and Safety Service so that appropriate procedures may be initiated where necessary, for instance, in the case of pregnancy or for people especially vulnerable to given risks, among others. The section on the Health and Safety Unit on the ULE web page may be consulted for details.

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Previous publication “Manual de Seguridad y Buenas Prácticas en el Laboratorio de la U.Le.”, compiled by various members of the academic research and teaching staff and of the professional, administrative, support and service staff of the University.

Appendices:

1a. Acceptance Document, Leon Version

1b. Acceptance Document, Ponferrada Version
2. Waybill for Internal Management of Hazardous Waste
3. Form for Requesting Supplies of Containers, Packaging, and Labels

ANEXO 1. DOCUMENTO DE ACEPTACIÓN

universidad de león

NOMBRE Y APELLIDOS: **TELÉFONO DE CONTACTO:** **CORREO ELECTRÓNICO:** **NOMBRE DEL LABORATORIO:** **DEPARTAMENTO:** **MOTIVO DEL USO DEL LABORATORIO:** **RESPONSABLE DE LA ACTIVIDAD QUE DESARROLLA:**

Por la presente, reconoce que:

- Ha leído la 'Guía de Seguridad en Laboratorios para Docentes, Investigadores y Personal Técnico'.
- Se compromete a cumplir las directrices indicadas en la misma.

León , ____ de _____ de _____

Fdo.: _____

DEBERÁ QUEDARSE CON UNA COPIA DE ESTA HOJA Y ENVIAR EL ORIGINAL POR CORREO INTERNO AL SERVICIO DE PREVENCIÓN DE LA UNIVERSIDAD DE LEÓN

ANEXO 1. DOCUMENTO DE ACEPTACIÓN

universidad de león

NOMBRE Y APELLIDOS: TELÉFONO DE CONTACTO: CORREO ELECTRÓNICO: NOMBRE DEL LABORATORIO: DEPARTAMENTO, ESCUELA: MOTIVO DEL USO DEL LABORATORIO: RESPONSABLE DE LA ACTIVIDAD QUE DESARROLLA:

Por la presente, reconoce que:

- Ha leído la 'Guía de Seguridad en Laboratorios para Docentes, Investigadores y Personal Técnico'.
- Se compromete a cumplir las directrices indicadas en la misma.

Ponferrada , ____ de _____ de _____

Fdo.: _____

DEBERÁ QUEDARSE CON UNA COPIA DE ESTA HOJA Y ENVIAR EL ORIGINAL POR CORREO INTERNO AL SERVICIO DE PREVENCIÓN DE LA UNIVERSIDAD DE LEÓN

ANEXO 2.

FICHA DE CONTROL DE LA GESTIÓN INTERNA DE LOS RESIDUOS PELIGROSOS

DEBERÁ RELLENARSE UNA FICHA POR CADA DEPÓSITO (BIDÓN O ENVASE)

Nº Registro: (No rellenar)

Persona que solicita la retirada de residuos peligrosos en el laboratorio:			
Tel.:	Fax:	Correo electrónico:	
Laboratorio:		Departamento:	
Edificio:		Planta:	Puerta:
RESPONSABLE DEL DEPARTAMENTO O GRUPO DE INVESTIGACIÓN:			

- Indique con una 'X' el tipo de residuo peligroso que contiene el depósito:

TIPO DE RESIDUO:			
RESIDUOS QUÍMICO		RESIDUO BIOSANITARIO	
Grupo I: Disolventes halogenados		Grupo I: Asimilables a Urbanos	
Grupo II: Disolventes no halogenados		Grupo II: Sanitarios no Específicos	
Grupo III: Disoluciones acuosas		Grupo III: Sanitarios Especiales o Biopeligrosos	
Grupo IV: Ácidos		Grupo IV: Tipificados en Normativas Específicas	
Grupo V: Aceites		Residuo Citotóxico	
Grupo VI: Sólidos			
Grupo VII: Especiales			
Otro. Indique el tipo de residuo		Otro. Indique el tipo de residuo	

Observaciones: _____

_____

- Tipo de depósito: ☐ Garrafa ☐ Envase ☐ Contenedor
- Volumen del depósito: _____
- Fecha de inicio de llenado (dd/mm/aaaa): (__ / __ / ____)
- Fecha de finalización de llenado (80 % de la capacidad del depósito) (dd/mm/aaaa): (__ / __ / ____)
- Firma de la persona que solicita la retirada de residuos:

Fdo. _____

- Firma del encargado de la gestión interna de residuos peligrosos en el laboratorio:

Fdo. _____

DEBERÁ DEJAR ESTA FICHA DE CONTROL FIRMADA JUNTO AL ENVASE A RECOGER

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ANEXO 3. SOLICITUD DE REPOSICIÓN DE ENVASES Y ETIQUETAS

Nº Registro:
(No rellenar)

Nombre del solicitante:			
Tel.:	**Fax:**	**Correo electrónico:**	
Laboratorio:		**Departamento:**	
Edificio:		**Planta:**	**Puerta:**
RESPONSABLE DEL DEPARTAMENTO O GRUPO DE INVESTIGACIÓN:			

- Indique el número de cada tipo de envase y etiqueta que desee solicitar:

BIDONES RÍGIDOS (DESTINADOS A ALMACENAR RESIDUOS QUÍMICOS)	**Núm.**
Bidón (translúcido) de **10 litros**	
Bidón (translúcido) de **25 litros**	
Bidón(translúcido) de boca ancha de **25 litros** (PARA MATERIAL DESECHABLE CONTAMINADO)	
Bidón (translúcido) de boca ancha de **60 litros** (PARA MATERIAL DESECHABLE CONTAMINADO)	

ENVASES RÍGIDOS (DESTINADOS A ALMACENAR RESIDUOS BIOSANITARIOS)	**Núm.**
Envase amarillo (Pictograma: Residuo Biosanitario) de **30 litros**	
Envase amarillo (Pictograma: Residuo Biosanitario) de **60 litros**	

ENVASES NO RÍGIDOS (DESTINADOS A ALMACENAR RESIDUOS BIOSANITARIOS)	**Núm.**
Bolsa roja de galga mínima de 300 (Pictograma: Residuo Biosanitario) de **20 litros**	

ENVASES RÍGIDOS (DESTINADOS A ALMACENAR RESIDUOS CITOTÓXICOS)	**Núm.**
Envase azul (Pictograma: Residuo Citotóxico) de **30 litros**	
Envase azul (Pictograma: Residuo Citotóxico) de **60 litros**	

ETIQUETAS (DESTINADAS A LA SEÑALIZACIÓN DE LOS ENVASES DE RESIDUOS QUÍMICOS)			**Núm.**
Grupo I: Disolv. halogenados [**Banda Naranja**]		Grupo V: Aceites [**Banda Marrón**]	
Grupo II: Disolv. no halogenados [**Banda Verde**]		Grupo VI: Sólidos [**Banda Amarillo Pálido**]	
Grupo III: Disolv. Acuosas [**Banda Azul Claro**]		Grupo VII: Especiales [**Banda Violeta**]	
Grupo IV: Ácidos [**Banda Roja**]		Otra. Indique el tipo	

Observaciones:_____

_____

- Fecha (dd/mm/aaaa): (__ / __ / ____)
- Firma de la persona que realiza la solicitud:

Fdo. _____

DEBERÁ DE ENTREGAR ESTA SOLICITUD FIRMADA AL RECIBIR LOS ENVASES Y/O ETIQUETAS

Appendix 4.

CONTACTS AND TELEPHONE NUMBERS OF USE IN AN EMERGENCY

https://servicios.unileon.es/unidad-prevencion-riesgos-laborales/emergencias/

♦ Accident Insurance

- Students: A Student Policy is in force. Forms for requesting a refund of costs arising from care received in any given instance may be obtained from the Human Resources Office, from the Administrative Office, or in certain buildings from the porter's lodge or from the Student Office.
- Professional, Administrative, Support and Service Staff (PASS) and Academic Research and Teaching Staff (ARTS): Such staff may seek assistance from the appropriate Benevolent Society or through Social Security arrangements.
- ARTS: This group of staff may be aided by the relevant insurance companies, if they are members of the Spanish State Civil Servants' Benevolent Society (MUFACE).
- Post-graduate Scholarship Students: ULE takes out an accident insurance policy each year, which means that the company may vary from time to time. For further information, contact the Research Office, Scholarship Section.