INDUSTRIAL HYGIENE AND SAFETY MANUAL FOR UPS STUDENTS

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PREPARED BY:

Technical Secretary of Human Resources Management

STUDY WITH SAFETY

INDUSTRIAL HYGIENE AND SAFETY MANUAL FOR STUDENTS OF THE SALESIAN POLITECHNIC UNIVERSITY

"Safety and health are everyone's job. Your participation is essential"

CONTENT

1 INTRODUCTION

In Ecuador there is a significant percentage of work-related deaths that has increased given the reports submitted by companies to the Ecuadorian Institute of Social Security. Thousands of people have been temporarily or permanently disabled. It is evident that aside from the costs related to these kinds of accidents, neither deaths nor disability, nor pain and suffering can be given an economic value.

Therefore, it is necessary to promote a culture of prevention so that students, professors, and the administrative and service staff at Universidad Politecnica Salesiana feel naturally involved in the development of a safe study and work environment where it is normal to do things right.

Risk assessment is now recognized as the basis for active occupational health and safety management. Studying, like any human activity that involves effort, can be done in a healthy and safe way or, on the contrary, it can entail risks for the students' physical and mental health.

The High Council at UPS assumes the commitment to the development, implementation, maintenance, and continuous improvement of the Integrated Management System for Safety, Health and Environment (UNISSMA for its name in Spanish) of Universidad Politécnica Salesiana by adopting the following measures:

- Institutionally accepting a **Safety, Health and Environmental Policy** that communicates the importance of recognizing, defining, and satisfying the needs of the University Community in an efficient and concrete manner, by prioritizing safety, health, and care for the environment, as well as contributing to the control of occupational risks and significant environmental aspects.
- Operating in a safe way by following the standards that have been developed for this purpose and complying with all applicable legislation in force.
- Establishing objectives and goals aimed at achieving and complying with the policy and the current legislation, as well as approving improvement programs that include the actions to be taken to achieve the objectives of a continuous improvement process.
- Ensuring the necessary human, economic, and technological resources, so that the management system has an institutional dynamic.
- Setting improvement objectives aligned with the Safety, Health, and Environmental Policy. Implementing, following up, measuring, and analyzing their results, as well as implementing action and improvement plans during the meetings of the health and safety at work committees.

2 MANUAL OBJECTIVES

2.1 GENERAL OBJETIVE

- Identify the risks and dangers to which students are exposed to inform employees and students about the prevention measures to be followed in the different fields of their academic programs and daily activities to avoid adverse situations, incidents and common accidents.

2.2 SPECIFIC OBJETIVES

- Establish basic prevention norms to protect UPS students.
- Maintain efficient and productive operations at the institution so as to allow processes designed within each program to be applied safely.

3 LEGAL CRITERIA

National and international occupational health and safety regulations are not applicable to students as they apply to employees at Universidad Politecnica Salesiana; however, it is the duty of UPS to make students aware of the guidelines that, as a university, are being taken to reduce risks within its operations and to take preventive and corrective actions.

Therefore, the internal regulations of Universidad Politecnica Salesiana are applicable and mandatory for all students. This arises from the need to prevent occupational hazards which undoubtedly can indirectly or directly affect safety and health within the operations that could materialize due to specific compliance of the Institution.

Universidad Politecnica Salesiana – UPS, created by Law No. 63 issued by the National Congress and published in the Official Registry, supplement dated August 5, 1994, No. 499, is a private non-profit institution, co-financed with funds from the State with its own legal status and responsible autonomy: academic, administrative, financial, and organizational.

4 SAFETY POLICY

INTEGRATED SAFETY, OCCUPATIONAL HEALTH, AND ENVIRONMENTAL POLICY

SCOPE

This Policy applies to all employees at Universidad Politecnica Salesiana.

REGULATIONS

The Universidad Politecnica Salesiana is an Institution that provides higher education services at a national level by developing its activities while preserving the environment and the safety and health of its staff, contractors, and neighboring communities. For this reason, its High Council considers this Policy an integral part of its services and, therefore, a priority in its entire institutional line, thus ensuring its dissemination, understanding and compliance at all levels of the Institution. To this end, the UPS assumes the following commitments, principles, and guidelines:

- Plan and execute its activities in an efficient, responsible, and profitable manner by maintaining an auditable system of environmental management and occupational health and safety focused on preventive actions and continuous improvement.
- Identify, evaluate, and control environmental aspects, dangers and risks related to its activities and services to avoid polluting the environment and causing harm to the health of its staff members.
- Comply with the applicable legal requirements and those to which the institution subscribes, including those related to significant environmental aspects and occupational health and safety risks.
- Promote the development of its collaborators' skills oriented to complying with the objectives and goals established in the UPS' Integrated Management System.
- Provide all the resources necessary to implement and maintain the university's Integrated Management System.
- Engage in continuous improvement. The continuous improvement of performance in safety, environment, and health must be promoted at all levels of Universidad Politecnica Salesiana to ensure its evolution.
- Take active measures to reduce our energy use through the GREEn program for its name in Spanish (Rational Management of the use of energy, water, and paper at UPS).
- This integrated policy works as a framework to establish and review the objectives and goals to accomplish a continuous improvement safety, health, and environment program, as well as improving the efficiency of the Integrated Management System of the UNISSMA.
- The High Council assumes these commitments and urges all its workers to support this policy.

5 DEFINITIONS AND ABREVIATIONS

Consequences: Alterations in people's health or material damages resulting from exposure to a risk factor.

Diagnosis of working conditions or panorama of risk factors: Systematic way of identifying, locating, and assessing risk factors in a way that can be periodically updated and that allows the design of intervention measures.

Exposure: Frequency with which people or the structure encounter the risk factors.

Risk factor: Any element whose presence or modification increases the probability of causing harm to those who are exposed to it.

Mechanical risk factor: Physical factors that can cause an injury due to the mechanical action of machinery elements, tools, pieces to work with or projected materials both fluid and solid.

Physical risk factor: Environmental factors of physical nature that can cause an adverse effect to health according to their intensity, exposure, and concentration.

Chemical risk factors: Organic and inorganic substances, both natural and synthetic, which during manufacture, handling, transport, storage or use, can be incorporated into the air as dust, fumes, gasses or vapor that can cause irritation, corrosion, asphyxia or toxicity in quantities that could harm people's health when in contact with them.

Biological risk factors: all living beings, whether of animal or plant origin, and all substances derived from them that are present in the workplace and may cause negative effects on the health of workers. Negative effects can manifest in infectious, toxic, or allergic processes.

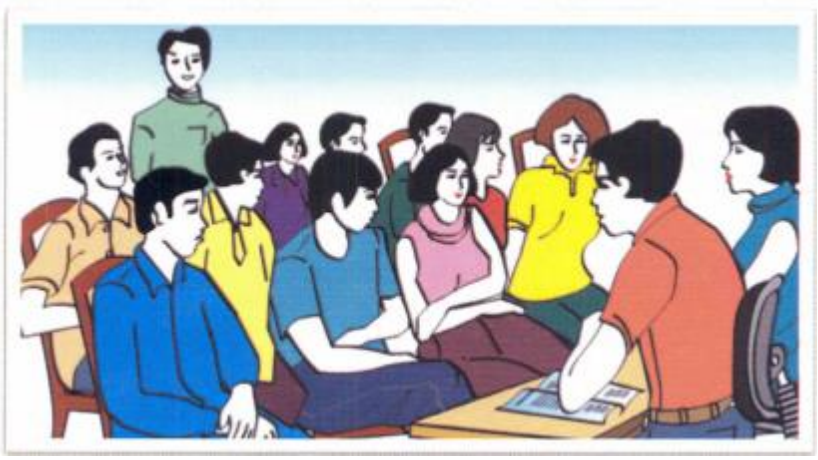
Ergonomic risk factor: Attributes or elements in some tasks that may increase the possibility of an injury to individuals or user groups exposed to them.

Psychosocial risk factors: Intrinsic and organizational aspects of work and human relationships that, when interacting with endogenous and exogenous human factors, may produce either psychological changes in people's behaviors (aggressiveness, anxiety, dissatisfaction) or physical or psychosomatic disorders (fatigue, headaches, pain in the shoulders, neck, back, or gastric ulcers, hypertension, cardiopathic disorders, or accelerated aging).

Probability: possibility that the events of the chain are completed in time, giving rise to unwanted or undesired consequences.

Risk: probability of occurrence of an event with negative characteristics.

6 CULTURE OF PREVENTION AT UNIVERSIDAD POLITECNICA SALESIANA



YOUR SAFETY AND HEALTH AS A STUDENT OF UNIVERSIDAD POLITÉCNICA SALESIANA IS ESSENTIAL

✓ You may have health problems if you do not adopt healthy practices in the classroom, at the desk, and with the computer.

✓You are responsible for your own health and need to adopt proper habits during your time as a student; therefore, you must observe the instructions to use machinery and equipment, adopt appropriate body postures, and comply with all instructions to preserve your health today and in the future.

✓ Because your health is important, UPS is committed to progressively improving health and safety conditions in all its facilities and activities.

✓ As a professional, you will be exposed to risks whose prevention you must understand from now on.

✓ It's your choice. You can study with guarantees for your own safety, or you bear the risks for your physical and mental integrity today and in the future. It's up to you.

BUT… WHAT IS OCCUPATIONAL HEALTH?

(Legend: Professors)

Health and Safety means betting on organizing work in a way that respects life and the full development of people. As a preventive measure, it is necessary to always ask for authorization from the university's teaching staff before working in a laboratory.

WEAR THE SAFETY CHIP•••

Scrupulously follow all the regulations for the use of the laboratories and the instructions of the person in charge.

1. Inform the professors or your area staff about problems or risks you may detect.

2. Understand and respect the safety signs and warning: maximum load notices, restricted area signs, danger signs, use of personal protective equipment and no entry signs, warning lights, audible alarms and the like have been installed after careful consideration. These messages should not be ignored.

3. Tell the person responsible (academic or technical staff) about any equipment that fails or is damaged. Do not try to repair it by yourself. The devices you handle should not be modified without the permission of your manager.

4. Keep your work area tidy and in safe conditions. Clean all the material you have used so that there are no traces of substances that could create a potential danger for other users.

5. Corridors and stairs must allow safe circulation and the use of emergency evacuation routes. They must not be used as storage or changing rooms.

(Safe Exit)

6. Access to fire extinguishing equipment must not be obstructed, hindered, or prevented. Never use the equipment for purposes other than putting out a fire.

7. In the facilities, corridors, laboratories, and rooms, do not run, throw objects, or make any movements that could destabilize or harm someone else. Even in the event of an emergency, it is generally safer to walk briskly than to run.

8. To avoid falls and slips, be careful when dealing with unevenness, steps, and stairs. Also, be careful during cleaning activities. Any liquid spilled on the floor must be cleaned up immediately.

9. Outside normal working hours you must not work in campus buildings without authorization, except for libraries or computer rooms. If you have authorization, you must not work alone or undertake any experimental work unless supervised by the person in charge.

10. Before taking part in a new activity, you must receive information about risks and dangers in the area.

11. Before participating in a new activity, you must receive technical information.

12. Acting safely in all life activities must become a habit.

13. Pay attention to the work you do. Haste is the best ally of accidents.

14. Follow the instructions and abide by the rules. If you don't know them, ask. Do not improvise.

15. If you see anomalies in the electrical installation, report them. Do not try to fix what you do not know.

16. Wash your hands before and after conducting a practice.

17. When finished using tools, put them away in their assigned places.

18. Do not accumulate trash and debris on the floor or in the machinery. Use the appropriate bins to dispose of them. Use the specific containers designed for polluting residues and substances.

19. Pay attention to your own hygiene due to the contamination risks when handling products for human consumption.

20. Wear protective gear when working in the laboratory (gloves, safety shoes, plugs, hearing aids, caps, aprons, masks, etc.). Keep them in good condition.

21. Wear the appropriate face shields, masks, and personal protective clothing. Splashes of aggressive industrial liquids can produce irreversible effects on the eyes.

22. Do not perform electrical work if you have not been trained and authorized to do so.

23. If you work with machines or tools powered by electricity, insulate yourself. Wear protective clothing and equipment.

24. Do not perform repairs on live installations or equipment.

25. Pay attention to abnormal heating in motors, cables, or cabinets.

26. It is forbidden to consume alcoholic, narcotic, and psychotropic substances on university premises when performing tasks under the supervision of teachers, or when performing activities outside the university: technical visits, internships, pre-professional practices.

27. If you handle chemical products, read the safety label, and wear the necessary personal protective gear. Request instructions from the laboratory manager regarding their use.

(Top: Security information forms: A basic tool for risk management
Bottom: Read attentively, obtain the equipment, and use chemical products)

28. Memorize and comply all safety instructions, both verbal and written. For example,

✓ Do not enter in a laboratory or practice room when the responsible person is not present unless you have a specific authorization.

✓ Improper use of appliances and machinery can have fatal results.

✓ Do not use any material or installation without previously obtaining specific instructions from a professor or supervisor about the operations that must be carried out and the precautions that will be adopted.

6.1 Risk Analysis in Areas and Laboratories

The classification of risk factors in physical, mechanical, chemical, biological, ergonomic and psychosocial is used.

6.2 Physical Risks

Refers to all environmental factors that depend on the physical properties of bodies, such as physical load, noise, illumination, radiation, high or low temperature, and vibration, which act on the worker's tissue and body organs and can produce harmful effects based on their intensity and time of exposure.

1. At UPS laboratories, students must identify dangers and risks to prevent accidents and illnesses.

(Physical Risks are associated with exposure to the following factors: Cold→ Colds, Light deficiency→ eye irritation, Noise→ hypoacusis)

(Physical Risks are associated with exposure to the following factors: RF Radiation→ unconfirmed harm to health, UV Radiation→ eye irritation, skin burns, Electricity→ electrocution)

(Physical Risks are associated with exposure to the following factors: Atmospheric discharges→ electrocutions, Oxygen deficiency→ asphyxiation, fainting, Rain→ colds)

6.3 Mechanical Risks

The mechanics laboratories at UPS entail a series of risks, both general and specific. The mechanical risks contemplate all the factors present in objects, machines, equipment, or tools, which can cause occupational accidents, due to lack of preventive and/or corrective maintenance, or lack of work tools and elements.

(Mechanical risks are associated with exposure to the following factors: Vehicle circulation in work areas→ harm to health due to accidents, Displacement via land, air, or sea→ harm to health due to transit accidents. Working at elevated heights higher than 1.8 meters→ blows, fractures, serious polytrauma)

(Mechanical risks are associated with exposure to the following factors: Same level falls → blows, fractures, Falls at different heights lower than 1.8 meters → blows, fractures and serious polytrauma. Rolling elements from machinery → entrapment)

(Mechanical risks are associated with exposure to the following factors: Falling tools and objects → blows, fractures, Falling tools and objects on feet → blows, fractures and serious polytrauma. Projection of particles → eye injuries)

RISKS FROM WORKING WITH TOOLS

Although there is a wide variety of different tools, we can basically distinguish two types of tools: manual and motorized.

1. Manual tools are the oldest working instruments and are so familiar, they are not often considered dangerous. However, they cause many accidents.

The main risks associated to the use of hand tools include:

- Blows and cuts in the hands caused by the tools themselves.
- Eye injuries due to particles coming from the objects being worked on.
- Blows to different parts of the body due to the firing of the tools themselves.
- Sprains due to overexertion or violent gestures.

- Indirect electrical contacts.

2. The main risk factors that encourage the materialization of accidents are:

- Use of tools for tasks they have not been designed for.
- Dangerous operations directed to a body part.
- Inadequate maintenance of the tool.
- Inadequate transport or storage.

3. Portable power tools are tools that require an input of electrical, pneumatic, or thermal energy to operate. These tools perform rotational or translational movements and percussion. The main risks involved include:

- By contact with the moving parts of the machine.
- Due to the power supply (electrocution, breaks or leaks of compressed air, etc.).
- Due to particle projections from the machine or the material being worked on.

4. Both manual or mechanical tools must be inspected and reported before carrying out assigned tasks:

- They must be made from resistant material.
- The joints between elements must be firm so to avoid their breakage or projection.
- Their handles must be adequately dimensioned and have an ergonomic design.
- Their shape must be smooth, without sharp edges or angles.
- They must not have slippery surfaces.
- They must have isolation if necessary.

5. Some motorized tools require protection equipment. For example, grinders, circular saws, or staplers and nail guns.

RISKS RESULTING FROM WORKING WITH MACHINES

6. Working with machines gives rise to a series of risks that, if materialized, cause injuries and/or mutilations to the human body and can even cause death. The most common risks of working with machinery are produced include:

• By contact with moving parts of the machine.
• Due to projections of thrown objects during the operation of the machine: either parts of the machine itself or parts of the material being worked on.

7. The most common injuries derived from working with machines are therefore, crushing, shearing, cutting, or severing, dragging, impact, punching, friction or abrasion and projection of materials.

8. In addition, working with machinery poses another series of risks to the health of the people who manipulate them or work in areas where machines are functioning. These risks include:

- Electrical risk that can cause injuries due to electric shock or burns. It can be caused by direct or indirect electrical contacts, electrostatic phenomena, or thermal phenomena derived from short circuits or overloads.
- Explosion risk, which happens whenever the equipment is powered by motor energy from flammable fuels or deflagrating substances. It is also possible in processes where energy is activated by using pressurized gases.
- Thermal risk, which can cause burns by contact with objects or materials at extreme temperatures or by radiation coming from heat sources.
- Electromagnetic radiation, which is manifested as radiation (visible, UV, IR, etc.) that harm organs related to vision and the skin.
- Noise: All equipment must emit noise under 80dB(A) and 135dB(C). Nonetheless, the concentration and simultaneous functioning of several machines can produce noise levels above these values. Repetitive exposure to elevated noise levels may provoke an illness known as hypoacusis as well as professional deafness. It can also cause accidents due to the masking of acoustic signals or by reducing the required attention or concentration.
- Vibrations: risk that goes hand in hand with noise, but in this case the energy transfer or the variable intensity wave goes through a solid medium. On several occasions this happens because lack of maintenance or adjusting of equipment pieces.
- Ergonomic risk: it can materialize in musculoskeletal injuries given the inadequate design of the control post, repetitive movements, forced or maintained postures, control of screens or displays, monotony, etc.

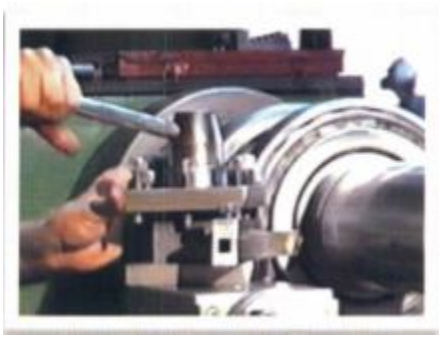
9. The lines of preventive action against mechanical risk in laboratories must be carried out before the damage occurs and must focus on:

- Safe design of all the equipment mechanisms.
- Protection and shelter from moving parts of the equipment and against projections.
- Clear work area and maintenance of safety distances.
- Training and information of people who operate machinery or tools.

GENERAL ORGANIZATION OF THE LABORATORY

SPACE DISTRIBUTION

10. Space distribution is of special importance when working with work equipment. In the case of machinery, for example, it is essential to have a complete vision of the different moves and actions carried out by the machines.



- 3 meters high from floor to roof.

- 2 square meters per person.
- 10 square meters not occupied per person.

11. The agglomeration of students around a machine can cause involuntary actions and accidents, so it is important to define safety distances to approach areas of danger.

Before operating any equipment,

- Check that the control devices can be accidentally or involuntarily activated.
- Identify the control device that allows for the complete stop of the machine in safe conditions.
- Identify the machine's power source.

MAINTENANCE

12. When working with machines, aside from their proper functioning, it is necessary to check if the safety elements are in good condition. If in doubt, ask the professor, lab manager, or teacher for the machine's maintenance log before operating it.

PROTECTIVE MEASURES

Collective protection equipment

13. When it is not possible to have a motor machine or tool with intrinsic prevention systems or design, safety systems must be installed, such as

• Restraints and barriers

Machines must have restraints and barriers for:

• All moving parts, all heating parts, or parts that could project solids, liquids, gasses, or vapors.

Restraints must prevent access to the space within the restrain and/or keep inside materials, working pieces, dust, fumes, gasses, or noise, which the machine could project or emit. There are also particular requirements related to electricity, vibrations, or visibility, among others.

6.4 Chemical Risks

Chemical risks include all elements and substances that, when in contact with the body either by inhalation, absorption, or ingestion, can provoke intoxication, burns, or systemic injuries, according to the level of concentration and time of exposure.

(Chemical risks are associated with exposure to the following factors: Refrigerants, Cable cleaning solvents, Nitrogen → and their consequences can be as follows: Respiratory problems; Dermatitis, skin irritations; respiratory problems)

The Chemistry labs at UPS may present a series of general and specific risks. In this guide we cover specific risks caused by exposition to chemical substances, especially when manipulating them directly, but also when chemicals are present or stored.

Chemical risk derives from the use or presence of dangerous chemical substances. Substances are dangerous when they present one or many of the following characteristics:

- It is dangerous to health.
- May cause a fire or explosion.
- It is dangerous to the environment.

TOXIC RISK

1. When a chemical substance is dangerous to people's health, it is known as a toxic risk. This risk can occur if the exposure to the chemical agent is not controlled.

2. The toxic risk of a chemical product depends on two factors: its toxicity and absorbed dose. Several factors may influence the toxic risk, such as composition, properties, concentration, duration of exposure, route of entry into the body, and workload.

- Toxicity: A substance's capability to harm.
- Dose: amount of product absorbed by the body.

3. Routes of entry into the body.

Mainly through four ways:

- Inhaling: airways are the main ways of penetration of chemical substances. From the lungs, chemical agents move to the blood and can affect other organs as the brain, liver, kidneys, etc. They can also go through the placenta and produce fetal malformations.
- Ingestion: the toxic product is introduced to the body through the mouth by contaminated food or drinks, or when after handling a chemical product, people bring their hands to their mouth to smoke or simply as an unconscious movement.

- Dermal: some chemical substances, such as irritants or corrosives, cause damage when they come into contact with the skin, mucous membranes or eyes, or through small skin lesions.
- Parenteral: it is produced by penetration of the contaminant through discontinuities in the skin such as cuts, punctures or the presence of ulcers, sores, or other uncovered wounds.

EFECTS OF TOXICITY IN THE BODY

4. The risks from working with chemicals are without doubt one of the most complex to analyze since the variety of harmful effects they have in the human body. The effects of toxic substances on the body can be:

- Corrosive: destruction of tissue on which the toxic substance acts.
- Irritants: irritation of the skin and mucous membranes of the throat, nose, eyes, etc. in contact with the poison.
- Pneumoconiosis: pulmonary alterations due to the accumulation of solid particles in the tissue.
- Asphyxiants: reduction or disappearance of oxygen from the air we breathe.
- Anesthetics and narcotics: Loss of sensitivity in a general or partial way by action on brain tissue.
- Sensitizing: development of allergic reactions in the presence of the toxic substance, even in small amounts.
- Carcinogenic, mutagenic, and teratogenic: occurrence of cancer, hereditary changes, and malformations in descendants.

(From left to right, top row: explosive, flammable, oxidizing, pressurized gas, danger to the environment; left to right, bottom row: toxic, corrosive, irritant, danger to health)

On the other hand, damage to health can be transitory or permanent. Additionally, damage to health can occur in different moments after exposure; therefore, the effect can be

- In the short term, when it occurs almost immediately, it is called "acute toxicity." For example, the inhalation of chlorine that causes immediate respiratory irritation.
- In the medium term, when the toxic has spread to the whole body through the blood, acting as a poison. For example, the use of solvents in poorly ventilated spaces can cause nausea, vomiting, etc.
- In the long term, after repetitive exposure, “chronic toxicity” presents itself, whose effects show up after a prolonged exposition to certain chemicals. It produces cancer, genetic

alterations, alterations to the hormonal and nervous systems, and some kinds of allergic sensitization.

The lapse between exposure and the appearance of health damage makes it difficult sometimes to establish a cause-effect relationship. However, more scientific evidence is accumulated everyday about the long-term effects of exposure to some substances.

RISK OF FIRE OR EXPLOSION

5. In addition to toxic risk, some chemical substances are flammable or explosive, so they can cause fires and/or explosions. This is a hazard that must be taken seriously when adopting preventive measures.

ENVIRONMENTAL RISK

6. On the other hand, when chemicals are diffused and stored in the environment, they pollute it and lower its quality. Diffusion can occur as waste, discharge, or air emissions. So that it gives rise to:

- Local pollution: water, soil, air, flora, and fauna.
- Global effects: loss of the ozone layer, greenhouse effect, loss of biodiversity, and others.

7. When a chemical is toxic to the environment, it is an ecotoxic substance. These are chemical substances or blends capable of producing damage in populations of living organisms. The risk of exposure to people from ecotoxicity of substances released into the environment focuses on:

- Contamination of food chains and drinking water sources.
- Deterioration of air quality.

PREVENTIVE MANAGEMENT AGAINST CHEMICAL RISK

8. Despite the complexity of chemical risk and the different effects and dangers it poses, preventive risk management is the same. In this way, the preventive management process against chemical risk comprises the following:

- Identifying dangerous substances: chemical labs at UPS have “safety data sheets” supplied by suppliers and properly labeled chemicals.
- Understanding the nature of dangerous substances: their toxicity to humans, the environment, and their ability to ignite or act as an oxidizing. For this, it is necessary to

know the route of penetration of each chemical, as well as their physical-chemical behavior.

- Eliminating and controlling risk: once a risk has been identified and the dangerous substance is known, it is necessary to evaluate the need of its use. This way, the lines of preventive action against chemical risk in laboratories must be conducted before the harm is produced. It must be focused on:
- Selecting the less harmful products and minimizing their use.
- Elimination or minimization of exposure to the chemical substance to lab users.
- Informing and training users about the substances in the laboratories, their risks, and how to prevent the risks.

BASIC PREVENTION MEASURES AGAINST CHEMICAL RISK

9. It is not always possible to eliminate or substitute all dangerous chemicals. In these cases, a series of preventive measures must be taken to control the risk they entail. Chemical laboratories must apply the following specific preventive measures.

GENERAL ORGANIZATION OF THE LABORATORY

- The student must discard the material that presents the slightest defect or that has suffered a hit of a certain consistency, even if no cracks or fractures are observed.
- Use support glass plates with rounded edges.
- Do not force the separation of glasses or containers that have been sealed one inside the other.
- Verify that the quality of the glass responds to the stress it will be subjected to.
- Do not force directly with your hands the closures of jars or bottles, stopcocks, connectors, etc., that have become clogged.
- Safety showers and eye washing fountains are mandatory in certain chemical laboratories for immediate washing in case of accidental contact with dangerous substances due to harmful, toxic, or dangerous splashes.

INDIVIDUAL PROTECTION

10. When manipulating chemical substances, laboratory users must wear personal protective equipment (PPES) to avoid the penetration of chemicals into the body either by inhalation, dermal, conjunctival, or parenteral route. People must wear the following:

- Anti-splash protection goggles.
- Suitable gloves
- Suitable masks
- Long sleeve robe
- Mob-cap.
- Face mask.

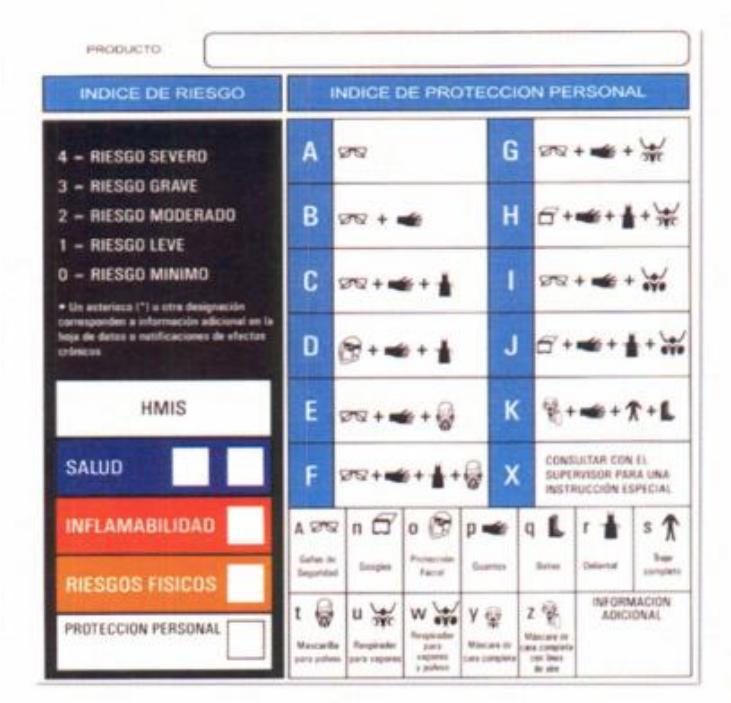
BASIC RULES TO PERFORM TRANSFERS

11. Basic rules for transfers:

- Transfer, whenever possible, small quantities of liquids, otherwise, use a specific area for it.
- Transfer flammable substances away from sources of heat or ignition (sparks, etc.).
- Carry out transfers of toxic, irritating and corrosive substances with protective clothing appropriate to the risks of the product.
- Avoid spills by using funnels, dispensers, or siphons for the transfer.
- Have a kit in the laboratory for collecting accidental spills (never use sawdust for this purpose).
- It is mandatory to comply with the information on the substances present, their possible risks, and preventive measures, as well as safe working methods.

INFORMATION AND TRAINING

12. The containers used by the chemistry laboratories of Universidad Politécnica Salesiana have security labels, which are mandatory. In the event that the original label of the chemical has deteriorated, or the chemical has been placed in a secondary container out of necessity, they must be labeled according to their safety data sheet, which is shown below.



Product

Risk index……personal protection index

4 – Severe risk
3 – Serious risk
2 – Moderate risk
1 – Slight risk
0 – Minimal risk

Health
Flammability
Physical risks
Personal Protection
A – safety goggles | n – goggles | o – face protection | p – gloves | q – boots | r – apron | s – full body suit | t – dust mask |u – respirator |w – respirator for vapors and dust | y – full face shield | z – full face shield with air flow | Additional information

13. If fluid transfers are performed in the laboratory, the new container must be correctly labeled to identify the substance it contains and thus understand what risks its use entails and what preventive or protective measures must be used by the person who handles the product. Therefore, containers for other products will not be reused without first removing the original label and not overlapping labels.

It is mandatory to review the safety data sheet for each substance. Safety data sheets are a basic element of prevention that must be requested from the laboratory technician.

- Manufacturer or supplier.
- Basic components.
- Possible reactions.
- Incompatibilities.
- Admissible exposure values.
- Safe storage instructions.
- Actions in the event of spills or leaks.
- Health effects of exposure.
- Routes of penetration in the organism.
- The safety and protection measures applicable to use.
- First Aid.

If the safety data sheet is missing, basic written instructions is essential. In chemistry laboratories there are panels or posters that inform about the risks of the main substances, their dangers, and safe usage guidelines.

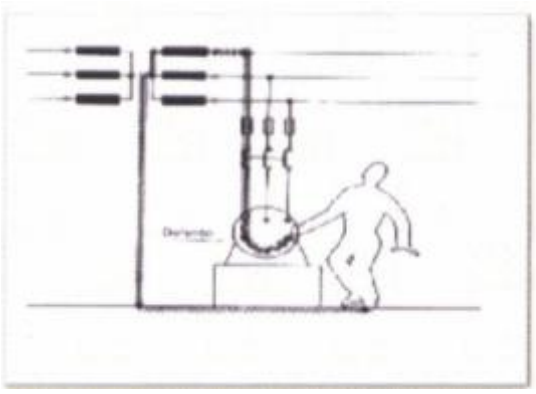
6.5 Electrical Risks in Laboratories.

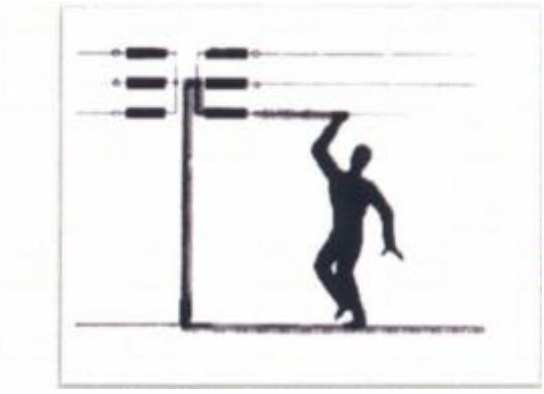
The laboratories at Universidad Politécnica Salesiana carry a series of risks:

1. The electrical risk is present in any task that involves manipulation or operation of low, medium, and high voltage electrical installations, as well maintenance operations, manipulation, and repair of the electrical equipment of the machines, and use in environments for which the apparatus has not been designed (humid and/or wet environments), etc. The following elements are included in the electrical risks posed:

- Electrocution: the possibility of circulation of an electric current through the human body.
- Burns due to shock or electric arcs.
- Falls or blows as a result of shock or electric arcs.
- Fires or explosions caused by electricity.

The passage of electrical current through the body can cause various injuries ranging from burns to ventricular fibrillation to death.





EFFECTS OF ELECTRICITY ON THE HUMAN BODY

2. When a person comes into contact with electric current, the entire organism is not affected equally. Some parts of the body that are more damaged than others:

- **Skin**: is the first point of contact. The main injury is a burn due to the thermal effect of the current. In low voltage, superficial burns (electrical spots) are caused at the point of entry and exit of the current. In high voltage, large burns can be produced with deep tissue destruction.
- **Muscles**: When an external electrical impulse reaches the muscle, it contracts. If the impulses are continuous, they produce successive contractions known as “tetanic contractions" so the person is physically unable to break contact from the conductive element on their own. In this situation, and depending on the contact time, the current continues to act, which can cause damage to other organs, as well as muscle and tendon ruptures. Tetanic contractions can also cause a sustained contraction of the respiratory muscles and lead to suffocation, which can irreversibly damage the brain and cause death.
- **Heart**: the electrical current produces a total alteration in the conduction system of the impulses that govern cardiac contraction. This produces the so-called "ventricular

fibrillation," in which each zone of the ventricle contracts or relaxes in an uncoordinated manner. Therefore, the heart is unable to effectively perform its function of sending blood to the body, thus interrupting circulation and leading to cardiac arrest.

- **Nervous system**: Nerve impulses are actually electrical impulses. When an external electrical current interferes with the nervous system, a series of alterations appear, such as vomiting, dizziness, vision alterations, hearing loss, paralysis, loss of consciousness or cardiorespiratory arrest. Other organs may also be affected, such as the kidney (kidney failure) or the eyes (electrical cataracts, blindness). Furthermore, electrical contact can indirectly cause accidents due to falls from great heights, hitting objects or projecting particles.

FACTORS THAT CONDITION DAMAGE BY ELECTRICAL CONTACT

3. The human body behaves as an electrical conductor when it accidentally comes into contact with two points at different voltages. This situation poses a risk for electrocution, since there is the possibility that the electric current circulates through the human body. There are several factors that can modify the consequences of electric shock, so the effects can be very diverse. The main factors are as follows:

- Intensity (milliamps): the other unit for measuring current is the ampere, which determines the intensity or amount of charge contained in the passage of current between two points with different potential. That is, it is the measure of the amount of current that passes through a conductor. This is usually the determining factor of the severity of injuries, that is, the higher the intensity, the worse the consequences. This means that "what kills is the intensity, not the voltage," since when an active element of the electrical installation or an element accidentally energized is touched, a potential difference is established between the part of the body that has touched it and the part of the body placed on the ground (normally hand-foot). This is called "contact voltage." This potential difference causes a current to circulate through the body. Depending on the resistance, the current can produce different effects, for example:

0.05 mA tongue tickle

1.1 mA hand tickle

0-25 mA muscular tetanic contractions

25-30 Ma risk of suffocation

> 50 mA ventricular fibrillation

> 4 A cardiac arrest

One way to reduce the intensity will obviously be by reducing the potential difference or by increasing the body's resistance by means of gloves, suitable footwear, not made of leather and without nails, and by increasing the ground resistance at the site.

- **Current frequency:** most of the installations are carried out in alternating current, but direct current also exists. The frequency of this current is measured in Hertz (Hz) -

oscillations per second. Direct current acts by heating and, although it is not as dangerous as alternating current, it can cause, at high intensities and prolonged exposure time, an embolism or death by blood electrolysis. In alternating current, if the frequency is superimposed on the nervous and circulatory rhythms, it can produce spasms and ventricular fibrillation. It is interesting to know that low frequencies are more dangerous than high frequencies; that is, values above 100,000 Hz are practically harmless.

- **Body resistance (ohms)**: the human body does not have a constant resistance. In fact, the resistance of human tissues to the passage of current is variable and will depend significantly on the voltage to which it is subjected and the humidity of the location. The skin is the first resistance to the passage of the current inside the body. Much of the electrical energy is used by the skin, producing burns, but without causing serious, deeper injuries than if the electrical energy were applied directly to the deep tissues. By lowering skin resistance, a low-voltage current can become life-threatening; for example, at a voltage of 220 volts, if the resistance of the skin decreases, this will imply that the intensity is increasing because intensity, resistance and voltage are related through Ohm's Law: V = I x R (voltage = intensity x resistance).
- **Ohm's Law:** Intensity is directly proportional to the potential difference and inversely proportional to the resistance. I (A) = V (V) / R (O).
- **Voltage (volts):** together with resistance, voltage is a factor that causes current to pass through the body. It is what has previously been called potential difference between two points. Contact tension arises from being applied between two different parts of the body. The default voltage results from an insulation flaw between two masses: a mass and the body, a mass and ground. High voltage injuries have a greater power of tissue destruction and are responsible for severe injuries; however, 120-220 volts can also cause electrocutions. Under normal circumstances, electrical discharges of up to 50 volts do not usually harm the body, because it is a so-called safety voltage. The so-called safety stresses for different body and site strengths include the following:

  Dry locations 50 V.

  Damp or wet locations 24 V.

  Submerged locations 12 V
- **Contact time:** together with intensity, contact time is the most important factor that determines the severity of injuries (bear in mind that with low voltage, the contact time can be lengthened due to the tetanic contraction that occurs from 10 mA .
- **Path of the current:** the point of entry and exit of the electric current in the human body is very important when establishing the seriousness of the injuries sustained due to electrical contact. Injuries are more serious when the current passes through of the nerve centers and vital organs such as the heart or the brain. "The one-hand rule" states that when working with live electrical circuits, only one hand should be used,

keeping the other hand away to the other side. This prevents the current from passing from one arm to another and therefore affecting vital organs.

- **Personal factors**: in addition to gender and age, a series of personal conditions can modify the body's susceptibility to the effects of electric current such as stress, fatigue, hunger, thirst, illness, etc.

4. Electrical accidents occur when the person comes into contact with the electrical current. This contact can be of two types:

- Direct electrical contact.
- Indirect electrical contact.

5. **Direct contact** is understood as the contact between people and active parts (called "phases") of the installation or equipment. The active parts can be conductors and conductive parts under tension in normal service. All electrical operations will be carried out on the phases (placement of switches), not on the neutral. Direct contact is the direct touch of the phase through which a current intensity determined by amperes circulates. They can be produced in the following ways:

- Phase-earth contact.
- Phase-neutral contact.
- Phase-machine contact with grounding.
- Phase-machine contact without grounding.

6. **Indirect contact** is one where the person comes into contact with elements of the installation or equipment that are not part of the electrical circuit and are accidentally active as a result of an insulation flaw. The main characteristic of an indirect contact is that only part of the default current circulates through the human body that makes the contact. The rest of the current circulates through earth contact of the mass. The current that circulates through the human body will be as small as the grounding resistance of the mass is low. If the machine made poor contact with the ground or was isolated from it, the indirect contact could be considered direct, since practically all the current circulates through the human body.

FIRE AND/OR EXPLOSION HAZARD

7. Working with electricity is often the cause of fires and explosions as it acts as a source of ignition. In fact, it is estimated that unsafe electrical systems are one of the main causes of fires.

- Aging of circuits and short circuits in sockets.
- Wiring overheating and electrical overloads.
- Flaws in electric motor circuits.
- Points of electricity and switches exposed to explosive atmospheres. A spark can be especially dangerous if work is conducted in explosive atmospheres or in the vicinity of flammable gases or liquids.

PREVENTIVE MANAGEMENT AGAINST ELECTRICAL RISK

8. Preventive management

- Use "bananas" with conductive parts covered with shrinkable or non-shrinkable insulating material.
- Discard all parts that are worn or do not guarantee safety.
- Implement equipment grounding, so that the "ground" circuit is closed to prevent any leakage current from passing through the user.
- Mandatory compliance with the internal regulations of each laboratory.

INDIVIDUAL PROTECTION EQUIPMENT

9. Depending on the specific task to be carried out, the need to use the following PPE will be assessed:

- Insulated gloves.
- Insulated handles on tools.
- Safety shoes with insulated soles.
- Insulated safety mats.
- Insulated safety benches.
- Safety poles for contacting elevated elements at medium or high tension.

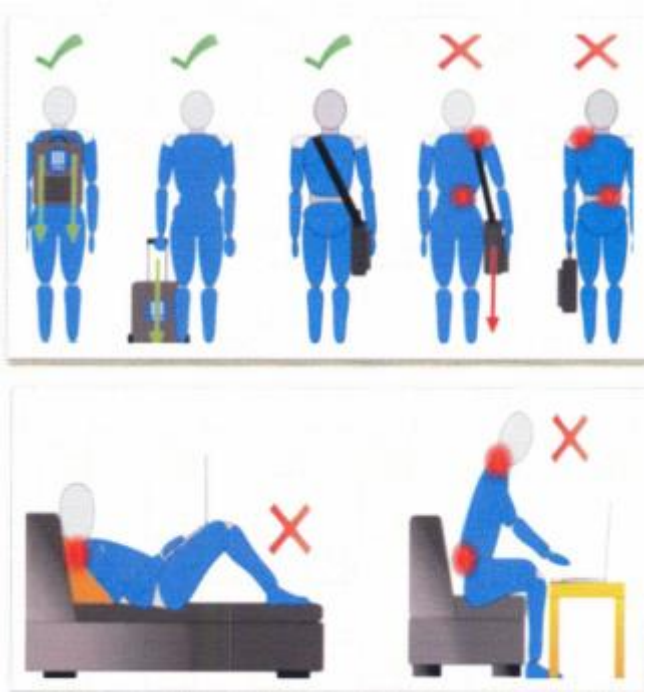
6.6 Ergonomic risks.

Involve all agents or situations related to the adaptation of work or work elements to human physiognomy.

(Ergonomic risks. Ergonomic risks are associated with exposure to the following factors: Forced positions (standing, seated and hunched) and Use of data screens have the following consequences, among others → skeletal muscular disorders of the spine and extremities, skeletal muscular disorders of the neck and back)

1. When using computers or display data screens (VDPs), be aware that their improper use can lead to back pain, repetitive motion injury, or other musculoskeletal injuries. If preventive measures are not taken, these health problems are aggravated. It can be caused by poor design of associated equipment such as chairs, insufficient space, lack of training, or failure to introduce regular breaks when working with data displays. Working with screens does not permanently damage the eyes, however many people who work report eye strain or eye strain.

- Adjust the height of the chair in such a way that it allows keeping the forearms flexed up to 90° and resting on the table without raising the shoulders and, if there is no table, place the computer on the briefcase or some similar object.
- Sit in a frontal position with respect to the screen.
- Use equipment with screen sizes from 14" and increase the size of the font used to display.
- To control possible reflections, regulate natural light with curtains or blinds. Avoid placing the equipment facing or with its back to the window. Place the equipment parallel to the ceiling lights and reinforce the lighting above the keyboard.
- Choose computers equipped with screens with anti-reflective treatment and the ability to provide good levels of contrast.
- Whenever possible use docking stations that allow the use of a peripheral keyboard and mouse.
- Worktables must have rounded edges, not be very reflective, neither too light nor too dark, and have the adequate size to place any necessary elements.
- Manual transport of portable work equipment should be done preferably in a backpack.



6.7 Biological Hazards.

Biological hazards are a group of organic, animate or inanimate agents present in certain work environments that can trigger infectious diseases, allergic reactions or poisoning when they enter the body. The handling of animal, vegetable waste and derivatives of contaminated instruments such as knives, syringes, scalpels, and industrial waste such as garbage, pose a source of high risk.

1. When research-related work is carried out outside of laboratories, personal protective equipment must be used.

(Biological risks. Biological risks are associated with exposure to the following factors: Fungi and parasites and mud and stagnant water have the following consequences, among others → intestinal infections, skin infections)

6.8 Psychosocial Risks.

Interaction in different work environments at UPS can cause psychological burdens on students that affect their health: migraines due to work overload, lack of vigor due to high-responsibility jobs, feelings of tiredness due to mental fatigue, possible gastrointestinal problems due to somatization and anxiety due to uncertainty about the future.

1. Students who identify this type of risk should seek support at the student welfare office.

6.9 Hygiene and Behavior Guidelines.

✓The use of an apron, preferably made from cotton, is mandatory.
✓Aprons must be fastened at all times.
✓In general, whenever working in the laboratory, gloves and safety goggles should be used.
✓Working in the laboratory with stockings or bare shoes is not permitted.
✓Personal objects must not be left worktables.
✓Before leaving the laboratory, aprons, gloves and other protective devices should be removed and hands washed. Under no circumstances will laboratory clothing be used outside of the laboratory (in the cafeteria, library, etc.).
✓Hair must be tied back. Bracelets, pendants or wide sleeves must not be worn during the practice or analytical techniques.
✓The use of contact lenses in the laboratory is not advisable. In case of projection of liquids into the eye, they are not removed quickly as soft lenses can absorb some organic vapors. Prescription safety glasses are preferred.

- ✓Eating or drinking is not permitted inside the laboratories. Containers are susceptible to contamination by sharing a contaminated atmosphere, so the use of water bottles, glasses, jars, as well as the intake of food, must be avoided.
- ✓No electrical element should ever be manipulated with wet hands, either in damp or accidentally wet environments (e.g., in the event of flooding) or in places with special characteristics (wet, damp, or dusty atmosphere) where the necessary means of personal protection is not used.
- ✓Established work procedures in electrical installations must be used.
- ✓During lab practice, samples to be used must be planned. The use of multiple bases (mobile strips) must be avoided.
- ✓The grounding of the equipment and installations must never be removed.
- ✓Operations on power lines, switchboards, transformation centers or electrical equipment must never be performed without the necessary training to do so.
- ✓Coverings or insulation from the active parts of the systems must never be removed.
- ✓As a general rule, work must be performed in the absence of voltage. Practice instructions must always propose manipulations without current; the circuit will only be powered after assembly and in the presence of the professor. The person in charge of the practice must clearly explain to students that once the correct operation has been verified and before beginning any maneuver to disassemble the equipment, the voltage must be cut off.
- ✓Should it be essential to carry out work with current, the appropriate means of protection and the appropriate personal protective equipment (PPE) must be used.
- ✓During practice, it is necessary to follow the predetermined colors for the use of cables.
- ✓Circulation routes in parking lots must be respected.
- ✓Compliance with the internal regulations of each laboratory is mandatory.

7 PERSONAL PROTECTIVE EQUIPMENT FOR LABORATORIES

In the mechanics laboratories, both teaching staff, laboratory technicians or teaching assistants, and students must use the most appropriate individual protections depending on the activity.

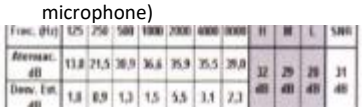
1. PPEs against the different types of risks are essentially designed to avoid chafing, punctures, cuts, and impacts, etc. Students are required to acquire the equipment to be able to work in the different laboratories.

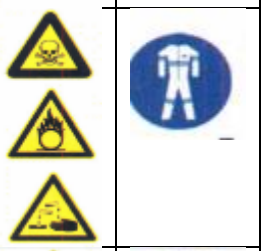
(Top row, left to right: head protection, eye protection, face protection
Bottom row, left to right: respiratory protection, ear protection, hand protection)

- **Helmets**: must be used whenever there is a risk of impact to the head.
- **Safety glasses:** must be used whenever mechanical chip removal work (grinder, milling machine, lathes, etc.), drilling, cutting materials with saws and welding is performed. The use of full frame types of glasses is recommended, since their design ensures total protection of the entire eye area, thus preventing the entry of particles from the sides or through the upper openings.
- **Hearing protectors:** There are several different models of earplugs, headphones, and helmets. They must be used in operations that, due to noise level or repetition throughout the day, may cause discomfort or hearing disorders.
- **Gloves**: must have abrasion, blade cut, tear, and puncture resistance. As additional requirements, they can offer impact cut and volumetric resistance.
- **Footwear**: Protective footwear must be worn in operations that entail a risk of blows due to falling objects, entrapment, etc.
- **Torso protection**: Personnel exposed to welding work must wear fireproof protective clothing and leather aprons, as well as personnel who perform oxyfuel cutting operations. This protection is intended to protect the user against small projections of molten metal and short-term contact with flames.

RISK FACTORS	DANGER	PPE ACCESORIES	SPECIFICATIONS	PROVISION	TYPE OF WORK	TYPE OF SIGNAGE	
						WARNING	OBLIGATION
MECHANICAL RISK	People falling from different heights	HARNESS	FULL BODY HARNESS MATERIAL: Polyamide, polyester, or nylon ANCHORAGE POINTS: Forged metal and a minimum of 4 distributed as follows: One (1) rear, one (1) ventral (which must not reach the worker's face in the event of a fall) and two (2) lateral points for positioning. HARDWARE: Buckles for adjustment and fastening to the body, which prevent the straps from slipping. SEAMS: Polyamide, polyester or nylon threads, of a different color than the bands to facilitate inspection. RESISTANCE: 2,500 Kg. STANDARD: ANSI Z359.1 Al0.32/EN358 /CE EN 361 NOTE Personal protective equipment will have Safety Equipment institute certification		ROUTINE/MINIMAL PPE/BASIC		
		LIFELINE	**LIFELINE WITH CUSHIONING** TAPE MATERIAL: Polyester, nylon, or polyamide. CARABINER TYPE: Super-fast, steel. DECELERATOR or ENERGY ABSORBER: 1m of polyamide, polyester, nylon or polyamide tape. RESISTANCE: 2,500 Kg ANSI STANDARD Z359,1 A10,14 NOTE: Personal protective equipment will have Safety Equipment Institute certification				
		CONNECTORS	**ANCHORAGE CONNECTORS** STANDARD: ANSI Z359,1 A10,14				
	Collisions with detached objects Fixed objects	SAFETY HELMET	**SAFETY HELMET** TYPE II: Impact energy attenuation, sharps penetration resistance CLASS E&G: Dielectric strength for 2,000 V Made of polypropylene, polyethylene or ABS Requires ventilation channels. that allows the assembly of hearing protector. Adjustment system to the diameter of the ratchet type head. STANDARD: ANSI Z89,1 2003 OSHA 29 CFR 1910.135 and 29 CFR 1926.100(b) NOTE: Personal protective equipment will have Safety Equipment Institute certification		ROUTINE/ MINIMAL PPE/BASIC		

RISK FACTORS	DANGER	PPE ACCESORIES	SPECIFICATIONS	PROVISION	TYPE OF WORK	TYPE OF SIGNAGE
MECHANICAL	Indirect electrical contact	DIELECTRIC SAFETY HELMET	**DIELECTRIC SAFETY HELMET** TYPE II: Impact energy attenuation, sharps penetration resistance CLASS E: Of dielectric material. Dielectric strength 20,000 Volts Made of polypropylene, polyethylene or ABS Requires ventilation channels that allow the assembly of a hearing protector as well as a chin strap (Only for work at height). Adjustment system to the diameter of the ratchet type head		NON-ROUTINE/MINIMAL PPE/BASIC	 
		GLOVES	**DIELECTRIC SAFETY GLOVES** Resistance to electrical testing with electrical voltage applied at 14,000 volts STANDARD ASTM F 2412 AND 2416/05.ASTM D120 Standard Specification for Rubber Insulating gloves, CE EN60903		NON-ROUTINE/MINIMAL PPE/BASIC	 
		SAFETY SHOES	**DIELECTRICAL SAFETY SHOES/BOOTS** Waterproof leather boots Non-slip and reinforced sole to prevent punctures Toecap: In thermoformed P.V.C material Resistance to electrical testing with electrical voltage applied at 14,000 volts in dry floor conditions. STANDARD ASTM F13, ANSI Z41 ASTM F2412 AND 2416/05.		NON-ROUTINE/MINIMAL PPE/BASIC	 
	Cuts and punctures	GLOVES	**HIGH SENSITIVITY PROTECTION GLOVE** Knitted glove, Lycra trimmed cuff, nitrile polyurethane impregnated palm For handling that requires great dexterity RESISTANCE: to abrasion, cutting, perforation and tearing STANDARD: CE EN420 EN388 Uses: maintenance, storage, manufacturing, materials handling		ROUTINE/ MINIMAL PEE/BASIC	 
		SAFETY SHOES	**SAFETY SHOES/BOOTS** Waterproof leather boots Non-slip and reinforced sole to prevent punctures Tip reinforced by steel capsule or thermoformed polyurethane Chemical resistant STANDARD: ASTM F13, ANSI Z41 ASTM F 2415-05, MI/75 C/75 EH steel toe rated and electrical hazard protection		ROUTINE-MINIMAL PPE-BASIC	 
	Particle Projection	IMPACT SAFETY GOGGLES	**UNIVERSAL FRAME STANDARD SAFETY GOGGLES** Universal frame glasses against perpendicular and lateral impacts, UV crack filter high speed impacts (120mfs) ANSI STANDARD Z87.1		ROUTINE/MINIMAL PPE/BASIC	 
		FACE PROTECTION	**FACE SHIELD** High performance facial protection, against splashes of liquids, chemicals, or particle impacts. 43 cm in length, providing better protection. ANSI STANDARD Z87.1		NON-ROUTINE/MINIMAL PEE/BASIC	 

RISK FACTORS	DANGER	PPE ACCESORIES	SPECIFICATIONS	PROVISION	TYPE OF WORK	TYPE OF SIGNAGE
PHYSICAL RISK	Extreme thermal contact	GLOVES WITH THERMAL RESISTANCE	GLOVE WITH THERMAL RESISTANCE RESISTANCE: heat due to contact, connective heat, radiant heat and flammability. STANDARD/Certificate CE EN 388 and EN 407 Category 2and EN 407 Category 2 Use: welding, inspection and contact with hot surfaces		ROUTINE/MINIMAL PPE/BASIC	 
	Exposure to thermal radiation, temperature, hot environments	WORK WEAR	WORK WEAR Long sleeve cotton shirt: 100% cotton or 88% cotton, 12% high resistance rayon. STANDARD: ANSI / ISEA 107 / 1999		ROUTINE/MINIMAL PPE/BASIC	
		EYE AND FACE PROTECTION	WELDING MASK Mask with 3 – 11 fixed tone electronic display Automatic dimming STANDARD: AS/NZS 1716 & 1337 / CE EN175		NON-ROUTINE	 
	Noise	AUDITIVE PROTECTORS	AUDITIVE PROTECTORS Table of attenuation at each octave band (NRR) Attenuation values at high (H), medium (M) and low frequencies (L). Conferred global attenuation or SNR value Perform training on the correct use and maintenance, as this is essential for the protector to be effective. All he instructions for use as well as limitations are always included in the manufacturer's information brochure that accompanies the equipment. STANDARD: ANSI S3.19-1974 AND ANSI S12.6		ROUTINE/MINIMAL PPE/BASIC	 
		AUDITIVE PROTECTORS WITH COMMUNICATION	AUOITIVE PROTECTORS WITH ACTIVE PROTECTION Table of attenuation at each octave band (NRR) Attenuation values at high (H:32dB), medium (M:29dB) and low frequencies (L:20d8), SNR: 31d8 Conferred global attenuation or SNR value. Perform training on the correct use and maintenance, as this is essential for the protector to be effective. a) Over-the-head harness (with/without microphone)  b) For helmet (with/microphone)  STANDARD: ANSI S3. 19-1974 and ANSI S12, 6		ROUTINE/MINIMAL PPE/BASIC	 

RISK FACTORS	DANGER	PPE ACCESORIES	SPECIFICATIONS	PROVISION	TYPE OF WORK	TYPE OF SIGNAGE
CHEMICAL RISK	Chemical exposure	**FULL BODY PROTECTION**	**WORK WEAR** Long-sleeved cotton shirt 100% cotton, or 88% cotton, 12% high resistance nylon 100% COTTON or 88% cotton - 12% high resistance nylon ANSI/ISEA STANDARD 107-1999		**ROUTINE/MINIMAL PPE/BASIC**	
		FULL BODY PROTECTION	**DISPOSABLE WORK WEAR** Clothing for use during sampling activities, work in confined spaces, work involving handling of hazardous chemicals. Barrier against dry and wet particles, liquid products and aerosols.		NON-ROUTINE/ MINIMAL PPE/BASIC	
		PARTIAL BODY PROTECTION	**APRON FOR HANDLING CHEMICALS** PVC plastic apron		**NON-ROUTINE/ MINIMAL PPE/BASIC**	
		EYE PROTECTION	**GOGGLES** Monoglasses for protection against fine dust or splashes of chemical products must have indirect ventilation and anti-fog UV filter High speed impacts (120m/s) ANSI Z87 .1 or CE EN 166 STANDARD NOTE: For the case of oxycutting/sole activities		**ROUTINE/MINIMAL PPE/BASIC**	
		RESPIRATORY, FACIAL AND EYE PROTECTION	**FULL FACE MASK** High-performance facial protection against splashes of liquids, chemicals, or particle impacts FILTERS FOR ORGANIC PRODUCTS AND INORGANIC VAPORS TYPE A2B2 STANDARD: ANSI Z87, 1		**NON-ROUTINE/MINIMAL PPE/BASIC**	
	CHEMICAL EXPOSURE	**RESPIRATORY PROTECTION**	**FREE MAINTENANCE RESPIRATORS** With capacity to filter dust and liquid particles without oil **HALF FACE MASK** Half-mask face piece made of elastomer, thermoplastic with easy-adjust elastic straps STANDARD: NIMOSH 42CFR8 ANSI Z88.2		**ROUTINE/MINIMAL PPE/BASIC**	
		GLOVES FOR HANDLNG OF CHEMICALS	**GLOVE FOR HANDLING CHEMICAL PRODUCTS** Nitrile glove. Long chemical resistant glove. Good grip both dry and wet. For handling chemical products. STANDARD: CE EN420 EH388		**ROUTINE/MINIMAL PPE/BASIC**	

8. SIGNAGE

The signage of each laboratory must be respected, as it warns of the existence of a risk, yet does not eliminate it or protect against it. Failure to acknowledge signage may result in being placed in harm's way.

(Safety colors used in signage. First row, top right to left: safety color, contrast color, symbol color, geometric shape, meaning. Second row, left to right: red, white, black, red circle, prohibition or obligation. Third row, left to right: yellow, black, black, yello triangle, Danger Warning. Fourth row, left to right: Green, white, white, green rectangle, rescue instructions and others. Fifth row, left to right: blue, white, white, blue filled circle, prohibition or obligation)

1. Signs

Learn emergency signage.

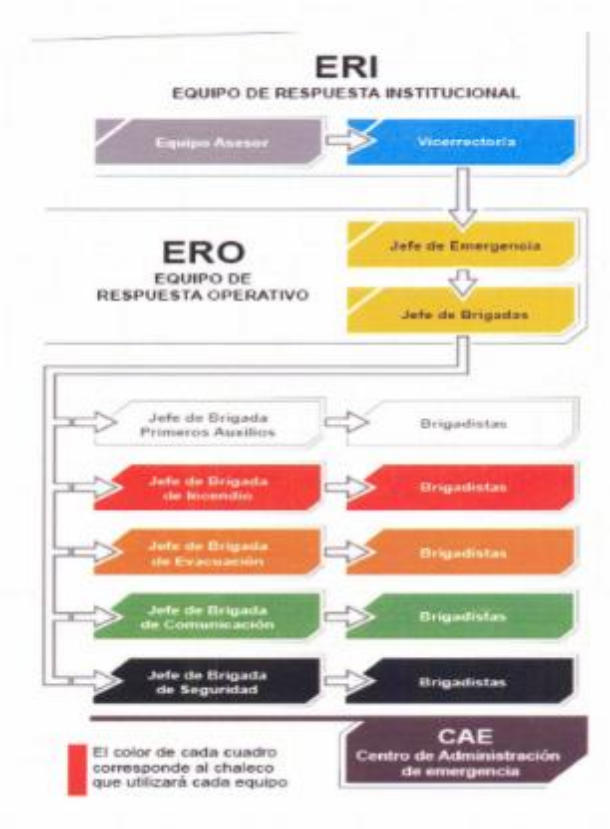
(Legend from top left to right: Exit, normal route, routine exit, emergency route, emergency exit. Bottom left to right: Extinguisher, fire hydrant, alarm button, emergency shower, emergency fountains for eye washing)

(Legend from left to right, top row: explosive, flammable, oxidizing, pressurized gas, danger to the environment; left to right, bottom row: toxic, corrosive, irritant, danger to health)

Safety signage {From left to right: Warning (Attention: Risk of splatters, risk of entrapment), Mandatory (Use of mask is mandatory, use of gloves is mandatory, Prohibition (Stop: Authorized personnel only, illegible), Emergency (Emergency eye washing fountains, alarm button)}

9. CASES OF EMERGENCIES.

UPS has emergency brigades that will help provide support in cases of incidents within the Institution.



ERI
INSTITUTIONAL RESPONSE TEAM

TEAM ADVISOR → VICE PRESIDENT →
ERO (Operative Response Team)
Head of Emergency → Head of Brigades

Head of Brigades, first aid → Brigade members
Head of Fire Brigade → Brigade members

Head of Evacuation Brigade → Brigade members

Head of Communication Brigade → Brigade members

Head of Security Brigade → Brigade members

CAE (Emergency Management Center)
The color of each block corresponds to the vest that each team will wear.

10. LIST OF DANGERS

1. MECHANICAL Slips and/or falls at the same level, falls from unhealthy postures, excessive efforts, falls from heights, falling tools, materials, etc. from height, dangers associated with lifting or manual handling of tools, materials, etc. Dangers from machinery and equipment (related with mounting, putting into service, functioning, maintenance, modification, repair and dismantling). Dangers associated with vehicles (transportation to locations, buses and external routes, surface.	**6. ERGONOMIC** Unhealthy postures, excessive efforts, inadequate consideration of the human anatomy of the arm, hand or leg-foot, inadequacy of machinery to human characteristics and capacities, work-related disorders of the upper limbs resulting from frequent tasks, baseboards, railings or inadequate protections on stairs, inadequate workstation design, manual handling and lifting of objects, repetitive stress, fatigue and/or stress, Portuguese static load and other related factors.
2. ELECTRICAL Direct electrical contact, indirect electrical contact, static electricity and other related types of contact.	**7. FIRE AND EXPLOSION** Gas fire and explosion, fire and explosion of liquids, fire and explosion of solids, combined fire and explosion electrical and other related fires.
3. PHYSICAL Noises, inadequate lighting, thermal load, (thermally inadequate environment, for example too hot), vibrations and	**8. BIOLOGICAL** Viruses, fungi, bacteria, by food, by animals (stings or bites), by plants (toxins or allergies) and others.

others.	
4. RADIATION Strong ionizing radiation, sources of non-ionizing radiation, lasers, machines that use high-frequency electromagnetic fields and others.	**9. PSYCHOSOCIAL** Stress, mental overload, lack of concentration, monotony, repetitiveness, attention to the public and others.
5. CHEMICAL SUBSTANCES Substances that can be inhaled, damage vision, cause harm upon contact or through absorption through the skin, substances that can cause harm if swallowed (i.e., by entering the body by mouth), vapors, dusts, fumes, gases, mists and others.	**10. NATURAL** Floods, lightning strikes, hurricanes, earthquakes, electrical storms, taken and others.
	11. OTHER HAZARDS Contractor activities, contact burns at high temperatures, Assault, physical aggression, social convulsions, seizure of land, Threat of

11. BIBLIOGRAPHY

Information sources

ILO International Labor Organization

National Institute of Work Safety and Hygiene (INSHT)

Ibero-American Social Security Organization (OISS).

I CERTIFY:

That the document "Industrial Hygiene and Safety Manual for students at Universidad Politécnica Salesiana" was approved by the High Council, through Resolution No. 112-06-2016-06-22 dated June 22, 2016.

(signatura: illegible)

Ana Maria Reino Molina

GENERAL SECRETARY

(seal: Universidad Politécnica Salesiana, General Secretary)