

SAFE WORKING PRACTICES IN THE LABORATORY



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1. INTRODUCTION

Occupational health and safety (OHS) combines the knowledge, procedures and measures to ensure a healthy and safe workplace, which is a condition for the successful performance of work by an employee during his/her working life.

Health and safety at work must be considered when planning the working environment (for example, laboratories), when designing all equipment and when arranging workplaces and other premises for individual processes.

Chemicals surround us everywhere: in the workplace, in the urban environment and in nature. We need them for a variety of purposes in engineering, science, food, agriculture and healthcare. When asked how and when we know enough about a substance for its safe use, we might quickly find ourselves embarrassed. Some laboratory tests can lead to accidents or injuries at work if they are not performed properly. The prevention of such events is the responsibility of all employees of the Jožef Stefan Institute (including contract workers, school pupils, students and trainees).

The Occupational Health and Safety Act ZVZD-1 (Official Gazette of the Republic of Slovenia, No. 43/2011), which is supplemented by numerous executive regulations issued on its basis and other laws, regulates the area of ensuring healthy and safe work practises, specifically:

- employees exposed to individual risk factors
- special categories, e.g., vulnerable employees (young employees, older employees, pregnant employees and young mothers, and the disabled - according to the Employment Relationships Act),
- employees who use specific equipment as part of their work,
- employees in specific working environments.

2. BASIC PRINCIPLES OF HEALTH AND SAFETY

- avoiding dangers;
- assessing risk;
- managing the source or sources of the hazard;
- adapting work to the individual through the appropriate design of the workplace and working environment, workplaces, work and technological procedures, the choice of work and personal protective equipment, and work and production methods, especially the elimination of monotonous work and conditions with a forced work rhythm and other unhealthy circumstances (often referred to as the humanisation of work);
- adapting to technical progress;
- replacing the dangerous with danger-free or less dangerous options;
- developing a comprehensive safety policy that includes technology, work organization, working conditions, interpersonal relationships and working-environment factors;
- giving priority to collective security measures over individual ones;
- giving the appropriate instructions and information to employees.



3. STATEMENT CONCERNING SAFETY WITH A RISK ASSESSMENT

According to the Occupational Health and Safety Act ZVZD-1, a safety statement and an associated risk assessment is the obligation of every employer (in our case it is the Jožef Stefan Institute). The aim of the risk assessment is to ensure, in advance, that no employee will be injured or become ill as a result of work, because of the implementation of the appropriate preventive measures. The risk assessment determines whether the work process is associated with hazards and, if there is a hazard, whether everything necessary has been done to ensure that the risk due to the existing hazard is sufficiently small or considered acceptable. A safety statement, together with a risk assessment, is thus the obligation of every employer, regardless of the size of the company or institution, and represents the basis of the employer's programme for ensuring health and safety at work in written form. With it, the employer clearly states that it is aware of its responsibilities in relation to ensuring health and safety at work, as well as the possible consequences if the employer does not comply with the regulations. The safety statement is thus a mechanism for the employer to carefully investigate what might endanger the health and safety of its employees. Its purpose is to eliminate or reduce residual hazards with as few resources as possible. The risk assessment is an ongoing process to achieve improvements in safety and the security culture in the company or institute. Therefore, it needs to provide preventive safety measures as well as being frequently updated.

4. SAFE WORKING PRACTICES IN THE LABORATORY

Only people considered to be medically fit (after a medical examination and with a medical certificate issued by an occupational medicine practitioner), trained in occupational hazards and familiar with the properties of chemical substances, the consequences of reactions, fire and explosion hazards and first-aid measures (for poisoning, burns, and electric shock) are allowed to work in a laboratory.

There can be several sources of potential hazard in a laboratory (broken glass, knives and cutting tools, foreign bodies that can affect the eyes, hot surfaces, the incorrect lifting and carrying of loads and electricity), as well as specific hazards, such as hazardous chemicals, nanoparticles, radiation sources (ionized and non-ionized, X-ray, etc.) and uncontrolled chemical reactions. The most common injuries when working in a laboratory are cuts, impacts, and damaged joints or sprains when walking and carrying loads.

4.1 Responsibilities of employees regarding safe working practises in a laboratory

The following are the responsibilities of employees (including students, interns, scholarship holders, etc.) with regards to safe working practises at the Institute:

- before starting work in a laboratory, the person must be instructed in safe working practises, and then sign a statement that he/she is familiar with the conditions, instructions and orders for working safely in the laboratory,
- he/she must pass a test of knowledge of occupational safety and fire protection before commencing work,
- he/she must follow the instructions of superiors and other instructions relating to working safely,
- he/she must use and maintain any necessary personal protective equipment,



- he/she must be able to provide first aid,
- he/she must have knowledge of accident rescue and firefighting.

The manager is responsible for safe working practises (the employer or the head of the organizational unit is responsible for all areas of the working process, including safety within his/her department). Each individual appointed by the head of the organizational unit, e.g., as the head of the laboratory, takes care of the employees who are subordinate to him or her. It is his/her duty to inform any new employee (including scholarship holders, students, trainees, etc.) of the potential for workplace injuries and health risks, as well as measures for working in safety. It is the duty of the new employee (including scholarship holders, students, trainees, etc.) to follow and implement these instructions. In particular, all staff of the Institute (including fellows, students, trainees, etc.) must:

- use work equipment and other facilities, including safety equipment, correctly, in accordance with the instructions of the manager;
- use personal protective equipment (PPE) correctly in accordance with the instructions of the manager in accordance with the purpose of the PPE;
- immediately inform the manager of any deficiencies, dangers, malfunctions or other problems that could endanger the health and safety at work of themselves or of others;
- work with the manager until a safe working environment and safe working conditions are established.

Unauthorized persons must not enter a laboratory on their own. Visitors must be escorted and adequately protected, making use of PPE. Children may only be present in the laboratory when accompanied by qualified JSI staff.

4.2 After working hours

After the work process is completed, the work surfaces must be cleaned. Hazardous substances must be properly labelled and stored in the appropriate places (e.g., chemical cabinets). It is necessary to ensure a safe environment in the laboratory, i.e., close water inlets, gas taps, valves on gas cylinders, turn off electrical switches, etc. For each laboratory, the operating unit (OU) manager must designate an employee who is responsible for verifying the correct implementation of all safety measures.

During periods when employees are not present (night work, weekends, holidays, etc.), only equipment for emergency experiments may operate, and with the permission of the OU manager. The person conducting the experiment must inform the general security coordinator (Jože Matko) in writing. He will inform the on-duty security service. The on-duty security guards must be acquainted with the special list of work equipment that is normally in operation and the special features of this equipment or laboratory space (action, information, contact person).

4.3 Work in the laboratory outside working hours

In order to work in a laboratory where hazardous substances are located or used and which poses a potential danger (biological, radiological, chemical, lasers, etc.), the heads of the OU, heads of laboratories or other responsible persons (appointed by the head of the OU) in accordance with the conventions related to safety, must issue a **Permit to Work in a Laboratory Outside Working Hours** (Annex p. 26).



4.4 Laboratory regulations

The basic rules of safe working in an individual JSI laboratory are written in the Laboratory Regulations. These laboratory rules apply to all laboratories at the JSI and to all employees located in the laboratory (researchers, students, cleaners, visitors, etc.). The provisions of the laboratory regulations must be known to the employees and must also be displayed in a visible place in each laboratory.

The laboratory regulations determine the general rules for work in the laboratory as well as specific instructions relating to an individual laboratory. All laboratory users must follow the instructions (either laboratory rules, written instructions for safe working or only oral instructions from the manager, mentor or authorized person for safe working in the laboratory). Employees may only enter the laboratory with the prescribed personal protective equipment and following the prescribed instructions for the individual laboratory.

A laboratory often contains a lot of harmful substances. To prevent these substances from entering the body, it is important to consider the following:

- Always wash your hands thoroughly after each session in the laboratory. Never touch your face or objects with contaminated hands.

- **The following are not allowed in the laboratory:**
 - o eating and drinking,
 - o smoking (this applies to all JSI premises),
 - o the storage of food and beverages in laboratory refrigerators,
 - o the storage of chemicals in food packaging,
 - o pipetting with the mouth.

4.5 Hazards in the laboratory

Laboratories contain many hazardous substances in small quantities. The main hazards in a laboratory are:

- toxic chemicals,
- flammable reagents,
- cryogenic materials,
- biological materials,
- compressed gases,
- radioactive substances,
- dangerous equipment.

Laboratory equipment (especially if handled carelessly) can cause fire, burns, electric shocks, cuts and injuries. Other health risks come from toxic substances that are routinely used in chemical and other laboratories. It is important to remember that any flammable substance can be explosive under certain conditions.

Despite the multitude of chemicals and the wide variety of equipment used in laboratories at the JSI, most injuries in the JSI laboratories result from glassware and sharp objects like needles.



4.6 Safe handling of chemicals

General rules for handling chemicals:

- Always read the Safety Data Sheet before handling any chemicals.
- Always remember that a mixture can be at least as dangerous as its components.
- Never use unlabelled chemicals.
- Always read labels carefully to make sure you have chosen the right chemical. Read a label three times: once, when you take it, once, just before use and once, after use. Compare the name, the formula and the concentration on the label with the instructions for performing the exercise or the protocol.
- Always label any packaging in which you save a sample immediately (and preferably before you use it).
- Never combine substances unless specifically instructed to do so (always follow the instructions on the compatibility of chemicals).
- **Never taste chemicals. Pipetting by mouth is prohibited.**
- Always avoid contact with the skin and eyes when working with chemicals.
- Always add the acid to the water, never add the water to the acid.
- Never pour water into chemicals heated above 90 °C.
- Always report a broken mercury thermometer immediately to the laboratory manager and then thoroughly ventilate the room.
- Before using a Bunsen burner, always check that it is in a safe position and that there are no flammable substances in the vicinity.
- Never pour chemicals into the sink or down the drain.
- Never remove chemicals from a laboratory without the knowledge of the laboratory manager.
- Never place chemicals close to the edge of a work surface or a shelf.
- Never expose chemicals to sources of heat, including room radiators and the sun.
- Never store chemicals in food packaging.
- Always use a safety carrier to transport bottles.
- Always assume that any unknown chemical is hazardous.

4.7 Safe handling of glassware and other sharp objects

Most damage to glassware occurs due to its improper use. When glass breaks, the sharp edges of the pieces represent an extremely high risk of a resulting cut. When working with glassware, always avoid rapid temperature changes. The glassware should be heated gradually and evenly over a large area. After heating, the glassware should be allowed to cool slowly. When handling hot glassware, always use the appropriate safety gloves.

General rules for the safe handling of glassware:

- Never use cracked or scratched glass. A defect in glass almost always starts on the surface. Glassware with notches and scratches must be immediately removed from use.
- Always use specially designed gloves when assembling or disassembling laboratory glassware.



- Never force glassware connections. In such cases, always ask for help from a person in the lab.
- After heating, glassware must be allowed cool slowly (to avoid internal stresses and subsequent cracking).
- Never heat closed glass containers.
- Remember that only special glassware can be evacuated (or be subject to a reduced pressure).
- Always hold a bottle with both hands when carrying it.
- Always wear rubber gloves when giving glass special cleaning.

Sharp objects represent a particular risk of injury in biochemistry (as well as in other laboratories), as they can break the skin and mucous membranes, allowing micro-organisms to enter the body. The risk is much greater if the objects are infected with dangerous biological agents.

Risk-mitigation measures for employees exposed to biological agents who also use sharp objects in their work include, general tissue-protection measures, vaccination and chemoprophylaxis, accident recording and prevention, accident measures and health monitoring.

The most common causes of incidents are:

- a perforation with a needle (during work, improper disposal and transport),
- covering a used injection needle or other sharp object,
- a cut to the skin with other sharp objects (e.g., a scalpel),
- splashing or spraying damaged skin or mucous membranes with blood

For safe work practises when handling sharp objects, the Instructions for the Safe Handling of Sharp Objects must be applied (Appendix p. 27).

4.8 Working safely with electrical appliances and equipment

Many pieces of electrical equipment and devices that transmit or use electricity are found in workplaces, including laboratories. Electrical equipment is now often used for heating, cooling, mixing, pumping, as well as for most physical measurement instruments. To ensure a safe environment when working with electricity, all electrical equipment must be regularly inspected and maintained. This electrical equipment must be installed in such a way that there is no danger of water or chemicals being split on the equipment. In the event that water or any other chemical is spilled on the electrical equipment, the appliance must be switched off immediately. It must not be used again until authorized by a responsible person.

A person experiences an electric shock when a large enough electrical current flows through the body or through a part of the body. This most often occurs when there is:

- direct contact with an electrically conductive part (phase conductor, part of an electrical device or installation) that is at a sufficiently high voltage;
- indirect contact with exposed conductive parts, which is most often due to a failure of the insulation.

A current of 25 mA can cause damage to the respiratory system; a current above 50 mA can lead to a loss of consciousness; a current of 100 mA will lead to death in most cases. The consequences also



depend on whether the object that is at a high voltage is only touched (with the hand being withdrawn immediately), or whether it is held and the current flows through the heart.

General rules for working with electricity:

- Always use an undamaged electrical extension cord, and only when absolutely necessary, and for as short a time as possible. Always remove it immediately after each use.
- Before using electrical equipment, always check that the power cable is undamaged (make sure that the insulation is not abraded or missing and that the wires are not damaged).
- Always report any problems with electrical devices and installations immediately to the head of the laboratory or the responsible person.
- Always make sure that the work surface under electrical equipment is dry (it must never be wet or even damp).
- Always make sure there are no flammable substances nearby.
- Always ensure that all switches on an appliance are in the "OFF" position before connecting it to the electrical socket. This will prevent any sparking as the plug is inserted.
- Before cleaning or replacing components, always make sure that the switch on the appliance is in the "OFF" position.
- Never handle electrical equipment with wet or damp hands, and never stand on a wet floor.
- Never pull the plug out of the socket forcefully.
- After finishing work, always check that all electrical devices are switched off.

Repairs to an electrical installation must only be carried out by qualified personnel. In the event of a failure or a problem with a piece of electrical equipment, you must immediately notify the head of the laboratory or the responsible person.

4.9 Use of personal protective equipment (PPE)

Personal protective equipment (PPE) is any equipment that an employee wears, holds or otherwise uses at work in such a way as to protect him/her from one or more risks to his/her health and safety. PPE also includes any equipment used to protect employees from injuries and to ensure their health. Working without the proper PPE is forbidden if the harmful effects or dangers arising from the work process cannot be eliminated using technical or organizational protective measures. PPE that is legally prescribed (Rules on Personal Protective Equipment used by employees at work) (Official Gazette of the Republic of Slovenia, No. 89/99, 39/05 and 43/11 - ZVZD-1) must be used for its intended purpose. PPE must meet the criteria of the Rules on Personal Protective Equipment (Official Gazette of the Republic of Slovenia, No. 29/05, 23/06, 17/11 - ZTZPUS-1, 76/11 and 33 / 18).

PPE designed to protect the employee from exposure to hazardous substances and biological agents does not completely prevent them; it only reduces their concentration ingested into the body to a safe level during the working life of the employee.

4.9.1 Protective eyewear (Safety glasses, safety goggles, etc.)

Protective eyewear protects the eyes from mechanical and optical hazards as well as from chemicals and other liquids. We distinguish several types of protective eyewear:

- goggles with side protection,
- close-fitting panoramic safety glasses.



When working in the laboratory it is recommended to wear glasses with side protection during working hours, and for those people who wear corrective glasses or contact lenses, the use of panoramic safety glasses is mandatory. The use of panoramic safety glasses or a face shield is mandatory when handling corrosive substances. When working with lasers, special glasses are required (depending on the class of laser - see the manual **Artificial Optical Radiation** on the IJS Health & Safety Unit (Služba za varnost in zdravje pri delu (SVZD) website).

4.9.2 Protective face masks

A protective face mask must have an appropriate protection factor with respect to the properties of the dangerous substance or the relevant contamination (solid particles, liquid, vapour or gas), the concentration of the dangerous substance and the time of exposure. The protective face mask must also be of an appropriate size and must fit snugly against the employee's face.

4.9.3 Protective laboratory coats

The laboratory coat must be appropriate to the category of resistance with respect to the properties of the materials being used, with long sleeves and reaching to, or over, the knees. The laboratory coat must close with press studs (for quick removal in the case of an accident). A white laboratory coat is recommended, which must be of the appropriate size.

4.9.4 Protective gloves

Protective gloves are defined as personal protective equipment that protects the hands from hazards. In addition to the hands, they can also cover the arm up to the elbow. The most important factor when choosing gloves is their intended use and the level of protection required. Protective gloves must always be checked for suitability before use (purpose of use, possibility of material defects, damage, cracks, etc.).

Protective gloves are categorised in terms of:

- the type of work (heavy work, detailed work, etc.)
- the type of hazard (cuts, burns, chemicals, etc.)
- the size.

When working with protective gloves, follow the *Instructions for Safe Work - Use of Protective Gloves* (JSI SVZD website).

4.9.5 Protective footwear

The use of open-toe shoes (slippers, sandals, etc.) is not permitted in a laboratory where hazardous substances are present. Footwear must protect the entire foot and allow a firm and safe step (i.e., a non-slip sole). Shoes with high heels and slippery soles are not suitable for laboratory work..

4.9.6 Maintenance of personal protective equipment (PPE)

PPE requires regular maintenance and cleaning. Torn laboratory coats are not permitted. Protective eyewear must be cleaned regularly. This can be done with water and then wiped while still wet with a cloth that leaves no traces of material on the eyewear. When handling the eyewear, you must ensure that the surfaces are not scratched. Damaged eyewear (e.g., broken lens, damaged frame) must not be used.

It is forbidden to carry contaminated PPE outside the laboratory.



5. PROCEDURES IN THE EVENT OF EMERGENCIES

In the event of an accident in the laboratory or other extraordinary event, it is necessary to act in accordance with the published documents governing such events.

At the JSI, the following documents are used in the event of an emergency:

- o **Reminder in the event of an emergency at the JSI** - applies to the entire JSI
- o **Contingency plan in the event of an emergency** - valid for the nuclear facility of the TRIGA research reactor, in other laboratories or JSI facilities where radiation sources are used, and in other laboratories or JSI facilities where there are no radiation sources, but which are located within the Reactor Center.
- o **Contingency plan for an emergency or accident at work with genetically modified organisms (GMOs)** - valid for specified biological laboratories of the JSI.

Relevant parts of these documents must be kept in an accessible and visible location in the laboratory. Each employee must be familiar with the procedures in the event of an emergency, relating to a specific job.

For laboratory work, an extraordinary event is any event that results in:

- an injury at work, a medical illness or an occupational disease,
- a fire and/or explosion,
- damage to equipment,
- material damage,
- a danger to the environment.

Due to the increased probability of extraordinary events occurring in a laboratory, at least two employees must always be present in the laboratory. Employees' presence in a laboratory must be recorded.

A “near accident” is an event that could have led to an emergency. These events are certain irregularities in the work process that did not cause injury to the employee or material damage (e.g., the dropping of a gas cylinder without damage to the gas cylinder or its surroundings). The head of the laboratory or the responsible person must be immediately informed about near accidents.

The most common injuries in laboratories where first aid must be provided are:

- cuts,
- burns,
- spray of corrosive substances.

The procedures for providing first aid for the above cases are:

- **CUTS:** The site of the incision must be cleaned and appropriately bandaged
- **BURNS:** Remove the heat from the burn using cold running water. Never apply any ointments.
- **SPRAY OF CORROSIVE SUBSTANCES:** In case of corrosive substances contacting the skin or mucous membranes, rinsing with water as soon as possible is extremely important. In the case of splashes in the eyes, rinse the eyes with an eyewash bottle or under the tap for at least 15



minutes. When the corrosive substance is on the skin, rinse the body in a shower. The possibility of splashes or spays in the eyes is prevented by using tight-fitting panoramic safety glasses or a face shield. Protective gloves and laboratory coats must be made of acid-resistant material.

For other injuries, the procedures for providing first aid are described in the General Part of the OHS (the IJS Health & Safety Unit (Služba za varnost in zdravje pri delu (SVZD) website).

5.1 General measures for preventing accidents

As specified in the introduction, only medically fit and trained people are allowed to work in a laboratory.

Contractors, maintenance staff and other workers employed in the laboratory only occasionally must be made aware of how to conduct their work safely and be reminded of the individual hazards to which they are exposed and the safety measures that they must comply with in their work.

All work in the laboratory must be carried out with the utmost care and with an awareness that any inaccuracy, carelessness and lack of knowledge relating to equipment and the properties of substances might lead to an accident.

New experiments should be carried out after an initial small experiment and taking into account all the safety measures. We do not try any substances in the laboratory.

Any spillages or breakages must be cleaned up or repaired immediately, using the correct measures and procedures. Substances in containers must never be left unlabelled. Before using any substance, carefully read the data sheet on the substance and if you have the slightest concern, consult with collaborators or the head of the laboratory.

In all workplaces we must pay attention to cleanliness and order, and use only the amounts of substances needed for each work process.

After completing the work, it is necessary to check the operation of the devices and, if necessary, switch them off (for example, heaters, lit burners, open gas and water taps, etc.).

Heads of departments or the heads of laboratories are obliged to carry out periodic inspections and tests of working equipment and measurements of the working environment. These activities must also be carried out when changing the work process or the working environment.

The arrangement of laboratories and equipment must comply with the applicable technical guidelines for laboratories. Planning and reviewing the condition of an individual laboratory from the point of view of ensuring health and safety at work must comply with the document, ***Guidelines for Ensuring Health and Safety in Chemical Laboratories; Guide to Laboratory Control*** (the IJS Health & Safety Unit (Služba za varnost in zdravje pri delu (SVZD) website).



6. HAZARDOUS CHEMICALS

Hazardous chemicals are defined on the basis of the Chemicals Act (Official Gazette of the Republic of Slovenia, No. 110/03 - official consolidated text, 47/04 - ZdZPZ, 61/06 - ZBioP and 16/08) and REGULATION (EC) no. 1272/2008 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 16 December 2008 on the classification, labelling and packaging of substances and mixtures, substances and preparations classified in one of the hazard classes (<https://eur-lex.europa.eu/legal-content/SL/TXT/HTML/?Uri=OJ:L:2008:353:FULL&from=EN>).

6.1 Classification of hazardous chemicals

The classification, labelling and packaging of hazardous chemicals in the European Union are based on a system that ensures that the hazardous properties of chemicals are identified and all users are informed about their safe use and their effects on health and the environment.

Hazardous chemicals are classified into the following hazard classes:

- A. Explosive chemicals are solid, liquid, pasty or gelatinous chemicals that can react exothermically even in the absence of air/oxygen, releasing very rapidly gases which, under certain conditions, detonate, ignite rapidly or explode due to heating, and increasing in pressure if are spatially limited;
- B. Oxidizing chemicals are chemicals that cause a strong exothermic reaction when in contact with other substances (mainly flammable substances);
- C. Highly flammable chemicals are liquid chemicals with an extremely low flash point and a low boiling point, and gaseous chemicals that are flammable when in contact with the air at normal temperature and pressure;
- D. Highly flammable chemicals are:
 - chemicals that can heat up when in contact with the air and ignite on their own at normal temperature and pressure without the supply of external energy,
 - solid chemicals that can ignite quickly after a brief contact with an ignition source and then burn, and are consumed even after the source has been removed,
 - liquid chemicals that have a very low flash point,
 - chemicals that, in contact with water or its vapour, release highly flammable gases in dangerous quantities;
- E. flammable chemicals are chemicals that have a low flash point;
- F. very toxic chemicals are chemicals that, if ingested, inhaled or passed through the skin in very small quantities, cause death or acute or chronic damage to a person's health;
- G. toxic chemicals are chemicals that, if ingested, inhaled or passed through the skin, cause death or acute or chronic damage to a person's health in small quantities;
- H. Harmful chemicals are chemicals that, if ingested, inhaled or passed through the skin, can cause death or acute or chronic damage to a person's health;
- I. corrosive chemicals are chemicals that can damage or destroy living tissue if they come in contact with it;
- J. irritant chemicals are chemicals that are not corrosive but can cause inflammation of the skin or mucous membranes in the event of short-term, prolonged or repeated contact;



K. Hypersensitivity chemicals are chemicals that can cause a hypersensitivity reaction when inhaled or passed through the skin, resulting in significant adverse effects upon continued exposure to this chemical;

L. carcinogenic chemicals are chemicals that, when ingested, inhaled or passed through the skin, can cause cancer or increase the incidence of cancer;

M. mutagenic chemicals are chemicals that, if ingested, inhaled or passed through the skin, can cause inherited genetic defects or increase the frequency of their occurrence;

N. Reproductive toxicants are chemicals that, when ingested, inhaled or passed through the skin, can cause or increase the incidence of non-hereditary adverse effects in offspring and/or adverse effects on male or female reproductive functions or abilities;

O. Environmentally hazardous chemicals are chemicals that, when released into the environment, can cause or are likely to cause immediate or long-term danger to one or more components of the environment.

7. LABELLING OF HAZARDOUS CHEMICALS



7.1 Danger signs (pictograms)

Danger signs are black signs on a white background, bordered with red. There are nine danger signs (pictograms). They are unambiguous in their meaning, and appear in combination with various descriptions, definitions and explanations..




We divide them into:

- a) signs for physical danger,
- b) signs for health hazards,
- c) signs for danger to the environment .





Physical hazards

Pictogram	Hazard class and category
 GHS 01: Explosive	Unstable explosives Explosives, divisions 1.1, 1.2, 1.3, 1.4 Self-reactive substances and mixtures, types A, B Organic peroxides, types A, B
 GHS 02: Flammable	Flammable gases, hazard category 1 Flammable aerosols, hazard categories 1, 2 Flammable liquids, hazard categories 1, 2, 3, 4 Flammable solids, hazard categories 1, 2 Self-reactive substances and mixtures, types B, C, D, E, F Pyrophoric liquids, hazard category 1 Pyrophoric solids, hazard category 1 Combustible solids, hazard category 3 Combustible liquids, hazard category 3 Self-heating substances and mixtures, hazard categories 1, 2 Substances and mixtures, which in contact with water, emit flammable gases, hazard categories 1, 2, 3 Organic peroxides, types B, C, D, E, F




 GHS 03: Oxidising	<p>Oxidizing gases, hazard category 1 Oxidizing liquids, hazard categories 1, 2, 3 Oxidizing solids, hazard categories 1, 2, 3</p>
 GHS 04: Compressed gases	<p>Gases under pressure: compressed gases; Liquefied gases; Refrigerated liquefied gases; Dissolved gases</p>
 GHS 05: Corrosive	<p>Corrosive to metals, hazard category 1</p>

Health hazards

Pictogram	Hazard class and category
 GHS 06: Toxic	<p>Acute toxicity (oral, dermal, inhalation), hazard categories 1, 2, 3</p>
 GHS 05: Corrosive	<p>Skin corrosion, hazard categories 1A, 1B, 1C Serious eye damage, hazard category 1</p>
 GHS 07: Harmful	<p>Acute toxicity (oral, dermal, inhalation), hazard category 4 Skin irritation, hazard categories 2, 3 Eye irritation, hazard category 2A Skin sensitization, hazard category 1 Specific target organ toxicity following single exposure, hazard category 3 Respiratory tract irritation Narcotic effects</p>
 GHS 08: Health hazard	<p>Respiratory sensitization, hazard category 1 Germ-cell mutagenicity, hazard categories 1A, 1B, 2 Carcinogenicity, hazard categories 1A, 1B, 2 Reproductive toxicity, hazard categories 1A, 1B, 2 Specific target organ toxicity following single exposure, hazard categories 1, 2 Specific target organ toxicity following repeated exposure, hazard categories 1, 2 Aspiration hazard, hazard category 1</p>



Environmental hazards

Pictogram	Hazard class and category
 GHS 09: Environmental hazard	Acute hazards to the aquatic environment, hazard category 1 Chronic hazards to the aquatic environment, hazard categories 1, 2 Environmental toxicity, hazard categories 1, 2

"Hazard class" means the type of physical hazard, health hazard or environmental hazard. Hazardous chemicals are classified into "hazard categories" in each hazard class, which means a further breakdown according to the criteria within each hazard class, which determines the severity of the hazard.

The number 1 represents the greatest danger. For example, reproductive toxicity means: Category 1A: Substances known to be toxic for reproduction to humans. Category 1B: Substances presumed to be toxic to humans. Category 2: Substances suspected of being toxic to humans for reproduction.

A more detailed classification of hazardous chemicals by classes and categories is given in **EC Regulation no. 1272/2008 on the classification, labelling and packaging of substances and mixtures** (<https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32008R1272&from=EN>).



7.2 Hazard statements and precautionary statements

Hazard statements: text relating to a hazard class or category that describes the type of hazard caused by a hazardous substance or mixture and, if applicable, the hazard level.

The label must include the relevant hazard statements according to the classification of the dangerous substance or mixture, marked with the letter H (meaning hazard) and a three-digit number.

Example:

- H203 - Explosive; risk of fire, shock wave or debris.
- H226 - Extremely flammable liquid and vapour.
- H271 - Can cause fire or explosion; strong oxidizing substance.
- H304 - Can be fatal if swallowed or enters airways.

- EUH 205 - Contains epoxy components. Can produce an allergic reaction.
- EUH 210 - Safety data sheet available on request.

Precautionary Statements: text describing the recommended measure to reduce or prevent adverse effects resulting from exposure to the hazardous substance or mixture due to its use or disposal.

The label includes the appropriate precautionary statements marked with the letter P (meaning precaution) and a three-digit number.

Example:

- P202 - Do not use until all safety precautions have been read.
- P234 - Store only in the original container.
- P280 - Wear protective gloves / protective clothing / eye protection / face protection.
- P322 - Special precautions (see on this label).
- P406 - Store in a corrosion-resistant container /... with a resistant inner lining.
- P403 + P235 - Store in a well-ventilated place. Store in a cool place.
- P371 + P380 + P375 - In the case of large fire and large quantities: clear the area. Extinguish from a great distance due to the risk of an explosion.

All hazard statements and precautionary statements are available on the website (e.g., <https://fvz.upr.si/wp-content/uploads/2019/09/Previdnostni-stavki.pdf>).

Information on hazardous chemicals can be deduced from the labels on the packaging and safety data sheets.

Information on labels according to GHS marking:

1. Name, address and telephone number of the supplier.
2. Product identifiers (name and trade name, rational molecular formula, CAS number, etc.).
3. Pictogram.
4. Warning word (Caution, Danger).
5. Hazard statements (H-phrases).



6. Precautionary statements (P-warnings).
7. Quantity (general use).
8. Additional information (additional hazard statements, etc.).

A warning word is a word indicating the relative degree of danger, alerting the reader to a possible danger; we distinguish between two stages:

- 'Danger' is a warning word indicating the categories of serious hazards;
- 'Warning' is a warning word to indicate categories of less serious hazards..

Example of a methanol label from Merck:

Signal word ("Danger")

UN 1230

**LiChrosolv®
Reag. Ph Eur
Methanol
gradient grade for liquid
chromatography
Méthanol
Alcoole metilico
Metanol**

Hazard pictograms: GHS02 (Flame), GHS05 (Skull and crossbones), GHS09 (Health hazard).

Hazard and precautionary statements:

Danger: Highly flammable liquid and vapour. Toxic if inhaled. Toxic in contact with skin. Toxic if swallowed. Causes damage to organs. Keep away from heat/sunlight/open flames/hot surfaces. • No smoking. Keep container tightly closed. Wear protective gloves/protective clothing/eye protection/face protection. If exposed: Immediately call a POISON CENTER or doctor/hospital.

Gefahr: Flüssigkeit und Dampf leicht entzündlich. Giftig bei Einatmen. Giftig bei Hautkontakt. Giftig bei Verschlucken. Schädigt die Organe. Von Hitze/Funkentzündern/Flammhitzen/Quellblähen fernhalten. Nicht rauchen. Behälter dicht verschlossen halten. Schutzhandschuhe/Schutzkleidung/Augenschutz/Geschosschutz tragen. Bei Exposition: Sofort GP/INFORMATIONSENTWURF oder Arzt anrufen.

Danger: Liquide et vapeurs très inflammables. Toxique par inhalation. Toxique par contact cutané. Toxique en cas d'ingestion. Risque avéré d'effets graves pour les organes. Tenir à l'écart de la chaleur/des étincelles/des flammes nues/autres sources chaudes. • Ne pas fumer. Maintenir le récipient fermé de manière étanche. Porter des gants de protection les vêtements de protection/l'un équipement de protection des yeux/du visage. EN CAS D'EXPOSITION: Appeler immédiatement un CENTRE ANTIPOISON ou un médecin.

Pericolo: Liquido e vapori facilmente infiammabili. Tossico se inalato. Tossico a contatto con la pelle. Tossico se ingerito. Pericolo danni agli organi. Tenere lontano da fonti di calore/da fiamme/scintille/accendi-fiumi • Non fumare. Tenere il recipiente ben chiuso. Indossare guanti/indumenti protettivi/protettore gli occhi/protettore il viso. IN CASO DI ESPOSIZIONE: Consultare immediatamente un CENTRO ANTIVELENI o un medico.

Peligro: Líquido y vapores muy inflamables. Tóxico si se inhala. Tóxico en contacto con la piel. Tóxico en caso de ingestión. Peligro daños en los órganos. Manténgase alejado de fuentes de calor, chispas, llama abierta o superficies calientes. • No fumar. Mantener el envase cerrado herméticamente. Llevar guantes, prendas, galga o máscara de protección. EN CASO DE EXPOSICIÓN: Llamar inmediatamente a un CENTRO ANTIVENENO o a un médico.

Perigo: Líquido e vapor facilmente inflamáveis. Tóxico por inalação. Tóxico em contacto com a pele. Tóxico por ingestão. Afeta os órgãos. Manter afastado de fontes de calor/incendios/aberta superfícies quentes. • Não fumar. Manter o recipiente bem fechado. Usar luvas de proteção/uso de proteção/protetor ocular/protetor facial. EM CASO DE EXPOSIÇÃO: Contate imediatamente um CENTRO DE INFORMAÇÃO ANTIVENENOS ou um médico.

Gevaar: Licht ontvlambare vloeistof en damp. Giftig bij inademing. Giftig bij contact met de huid. Giftig bij inslikken. Veroorzaakt schade aan organen. Verwijder houden van warmte/vonken/open vuur/hete oppervlakken • niet roken. Het goed afsluiten verpakking bewaren. Beschermende handschoenen/beschermende kleding/og- bescherming/gezichtsbescherming dragen. NA blootstelling: Onmiddellijk een vergiftigingscentrum of een arts raadplegen.

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7.3 Safety data sheets

Most of the information on the properties of hazardous substances can be found on the **safety data sheets**. This is a document that a legal or natural person who manufactures or places a dangerous substance on the market must deliver to the user, in order to protect health and the environment, as well as health and safety at work. A safety data sheet is mandatory for substances and mixtures classified as hazardous.

Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) defines the management of chemicals throughout the European Union, establishes a better overview of the safe handling of chemicals and reduces risks to human health and the environment. REACH is the legislation applicable to the manufacture, placing on the market and use of substances on their own, in mixtures or in products. REACH ensures that manufacturers, importers and other actors in the supply chain (from distributors to professional users) provide information about the properties of chemicals and ways to reduce the risks during their use, and provides users with relevant information about safe use and potential adverse effects.

The main instrument for such a downstream supply notification is the safety data sheet. The manufacturer, importer or downstream user must prepare a safety data sheet in accordance with Annex II of the REACH Regulation.

The safety data sheet now has an appendix that includes exposure scenarios setting out the conditions under which the substance or preparation can be used safely. This information is also part of the registration dossier.

Suppliers must provide a safety data sheet in the following cases:

- the substance and mixtures (from 1 June 2015) are classified as hazardous in accordance with the CLP Regulation (CLP stands for Classification, Labelling and Packaging of Hazardous Substances and Mixtures);
- the mixture is classified as dangerous according to the Dangerous Preparations Directive (prior to 1 June 2015);
- the substance is persistent, bio-accumulative and toxic (PBT) or very persistent and very bio-accumulative (vPvB), as defined in REACH (Annex XIII), or
- The substance is included in the list of substances of very high concern and may be included in Annex XIV.

Under certain conditions, a safety data sheet is also required for specific mixtures that do not meet the criteria for classification as hazardous.

In some cases, the safety data sheet needs to be updated and reissued:

- as soon as new hazard information or information that may affect risk-management measures becomes available;
- where an authorization under REACH is granted or refused;



- when a restriction is introduced under REACH.

Suppliers must provide free, updated safety data sheets for all former recipients to whom a substance or mixture has been supplied in the past 12 months. The safety data sheet must be divided into 16 sections in accordance with an international agreement and must be submitted in the official language of one or more EU Member States in which the substance or mixture is placed on the market.

The safety data sheet includes the following 16 sections:

1. Identification of the substance/mixture and of the company/undertaking
2. Identification of hazards
3. Composition/information on ingredients
4. First-aid measures
5. Firefighting measures
6. Accidental release measures
7. Handling and storage
8. Exposure controls/personal protection
9. Physical and chemical properties
10. Stability and reactivity
11. Toxicological information
12. Ecological information
13. Disposal considerations
14. Transport information
15. Regulatory data
16. Other information

Instructions for safe working practises

- <http://www.inchem.org/#/search> (Internationally peer-reviewed chemical safety information)
- Practical guidelines for working with hazardous chemical substances (Official Gazette of the Republic of Slovenia, No. 50/03 and 78/18)

7.4 Storage

When storing hazardous chemicals, we act in accordance with the **Rules on Technical and Organizational Measures for the Storage of Hazardous Chemicals** (Official Gazette of the Republic of Slovenia, No. 23/18).



PRILOGA 2: Pravila glede skupnega skladiščenja

Razred skladiščenja		13	12	11	10	8B	8A	7	6.2	6.1B	6.1A	5.2	5.1C	5.1B	5.1A	4.3	4.2	4.1B	4.1A	3	2B	2A	1		
Eksplozivi	1																								
Plini	2A			2			2						1										2	3	1
Aerosoli	2B												1												
Vnetljive tekočine	3			5										4											
Kemikalije, ki lahko povzročijo eksplozijo	4.1A	1	1	1	1	1	1					1							1	1					
Vnetljive trdne kemikalije	4.1B										4	1		4			6	6							
Piroforne in samosegrevajoče kemikalije	4.2			6	6	6	6										6								
Kemikalije, ki v stiku z vodo sproščajo vnetljive pline	4.3		6	6	6	6	6																		
Oksidativne tekočine in trdne snovi	5.1A																								
	5.1B			7	7	7	7			4	4		1												
	5.1C	1	1	1	1	1	1						1												
Organski peroksidi	5.2			1	1																				
Gorljive kemikalije z resnimi učinki na zdravje	6.1A			5																					
Negorljive kemikalije z resnimi učinki na zdravje	6.1B			5																					
Infektivne snovi	6.2																								
Radioaktivne snovi	7							1																	
Gorljive jedke snovi	8A																								
Negorljive jedke snovi	8B																								
Gorljive tekoče kemikalije, razen tistih, ki so uvrščene v razred skladiščenja 3	10																								
Gorljivi trdni proizvodi	11																								
Negorljivi proizvodi	12																								
Negorljive trdni proizvodi	13																								

Zelena: Skupno skladiščenje dovoljeno	Rumena: Skupno skladiščenje dovoljeno z omejitvami, ki so označene s številkami in opisane v opombah k tabeli	Rdeča: Zahteva se ločeno skladiščenje
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8. SAFETY SIGNS

Safety signs are signs that refer to a specific facility, activity or condition and provide information or instructions on ensuring health and safety at work. A sign can be an inscription, a colour, an indicator light, an audible signal, voice or hand communication.


The purpose of safety labels is to provide a quick and easy-to-understand warning of objects and substances that may pose a particular hazard.

Signs by their meaning:


- prohibit (red)
- warn (yellow)
- prescribe (blue)
- guide (green)

The shape, colour and size of safety signs and the obligations of employers regarding the use of safety signs are determined by the Rules on Safety Signs (Official Gazette of the Republic of Slovenia, Nos. 89/99, 39/05 and 34/10).

8.1 Prohibiting signs

Appearance	Pictogram and colour
	a black pictogram on a white background with a red border and a red diagonal line, with the red colour occupying at least 35% of the surface of the sign

8.2 Warning signs

Appearance	Pictogram and colour
	black pictogram on a yellow background with a black border, with the yellow colour having to occupy at least 50% of the surface of the sign

8.3 Obligation signs

Appearance	Pictogram and colour
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a white pictogram on a blue background, with the blue colour occupying at least 50% of the surface of the sign

8.4 Emergency signs and first aid

Appearance	Pictogram and colour
	a white pictogram on a green background, with the green colour having to occupy at least 50% of the surface of the sign

8.5 Fire signs

Appearance	Pictogram and colour
	a white pictogram on a red background, with the red colour having to occupy at least 50% of the surface of the sign

9 WASTE

Waste that contains hazardous substances is referred to as hazardous waste. Hazardous waste must not be mixed with general rubbish or disposed of down drains.

Containers for waste chemicals are marked with labels containing the following information:

1. type of chemical waste,
2. danger symbol,
3. classification number,
4. date of generating the chemical waste,

Spilled or scattered chemicals are removed according to the instructions of the head of the department or the responsible persons for the laboratory.

Waste chemicals must be handed over to the **Waste Chemicals Management Service** in the manner defined in the Rules of Procedure (<http://k1.ijs.si/srok/>).



10 ANNEX



LABORATORY WORK PERMIT (for work outside regular working hours)

The work permit for the laboratory must be completed and issued in order to ensure the health and safety of employees as well as fire safety. The application for a permit is submitted by the employee who will work in the laboratory, to the head of the department or by a deputy appointed by the head (the responsible person). The permit must be carried by the employee in the laboratory at all times for which the issuance of the permit for work in the laboratory relates. At least two employees must be present during the work in the laboratory, the other of which is located close by.

Before starting work in the laboratory, it is necessary to ensure a safe working environment where work with hazardous substances (chemical, biological, radioactive and others) will be carried out. The amount of hazardous substances required for work should be limited. Other hazardous substances must be properly stored in suitable cabinets in an appropriate manner. The responsible person issuing the permit must inspect the working location and issue the permit if the conditions are met. The issued permit can be revoked by the responsible person if he/she finds a change in the safety conditions or if the employee does not comply with the requirements for safe working practises.

<i>To be completed by the employee</i>	Name of person applying for a permit to work outside regular working hours:	BRIEF DESCRIPTION OF THE WORK: (taking into account hazardous substances, heating and other devices used in the work, use of a fume hood, etc.) Written work procedures can be referred to in the job description..
	Name of the laboratory (LABORATORY DESIGNATION)	
	Date, from to hours.	
	Other people present in the laboratory at the same time	
<i>To be completed by the responsible person</i>	Name of the person granting permission for the permit:	Additional requirements
	Signature:..... . Date:.....	



SAFE HANDLING OF SHARP OBJECTS

Sharp objects present a special risk of injury in a laboratory, as they can pierce the skin and mucous membranes, allowing micro-organisms to enter the body. The risk is all the greater if the objects are infected with dangerous biological agents.

Risk-reduction measures for employees exposed to biological agents who use sharp objects in their work include general protective measures in tissue management, vaccination and chemoprophylaxis, accident recording and prevention, accident measures and health monitoring.

An incident is an injury with an infected sharp object, spillage or scattering of blood or body fluids with an admixture of blood on damaged skin or eye, nasal and oral mucosa. An incident is also a spillage of blood over a large area of normal skin or mucous membranes (Lužnik - Bufon, 2002).

The most common causes of incidents:

- puncture with a needle (during work, improper disposal and transport),
- covering a used injection needle or other sharp object,
- incision with other sharp objects (e.g., a scalpel),
- spilling or spraying damaged skin or mucous membranes with blood (Kersnič, Stare, 2003).

Workers at high risk:

- disabled workers,
- migrant workers,
- younger and older workers,
- pregnant and breastfeeding women,
- unskilled or inexperienced workers,
- maintenance staff,
- employees with a weakened immune system,
- employees with diseases such as bronchitis (Kersnič, Stare, 2003).

HIV, HBV and HCV are not transmitted through intact skin, nor are they transmitted through the air.

Measures to prevent infections in employees

Technical protection is represented by:

- risk factors for a safe working environment are, for example, a collector for sharp objects on a work surface. Controlling waste disposal, improving working conditions (lighting, ventilation, etc.), improving work organization, for example, eliminating fatigue (e.g., short breaks) that can cause injuries to employees, improving the compliance with work procedures;
- use of safe tools for each work process, e.g., vacuum needleless systems, sharp objects with sharpness protection, syringes with the needle withdrawn into the syringe after inoculation;
- safe implementation of the work process by following the instructions for safe work practises, precautionary measures that are part of standard measures and strict adherence to standards.

Personal protective equipment:

- Gloves do not prevent mechanical tissue damage, they only reduce the possibility of transmitting blood-borne viruses. Gloves must be of good quality and as impermeable as possible. Gloves are only used for a single procedure when working with a biological agent or hazardous substance and are replaced as needed. Gloves are not cleaned or disinfected for further use. If the gloves are mechanically damaged during use, they must be removed immediately, disinfected and replaced with new ones. See: Instructions for Safe Work - Use of protective gloves and Instructions for safe work with biological agents (SVZD JSI website).
- Protective laboratory coat, fastening with concealed studs, comfortable and washable at 95 ° C.



- A protective mask must have an appropriate protection factor according to the type of the hazardous substance or contamination (solid particles, liquid, vapour or gas), the concentration level of the dangerous substance and the exposure time. The protective mask must also be of the appropriate size.
- Goggles or eye visor must be used when there is a risk of splashes of hazardous substances and biological material.
- Protective footwear must be in accordance with the standards on safe laboratory footwear.

Other measures:

- medical examination (in accordance with the Rules on Preventive Medical Examinations of Employees (Official Gazette of the Republic of Slovenia, No. 87/02, 29/03 - amended, 124/06 and 43/11 - ZVZD-1)
- hepatitis B vaccination
- observance of general precautionary measures or instructions for safe working practises
- use of safe operational techniques without the provision of instruments
- recording, analysis and elimination of causes

In accordance with the Vaccination and Protection with Medicinal Products Program, the Health Care Institute of Slovenia covers the costs of vaccination for high-school and university students who are exposed to the risk of infection during practical exercises, while employers cover the costs for employees. Vaccination and protection with drugs against a specific infectious disease must be carried out in accordance with the safety declaration, with an assessment of the risk of workplaces for people exposed to infectious diseases and people who might transmit the infection to other people at work.

Measures to prevent accidents happening to employees

- **Proper work procedures:** It is important to introduce new employees to safe working practises, teach them about work procedures and control the implementation of procedures, use safe and ergonomic work equipment, and use personal protective equipment.
- **Proper disposal of sharp infectious objects:** means disposing of used sharp objects in dedicated bins immediately after use, without intermediate disposal or needle protection according to the "hand-to-hand" system, using hard plastic bins and filling bins only up to three quarters of the maximum available space. Containers are not emptied but closed and removed together with other hazardous waste.



- **Appropriate cleaning of working equipment - accessories:** manual cleaning after preliminary decontamination, machine cleaning in a thermo-disinfector or ultrasonic cleaning. For infectious waste, a method of pre-sterilization, collection and destruction must be determined.
- **Care for positive health:** the risk of injury and consequent infection is increased by fatigue, repetitive work and illness (Lužnik - Bufon, 1995).

Pursuant to Article 14 of the Decree on Criteria for Classification of Work with Genetically Modified Organisms in a Closed System in the Safety Class and on Retention and Other Safety Measures for an Individual Safety Class (Official Gazette of the RS No. 71/2011), all employees working with genetically modified organisms are provided with training once a year on working with GMOs. This information is kept in records. The training is provided by the Biosafety Commissioner at the JSI, dr. Jerica Sabotič.