UNIVERSITÉ DE SHERBROOKE

Health and Safety Manual

Laboratory Work

Health and Safety in the Workplace and Study Environment (SSMTE)

Building Services

Purpose

This document stems from the Université de Sherbrooke Policy 2500-004 regarding occupational health and safety in the workplace and study environment. The Université de Sherbrooke is aware of the need to provide its staff and students with a healthy and safe environment. It is the University's belief that such an environment is of mutual benefit to employees and staff. The University offers training in laboratory health and safety for newcomers three times a year; this manual is a complement to the training, since it can be given to newcomers as soon as they arrive. The purpose of the document is twofold. First, it aims to set down fundamental notions of health and safety, especially in light of the work performed in laboratories at the Université de Sherbrooke. Second, it aims to remind all employees and students of their obligations regarding their own health and safety, as well as that of their colleagues. Finally, the document provides a way for the Université de Sherbrooke to ensure that all employees and students, current and future, are made aware of good practices in health and safety, as well as their obligations.

This manual was developed by the Université de Sherbrooke's health and safety in the workplace and study environment (SSMTE) division for use by staff and students. It is complementary to the first pages of laboratory notebooks, which must also be read and signed before any experimental work can be started.

Any and all handling that takes place in research laboratories is the sole responsibility of the professors in charge of the activities undertaken in their respective laboratories. They may complete the present document by providing specific instructions for their research groups. Experimenters must be properly trained in potential hazards before they can begin handling. A rigorous risk analysis process must be carried out before any new experiment or initial handling of a device can take place.

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1. Act respecting Occupational Health and Safety

1.1. Definitions

It is essential to understand that acts in work health and safety are written so as to be as general as possible. The legislation categorizes two groups required to comply with such acts, namely the employer and the workers.

In an academic context, and more specifically at the Université de Sherbrooke, the mention “employer” is not exclusively limited to the University as an institution but also includes each of its researchers who supervise research projects. The term “worker,” for its part, also encompasses an expanded population. Regardless of their status, all employees and students at the University are here designated as “workers” or “employees.” Even if undergraduate and graduate students are not legally considered employees, the Université de Sherbrooke morally considers them employees in matters of health and safety.

1.2. Obligations of the Employer and Employer Representatives

In accordance with Section 51 (partially reproduced in this document) of the Act Occupational Health and Safety (AOHS, L.R.Q., Chapter S-2.1), employers must take the measures required to protect the health, physical safety, and well-being of workers. More specifically, they are required to:

- Ensure that institutions are equipped and configured so as to protect workers.
- Ensure that the organization of work as well as the methods and techniques used are safe.
- Implement methods and techniques that aim to identify, control, and eliminate risks.
- Provide safe materials.
- Adequately inform workers on risks and ensure their access to appropriate training, practice, and supervision.
- Ensure that, while working, workers use means and equipment for individual protection.

In addition, according to Section 62.1, employers cannot permit the use, handling, or storage of any controlled product in the workplace unless it has a label and safety data sheet consistent with the law and regulations in force. The employer must also ensure that workers have received the training and information needed to safely accomplish the work they are given.

Finally, Bill C-21, that is, Section 217.1 of the Canadian Criminal Code, stipulates that "everyone who undertakes, or has the authority, to direct how another person does work or performs a task is under a legal duty to take reasonable steps to prevent bodily harm to that person, or any other person, arising from that work or task." The best way to protect oneself from potential prosecution is to exercise due diligence. This involves three obligations:

- the obligation of foresight, involving risk analysis and identification;
- the obligation of effectiveness, involving the establishment of appropriate preventive measures (training, protective equipment, etc.);
- the obligation of authority, involving the application and enforcement of safety procedures.

Through its SSMTE division staff (www.usherbrooke.ca/immeubles/ssmte), the Université de Sherbrooke offers training support, risk analysis, and waste management in line with hazardous waste disposal. Operating and maintaining the mechanical systems in the building is the responsibility of the Building Services. Research devices and equipment are kept clean and in good working condition by users.

Likewise, through SSMTE responsible persons, the Université de Sherbrooke assumes its environmental responsibilities by ensuring that its mechanical systems and waste management systems for hazardous waste disposal contribute to preserving the quality of the environment and to respecting the standards in effect.

1.3. Obligations of Workers

Also according to AOHS, Section 49 states that workers are required to:

- Become familiar with the prevention programs that apply to them.

- Take necessary measures to protect their health, safety, and physical well-being.
- Make sure that they do not endanger the health, safety, or physical well-being of others in or near their workplaces.
- Submit to health exams required for the application of the law and regulations.
- Participate in identifying and eliminating risks of work accidents and occupational diseases in the workplace.
- Collaborate with the health and safety committee and, if applicable, with any other persons in charge of applying the current law and regulations.

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2. Chemical Products: Classification, Storage, and Handling

2.1. Classification Principles

2.1.1. WHMIS Classification

Laws and regulations pertaining to the Workplace Hazardous Materials Information System (WHMIS) require all employers to provide their workers with relevant information on the hazardous properties of the products they handle or with which they come into contact. The WHMIS is used to show risks and toxicity, rather than storage compatibility. For example, hydrochloric acid (a strong acid) and sodium hydroxide (a strong base) both belong to WHMIS class "E," meaning corrosive. However, these two products obviously cannot be stored together.

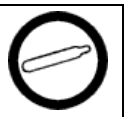
The Université de Sherbrooke is required to comply with all WHMIS requirements. Material safety data sheets give information on products used in laboratories and their properties. Everyone, regardless of position, is required to become aware of risks by consulting the data sheets of the products they work with, as well as take into account the information and recommendations they provide. Everyone must also take into consideration that the data sheets are prepared irrespective of the quantities handled, and make appropriate adjustments.

Data sheets must be less than three years old and are available online on the websites of suppliers (for example the Sigma-Aldrich site: http://www.sigmaaldrich.com/safety-center.html). Informations can also be obtained online from several other sources, including:

- The Canadian Centre for Occupational Health and Safety (CCOHS) at http://ccinfoweb.cchst.ca.
- The *Service du Répertoire Toxicologique de la Commission de la Santé et de la Sécurité du Travail* (CSST) (= toxicology directory service of the occupational health and safety commission) at www.reptox.csst.qc.ca, see http://www.reptox.csst.qc.ca/ToEnglishUsers.htm. This is not a provider of material safety data sheets, but it gives very useful informations about the safe handling of controlled products.

The general principles relative to chemical product classification and storage, regardless of form, aim to avoid incompatibility. To this end, it is important to understand the subtle differences between classification and storage. First, the WHMIS classification system primarily seeks to identify chemical products according to the risks they represent for the health and safety of individuals. It is foremost a Canadian presentation and information system, complemented by the establishment of safety instructions specific to each product. More information on WHMIS classes can be found in Appendix 2. Only the classes and their logos are indicated here.

Table 1: WHMIS product classes and associated logos

• **A** Compressed gas	
• **B1** Flammable gas • **B2** Flammable liquid • **B3** Combustible liquid • **B4** Flammable solid • **B5** Flammable aerosol • **B6** Reactive flammable material	
• **C** Oxidizing material	
• **D1A** Very toxic material causing immediate and serious effects • **D1B** Toxic material causing immediate and serious effects	
• **D2A** Very toxic material causing other effects • **D2B** Toxic material causing other effects	
• **D3** Infectious material	
• **E** Corrosive material	

- **F** Dangerously reactive material 

2.1.2. GHS Classification

Since 1992, the United Nations Organization has developed its own Globally Harmonized System (GHS) for Classification and Labelling of Chemicals to standardize the symbols and warnings of risks and caution used by various countries. Suppliers of chemical products are increasingly applying this system in North America as well, replacing WHMIS. The symbols are similar to those of WHMIS, but another symbol has been added to describe environmental risks (see Table 2).

The data sheets determined by the GHS display information on product-related hazards as well as on transportation, regulations, and ecological data (see Appendix 3). Hazard warnings and cautionary measures are indicated on product bottles and data sheets (statements H and P, see http://www.sigmaaldrich.com/help-welcome/hazard-and-precautionary-statements.html#hazard).

Table 2: WHMIS/GHS symbols and description of GHS product classes

WHMIS symbol	GHS symbol	GHS detail
 Gas under pressure	 Gas under pressure	Includes any product, material, or substance contained under pressure and that can explode when the container is subjected to heat or impact.
 Flammable material	 Flammable liquid or vapour	Includes all products that can ignite when exposed to heat, a spark, or a flame.

 Oxidizing material	 Can cause or intensify a fire	Any substance that can cause or contribute to the combustion of another material by yielding oxygen or another oxidizing substance.
 Toxic material causing immediate and serious effects	 Fatal in case of ingestion	Any substance that, in a single exposure, can cause death.
 Very toxic material with other effects	 Health hazard	Substances that, after a certain time, can cause temporary or permanent health effects.
 Toxic material with other effects	 Warning mention	Warning symbol referring to particular risks explained on the label.
 Corrosive material	 Corrosive material	Material that, by chemical action, can cause serious harm to living tissue and, in case of a leak, can damage or even destroy other goods.
 Reactive material	 Self-reactive material	Substance characterized by its instability, incompatibility, and considerable reactivity, and that is prone to violent reactions when subjected to impact, heat, or humidity.

N/A	 Environmental hazard	Toxic product for the environment because it can cause bioaccumulation and/or environmental deterioration.

2.1.3. SYCLAUN Storage Classification

To ensure safe storage of chemical products used in laboratories, the Université de Sherbrooke has established its own classification system (Standardized Classification System = SYstème de CLAssification UNiformisé, or SYCLAUN) based on the physical/chemical properties of various products. Each container should bear one or two labels corresponding to its classification. The classification principles used in the SYCLAUN system aim to avoid any incompatibility and are based on the following concepts:

- Containers of substances with acidic properties are stored separately from containers of substances with alkaline properties. Mineral acids are stored apart from organic acids, which also have flammable properties.
- Containers of substances with oxidizing properties are separated from containers of substances with reducing properties and from flammable materials.
- Containers of substances with reducing properties are separated from containers of substances with oxidizing properties and from flammable materials.
- Highly reactive products undergo an individual evaluation that takes into account all of the product's properties; they are stored according to the results of this evaluation.
- Special attention should be given to all products that are incompatible with water and/or air.
- Particular attention should also be given to products that form peroxides during storage (see http://www.usherbrooke.ca/immeubles/fileadmin/sites/immeubles/documents/Securite_chimique/FSC2_Produits_vieillissants_mal_01.pdf).

- Products which belong to several classes because of their properties undergo an individual evaluation according to their risks. Following are the SYCLAUN classes in descending order of priority:
    1. R / X / I
    2. E / F
    3. A / B
    4. C / D / S

Table 3: SYCLAUN product classification system

A	**ACIDS**
B	**BASES**
C	**ORGANIC SOLIDS and aqueous solutions of organic solids or liquids**
D	**ORGANIC LIQUIDS and solutions of class C or S products in a flammable or combustible solvent**
E	**OXIDIZERS**
F	**REDUCERS**
I	**GASES**
(Sub-Classes)	
A: Acidic and corrosive products	
B: Basic and corrosive products	
C: Organic products	
D: Organic, flammable, or combustible products	
E: Oxidizers	
F: Reducers	
S: Inorganic products	
R	**DANGEROUSLY REACTIVE PRODUCTS**
(Sub-Class)	
A: Acidic and corrosive products	
B: Basic and corrosive products	
C: Organic solids	
D: Flammable liquids	
E: Oxidizers	
F: Reducers	
S: Inorganic products	
S	**INORGANIC PRODUCTS**
X	**EXPLOSIVE**
(Sub-Classes)	

A: Acidic and corrosive products B: Basic and corrosive products C: Organic solids D: Flammable liquids E: Oxidizers F: Reducers S: Inorganic products

As a complement to the SYCLAUN system, it is important to adapt storage units to the substances they contain. Hence, flammable substances must be stored in fire-resistant cabinets as set out in the National Fire Code (NFC). Corrosive materials must be kept in corrosion-proof cabinets. Materials that are highly reactive or incompatible with water must be stored in such a way as to avoid accidental contact with water (desiccator or glove box), especially in case of water-related damage. In addition, products that are unstable at room temperature are stored in refrigerators with sparkproof interiors and, when needed, in such freezers, at the right temperature. Finally, even if chemical hoods are not places of storage, certain nauseating products can be stored in a hood that is not used on a regular basis. Only class C and S products, as well as class A, B, E, and F solids, should be put away on shelves fitted with rims to avoid products from falling. Plan for at least one meter of space between the incompatible classes (A and B or E and F).

At the time any chemical product is received, it is your responsibility to affix the appropriate label(s) on the bottle. Remember also to write on the label the date the product arrived; this is especially useful for products that do not age well. A database of more than 45,000 products and their SYCLAUN codifications can be consulted on the following website: http://www.usherbrooke.ca/immeubles/sante-et-securite/produits-chimiques/classification-et-entreposage-des-produits-chimiques/. Login as “Compte Invité” to access the database. The most precise search can be done using the CAS number of the compound.

Incompatibilities between products belonging to the various classes are indicated in the table below. Note that only C, D, and S class products are mutually compatible; otherwise, products are only compatible with other products in their same class.

	A	B	C	D	E	F	S
A	O	X	X	X	X	X	X
B	X	O	X	X	X	X	X
C	X	X	O	O	X	X	O
D	X	X	O	O	X	X	O
E	X	X	X	X	O	X	X
F	X	X	X	X	X	O	X
S	X	X	O	O	X	X	O

Figure 1: Compatibility (O) and incompatibility (X) of classes and products (SYCLAUN)

It is also essential to properly identify cupboards and cabinets used to store the above-mentioned materials so that they can easily be found in case of emergency.

2.2. Handling and Storage of Chemical Products

Experiments involving particularly reactive or unknown agents should begin on a small scale before being expanded. Special attention should be given to the use of explosive or reactive compounds such as peroxides, peracids, perchlorates, nitrates, azides, compounds including a diazo group, etc. Supervisors and colleagues should be informed when these potentially explosive agents are being handled. For example, the following data sheet presents safe handling procedures for solutions with pyrophoric compounds: http://www.usherbrooke.ca/immeubles/fileadmin/sites/immeubles/documents/Securite_chimique/FSC3_Composes_pyrophoriques.pdf. Other data sheets dealing with particular risks and ways to effectively protect oneself can be found on the SSMTE division website: http://www.usherbrooke.ca/immeubles/sante-et-securite/produits-chimiques/fiches-de-securite-chimique/.

Over time, many researchers' awareness of the risks involved with organic solvents declines. It should be kept in mind that many of these solvents are highly flammable (acetone, methanol, ethanol, hexane, etc.); others are very toxic (methanol, benzene, etc.); and still others can, in the long term, generate potentially explosive peroxides (ethers, etc.). Toxic or

volatile chemical products must at all times be handled under a chemical hood. Researchers are invited to minimize the quantities of flammable liquids that they keep at their workstations outside of solvent cabinets.

In the event that these products must be handled outside the chemical hood, the user should use appropriate respiratory protection equipment and ensure that other users are aware of the hazards so that they can take proper measures. All main or temporary containers must be clearly identified with the risks associated with their use. Because many chemical products become unstable over time, it is recommended to indicate the date of preparation, or purchase and opening, on bottles.

Storage of chemical products is one of the crucial points in laboratory safety. It is primordial that incompatible products be stored in such a way that no contact is possible between products. This way, if an accident were to occur in a place of storage, the consequences would not be complicated or amplified by a series of chain reactions.

The first fundamental rule for chemical product storage is that each product should be correctly and clearly identified. Containers should be classified and dated at the time they are received and/or opened. In addition, chemical products must have a specific storage place and should at no time be stored directly on the floor or in a chemical hood. Cabinet shelves should be fitted with edges. These edges must be high enough to offer the desired protection, but should not obstruct access to the shelf. At the Université de Sherbrooke, chemical products are stored according to their SYCLAUN classifications, using a non-compatibility table (see page 18). It is important to verify the compatibility of products both horizontally and vertically, and to plan one meter of space between products belonging to incompatible classes.

An updated inventory of chemical products in the laboratory should be kept (in Excel format, for example). The date of purchase of the compounds should be indicated. If possible, provide hyperlinks to the compounds' material safety data sheets (MSDS). Plan to make an inventory of chemical products at least once per year, and take advantage of the opportunity to eliminate products that have expired or are no longer useful, or those whose containers are damaged. As a safety precaution, it is preferable to limit the number of flammable and potentially explosive materials; order only the quantities that are needed.

2.3. Handling and Transportation of Hazardous Products

Because liquid chemical products and especially concentrated solvents, acids, and bases represent additional risk in case of a spill, they should always be transported safely.

This is why it is important to use rubber containers provided for this purpose to transport four-litre bottles by hand. If available, the lid must always be fastened and the bottle should be held vertically by hand. It is important not to swing bottles during transportation and always ask for help opening doors when hands are full.

If you are unable to safely transport a container because of its excessive weight or if you are carrying too many bottles, you must either use a cart with edges or carry the bottles in their original cartons, using a normal cart.

Controled chemical products cannot be transported in a personal vehicle if the driver has not been trained specifically for the transport of dangerous goods. It is also important to determine whether you need a regulatory document on hazardous goods transportation before sending anything outside your campus. For more information, contact the SSMTE division by email at tmd@usherbrooke.ca or consult the website at http://www.usherbrooke.ca/immeubles/sante-et-securite/envoi-de-produits-dangereux/.

2.4. Use and Handling of Gas Cylinders

Because the colours of gas bottles are chosen by their manufacturers, it is important to never remove the label affixed to the bottle, since it gives important information on the contents (identification of the gas; risks; first aid; etc.).

Rules relative to the moving of gas cylinders apply irrespective of transportation distance. Gas cylinders should be transported standing up in carts specially designed for this purpose. Such carts can be borrowed from the stores. Gas bottles must be equipped with firmly screwed caps and be attached to the cart at the time of transportation. It is prohibited to take an elevator with a gas bottle. Put the gas bottle in the elevator, select the floor, and use the stairs.

All cylinders must be individually and safely secured using an appropriate medium at the time of use and storage. Unused cylinders must remain fixed and secured using their caps. Always keep gas bottles in a vertical position. “EMPTY” [*VIDE*] labels should be placed on empty cylinders. In addition, only the cylinders needed for experiments should be present in the laboratory. Cylinders containing flammable, oxidizing, corrosive or toxic gases may not be stored inside the building. When not used for an extended period, they must be placed in a locked cage outside. Small gas cylinders can be secured to a stand inside a chemical hood, while they are being used. Cylinders must not be subjected to extreme temperatures (> 50 °C). Oxidizing gases must be kept away from combustible gases by at least six metres within a laboratory, or separated by a wall with 30-minute (minimum) fire resistance. The use of certain toxic gases (carbon monoxide, for example) requires the installation of a proper detector in the room. Notify the SSMTE division (info.sst@usherbrooke.ca) before using such a gas.

Because of the high pressure inside it, a cylinder should never be used without a pressure regulator, which makes it possible to reduce the pressure within the cylinder to variable and usable levels. After fitting the regulator and before using the gaz, make sure the system is airtight by applying a few drops of soapy water solution on joints. A regulator should never be oiled or greased because certain oxidizing gases such as oxygen can ignite these products and cause explosions. An appropriate pressure regulator that is adapted to a given cylinder should always be used. For each type of gas, there is a corresponding type of pressure regulator. If the regulator does not seem to be easy to install on the cylinder, it is probably because it is not the right type. Suppliers of scientific materials (Fisher or VWR, for example) provide a list of appropriate pressure regulators in their catalogues. Never place yourself directly in front of a pressure regulator while opening a cylinder. Always make the following adjustments while keeping a certain distance from the cylinder: first, make sure the regulator's valves are closed. Completely open the cylinder's main valve, minus ¼ turn. Adjust the regulator's pressure-reducing valve and then adjust gas flow using the regulator's flow control valve. To close everything, first close the cylinder's main valve, let the gas in the pressure regulator disperse, and finally, in order, completely close the pressure-reducing valve and then the flow control valve.

Cylinders containing corrosive gases require additional handling precautions. The pressure regulator must be cleaned with nitrogen after each use to eliminate any trace of corrosive gas that could damage it. Valve corrosion can cause obstructions and give the impression that the cylinder is empty. Put the date on the cylinder upon reception and eliminate it after one or two years of on-site storage. Use the University's hazardous materials disposal services (see Section 0).

2.5. Cryogenic Substances

Cryogenic liquids such as liquid nitrogen (boiling point: -196°C at atmospheric pressure) can cause serious and almost instantaneous burns on skin contact. As a result, cryogenic liquids must be handled with appropriate and comprehensive protective equipment including lab coat, insulating gloves, protective glasses and, preferably, a complete face guard. They must also be used and stored in well-ventilated areas because they pose significant risks of simple asphyxiation. One litre of liquid nitrogen yields 691 litres of gas. In a small and closed room, the percentage of oxygen in the air can therefore drop dangerously low. Cryogenic liquids have properties similar to those of compressed gases. They also have a high expansion ratio during evaporation, enabling very high pressure to develop in hermetically sealed containers. Be careful while transporting Dewar type containers that are very fragile and produce sharp glass when they break. It is recommended to place a foam lid on the Dewar during transportation between the tank and the laboratory.

Dry ice also represents risks of chilblain or burns, because its sublimation temperature is -78°C at atmospheric pressure. Since a litre of the solid yields 845 litres of gas, it is important not to store it in a tightly sealed recipient, since this can cause an explosion.

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3. Biological Materials: Classification and Handling

3.1. Classification

3.1.1. Risk Groups

Infective organisms can be evaluated according to different characteristics, namely pathogenicity, infectious dose, mode of transmission, host, preventive measures, and the availability of effective treatment. Analyzing these parameters enables classification according to the risk group, that is, the hazard it represents for health in the context of laboratory handling. Four levels of risk have been defined:

Risk Group 1: low risk for the handler and the community.

Risk Group 2: moderate risk for the handler and low risk for the community.

Risk Group 3: high risk for the handler but low risk for the community.

Risk Group 4: high risk for the handler and the community.

Additional information on classification by risk group can be found on the Public Health Agency of Canada website at http://www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index-eng.php.

3.1.2. Containment Levels

The principle behind the classification of infective agents according to containment level (CL) is to define the level of minimal safety needed for laboratory work involving a given pathogen to be free of hazards. Containment levels are established according to several criteria that take into account the risk group, the facilities available for handling, and technical obligations associated with the handling of the pathogen. Four CL are described here:

Containment Level 1: applies to laboratories that handle agents belonging to risk group 1. No special procedures are required for this type of laboratory other than fundamental rules of health and safety. The waste material produced must nevertheless be decontaminated before disposal.

Containment Level 2: applies to laboratories that handle agents belonging to risk group 2. Although these agents are not generally transmitted by airborne routes, care must be taken to avoid the generation of aerosols or splashes, since mucous membranes are the main infection route. The use of biological safety cabinets, centrifuges with rotors or sealed buckets, gloves, lab coats, and protective eyewear offer adequate protection. The waste material produced must be decontaminated before disposal.

Containment Level 3: applies to laboratories that handle agents belonging to risk group 3. These agents can generally be transmitted by airborne routes and a low dose can cause a serious or life-threatening disease. The preventive measures required to handle these agents include respiratory protection, HEPA filtration of laboratory air before it is evacuated, and strictly controlled access to laboratories.

Containment Level 4: applies to laboratories that handle agents belonging to risk group 4. These agents have the potential for aerosol transmission. Exposure to a low dose can cause a very serious and often fatal disease for which no vaccine or treatment is available. Working in CL4 requires that the researcher be isolated from the pathogen using a positive pressure suit, or that the pathogen be contained in a Class III BSC. The containment perimeter must be sealed and under negative pressure.

For more information on containment levels and their characteristics, visit the Public Health Agency of Canada at http://www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index-eng.php.

Because the use of containment laboratories is strictly regulated, directives for handling pathogens must be respected in both research and teaching laboratories in order to ensure that work is completed safely.

The CL required to handle an organism is generally written on the specification sheet provided on purchase of a cell line or pathogen. This information can also be obtained from the supplier (for example the ATCC website at http://www.atcc.org). A sample specification sheet is presented in Appendix 5. However, you must determine the containment level required for a given pathogen in the directory of safety data sheets for pathogens on the Public Health Agency of Canada website at http://www.phac-aspc.gc.ca/lab-bio/res/psds-

ftss/index-eng.php. For the handling of clinical isolates of a pathogen agent, see the PHAC directory of safety data sheets at the same address. Note that the minimum required containment level for handling human or animal tissue is CL2.

The Université de Sherbrooke currently holds permits for operating CL1 and CL2 laboratories only.

3.2. Handling of Biological Materials

3.2.1. Ground Rules

When handling infectious agents, it is important to respect the established biosafety rules. Individuals who handle such agents frequently minimize the hazards that a given pathogen represents. Certain situations involving infectious aerosols, splashes, spills, or injury can cause individuals and/or their colleagues to become infected. As a result, certain fundamental rules have been established. Immediately following a splash or spill, surfaces and materials must be disinfected using a product recognized for its effectiveness, consistent with the procedures described in Section 8.2.4. Gloves should not be worn when handling a flame. Hands should be washed before leaving the laboratory and at the end of the day, irrespective of the use of gloves. Consistent with the directives set out in Section 7.5, waste materials must be decontaminated before being discarded. Finally, autologous experiments (performed on a cell isolate from the experimenter himself) are forbidden. These experiments constitute a real hazard for the experimenter, who no longer benefits from the protection that the immune system normally provides against foreign agents.

3.2.2. Handling in CL2

All individuals with access to the containment level 2 zone are required to have followed prerequisite training in biosafety, or to be supervised by another individual who has undergone this training. Safety measures during the manipulation of infectious agents in CL2 are in addition to the basic rules established above. To preserve the containment zone, the doors of CL2 laboratories must remain closed at all times. When there is a risk that the

experiment will produce aerosols or will require large volumes or concentrations of infectious agents, it is important that the experiment be performed inside an appropriate biological safety cabinet (BSC). The various types of biological safety cabinets are described in Section 5.4. The centrifuges used must be equipped with rotors or sealed safety buckets to reduce the risk of contamination. For detailed notes on BSC handling, see Appendix 6.

It is important to know that certain situations, such as the handling of pseudotyped first, second, or third generation lentiviruses or retroviruses, require special measures. Despite the fact that these viruses are incapable of replicating, they must be handled in CL2 using CL3 operational protocols. Detailed notes on CL3 handling can be found in Appendix 11. For more information on CL3 handling rules, contact the SSMTE division by email at Biosecurite@USherbrooke.ca. Standards for CL3 operational practices are also available in the document titled *Laboratory Biosafety Guidelines*, 3rd edition, published by the Public Health Agency of Canada, available at http://www.phac-aspc.gc.ca/publicat/lbg-ldmbl-04/index-eng.php.

3.3. Transportation, Handling, and Importing of Biological Materials

3.3.1. Transportation and Handling of Biological Materials

Biological materials must always be handled safely to avoid spills and splashes. When moving items, it is recommended to use closed containers and to place tubes in stands. If you have a large quantity of material to transport, the safest method is to use a cart with raised edges. Finally, containers that cannot be closed must be placed in hermetically sealed receptacles during transportation.

Since the transportation of biological materials is strictly regulated, you may not transport these materials using a personal vehicle. You are required to obtain documents in compliance with the *Transportation of Dangerous Goods Regulations* before sending anything off campus in any way. For more information, contact the SSMTE division by email at TMD@USherbrooke.ca or consult the website http://www.usherbrooke.ca/immeubles/sante-et-securite/envoi-de-produits-dangereux/.

3.3.2. Importing and Acquiring Biological Materials

Importing agents that carry biological hazards requires the obtaining of a permit, and in certain cases, a certificate of approved facilities authorized by the biosafety advisor. In the case of an acquisition from within Canada, regulation documents and the approval of the biosafety advisor are also required. For more information, contact the SSMTE division by email at Biosecurite@USherbrooke.ca or consult the following website: http://www.usherbrooke.ca/immeubles/sante-et-securite/biosecurite/importations-et-acquisitions/.

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4. Work Involving Animals

All experiments conducted on animals must comply with the Université de Sherbrooke's *Politique en matière d'éthique de l'expérimentation animale* (animal experimentation policy), consistent with the standards of the Canadian Council on Animal Care (CCAC). The Institutional Animal Care Committee (IACC) and the two faculty committees (Faculty of Science and Faculty of Medicine and Health Sciences) on animal protection (*Comités facultaires de la protection des animaux* or CFPA) supervise the application of this policy. All animal-related experimental protocols must therefore be evaluated and approved by the CFPA. In addition, as per the *CCAC Guidelines on Institutional Animal User Training*, all collaborators must have undergone theoretical training. Moreover, specific training on the procedures described in the protocol must be given to anyone who handles animals. Given the risk of zoonosis (an infection that can be transmitted from animals to humans) and the risk of experiment-related infections, individuals called to work with animals are subject to medical assessment before and throughout the study. Additionally, depending on the risks associated with the protocol, staff vaccination may be required before the study can begin. For more information on regulations involving work with animals, see the CCAC website at http://www.ccac.ca/en. For assistance with experimental protocols, contact the veterinarian in charge of animal supply facilities, Dr. Michel Talbot V.D.D. (Michel.Talbot@USherbrooke.ca).

4.1. Animals Kept in Supply Facilities

Given the risks involved in working with laboratory animals, access to animal supply facilities is strictly controlled. In addition, you must wear individual protective equipment including a lab coat, gloves, a mask, and shoe covers. In certain cases, you may be required to wear protective goggles and bite-resistant gloves. Veterinarian Dr. Michel Talbot is responsible for managing the animal supply facilities and overseeing animal health. The technicians at the animal supply facilities are responsible for checking the animals' state of health, and in case of problems, must warn the veterinarian and the research team. They are also responsible for

teaching the techniques described in the protocol and can provide technical assistance if needed.

4.2. Wild Animals

Working with wild animals involves high risks, since their medical history is unknown; as a result, it is necessary to be very careful when handling them. For more information on handling wild animals, consult the *CCAC Guidelines on the Care and Use of Wildlife* at http://www.ccac.ca/Documents/Standards/Guidelines/Wildlife.pdf.

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5. Individual Protection Regulations

Appendix 1 presents the personal protective equipment that should be accessible to researchers.

5.1. Face Protection

5.1.1. Protective goggles

Safety goggles must be worn at all times inside laboratories at the Department of Chemistry. This obligation applies not only to employees and students, but also to anyone entering the laboratories: visitors, workers, etc. Laboratory supervisors are strictly required to enforce this regulation at all times. Additional safety goggles must be provided in appropriate boxes at laboratory entrances.

In biological research laboratories, wearing protective goggles is required when handling chemical products or biological materials likely to produce splashes. Communicate with your colleagues present in the lab in case your manipulation may splash on them. Working with animals also requires the use of safety goggles.

Prescription safety goggles must be equipped with additional lateral guards and must meet the standards of the American National Standard Institute (ANSI 287.1). Certain models of safety goggles are worn over prescription glasses.

Wearing contact lenses is permitted but not recommended for individuals who work in laboratories during the handling of volatile chemical products. Employees and students who wear contact lenses must report this to their laboratory supervisors. They are not a substitute for safety goggles.

When handling volatile and eye-irritating products outside a chemical hood, it is recommended to wear goggles, *i.e.* protective glasses that are closed on all sides.

5.1.2. Protective Window

A hood window offers good protection against splashes of corrosive or hazardous products. However, it is also recommended to wear protective goggles and to work with the window lowered in front of the face. A face mask should be worn each time handling involves a risk of explosion or projection. It is also used to offer protection from projected cryogenic liquids and from liquids at high temperatures. An explosion-resistant screen can also be placed between the laboratory setup and the experimenter.

5.1.3. Hair

In laboratories, long hair must be tied back safely, especially when performing handling in the presence of an open flame or devices involving moving parts. Wearing a veil or scarf is not recommended and can be prohibited when working with machines or fixtures with moving parts. If they are worn at the neck or the head, they must be worn in such a way as to avoid getting caught; excess fabric and hair must be secured.

5.2. Body Protection

Individual protection elements such as lab coats and gloves must not be worn in common areas (hallways, bathrooms, computer rooms, secretariat, etc.) and especially not in rooms containing food (cafeteria, lounges, etc.).

5.2.1. Lab Coat Use

Wearing a lab coat, correctly fastened, is mandatory for all employees and students working in a laboratory. Cotton coats are preferred for their non-flammable properties. If the work requires the use of pyrophoric compounds, or a flame, it is desirable to have the fabric treated for fire-resistance. Fastening the lab coat with a snap-fastener makes it possible to remove it very quickly in case of fire or a product spill. It is recommended to wear a lab coat that reaches the knees, with sleeves that end where the glove begins, to avoid exposing unprotected skin.

5.2.2. Hand Protection

In the research laboratories at the Université de Sherbrooke, gloves must be worn when handling materials that involve a risk of splashing, a biological risk, or a risk of skin contamination. More specifically, the presence of skin lesions on hands or work with human/animal tissues requires the use of gloves since these elements are likely to represent a risk to the experimenter's health. Gloves must be removed if they are contaminated or after the work with contaminated material is finished.

A number of types of gloves are available. When handling chemical products, it is recommended to wear gloves appropriate to the products used. It is important to know that certain types of gloves offer only temporary or very limited protection against various chemical products, since they tend to deteriorate or are permeable to certain products. For example, disposable nitrile gloves offer protection from most solvents, but are permeable to acetone and chlorinated solvents within five minutes of use. Viton or neoprene gloves offer better protection against these solvents than nitrile gloves. Moreover, in an experiment involving ethidium bromide, it is recommended to wear nitrile gloves rather than latex gloves. It is important to note that disposable nitrile gloves offer satisfactory protection for short-term exposure, but if you must perform handling for a longer period, it is preferable to wear two layers of gloves. A chemical safety sheet for ethidium bromide is available from the SSMTE division at http://www.usherbrooke.ca/immeubles/sante-et-securite/produits-chimiques/fiches-de-securite-chimique/. When handling concentrated acids or bases, it is recommended to use neoprene gloves resembling dish washing gloves, which are sufficiently thick and completely cover the wrists. Thin disposable gloves can be appropriate if the only risk involved is splashing. Where immersion in a chemical product is involved, thicker gloves should be chosen. A chemical safety sheet on how to select proper gloves can be found at http://www.usherbrooke.ca/immeubles/sante-et-securite/produits-chimiques/fiches-de-securite-chimique/.

Wearing insulated gloves is also recommended to avoid risks of thermal burns while handling objects, substances, or equipment subjected to extreme temperatures. Moreover, when using equipment or tools that involve a risk of cutting or perforation, it is recommended to wear resistant gloves such as leather or Kevlar gloves.

Glove suppliers suggest ideal materials for protection against chemical products:

- http://www.showabestglove.com/site/chemrest/
- http://www.mapaglove.com/ChemicalSearch.cfm?id=1
- http://www.ansellcanada.ca/pages/doc/GuideResistance/8thChm_Canada_Eng%20FINAL.pdf

To avoid contaminating telephones, calculators, computer keyboards, and doorknobs with soiled gloves, it is important to remove gloves before handling such items. The safest way to do this is to turn the gloves inside out, so that skin is never in contact with contamination. Do not attempt to wear disposable gloves that have already been worn. Also note that neoprene gloves must be washed in water and dried (inside and out) before they can be worn again.

5.2.3. Leg Protection

All employees working in laboratories at the Department of Chemistry must wear long pants. Bermuda pants, capri pants and nylon stockings are forbidden in these laboratories. However, in biological and medical research laboratories, although wearing long pants is recommended at all times, it is required only when handling biological or chemical products that represent a risk of contamination or skin injury (directly or in close vicinity, like by your bench neighbour). Solutions of corrosive and/or toxic products represent such risks in case of contact.

5.2.4. Foot Protection

The Université de Sherbrooke requires that low-heeled shoes that are closed at both ends be worn at all times in laboratories. Closed slipper/shoes, or mesh tennis shoes, may be authorized or prohibited by the laboratory supervisor. The use of closed shoes that cover the entire foot is, however, mandatory in CL2 laboratories or when handling radio-isotopes.

5.3. Respiratory System Protection

5.3.1. Chemical Hood

Handling that involves the use of solvents and other volatile products (flammable or combustible), as well as concentrated acids or bases, absolutely must be done under a chemical hood. Operations that can release harmful dust or smoke must also be done under a hood. The experimenter must make sure that the hood is working properly. This can easily be determined by attaching a piece of paper to the bottom of the hood window. The paper must be sucked in toward the inside.

The hood offers best protection when its window is lowered to roughly the 2/3 mark. The audible alarm must not be muted, as the user needs to be warned when evacuation falls below a predetermined value. If the alarm sounds continually, notify the maintenance, prevention, and repair services of the *Service des immeubles* or Building Service (ext. **67800**). Hoods are calibrated by ventilation engineers roughly once per year. They are also adjusted to run properly when the laboratory windows are closed. Do not open laboratory windows, or else ventilation will be unbalanced and you may no longer be protected while working under a chemical hood.

To make sure the hood provides maximum protection, the following directives should be observed:

- All large equipment inside the hood should be placed on blocks or legs to allow air to circulate underneath it.
- Only materials used in a current experiment should be placed inside the hood. Overloading the hood can cause problems with air circulation.
- Use the hood with the window lowered as much as possible without adversely affecting activities.
- Work as far inside the hood as possible. A minimum of 15 cm is recommended.
- Stand in front of the hood, with only forearms inside. The lowered window will protect your face and neck from any projections.
- Chemical solutions and products should also be placed well inside the hood.
- Avoid drafts in front of the hood. Foot traffic can be sufficient to cause air turbulence.

- Avoid leaving paper in the hood, especially when working with flammable products. Papers sucked into the hood duct can dramatically reduce its effectiveness.
- All chemical product and solvent transfers should be made under the hood (filling of wash bottles, for example). Limited quantities should be handled.
- Used solvents and other waste stored in a chemical hood must be clearly identified. Limit quantities to one 4 L bottle.
- Keep the hood window lowered when you are away.

When the protection provided by the chemical hood is insufficient, inadequate, or non-existent, masks with cartridges for vapours should be worn. A risks analysis must be carried out on a case-by-case basis. Contact a member of the health and safety team (SSMTE) for help and advice on the choice of the best respiratory protection (info.sst@usherbrooke.ca). Appropriate particle masks must also be worn when handling ultrafine powders. All contaminated surfaces must be cleaned and decontaminated as soon as possible.

5.3.2. Masks for Organic and Inorganic Vapours

Two types of masks and cartridges are available for protection from organic and inorganic vapours. Half masks and complete face masks can be used with specific cartridges equipped or not with a P100 pre-filter. Activated carbon cartridges offer protection against organic vapours, chlorine, sulfur dioxide, chlorine dioxide, hydrogen chloride, hydrogen sulfide, ammonia, methylamine, formaldehyde, and hydrogen fluoride. The same cartridges equipped with a P100 pre-filter offer the same chemical protection in addition to protection against all types of particle aerosols. Individuals who have to wear this type of respiratory protection must undergo specific training from laboratory supervisors, as well as a qualitative test, the fit test, to adjust masks before their initial use. The SSMTE division can be contacted for this test (info.sst@usherbrooke.ca).

Protection factors have been developed for the various types of masks. The protection factor (PF) is defined as the relation of contaminant concentrations measured outside the protective device (C_o) and inside the respiratory protection device (C_i): $PF = C_o/C_i$. A disposable half mask has a PF of 10, a half mask with cartridges has a PF of 25, and a full face mask with

cartridges has a PF of 50 to 100. Depending on the concentration of toxic particles, a given mask therefore may not offer sufficient protection; make sure to use adequate protection.

5.3.3. Masks for Particle Aerosols

Two 3M type masks are also available for protection against particle aerosols. First, there are 8511 N95 type disposable masks, which are suitable for dusty environments that do not contain oil in aerosol form. Second, there are 3M (6000 series) half masks, which are used with 7093 P100 cartridges. This type of cartridge provides greater protection against all types of particle aerosols.

5.3.4. Definitions of Particle Filter Types

Type	Efficiency level*	Use
N95	95%	Oil-free particle aerosols
R95	95%	All particle aerosols
P100	99.97%	All particle aerosols

* Determined for 0.3 micron particles.

5.4. Biological Safety Cabinets

The use of biological safety cabinets (BSC) is an effective primary means for containment when combined with other safe laboratory practices. Depending on the class, BSCs provide protection for the environment, the user, and/or the sample. As such, they are used for handling infectious, toxic, or allergenic materials requiring CL2 or above. To ensure a safe work environment, BSCs must comply with standard NSF-49 and be subject to a yearly certification program. It is important to avoid handling hazardous chemical products within BSCs, since most of them recycle air within the laboratory. Furthermore, certain chemical products can damage the HEPA filter, an essential element for the smooth running of the BSC. It should also be noted that laminar flow hoods (Appendix 7, Fig. 1) are not BSCs since

they are designed to protect only the sample and not the experimenter or the environment; they must consequently be avoided for handling in CL2 and above.

5.4.1. Class Descriptions

Class I

BSCs in this class protect the experimenter and the environment but not the sample contained inside the BSC. Indeed, ambient air passes directly on the working surface before being vacuumed through a HEPA filter, then evacuated in the laboratory (Appendix 7, Fig. 2a and 2b).

Class II

This type of BSC enables protection of the experimenter, the environment, and the sample. It is adapted for CL2 and CL3 handling. However, if the experimenter is wearing a pressure suit, a class II BSC can be used for CL4 experiments. There are four types of class II BSCs, namely A1, A2, B1, and B2. They are distinguished by, among other things, the speed and direction of air flow, as well as their evacuation system (Appendix 7, Fig. 3-6).

Class III

This BSC class is adapted for handling agents belonging to risk group 4 and provides protection for the experimenter, the sample, and the environment. It is characterized by a completely closed and gastight work environment whose air supply and evacuation is provided through HEPA filters. The working surface is accessible by means of long rubber gloves fastened to the panel in front of the cabinet. This device is an alternative to maximum security laboratories, where a pressure suit must normally be worn (Appendix 7, Fig. 7).

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6. General Regulations

6.1. Limitations

The following list of regulations is not restrictive. At any time, supervisors may restrict or end certain tests or work if they deem them unsafe.

6.2. Laboratory Accessibility

Access to research laboratories is restricted; all visitors must be accompanied by a member of the laboratory and comply with the safety procedures in force.

6.3. Training

Within four months following their arrival, all new students and employees must undergo health and safety training. It is the responsibility of the professor in charge of the laboratory to ensure that newcomers are properly trained in safety regulations and emergency procedures before they can handle equipment or hazardous materials. It is also essential to make sure that they are familiar with all equipment controls, in particular start and stop procedures, before using this equipment. As needed, ask for help from an experienced individual in your department.

Supervisors can write, update, and provide the procedures for operating and maintaining the equipment used in their laboratories.

6.4. Risk Analysis

The establishment of any new experiment or major change to experimental fixtures must be preceded by a proper risk analysis, that is, a thorough reflection on all possible risks, as described below.

6.4.1. Chemical Risks

Before beginning an experiment involving the use of chemical products, the employee or student must absolutely be familiar with the risks associated with the products in question by, among other things, becoming familiar with the relevant safety data sheets. These data sheets are usually available from the suppliers of chemical products, or on one of the websites indicated on the following site: http://www.usherbrooke.ca/immeubles/sante-et-securite/produits-chimiques/fiches-signaletiques/. As needed, SSMTE division staff can also be consulted (info.SST@USherbrooke.ca or GMD@USherbrooke.ca). Appendix 3 provides an example of a safety data sheet, as well as a glossary of terms and abbreviations found on this sheet.

6.4.2. Biological Risks

Setting up a biological experiment requires an evaluation of the risks involved. Hence, it is important to become familiar with the type of biological material and the CL required for safe handling. Several aspects must be considered, for example the quantities and concentrations of the biological agent needed, the type of experiment conducted (in vitro, in vivo, etc.), and the possibility of generating aerosols. When using recombinant organisms, it is important to know if they can produce toxins or virulence factors, if they have oncogenetic properties, if they are capable of replication or reversion, and if they modify their host organisms. A decision grid regarding risks and the required CL is available in Appendix 8. If needed, you can also consult SSMTE division staff (Biosecurite@USherbrooke.ca).

6.4.3. Nuclear Risks

Open and closed radioactive sources are used in several laboratories at the Université de Sherbooke. Each laboratory must have an internal permit before admitting these sources. Any employee or student required to handle an open or sealed source must have followed specific training in radiation protection. For more information on the training or risk evaluation for the handling of radioactive sources, see the SSMTE's *Guide de radioprotection* at http://www.usherbrooke.ca/immeubles/sante-et-securite/radioprotection/guide-de-radioprotection/ or request assistance from radiation protection advisors.

6.4.4. Electrical Risks

It is mandatory to clearly indicate the hazards in line with experiments that use electric current with high intensities or high voltage. In addition, special attention must be paid to the electrical components of devices, and especially their wires, in order to make sure that they are free of defects. Any modification or direct plugging (other than using an electrical plug) can be done only by a person who has a qualifying certificate in electricity.

In the case of electrical devices that require buffers, for example electrophoresis devices, it is important to make sure that there are no leaks and that the working surface is dry before turning on the device, as ionic solutions are conductive. In addition, you should never tamper with an electrical device so as to override the security system.

6.4.5. Thermal Risks

The hazards associated with experiments conducted at high temperatures and experiments involving cryogenic substances must also be clearly indicated by means of a display including the temperatures or substances involved. Personal protective equipment in line with thermal stress must be available and worn as needed.

6.4.6. Mechanical Risks

Special attention should be paid to any experimental fixtures, equipment, or tools equipped with moving parts that can involve hazards to physical integrity. In such cases, it is necessary to avoid wearing clothes or accessories that may constitute an additional hazard. Long hair must be tied back, and jewelry such as necklaces and bracelets are prohibited, as are veils and scarves. In addition, to minimize risks, it is important to protect rotating parts using appropriate devices. For example, belt drive vacuum pumps must always be equipped with guards.

Attention must be given to hazards relating to pieces of glass placed under vacuum or pressure, as they can implode or explode if the glass has a weakness (a crack in the form of a star, for example) and project very sharp pieces of glass. Regularly inspect your glassware

and discard or repair any damaged items. Check your glassware before putting it under vacuum, and protect it with plastic mesh netting if you leave it under vacuum or under pressure for long periods. Be particularly careful with Dewar flasks, which are glassware under vacuum. They can break on impact and release cryogenic liquids.

Work with centrifuges must be approached with caution since they can cause the formation of biological or chemical aerosols and can project objects. First, it is important to always verify the condition of the tubes before using them. Do not use a tube that is cracked, and be sure to respect the maximum g-force that it can tolerate. Avoid filling tubes to capacity and make sure that lids are secured to reduce risks of spills or leaks that can produce aerosols. In the centrifugation of infectious material, it is important to use a rotor or sealed buckets that can be handled in a BSC, and to decontaminate these elements after they are used. Take care to always properly balance the centrifuge before turning it on (Appendix 10) and never stop the rotor with hands or an object. Finally, it is important to regularly maintain the centrifuge to ensure that no objects hinder the rotation or the locking mechanism, as well as to replace the O-rings if they are dried out or cracked.

6.4.7. Risks Related to the Use of Lasers

A number of laboratories use high-power lasers. These lasers can cause serious injury, particularly to the eyes. A laser safety program has been established at the Université de Sherbrooke, and anyone required to handle a class 3B or 4 laser must also undergo a prior ophthalmological exam. Access to the laser zone must be controlled and this area should be identified by a standard sign and a light sign. For additional information, consult the laser safety tab on the SSMTE website (http://www.usherbrooke.ca/immeubles/sante-et-securite/securite-laser/).

6.5. Location of Safety Equipment

Students and employees must make sure they have noticed the locations of the nearest chemical hoods, biological safety cabinets, hand washing areas, eyewash stations, emergency showers, extinguishers, fire-retardant blankets, and first aid kits. They also must

understand how these items are used before beginning any handling. Remember to check the contents of the first aid kit each month. It is also essential to determine and identify potential risks before beginning work. Laboratory supervisors are required to ensure and document that these instructions have been understood.

6.6. Clearing of Passageways

All access paths, eyewash stations, and emergency showers must remain unobstructed at all times to allow evacuation or effective use in case of emergency. Extinguishers must also remain accessible at all times. A chair, a machine part, a box, or any other object blocking free circulation, temporarily or permanently, is considered an obstacle.

6.7. Running Water

For environmental reasons in particular, it is important to avoid letting water run unnecessarily in laboratories (faucets, vacuum pump systems, etc.). As regards water coolers, there is an additional risk of spilling and even flooding. It is therefore important to secure any pipes in which water is circulating, for example using mesh attached to the cooler, especially if reflux is left unattended, for example in the evening or on the weekend. Also remember to move away any water-reactive compounds. It should be noted that the water in laboratories is not considered drinkable.

6.8. Storage Heights and Heavy Loads

Storing material or equipment at excessive heights can compromise the safety of laboratory users in a variety of situations. Objects put away on tablets or shelves in the laboratory must be easy to reach for a person of average height. Otherwise, it is recommended to use a stool or footstool to reach the object safely. Do not place heavy objects above shoulder height.

In addition, for safety reasons, it is not appropriate to put away heavy objects in high places. Because of their weight, such objects are likely to cause serious injury in case of a fall. In practice, heavy objects should be put away directly on the floor or on lower shelves. To avoid

injury, it is recommended to get the help of another person to move very heavy weights and to use appropriate tools to handle loads, that is, weights that cannot be handled safely. Generally speaking, loads above 50 lbs (22.7 kg) should not be handled by a single person.

6.9. Responsibility and Courtesy

It is a good idea to make colleagues aware of hazards associated with the products being used and with the handling that is being done in order to allow them to better protect themselves from these hazards. All laboratory users must be aware of this collective responsibility and actively participate in establishing work habits that promote safety. Disciplined and responsible behaviour is strongly encouraged. It is also essential to show diligence by reporting any dangerous or unacceptable behaviour.

Out of respect for others, avoid touching fixtures or equipment that is in use. Laboratory users must also clean their work spaces and put away materials after completing their experiments. Also note that running is prohibited in laboratories.

Any tools, devices or chemical products belonging to a research laboratory must remain in the laboratory and any borrowing must have prior approval from laboratory supervisors. Any destruction of material or equipment must be reported to supervisors. Special attention must be given to the state of electrical wires, and any anomalies must be reported to supervisors.

All laboratory users are encouraged to make suggestions for improving safety. All ideas will be followed up by the health and safety committee.

6.10. Sound Level

For everyone's safety, it is important for the sound level in a laboratory to remain moderate. Each person present in the room must be able to hear any unexpected spill or incident, as well as be able to react quickly. As a result, it is prohibited to wear headphones in both ears. In addition, wearing headphones is prohibited in CL2 laboratories because they involve a risk of infection to the ears. Although music can be tolerated at a reasonable level by the professor in charge of the laboratory, it is prohibited in teaching laboratories.

6.11. Working Alone

For safety reasons, work alone in the laboratory is strongly discouraged. Supervisors should approve in advance any laboratory work to be done alone, whether during or outside normal work hours. Working alone must involve a low level of risk. The risk represented by the work must be evaluated on a case-by-case basis. University security may formally require persons working alone and outside working hours to identify themselves.

6.12. Food and Beverages

Preparing, consuming, or storing food or beverages in laboratories is strictly forbidden. The cafeteria or the break rooms should be used for these purposes.

6.13. Personal Effects

To avoid destruction, contamination or theft, all personal effects, including clothes, handbags, backpacks, books, laptop computers, etc. that are not essential to accomplishing work must preferably be left outside the laboratories; otherwise, necessary precautions must be taken to protect personal effects in the laboratory.

6.14. Incident or Accident report

All accidents or incidents, with or without injury, must be reported to laboratory supervisors. In addition, a report must be completed by the University's security staff. For emergencies, **811** (main campus) and **511** (health campus) offer rapid assistance. For special and non-urgent situations, ext. **67699** (internal line) or **819-821-7699** (external line) can be used to reach security staff.

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7. Waste Management

To minimize the environmental impact of education and research activities, the Université de Sherbrooke has adopted various waste management standards. They are described below.

See Appendix 4 for pictures of containers provided to researchers for collecting hazardous waste.

7.1. Producer's responsibility

Those who produce waste become responsible for it. Consequently, they cannot perform operations without prior study of hazardous waste disposal, and without the prior suggestion and adoption of an appropriate solution. In the chemistry department, it is incumbent on the researcher to destroy the most reactive products to make them safe for transportation. Experimenters can contact the SSMTE division for advice on the best way to destroy a reagent, or consult the following article: Lunn, G.; Sansone, E.B. *J. Chem. Edu.* **1992**, 972-976 (http://pubs.acs.org/doi/pdf/10.1021/ed071p972).

The Université de Sherbrooke's hazardous waste management system includes weekly collecting of waste in laboratories, as well as temporary storage and final disposal consistent with government requirements. Laboratory users must simply dispose of waste in the appropriate and well identified containers provided for this purpose. The SSMTE staff provides medium- and large-sized labels for properly identifying the waste containers you will need to use. It is best not to use overly large containers for infrequent waste, so as to ensure that it is regularly collected. The University is billed depending on the container's size, rather than the volume of its content; the choice of bottle size is therefore a factor to consider. Empty and rinsed bottles of chemical products can be reused for waste, but remember to identify them as such using the label that will be given to you by SSMTE staff. No chemical waste should be stored for more than six months to one year.

7.2. Management of Liquid Waste

Liquid waste is separated into five categories to avoid incompatibility and facilitate disposal.

1) Non-halogenated organic liquid waste
2) Halogenated organic liquid waste
3) Diluted acidic aqueous solutions
4) Diluted basic aqueous solutions

Make sure not to overfill the containers provided to you. The 10 or 20 L containers have a shoulder line that should not be exceeded. Indicate the content on the label as soon as you begin filling the container (one of the four classes described above). Be specific if the container contains only one or two types of solvents (acetonitrile/water 60:40, for example).

Solutions containing oxidizers, toxic compounds (cyanide ions, ethidium bromide, phenol, formol, heavy metal salts, etc.) or high concentrations of acids or bases (> 5 M) should be segregated from the other solutions and given to the persons in charge of collecting waste, in clearly identified containers. If the solution comes from the destruction of reactive compounds, this should be specified on the label (for example neutralized alkali metal or neutralized metal hydride). Any questions on this subject can be addressed to SSMTE technical staff at the time of collection, or by email at GMD@USherbrooke.ca.

The Environment Quality Act, the by-laws of the City of Sherbrooke, and the policy in force at the Université de Sherbrooke all prohibit sewer disposal of any toxic or flammable products, which may cause damage to pipes, equipment, or the environment, and which can endanger municipal or University employees, and aquatic wildlife.

7.3. Management of Solid Waste

As for solid waste, including metals, it must be individually gathered in clearly identified containers provided for this purpose. In no case should it be thrown away in trash bins. Note that solids saturated with volatile material should be left under a chemical hood for evaporation before being put in a recovery container.

7.4. Management of Other Waste

Broken glass (pipettes or glassware) is placed in waxed cardboard containers already identified for this purpose and available at the hazardous materials management centre (chemistry store at the Faculty of Science; Z6-1017 at the Faculty of Medicine and Health Sciences). When the box is full, cover it with its lid and seal it with duct tape. It can then be placed in the hallway by the laboratory door and will be picked up by cleaning staff. Avoid throwing paper into these containers, since a reaction could occur with the chemical waste in the pipettes (concentrated acid, for example) and cause fire. Note that these boxes are not intended for empty bottles, which can be simply rinsed or left beneath a hood for evaporation, and then thrown away in regular trash bins.

Needles that are not contaminated with biological products can be thrown into white plastic containers, also available from the hazardous materials management centre and already identified for the purpose. When the bottle is full, it must be properly closed with its cap and given to technical staff in charge of collecting hazardous waste.

Anyone who finishes a bottle (acid, base, solvent, or reagent) is responsible for properly rinsing it or ensuring that any remaining volatile matter has evaporated, and then disposing of it in the trash bin. It is important to emphasize that chemical product containers are not recyclable and cannot be collected for recycling.

Special attention should also be paid to mixtures whose composition or nature is unknown, or high-risk agents such as heavy metals, or potentially explosive or dangerously reactive substances, or gas, to make sure they are properly and safely collected. Large gas bottles are collected by the supplier, but not small ones ("lecture bottles"). Once small gas bottles are empty, they must be identified as such and given to technical staff in charge of collecting hazardous waste. If unsure how to proceed, contact the SSMTE staff in charge of waste management on campus (by phone at extension 67626 or by email at GMD@USherbrooke.ca).

Large volumes of agar or melted agarose are not to be poured in the sink, since they can congeal and obstruct waste pipes. Agarose waste contaminated with ethidium bromide must be disposed of in the container provided for this purpose, which will then be picked up by SSMTE staff at the time of collection. Agar waste must be treated like non-anatomical solid biological waste according to the procedure in force in your sector (see 7.5.2 below).

7.5. Biological Waste Management

7.5.1. Anatomical Waste

During experiments involving animals, it is important to separate anatomical waste from other biomedical waste (gauzes, gloves, etc.). All anatomical waste must be brought to the freezer located at the drop-off area of the Faculty of Medicine and Health Sciences or at building D5 of the Department of Biology, so that the SSMTE division can keep a waste register and eliminate said waste by incineration.

7.5.2. Non-Anatomical Solid Waste

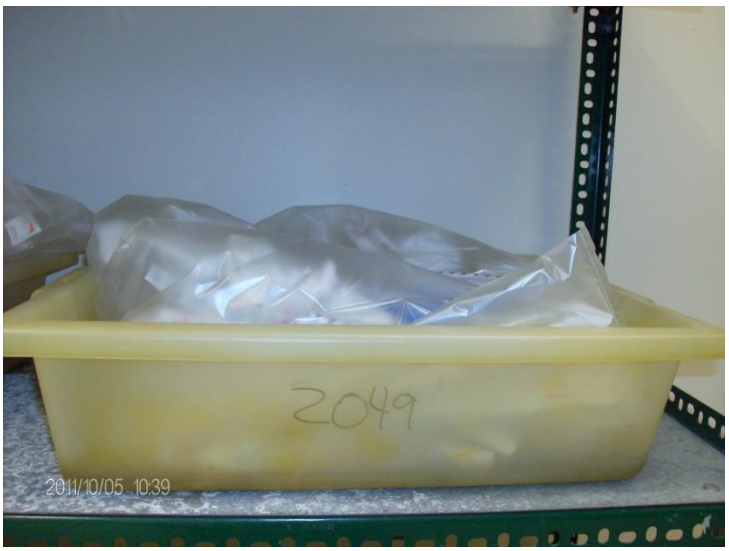
The procedure for eliminating solid non-anatomical waste depends on the sector, such as the Faculty of Medicine (Wing 4 and PRAC), the Pharmacology Institute of Sherbrooke (PIS), the main campus, the CRC, or the Research Centre on Aging. It is important to become informed on the procedure in place within the sector where you work.

Faculty of Medicine (Wing 4 and PRAC), PIS, and Faculty of Engineering (main campus)

Waste must be placed in an autoclavable bag labelled with your room number (see picture below). It is important that bags not be overloaded, doubled, or hermetically sealed. Labware cleaning staff is responsible for decontamination and for keeping the autoclave register. Handling of decontaminated waste is the responsibility of University cleaning staff.

Department of Biology (main campus)

Waste must be put in a plastic autoclavable bag placed in a bin labelled with your room number (see picture below). It is important that bags not be doubled or hermetically sealed. The bottom of the bin must be covered with water to permit efficient decontamination of your waste. During decontamination, it is important not to overload the bag. Regular sterilization efficacy tests are mandatory. These tests are generally performed using a vial containing spores of *Geobacillus stearothermophilus*. The vials must be placed in the middle of the load to be autoclaved; then, at the end of the cycle, they are incubated to determine the presence of bacterial growth. If a test shows growth after 24 hours, the load must undergo another complete decontamination cycle. Laboratory staff members are responsible for keeping a register and for eliminating decontaminated waste.



Autoclavable bag placed in a bin for decontamination.

Centre de recherche clinique (CRC) and Research Centre on Aging

Waste must be placed in a plastic autoclavable bag. It is important that bags not be overloaded, doubled, or hermetically sealed. Sanitary maintenance staff at the CHUS or the research centre is responsible for decontamination, keeping the autoclave register, and handling decontaminated waste.

7.5.3. Prickly, Sharp, and/or Cutting Solid Waste

This category includes not only needles and blades, but also disposable tips of micropipettes, since these can easily pierce autoclavable bags. You must dispose of this waste in puncture-

resistant containers labelled *Biorisque* (biohazard), available free of charge at hazardous waste management centres. Product sterilization and elimination is performed in accordance with the procedure in place within your sector for managing solid non-anatomical waste (see section 7.5.2).

7.5.4. Liquid Waste

This category includes culture media, blood samples, and any other liquids contaminated by an infectious agent. Before performing decontamination, it is important to determine the appropriate technique for a given infectious agent. It is also important to make sure that the liquid does not interfere with the disinfectant solution to be used. Most liquid waste can be decontaminated by dilution with bleach, but it is important to adjust the concentration of active chlorine (0.01-5%) and the contact period in order to ensure thorough disinfection. A commercial solution of bleach for domestic use contains an average of 50g/L of active bleach, and must therefore be diluted 1:500 or used undiluted for effective disinfection. Also keep in mind that a commercial solution of bleach naturally loses roughly half of its active chlorine in approximately 25 to 30 weeks. After the decontamination, you must determine whether the disinfectant used can be eliminated in the city's sewer system. When in doubt, contact the SSMTE division at GMD@USherbrooke.ca. For more details on various active compounds, see the *Laboratory Biosafety Manual,* 3rd edition, published by the World Health Organization and available at the following address: http://www.who.int/csr/resources/publications/biosafety/Biosafety7.pdf. A table covering the principal disinfectants and their microbicidal effects can be found in Appendix 9.

7.6 Recycling

Material that has come into contact with chemical or biological products is not accepted by recycling companies in the city of Sherbrooke, even if you consider that you have sufficiently rinsed it. Conversely, electronic components must be recycled. Notify the laboratory supervisor so that he or she can dispose of it properly. Materials such as paper, cardboard, and plastic must also be sent for recycling. Used batteries can be placed in containers distributed throughout the University, or given to SSMTE technical staff during collection. For any questions on sustainable development at the Université de Sherbrooke, see the following

website: http://www.usherbrooke.ca/developpement-durable/ and address your questions to Stéphane Meloche (Stephane.Meloche@USherbrooke.ca; extension 63857).

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8. Safety Measures

Emergency measures have been developed by the University's Security division. They are detailed (in French) on the following website: http://www.usherbrooke.ca/urgence/mesures-durgence/. They are also available on each faculty and departmental intranet (which can be accessed through the welcome page of the faculty or department of study). Each research group is invited to define its own emergency measures according to the risks present in its laboratories. They are further invited to discuss emergency measures and to practice them regularly, for example upon the arrival of a new group member. Emergency equipment must be available either in the laboratories or nearby.

8.1 Emergency Equipment

8.1.1 Absorbent Materials

Users of chemical products can clean up small spills, depending on the danger of a given product. If unsure of the relevant procedures, you should notify the person responsible for the laboratory, or someone with experience.

It is recommended that absorbent layers be kept nearby, for example those used by the Sigma-Aldrich company to wrap its products. Any major spill will be managed by the emergency team of the SSMTE division. Security Services should be notified first via 811 (main campus) or 511 (health campus); they will then contact the SSMTE division 24/7.

8.1.2 Extinguishers

Anyone working in a laboratory must be familiar with the location of extinguishers, as well as their use. The area surrounding an extinguisher must be kept clear at all times to facilitate access. Each functional extinguisher is equipped with a sealed pin, which can be removed by first turning it to break the seal.

An extinguisher that has been partially emptied should never be put back in place. Any fire must be reported to the Safety and Prevention division by dialing 811 (main campus) or 511 (health campus). An agent will then come to the incident's location, as well as replace the used extinguisher.

Two types of extinguishers are found in and near laboratories:

- In laboratories: BC type extinguishers that contain CO_2. They are recognizable by their cone-shaped tubes and are used to (cleanly) extinguish small type B solvent fires or type C electrical fires.
- In hallways: ABC type extinguishers that contain a non-conductive chemical powder. They are recognizable by their small pressure gauges and the absence of a discharge horn and are used (efficiently, but not as cleanly) to extinguish type A solid matter fires (wood, paper, plastic, etc.), type B solvent fires, and type C electrical fires.

In the case of metallic fires (sodium or magnesium, for example), water must absolutely not be used. If an appropriate type D extinguisher is not available, the use of dry sand or another non-combustible material is recommended.

It is important that the powder be directed at the base of the fire and that one stand as far back as possible from it (3 or 4 m for a powder extinguisher, or 1 to 1.5 m for a CO_2 extinguisher), making sure to keep an exit door behind one's back.

Extinguishers empty within approximately ten seconds, which is enough time to put out a fire (if there is no result after five seconds, or if the fire is too large, then the premises should be left immediately).

8.1.3. Eyewash Fountains and Emergency Showers

If a chemical product comes into contact with the eyes or with any other body part, an eyewash fountain or an emergency shower should be used immediately to reduce potential adverse effects. Affected parts should be rinsed for at least 15 minutes. Since these devices are used in emergency situations—when one is potentially in a state of panic—they must be kept clear of obstructions at all times. Do not hesitate to ask for help if you need to use one of these devices, since it can be difficult to rinse your eyes properly without help.

All persons working in laboratories must know where the eyewash fountains and emergency showers are located, and how to use them. Finally, note that the Université de Sherbrooke is responsible for verifying and draining these devices each month.

8.1.4. Fire Blankets

Fire blankets must be easily accessible at all times. They are used to smother fires. It is important to remember that victims must wrap themselves in the fire blanket and then roll on the ground to avoid “candle effect” burns.

8.1.5. First Aid Kits

A first aid kit compliant with existing regulations must be accessible in each laboratory. Each person working in a laboratory must know the kit’s location. The persons responsible for the laboratory must manage its contents, regularly do its inventory, and renew its content according to needs.

8.2 Emergency Procedures

The following procedures demonstrate the key steps to follow in case of an emergency, whether related to a medical reason, a fire, or a hazardous substance. A witness to an incident is encouraged to intervene if he or she feels comfortable doing so, but only on the condition that the incident’s consequences can be minimized with little risk to him- or herself. In all cases, and regardless of the situation, it is essential to look after one’s own safety first.
The Security Services division can be contacted via **811** (internal phone, main campus), or **819-821-7699** (from an external or mobile phone, on main campus or from PRAC), or **511** (health campus).

8.2.1. Medical Emergency

1) Dial 811 (main campus), or 819-821-7699 (external or mobile phone) or 511 (health studies campus) to contact Security Services;
2) Provide the following information:
   - Your name
   - The location of the incident (as indicated above the door to the room)
   - The nature of the problem;

3) Follow the instructions given by the Security Services representative;
4) Give first aid, if possible;
5) Stop any experiment in progress if it entails additional risks.

8.2.2. Fire, Smoke, or Fire Odors

1) Warn all persons in the laboratory and move everyone away from the hazardous zone;
2) Dial 811 (main campus), or 819-821-7699 (external or mobile phone), or 511 (health studies campus), to contact the Security Services division;
3) Provide the following information:
   - Your name
   - The location of the incident (as indicated above the door to the room)
   - The nature of the problem;
4) Follow instructions from the Security Services division representative;
5) If you are able to do so, use an extinguisher to try to put out the fire;
6) If the fire cannot be controlled, leave the hazardous zone and pull the fire alarm station located in the hallway;
7) Close all doors as you leave;
8) Leave the building through the nearest exit, never use an elevator;
9) Go to the designated meeting point.

8.2.3. Hazardous Substance Accident

You might be called to intervene in the case of minor damage from a chemical product if your health is not endangered (depending on the quantity, toxicity, and volatility of the chemical product), and if containment and absorption equipment is available. Consult the material safety data sheet to find out what doses are toxic and what measures need to be taken in case of accidental dispersion. If you are not sure how to proceed, do not hesitate to have the premises evacuated and to call security using the following procedure:

1) Warn all persons present and if necessary, evacuate the premises immediately;
2) Dial 811 (main campus), or 819-821-7699 (external or mobile phone), or 511 (health studies campus), to contact the Security Services division;

3) Provide the following information:
   - Your name
   - The location of the incident (as indicated above the door of the room)
   - The nature of the problem
   - The type of product: gas, liquid, or solid
   - The name of the product and, if possible, its quantity
   - Your skills in handling this product
   - The potential hazards (injuries, intoxication, contamination, etc.);
4) Follow instructions from the Security Services division representative.

If anyone has been spattered with a hazardous chemical substance, help them remove their contaminated clothing and take them to the nearest safety shower. It is important to rinse skin for at least 15 minutes before consulting a doctor. If the eyes were splashed, rinse them for at least 15 minutes with the eyewash, opening the eyes wide if possible. The substance's data sheet also indicates what first aid should be given in case of contact with skin or eyes. The Security Services division should also be notified as soon as possible.

8.2.4. Biological Substance Spill (more than 1 ml)

1) Allow aerosols to settle for at least 2 minutes;
2) In the case of contamination, change lab coat and wash hands;
3) Cover the liquid with absorbent paper;
4) Abundantly spray with disinfectant in a circular motion, moving from the outside in;
5) Allow 30 minutes for the spray to work;
6) Throw paper away with ordinary trash;
7) Clean the area with soapy water and rinse.

In case of a major spill or emergency, dial 811 (main campus), or 819-821-7699 (external or mobile phone), or 511 (health studies campus), to contact the Security Services division, which will then contact the SSMTE division.

8.2.5. Evacuation Procedure

Two types of evacuation signals are in place at the Université de Sherbrooke:

- Precursor signal: 20 beeps per minute or one beep every 3 seconds. Secure any experiments in progress and get ready to go outside. Close the laboratory windows and door, and wait for instructions from the person in charge of evacuation, or for the evacuation signal.
- Immediate evacuation signal: 120 beeps per minute or two beeps per second. Leave the building right away, calmly, through the nearest safe exit, and follow instructions from the persons in charge of evacuation (wearing an orange or blue security patch). Do not use elevators.

In certain cases, the evacuation signal will sound immediately, without a precursor signal. Hurry to secure the laboratory and leave the premises. Make sure to close the windows and doors.

When you have to evacuate your building, join your assembly point outside and await instructions from the security guards or from the persons in charge of evacuation before returning inside the building.

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9. Resource Persons

Resource persons are available in every department at the Université de Sherbrooke. It is important to become familiar with the members of the Health and Safety Committee, as well as evacuation coordinators and first aid attendants, within your department. Information on emergency procedures and faculty resource persons can be obtained by logging into the intranet section of your faculty's website.

10. *Santé et sécurité en milieu de travail et d'études* (SSMTE) Division

The SSMTE division at the Université de Sherbrooke is associated with the *Service des immeubles* or Building Services and can be found in building B4. Among other things, it is responsible for managing waste and transporting hazardous materials off campus. It also offers workstation risk analysis, for example as part of the provincial Safe Maternity Experience Program. Employees and students can use this service to assess the risks involved in their work environments during pregnancy or breast-feeding.

SSMTE staff members are available to answer any questions you may have on hazardous materials, laser-related and biological risks, radiation protection, or workstation ergonomics.

The division's organizational structure and contact information can be consulted at http://www.usherbrooke.ca/immeubles/le-service/personnel/ssmte/.

For any questions regarding the management of hazardous waste, write to GMD@USherbrooke.ca.

For any questions regarding the transportation of hazardous materials, write to TMD@USherbrooke.ca.

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Appendix 1: Personal Protective Equipment

1. Glasses

Regular

over-glasses

eyeglasses

goggles

2. Face Shield for Handling Cryogens

3. Lab coat

4. Gloves

Disposable nitrile gloves

Thick neoprene gloves

Gloves for cryogens or high temperatures

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Appendix 2: Further Information on WHMIS Categories

WHMIS is a Pan-Canadian system designed in collaboration with employers, unions, and provincial and federal governments. Its aim is to protect worker health and safety by promoting access to information on hazardous materials used in work settings, especially by means of training, proper labelling, and the providing of specific data sheets. It determines responsibilities concerning hazardous materials for suppliers, employers, and workers. For more information, see http://www.reptox.csst.qc.ca/SIMDUT.htm.

The risks represented by the products are detailed on their respective data sheets, which must be made available by suppliers, usually on their websites. The various grids are explained on the following website: http://www.reptox.csst.qc.ca/Documents/SIMDUT/GuideAng/Htm/GuideAng.htm.

It is important to thoroughly understand the following terms and abbreviations:

- **Lethal dose 50** (LD50): Amount of a substance that causes the death of 50% of laboratory animals exposed to it orally (ingestion) or cutaneously. Expressed in mg/kg.
- **Lethal concentration 50** (LC50): Concentration of a substance in the air that causes the death of 50% of laboratory animals exposed to it by inhalation, generally for 4 hours. Expressed in mg/m^3.
- **Flash point**: Lowest temperature at which a substance gives off sufficient vapours to form a flammable mixture with the air on contact with a flame or spark. The lower a liquid's flash point, the greater the risk of fire.
- **Auto-ignition point**: Lowest temperature at which spontaneous combustion of a product occurs. It begins to burn by itself in the absence of any flame or spark. The closer the auto-ignition temperature to the ambient temperature, the greater the risk of fire.
- **Lower and upper explosive limit or flammable limits**: Minimum and maximum concentrations of a product in the air between which a flammable or explosive mixture can form in the presence of an ignition source. These concentrations are expressed as a percentage of the volume in the air. Their values vary depending on temperature and

pressure. Thus, unless otherwise indicated, the concentrations are usually given at 25°C and 1 atm.

- **Exposure limits**: Three values are usually indicated regarding the exposure level in the air that must not be exceeded:
  - **Short-term exposure value** (STEV): Not to be exceeded over a 15-minute period.
  - **Time-weighted average exposure value** (TWA): Not to be exceeded for an 8-hour workday and a 40-hour workweek.
  - **Immediately dangerous to life or health** (IDLH): Maximum concentration of a product in an area from which an individual could escape within 30 minutes without experiencing escape-impairing symptoms or irreversible health effects.
  - Example for acetone: STEV = 1000 ppm, TWA = 500 ppm, and ILDH = 2500 ppm.

WHMIS divides hazards into six categories (A to F) each represented by a symbol, and certain categories are separated into divisions. A product can belong to several categories, in which case the different symbols are written on the bottle.

- **Category A: compressed gas**, *i.e.* any substance contained under pressure, including a compressed gas, a dissolved gas, or a gas liquefied by compression or refrigeration.
  - Examples: argon, nitrogen (gaseous or liquid), oxygen, acetylene, etc.
  - Risks: projection of the gas bottle under pressure, explosion under the effect of impact or heat, simple or chemical asphyxia, and risks specific to cryogenic substances.
  - Precautions: handle gas bottles with care (see recommendations in Section 2.4.).

- **Category B: flammable and combustible substances** separated into six divisions:
  - **B1 –** flammable gas: gas that forms a flammable mixture starting at a concentration below or equal to 13% per volume of air, or whose explosive range is at least 12%.
  - Examples: hydrogen, acetylene, propane, etc.

- **B2** – flammable liquids (flash point ≤ 37.8°C or 100°F)
- Examples: acetone, hexane, ethanol, etc.
- **B3** – combustible liquids (37.8°C ≤ flash point ≤ 93.3°C or 100°F ≤ flash point ≤ 200°F)
- Examples: kerosene, glacial acetic acid, etc.
- **B4** – Flammable solids: will cause a fire under the effect of friction or heat, can be ignited readily, and when ignited cause vigorous and persistent burns.
- Examples: yellow phosphorous, silicon, silicium, sodium borohydride, etc.
- **B5** – flammable aerosols: aerosols which, when the container valve is pressed and exposed to fire, will cause a flashback.
- Examples: paints, cleaning products (because propellants in cans are often flammable gases), etc.
- **B6** – flammable reactive materials: products that can spontaneously combust on contact with air and/or that yield a flammable gas; or that spontaneously ignite on contact with water or water vapour.
- Examples: lithium hydride, potassium, magnesium, etc.
- Precautions: whenever possible, all category B products should be kept away from oxidizing materials (category C) and heat sources during storage and use.

- **Category C: oxidizing materials**, which cause or contribute to the combustion of materials by yielding oxygen or another oxidizing substance.
  - Examples: oxygen, chlorine, nitric acid, organic peroxides, etc.
  - Risks: can cause a fire or explosion; are incompatible with combustible and flammable organic substances.
  - Precautions: especially keep away from category B and organic materials.

- **Category D: materials causing immediate and serious toxic effects, and infectious materials,** divided into several categories and sub-categories:
  - **D1** – materials with toxic and serious effects:
    - **D1A** – very toxic materials with very low LD50 and LC50 values.
    - Examples: formaldehyde, methanol, HF, H_2SO_4, etc.

        - **D1B** – toxic materials with low LD50 and LC50 values, but higher than those mentioned above.
        - Examples: ammonia, diethylamine, propionic acid, etc.
    - **D2** – materials with other toxic effects:
        - **D2A** – very toxic materials that cause sufficiently serious reactions to threaten life or cause serious permanent disability.
        - Risks: teratogenicity and embryotoxicity, carcinogenicity, reproductive toxicity, respiratory sensitization, or mutagenicity proven in humans.
        - Examples: lead, mercury, benzene, asbestos, PCB, etc.
        - **D2B** – toxic materials which, in trials for chronic toxic effects, cause irritations, burns, or sensitization.
        - Risks: skin and eye irritation, skin sensitization, or proven mutagenicity.
        - Examples: acetone, ethanol, hexane, etc.
    - **D3** – infectious materials (biological risks), i.e. various organisms and their toxins, if it was demonstrated that the organism caused disease in humans or animals or was the probable cause thereof; special training is required to handle these infectious agents.
        - Examples: viruses and bacteria.

- **Category E: corrosive materials**, *i.e.* any product that has a corrosive effect on metals and/or skin.
    - Examples: acids (pH ≤ 2) and bases (pH ≥ 12), phenol, chlorine, etc.
    - Risks: corrosion; skin, eye, and respiratory burns; reactions with other products, etc.
    - Precautions: wear required personal protective equipment and make sure that area is well-ventilated.

- **Category F : dangerously reactive materials** that can be classified according to their characteristics:
    - Subject to violent polymerization, decomposition, or condensation (examples: methyl acrylate, hydrogen cyanide, etc.).

- Self-reactive under the effect of impact or an increase in pressure or temperature (examples: picric acid, diazomethane, nitroglycerine, etc.).
- Prone to react violently to water and yield toxic gas (examples: phosphorus pentachloride, aluminium chloride, etc.).
- Risks: fire, explosion and incompatibility with other products, etc.
- Precautions: keep away from heat; use laboratory's exhaust hood and open container delicately; wear personal protective equipment, especially a visor; follow manufacturer's recommendations regarding storage measures; regularly check for and dispose of old products.

To conclude, all individuals working in a laboratory should:

- **Read and understand the safety data sheet before using a chemical product;**
- **Always wear the recommended personal protective equipment written on the sheet;**
- **Avoid all contact with the chemical product (skin, eyes, and respiratory tract).**

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Appendix 3: Material Safety Data Sheets

A3.1. WHMIS vs. GHS

WHMIS (9 sections)	GHS (16 sections)
Product Information	Product Identification
	Hazards identification*
Hazardous Ingredients	Composition / Information on Ingredients
First Aid Measures	First Aid Measures
Fire or Explosion Hazard	Fire Fighting Measures
	Accidental Release Measures
Preventive Measures	Handling and Storage
	Exposure Controls / Personal Protection
Physical Data	Physical and Chemical Properties
Reactivity Data	Stability and Reactivity
Toxicological Properties	Toxicological Information
	Ecological Information*
	Disposal Considerations
	Transport Information*
	Regulatory Information*
Preparation Information	Other Information

*New informations

Source: http://www.ccohs.ca/oshanswers/legisl/msds_prep.html

A3.2. Glossary

Also see the lexicon available at http://www.reptox.csst.qc.ca/Lexique-A.htm

Acute toxicity: Adverse health effects following brief exposure to a chemical product.

Allergen: Compound that causes an immune response (dermatitis, eczema, conjunctivitis, rhinitis, asthma, and/or bronchitis) following prolonged or repeated contact.

Antagonism: Situation that arises when the combined effect of two or more compounds is less toxic than the individual effects of these substances.

Auto-ignition point: Lowest temperature at which a liquid spontaneously ignites without any apparent source of ignition such as a spark or flame.

C or CEV: Ceiling Exposure Value = exposure value that must never be exceeded for any length of time. This value is expressed in ppm or mg/m³.

Carcinogenicity: Undesirable effects due to a chemical product and expressed by the appearance or aggravation of cancer.

Chronic toxicity: Adverse effects following long-term exposure to a chemical product.

Explosive or flammable limit: Minimum (lower limit) or maximum (upper limit) concentration of a flammable gas or vapour in the air between which ignition may occur.

Fire point: Temperature at which the quantity of vapours released by the solvent is sufficient for combustion to continue even after the heat source responsible for the fire is removed.

Flash point: Lowest temperature at which a liquid can ignite on contact with a heat source such as a flame, spark, etc. If the heat source is removed, the fire stops.

IDLH: Immediately Dangerous to Life or Health = maximum concentration of a product in an area from which an individual can escape in a timeframe of 30 minutes, without experiencing symptoms that prevent escape and without producing irreversible effects to health.

LC50: Lethal concentration 50% = concentration of vapours, gas, or suspended matter that kills 50% of animals in a test group. The information normally includes the animal, route of entry, and time of exposure (4 hours by default).

LD50: Lethal dose 50% = dose of a liquid or solid that kills 50% of animals in a test group, measured over 24 hours. Information normally includes the animal and the route of entry.

Local toxicity: Adverse effects at the point of contact with a chemical product.

Mutagenicity: Undesirable effects of a chemical product that provokes the appearance of damage in DNA, possibly leading to mutations.

Relative vapour density: Relationship between the mass of a vapour or a gas and the mass of an equivalent volume of air. This information will tell you whether the vapour will be located closer to ground level ($d>1$) or to ceiling level ($d<1$).

Sensitization: Reaction of an organism following exposure to a physical, chemical, or biological agent leading to an allergic response of the respiratory tract (rhinitis, asthma) or the skin (eczema).

Specific toxicity: Adverse effects on a specific organ.

STEL: Short Term Exposure Limit = the 15-minute time-weighted average concentration for exposure to a chemical substance (in the form of gas, dust, vapours, or mist) present in the air in a worker's respiratory zone, which should not be exceeded at any time during a

workday, even if the time-weighted average exposure value is not exceeded. This value is expressed in ppm, mg/m³ or fibre/cm³.

Synergy: Situation produced when simultaneous exposure to two or more chemical products provokes health effects that are greater than the sum of the individual effects of these products.

Systemic toxicity: Adverse effects observed following exposure to a chemical product in multiple areas (liver, kidneys, lungs, blood, etc.).

Teratogenicity: Adverse effects on fetal development, which may cause physical malformations, without affecting the mother.

TWA: Time weighted average = average concentration, weighted for a period of 8 hours per day, of a chemical substance (in the form of gas, dust, smoke, vapours, or mist) present in the air in a worker's respiratory zone. This value is expressed in ppm, mg/m³ or fibre/cm³.

A3.3. Example: material safety data sheet for concentrated hydrochloric acid, as provided by the company Sigma-Aldrich.

SIGMA-ALDRICH *sigma-aldrich.com*

Material Safety Data Sheet

Version 5.0
Revision Date 05/27/2011
Print Date 02/20/2012

1. PRODUCT AND COMPANY IDENTIFICATION

Product name : Hydrochloric acid, 37%
Product Number : 320331
Brand : Sigma-Aldrich
Product Use : For laboratory research purposes.
Supplier : Sigma-Aldrich Canada, Ltd
2149 Winston Park Drive
OAKVILLE ON L6H 6J8
CANADA
Manufacturer : Sigma-Aldrich Corporation
3050 Spruce St.
St. Louis, Missouri 63103 USA
Telephone : +1 9058299500
Fax : +1 9058299292
Emergency Phone # (For both supplier and manufacturer): 1-800-424-9300
Preparation Information : Sigma-Aldrich Corporation
Product Safety - Americas Region 1-800-521-8956

2. HAZARDS IDENTIFICATION

Emergency Overview

WHMIS Classification

D1B Toxic Material Causing Immediate and Serious Toxic Effects; Toxic by inhalation.
E Corrosive.

GHS Classification

Acute toxicity, Oral (Category 5)
Acute toxicity, Inhalation (Category 3)
Skin corrosion (Category 1B)
Serious eye damage (Category 1)
Specific target organ toxicity - single exposure (Category 3)

GHS Label elements, including precautionary statements

Pictogram

Signal word Danger
Hazard statement(s)
H303 May be harmful if swallowed.
H314 Causes severe skin burns and eye damage.
H331 Toxic if inhaled.
H335 May cause respiratory irritation.
Precautionary statement(s)
P261 Avoid breathing dust/ fume/ gas/ mist/ vapours/ spray.
P280 Wear protective gloves/ protective clothing/ eye protection/ face protection.
P305 + P351 + P338 IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

P310 Immediately call a POISON CENTER or doctor/ physician.
HMIS Classification
Health hazard: 3
Flammability: 0
Physical hazards: 0
NFPA Rating
Health hazard: 3
Fire: 0
Reactivity Hazard: 1
Potential Health Effects
Inhalation Toxic if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Skin Harmful if absorbed through skin. Causes skin burns.
Eyes Causes eye burns.
Ingestion Harmful if swallowed.

3. COMPOSITION / INFORMATIONS ON INGREDIENTS

Formula : HCl	No.-CAS	No.-CE	No.-Index	Concentration
Hydrochloric acid	7647-01-0	231-595-7	017-002-01-X	37 %
Water	7732-18-5	231-791-2	-	63 %

4. FIRST AID MEASURES

General advice
Consult a physician. Show this safety data sheet to the doctor in attendance.Move out of dangerous area.
If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.
In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.
In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.Continue rinsing eyes during transport to hospital.
If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

5. FIRE-FIGHTING MEASURES

Conditions of flammability
Not flammable or combustible.
Suitable extinguishing media
Use extinguishing measures that are appropriate to local circumstances and the surrounding environment.
Special protective equipment for fire-fighters
Wear self contained breathing apparatus for fire fighting if necessary.
Hazardous combustion products
Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas
Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas
Explosion data - sensitivity to mechanical impact
no data available
Explosion data - sensitivity to static discharge
no data available
Further information
The product itself does not burn.

6. ACCIDENTAL RELEASE MEASURES

Personal precautions
Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.

Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.
Methods and materials for containment and cleaning up
Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.Soak up with inert absorbent material and dispose of as hazardous waste. Keep in suitable, closed containers for disposal.

7. HANDLING AND STORAGE
Precautions for safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapour or mist.
Conditions for safe storage
Keep container tightly closed in a dry and well-ventilated place. Containers which are opened must be carefully resealed and kept upright to prevent leakage.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION
Components with workplace control parameters

Components	CAS-No.	Value	Controlparameters	Basis
Hydrochloric acid	7647-01-0	(c)	2 ppm, 3 mg/m^3	Canada. Alberta, Occupational Health and Safety Code (table 2: OEL)
		C	2 ppm	Canada. British Columbia OEL
		CEV	2 ppm	Canada. Ontario OELs
		C	5 ppm, 7.5 mg/m^3	Canada. Quebec OELs

Remarks : Occupational exposure limit is based on irritation effects and its adjustment to compensate for unusual work schedules is not required

A substance which may not be recirculated in accordance with section 108.
Personal protective equipment
Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type ABEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).
Hand protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.
Eye protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).
Skin and body protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.
Hygiene measures
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.
Specific engineering controls
Use mechanical exhaust or laboratory fumehood to avoid exposure.

9. PHYSICAL AND CHEMICAL PROPERTIES
Appearance
Form liquid
Colour light yellow
Safety data

pH	no data available
Melting point/freezing point	-30 °C (-22 °F)
Boiling point	> 100 °C (> 212 °F)
Flash point	not applicable
Ignition temperature	no data available

Autoignition temperature	no data available
Lower explosion limit	no data available
Upper explosion limit	no data available
Vapour pressure	226.636 hPa (169.991 mmHg) at 21.1 °C (70.0 °F) 546.596 hPa (409.981 mmHg) at 37.7 °C (99.9 °F)
Density	1.18 g/mL at 25 °C (77 °F)
Water solubility	soluble
Partition coefficient:n-octanol/water	no data available
Viscosity, dynamic	2.3 mPa.s at 15 °C (59 °F)
Relative vapour density	no data available
Odour	pungent
Odour Threshold	no data available
Evaporation rate	no data available

10. STABILITY AND REACTIVITY

Chemical stability

Stable under recommended storage conditions.

Possibility of hazardous reactions

no data available

Conditions to avoid

no data available

Materials to avoid

Bases, Amines, Alkali metals, Metals, permanganates, e.g. potassium permanganate, Fluorine, metal acetylides, hexalithium disilicide

Hazardous decomposition products

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas

Hazardous decomposition products formed under fire conditions. - Hydrogen chloride gas

Other decomposition products - no data available

11. TOXICOLOGICAL INFORMATION

Acute toxicity

Oral LD50

LD50 Oral - rabbit - 900 mg/kg (Hydrochloric acid)

Inhalation LC50

Dermal LD50

no data available (Hydrochloric acid)

Other information on acute toxicity

no data available (Hydrochloric acid)

Skin corrosion/irritation

no data available (Hydrochloric acid)

Serious eye damage/eye irritation

no data available (Hydrochloric acid)

Respiratory or skin sensitization

no data available (Hydrochloric acid)

Germ cell mutagenicity

(Hydrochloric acid)

no data available (Hydrochloric acid)

(Hydrochloric acid)

Carcinogenicity

This product is or contains a component that is not classifiable as to its carcinogenicity based on its IARC, ACGIH, NTP, or EPA classification. (Hydrochloric acid)

IARC: 3 - Group 3: Not classifiable as to its carcinogenicity to humans (Hydrochloric acid)

Reproductive toxicity

no data available (Hydrochloric acid)

Teratogenicity

no data available (Hydrochloric acid)

Specific target organ toxicity - single exposure (Globally Harmonized System)

Inhalation - May cause respiratory irritation. (Hydrochloric acid)
Specific target organ toxicity - repeated exposure (Globally Harmonized System)
no data available
Aspiration hazard
no data available (Hydrochloric acid)
Potential health effects
Inhalation Toxic if inhaled. Material is extremely destructive to the tissue of the mucous membranes and upper respiratory tract.
Ingestion Harmful if swallowed.
Skin Harmful if absorbed through skin. Causes skin burns.
Eyes Causes eye burns.
Signs and Symptoms of Exposure
burning sensation, Cough, wheezing, laryngitis, Shortness of breath, spasm, inflammation and edema of the larynx, spasm, inflammation and edema of the bronchi, pneumonitis, pulmonary edema, Material is extremely destructive to tissue of the mucous membranes and upper respiratory tract, eyes, and skin. (Hydrochloric acid)
Synergistic effects
no data available
Additional Information
RTECS: MW4025000

12. ECOLOGICAL INFORMATION
Toxicity
Toxicity to fish LC50 - Gambusia affinis (Mosquito fish) - 282 mg/l - 96 h (Hydrochloric acid)
Persistence and degradability
no data available
Bioaccumulative potential
no data available
Mobility in soil
no data available (Hydrochloric acid)
PBT and vPvB assessment
no data available
Other adverse effects
no data available

13. DISPOSAL CONSIDERATIONS
Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Contact a licensed professional waste disposal service to dispose of this material. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber.
Contaminated packaging
Dispose of as unused product.

14. TRANSPORT INFORMATION
DOT (US)
UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid
Marine pollutant: No
Poison Inhalation Hazard: No
IMDG
UN number: 1789 Class: 8 Packing group: II EMS-No: F-A, S-B
Proper shipping name: HYDROCHLORIC ACID
Marine pollutant: No
IATA
UN number: 1789 Class: 8 Packing group: II
Proper shipping name: Hydrochloric acid

15. REGULATORY INFORMATION

WHMIS Classification
D1B Toxic Material Causing Immediate and Toxic by inhalation.
E Serious Toxic Effects Corrosive
This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

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16. OTHER INFORMATION
Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Co., shall not be held liable for any damage resulting from handling or from contact with the above product. See reverse side of invoice or packing slip for additional terms and conditions of sale.

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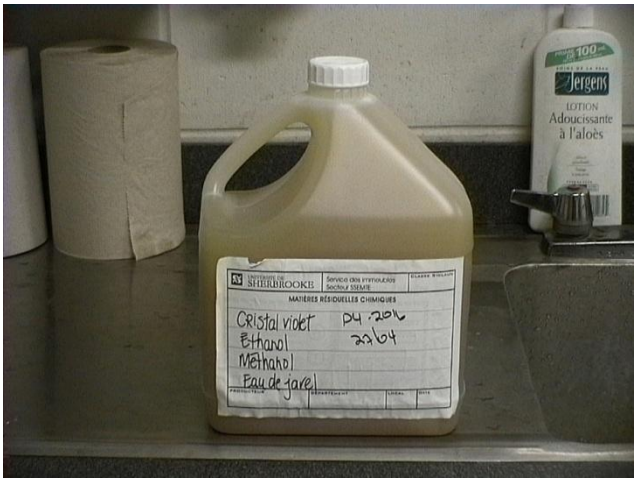
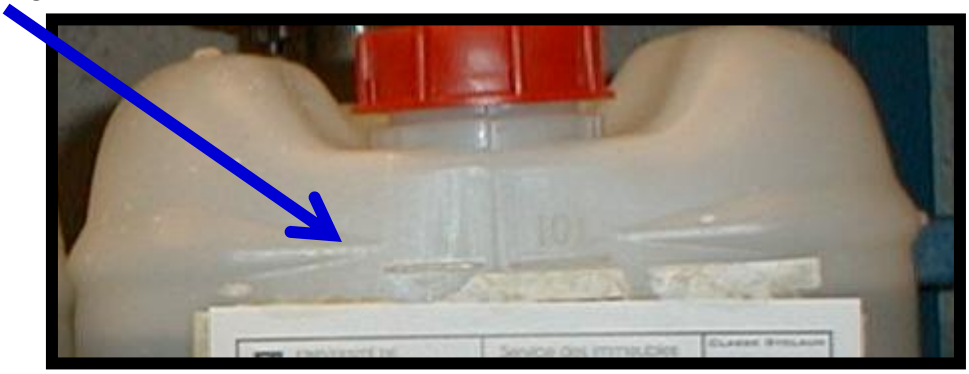
Appendix 4: Containers for Hazardous Waste

Containers for liquid waste:



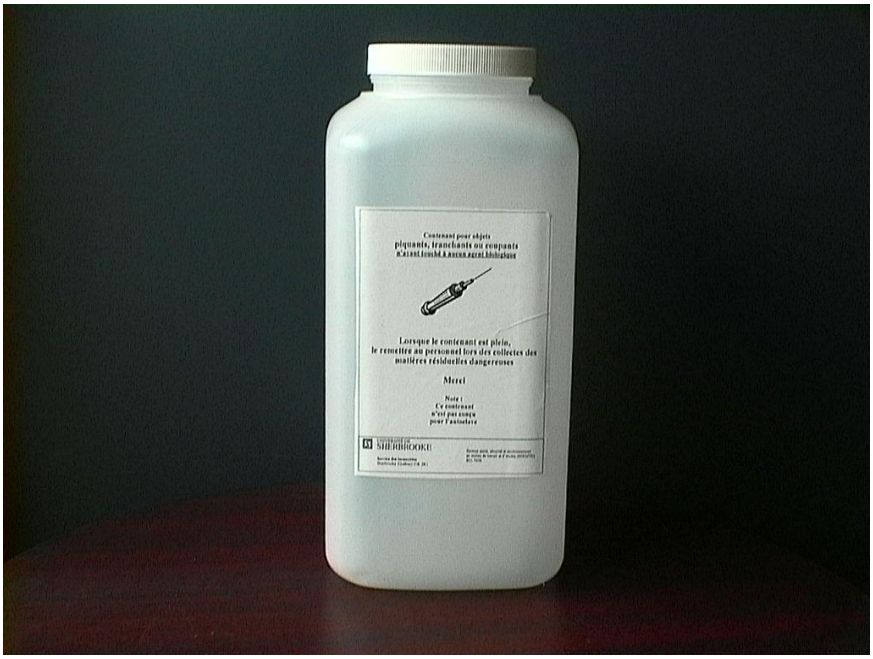
Maximum filling line



Containers for broken glass:

Once filled, attach the lid securely with tape and put the container in the hallway.

Container for used needles, not contaminated by any infectious material:



Puncture proof containers for prickly, sharp, and/or cutting biomedical waste:

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Appendix 5: Specification Sheet for Raji Cell Line, as Provided by ATCC

ATCC

Product Information Sheet for ATCC® CCL-86™

Cell Line Designation: Raji

ATCC® Catalog No. CCL-86™

Table of Contents:

Cell Line Description

Organism: *Homo sapiens* (human)
Tissue: Burkitt's lymphoma; B lymphocyte
Age: 11 years
Gender: male
Ethnicity: Black
Morphology: lymphoblast
Growth properties: suspension
DNA Profile: (STR analysis)

Amelogenin: X,Y
CSF1PO: 10,12
D13S317: 13
D16S539: 8,11
D5S818: 10,13
D7S820: 10
TH01: 6,7
TPOX: 8,13
vWA: 16,19

Virus Resistance: The cells are partially resistant to poliovirus and vesicular stomatitis viruses.
Reverse Transcriptase: negative
Karyotype: Karyotype 100% stable within male diploid stemline of 46. Cells with 47 chromosomes frequently contained an extra "E" group chromosome. There is 6% polyploidy and occasional disparity in the size of the homologs of the number 1 chromosome and the number 4 chromosome.
Note: Cytogenetic information is based on initial seed stock at ATCC. Cytogenetic instability has been reported in the literature for some cell lines.
Depositor: W. Henle
Comments: EBNA positive. The Raji line of lymphoblast-like cells was established by R.J.V. Pulvertaft in 1963 from a Burkitt's lymphoma of the left maxilla of an 11-year-old Black male.

Biosafety Level: 2

Appropriate safety procedures should always be used with this material. Laboratory safety is discussed in the following publication: *Biosafety in Microbiological and Biomedical Laboratories*, 4th ed. HHS Publication No. (CDC) 93-8395. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. Washington DC: U.S. Government Printing Office; 1999. The entire text is available online at www.cdc.gov/od/ohs/biosfty/bmbl4/bmbl4toc.htm.

Use Restrictions

These cells are distributed for research purposes only. ATCC recommends that individuals contemplating commercial use of any cell line first contact the originating investigator to negotiate an agreement. Third party distribution of this cell line is discouraged, since this practice has resulted in the unintentional spreading of cell lines contaminated with inappropriate animal cells or microbes.

Handling Procedure for Frozen Cells

To insure the highest level of viability, thaw the vial and initiate the culture as soon as possible upon receipt. If upon arrival, continued storage of the frozen culture is necessary, it should be stored in liquid nitrogen vapor phase and not at –70°C. Storage at –70°C will result in loss of viability.

SAFETY PRECAUTION: ATCC highly recommends that protective gloves and clothing always be used and a full face mask always be worn when handling frozen vials. *It is important to note that some vials leak when submersed in liquid nitrogen and will slowly fill with liquid nitrogen. Upon thawing, the conversion of the liquid nitrogen back to its gas phase may result in the vessel exploding or blowing off its cap with dangerous force creating flying debris.*

1. Thaw the vial by gentle agitation in a 37°C water bath. To reduce the possibility of contamination, keep the O-ring and cap out of the water. Thawing should be rapid (approximately 2 minutes).

2. Remove the vial from the water bath as soon as the contents are thawed, and decontaminate by dipping in or spraying with 70% ethanol. *All of the operations from this point on should be carried out under strict aseptic conditions.*

3. Transfer the vial contents to a centrifuge tube containing 9.0 ml complete culture medium and spin at approximately 125 x g for 5 to 10 minutes.

4. Resuspend the cell pellet with the recommended complete medium (see the specific batch information for the culture recommended dilution ratio) and dispense into a 25 cm^2 or a 75 cm^2 culture flask. *It is important to avoid excessive alkalinity of the medium during recovery of the cells. It is suggested that, prior to the addition of the vial contents, the culture vessel containing the complete growth medium be placed into the incubator for at least 15 minutes to allow the medium to reach its normal pH (7.0 to 7.6).*

5. Incubate the culture at 37°C in a suitable incubator. A 5% CO_2 in air atmosphere is recommended if using the medium described on this product.

American Type Culture Collection
P.O. Box 1549
Manassas, VA 20108 USA
www.atcc.org

800-638-6597 or 703-365-2700
Fax: 703-365-2750
E-mail: tech@atcc.org
Or contact your local distributor.

Handling Procedure for Flask Cultures

The flask was seeded with cells (see specific batch information), grown, and completely filled with medium at ATCC to prevent loss of cells during shipping.

1. Upon receipt visually examine the culture for macroscopic evidence of any microbial contamination. Using an inverted microscope (preferably equipped with phase-contrast optics), carefully check for any evidence of microbial contamination

2. Incubate the flask in an upright position for several hours at 37°C. After the temperature has equilibrated, aseptically remove the entire contents of the flask and centrifuge at 125 xg for 5 to 10 minutes. Remove shipping medium and save for reuse. Resuspend the cell pellet in 10 ml of this medium.

3. From this cell suspension remove a sample for a cell count and viability. Adjust the cell density of the suspension to 3-5 x 10^5 viable cells/ml in the shipping medium.

4. Incubate the culture, horizontally, at 37°C in a 5% CO_2 in air atmosphere. Maintain the cell density of the culture as suggested under the subculture procedure.

Subculturing Procedure

Cultures can be maintained by addition of fresh medium. Alternatively cultures may be established by centrifugation with subsequent resuspension at 3-5 x 10^5 viable cells/ml. A maximum 2-3 x 10^6 viable cells/ml is obtainable.

Medium Renewal

Every 2 to 3 days

Complete Growth Medium

The base medium for this cell line is ATCC-formulated RPMI-1640 Medium, Catalog No. 30-2001.
To make the complete growth medium, add the following components to the base medium:

- fetal bovine serum to a final concentration of 10%

This medium is formulated for use with a 5% CO_2 in air atmosphere.
ATCC tested fetal bovine serum is available as ATCC® Catalog No. 30-2020.

Cryoprotectant Medium

Complete culture medium described above supplemented with 5% (v/v) DMSO.

Cell culture tested DMSO is available as ATCC® Catalog No. 4-X.

Additional Information

Additional product and technical information can be obtained from the catalog references and the ATCC Web site at www.atcc.org, or by e-mail at tech@atcc.org.
Viral testing: ATCC confirmed this line tested positive for the presence of Epstein Barr virus (EBV) viral DNA sequences via PCR.

References

(additional references may be available in the catalog description at www.atcc.org)

Pulvertaft RJ. **Cytology of Burkitt's tumour (African lymphoma)**. Lancet 1: 238-240, 1964

Epstein MA and Barr YM. **Characteristics and mode of growth of a tissue culture strain (EB1) of human lymphoblasts from Burkitt's lymphoma**. J. Natl. Cancer Inst. 34: 231-240, 1965

Ohsugi Y et al. **Tumorigenicity of human malignant lymphoblasts: comparative study with unmanipulated nude mice, antilymphocyte serum-treated nude mice, and X-irradiated nude mice**. J. Natl. Cancer Inst. 65: 715-718, 1980 PubMed: 81028722

Moore PS et al. **Primary characterization of a herpesvirus agent associated with Kaposi's sarcoma**. J. Virol. 70: 549-558, 1996 PubMed: 96099469

Epstein MA et al. **Morphological and virological investigations on cultured Burkitt tumor lymphoblasts (strain Raji)**. J. Natl. Cancer Inst. 37: 547-559, 1966 PubMed: 67042805

Trans. N.Y. Acad. Sci. 29: 61, 1966

RF42259: Clark RA et al. **Tenascin supports lymphocyte rolling**. J. Cell Biol. 137: 755-765, 1997 PubMed: 97296342

Rich SA et al. **Purification, microresequencing, and immunolocalization of p36, a new interferon-alpha-induced protein that is associated with human lupus inclusions**. J. Biol. Chem. 271: 1118-1126, 1996 PubMed: 96132854

Hay, R. J., Caputo, J. L., and Macy, M. L., Eds. (1992), **ATCC Quality Control Methods for Cell Lines**. 2nd edition, Published by ATCC.

Caputo, J. L., **Biosafety procedures in cell culture**. J. Tissue Culture Methods 11:223-227, 1988.

Fleming, D.O., Richardson, J. H., Tulis, J.J. and Vesley, D., (1995) **Laboratory Safety: Principles and Practice**. Second edition, ASM press, Washington, DC.

ATCC Warranty

The viability of ATCC products is warranted for 30 days from the date of shipment. If you feel there is a problem with this product, contact Technical Services by phone at 800-638-6597 or 703-365-2700 or by e-mail at tech@atcc.org. Or you may contact your local distributor.

Disclaimers

This product is intended for laboratory research purposes only. It is not intended for use in humans.
While ATCC uses reasonable efforts to include accurate and up-to-date information on this product sheet, ATCC makes no warranties or representations as to its accuracy. Citations from scientific literature and patents are provided for informational purposes only. ATCC does not warrant that such information has been confirmed to be accurate.

This product is sent with the condition that you are responsible for its safe storage, handling, and use. ATCC is not liable for any damages or injuries arising from receipt and/or use of this product. While reasonable effort is made to insure authenticity and reliability of strains on deposit, ATCC is not liable for damages arising from the misidentification or misrepresentation of cultures.

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Appendix 6: Handling Procedures in a Biology Safety Cabinet (BSC)

Preparation for use:

1. Activate the cabinet and make sure that ventilation is adequate by checking the pressure indicator;

2. Turn off the UV lamp (if it is on) and wait 15 minutes for the cabinet to be purged of any contaminants;

3. Disinfect the working surface and all inner walls (including the window) with a disinfectant product (e.g. EtOH 70%);

4. Disinfect all materials that must be introduced into the BSC, without obstructing the ventilation grills.

Ground rules for handling:

1. Wear appropriate personal protective equipment, such as gloves and a lab coat;

2. Perform handling as far inside the BSC as possible and never obstruct the ventilation grills surrounding the working surface;

3. Move slowly to avoid interfering with the airflow at the front of the BSC;

4. Use a vacuum system when transferring liquids (e.g. a Pipet-Aid® or a vacuum pump containing bleach);

5. Discard disposable tips of micropipettes in an anti-perforation container to be placed below the cabinet;

6. Place any devices such as homogenizers, centrifuges, or ultrasound devices at the back of the BSC and cease all handling while they are functioning;

7. Place material in such a way as to minimize movements within the cabinet; determine where the “clean zone” and the “contaminated zone” will be (the “contaminated zone” is generally at the back of the cabinet);

8. To avoid cross-contamination:

    a) Do not leave materials such as bottles, flasks or culture plates open in the cabinet;

    b) Never set down a lid during handling;

    c) Never sweep over open materials with hands or objects;

d) Never touch the neck of a bottle with a pipette when transferring liquids.

9. Decontaminate and immediately clean up any spill or splash in the cabinet and do not stop BCS ventilation during decontamination;

10. **Using an open flame in a BSC is forbidden**: it could disrupt air flow or damage the HEPA filter and thus undermine the protection of staff members, the environment, and/or the sample.

After use:

1. Decontaminate all materials that must be removed when the work is over;

2. Decontaminate all materials that need to remain in the cabinet as well as the BSC inner surfaces;

3. Dispose of waste according to procedures described in section 7.5;

4. Remove lab coat and dispose of gloves in biological waste bag;

5. **You must wash your hands prior to leaving the room.**

Never open a BSC in order to repair it, because a formaldehyde gas decontamination procedure must first be undertaken. Opening the BSC can expose you to infectious agents. Furthermore, formaldehyde being a harmful gas, it must be handled by experts only.

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Appendix 7: Biological Handling Cabinets

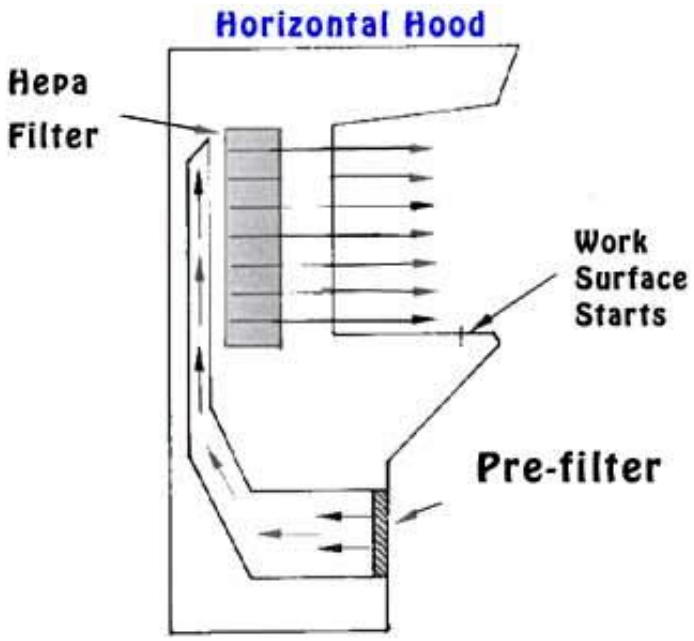

Figure 1. Image of a horizontal laminar flow hood

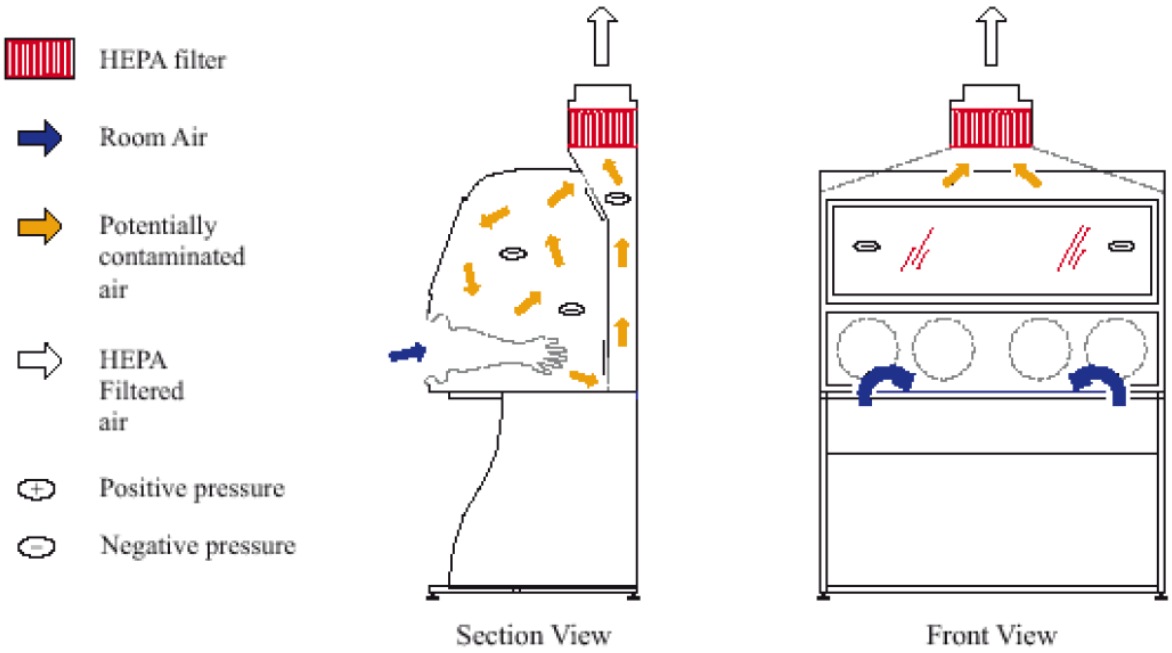

Figure 2a. Class 1 Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

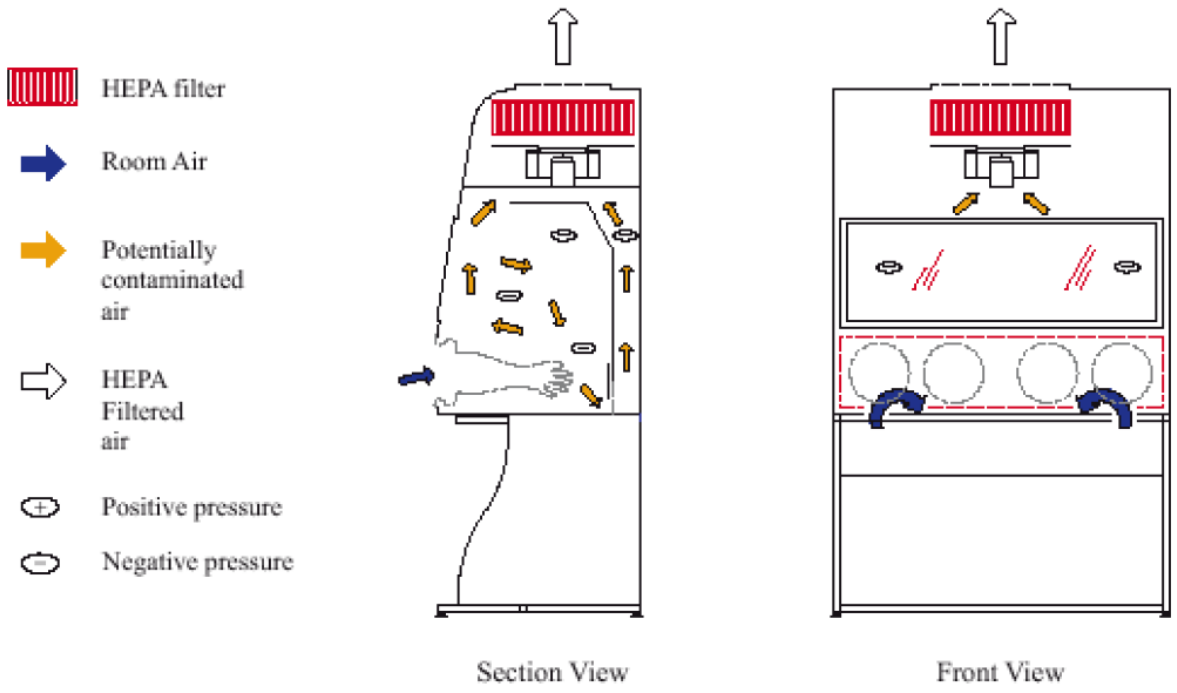

Figure 2b. Class 1 Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

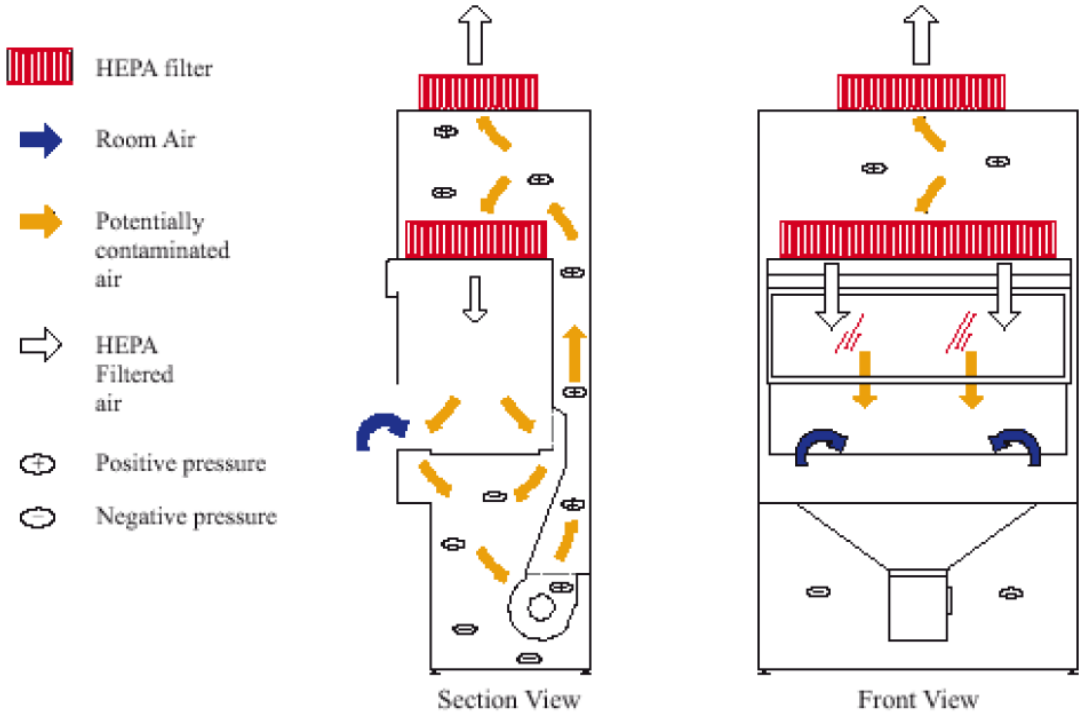

Figure 3. Class II / type A1 Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

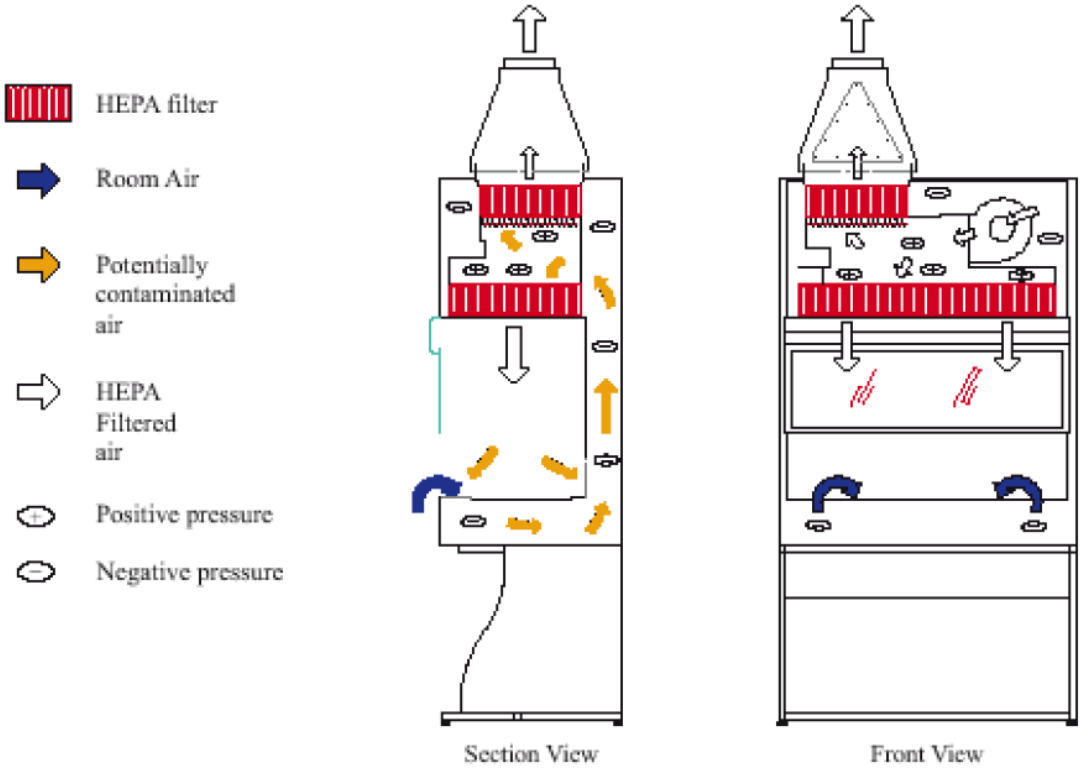

Figure 4. Class II type A2 Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

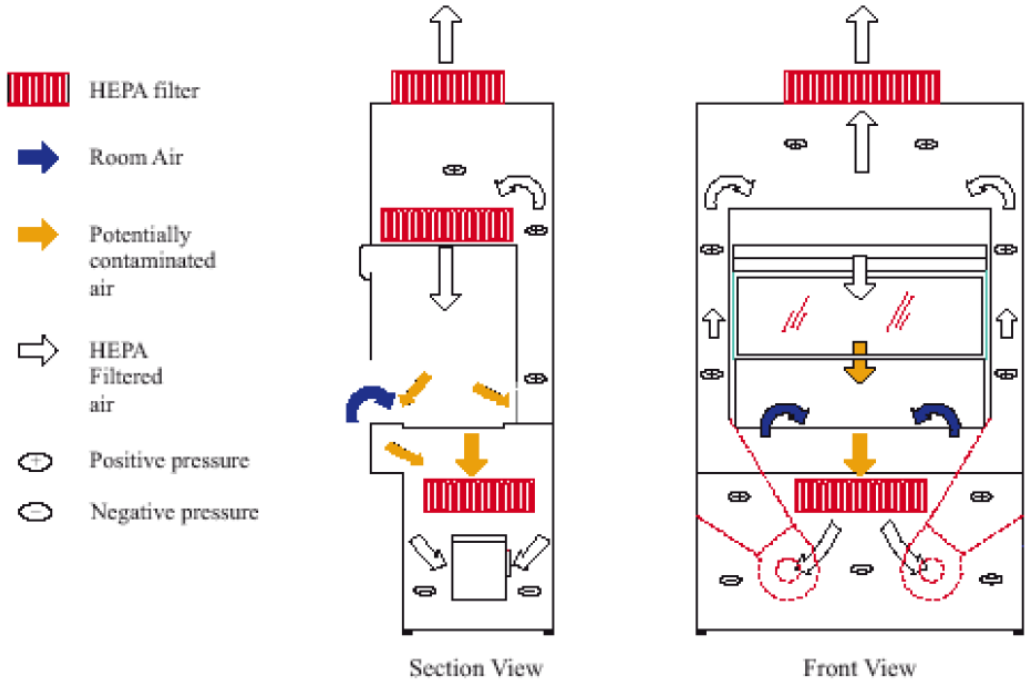

Figure 5. Classe II type B1Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

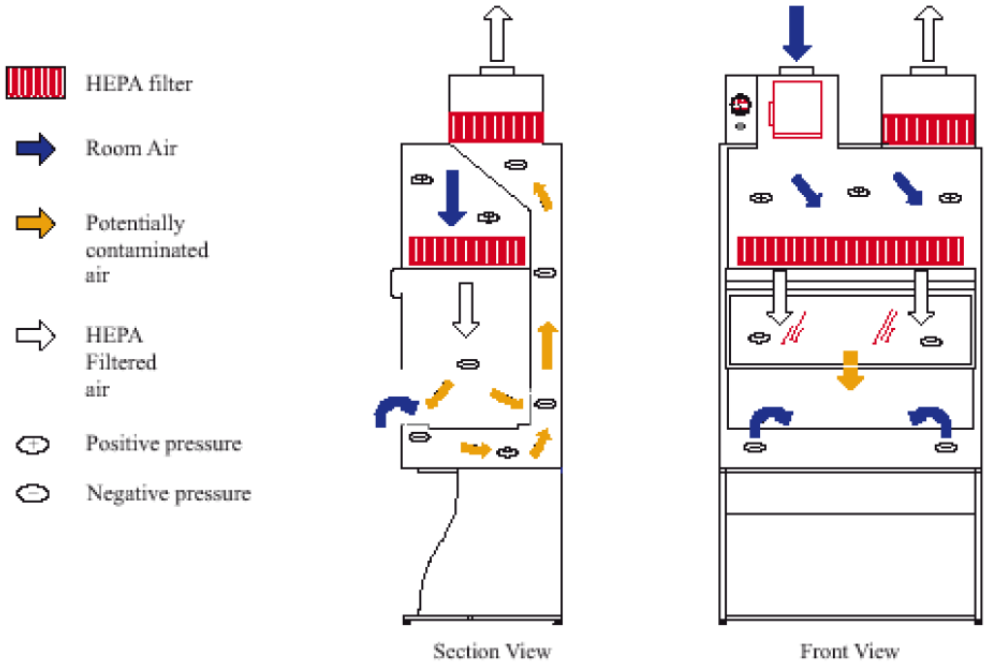

Figure 6. Classe II type B2 Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

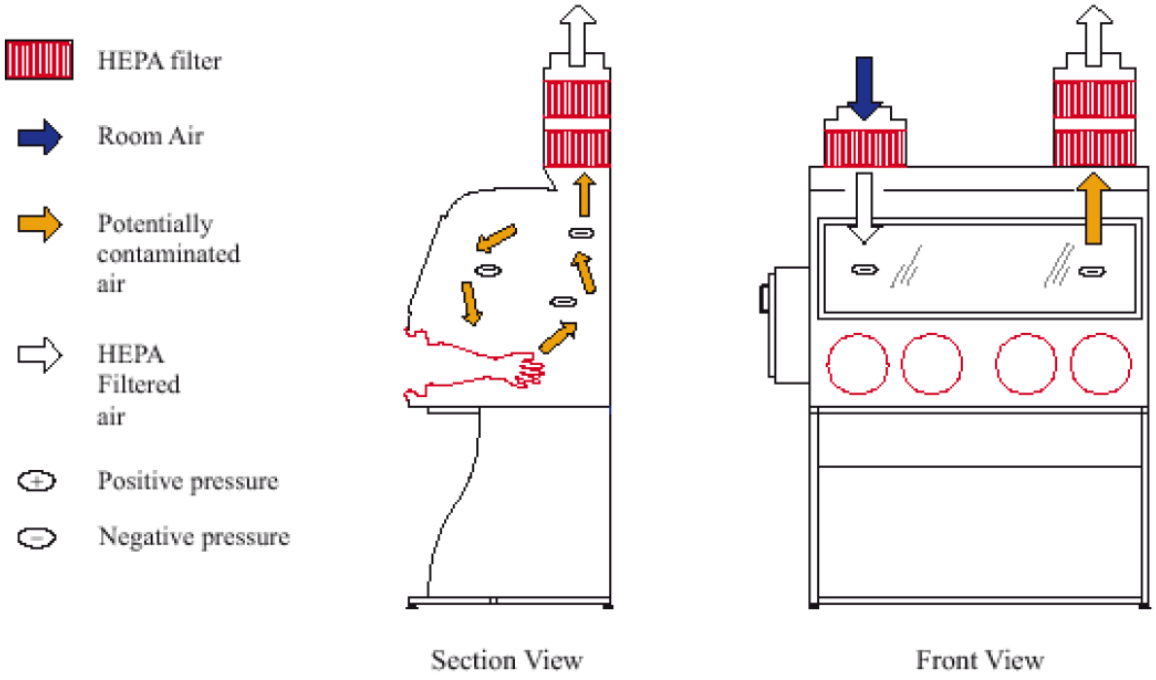

Figure 7. Class III Biological safety cabinet (BSC)

Taken from Laboratory Biosafety Guidelines, 3rd edition, PHAC, 2004.

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Appendix 8: Decision Model for Biological Risks and Required CL

Consequences (Personnal or collective)	Low	Moderate	High
Severe	Physical CL2 **Operational CL3**	Physical CL2 **Operational CL3**	**Physical CL3** **Operational CL3**
Moderate	Physical CL2 Operational CL2	Physical CL2 Operational CL2	Physical CL2 **Operational CL3**
Limited	Physical CL2 Operational CL2 (with minor deviations possible)	Physical CL2 Operational CL2	Physical CL2 **Operational CL3**

Probability

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Appendix 9: Disinfectants

Table 1. Disinfectants and their microbicidal power

Active compounds	Final effective concentration	Contact time (min.)	Activity reduced by organic matter	Microbicidal effects				
				Vegetative bacterium	Bacterial spore	Enveloped viruses	Non-enveloped viruses	Fungi [a]
Alcohols (ethanol or isopropanol) [b]	70-85 %	10-30	+	+	-	+	±	+
Quaternary ammonium [c]	0.1-2 %	10-30	+	+	-	+	-	±
Chlorinated compounds	0.01-5 %	10-30	+	+	±	+	+	+
Formaldehyde (gas) [d]	0.3g/pi^3	60-180	-	+	+	+	+	+
Gluteraldehyde	2 %	10-600	-	+	+	+	+	+
Iodophor compounds	0.47 %	10-30	+	+	-	+	±	±
Phenolic compounds [e]	0.2-3 %	10-30	±	+	-	+	±	±
Hydrogen peroxide	6 %	10-600	-	+	+	+	+	+

Adapted from *Biological Safety. Principles and Practices, 3rd edition*, Fleming, D.O. and Hunt, D.L., ASM Press 2000

+ indicates an effective microbicidal effect. ± indicates a mild microbicidal effect. – indicates that no microbicidal effect has been observed. To ensure effective disinfection, the use of a product demonstrating a weak (±) or absent (-) microbicidal effect must be avoided.

[a] Source: *Biosafety in Microbiological and Biomedical Laboratories, 5th edition*, published by the U.S. Department of Health and Human Services: http://www.cdc.gov/biosafety/publications/bmbl5/

[b] Maximum effectiveness is reached when dilution in water is approximately 70% (v/v). The germicidal power of alcohol is greater when it is mixed with other agents such as formaldehyde or chlorine (*Laboratory Biosafety Manual, 3rd edition*, WHO, 2004).

[c] Often used as a mixture with other disinfecting agents such as alcohols. The effectiveness of quaternary ammonium is reduced by water hardness (*Laboratory Biosafety Manual, 3rd*

edition, WHO, 2004) and it is inefficient against Gram bacteria (*Guideline for Disinfection and Sterilization in Healthcare Facilities*, CDC, 2008).

[d] Used for complete disinfection of BSCs. Formaldehyde is effective when room temperature is above 20°C with approximately 70% relative humidity. Its action is slow and ineffective against prions. It is a dangerous gas and as such it must be handled by specialized staff (*Laboratory Biosafety Manual, 3rd edition, WHO, 2004*).

[e] The effectiveness of these compounds is reduced by water hardness and they must therefore be diluted in deionized water. Since these compounds are able to go through rubber, they can be absorbed by the skin if handled with latex gloves (*Laboratory Biosafety Manual, 3rd edition, WHO, 2004*).

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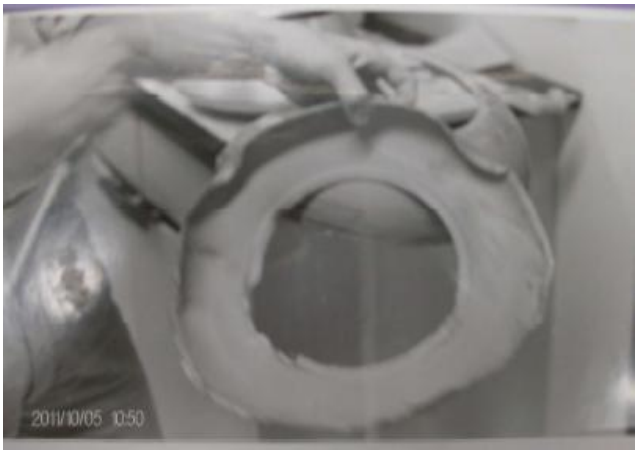
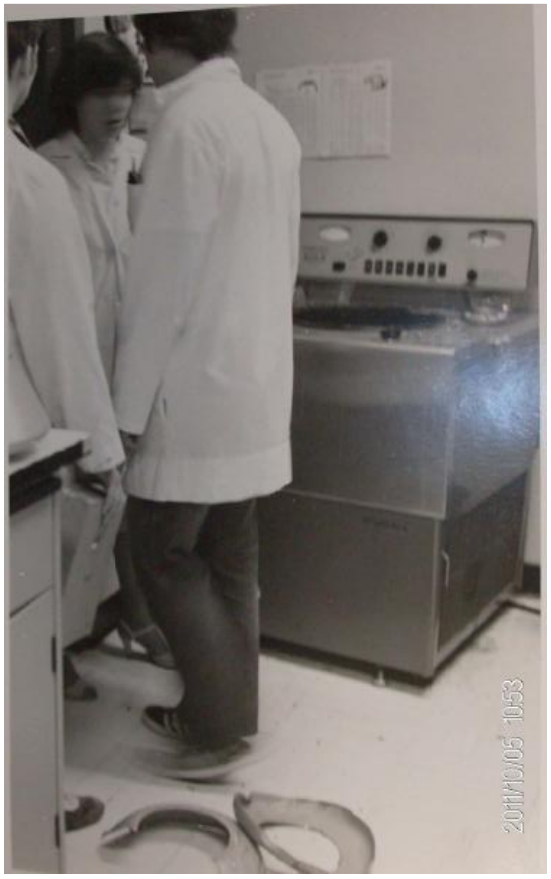
Appendix 10: Accident Involving a Poorly Balanced Centrifuge

Rotor before accident:

Rotor after accident:



Centrifuge after accident:



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Appendix 11: CL3 Operational Protocol When Handling Pseudotyped Viruses and Lentiviruses

A11.1. Handling in a BSC

1- Put on the necessary personal protective equipment: a first pair of gloves, a lab coat, a head covering (bonnet), and shoe covers. The first pair of gloves must cover the sleeves of your lab coat. Then put on a disposable waterproof lab coat that fastens in the back, as well as a second pair of gloves that must cover the sleeves of the disposable lab coat.

Preferably, the first pair of gloves should be made of nitrile since this material offers better protection against disinfecting products.

2- Pay special attention to the state of the gloves:

a- If a glove is perforated, it must immediately be replaced;

b- If there is a possibility of glove contamination during handling, the second pair of gloves must be removed and disposed of in the bag used for solid infectious waste within the BSC. Gloves should be within reach of the BSC to facilitate their replacement.

3- Place all the necessary materials within the BSC so as to minimize entrances and exits.

4- Determine where the “clean zone” and the “contaminated zone” will be and place a bag for solid infectious waste inside the cabinet.

5- During handling procedures, aerosol production and splashes must be avoided:

a- Do not pour liquid from one container to another;

b- When transferring a liquid, place the tip of the serological pipette against the sidewall of the receiving container and gently let the liquid run down;

c- Do not eject the last drop of liquid.

6- When working with micropipettes:

a- You must use disposable tips with filters;

b- Gently aspirate and eject the liquid along the sidewall, or directly in the liquid;

c- Gently eject the tip in the infectious solid waste bag located in the cabinet.

7- The use of a vortex is to be avoided, but if absolutely necessary, you must:

a- Use the vortex under the cabinet;

b- Set to the minimum speed required for your tests;

c- Make sure that the tubes are hermetically sealed;

d- After they have been stirred, let the tubes sit for approximately two minutes before opening them.

8- Use a centrifuge that is equipped with a rotor or tightly sealed buckets and decontaminate them after every use.

9- Infectious liquid waste, if produced, can be disposed of in a container to which undiluted bleach has been added (the desired dilution of the bleach is 1/5); the container is to be placed under the cabinet. Allow a contact period of 60 minutes for decontamination.

10- When handling in the cabinet has ended, the second pair of gloves must be removed and disposed of in the infectious solid waste bag located in the BSC.

11- Before removing infectious material (including waste), make sure that lids are definitely in place and caps are well fastened. All materials must be decontaminated with 70% ethanol.

Following is a summary of the decontamination method:

a- Remove a glove from the second pair and dispose of it with other solid infectious waste inside the cabinet so as to handle the container of EtOH 70% without contaminating it;

b- Spray all surfaces of materials with EtOH 70%;

c- Remove the second glove of the second pair and dispose of it with other infectious waste inside the cabinet;

d- Fasten the solid infectious waste bag with tape and make sure that the bag is not leaking or punctured. Dispose of the bag in the garbage for solid biological waste that is to be decontaminated (do not reopen the solid infectious waste bag for the autoclave decontamination cycle);

e- You can remove infectious materials from the BSC.

12- In order for colleagues in the laboratory to quickly become aware of the presence of infectious materials, you must identify culture plates, flasks, or tubes that are stored or placed in incubation. For example, you may affix red stickers on them. Indicate the type of virus, its strain, its concentration, the date, and the name of the experimenter.

13- Disinfect the inside of the cabinet and the non-infectious materials (e.g. boxes of tips) with a virucidal disinfectant (e.g. PerCept™, available in the FMSS store; the product information data sheet is in Appendix 12) and then clean using EtOH 70%.

14- For long-term storage, infectious liquid must be aliquoted in freezing tubes and conserved in a box identified as infectious material at -80°C. The following information should be found on the box: the type of virus, its strain, concentration, the date, and the name of the experimenter.

15- Before leaving the room where the BSC is located, clean the first pair of gloves using disinfectant (PerCept™), then remove protective clothing (disposable lab coat, shoe covers, bonnet) and dispose of the first pair of gloves with solid biological waste.

16- You must absolutely wash your hands before leaving the room.

A11.2. Additional personal protective equipment

Head covering:

Shoe covers:

Disposable lab coat (with back opening):

A11.3. Emergency Measures

A11.3.1. Spills

Minor spill within the BSC (less than 10ml)

1- Replace the second pair of gloves with a new pair;

2- Place absorbent paper on the spilled liquid;

3- Spray with disinfectant (PerCept™) using a circular motion and moving from the outside in;

4- Wait for at least 15 minutes;

5- Dispose of the paper in the solid infectious waste bag located under the cabinet;

6- Decontaminate any material that could have been contaminated;

7- Perform a second cycle of decontamination (steps 2 to 6).

Major spill, or spill spread over a large surface in the BSC

1- Remove the second pair of gloves;

2- Remove the personal protective equipment (disposable lab coat, bonnet, shoe covers, and both pairs of gloves) and dispose of it with solid biological waste so that it may be decontaminated, then put on new personal protection equipment;

3- Wait approximately 5 minutes before returning to the BSC in order for aerosols to subside;

4- Place absorbent paper on the spilled liquid and spray with disinfectant using a circular motion, moving from the outside in;

5- Wait for at least 15 minutes;

6- Dispose of the paper in the solid infectious waste bag located under the cabinet;

7- Decontaminate **ALL** the material in the cabinet, including the inner walls of the BSC, using disinfectant (PerCept™);

8- Perform a second cycle of decontamination (steps 4 to 7).

Minor spill outside the BSC (less than 10ml)

1- Warn all people present in the laboratory;

2- Remove the second pair of gloves;

3- Remove the personal protection equipment (disposable lab coat, bonnet, shoe covers and both pairs of gloves) and dispose of them with solid biological waste so they may be decontaminated, then put on new personal protection equipment;

4- Place absorbent paper on the spilled liquid;

5- Spray with disinfectant (PerCept™) using a circular motion, moving from the outside in;

6- Wait for at least 15 minutes;

7- Dispose of the paper in the solid infectious waste bag located under the cabinet;

8- Perform a second cycle of decontamination (steps 3 to 6).

Major spill, or spill spread on a large surface outside the BSC

1- Warn all people present in the laboratory;

2- Immediately exit the laboratory and remove personal protective equipment. Dispose of this clothing while making sure it can be decontaminated in the autoclave;

3- Contact the Security Services by dialing **811** (main campus), **511** (health campus) or **819-821-7699** (from an external line); the Security will then contact the SSMTE division.

4- Make sure that access to the laboratory is forbidden while waiting for the arrival of SSMTE division staff.

A11.3.2. Exposure to Infectious Material

Skin and mucous membranes can accidentally be exposed to infectious material when working with culture supernatant or blood products. In all cases, after exposure to infectious material, contact the Security Services by dialing **811** (main campus), **511** (health campus) or **819-821-7966** (from an external line). A medical assessment of your condition will subsequently be performed.

Skin exposure

1- Remove anything covering the patch of skin that has been exposed (gloves, lab coat, etc.);

2- Rinse in lukewarm water and gently clean with mild soap;

3- DO NOT USE irritant disinfectants (alcohol or peroxide);

4- DO NOT RUB the exposed zone;

5- Contact the Security Services by dialing **811** (main campus), **511** (health campus) or **819-821-7966** (from an external line).

Exposure following a wound

1- Remove anything covering the wound (gloves, lab coat, etc.);

2- Rinse in lukewarm water and gently clean the wound with mild soap;

3- DO NOT USE irritant disinfectants (alcohol or peroxide);

4- DO NOT RUB or APPLY PRESSURE to the wound;

5- Allow bleeding for at least 10 minutes under cold water;

6- Contact the Security Services by dialing **811** (main campus), **511** (health campus) or **819-821-7966** (from an external line).

Nose and mouth mucous membrane exposure:

You must rinse the zone that has been exposed for at least ten minutes using tap water.

Eye exposure

If you are not alone, ask for help and rinse eyes at the eyewash fountain for at least 10 minutes.

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Appendix 12: Material Safety Data Sheet for PerCept™ Disinfectant as Provided by the Company Virox

PERCEPT CONCENTRATED GENERAL VIRUCIDE DISINFECTANT CLEANER (CAN)

HMIS		NFPA	Personal protective equipment
Health	3	3	
Fire Hazard	0	0	
Reactivity	0	0	

Version Number: 7 Preparation date: 2011-02-14

1. PRODUCT AND COMPANY IDENTIFICATION

Product name: PERCEPT CONCENTRATED GENERAL VIRUCIDE DISINFECTANT CLEANER (CAN)

MSDS #: MS0400148
Product Code: 4337151, 4337041
Recommended use: Disinfectant. This product is intended to be diluted prior to use.

Manufacturer, importer, supplier:

US Headquarters
Diversey, Inc.
8310 16th St.
Sturtevant, Wisconsin 53177-1964
Phone: 1-888-352-2249
MSDS Internet Address: www.diversey.com

Canadian Headquarters
Diversey, Inc. - Canada, Inc.
2401 Bristol Circle
Oakville, Ontario L6H 6P1
Phone: 1-800-668-3131

Emergency telephone number: 1-800-851-7145 (U.S.); 1-651-917-6133 (Int'l)

2. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
DANGER. CORROSIVE TO EYES. CAUSES EYE BURNS. MAY BE MILDLY IRRITATING TO SKIN. HARMFUL OR FATAL IF SWALLOWED.

Principal routes of exposure: Eye contact. Skin contact. Inhalation.
Eye contact: Corrosive. Causes permanent eye damage, including blindness.
Skin contact: May be mildly irritating to skin.
Inhalation: May cause irritation and corrosive effects to nose, throat and respiratory tract.
Ingestion: Corrosive. Causes burns to mouth, throat and stomach.

3. COMPOSITION/INFORMATION ON INGREDIENTS

Ingredient(s)	CAS #	Weight %	LD50 Oral - Rat (mg/kg)	LD50 Dermal - Rabbit	LC50 Inhalation - Rat
Phosphoric acid	7664-38-2	0 - 10%	1530	=2730 mg/kg	>850 mg/m³ (1 h)
Hydrogen peroxide	7722-84-1	0 - 10%	801	=2000 mg/kg	=2 mg/L (4 h)

4. FIRST AID MEASURES

Eye contact: Immediately flush eyes with running water for 15-20 minutes, keeping eyelids open. Get medical attention immediately.
Skin contact: Immediately flush with plenty of water. Get medical attention.
Inhalation: If breathing is affected, remove to fresh air. Get medical attention immediately.
Ingestion: If swallowed, rinse mouth. Give a cupful of water or milk . Do not induce vomiting. THEN IMMEDIATELY CONTACT A PHYSICIAN OR POISON CENTER. Never give anything by mouth to an unconscious person.
Notes to physician: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression and convulsion may be needed.
Aggravated Medical Conditions: Individuals with chronic respiratory disorders such as asthma, chronic bronchitis, emphysema, etc., may be more susceptible to irritating effects

5. FIRE-FIGHTING MEASURES

Suitable extinguishing media: The product is not flammable. Extinguish fire using agent suitable for surrounding fire.
Specific hazards: Decomposition releases oxygen, which may intensify fire .
Unusual hazards: Oxidizer. Decomposition releases oxygen, which may intensify fire .
Specific methods: No special methods required

Special protective equipment for firefighters: As in any fire, wear self-contained breathing apparatus pressure-demand, MSHA/NIOSH (approved or equivalent) and full protective gear
Extinguishing media which must not be used for safety reasons: No information available

6. ACCIDENTAL RELEASE MEASURES

Personal precautions: Use personal protective equipment
Environmental precautions and clean-up methods: Clean-up methods - large spillage. Use appropriate containment to avoid environmental contamination. Absorb spill with inert material (e.g. dry sand or earth), then place in a chemical waste container. Use a water rinse for final clean-up.

7. HANDLING AND STORAGE

Handling:
Avoid contact with skin, eyes and clothing. Do not taste or swallow. Avoid breathing vapors or mists. Use only with adequate ventilation. Remove and wash contaminated clothing and footwear before re-use. Wash thoroughly after handling. Product residue may remain on/in empty containers. All precautions for handling the product must be used in handling the empty container and residue. Mix only with water . DO NOT MIX WITH AMMONIA, BLEACH, OR OTHER CHLORINATED COMPOUNDS . Can react to release chlorine gas . FOR COMMERICAL AND INDUSTRIAL USE ONLY.
Storage:
Protect from freezing. Keep tightly closed in a dry, cool and well-ventilated place. KEEP OUT OF REACH OF CHILDREN.

8. EXPOSURE CONTROLS / PERSONAL PROTECTION

Engineering measures to reduce exposure:
Good general ventilation should be sufficient to control airborne levels Respiratory protection is not required if good ventilation is maintained.

Personal Protective Equipment

Eye protection: Chemical-splash goggles.
Hand protection: Chemical-resistant gloves
Skin and body protection: If major exposure is possible, wear suitable protective clothing and footwear.
Respiratory protection: In case of insufficient ventilation wear suitable respiratory equipment. A respiratory protection program that meets OSHA's 29 CFR 1910.134 and ANSI Z88.2 requirements must be followed whenever workplace conditions warrant a respirator's use.
Hygiene measures: Handle in accordance with good industrial hygiene and safety practice

Ingredient(s)	CAS #	ACGIH	OSHA	Mexico
Phosphoric acid	7664-38-2	3 mg/m³ (STEL) 1 mg/m³ (TWA)	1 mg/m³ (TWA)	3 mg/m³ (STEL) 1 mg/m³ (TWA)
Hydrogen peroxide	7722-84-1	1 ppm (TWA)	1 ppm (TWA) 1.4 mg/m³ (TWA)	2 ppm (STEL) 3 mg/m³ (STEL) 1 ppm (TWA) 1.5 mg/m³ (TWA)

9. PHYSICAL AND CHEMICAL PROPERTIES

Physical State: Liquid
Appearance: Aqueous solution
Specific gravity: 1.069
Vapor density: No information available
Boiling point/range: Not determined
Decomposition temperature: Not determined
Solubility: Completely Soluble
Solubility in other solvents: No information available
Partition coefficient (n-octanol/water): No information available

Bulk density: No information available
Evaporation Rate No information available
Color: Clear Colorless
Odor: Characteristic
Melting point/range: Not determined
Autoignition temperature: No information available
Density: 8.92 lbs/gal 1.069 Kg/L
Flash point: > 200 °F > 93.4 °C
Viscosity: No information available

Elemental Phosphorus: 1.92 % by wt.
pH: 0.7
Explosion limits: - upper: Not determined **- lower:** Not determined

VOC: 0 % *
Dilution pH: 1.8 @ 1:16

* - Title 17, California Code of Regulations, Division 3, Chapter 1, Subchapter 8.5, Article 2, Consumer Products, Sections 94508

10. STABILITY AND REACTIVITY

Stability:	The product is stable
Polymerization:	Hazardous polymerization does not occur
Hazardous decomposition products:	Oxygen.
Materials to avoid:	Ammonia. Bases . Reducing agents. Do not mix with chlorinated products.
Conditions to avoid:	Do not mix with any other product or chemical . Do not freeze.

11. TOXICOLOGICAL INFORMATION

Acute toxicity:	Corrosive to eyes. Oral LD50 estimated to be greater than 5000 mg/kg. Dermal LD50 estimated to be > 2000 mg/kg.
Component Information:	See Section 3
Chronic toxicity:	None known
Specific effects	
Carcinogenic effects:	None known
Mutagenic effects:	None known
Reproductive toxicity:	None known
Target organ effects:	None known

12. ECOLOGICAL INFORMATION

Environmental Information:	No data available

13. DISPOSAL CONSIDERATIONS

Waste from residues / unused products:
PESTICIDAL WASTE - Observe all applicable Federal/Provincial/State regulations and Local/Municipal ordinances regarding disposal of pesticide wastes. Undiluted product is regulated under environmental and transportation laws as a corrosive waste.
RCRA Hazard Class: D002

14. TRANSPORT INFORMATION

DOT/TDG/IMDG: Please refer to the Diversey HazMat Library, http://naextranet.diversey.com/dot/, for up to date shipping information.

DOT Bill of Lading Description:	Disinfectants
IMDG Bill of Lading Description:	Same as DOT above.

15. REGULATORY INFORMATION

International Inventories at CAS# Level

All components of this product are listed on the following inventories: U.S.A. (TSCA), Canada (DSL/NDSL).

Canada
WHMIS hazard class: Non-controlled

16. OTHER INFORMATION

Reason for revision:	Not applicable
Prepared by:	NAPRAC
Additional advice:	None

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