KEY CONTACTS

EMERGENCY – 613-562-5411

Additional telephone numbers (uOttawa extension)

Protection Services (General Inquiries) .......................................................... 5499
  - Fire Prevention Coordinator ........................................................................ 6091
Health and Wellness Office (Human Resources) ........................................... 1473
Facilities (Maintenance) .................................................................................. 2222
Office of Risk Management (ORM) ................................................................. 5892
  - Risk Management Specialist; Occupational Health and Safety ............... 2486
  - Risk Management Specialist; Environment and Hazardous Waste ........ 3055
  - Risk Management Specialist; Radiation .................................................. 3057
  - Risk Management Specialist; Biosafety ................................................... 3153
Health, Safety and Risk Manager (Science) ................................................... 6425
Health, Safety and Risk Manager (Medicine) .................................................. 3210
Health, Safety and Risk Manager (Engineering) ............................................ 6829
Health, Safety and Risk Manager (All Other Faculties, Housing Services) .... 2627
Health, Safety and Risk Manager (Facilities) .................................................. 6992
EMERGENCY PROCEDURES
Immediately report all emergencies to Protection Services at ext. 5411 or 613-562-5411. Campus landlines are preferred due to the ability for Protection Services to identify a caller’s location.

Immediately advise Protection Services (ext. 5411) in the event of a critical injury or a fatality.

If first aid treatment is required, report to the first aid station nearest you, or call Protection Services at ext. 5411.

Civic authorities (i.e. 911) may also be contacted for assistance; however, the 911 dispatcher may not be familiar with the uOttawa property, building addresses or campus vernacular (such as building names) – thereby losing precious time in emergency situations. Protection Services has intimate knowledge of the University and is able to provide first aid, oxygen therapy and are also equipped with automated external defibrillators (AEDs). Protection Services will also provide civic authorities with an escort to the incident scene while assistance is provided at the incident scene.

Be prepared for what to do in the event that you need to quickly evacuate your lab! Consult emergency procedures for specific events.

Accident / Incident Reporting Procedure
All accidents / incidents must be reported to your supervisor and to the University using the University of Ottawa Accident, Incident or Occupational Illness Report. This includes:

- All accidents, incidents or suspected occupational diseases requiring medical attention and/or loss in working days as a result of work-related hazards; and,
- Other incidents, including those involving only minor injuries, “close calls” or “near misses” without injury, direct exposure to chemicals, damage to equipment, chemical odours or spills and leaks of hazardous materials.

The Accident, Incident or Occupational Illness Report form is available online. The report must be submitted to the Health and Wellness Office within 24 hours of the occurrence. The Health and Wellness Office is located at Tabaret Hall, Room 017. The report may be mailed via INTRA mail, faxed to 613-562-5206, or emailed to hrhealth@uottawa.ca.

There is no penalty or retribution for submitting a report.

First Aid and Medical Emergencies
In the event of any medical emergency, contact Protection Services at ext. 5411.

A basic knowledge of first aid procedures is essential for working anywhere where there is a significant risk of accidents, such as in laboratories and workshops. Standard First Aid workshops are offered (at a cost) by the Office of Risk Management.

There are also designated individuals in your work area with First Aid, CPR and AED training. Refer to the uOttawa Designated First Aider program, look for the green first aid signage throughout the building, or contact the Office of Risk Management for information.
If supplemental first aid kits are desired, they may be purchased by the Faculty, Department or researcher. A list of recommended supplies can be found in Appendix 2 of the Designated First Aider guidelines or from the Office of Risk Management.

**Initial First Aid Assessment**
- Assess the safety of the scene for yourself and the casualty. If required, remove danger or remove casualty from danger (if possible and safe to do so).
- Assess the cause of the accident. Quickly determine how the situation may have occurred, if possible. If a neck or spinal injury is suspected, do not move the casualty if the area is secure.
- Identify yourself and offer to provide assistance.
- Instruct casualty to lie still (if conscious); offer reassurance and support.
- Assess the casualty.
  - Check the level of consciousness.
  - Is the airway open? Is the casualty breathing?
  - Does the casualty have a pulse? Is there severe bleeding?
- Send for help. Designate someone to go for help and have them return to the scene and report to you. Provide the following information to the designated person:
  - Your identity;
  - Description of suspected accident circumstances;
  - Exact location of emergency;
  - Number of casualties;
    - Type(s) of injuries;
    - Condition of casualty;
  - Direct phone number where you can be reached, if applicable.

**Critical Injuries and Fatality**
- Immediately contact Protection Services at ext. 5411. Indicate that there has been a critical injury or fatality.
- Describe the emergency and the location. Provide any necessary first aid within your capabilities. Do not move injured person unless in immediate danger.
- Remain with injured person until help arrives.
- Do not further alter the scene unless for
  - Saving life, relieving human suffering, maintaining essential public utility or transportation service, preventing unnecessary damage, or unless instructed by authority having jurisdiction (i.e. Ministry of Labour Inspector).
- Await arrival of Protection Services; remain available in a safe location in case further information is required.

**Chemical Contact with, and Burns to the Skin**
- Remove contaminated clothing. If the contaminant is in a powdered form, brush it off clothes and skin while limiting contact with uncontaminated surfaces as much as possible.
- Rinse the affected area thoroughly with copious amounts of cool, running water. Use an emergency shower if necessary. Rinse the area with running water for a minimum of 15 minutes.
- Do not apply ointment unless specifically designed for the substance(s) involved.
• **Do not apply water to burns from any metals** (such as sodium, potassium, magnesium, and aluminium, etc.).
• Seek medical attention and bring the Safety Data Sheet.

**Chemical Contact with Eyes**
• Proceed to the emergency eye / face wash station immediately and activate.
• Hold lids apart and flush the eye(s) with copious amounts of running water for a minimum of 15 minutes. If a tap or hose is used, direct water flow on the bridge of the nose; water will run into the eyes.
• Seek medical attention and bring the Safety Data Sheet.

**Asphyxiation**
• If safe to do so, remove casualty from the area.
• Loosen tight-fitting clothing.
• A person trained in CPR should monitor the victim's airway and vital signs.
• Seek medical attention.

**Cuts and Animal Bites**
• Allow the wound to bleed uninhibited for a few seconds to purge the wound.
• Apply pressure to the wound with a sterile pressure dressing. In circumstances where there is an object protruding from the wound, apply pressure around the wound.
• If bleeding is able to be stopped, cleanse and dress the wound.
• Seek medical attention for cuts (including small cut) and bites, based on the level of risk.
• Advise medical staff if there was a known infection (i.e. animal, virus, etc.) present.

**Major Fire Emergencies**
1. In the event of a major fire beyond your control, shout "FIRE, FIRE, FIRE" and pull the nearest fire alarm. Pull stations are usually located in the corridor near an exit / stairway.
2. If safe to do so, attempt to rescue persons in immediate danger while exiting. Do not endanger yourself.
3. Do not attempt to fight a major fire on your own.
4. Pull the nearest fire alarm, pull stations are usually located in the corridor near an exit / stairway.
5. Close, but do not lock doors. Leave the building and proceed to the muster point.
6. Call Protection Services at ext. 5411. Provide information on the situation including the location and details of the occurrence.
7. Remain available in a safe location in case further information is required.

**Small Fire Emergencies**
1. Determine if the fire can be safely fought (fight or flight).
2. Identify an exit.
3. Small fires may be fought with appropriate fire extinguishers or suffocated with sand, water or cover.
4. If fire escalates, retreat. Follow procedure for Major Fire Emergency.
5. Ensure fire is properly extinguished by trained personnel. Advise Protection Services, the Facility Manager, and / or Building Wardens.
6. Remain available in case further information is required.
7. Complete an Accident, Incident or Occupational Illness Report.

Clothing Fires
- Stop (where you are); drop (to the floor); roll (to smother the flames).
- Shout for help.
- Avoid the use of fire extinguishers on people to the extent possible. If absolutely necessary, do not aim at a person’s face. After the fire has been extinguished, proceed to the nearest emergency shower and cool the burned areas with a copious amount of water.
- Seek medical attention and bring the Safety Data Sheet (if applicable).

Spills
Users working with hazardous materials will, in most cases, be able to safely and efficiently clean a spill. The user is required to know the hazardous properties of the materials prior to its use and be prepared for potential spills; therefore, the user is likely the most qualified to address the spill. Users and laboratories are equipped with basic spill kits for small spills (i.e. maximum 4L liquid spill).

More hazardous materials, such as mercury and hydrofluoric acid, require specialized spill kits and are provided to those users and/or available in centralized locations on campus. Spills of greater volume may require additional intervention as well as larger kits.

For all spills of hazardous materials, determine if you can safely contain, control and clean the spill.
- If unsure or the situation is unsafe, call Protection Services at ext. 5411. Do not activate the fire alarm unless there is a fire.
- If the chemical enters a floor or sink drain, immediately block the drain (if safe to do so) and contact Protection Services at ext. 5411. Floor drains can be protected using the granulated absorbent material in the spill kit. No hazardous materials (including hazardous waste) should be permitted to enter lab sinks at any time.
- If hazardous vapours are being generated which may migrate outside of the localized area, alert people in the affected area and contact Protection Services at ext. 5411.

When reporting a spill to Protection Services, provide your name, a phone number where you can be reached and exact details of the spilled material, such as:
- If anyone has been injured or exposed;
- Name (including the spelling) and/or CAS number of the spilled material;
- Type of material (liquid, solid, gas),
- Identification properties (colour, odour, etc.)
- Location(s) of the spill;
- Quantity or volume;
- Properties of the spilled material, including (if applicable / known):
  - Concentration
  - Vapour pressure
  - Flash point
  - LEL / UEL
- Associated hazards;
- First aid measures for persons exposed;
The caller must remain available in a safe location in the event that further information is required by Protection Services. While not recommended, if you must leave the spill scene for any reason, place signage warning others of the nature of the spill; provide your name, direct telephone number and time when you will return.

Once the spill has been absorbed, place all clean-up material (including disposable protective equipment) in a sealable, labelled container; the contents will be considered hazardous waste. A uOttawa hazardous waste label must be applied to the container. The user must submit the Accident, Incident or Occupational Illness Report.

Formal Spill Response Training is available from the Office of Risk Management.

For additional information, please consult the Hazardous Materials and Hazardous Waste Directive or contact the Office of Risk Management.

**Chemical Spills**

1. Alert all personnel present and evacuate the room. Minimize spread of the spill to the extent possible. Do not remove contaminated material out of area of spill. Close the door and post a warning sign including your name, direct telephone number, date and time, and the following message "no entry – chemical material spill".
2. Access to area is restricted to those cleaning the spill.
3. If flammable material is involved, eliminate all ignition sources (including burners, hotplates, etc.). If vapours are potentially flammable or explosive, do not attempt to switch any electrical equipment on or off.
4. Quickly block or contain the size and spread of a spill by using appropriate absorbing material (such as sand, vermiculite, inert absorbent, spill pillows, berms, etc.).
5. Ensure the fume hood sash (where applicable) is open to capture or direct flow of gases and vapours.
6. When cleaning a spill, ensure that appropriate personal protective equipment is worn; this may include respiratory protection, gloves, protective eyewear and clothing, etc.
7. Clean the spill from the outer perimeter and address obstacles (such as broken glass, physical objects, etc.) as you clean to the centre. Use forceps or tongs to handle broken materials. A final surface decontamination may be required.
8. Once the spill has been absorbed, place all clean-up material (including disposable protective equipment) in a sealable, labelled container. The contents will be considered as hazardous waste. A uOttawa hazardous waste label must be applied to the container.
9. Inform the principal investigator responsible for the lab / research project.
11. Remain available in a safe location in case further information is required.

**Mercury Spills**

1. Alert all personnel present and evacuate the room. Minimize spread of the spill to the extent possible. Do not remove contaminated material out of area of spill. Close the door and post a warning sign including your name, direct telephone number, date and time, and the following message "no entry - mercury spill".
2. Access to area is restricted to those cleaning the spill.
3. Quickly block or contain the size and spread of a spill by using appropriate absorbing material (such as sand, vermiculite, inert absorbent, spill pillows, berms, etc.).
If a large spill of mercury is involved or if vapours are being released (i.e. mercury is located on a heated surface), contact Protection Services at ext. 5411.

5. If a small amount of mercury is spilled (i.e. the amount within a broken thermometer), use an aspirator bulb, medicine dropper or mercury sponge to pick up droplets. If available, use a mercury spill kit available from the Health, Safety and Risk Manager and/or the Office of Risk Management. When cleaning the spill, appropriate respiratory and protective clothing must be worn. Clean from the perimeter of the spill inwards; use forceps or tongs to handle broken materials. Place the mercury in a container, cover with water and/or oil and seal the container. Label the container for disposal as hazardous waste.

6. If the mercury has broken into many droplets, or if droplets have worked into cracks or other hard to clean areas, sprinkle with sulphur powder or commercial products that will form amalgam when in contact with mercury. Leave the area for several hours and then collect and place solid waste into a container, seal it and label it for disposal as hazardous waste.


8. Remain available in a safe location in case further information is required.

The University of Ottawa operates a mercury thermometer replacement program. For more information, please consult the Health, Safety and Risk Manager.

Biohazard Spills

1. Alert all personnel present and evacuate the room. Minimize spread of the spill to the extent possible. Do not remove contaminated material out of area of spill. Close the door and post a warning sign including your name, direct telephone number, date and time, and the following message "no entry - biohazardous material spill". Specify the hazardous agent. If there is a risk of aerosolization, remove contaminated clothing and leave the area for at least 30 minutes to allow aerosols to settle. Thoroughly wash exposed skin with soap and water.

2. Access to area is restricted to those cleaning the spill.

3. Quickly block or contain the size and spread of a spill by using appropriate absorbent material available in the lab spill kit, or by using any of the following: paper towel, sand, vermiculite, inert absorbent, spill pillows, berms, etc.

4. Using an appropriate concentrated disinfectant, cover the spill area. Pour disinfectant from the outside towards the inside of the spill. For more hazardous substances, allow the disinfectant to act for 20 minutes.

5. When cleaning a spill, ensure that appropriate personal protective equipment is worn; this may include respiratory protection, gloves, protective eyewear and clothing, etc.

6. Clean the spill from the outer perimeter and address obstacles (such as broken glass, physical objects, etc.) as you clean to the centre. Use forceps or tongs to handle broken materials.

7. All contaminated materials and equipment must be properly decontaminated or properly disposed of as hazardous waste.

8. All adjacent areas should also be disinfected.

9. Remove contaminated clothing by turning the exposed area inward and autoclaving.

10. Wash all exposed skin with disinfectant soap, following standard washing practices.

11. Inform the principal investigator responsible for the lab/research project.


13. Remain available in a safe location in case further information is required.
For Other Biohazardous Spills (i.e. within a biological safety cabinet, within a centrifuge, during transfer, or spills of blood and bodily fluids, refer to the Biological Spill Response Plan, available from the Office of Risk Management.

**Radioactive Spills**

1. Alert all personnel present and evacuate the room. Minimize spread of the spill to the extent possible. Do not remove contaminated material out of area of spill. Close the door and post a warning sign including your name, direct telephone number, date and time, and the following message "no entry – radioactive material spill". Specify the radioisotope involved.

2. Access to area is restricted to those cleaning the spill.

3. Prior to vacating the area, remove any contaminated clothing and shoes. If spill is on the skin, wash thoroughly with soap and tepid water. Multiple washings are superior to one rigorous washing; take care not to abrade the skin. Monitor area for activity following each wash and document findings.

4. Contain, control and clean the spill by using appropriate absorbent material.

5. Obtain any additional supplies and/or personal protective equipment (overalls, shoe coverings) required for clean-up. **Do not spread contamination in doing so.**

6. Contain and clean spill by cleaning from its perimeter inward. Collect all contaminated material in appropriate containers and/or bag(s); label appropriately. Use forceps or tongs to handle broken materials.

7. Decontaminate spill area(s) with appropriate solutions and materials. Monitor for contamination with appropriate detector or wipe test. Document findings.
   a. Re-clean contaminated area if contamination is found. Three clean procedures should remove all contamination.
   b. If contamination remains, contact the **Risk Management Specialist; Radiation** and/or the **Office of Risk Management**.

8. Complete an **Accident, Incident or Occupational Illness Report** and **Hazardous Materials Technical Services Regular Collection Request**.

9. Remain available in case further information is required.

**Leaving the scene:**

- While not recommended, if you must leave the scene for any reason, monitor self (especially feet, hands (including gloves, lab coat, etc.)) for contamination prior to leaving. Record results.
  - Leave any contaminated items behind. Remove and take dosimetry badge to avoid erroneous data collection.
- Lock and place a sign on the door (name, direct telephone number, nature of incident and time you will return).
GENERAL LABORATORY SAFETY GUIDELINES

The independent requirements of each lab cannot be individually addressed in this document; however, the following points are intended as general safety guidelines for laboratory users. Supervisors are encouraged to expand these general guidelines to suit their individual needs.

Awareness

- Be aware of campus emergency procedure and how emergencies affecting campus will be communicated to you via uoAlert.
- Be familiar with the locations and operation of safety and emergency facilities such as
  - Fire extinguishers;
  - Fire alarm pull stations;
  - Fire hose cabinets;
  - First aid kits;
  - Spill kits;
  - Emergency wash facilities (eyewashes, showers, etc.);
  - Emergency communication devices, including telephones, panic buttons (stationary and remote)
  - Emergency exits routes – both primary and secondary.
- Be alert to conditions in the workplace, including potential unsafe conditions that may develop.
- Promptly report unsafe conditions, accidents, incidents, near missed and concerns to your supervisor.
- Complete mandatory training (including job-specific training).
- Ensure entry signage (i.e. including hazards within the lab, responsible party, required personal protective equipment, etc.) is present on doors to the lab.

Proper Usage of Laboratories

- Work spaces must be kept clean and free of clutter (including chemical products, specimens, etc.).
- Smoking, eating, drinking and chewing of gum is not permitted in laboratories or workshops.
- Running, horseplay or inappropriate use of lab materials or equipment is not permitted.
- Keep laboratory and workshop doors closed to maintain proper air balancing of the lab.
- Exits, passageways and access to emergency equipment (including eye / face wash stations, emergency showers, fire extinguishers, first aid kits, spill kits and electrical panels) must be keep readily accessible at all times.
- Keep lab doors closed – this ensure security and that engineering controls (i.e. ventilation, fume hoods, etc.) will function as intended.

Conducting Experiments and Performing Work

- Performing unauthorized work, preparations or experiments is prohibited.
- Conduct pre-experiment hazard identification and risk assessment before beginning work. Implement reasonable hazard controls for foreseeable tasks.
- Update written experiment protocols with applicable health and safety information, e.g., identify particularly hazardous steps that must be performed with special control measures (i.e. inside a fume hood).
- Read and understand the Safety Data Sheets (SDS) prior to using a product. Work with materials only when you know their hazardous properties (flammability, reactivity, toxicity,
etc.), handling and storage requirements, their interactions with other substances and the associated emergency procedure(s).

- Check all equipment for damage prior to setting up experimental apparatus.
- Select a suitable experiment location. Experiments involving hazardous materials should be conducted within a vented fume hood or within other suitable containment means.
- Advise users of shared lab spaces of hazardous experiments in progress.
- Do not leave an experiment unattended. If necessary, post suitable warning signs including your name and the direct number where you can be reached. If an emergency occurs involving, or impacting, the experiment, uOttawa will make attempts to notify the user(s) of the situation; however, the principle concern of University responders is to people, property and the environment.
- Label reagents and samples according to WHMIS legislation.
- Verify expiry properties (i.e. condition, date, etc.) of hazardous materials.
- Maintain the lab chemical inventory. Do not remove chemicals from the laboratory without updating your chemical inventory (including materials disposed of hazardous waste).
- Store hazardous materials according to chemical compatibilities.
- Store hazardous materials in appropriate locations (i.e. flammable / corrosive storage cabinets).
- Reagent bottles – empty or full – should not be stored on the floor or in the sink.
- Transport hazardous chemicals and chemical waste in secondary carriers or on special transport carts.
- Do not pipette by mouth.
- Conduct work in an area that is equipped to mitigate hazardous properties of the material(s).
- Clean up spills immediately in accordance with the spill response and recovery procedure applicable to the material. Ensure that clean-up materials are available prior to starting work. If the spill is too large (or unsafe) to handle or if you’re not certain what to do, contact Protection Services at ext. 5411.
- Wear and use applicable personal protective equipment and safety devices.

**Leaving the Lab**

- Clean you work area before you leave. Ensure equipment and materials are returned to their proper storage location.
- Ensure emergency contact information is up-to-date.
- Perform a safety check at the end of each experiment or work day. Ensure that gas, water, electricity, vacuum lines, air, heaters etc. have been turned off / secured.
- Lower sashes on fume hoods.
- Remove and leave your protective equipment (including gloves and lab coats) in the lab.
- Wash your hands.
INTRODUCTION

All laboratories and workshops can be inherently hazardous places; even the most experienced workers can be at risk. The attitudes and actions of those who work in a laboratory determine their own health and safety as well as that of their colleagues and, ultimately, that of the community. Health and safety standards are intended to reduce to an acceptable level the risks inherent in the use of hazardous materials and potentially dangerous procedures, practices and/or equipment.

Different standards are set for different levels of risk. High levels of risk require more stringent protocols and procedures than lower levels of risk. Compromises are, therefore, made in setting safety standards so as not to impede work, while keeping the inherent risks at an acceptable level. Laboratory equipment and design has become significantly more sophisticated and safer; however, equipment is still reliant on safe and proper utilization by properly trained and competent personnel, who must be safety-conscious at all times.

This is the third (3rd) edition of the University of Ottawa Laboratory Safety Manual. This manual supersedes all previous versions. This document is intended to provide basic rules for safe practices in a laboratory at uOttawa. Individual principal investigators, lab managers and supervisors must identify and supplement this document with specific safe work procedures and training specific to the needs of their laboratory safety programs when the subject is not adequately addressed by this document.

In all cases, the individual supervisor is ultimately responsible for teaching, implementing and enforcing safe work practices and must insist upon the use of such procedures to eliminate unnecessary hazards or mitigate unacceptable risk for situations and workplaces under their authority.

Since this document is intended to be periodically revised, readers are asked to convey comments, suggestions, errors or omissions to their faculty’s Health, Safety and Risk Manager or to the Office of Risk Management.

Acknowledgements

The University of Ottawa recognizes the valuable contributions and dedication of those involved in the creation and revision of this document, including:

- The Faculty Health, Safety and Risk Managers,
- Senior technical support staff of the Faculties of Engineering, Medicine and Science;
- the Office of Risk Management;
- the Health and Wellness Office (Human Resources)
- Protection Services; and
- Facilities.

This document was originally shaped by similar documents from McMaster University and McGill University. The document’s content was further developed and adapted by the above noted Faculties and Services to meet the specific needs of the University of Ottawa.

Any questions, concerns or recommendations may be addressed to the Faculty Health, Safety and Risk Manager and/or the Office of Risk Management.
DEFINITIONS

**Combustible liquid** – Liquids having a flash point between 37.8°C and 93.3°C. Examples of combustible liquids include toluene, kerosene, etc.

**Compressed gas** – any contained mixture or material with either an absolute pressure exceeding 275.8 kPa at 21°C or an absolute pressure exceeding 717 kPa at 54°C, or both, or any liquid having an absolute vapour pressure exceeding 275.8 kPa at 37.8°C.

**Corrosive** – Substances that, by direct chemical action, are injurious to body tissue or corrosive to metal. A corrosive injury may range from minor (irritation) to actual physical disruption of body tissues and/or burns. Examples of corrosive materials may include acids, bases, bromine, peroxides, acetic, anhydride, etc.

**Critical Injury** – an injury of a serious nature that
- a) Places life in jeopardy;
- b) Produces unconsciousness;
- c) Results in substantial loss of blood;
- d) Involves the fracture of a leg or arm but not a finger or a toe;
- e) Involves the amputation of a leg, arm, hand or foot but not a finger or a toe;
- f) Consists of burns to a major portion of the body; or
- g) Causes the loss of sight in an eye.

**Facilities** – University service managing the physical infrastructure and utility services; located at 141 Louis-Pasteur. Facilities also operate the 2222 Call Centre. Individual Faculties may also have a facilities department or team internal to the Faculty; these units are two distinct entities.

**Flammable liquid** – Flammable liquids have flash points below 37.8°C, and include solvents such as acetone, ethyl alcohol and xylene.

**Flash point** – the lowest temperature at which vapours of the material will ignite, when in the presence of an ignition source.

**Hazard** – any source of potential damage, harm or adverse health effect on someone or something.

**Human Resources** – University service managing the workers of uOttawa; located at Tabaret Hall.

**Lower Explosive Limit (LEL)** – the lowest concentration of a material in air (expressed as a percentage) which can burn or explode. When concentrations of the chemical in the air are below the LEL, the chemical mixture is “too lean” to burn.

**Ignitible solids** – Solids capable, under standard temperature and pressure, of causing fire through friction, absorption of moisture or spontaneous chemical changes and which, when ignited, burn so vigorously and persistently that they cause a danger. Example of ignitible solids includes charcoal, white phosphorous, magnesium alloys, hexamine, beryllium, hafnium powder, zirconium, sodium, potassium, etc. Those ignitible solids that ignite upon contact with water or air are treated as reactive materials.
Office of Risk Management – University service managing the institution’s health and safety, enterprise risk management, environmental and research safety compliance portfolios.

Pathogen Safety Data Sheet (PSDS) – technical documents describing the hazardous properties of a human pathogen and recommendations for work involving the agents in a laboratory setting. PSDS are produced by the Public Health Agency of Canada (PHAC) as educational and informational resources for laboratory personnel working with infectious substances.

Protection Services – Protection Services (ext. 5411) acts as the University’s own emergency response team. Dial ext. 5411 on any University phone or 613-562-5411 from a cellphone.

Regulatory Agency – an external agency enforcing the requirements of various health, safety and environmental legislation. Examples include the Ministry of the Environment, Ministry of Labour, Canadian Nuclear Safety Commission, etc.

Risk – The chance or probability that a person will be harmed or experience an adverse health effect if exposed to a hazard.

Safety Data Sheet (formerly called “Material Safety Data Sheet”) – is an information sheet that each manufacturer must prepare for the hazardous products they sell. The information contained in a SDS is intended to communicate hazards, properties, handling, storage and disposal guidelines, and emergency response requirements.

Spill – occurs when a material is caused or allowed (especially accidentally or unintentionally) to fall, flow, or run out of a container so as to be lost or wasted. A spill may occur with materials in liquid, solid or gaseous states.

Supervisor – means a person who has charge of a workplace or authority over a worker or another person. Depending on the workplace relation, a Supervisor may include, for example, the President, Vice-Presidents, Directors, Deans, Manager, or Principle Investigator. The determination as to whether a person is a Supervisor is not dependent on that person’s job title; rather on whether the person has charge of a location (for example, an office or laboratory) where the work is done on a paid or unpaid basis or when they give direction over the work done by others (including workers, students, visitors, volunteers, or learners).

Toxic material – substances that may cause injury or illness to an individual if the substance is able to enter the body. The common route of exposure is inhalation (i.e. breathing).

Upper Explosive Limit (UEL) – the highest concentration of a material in air (expressed as a percentage), which can burn or explode. When concentrations of the chemical in air are above the UEL, the chemical mixture is “too rich” to burn.

Volunteer – refers to a person who is not a worker or a student but who performs work at the University workplace to help out or for other reasons associated with education or training. The minimum age of a volunteer at uOttawa is sixteen (16) years old.

Worker – means any of the following:
a) A person who performs work or supplies services for monetary compensation. This means a University employee and includes a person who performs work or supplies services for monetary compensation. Students hired by the University to perform paid work-study program duties or co-operative education placement duties for the University are considered workers.

b) A high school student who performs work or supplies services for no monetary compensation under a work experience program authorized by the school board that operates the school in which the student is enrolled.

c) A person who performs work or supplies services for no monetary compensation under a program approved by a college of applied arts and technology, university or other post-secondary institution.

d) A person who receives training from an employer, but who, under the Employment Standards Act, 2000, is not an employee for the purposes of that Act because the conditions set out in subsection 1 (2) of that Act have been met.

e) Such other persons as may be prescribed who perform work or supply services to an employer for no monetary compensation.

**RESPONSIBILITIES**

The duties and responsibilities presented below are intended to summarize and elaborate on those described in two University of Ottawa policies and procedures:

- Policy 72 – Environmental and Sustainability Policy; and
- Policy 77 – Occupational Health and Safety
  - Procedure 14-1 – Internal Responsibility Procedure for Health and Safety Issues

The information presented within this document is not intended to serve as a substitute for these University policies. These policies should be consulted by those wishing further clarification of their responsibilities.

**Individuals**

Each individual is responsible for complying with all policies, procedures, directives and standards established by the authority having jurisdiction, the University, or their specific faculty or department.

In particular, each individual is responsible for conducting activities in a manner that will not endanger themselves or others. Individuals must exercise all reasonable care in activities that may pose a risk. When directed to do so, all University workers (including researchers and, in some cases, students) shall participate in training and information sessions that may be offered. Each individual is responsible to ensure that he / she has received the requisite training (mandatory, job specific, etc.).

All individuals shall provide assistance and cooperate with University and regulatory authorities (including Joint Occupational Health and Safety Committee members) conducting inspections, audits or investigations in accordance with specified policies and procedures.

All individuals are required to report all known hazards to their immediate supervisors.
Supervisors
Supervisors are responsible for ensuring compliance with all policies, procedures, directives, and standards established by the authority having jurisdiction, the University, or their specific faculty or department. Supervisors shall provide opportunities for personnel under their authority to attend appropriate training or information sessions required by the University or faculty (including mandatory and job specific training).

Supervisors must also initiate necessary preventive and corrective action to mitigate hazards associated with activities under their authority. Supervisors are required to take corrective action, within the scope of their authority, as soon as they are made aware of a situation involving non-adherence to policy and procedures, or laws and bylaws. Situations requiring further assistance or intervention are to be reported to their immediate supervisor for resolution and/or escalation.

Principal Investigators
Principal investigators are considered supervisors and are responsible for ensuring that all those under their authority are diligent in the application of their responsibilities. They are responsible for communicating procedures, standards and guidelines in teaching and research activities that they supervise and for ensuring compliance thereto.

Principal investigators are responsible for developing and establishing specific procedures for activities under their authority (including research), in support of University or faculty directives, and in conformance with external agency requirements. Principal investigators must also initiate necessary preventive measures to manage hazards associated with activities under their authority.

Principal investigators are required to take corrective action, within the scope of their authority, as soon as they are made aware of a situation involving non-adherence to policy and procedures, or laws and bylaws. Situations requiring further assistance or intervention are to be reported to their department chairperson.

Department Chairs
Department chairs are responsible for monitoring compliance with all directives, procedures and standards established by the University, their faculty or by regulatory agencies at the individual department level.

This includes supporting the implementation and maintenance of faculty directives and monitoring adherence to them at the department level. Department chairs must also initiate necessary preventive measures to control hazards associated with activities under their authority.

Department chairs are required to take corrective action, within the scope of their authority, as soon as they are made aware of a situation involving non-adherence to policy and procedures, or laws and bylaws. Situations requiring further assistance or intervention are to be reported to their Dean.

Deans
Deans are responsible for overseeing compliance with all directives, procedures and standards established by the University, their faculty or by regulatory agencies at the faculty level. The Dean must also ensure that appropriate programs are in place at the faculty level.
This includes developing, establishing and maintaining objectives, plans, directives, guidelines and procedures necessary to manage hazards and to ensure sound management of environmental issues applicable to their faculty. Deans shall allocate or, if necessary, request sufficient resources to ensure the effective operation of these programs. They are also responsible for monitoring adherence with directives, guidelines, procedures and standards established for their faculty.

Deans are required to take corrective action, within the scope of their authority, as soon as they are made aware of a situation involving non-adherence to policy and procedures, or laws and bylaws. Situations requiring further assistance or intervention are to be reported to the appropriate University authority.

Enforcement
Personnel working in lab are responsible for their actions. Supervisors are empowered to manage their workplace and promptly address situations of non-conformance. The enforcement of laboratory practices is governed by the respective collective agreement applicable and/or University policy. Escalation procedures may include:

- Reminder of proper conduct;
- Formal warning;
- Meeting with Supervisor / Lab Manager;
- Meeting with Director / Chair;
- Temporary loss of lab privileges;
- Permanent loss of lab privileges.

Concurrent enforcement may be applied as the case warrants.

TRAINING
Prior to being provided access to laboratory spaces, users are advised to complete training for the work that they will conduct. The recommended minimum requirements for laboratory access are:

- Legislative mandatory training (online/in-class);
- uOttawa Laboratory WHMIS (online);
- Laboratory Safety (in-class);
- Spill Response Training (in-class).

All persons working in laboratory spaces will require additional training, based on their work. Some examples may include:

- Transportation of Dangerous Goods (online)
- Biosafety Training – For Users (in-class)
- Radiation Safety Training – For Users (in-class)
- Principles of Laser Safety (in-class)
- Autoclave Safety (in-class)

Contact your supervisor, Health, Safety and Risk Manager, or the Office of Risk Management for additional questions or concerns. Refresher training is recommended and may be required in certain circumstances.
OPERATING AND MAINTENANCE PROCEDURES

Hazardous Materials Procurement
To best ensure compliance with legislative requirements regarding the labelling of hazardous materials, safety data sheets and to minimize inventories, personnel are asked to channel purchases of hazardous materials through their respective purchasing stores (i.e. the Faculty of Science Store, Engineering Shipping/Receiving, the Visual Arts Store, the Faculty of Medicine Shipping / Receiving, etc.).

While not recommended, if an individual obtains hazardous materials directly (i.e. not via uOttawa channels) and bring such materials to the workplace, note that the following requirements must be met:

- Hazardous products must be properly labelled according to WHMIS legislation;
- Hazardous products must be inventoried (including bar-coded) in the uOttawa chemical inventory;
- Hazardous products must have a current SDS available (either online or in print); lab users must be trained on how to access SDS within the lab (i.e. via paper copy or online).

Waste Minimization
The cost of hazardous waste disposal is of growing concern to the University. Prior to ordering new material, please consider its intended use, properties, quantity and final disposal. Proper management of hazardous materials will help minimize disposal costs and may be achieved by observing the following:

- Do not overstock. One of the main sources of laboratory waste is surplus stock, which can be the result of overbuying. It may be tempting to take advantage of lower unit prices by buying in quantity for future use; however, the costs associated with storage and disposal of surplus (or expired) materials may ultimately nullify any savings realized at the time of purchase. Central purchasing through campus stores can assist in solving these issues; users are able to buy the quantity they need at a competitive price.
- Do not accept donations of materials you do not plan to use. Traditionally, many external organizations and individuals (and in some cases, retiring Principal Investigators, Lab Managers, etc.) have donated unwanted reagents, materials and equipment to universities, which eventually absorb the costs of management and disposal. Donated materials may be enticing; however, consider the costs associated with their use and final disposal.
- Whenever possible, recycle materials rather than dispose of them. For procedures and schedules, contact your faculty representative, or the Office of Risk Management. For information concerning recycling of non-hazardous materials, contact your Facility Manager or the Facilities Recycling Coordinator. The University of Ottawa has established recycling programs for some hazardous wastes, including batteries and fluorescent light bulbs.
- Conserve energy and water to the extent possible. Turn off lights and equipment if not in use.
- Label all waste materials. If the identity of a hazardous waste is not known, it must be assessed and analyzed by lab personnel – or in some cases, specialized contractors – prior to disposal. Costs of ensuring that a material does not present a hazard can be exorbitant and unnecessary. Contact enviro@uottawa.ca for information.
Hazardous Waste Disposal
Note that the following points are general procedures only. Detailed information on specific classes of waste may be found from your respective Faculty / Service, consulting the Directive, or by contacting the Office of Risk Management.

Waste Pick-Up
To arrange for a pick-up of hazardous waste, a laboratory representative must complete and submit the appropriate hazardous waste collection form:

- **Hazardous Materials Technical Services Regular Collection Request** – used for the disposal of hazardous chemicals or materials resulting from a by-product of laboratory activities or to request a new hazardous waste container and/or replacement container and spill kit. All requests are scheduled for the next available time slot according to the regular hazardous waste service schedule.

- **Hazardous Materials Technical Services – Special Request** – used for laboratory decommissioning, extremely reactive and/or dangerous hazardous waste (i.e. explosive waste, etc.). The user is encouraged to attach all applicable supporting documentation, including chemical inventory, photos, instructions, etc. These services are scheduled outside of the regular hazardous waste schedule; therefore, it is important to plan ahead, as the Office of Risk Management cannot guarantee service in the same week.

Chemical Waste Containers:
All chemical waste containers must be labelled with the University of Ottawa hazardous waste label, which is available from the Faculty of Science or Faculty of Medicine Stores, or the Office of Risk Management.

Biohazardous / Sharps Waste Containers:
Biohazardous waste containers are puncture proof and colour coded according to the types of wastes they contain. Yellow containers are for biohazardous sharps; white containers are for all other sharps.

Caution – the use of syringes and needles present an additional hazard given the risk of puncture. A needlestick injury – especially those with chemical and/or biological implications – will likely require additional medical care. As a result, every effort should be made to use safety-engineered needles to minimize the risk of injury. Syringes and needles should not be bent or recapped at any times; they should be immediately disposed of in a proper – dependent on the hazard – waste container.

For more information contact the Office of Risk Management.

Radioactive Waste Container:
Labelling requirements vary depending on the type of waste. For more information contact the Office of Risk Management.

Waste Collection and Containment
- Waste generators are responsible for the waste they generate until it is accepted for disposal by the hazardous waste technician.
- Do not dispose of hazardous materials down a drain.
- Do not mix incompatible chemical wastes.
• Do not pour active reactions into a waste container. Allow the reaction to complete and then dispose of in the hazardous waste container. Rinse containers two-to-three (2-3) times and collect rinse water in the same hazardous waste container.
• Waste containers must not allow pressure build-up. Do not completely seal waste containers until they are ready for pick-up.
• Metallic waste containers used for flammable liquids must be grounded during filling procedures.
• Inappropriate waste containers will not be accepted. All waste materials must be safely contained. Use appropriate containers and ensure that they are clean, that they do not leak, and that they are sealed when offered to the hazardous waste technician.
• Improperly labelled and packaged containers will not be accepted. All hazardous waste containers must be labelled with an appropriately completed uOttawa hazardous waste label. Materials still in their original containers must have a label identifying their contents. If these materials are considered waste, they still require the completed hazardous waste label.
• Containers are considered full at 75% capacity. Overfilled and/or leaking containers will not be accepted.
• Upon receipt of new waste containers, place a small volume of water in the waste container.
• Do not store full hazardous waste containers; users may request a hazardous waste pick-up by completing the Hazardous Materials Technical Services Regular Collection Request.
• Hazardous waste awaiting pick-up must be located away from sewer access (i.e. sinks, floor drains, etc.).

Periodic Safety Check
As part of a supervisor’s commitment to lab safety, regular safety checks are recommended to be conducted by the lab manager, supervisor or delegated competent person in the laboratory. Once per month (or more frequent, as needed), check the condition of the following equipment and materials. Report any problems you are unable to address to your supervisor or your Facility Manager / Building Administrator, or Health, Safety and Risk Manager.

Fire Extinguishers
Verify that the fire extinguisher:
• Is in its proper location;
• Is accessible;
• Is fully charged, as indicated by the gauge, or weight for CO₂ extinguishers;
• Its pin is secured via clip / breakable tie-wrap.
If the fire extinguisher is deficient, contact Protection Services at ext. 5499 to have the extinguisher immediately replaced.

Chemical Storage Compartments
Verify that the contents are organized in accordance with their chemical compatibilities (including any hazardous waste), that expired products are removed and properly disposed of, and that containers are secondarily contained in the event of a spill. If the compartment is vented, verify that proper air flow is being maintained and that the cabinet integrity remains intact.

Tubing (Water, Vacuum or Gas)
Verify that connections are appropriately secured and that there are no leaks. Rubber tubing should be regularly checked for cracking.

**Glassware**
Periodically verify a random selection of glassware. Cracking, stars, chips, etc. are all evidence that the glassware should be removed from service and repaired / replaced.

**Emergency Devices**
Emergency devices need to work in the event of an emergency. Periodically verify the activation of emergency control devices, including:
- Emergency call (panic) buttons – both fixed and mobile; notify Protection Services in advance of any test.
- Emergency stop buttons – both operator-activated and lab/workshop activated.

**Procedures for Permanently Vacating Laboratories**
The laboratory area, when permanently vacated, must be left free of hazards, safe and in tidy condition. The outgoing lab manager / supervisor have the most intimate knowledge of the work that occurred within the lab; therefore, they are the best-suited to ensure that any (potential) remnant hazard is mitigated prior to reoccupation of the incoming lab manager / supervisor. Proper decommissioning will ensure the future lab users are healthy and safe. For assistance, contact the Faculty Health, Safety and Risk Manager.

**After-Hours Work**
Working alone is considered an unsafe practice at any time and is strongly discouraged. If, however, the nature of the work makes working alone unavoidable, measures must be taken to ensure that others are aware that you are doing so and to have someone check in with you from time to time, either in person or by telephone.
- Obtain written permission from your supervisor prior to working alone. Determine if special procedures are required (i.e. buddy system).
- Ensure that you carry a University of Ottawa ID card at all times.
- Call Protection Services at ext. 5499 to advise them where you will work and for how long.
- Call Protection Services again when leaving the area.

Refer to the Working in Isolation guideline, available from the Office of Risk Management for more information.

**SAFETY PROTOCOLS AND EQUIPMENT**

**Personal Protective Equipment**
Remember – personal protective equipment does not remove the hazard itself; it is therefore considered as the last line of defence against a hazard.

Personal protective equipment is legislatively required when users are exposed to the:
- Hazard of head injury (Regulation 851, s. 80);
- Hazard of eye injury (Regulation 851, s. 81);
- Hazard of foot injury (Regulation 851, s. 82);
- Hazard of injury from contact with the worker’s skin (Regulation 851, s. 84);
• Hazard of falling more than 3 meters (Regulation 851; s. 85)

Additionally, long hair, jewellery and/or clothing must be suitable confined to prevent entanglement with any rotating shaft, spindle, gear, belt or other source of entanglement (Regulation 851, s. 83).

Personal protective equipment must be appropriate in the circumstances and the user instructed and trained in its care and use before wearing / using the equipment or device. **It is the supervisor’s responsibility to conduct a hazard assessment and determine if additional (or in rare cases, less) personal protective is required.**

In the absence of a hazard assessment conducted by the lab supervisor identifying the required personal protective equipment, the minimum requirements for any laboratory work include:

- Long pants (shorts and Capri pants are not appropriate for laboratory work);
- Lab coat (knee-length with snaps (no buttons);
- Proper footwear (closed-heel and toe);
- Protective eyewear (impact glasses, splash goggles, and/or face shield);
- Gloves (nitrile, leather, vinyl, etc.)

There are many different types of protective equipment for different types of hazards. For example, protective eyewear protecting from impact will not provide sufficient protection for splashes. It is therefore vital for the supervisor to identify the level of protection required based on the activities occurring within his/her laboratory. Remember that not all protective equipment is created equal. Different suppliers, hazards, situations and interaction with other protective equipment can impact the protective factor of a given piece of protective equipment.

Supervisors are responsible for ensuring access to, and the use of the required personal protective equipment within the area of their responsibility.

It is the user's responsibility to maintain any personal protective equipment assigned to them in good and useable condition. The Lab Manager / Supervisor are responsible to maintain, in good and useable condition, any generic stock of personal protective equipment for the lab. In any event, if the condition of the protective equipment is in doubt, the user must inform their supervisor and not use the equipment.

Leave protective equipment (lab coats, gloves, etc.) inside lab when leaving the work area. A storage area for protective equipment (i.e. drawer, cabinet, etc.) can provide a hygienic location for the safe storage of protective equipment within a lab. Do not contaminate public hallways and rooms. Wash hands and forearms with soap and water before leaving the work area.

Refer to the uOttawa Guideline on [Personal Protective Equipment, available from the Office of Risk Management](#).

**Gloves**

Not all gloves are appropriate for all circumstances. A wide variety of gloves are available to protect against chemical exposure. Because the permeability of gloves of the same or similar material varies from manufacturer to manufacturer, no specific recommendations can be provided. Appendix E lists the chemical resistances of some common glove materials. Be aware that no glove offers unlimited protection and that hazardous materials will eventually diffuse through. As this occurs, the
hazardous material is held against the worker’s hand longer and the individual may then be more exposed to the chemical than if the glove had not been worn. This is not to say that gloves should not be worn; only that they must be changed out / disposed of when this occurs.

- Always inspect gloves prior to use – this will help ensure the absence of cracks or small holes in gloves. Note that aged nitrile gloves can degrade over time.
- Do not wear gloves in public areas. Remove gloves before leaving the work area and before handling lab equipment such as telephones, doorknobs, writing instruments, and laboratory notebooks. Transporting hazardous materials may be conducted over short distances between labs with the “one-gloved approach” so as to maintain worker protection.
- Gloves may be reused, cleaned, or discarded, consistent with their use and contamination.

**Eye Protection**

Eye protection is mandatory in most laboratories where hazardous (i.e. corrosive, flammable or toxic) materials are used or stored, as well as anywhere near high-pressure, vacuum equipment or when carrying out work that can generate dusts, sprays or other projectiles.

The wearing of contact lenses in a laboratory is also strongly discouraged unless while wearing chemical splash safety goggles. Vapours can readily enter the space between the lenses of impact safety glasses and the eyes. This can make the lenses difficult to remove and further increase the risk of permanent eye damage.

Depending on the protection required during a specific procedure, regular safety glasses, chemical safety goggles or a full-face shield may be necessary. The supervisor is responsible for identifying the proper type of protective eyewear. Consult with your supervisor for additional, lab-specific information.

**Hearing Protection**

Hearing protection is required to be worn if noise levels regularly exceed 85 dBA (decibels). It is permissible to be exposed to noise levels greater than 85 dBA for short durations without hearing protection. Personal headsets for audio players are not considered adequate hearing protection.

Contact your supervisor, Health, Safety and Risk Manager, the Office of Risk Management or refer to the Hearing Conservation Program for more information. Audiometric evaluations are recommended for all at-risk workers and are available at no-cost to the worker via the Health and Wellness office (Human Resources).

**Clothing**

Be aware that there are hazards associated with materials commonly used in personal clothing. Cotton is highly permeable. Nylon, polyester and spandex are easily melted. Body-hugging materials (such as spandex) will saturate and hold spilled chemicals close to the skin. Evaluate the potential hazards of your activities and wear clothing appropriate for the circumstances of your work. Knee-length lab coats are recommended to be worn at all times in laboratories when work involves hazardous chemicals, biohazards, or radioisotopes. All lab coats must have snap fasteners rather than buttons so that they can be quickly removed in the event of an emergency.

Contaminated lab coats or clothing may not be washed with other laundry (i.e. do not wash your contaminated clothing at home).
**Respiratory Protection**

In some cases, respiratory protection will be required to ensure adequate protection; there may even be situations where respiratory protection is needed in addition to engineered controls (i.e., fume hoods). Not all respiratory protection is created equal. There are various types of tight fitting face pieces, with different types of cartridges for different types of hazards. Depending on the hazard, supplied air respiratory protection may be required. Respirators are required to be fit-tested to ensure a proper fit, with fit tests occurring every two years and also when the user has undergone any major physiological changes (i.e. major weight gain / loss, facial surgery, etc.

Refer to the Selection, Use and Care of Respiratory Protection guideline, available from the Office of Risk Management.

**Laboratory Equipment**

**Laboratory General Ventilation**

Laboratory ventilation will exist at an elevated – that is, increased – rate than that of an office-type environment. For example, ventilation within the laboratory will generally operate with at least six (6) air changes per hour; meaning that air within the lab will be completely changed at least 6 times over the course of 1 hour. Depending on the design and operations conducted within the laboratory, a greater number of air changes may be required. General ventilation is not the same as other hazard controls – such as local exhaust ventilation or fume hoods. If assistance is required in the determination of hazard controls, you may contact the Faculty Health, Safety and Risk Manager.

**Fume hoods**

Fume hoods serve to control exposure to toxic, flammable or offensive vapours. The fume hood is not an appropriate means for disposing of chemicals and is also not intended as a storage cabinet. Stored chemicals can interfere with efficient hood operation and in the event of an accident or fire every item in the hood may become involved and escalate an otherwise potentially less-hazardous incident. The following are basic reminders for users:

- Be sure the hood is working properly. A continuous monitoring device will provide visual evidence of face velocity. Alternatively, a narrow strip of tissue paper can be a reasonable, short-term indicator of good airflow.
- Minimize storage of hazardous materials in fume hoods and dispose of collected waste promptly.
- Only materials being used in an on-going experiment should be kept in the fume hood. Cluttering of the hood will create disruptions in airflow.
- Large apparatus inside a fume hood should be placed upon blocks or legs to allow air to flow underneath.
- Equipment should be placed as far back in the hood as practical and activities carried out at least 15 cm (6 in.) from the front edge of the fume hood.
- Keep your head outside of the fume hood whenever possible. Avoid cross drafts at the face of the fume hood. A fume hood’s airflow can be disrupted by drafts from windows, doors, and even by the positions of the workers at the fume hood.
- Keep the sash clean and clear.
- Operate the fume hood with the sash as low as practical.
- Keep the fume hood sash closed when the fume hood is unattended.
- Clean all chemical residues from the fume hood chamber after each use with appropriate solution.
• Electrical devices (unless certified explosion-proof) should be connected outside of the fume hood to avoid sparks, which may ignite a flammable or explosive material.
• In emergency situations (i.e. fires, gaseous emissions, spills), pull the sash down completely and increase flow (i.e. press the “+” button, or “purge”). Call Protection at ext. 5411 and vacate the lab. Remain available at a safe location for follow-up.
• For any situation requiring fume hood maintenance or repairs, report the matter to your supervisor. If immediate repairs are required (i.e. the fan has ceased functioning), close the fume hood sash and call Facilities at ext. 2222 and notify your supervisor and other lab users.

Facilities conduct annual maintenance on all fume hoods. Refer to the Fume Hood User Guideline, available from the Office of Risk Management for more information.

Gloveboxes
A glovebox is a sealed chamber used to carry out air- and water-sensitive chemistry (including chemical reactions) under an inert atmosphere. It is normally filled with nitrogen, although argon is sometimes used.

Built into the front window of the glovebox are rubber arms that permit the user to work inside the box without compromising the inert environment inside. One or more antechambers, which can be sealed at both ends to permit evacuation and refilling with inert gas, are mounted on the side of the box; this enables materials to be brought in and out while protecting the inert atmosphere in the box. Reactive materials – which may otherwise create a hazard outside the glovebox – can be safely manipulated inside the glovebox. Additional safe-use procedures will be provided by your supervisor.

Solvent Stills
In cases where commercially available solvent purification system cannot be used, solvent stills may be used to obtain dry, oxygen free, high purity solvents after supervisor permission has been sought in writing. In addition to the lab-specific training, the Faculty of Science has developed generic solvent still safety training online; training should be completed prior to first using the solvent still.

Emergency Showers
• Be familiar with the location and operation of the emergency shower nearest to your laboratory or workshop.
• The shower area must be readily accessible and be kept clear of obstructions within a one (1) meter radius. Remember, negotiating clutter will be more difficult in an emergency.
• Rinse the affected area for a minimum of 15 minutes with copious amounts of water.
• The use of emergency showers must be reported on an accident/incident report form.
• Installations will be regularly inspected by Facilities; do not activate an emergency shower unless there is an emergency requiring its use.
• Additional information is available on the Emergency Shower Safety Sheet.

Eye / Face Wash Stations
• Be familiar with the location and operation of the eye wash station nearest to your laboratory or workshop.
- The eye wash station area must be readily accessible, and be kept clear of obstructions within a one (1) meter radius. Remember, negotiating clutter will be more difficult in an emergency.
- Flush eyes and/or face for a minimum of 15 minutes with a copious and gentle flow of potable water.
- The use of eyewash stations must be reported on an accident/incident report form.
- Lab users are responsible to inspect their eyewashes at regular intervals. Cold water stations must be tested monthly; warm water stations must be tested weekly (warm water stations are identifiable by their water mixing valve). Record the inspection on the eyewash inspection form.

Biological Safety

Biological Safety Cabinets
A biological safety cabinet (BSC) is intended for use with biological hazards. A BSC is designed to protect the user from exposure to infectious material or toxins, to prevent loss of containment and – depending on the type of cabinet – to protect the research specimen from contamination.

- Biological safety cabinets must be certified at the time of installation, annually and whenever they are relocated. To arrange for certification, contact the Office of Risk Management.
- Do not block the intakes or exhaust grills. Keep equipment at least 15 cm (6 inches) inside the cabinet window.
- Perform transfers of viable materials as deeply into the cabinet as possible.
- Disinfect interior surfaces of work area regularly with an appropriate disinfectant, such as 70% ethyl alcohol. Disinfect the surfaces of devices and equipment before removal from the cabinet.
- After activating cabinet's fan, allow the fan to operate for five (5) minutes before beginning work; this will allow sufficient time to purge airborne contaminants that may be present. Allow the fan to run an additional five (5) minutes following completion of work.
- Minimize air turbulence both outside the cabinet (e.g. pedestrian movement nearby) and inside (e.g. use of flames). Use of sustained open flames within a biological safety cabinet is prohibited. If a heating element is required, consult with the Biosafety Compliance Specialist regarding alternatives to open flames.
- Do not work in cabinet when germicidal (UV) lamp is on.

Cryostats
Cryostats are used to cut histological slides. The precision of the cutting process is in micrometres and tissues sectioned can be as thin as one (1) micrometre. Specimens are mounted within a cold, climate-controlled cabinet, which can typically be -20°C to -30°C. The slide is placed within the cryostat and is advanced forward toward the sharp blade within the cryostat cabinet. This allows tissues to be sectioned and mounted on slides for use elsewhere. The mounted slide is removed from the cryostat and dried.

The most common hazard with cryostats is the contact with the sharp blade of the equipment; lacerations are possible when handling, or coming in contact with, the blade. Therefore, when changing the blade of a cryostat or performing maintenance (i.e. cleaning), it is recommended to lock the blade rotation and remove with tongs / forceps to maintain distance and/or to use cut-resistant gloves. Additional safe-use procedures will be provided by your supervisor.
Autoclaves
An autoclave is a pressure vessel, which is used at uOttawa to carry out decontamination and/or sterilization processes requiring elevated temperature and pressure. As a result, it is critical to understand the use principles and safety features of autoclaves. The University of Ottawa offers regular training in Autoclave Safety. All users operating autoclaves or generating materials that someone else will autoclave must attend the training. A key component of the training is to understand which materials must never be placed in an autoclave, e.g., chlorinated compounds.

Registration for Autoclave Safety training is available on the Office of Risk Management website.

Centrifuges
Driven by a motor spinning liquid sample vials at high speed, a centrifuge will separate fluids of greater and lesser density. There are various types of centrifuges, depending on the size and the sample capacity. Centrifuges must be carefully balanced, as small imbalances can result in unbalanced forces at the high speed of operation – this can lead to personal injury and property damages.

Because centrifuges have tremendous energies, centrifuges must be interlocked, meaning that the device is not permitted to start or operate with the lid open or removed. It is recommended that the centrifuge is inspected prior to use, its use logged via a central centrifuge log book and is properly maintained in accordance with the manufacturer specifications. Due to the high speed, aerosolization of hazardous materials is another potential hazard. Special aerosol-tight gaskets are available for centrifuges intended for use at high speeds with hazardous materials. Additional safe-use procedures will be provided by your supervisor.

Fire Safety
Familiarize yourself with the location and operation of the fire extinguishers, emergency exits, evacuation routes, fire alarm systems (including pull stations) and fire suppression systems in your area.

If the fire alarm sounds, follow the evacuation routes established for your area and building. Use stairs that are clear of smoke; never use elevators. Be observant and report anomalies (such as fire, smoke, odours) to Building Wardens (who can be identified by their blue vests and yellow hats) or Protection Services. Once outside of the building, move away from the doors to enable others to exit. Proceed to your designated assembly (muster) point. Never re-enter the building until authorization has been received from the Ottawa Fire Department or Protection Services.

Fire Prevention
The most effective means of controlling a fire is to prevent one from occurring. The following points are recommended guidelines to help prevent fires:

- Minimize the quantities of flammable materials kept on hand.
- Use approved flammable storage cabinets. Keep doors of these cabinets closed and latched at all times. No other materials should be stored within these cabinets.
- Unless necessary for your work, keep flammable materials away from heat, flame and direct sunlight. No welding, soldering or flame/spark generating activity should be performed in their vicinity.
• Static charges can build up in pipes or other apparatus through which flammable liquids are flowing; such equipment must be electrically grounded.
• In cases where quantities of flammable or explosive chemicals are spilled and/or being evaporated, refrain from switching on/off electrical equipment.
• Smoking is not permitted in any building or within 9 meters of any entry, including building air intakes.

Fire Extinguishers
Fire extinguishers provide limited operable discharge lasting just 10 – 12 seconds and can be used to assist in vacating a hazardous environment. In most instances, a type ABC extinguisher is installed near the entrance / exit to the lab. If the fire is too great, close the door immediately, activate the alarm at the nearest fire alarm pull station and evacuate the building.

Not all fire extinguishers are created equal; it is important to understand the limitations of each type of extinguishing media. In selecting the appropriate extinguishers for the laboratory, the type of combustible material must be considered:
• Class A (H₂O) fires involve ordinary combustible materials such as wood, cloth, paper, rubber and many plastics.
• Class B (CO₂) fires involve flammable liquids and gases, oils, greases, tars, oil-base paints, lacquers and some plastics.
• Class C (dry chemicals) fires involve Class A and/or B materials in the presence of live electrical equipment, motors, switches and wires.
• Class D fires involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium and any other finely-divided metals, which are oxidizable.
• Class K fires involve are fires involving oils and grease and are typically kitchen-related fires.

Remember, do not attempt to fight a major fire on your own. If you choose to fight a small fire, always have an escape route available – a small fire may quickly develop into a large fire. All laboratories where flammable materials are used must be equipped with an appropriate fire extinguisher. In the event of a problems with a fire extinguisher (such as an empty or damaged extinguisher), if a replacement is required, or if a different type of extinguisher is required, notify Protection Services at ext. 5499 or the Fire Prevention Coordinator at ext. 6091. The extinguisher must be replaced prior to the continuation of work.

Fire Safety Training is available from the Office of Risk Management.

Radiation Safety
All users must receive training prior to using radioactive materials and must be operating under an active radioisotope permit, issued by the Office of Risk Management. Detailed information on radiation safety is provided by the Canadian Nuclear Safety Commission posters, which are required in all radiation work areas. For further information, training, or questions contact the Office of Risk Management.

Refer to the Radiation Safety Manual, available from the Office of Risk Management, for additional information.

X-Ray Generators
• Understand and follow all operational instructions and precautions specified by the supplier of the instrument before its use.
• Warning signs must be displayed on or near the main power switch of the instrument and on the entry door to the location.
• The Ontario Ministry of Labour regulates x-ray safety and all activities must comply with Regulation 861 made under the Occupational Health and Safety Act.
• Contact the Office of Risk Management for more detailed information.

Lasers
• Understand and follow all precautions specified by supplier of the instrument before its use.
• Warning signs must be posted in laser areas and on doors leading to those areas.
• Specialized protective eyewear for the particular wavelength and power level may be required.
• Laser beams must be kept at, or below, waist level.
• Never look directly at the beam or pump source.
• Use the image converter to view the beam pattern directly.
• Ensure that there are no unwanted reflective objects in or along the path of the beam; even buttons or screw heads can create a beam-scatter hazard. Remove rings, watches and other jewellery.
• If possible, keep the room illumination level high to avoid pupil dilation.

UV Radiation
• Understand and follow all precautions specified by supplier of the instrument before its use.
• Warning signs must be posted in UV areas and on doors leading to those areas.
• Always wear protective safety glasses with applicable UV filtering lenses.
• Protect all skin from UV radiation.
• UV sources should be operated within an enclosure and adequately cooled to prevent the mercury lamp from exploding and leaking hot mercury vapour.

Microwaves
• Do not attempt to operate microwaves with the door open.
• Do not tamper with or defeat safety interlocks.
• Ensure that seals around door are clean and undamaged.
• Loosen lids on containers to relieve pressure build up during heating processes.
• Do not use metal containers or materials in microwave.
• Only qualified and trained people should alter or modify microwave ovens.
• Label as “no food/drink” or “for laboratory use only”.

Fluxers
A fluxer is a sample preparation instrument used to transform powders of cements, ores, slag, sediments, soils, rocks, ceramics, pigments, glasses and other materials into either glass disks or acid solutions. Glass disks are typically intended for x-ray fluorescence (XRF) analysis, while solutions are prepared for analysis by atomic absorption (AA) or inductively coupled plasma mass spectrometry (ICP-MS). A programmable interface executes each fusion step in a sequential order to obtain a perfect glass disk or solution.
A fluxer should be operated in a fume hood with minimum radial clearance of 30 cm (12 in.) and minimum vertical clearance of 90 cm (36 in). Keep hands away from the arm towards the end of the fusion process as it will abruptly drop onto its bumpers when pouring the molten sample. Some substances may lead to boiling spurts, therefore appropriate safety equipment, such as adequate eye protection and gloves, should be worn while operating the fluxer. Care should be taken when handling the instrument immediately after fusion as some parts of the instrument may still be very hot. The manual shutoff valve of the propane gas line should be closed when the instrument is not in use.

**High Magnetic Fields**
The high magnetic fields present in magnetic resonance laboratories may pose serious health risks to those with cardiac pacemakers, prosthetic implants, or artificial limbs. Those having such implants or prosthesis should consult their physician before entering the vicinity of a high field magnet. Since the attraction of ferromagnetic objects, such as gas cylinders or metal tools, towards high field magnets can be enormous, there is also a risk associated with handling metallic objects near high field magnets. Persons are at risk when they are between the magnet and a nearby heavy ferromagnetic object. Areas surrounding NMR magnets (above, below, radially, etc.) must be well indicated with warning signs.

The presence of strong magnetic fields may also lead to the loss of magnetically stored data (e.g. bank cards, computer disks, etc.). As a result, such objects should be kept well away from high field magnets. Other devices such as analogue watches, oscilloscopes, video monitors or motorized devices may not operate properly when located near a high field magnet.

**Electrical Safety**
Electricity is a requirement of day-to-day life. The following brief points will help lab users ensure their safety when working with electrical equipment.

- All electrical apparatus must be properly grounded. The ground pin of a 3-pronged plug is never to be removed.
- All electrical equipment must meet CSA (or equivalent) requirements.
- Frayed / damaged wires and cords must not be used.
- Refrain from using portable space heaters in proximity with combustible and flammable material.
- Do not pull on wires of electrical equipment.
- Ensure that all wires are dry before plugging into circuits.
- Electrical connections for equipment used within a fume hood should be made on the exterior of the fume hood.
- All electrical equipment in wet locations must be equipped with ground fault circuit interrupters (GFCI).
- Circuit breaker panels must be easily accessible and clearly marked. A one (1) metre radius is required to be maintained.
- The use of extension cords as permanent wiring is not permitted.
- Only qualified and trained personnel shall repair / modify electrical or electronic equipment.

**Static Electricity and Sparks**
- Static electricity and sparks have the potential to cause a fire, under the right circumstances. Always be conscious of the potential for generating sparks and reduce their potential to the extent possible.
- A dry atmosphere promotes the formation of electrical charges.
- Sources of sparks and static electricity may include:
  - Switches and thermostats;
  - Electrical contacts (e.g. light switches, thermocouples, refrigerators, etc.);
  - Decanting of organic liquids from one metal container to another;
  - Plastic aprons;
  - Metal clamps, nipples or wires used with non-conducting hoses;
  - Gases released quickly from cylinders under high pressure;
  - Etc.

For more information, consult the Electrical Safety Guidelines available from the Office of Risk Management.

**Glassware**

**Handling glass rods or tubes**
- Fire-polish the ends.
- Lubricate with water, glycerine or other acceptable lubricant when inserting through a stopper.
- Ensure stopper holes are properly sized and are not too small.
- Insert carefully, with a slight twisting motion, keeping hands close together to maintain control and leverage.
- Use gloves or a cloth towel to protect your hands; refrain from using excessive force.

**General Glassware Safety**
- Protect glass that is subject to high pressure or vacuum. Wrapping glass vessels with cloth tape or plastic wrapping will minimize the possibility of projectiles in the event of a vessel failure.
- Glass is weakened by all types of stresses (e.g. heating, bumping, etc.). Handle used glassware with extra care.
- Verify the integrity of the glassware prior to use. Scratched, chipped, cracked or star-cracked vessels cannot sustain normal stresses; repair or discard all damaged glassware. If glassware is contaminated (i.e. chemical or biological), dispose according to proper waste stream. Label the container appropriately.

**Cleaning Broken Glassware**
- Use a dustpan and brush to pick up broken glass. Do not use your hands, even for large pieces.
- Discard broken glass and Pasteur pipettes in a broken glass container or other rigid container separate from regular garbage. If glassware is contaminated (i.e. chemical or biological), dispose according to proper waste stream. Label the container with the appropriate waste label.

**GUIDELINES FOR SPECIFIC CLASSES OF HAZARDOUS MATERIALS**

All materials, including hazardous materials, will generate some type of waste. It is important to understand that the hazardous waste can be just as hazardous, if not more so, than the original material. Refer to the Hazardous Materials and Hazardous Waste Directive for more information on disposal of hazardous waste (including biological and radiological waste).
Flammable, Combustible and Ignitable Materials

Storage
Flammable and Combustible Liquids:
- Flammable and combustible liquids in laboratories may only be stored in either a glass container of 4L (1 gallon) capacity or less, or metal or plastic containers of 20L (5 gallons) or less.
- Flammable liquids must be stored in approved flammable storage cabinets. Doors to flammable storage cabinets are to be kept closed. Refer to the Flammable Storage Cabinet Safety Sheet, available from the Office of Risk Management.
- Heat-sensitive flammable liquids must be stored in explosion-proof refrigerators. Normal refrigerators or cold rooms are not to be used for the storage of flammable liquids.
- Reactive chemicals are not to be stored in the same storage cabinet as flammable liquids.
- Purchase and store only quantities actually required for the work. Maintain a reduced inventory to the extent possible.

Ignitable Solids:
- Store in an airtight container or bottle to prevent dispersal of dust. Store under an inert material if necessary.
- Ignitable solids must be stored in approved flammable storage cabinets. Doors to flammable storage cabinets are to be kept closed. Refer to the Flammable Storage Cabinet Safety Sheet, available from the Office of Risk Management.

Handling
Flammable and Combustible Liquids:
- Consult the Safety Data Sheets (SDS) prior to using the product.
- Flammable and combustible liquids must be used in well-ventilated areas.
- Keep away from sources of ignition.
- Flammable liquids should be transferred inside a fume hood.
- If transferring between metal containers, both containers must be grounded.
- Some flammable liquids (e.g. ethers) are also peroxide formers; additional caution must be exercised in accordance with the safety data sheet (SDS).

Ignitable Solids:
- Consult the Safety Data Sheets (SDS) prior to using the product.
- Ignitable solids must be used in well-ventilated areas.
- Keep away from sources of ignition.
- Clean the work area frequently to prevent the accumulation of ignitable dusts.

Solvents
Many solvents are flammable or combustible liquids and should be handled as such; however, some solvents have additional hazardous characteristics. Benzene and many halogenated hydrocarbons are known or suspected carcinogens and should be considered chronically toxic. Ethers are peroxide formers and should be considered potentially explosive. Ensure care when handling any hazardous material. Supervisors must provide proper instruction to lab users.

Solvents should be stored and handled as flammable or combustible liquids. Avoid exposure to the liquids and their vapours. Avoid skin contact as absorption may cause dryness and cracking of the
skin, potentially leading to infection and/or allergic responses. Additional, substance-specific precautions may be required (e.g. ethers).

**Corrosive Materials**

**Storage**
- Acids and bases must not be stored together (i.e. in the same cabinet or on the same shelf) unless protected by secondary containment.
- Store in approved corrosive cabinet.
- Never store corrosive materials on shelves higher than waist level.
- Store away from high traffic areas.
- Corrosive compressed gases must be stored in a well-vented area (i.e. gas cabinet).

**Handling**
- Consult the Safety Data Sheets (SDS) prior to using the product.
- Do not add water to a highly-concentrated acid, as it can result in a violent exothermic reaction and may cause serious injury. Always add acid to water.
- Keep corrosives away from heat sources to avoid production of fumes. Avoid direct contact with fumes.

**Reactive Materials**
Reactive materials are substances which can create violent reactions during which the spontaneous liberation of heat and/or gases is too rapid to be safely dissipated by the surroundings. Thus, the reaction may result in out of control situations (i.e. vessel ruptures, explosions, uncontrollable release of toxic vapours, flammable gas evolves, spontaneous ignition occurs, etc.

Reactive materials may be grouped in five broad categories:
1. Explosive (shock sensitive and/or heat) sensitive) materials
2. Water reactive materials
3. Air reactive materials
4. Oxidizers and reducers
5. Peroxide formers

**Storage - General**
- Maintain only quantities that you require.
- Completely isolate these chemicals from any sources of heat or moisture.
- Clearly label the area where reactive chemicals are stored.
- Date the container with the procurement date.

**Handling - General**
- Exercise extreme caution when handling these materials.
- Consult the Safety Data Sheets (SDS) prior to using the product.

**Visual Signs of Instability**
The first signs of chemical aging, peroxide formation or chemical instability are usually visual. To make an early diagnosis and prevent an explosion and potential serious injury, **visually** verify for:
- Discolouration of the liquid/solution. Consult the safety data sheet for the original properties of the material.
• Formation of crystals inside the solution is often an indication of peroxide formation.
• Formation of crystals around the cap of the bottle is usually a sign of advanced peroxide formation. **The bottle should not be moved or further manipulated.** Report the situation to the Health, Safety and Risk Manager and / or the Office of Risk Management for safe and immediate removal.
• Some materials are wetted for safe handling and storage (i.e. picric acid) and should appear paste-like. Once these materials dry out, they become extremely shock-sensitive and explosive.

**Explosives (Shock / Heat Sensitive) Materials**

Hazardous materials may be become even more so hazardous due to chemical changes in their composition. Such materials may become readily sensitive to friction, shock, or sudden heating, or which can become shock-sensitive when allowed to dry out (e.g. picric acid). Examples may include certain azides, diazo compounds, n-nitro compounds, picrates (especially metal salts), polynitroalkyl compounds, polynitroaromatic compounds, etc.

If such materials are required, purchase in the smallest size available and only when absolutely necessary. Whenever possible, use chemicals with added inhibitors. Date all chemicals when first delivered and opened; log their ownership and location using the chemical inventory. Protect these materials from physical shock, elevated temperature, light, ignition sources and other reactive chemicals. Store all explosive compounds in areas isolated from high-traffic areas and away from other combustible materials. Use a dedicated flammable storage cabinet and clearly label the area where explosives are stored. Ensure to inspect containers regularly for crystallization of liquids (e.g. peroxide formation in ethers), discoloration, or drying out.

**Water Reactive Materials**

These materials must be stored in a cool, water-proof area. They should be properly desiccated whenever possible and not stored in proximity to water sources (i.e. under a sink) or other reactive materials. Clearly label the area where water reactive materials are stored. Ensure that proper extinguishing media is available. Examples may include alkali metals (sodium), organometallic compounds, halides, hydrides, peroxides, carbides, oxides, phosphides, anhydrides, etc.

**Air Reactive Materials**

Metallic dusts (e.g. nickel, titanium) etc. should normally be stored in containers with some moisture. Other solids should be stored under an inert gas or liquid. Isolate such materials from oxidizing agents. Clearly label the area where air reactive materials are stored. Minimize to the extent possible their exposure to air. Ensure that proper extinguishing media is available.

**Oxidizers and Reducers**

Minimize, to the extent possible, the possibility of oxidizers and reducers coming in contact with one another; oxidizers and reducers should be stored in separate storage cabinets or shelves. Isolate oxidizers and reducers from other potentially reactive materials. Do not store oxidizers with flammable liquids. Many oxidizers and reducers are also explosive, water reactive or air reactive – ensure to understand the hazards and implement the appropriate precautions for the materials in question.

**Perchloric Acid**

At standard temperatures, 73% perchloric acid solution reacts as a strong non-oxidizing acid, is relatively stable and may be stored for extended periods in glass bottles with no contact with oxidizable material. At high temperatures (~160°C), it becomes a strong and active oxidizing agent and a strong dehydrating reagent (anhydrous perchloric acid). Contact with organic matter or other
combustible material may cause fire or explosion. Examples of chemicals incompatible with perchloric acid include plastics (acrylonitrile, nylon, Polyester-Dacron, cellulose based lacquers); metals (copper, copper alloys, perchlorate salts, aluminium, high nickel alloys); other materials (cotton, wool, wood, glycerin-lead oxide).

Obtain anhydrous perchloric acid (>85%) in the smallest size available. Never store anhydrous perchloric acid for more than 30 days; ensure that all chemical containers are dated when they are first delivered and opened. Store the container in a flammable storage cabinet, away from organic materials. Do not allow perchloric acid to come into contact with strong dehydrating agents (such as concentrated sulphuric acid, anhydrous phosphorous pentoxide) or other organic materials.

Check containers regularly for formation of crystals around the cap, or discolouration of the clear white solution; a yellow discolouration indicates expiry. Any discolouration of the anhydrous acid requires its immediate disposal. If discolouration or crystal formation is noted, do not move bottle or attempt to remove the cap. Contact the Health, Safety and Risk Manager and / or the Office of Risk Management for assistance in disposing the material.

Appropriate protective equipment and fume hood must be used. Clearly identify any fume hoods used for perchloric acid work as perchloric acid vapours tend to condense on the inside of fume hoods and the inner lining of ducts, eventually forming perchlorate crystals, which are shock-sensitive explosives. Keep the quantities handled to a minimum.

In wet combustion, treat the sample with nitric acid to destroy easily oxidizable matter. For anhydrous perchloric acid (>85%) a second person must be informed of the intended use of anhydrous perchloric acid and be in the same room with research worker during the experiment. A lab coat, safety glasses, thick gauntlets and rubber apron must be worn. Only freshly prepared acid may be used. Do not make any more anhydrous perchloric acid than is required for a single day's use.

Disposal of perchloric acid (73% or less) will follow the general disposal guidelines for reactive wastes. Do not combine with any other types of waste. Anhydrous perchloric acid (>85%) must be disposed of at the end of each day by dilution and neutralization.

**Peroxide Formers**

Common laboratory chemicals can form peroxides when exposed to air over time. Peroxides can be treacherously and violently explosive in concentrated solution or as solids. There are maximum storage times depending on the group of chemicals. Examples of peroxide-forming chemicals, (including maximum storage times):

- **Discard after 3 months**: isopropyl ether, divinylacetylene, potassium metal, potassium amide, sodium amide, vinylidene chloride (dichloroethylene).
- **Discard after 12 months**: *butadiene, *tetrafluoroethylene, *vinyl chloride.

*These monomers must be stored with a suitable polymerization inhibitor.*
Procure ethers and other peroxidizable compounds in the smallest size possible to limit amounts exposed to air. Date all chemicals when they are received and when they are opened. Store materials in air-tight, amber glass bottles, in a dark location and under inert atmosphere, if possible. Test all ethers and peroxidizable compounds for peroxide concentration at regular intervals. If peroxide concentrations are acceptable, re-date the container and retest at the next scheduled test date. If the peroxide concentrations are not acceptable, or if crystals have formed in the bottle or around the cap, do not move the bottle or attempt to remove the cap. Contact the Health, Safety and Risk Manager and / or the Office of Risk Management for assistance in disposal.

**Highly Toxic Materials**

A highly (or acutely) toxic material is anything which, when ingested, inhaled or absorbed in relatively small amounts, may cause damage to bodily structure or function. There are many such substances, of both biological and chemical origin. A few examples include arsenic trioxide, cyanides, nickel carbonyl, phosgene, tetrodotoxin, etc.

Because of their toxic nature, these highly toxic, carcinogenic or mutagenic materials must be locked in specific storage areas (e.g. cabinet or cupboard) with access limited to authorized personnel. These substances must only be used in well-ventilated areas (i.e. within a fume hood).

If a worker is pregnant (or planning to become pregnant), exposure to these materials must be further assessed and very likely eliminated altogether. Consult the Pregnant Workers Guideline, available from the Office of Risk Management.

**Biohazardous Materials**

Biohazard is a generic term used to describe bacteria, viruses, fungi or other infectious agents. These agents are designated according to risk to the individual and community. To ensure maximum safety to both parties, Health Canada (HC) and the Public Health Agency of Canada (PHAC), the Canadian Food Inspection Agency (CFIA) and other regulators have created standards and guidelines which address these biological hazards.

Additionally, before commencing new experiments involving biohazardous agents, the researcher must obtain the approval of the University of Ottawa Biosafety Committee. To determine the required level of containment, decontamination procedures, training and any other special procedures required for the nature of the work being performed, contact the Office of Risk Management. Depending on the hazardous agent, appropriate immunizations may be required.

The following points are general precautions when working with biohazardous materials:

- Protective clothing must be worn by all personnel.
- Long hair must be tied back or otherwise restrained.
- Wash hands frequently in accordance with hand-washing best practices.
- Whenever exiting laboratory, remove protective clothing and wash hands.
- Procedures should minimize the creation of aerosols.
- Never pipette by mouth.
- Needles must not be bent or recapped. The use of safety-engineered needles is strongly recommended.
- Follow recommended procedures for decontamination of work surfaces and equipment.
Questions related to biohazardous materials, procedures and waste may be directed to the Risk Management Specialist – Biosafety at the Office of Risk Management.

Radioactive Materials
The procurement, use and disposal of radioactive material is regulated by the Canadian Nuclear Safety Commission (CNSC). This federal agency ensures control through numerous regulations and by conditions appended to the Consolidated Radioisotope Licence issued to the University of Ottawa. In turn, the university ensures compliance with these regulations and conditions through the radiation safety program administered by the Office of Risk Management and the Radiation Safety Committee. No person is permitted to possess or use radioactive material unless approved by the Assistant Director, Radiation and Biosafety.

Radioactive materials found at the University of Ottawa will generally fall into two categories:

1. **Sealed sources**
Radioactive materials that are encapsulated within devices (liquid scintillation counters) or within another material that prevents direct contact or dispersal of radioactive material.

2. **Open sources**
Radioactive materials in a form that permits direct contact and can be subdivided. Common forms of open source radioactive material include:
   - Aqueous and non-aqueous radioactive materials;
   - Solid radioactive materials (powders or contaminated materials such as pipette tips, Pasteur pipettes, test tubes, petri dishes, gloves, syringes);
   - Liquid scintillation cocktails containing dissolved radioactive material.

All users of radioactive materials are required to comply with – at minimum – the requirements below:
   - Comply with the requirements of the Canadian Nuclear Safety Commission and the conditions of radioisotope permits.
   - Radioactive material must be strictly controlled and managed, so as to track its possession, use and disposal.
   - Use time, distance and shielding to keep radiation exposure to as low as reasonably achievable (ALARA).
   - Keep the laboratory locked and secured when unattended. Unauthorized persons are not permitted in the laboratory at any time.
   - Refrain from working with radioactive materials if you have open cuts or abrasions.
   - On a regular basis (weekly for a Basic lab and after each use for an Intermediate lab) monitor and, if necessary, decontaminate equipment, trays, floor and working surfaces. Keep a record of the measurements and actions taken.
   - Use disposable absorbent liners on trays or other work surfaces.
   - Wash hands after using radioactivity and prior to leaving the laboratory.
   - Laboratory equipment must be decontaminated before they are used for other purposes.
   - Use a fume hood for any work with dry powder or volatile substances.

**Personal Protective Equipment**
- In addition to standard personal protective equipment (i.e. lab-coat, protective eyewear and disposable gloves), wearable dosimeter(s) – used to assess exposure – may be required.
Storage
- Label waste containers and storage facilities for radioactive materials with the appropriate signage.
- Store radioactive materials in a secure area.
- Ensure adequate shielding is in place (where required).

Disposal
Questions related to radiological materials, procedures and waste may be directed to the Risk Management Specialist – Radiation at the Office of Risk Management.

Cryogenic Materials
Cryogenic materials are primarily characterized by extremely low temperatures. Cryogenic liquids typically have boiling points between -100°C and -270°C. Consequently, they must be liquefied under high pressure. These conditions create certain hazards, including:
- Cold boil-off vapour, which will rapidly freeze human tissue. Cold burns and frostbite caused by cryogenic liquids can result in extensive tissue damage.
- Materials such as carbon, steel, plastics, and rubber become brittle or even fracture under stress at these temperatures. Selection of proper material is important.
- The low temperatures can condense contaminants from the atmosphere. Liquid nitrogen can condense oxygen from the surrounding atmosphere, creating an explosive mixture if organic material is also condensed. Liquid hydrogen can do the same, forming an explosive hydrogen-oxygen solid.
- All cryogenic liquids produce large volumes of gas when they vaporize. For example, liquid nitrogen will expand at a ratio of 696:1 as it vaporizes. If these liquids vaporize in a sealed container, they can produce enormous pressures which could rupture the vessel. For this reason, pressurized cryogenic containers are usually protected with multiple pressure relief devices, usually a pressure relief valve and a frangible (i.e. bursting) disc. In rare and extreme cases, cryogens can condense sufficient moisture from the air (i.e. ice) to block pressure relief valves in storage vessels, creating the potential for dangerous pressure buildup.
- Vaporization of cryogenic liquids (except oxygen) in an enclosed area (i.e. elevators, small labs, etc.) can cause asphyxiation. Vaporization of liquid oxygen can produce an oxygen-rich atmosphere which will support and accelerate the combustion of other materials. Vaporization of liquid hydrogen can form an extremely flammable mixture with air.

Personal Protective Equipment
- Protect skin from contact. Wear lab-coat, protective eyewear, face shield, and loose-fitting, cryogenic gloves.

Storage
- Store and use cryogenics in well ventilated areas.
- Store in well insulated container designed to minimize loss of product from boil-off (i.e. dewar).

Handling
- Metallic objects such as watches, rings, bracelets or other jewellery should not be worn.
- Use only approved containers capable of withstanding extreme cold without becoming brittle (i.e. dewar).
• Perform the following tasks slowly to minimize boiling and splashing:
  o Charging or filling a warm container with cryogenic liquid;
  o Inserting objects into a cryogenic liquid.
  o Pouring cryogenic liquid into smaller containers.
• Use tongs to withdraw objects immersed in a cryogenic liquid.
• Never touch uninsulated pipes or vessels containing cryogenic liquids.

Most cryogenic materials will evaporate in normal atmospheric conditions. For any further assistance, contact your Health, Safety and Risk Manager and / or the Office of Risk Management.

Compressed Gases
It is recommended that compressed gas cylinders be purchased from the uOttawa compressed gas supplier. The supplier has a cylinder return program and will recoup the empty (or unwanted) cylinders.

Storage and Set Up
• All gas cylinders, full or empty, must be properly secured at all times. Always store gas cylinders in the upright position.
• The valve protection cap must be attached when a cylinder is not connected to a regulator.

While in Use
• Use only in well ventilated areas.
• Toxic, flammable and corrosive gases must be dispensed in a properly functioning exhaust system.
• Flammable gas cylinders, lines and equipment must be bonded and grounded.
• Do not connect full and empty cylinders in series. Serious back pressure can occur when an empty cylinder is attached to a pressurized system.
• Never tamper with safety devices in valves or cylinders. Do not use adaptors or Teflon tape to attach regulators to gas cylinders. Do not lubricate.

Handling
Transportation:
• Move cylinders only with an approved cylinder cart. Avoid collisions with other objects.
• The weakest part of a compressed gas cylinder is its valve stem. Do not move cylinders without the protective valve cap.
• Never attempt to lift or move cylinder by holding onto the valve stem at the top of the cylinder. The collar is not welded onto the cylinder and may dislodge.
• Do not allow a cylinder to drop.
• Special transportation services are available for transfers across campus / streets, etc.

While in Use:
• Never use a cylinder that is not properly identified.
• Never subject any part of a compressed gas cylinder to high temperatures or flames.
• When discharging gas into a liquid, a trap or suitable check valve must be used to prevent liquid from re-entering the cylinder or regulator.
• Never direct high-pressure gas (including compressed air) at a person.
• Avoid running flammable gas lines near heat sources or open flame.
• Do not extinguish a flame involving highly combustible gas until the source of gas has been shut off.

Disposal
• Return cylinders promptly to the supplier, even if only partially used.
• When returning empty cylinders, close the valve before shipment; leave some positive pressure in the cylinder – approximately 10% of original capacity is recommended.
• Replace any valve outlet and protective caps originally shipped with cylinder.
• Lecture bottles are considered hazardous waste and should be disposed of in accordance with the [Hazardous Materials and Hazardous Waste Directive](#).

Refer to the Compressed Gas Guideline, available from the Office of Risk Management, for additional information.

Additional Hazardous Materials Requiring Special Handling, Storage and Disposal Procedures

Reactive Metals
• Metals are not to be disposed of to the sewer.
• Check for complete oxidation before preparing the material for disposal. If only surface oxidation has occurred, the metal might still be salvageable. Otherwise, prepare a waste container for waste metals, identified with hazardous waste labels.
• Most metals may be stored in glass or plastic bottles, in a regular storage cabinet or on storage shelves.
• Finely divided metals such as zinc, barium or magnesium can be highly pyrophoric (i.e. may ignite spontaneously in air at or below 55°C) and should be stored under nitrogen or an inert gas and in a flammable storage cabinet.
• All compatible waste metals may use the same container. Once the container has reached 75% capacity, seal the container and list the contents on the hazardous waste label.

Batteries
• Gloves should be worn if the outer casing of the battery is damaged and / or leaking.
• Lithium batteries are considered to be reactive waste and therefore should be stored separate from regular household batteries or mercury and cadmium batteries.
• Batteries with live ends should be taped to prevent accidental contact in the recycling receptacle.
• Waste batteries are considered a toxic metal waste and therefore should not be disposed as regular waste. Recycling receptacles (small white buckets) can typically be found on the side of the waste stations located in most buildings. For more information on the recycling process, please contact [Facilities](#).

Transportation of Hazardous Materials
This service is designed to transfer or dispose of hazardous materials for uOttawa (off-site). A few examples of this service include:
• Disposing of wastes generated off-site (field stations to Campus for disposal)
• Relocating Research from a location off-site back to uOttawa

**Costs not covered by Risk Management.**
For special transfer requests, it is recommended to plan well in advance as the logistics involved in the transportation of hazardous waste and hazardous materials requires a significant amount of resources. To request the transportation of hazardous materials, please contact enviro@uottawa.ca.

The transfer of hazardous materials between labs on campus or from Shipping and Receiving to one’s laboratory should be conducted with care and protection. The hazardous material(s) – while in a “contained” state – are still hazardous materials. Secondary containment and personal protective equipment may be required to suitably protect the user.

Reproductive Hazards

Certain laboratory materials (specifically those classified as teratogens) have the potential to impact human reproductive systems or cause birth defects. All persons can be at risk. Working with certain hazardous substances or under certain working conditions can lead to abnormal reproductive health. Many substances used in research labs have potential for reproductive toxicity and require strict control measures. In some cases, the link to reproductive toxicity may not be definitively established; it is therefore important to fully understand the actual and potential hazards of a particular product or process in order for suitable hazard controls to be implemented.

Pregnant Personnel

Personnel who are, or may become, pregnant while working in a laboratory environment require special consideration. The Ontario Human Rights Code requires the accommodation – without penalty – for any pregnant worker in cases where pregnant workers are exposed to risks that may not otherwise be present. There is a duty for the University and the pregnant worker to enter into a cooperative and respectful dialogue as early as possible in order to develop, implement and maintain appropriate accommodation measures to ensure the health and safety of the pregnant worker and unborn child. This dialogue may involve the University, the pregnant worker and the workplace bargaining unit, if/where applicable.

The University has an obligation to offer reasonable accommodation measures and to make reasonable efforts to eliminate barriers to a pregnant worker. Reasonable accommodation measures may refer to a change to the work, work methods or workplace so as to enable the person to satisfy the bona fide occupational requirements of the job and to achieve the outcomes or deliverables of the job. An accommodation is not an entitlement program; it is a method of enabling a worker to deliver the required results of the job.

Refer to the Pregnant Laboratory Workers guideline, available from the Office of Risk Management.

PROJECT RISK ASSESSMENT

Research, by its nature, is risky. The expected outcome(s) of a laboratory research project or experiment may not be fully realized. In many cases, the situation may not be hazardous; however, it is important to be prepared for unexpected (and potentially dangerous) situations that may manifest themselves during a project. For this reason, the University of Ottawa has developed a Project Hazard Identification and Risk Assessment form, intended to be completed by supervisors of research projects.

The Project Risk Assessment is intended to aid in identifying hazards associated with each phase of the project. The supervisor is responsible for the identification of the hazard(s), the estimation of risk associated thereto and evaluating control measures to eliminate or mitigate the impact of the
hazard. The Hazard Identification and Risk Assessment is available on the Office of Risk Management website. The supervisor is responsible for completing and maintaining the Project Risk Assessment.
APPENDIX A – UNIVERSITY OF OTTAWA SAFETY SERVICES

Protection Services
Protection Services (ext. 5411) acts as the University’s own emergency response team. Protection Services has offices on every campus (main campus, Roger Guindon and Lees), which should be contacted immediately during an on-campus emergency. Dial ext. 5411 on any University phone or 613-562-5411 from a cellphone. If your office is located off campus (i.e. where Protection cannot immediately respond in the event of an emergency situation), call 911. When it is safe to do so, report the matter to Protection Services.

Fire Prevention Coordinator
The Fire Prevention Coordinator is provided as a service under Protection Services. The mandate of the fire prevention coordinator is to oversee the execution of regular fire drills, the installation, maintenance, training and inspection of fire extinguishers and the investigation of incidents involving fires. In addition, the fire prevention coordinator inspects buildings and provides recommendations with regards to fire safety. Any questions concerning fire safety should be directed to the Fire Prevention Coordinator at ext. 6091.

Office of Risk Management
The Office of Risk Management (ext. 5892) provides technical support to the University community so that activities may be carried out in a healthy, safe and environmentally conscious manner. Its mandate includes the development, coordination and implementation of University-wide health, safety, risk and environmental management policies, procedures, plans and programs encompassing hazardous substances, biosafety and radioactive materials. In addition, it provides specialized services such as coordinating the disposal of biohazardous, chemical and radioactive materials, providing information and training, conducting assessments, inspections and audits.

Health, Safety and Risk Managers (HSRMs)
Five officers are dedicated to providing full time support with risk, environment and health and safety issues at specific faculties and a service. These individuals manage the above-noted duties while supporting the individual Faculty / Service direction. HSRMs are available in the Faculties of Science, Medicine, Engineering, Arts, Education, Health Sciences, Law, School of Management and Social Sciences as well as and Facilities and Housing.

Human Resources
Services provided through the Human Resources include staffing, training and development, workshop registration, information systems, and health and wellness services.

Health and Wellness Office
The Health and Wellness Office promotes safe and healthy working conditions for all employees at the University. The service is primarily preventative rather than curative and it is designed to supplement rather than replace medical services available to employees through their personal physician and community clinics such as the University of Ottawa Health Services. The office also promotes and monitors compliance with the requirements of provincial legislation on matters pertaining to workers’ compensation.

Health Services
Health Services is open to all. It is a University-based clinic prioritizing the needs of students. Some of its services are exclusive to students and funded by the University through student fees. Medical
services are provided to students, staff and the community at large. Physicians include family practitioners, and specialists in Gynaecology, Obstetrics, Dermatology, and Psychiatry. Additionally, the service staffs Health Educators and provides Health Promotion services.

Facilities
The primary mandate of Facilities is to maintain the infrastructure and grounds of the University. Examples of Facilities’ principal functions include: heating, ventilation and air-conditioning; electricity and plumbing; campus roads; traffic signs; housekeeping; maintenance of grounds (icy conditions); transportation; testing of the emergency showers; and maintenance of temporary buildings. Facilities also coordinates non-hazardous waste collection, recycling and implements the University’s energy conservation program.

Facilities provides assistance in the event of maintenance emergencies. All maintenance emergencies should be directed to the Facility Manager responsible, or in the event of a major emergency, directly to the Call Centre at 613-562-5800, ext. 2222. A maintenance emergency refers to situations where the condition of buildings, grounds and vehicles can affect the safety of users, or can create a dangerous situation (i.e. ventilation failures). The Call Centre can be reached 24 hours a day, 7 days a week.

Committees
In addition to the services listed above, there are several relevant committees within the University of Ottawa. These include:

- University Joint Occupational Health and Safety Committee;
  - Sub committees (Office, Laboratory, Facilities / Protection)
- Biosafety Committee;
- Radiation Safety Committee;

For additional information on any of these committees, contact the Office of Risk Management at ext. 5892.
APPENDIX B – INCOMPATIBLE HAZARDOUS MATERIALS FAMILIES

The term "incompatible chemicals" refers to chemicals that can react with each other:
- violently;
- with evolution of substantial heat;
- to produce flammable products; or,
- to produce toxic products.

Table 1 below contains general classes of incompatible materials. These examples are illustrative of common laboratory chemicals. They are not intended to be exhaustive.

<table>
<thead>
<tr>
<th>A</th>
<th>ACIDS</th>
<th>B</th>
<th>METALS, BASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxidizing Agents</td>
<td></td>
<td>Reducing Agents</td>
<td></td>
</tr>
<tr>
<td>Chlorates</td>
<td>Ammonia</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromates</td>
<td>Carbon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium Trioxide</td>
<td>Metals</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dichromates</td>
<td>Metal Hydrides</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halogens</td>
<td>Nitrites</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Halogenating Agents</td>
<td>Organic Compounds</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hydrogen Peroxide</td>
<td>Phosphorus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitric Acid</td>
<td>Silicon</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nitrates</td>
<td>Sulphur</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perchlorates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peroxides</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Permanganates</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Persulfates, Metals</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2 provides a more complete list of specific compounds that can pose reactivity hazards. The chemicals in the left-hand column should be transported, stored, used and disposed of in such a manner that they do not accidently come into contact with the corresponding chemicals in the right-hand column.

<table>
<thead>
<tr>
<th>This chemical:</th>
<th>Is INCOMPATIBLE with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetic Acid</td>
<td>Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates</td>
</tr>
<tr>
<td>Acetone</td>
<td>Concentrated nitric and sulfuric acid mixtures, chlorinated solvent/alkali mixtures</td>
</tr>
<tr>
<td>Acetylene and monosubstituted acetylenes</td>
<td>Chlorine, bromine, copper, fluorine, silver,</td>
</tr>
<tr>
<td>This chemical:</td>
<td>Is INCOMPATIBLE with:</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Alkali, alkaline earth metals such as powdered aluminium, magnesium, calcium,</td>
<td>Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide,</td>
</tr>
<tr>
<td>lithium, sodium and potassium</td>
<td>halogens</td>
</tr>
<tr>
<td>Aluminium and its alloys (particularly powders)</td>
<td>Acid or alkaline solutions, ammonium persulphate and water, chlorinated compounds,</td>
</tr>
<tr>
<td></td>
<td>nitrates, and organic compounds in nitrate/nitrite salt baths.</td>
</tr>
<tr>
<td>Ammonia (anhydrous)</td>
<td>Mercury (in manometers, for example), chlorine, calcium hypochlorite, iodine,</td>
</tr>
<tr>
<td></td>
<td>bromine, hydrofluoric acid (anhydrous)</td>
</tr>
<tr>
<td>Ammonium nitrate</td>
<td>Acids, powdered metals, flammable liquids, chlorates, nitrites, sulphur, finely</td>
</tr>
<tr>
<td></td>
<td>divided organic or combustible materials</td>
</tr>
<tr>
<td>Aniline</td>
<td>Nitric acid, hydrogen peroxide</td>
</tr>
<tr>
<td>Arsenical materials</td>
<td>Any reducing agent</td>
</tr>
<tr>
<td>Azides</td>
<td>Acids</td>
</tr>
<tr>
<td>Barium peroxide</td>
<td>Combustible organics, oxidizable materials, and water</td>
</tr>
<tr>
<td>Barium rhodanide</td>
<td>Sodium nitrate</td>
</tr>
<tr>
<td>Bismuth and its alloys</td>
<td>Perchloric acid</td>
</tr>
<tr>
<td>Bromine</td>
<td>Ammonia, acetylene, butadiene, butane, methane, propane (or other petroleum gases),</td>
</tr>
<tr>
<td></td>
<td>hydrogen, sodium carbide, benzene, finely divided metals, turpentine</td>
</tr>
<tr>
<td>Calcium or sodium carbide</td>
<td>Moisture (in air) or water</td>
</tr>
<tr>
<td>Calcium oxide</td>
<td>Water</td>
</tr>
<tr>
<td>Carbon (activated)</td>
<td>Calcium hypochlorite, all oxidizing agents</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>Sodium</td>
</tr>
<tr>
<td>Chlorates or perchlorates</td>
<td>Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials</td>
</tr>
</tbody>
</table>
# Table 2 – Incompatible Families

<table>
<thead>
<tr>
<th>This chemical:</th>
<th>Is INCOMPATIBLE with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chlorine</td>
<td>Acetone, acetylene, ammonia, benzene, butadiene butane and other petroleum gases, hydrogen, metal powders, sodium carbide, and turpentine</td>
</tr>
<tr>
<td>Chlorine dioxide</td>
<td>Ammonia, hydrogen sulphide, methane, and phosphine</td>
</tr>
<tr>
<td>Chloroform</td>
<td>Strong bases, ketones and strong base, alkaline metals, aluminium, strong oxidizers</td>
</tr>
<tr>
<td>Chromic acid and chromium trioxide</td>
<td>Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general</td>
</tr>
<tr>
<td>Copper</td>
<td>Acetylene, hydrogen peroxide</td>
</tr>
<tr>
<td>Cumene hydroperoxide</td>
<td>Acids (organic or inorganic)</td>
</tr>
<tr>
<td>Cyanides</td>
<td>Acids or alkalis</td>
</tr>
<tr>
<td>Flammable Liquids</td>
<td>Ammonium nitrate, chromic acid, hydrogen peroxide, halogens</td>
</tr>
<tr>
<td>Fluorine</td>
<td>Most materials</td>
</tr>
<tr>
<td>Hydrazine</td>
<td>Hydrogen peroxide, nitric acid, or any other oxidant</td>
</tr>
<tr>
<td>Hydrocarbons such as benzene, butane, gasoline, propane, etc.</td>
<td>Fluorine, chlorine, bromine, chromic acid, sodium peroxide</td>
</tr>
<tr>
<td>Hydrocyanic acid</td>
<td>Nitric acid, alkali</td>
</tr>
<tr>
<td>Hydrofluoric acid or anhydrous hydrogen fluoride</td>
<td>Ammonia (aqueous or anhydrous)</td>
</tr>
<tr>
<td>Hydrogen peroxide 3%</td>
<td>Chromium, copper, iron, most metals or their salts</td>
</tr>
<tr>
<td>Hydrogen peroxide 30% to 90%</td>
<td>Chromium, copper, iron, most metals or their salts, aniline, any flammable liquid, combustible materials, nitromethane, and all other organic matter.</td>
</tr>
<tr>
<td>Hydrogen sulphide</td>
<td>Fuming nitric acid, oxidizing gases</td>
</tr>
<tr>
<td>Hypochlorites</td>
<td>Acids, activated carbon</td>
</tr>
<tr>
<td>This chemical:</td>
<td>Is INCOMPATIBLE with:</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Iodine</td>
<td>Acetylene, ammonia (aqueous or anhydrous), hydrogen</td>
</tr>
<tr>
<td>Lithium</td>
<td>Acids, moisture in air, and water</td>
</tr>
<tr>
<td>Lithium aluminium hydride</td>
<td>Air, chlorinated hydrocarbons, carbon dioxide, ethyl acetate, and water</td>
</tr>
<tr>
<td>Mercuric Oxide</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Mercury</td>
<td>Acetylene, alkali metals, ammonia, nitric acid with ethanol, fulminic acid, and oxalic acid</td>
</tr>
<tr>
<td>Nitrates</td>
<td>Sulphuric acid</td>
</tr>
<tr>
<td>Nitric acid (concentrated)</td>
<td>Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulphide, flammable liquids, flammable gases, copper, brass, any heavy metals</td>
</tr>
<tr>
<td>Nitrites</td>
<td>Acids, potassium or sodium cyanide</td>
</tr>
<tr>
<td>Nitroparaffins</td>
<td>Inorganic bases, amines</td>
</tr>
<tr>
<td>Oxalic acid</td>
<td>Silver, mercury</td>
</tr>
<tr>
<td>Oxygen (liquid or enriched air)</td>
<td>Flammable gases, liquids, or solids such as acetone, acetylene, grease, hydrogen, oils, and phosphorus</td>
</tr>
<tr>
<td>Perchloric acid</td>
<td>Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease, oils, and reducing agents</td>
</tr>
<tr>
<td>Peroxides (organic)</td>
<td>Acids (organic or mineral), avoid friction, store cold</td>
</tr>
<tr>
<td>Phosphorus (white)</td>
<td>Chlorates and perchlorates, nitrates and nitric acid</td>
</tr>
<tr>
<td>Phosphorous pentoxide</td>
<td>Organic compounds or water</td>
</tr>
<tr>
<td>Phosphorous (red)</td>
<td>Oxidizing materials</td>
</tr>
<tr>
<td>Phosphorous (white)</td>
<td>Air (oxygen) or other oxidizing material</td>
</tr>
<tr>
<td>Picric acid</td>
<td>Ammonia heated with oxides, or salts of heavy metals and friction with oxidizing agents, or</td>
</tr>
<tr>
<td>This chemical:</td>
<td>Is INCOMPATIBLE with:</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Potassium</td>
<td>friction associated with picric acid crystals</td>
</tr>
<tr>
<td>Potassium chlorate or perchlorate</td>
<td>Air (moisture and/or oxygen), carbon tetrachloride, carbon dioxide, water</td>
</tr>
<tr>
<td>Potassium permanganate</td>
<td>Acids and their vapours, combustible materials, especially organic solvents, phosphorus, and sulphur</td>
</tr>
<tr>
<td>Selenides</td>
<td>Reducing agents</td>
</tr>
<tr>
<td>Silver</td>
<td>Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid, nitric acid with ethanol</td>
</tr>
<tr>
<td>Sodium</td>
<td>As for potassium</td>
</tr>
<tr>
<td>Sodium amide</td>
<td>Air (moisture and oxygen) or water</td>
</tr>
<tr>
<td>Sodium chlorate</td>
<td>Acids, ammonium salts, oxidizable materials and sulphur</td>
</tr>
<tr>
<td>Sodium hydrosulfite</td>
<td>Air (moisture) or combustible materials</td>
</tr>
<tr>
<td>Sodium nitrite</td>
<td>Ammonia compounds, ammonium nitrate, or other ammonium salts</td>
</tr>
<tr>
<td>Sodium peroxide</td>
<td>Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural</td>
</tr>
<tr>
<td>Sulphides</td>
<td>Acids</td>
</tr>
<tr>
<td>Sulphur</td>
<td>Any oxidizing materials</td>
</tr>
<tr>
<td>Sulphuric acid</td>
<td>Chlorates, perchlorates, permanganates (compounds of light metals, such as sodium, lithium, and potassium)</td>
</tr>
<tr>
<td>Tellurides</td>
<td>Reducing agents</td>
</tr>
<tr>
<td>Water</td>
<td>Acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, chromic acid, phosphorous</td>
</tr>
<tr>
<td>This chemical:</td>
<td>Is INCOMPATIBLE with:</td>
</tr>
<tr>
<td>----------------------------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td></td>
<td>pentoxide, phosphorous oxychloride, phosphorous pentachloride, sulphuric acid and sulphur trioxide</td>
</tr>
<tr>
<td>Zinc Chlorate</td>
<td>Acids or organic materials</td>
</tr>
<tr>
<td>Zinc (particularly powder)</td>
<td>Acids or water</td>
</tr>
<tr>
<td>Zirconium (particularly powder form)</td>
<td>Carbon tetrachloride and other halogenated hydrocarbons, in peroxides, sodium bicarbonate, and water</td>
</tr>
</tbody>
</table>
APPENDIX C – BIBLIOGRAPHY


APPENDIX D – RESOURCE LINKS

- Accident, Incident or Occupational Illness Report
- Office of Risk Management
  - Health, Safety and Risk Managers
    - Engineering
    - Facilities
    - Medicine
    - Science
    - All other Faculties
- Hazardous Materials Technical Services Regular Collection Request
APPENDIX E – CHEMICAL RESISTANCES OF COMMON GLOVE MATERIALS
How to Read the Charts

Three categories of data are represented for each Ansell product and corresponding chemical: 1) overall degradation resistance rating; 2) permeation breakthrough time, and 3) permeation rate.

Standards for Color-Coding

A glove-chemical combination receives **GREEN** if either set of the following conditions is met:
- The degradation rating is Excellent or Good
- The permeation breakthrough time is 30 minutes or longer
- The permeation rate is Excellent, Very Good, or Good.

**OR**
- The permeation rate is not specified
- The permeation breakthrough time is 240 minutes or longer
- The degradation rating is Excellent, Very Good, or Good

A glove-chemical combination receives **RED** if: the degradation rating is Poor or Not Recommended, regardless of the permeation rating.

All other glove-chemical combinations receive **YELLOW**. In other words, any glove-chemical combination not meeting either set of conditions required for Green, and not having a Red degradation rating of either Poor or Not Recommended, receives a **YELLOW** rating.

### Key to Permeation Rate

<table>
<thead>
<tr>
<th>Simply Stated, Drops/hr Through a Glove (eyedropper-size drops)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E - Excellent; permeation rate of less than 0.9 µg/cm²/min.</td>
</tr>
<tr>
<td>VG - Very Good; permeation rate of less than 9 µg/cm²/min.</td>
</tr>
<tr>
<td>G - Good; permeation rate of less than 90 µg/cm²/min.</td>
</tr>
<tr>
<td>F - Fair; permeation rate of less than 900 µg/cm²/min.</td>
</tr>
<tr>
<td>P - Poor; permeation rate of less than 9000 µg/cm²/min.</td>
</tr>
<tr>
<td>NR - Not Recommended; permeation rate greater than 9000 µg/cm²/min.</td>
</tr>
</tbody>
</table>

**Note:** The current revision to the ASTM standard permeation test calls for permeation to be reported in micrograms of chemical permeated per square centimeter of material exposed per minute of exposure, “µg/cm²/min.”

### Key to Permeation Breakthrough

| >Greater than (time) <Less than (time) |

### Key to Degradation Ratings

<table>
<thead>
<tr>
<th>Simply Stated, Drops/hr Through a Glove (eyedropper-size drops)</th>
</tr>
</thead>
<tbody>
<tr>
<td>E - Excellent; fluid has very little degrading effect.</td>
</tr>
<tr>
<td>G - Good; fluid has minor degrading effect.</td>
</tr>
<tr>
<td>F - Fair; fluid has moderate degrading effect.</td>
</tr>
<tr>
<td>P - Poor; fluid has pronounced degrading effect.</td>
</tr>
<tr>
<td>NR - Fluid was not tested against this material.</td>
</tr>
</tbody>
</table>

### Note:** Any test samples rated P (Poor) or NR (Not recommended) in degradation testing were not tested for permeation resistance. A dash (-) appears in those cases.

### Specific Gloves Used for Testing

<table>
<thead>
<tr>
<th>Degradation</th>
<th>Permeation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrile</td>
<td>Sol-Vex® 37-145</td>
</tr>
<tr>
<td>(11 mil/0.28 mm)</td>
<td>(22 mil/0.54 mm)</td>
</tr>
<tr>
<td>Neoprene Unsupported</td>
<td>29-865</td>
</tr>
<tr>
<td>(18 mil/0.46 mm)</td>
<td>(18 mil/0.46 mm)</td>
</tr>
<tr>
<td>Polyvinyl Alcohol Supported</td>
<td>PVA™</td>
</tr>
<tr>
<td>Polyvinyl Chloride Supported</td>
<td>Snorkel®*</td>
</tr>
<tr>
<td>Natural Rubber Latex</td>
<td>Canners 392</td>
</tr>
<tr>
<td>(19 mil/0.48 mm)</td>
<td>(19 mil/0.48 mm)</td>
</tr>
<tr>
<td>Neoprene/Latex Blend</td>
<td>Chemi-Pro 224</td>
</tr>
<tr>
<td>(27 mil/0.67 mm)</td>
<td>(27 mil/0.67 mm)</td>
</tr>
<tr>
<td>Laminated LCP™ Film</td>
<td>Barrier 2-100</td>
</tr>
<tr>
<td>(2.5 mil/0.06 mm)</td>
<td>(2.5 mil/0.06 mm)</td>
</tr>
</tbody>
</table>

Single palm thickness is listed in both mil and metric millimeter (mm) for Unsupported Gloves. Supported Gloves are specified by glove weight, not thickness.

Why is a product with a shorter breakthrough time sometimes given a better rating than one with a longer breakthrough time?

One glove has a breakthrough time of just 4 minutes. It is rated “very good,” while another with a breakthrough time of 30 minutes is rated only “fair.” Why? The reason is simple: in some cases the rate is more significant than the time.

Imagine connecting two hoses of the same length but different diameters to a faucet using a “Y” connector. When you turn on the water, what happens? Water goes through the smaller hose first because there is less space inside that needs to be filled. But when the water finally gets through the larger hose it really gushes out. In only a few minutes, the larger hose will discharge much more water than the smaller one, even though the smaller one started first.

The situation is similar with gloves A combination of a short breakthrough time and a low permeation rate may expose a glove wearer to less chemical than a combination of a longer breakthrough time and a much higher breakthrough rate, if the glove is worn long enough.

SPECIAL NOTE: The chemicals in this guide highlighted in BLUE are experimental carcinogens, according to the ninth edition of Sax’ Dangerous Properties of Industrial Materials. Chemicals highlighted in GRAY are listed as suspected carcinogens, experimental carcinogens at extremely high dosages, and other materials which pose a lesser risk of cancer.
### Permeation/Degradation Resistance Guide for Ansell Gloves

The first square in each column for each glove type is color coded. This is an easy-to-read indication of how well suited for application with that chemical. The color represents an overall rating for both degradation and permeation. The letter in each square is for Degradation alone:

- **RED**: Avoid use of the glove with this chemical.
- **YELLOW**: The glove is suitable for application under careful control of its use.
- **GREEN**: The glove is very well suited for application with that chemical.

#### CHEMICALS

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Degradation Rating</th>
<th>Permeation Breakthrough Rate</th>
<th>Permeation Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acetaldehyde</td>
<td>E</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>2. Acetic Acid</td>
<td>E</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>3. Acetone</td>
<td>&gt;480 E</td>
<td>P</td>
<td>E</td>
</tr>
<tr>
<td>4. Acetonitrile</td>
<td>&gt;480 E</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>5. Acrylic Acid</td>
<td>—</td>
<td>G</td>
<td>G</td>
</tr>
<tr>
<td>6. Acrylonitrile</td>
<td>E</td>
<td>&gt;480 F</td>
<td>E</td>
</tr>
<tr>
<td>7. Allyl Alcohol</td>
<td>&gt;480 E</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>8. Ammonium Gas</td>
<td>19 E &gt;480 A</td>
<td>P</td>
<td>P</td>
</tr>
<tr>
<td>9. Ammonium Fluoride, 40%</td>
<td>—</td>
<td>E</td>
<td>E</td>
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<tr>
<td>10. Ammonium Hydroxide</td>
<td>E 30</td>
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</tr>
<tr>
<td>11. Amyl Acetate</td>
<td>&gt;480 E</td>
<td>E</td>
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</tr>
<tr>
<td>12. Amyl Alcohol</td>
<td>—</td>
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<td>E</td>
</tr>
<tr>
<td>13. Aminole</td>
<td>&gt;480 E</td>
<td>F</td>
<td>E</td>
</tr>
<tr>
<td>14. Aqua Regia</td>
<td>12 G</td>
<td>G</td>
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<tr>
<td>15. Benzaldehyde</td>
<td>&gt;480 E</td>
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<tr>
<td>16. Benzene, Benzol</td>
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<tr>
<td>17. Benzyl chloride</td>
<td>—</td>
<td>G</td>
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<td>18. Benzotrifluoride</td>
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<tr>
<td>20. 1-Bromopropane</td>
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<td>21. Bromopropionic Acid</td>
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<td>22. Butyl Acetate</td>
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<td>23. Butyl Alcohol</td>
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<tr>
<td>24. Butyl Cellosolve</td>
<td>323 G 188 30 E 140 F</td>
<td>E 390 G E 250 E 240 G</td>
<td>E 250 E 210 G</td>
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<td>25. Butyl Cellosolve Acetate</td>
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<td>26. Butyl Cellosolve Solvent</td>
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<td>28. Chloroform</td>
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<td>29. Chloronaphthalene</td>
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<td>30. Chloroprene</td>
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<td>38. Chloroform</td>
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<td>39. Chloroform</td>
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<td>40. Chloroform</td>
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<td>41. Chloroform</td>
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<td>42. Chloroform</td>
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<td>44. Chloroform</td>
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<tr>
<td>45. Chloroform</td>
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</table>

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**CAUTION:** This product contains natural rubber latex which may cause allergic reactions in some individuals.
### CHEMICALS

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<thead>
<tr>
<th>Chemical</th>
<th>LAMINATE FLM</th>
<th>NITRILE</th>
<th>UNSUPPORTED NEOPRENE</th>
<th>SUPPORTED POLYVINYL ALCOHOL</th>
<th>POLYVINYL CHLORIDE (Vinyl)</th>
<th>NATURAL RUBBER</th>
<th>NEOPRENE/NATURAL RUBBER BLEND</th>
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<tr>
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<td>Permeation Rate</td>
<td>Breakthrough Rate</td>
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<thead>
<tr>
<th>CHEMICAL</th>
<th>LAMINATE BARRIER</th>
<th>NITRILE SOL-VEX</th>
<th>UNSUPPORTED NEOPRENE 29-865</th>
<th>SUPPORTED POLYVINYL CHLORIDE PVA</th>
<th>POLYVINYL CHLORIDE (Vinyl) SNORKEL</th>
<th>NATURAL RUBBER CANNERS AND HANDLERS</th>
<th>CHEMICAL PRO</th>
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<tr>
<td>91. 1-methoxy-2-propoxypropane</td>
<td>▲ &gt;480 E</td>
<td>E</td>
<td>&gt;360 E</td>
<td>P</td>
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<tr>
<td>92. Methyl Alcohol</td>
<td>E &gt;480 E</td>
<td>E</td>
<td>&gt;198 VG</td>
<td>E</td>
<td>G 65 NR</td>
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<tr>
<td>93. Methylene</td>
<td>▲ &gt;480 E</td>
<td>E</td>
<td>&gt;140 G</td>
<td>NR</td>
<td>—</td>
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<tr>
<td>94. Methyl Cellosolve</td>
<td>E 440 E</td>
<td>F</td>
<td>11 G</td>
<td>P</td>
<td>—</td>
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<td>95. Methylene Bromide</td>
<td>▲ &gt;480 E</td>
<td>E</td>
<td>NR</td>
<td>—</td>
<td>—</td>
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<tr>
<td>96. Methylene Chloride</td>
<td>E 20 VG</td>
<td>NR</td>
<td>—</td>
<td>NR</td>
<td>—</td>
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<td>97. MDI (Isocyanate)</td>
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<tr>
<td>98. Methyl Amyl Ketone</td>
<td>E &gt;480 E</td>
<td>F</td>
<td>53 F</td>
<td>F 10</td>
<td>E &gt;360 NR</td>
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<tr>
<td>99. Methyl Ethen Ketone, MEK</td>
<td>E &gt;480 E</td>
<td>NR</td>
<td>—</td>
<td>P</td>
<td>90 VG NR</td>
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<tr>
<td>100. Methyl Glycol Ether</td>
<td>▲ &gt;480 E</td>
<td>F</td>
<td>11 G</td>
<td>P</td>
<td>—</td>
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<tr>
<td>101. Methyl Iodide</td>
<td>▲ &gt;480 E</td>
<td>NR</td>
<td>—</td>
<td>NR</td>
<td>—</td>
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<tr>
<td>102. Methyl Isobuty Ether</td>
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<td>F</td>
<td>—</td>
<td>NR</td>
<td>—</td>
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<tr>
<td>103. Methyl Methacrylate</td>
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<td>NR</td>
<td>—</td>
<td>NR</td>
<td>—</td>
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<tr>
<td>104. N-Methyl-2-Pyrrolidone</td>
<td>▲ &gt;480 E</td>
<td>NR</td>
<td>—</td>
<td>NR</td>
<td>—</td>
<td>—</td>
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<tr>
<td>105. Methyl t-Butyl Ether</td>
<td>E &gt;480 E</td>
<td>E</td>
<td>&gt;360 E</td>
<td>G</td>
<td>100 F E 60 G NR</td>
<td>—</td>
<td>—</td>
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<tr>
<td>106. Mineral Spirits, rule 66</td>
<td>E &gt;480 &gt;480 E</td>
<td>E</td>
<td>&gt;360 E</td>
<td>E</td>
<td>100 F E 60 G NR</td>
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<td>—</td>
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<tr>
<td>107. Monoethanolamine</td>
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<td>—</td>
<td>E &gt;360 E</td>
<td>E</td>
<td>260 F E &gt;360 E NR</td>
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<tr>
<td>108. Morpholone</td>
<td>▲ &gt;480 E</td>
<td>NR</td>
<td>—</td>
<td>P</td>
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<tr>
<td>109. Muriatic Acid</td>
<td>▲ &gt;480 E</td>
<td>E</td>
<td>&gt;360 E</td>
<td>E</td>
<td>&gt;480 NR E &gt;360 E</td>
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<tr>
<td>110. Naphtha VM&amp;P</td>
<td>E &gt;480 E</td>
<td>E</td>
<td>&gt;360 E</td>
<td>G</td>
<td>100 F E &gt;420 E NR</td>
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<tr>
<td>111. Nitric Acid, 10%</td>
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<td>E</td>
<td>&gt;360 E</td>
<td>E</td>
<td>&gt;480 NR E &gt;360 E</td>
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<tr>
<td>112. Nitric Acid, 70%</td>
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<td>NR</td>
<td>—</td>
<td>NR</td>
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<tr>
<td>113. Nitric Acid, Red Fuming</td>
<td>▲ &gt;480 E</td>
<td>NR</td>
<td>—</td>
<td>NR</td>
<td>—</td>
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<tr>
<td>114. Nitrobenzene</td>
<td>▲ &gt;480 E</td>
<td>NR</td>
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<td>NR</td>
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<tr>
<td>115. Nitromethane, 95%</td>
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<td>F</td>
<td>30 F</td>
<td>F</td>
<td>60 G E &gt;360 E P</td>
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<tr>
<td>116. Nitropropane, 95.5%</td>
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<td>E</td>
<td>&lt;10 F E &gt;360 E NR</td>
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<tr>
<td>117. Cetyl Alcohol</td>
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<td>—</td>
<td>E &gt;360 E</td>
<td>E</td>
<td>218 E G &gt;360 E F</td>
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<td>118. Oleic Acid</td>
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<td>E</td>
<td>218 E G &gt;360 E F</td>
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<tr>
<td>119. Oxalic Acid, saturated</td>
<td>—</td>
<td>—</td>
<td>E &gt;360 E</td>
<td>E</td>
<td>&gt;480 G 40 F</td>
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<tr>
<td>120. Pad Bch 1/Asphalt Chem.</td>
<td>—</td>
<td>F</td>
<td>&gt;480 E</td>
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<tr>
<td>121. Palmatic Acid, saturated</td>
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<td>G</td>
<td>&gt;480 E</td>
<td>G</td>
<td>30 G —</td>
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<tr>
<td>122. Pentane</td>
<td>E &gt;480 E</td>
<td>E</td>
<td>&gt;360 G</td>
<td>E</td>
<td>30 G —</td>
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<tr>
<td>123. Pentachlorophenol, 5%</td>
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<td>E</td>
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<tr>
<td>124. Perchloric Acid, 65%</td>
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<td>—</td>
<td>E &gt;360 E</td>
<td>E</td>
<td>&gt;480 NR E &gt;360 E</td>
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<td>125. Perchloroethylene</td>
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<td>G</td>
<td>300 VG NR</td>
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<td>126. Phenol</td>
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<td>NR</td>
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<td>&gt;360 E</td>
<td>G</td>
<td>&gt;360 F G 75 VG E 90</td>
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<tr>
<td>128. PMA Glycol Ether Acetate</td>
<td>▲ &gt;480 E</td>
<td>E</td>
<td>200 F G 37</td>
<td>F</td>
<td>&gt;360 E P —</td>
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<tr>
<td>129. Potassium Hydroxide, 50%</td>
<td>—</td>
<td>—</td>
<td>E &gt;360 E</td>
<td>E</td>
<td>&gt;360 NR — E &gt;360 E NR</td>
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<td>130. Propene Gas</td>
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<tr>
<td>131. Propyl Acetate</td>
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<td>20 G</td>
<td>P</td>
<td>—</td>
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<tr>
<td>132. Propyl Alcohol</td>
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<td>F</td>
<td>&gt;360 E</td>
<td>E</td>
<td>323 E P —</td>
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<tr>
<td>133. Propylene Oxide</td>
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<td>NR</td>
<td>—</td>
<td>NR</td>
<td>—</td>
<td>—</td>
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<tr>
<td>134. Pyridine</td>
<td>▲ &gt;480 E</td>
<td>E</td>
<td>NR</td>
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<td>135. Rubber Solvent</td>
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<td>—</td>
<td>E &gt;360 E</td>
<td>E</td>
<td>43 F E &gt;360 E NR</td>
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</table>

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**CAUTION:**

Laminate degradation test against this chemical was not run. However, since its breakthrough time is greater than 480 minutes, the Degradation Rating is expected to be Good.

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<thead>
<tr>
<th>CHEMICAL</th>
<th>LAMINATE</th>
<th>NITRILE</th>
<th>UNSUPPORTED</th>
<th>POLYVINYL</th>
<th>POLYVINYL</th>
<th>NATURAL</th>
<th>NEOPRENE</th>
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<td></td>
<td>BARRIER</td>
<td>SOL-VEX</td>
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<td>CHLORIDE</td>
<td>CHLORIDE</td>
<td>RUBBER</td>
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<td>Breakthrough</td>
<td>Rate</td>
<td>Permeation</td>
<td>Breakthrough</td>
<td>Rate</td>
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<td>137. Skydrol hydraulic fluid</td>
<td>E</td>
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<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
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<td>138. Sodium Hydroxide, 50%</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>&gt;480</td>
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<td>139. Stoddard Solvent</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>E</td>
<td>139</td>
</tr>
<tr>
<td>140. Styrene</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>NR</td>
<td>—</td>
<td>—</td>
<td>NR</td>
</tr>
<tr>
<td>141. Sulfur Dichloride</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>G</td>
<td>&gt;360</td>
<td>E</td>
<td>NR</td>
</tr>
<tr>
<td>142. Sulfuric Acid, 95%</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
<td>NR</td>
<td>—</td>
<td>—</td>
<td>F</td>
</tr>
<tr>
<td>143. Sulfuric Acid 120%, Oleum</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>F</td>
</tr>
<tr>
<td>144. Sulfuric 47%, battery acid</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>&gt;480</td>
</tr>
<tr>
<td>145. Tannic Acid, 65%</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>&gt;480</td>
</tr>
<tr>
<td>146. Tetrachloroethene</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>G</td>
<td>300</td>
<td>VG</td>
<td>NR</td>
</tr>
<tr>
<td>147. Tetrachloroethylene</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>NR</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>148. Toluene, toluidine</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>F</td>
<td>10</td>
<td>F</td>
<td>NR</td>
</tr>
<tr>
<td>149. Toluen Di-isocyanate (TDI)</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>NR</td>
<td>—</td>
<td>—</td>
<td>NR</td>
</tr>
<tr>
<td>150. Triallylamine</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>—</td>
<td>&gt;480</td>
<td>E</td>
<td>—</td>
</tr>
<tr>
<td>151. Trichloroethylene, TCE</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>NR</td>
<td>—</td>
<td>—</td>
<td>NR</td>
</tr>
<tr>
<td>152. Trichlorotrifluoroethane</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>154. Triethanolamine, 85%</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>E</td>
<td>&gt;360</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>155. Turpentine</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>G</td>
<td>75</td>
<td>NR</td>
<td>—</td>
</tr>
<tr>
<td>156. Vertrel MCA</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>G</td>
<td>110</td>
<td>G</td>
<td>E</td>
</tr>
<tr>
<td>157. Vertrel SMT</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>158. Vertrel XE</td>
<td>E</td>
<td>105</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
<td>E</td>
<td>47</td>
</tr>
<tr>
<td>159. Vertrel XE</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
<td>E</td>
</tr>
<tr>
<td>160. Vertrel XE</td>
<td>E</td>
<td>120</td>
<td>E</td>
<td>&gt;480</td>
<td>E</td>
<td>E</td>
<td>105</td>
</tr>
<tr>
<td>161. Vinyl Acetate</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>F</td>
<td>18</td>
<td>F</td>
<td>NR</td>
</tr>
<tr>
<td>162. Vinyl Chloride Gas</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>163. Xenyle, Xylo</td>
<td>▲</td>
<td>&gt;480</td>
<td>E</td>
<td>G</td>
<td>75</td>
<td>NR</td>
<td>—</td>
</tr>
</tbody>
</table>

Note: All numeric designations within the product classifications are denoted in minutes.

▲ A degradation test against this chemical was not run. However, since its breakthrough time is greater than 480 minutes, the Degradation Rating is expected to be Good to Excellent.

■ A degradation test against this chemical was not run. However, in view of degradation tests performed with similar compounds, the Degradation Rating is expected to be Good to Excellent.

* CAUTION: This product contains natural rubber latex which may cause allergic reactions in some individuals.

**NOTE:**

These recommendations are based on laboratory tests and reflect the best judgement of Ansell Occupational Healthcare in the light of data available at the time of preparation and in accordance with the current revision of ASTM F 739. They are intended to guide and inform qualified professionals engaged in assuring safety in the workplace. Because the conditions of ultimate use are beyond our control, and because we cannot run permeation tests in all possible work environments and across all combinations of chemicals and solutions, these recommendations are advisory only. The suitability of a product for a specific application must be determined by testing by the purchaser.

The data in this guide are subject to revision as additional knowledge and experience are gained. Test data herein reflect laboratory performance of partial gloves and not necessarily the complete unit. Anyone intending to use these recommendations should first verify that the glove selected is suitable for the intended use and meets all appropriate health standards. Upon written request, Ansell will provide a sample of material to aid you in making your own selection under your own individual safety requirements.

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