

General and Laboratory Safety Handbook

an Overview of Safe Operating Procedures



Department of
Agricultural, Food and Nutritional Science



Fire/Police/Ambulance call → 911

OBJECTIVES OF THE AFNS SAFETY PROGRAM

- To encourage everyone in AFNS to *focus on safety* in planning and in daily activities.
- To offer routine and defined *safety support*.
- To ensure proper *security* of facilities and equipment, and of personal items.

This Handbook outlines general and laboratory safety procedures, and additional information is presented on our safety web pages. However, these information sources can only *supplement* the necessary *job-related training* arranged by supervisors, i.e. task- and site-specific ‘safety information’, and any other required training. If you have questions or concerns, you are encouraged to consult with your supervisor or other staff, and to check safety literature.

SAFETY IS...

A PERSONAL ACTIVITY AND A SHARED RESPONSIBILITY

The Department strives to maintain a safe environment and to encourage safe practices. *However, the individual and ‘work groups’ must also accept responsibility for safety and security.* This means being familiar with safety aspects and employing that knowledge every day. You must know how to *properly and safely handle* chemicals, radioisotopes, biohazardous materials, and equipment used in your work, and how to *properly perform* specific tasks or techniques *before* commencing work. [For information about the *responsibilities* associated with *Due Diligence* and *WHMIS* see Appendices 1 and 11.]

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Note: Our safety web site <http://www.safety.afns.ualberta.ca> always has the most recent update of this Handbook, safety links (e.g. MSDS’s), *Special Safety Notices*, listings of the Safety Committees, First Aiders, and Safety Designates, etc. Please send suggestions for this Handbook or the safety web pages to: Lynn Elmes (AFNS, 4-10 Ag/For Ctr; lynn.elmes@ales.ualberta.ca). Handbook updated: July 2010

EMERGENCY PROCEDURES

FIRE

When the Fire Alarm Sounds

Stop what you are doing and **leave**. **Do not assume it is a drill!** During working hours Emergency Wardens check that everyone evacuates.

Responding to and Reporting a Fire

If you discover smoke or other evidence of any Fire or Emergency:

1. **Activate** the nearest fire alarm box as you leave. [*Only if safe to do so*, shut down critical experiments and turn off associated services before you leave. Do **not** take extra time to collect coats or other personal items.]
2. **Remove** injured or disabled persons from danger, *only if it is safe for you to do so*. [In the Ag/For Ctr injured/disabled persons can be taken to the *west* or *north* stairwell to await rescue—other stairwells are *not* ‘fire refuges’.]
3. **Close** doors to prevent fire from spreading (*for security, doors can be locked, if desired*).
4. **Evacuate** via the nearest safe exit (*know, in advance, of at least two exits*). Do **not** use an elevator. If in smoke or heat, stay **low**.
5. **Advise** an Emergency Warden of the location and nature of the fire, and, if you know of anyone still in the building, say where.
6. The **Control Centre (2-5555)** should be advised of the location and nature of the fire.

Should You Try to Control or Put Out a Fire?

Only if you have **activated the fire alarm, and if** there is **no significant personal risk, and if** you have a **safe exit, and if the fire has not spread significantly from its origin** (e.g. it is relatively easily extinguishable, such as in a waste basket), **then you may attempt to extinguish, confine, or control the fire** until the Fire Dept arrives (except, perhaps, for persons quite experienced with fire extinguisher use, the general rule to follow is: if one fire extinguisher is not enough, evacuate the area).

Know the *location and use* of fire extinguishers *before* a fire emergency arises (they are typically near the main exits of labs and in the former fire hose hallway cabinets). To use an extinguisher, **PASS**:



- P**ull the pin out
- A**im low at the base of the fire
- S**queeze the trigger
- S**weep from side-to-side

Our dry chemical fire extinguishers are rated for type A, B and C fires (i.e. all fires except metal fires—sand can be used to smother metal fires).

Report fire extinguisher use (Ag/For Ctr: Len Steele or Lynn Elmes; Research Stations: Unit Manager) — they must be recharged.

7. The fire should also be reported to the U of A Fire Protection Officer at **2-5614**. This will normally be done by someone in the “official chain of responders.”

HAZARDOUS SPILLS

Spills which are of immediate danger should be reported to the Control Centre (**2-5555**), after evacuating the area (closing doors). No one should be allowed to enter the area without personal protective equipment which protects against both the spilled material and any associated vapours.

All chemical spills, including ‘less serious’ ones, should be reported to:

Ag/For Centre: Lynn Elmes (4-04; 2-5785)

Research Stations: Unit Manager

For **information on the containment and clean-up of spills** (chemicals, radioisotopes, biohazards, microbes), **see** Appendix 11 (Workplace Hazardous Materials Information System), **page 34**.

INJURY or ILLNESS

If a medical emergency requiring outside aid, call **911**. Work-related injuries, especially where lost time is a possibility, or sudden illness should be reported to Lynn Elmes (Ag/For Ctr) or the Unit Manager (elsewhere). Main Ag/For Ctr first aid kits, which contain report forms, are in: center area of 1-20; 2-58; outside 3-51; NE corner of 4-35. Know locations in your work areas of basic first aid kits, emergency showers/eye-washes, and safety equipment. First Aiders are listed on our safety website and with the main first aid kits. On regular working days, the Health Centre (2nd floor SUB) is open 8:00-5:00. Campus Security personnel (**2-5050**) are first aiders.

BUILDING (‘infrastructure’) PROBLEMS

In the event of serious water or steam leaks, suspected natural gas leaks, unusual odours (not easily traceable to lab work), heating or humidity problems, malfunctioning fans or fume hoods, plugged drains, burnt-out lights, etc., call:

Physical Plant, Maintenance/Repairs—**2-4833**

After-Hours Emergency Contacts

Medical emergency: call **911**.

Fire emergency: pull the fire alarm and call **2-5555** (Control Ctr)—p. 3 has detailed procedures.

'Safety emergency': call **2-5555** (Control Ctr).

'Building emergency': call **2-4833** (see p. 3).

'Other emergencies': as appropriate, contact at home Lynn Elmes (780-417-2986) for the Ag/For Ctr; your Unit Manager; Supervisor; or a Department or Trust Tech.

Report important problems, but 'not quite emergencies', to a Tech, Supervisor, Unit Mgr, or in the Ag/For Ctr to Lynn Elmes.

Safety Equipment, Emergency Exits, etc.

For all areas in which you work, you should know the locations of the nearest:

- fire alarms and fire extinguishers
- emergency exit routes (at least **two**)
- emergency showers/eyewash stations
- first aid supplies
- spill kits and supplies
- face shields, rubber aprons, etc.
- telephone
- safety reference materials, such as Material Safety Data Sheets (see Appendix 2 for other resources)



Medical Conditions / Contact Lenses

For your own safety, be sure to notify those in your 'work group' and 'work area' of any medical information that might be required in an emergency (e.g. allergies, diabetes). Also notify others if you wear contact lenses (that could be important if a chemical or other material enters your eye).

Expressing Your Concerns About Safety

Safety is a shared responsibility. You are encouraged to raise safety concerns about the workplace itself or work which is being carried out in an unsafe manner. As a first step, discuss concerns with a tech or your supervisor. If you wish to express your concerns further, please do so in the order:

1. Ag/For Ctr: Lab Manager, Lynn Elmes (2-5785).
Research Stations: Unit Manager.
2. Safety Committee Chair (Ag/For Ctr: Lynn Elmes, 2-5785; Research Stations: Janes Goller, 2-7688).
3. John Bell (Asst Chair, Admin, 8-1907) or AFNS Chair.
4. The Office of Environmental Health and Safety (107 Education Car Park; 2-1810).

Safety Committees / First Aiders

The AFNS safety web site (see p. 2) has lists of Ag/For Ctr (AFC) and Research Stations Safety Committees and of their First Aiders (lists of AFC First Aiders are posted in various AFC areas).

Safety Inspections

Safety inspections in the Ag/For Centre are conducted periodically, and are announced in advance (checklists, showing items to be examined, are made available to research groups/labs prior to inspection). Sites off the main campus determine their own safety inspection frequency and format.

Safewalk

Office: 030-E SUB U of A Students' Union

Hours during which Walks are Available

Fall/Spring 7:00pm-12:30am (-11:00pm Sunday)

Winter 5:00pm-12:30am (-11:00pm Sunday)

Summer 9:00pm-12:00am (Mon-Thurs)

safewalk@ualberta.ca www.su.ualberta.ca/safewalk

Call **492-5563** (4-WALK-ME) and give your name, location, destination, and the time you would like to be met. Dispatchers will send a team to meet you and walk you within the area bounded by 72 Ave. to the South, 91 St. to the East, and the river to the North and West; Safewalk will also accompany clients on the LRT, and within three blocks of any station.

If you know in advance when you would like to be met, call the office during the day (note that walks left on voice mail cannot be accepted). Arrangements can also be made—in person at the office—for Safewalk every week at the same time and location.

Closed holidays and long weekends. If you need a walk outside the hours above, contact Campus Security at **492-5252**. If you reach Safewalk's voice mail after hours, you can be forwarded to Campus Security automatically by pressing zero (0) during the outgoing message.

Safety Guidelines and Procedures

Working alone (also see Appendix 10, p. 26)

Research or other tasks may require students or staff to be present outside normal hours. If you are alone, e.g. in a lab, precautions to *minimize risk* include notifying your supervisor and/or others in the vicinity. Please refer to the appropriate Working Alone Protocol. Do **not** carry out potentially hazardous experiments if you are alone.

Unattended experiments

Unattended experiments which could pose a safety hazard should a problem occur, especially outside of normal working hours, should be kept to an *absolute minimum*. Before an experiment is left unattended, take *precautions* to prevent spills, ‘floods’ or fires in case of mechanical, power, or water failure. Secure water and vacuum hoses with a band clamp (not ‘wire’) on each connection, and make sure water outlet tubing is securely inserted into sink drains to a depth of at least 12" (~30 cm). Use tygon or polypropylene (not ‘rubber’) tubing for all water flow. A reaction mixture must be clearly identified, and *clear written instructions* should be left outlining handling procedures in case an emergency shutdown is required or other problems occur.

Working off the main campus

If you work at a facility off of the main campus, e.g. Edmonton Research Station, Kinsella or Ministik, consult with the Unit Manager or other appropriate personnel to *ensure you obtain all required site-specific safety information and training* (operation of machinery, working with animals, working with herbicides or pesticides, etc.).

Unauthorized assistance with work

Unauthorized persons may *not* assist you in your work. Examples are family members or friends who are not bona fide University employees.

Children not allowed in restricted areas or labs

Concerns have been expressed regarding work and safety issues surrounding children in restricted areas (on or off the main campus) and labs during office hours, evenings and on weekends.

The University of Alberta Risk Management policy is that *children of staff, teaching assistants, graduate students, volunteers or students are not allowed in restricted areas or in laboratories at any time*. The liability issues for the University and the potential dangers for children are such that the University requires everyone to adhere to this policy in all circumstances.

Locking doors—safety of facilities

Whenever there is no one left in a lab or other restricted area, doors should be closed and locked (if you are not sure if there is anyone in the area, lock the doors).

Hallway doors accessing Ag/For Centre lab areas are locked from ~5:00 p.m. to ~8:00 a.m. on regular working days, and all day otherwise, including weekends. North stairway doors, except for the 1st floor, are locked 24 hours every day.

Uncluttered laboratories & other work areas

Chemicals, *clean* glassware and equipment must be returned to proper storage when no longer in use, as cluttered bench and table tops are an invitation to contamination and other hazards.

Particular attention should be paid to aisles and passageways. They must be free of obstruction, allowing a ready means of evacuation.

Hand-held emergency eye wash/showers must be readily accessible, not blocked by items nearby. They should be *flushed weekly* to remove rusty water.

Bicycles and pets are not allowed inside buildings.

Storage of chemicals & other hazardous materials

(for additional information see Appendix 4)

Incompatible chemicals must *not* be stored in close proximity or within the same confined space (consult their Material Safety Data Sheets; if not available, check other sources—see Appendix 2).

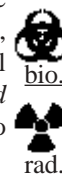
Flammable and combustible liquids must be stored in approved cabinets (which should not be near room exits or in main aisles). Ordinary refrigerators and cold rooms *must not* be used for storage of flammable liquids (e.g. diethyl ether). *Refrigerators rated for storage of flammables are in AF 1-20K, and 4-35*. [See also ‘Flammable and Combustible Liquids’ in Appendix 3.]

Routine reagent chemicals should be stored on shelves (best with glass sliders or doors) or in cabinets designed for this purpose.

Do not place reagent bottles directly on the floor.

Noxious chemicals should be stored in well-ventilated cupboards, or in designated fume hoods or areas in fume hoods (note: fume hoods used routinely for lab work should *not* be major storage places for chemicals).

Biohazardous infectious materials must be clearly marked and in secure storage. Incubators, refrigerators, cold rooms, etc. containing potential pathogens must have clearly visible *biohazard* labels; those containing *radioisotopes* must also be properly marked.



New reagents or reactions

When using a new reagent (or running a new reaction), *check* toxicity, flammability, incompatibilities, storage, disposal information, etc. in its Material Safety Data Sheet (if an MSDS is not available, check the container label; a source listed in Appendix 2 may also be useful).

Appropriate carrying devices (e.g. ‘rubber’ holders suitable for bottles up to 4 L) should be used to transport chemicals, especially outside labs.

Labelling chemicals, solutions/mixtures, samples

On a new reagent, print the *month and year received* and *supervisor's name or initials*. Containers of transferred reagents, solutions/mixtures or samples *must* also be similarly *labelled*.

Radioisotopes

Radioisotopes may be handled only by authorized users in approved areas. Radioisotope labs are marked with appropriate signage. Consult the permit holder before working in a radioisotope area. *Before working with radioisotopes, it is necessary to pass the U of A radiation safety exam*, usually after taking the U of A course (or acceptable equivalent). *Permit holders (and users)* must ensure *proper records* are kept of radioisotope stocks and usage, and *regular swipes* are done to verify areas and equipment are not contaminated.

Fume hoods

Toxic, hazardous or odorous materials must be handled in a fume hood (or other confining device, e.g. a vacuum system). Hoods operate 24 hours a day (notice is normally given of shut downs).

Do not leave hood doors wide open. They should be ~30 cm (1 ft) from the surface during idle periods.

Do not use fume hoods for storage of numerous containers, as they reduce air flow and create a hazard.

Contact Lynn Elmes or a department tech if you suspect a fume hood is not functioning properly.

Microorganisms/biohazards

U of A EH&S needs a Biosafety Registry *before* work can begin. Researchers *must provide a copy of a grant application* involving biohazards, human body substances, recombinant DNA, transgenics, etc. *at the time of submission* for Biosafety Officer review, as such grants require *prior* biosafety certification.

Be familiar with containment level guidelines *before use*. Level II and above organisms, i.e. agents of moderate or significant pathological risk, require biological safety cabinets and biohazard signs.

Biohazardous materials must only be in designated biohazard areas. *They must be rendered nonbiohazardous before being moved to other areas or sent for disposal.* Exception: transport between biohazard areas can be done with proper secondary containment (durable, leakproof outer container filled with enough material to adsorb the biohazard sample if it leaks).

If you're wearing a lab coat when you wish to exit a biohazard area, *remove it* before going elsewhere.

Biohazard areas are monitored by the Biosafety Division of the Office of Environmental Health and Safety to ensure required procedures are followed.

Biological safety cabinets

Biological safety cabinets are designed to protect the user and the environment from hazards, e.g. handling of bacterial pathogens. They also protect materials being handled from environmental contamination. Contact Lynn Elmes (AF 4-04; 2-5785) for information on use, specifications and operation.

As of January 2009 units were in: AF1-25,2-38(2), 2-50(3),3-11G3,3-42,3-44,3-52B,4-32L(2),4-60F1.

Biohazard hoods do not provide protection from radioactive or other chemical substances. Air is discharged into the lab after bacteria are removed by a HEPA filter. Do not tamper with cabinet filters or blowers as this may impair function. Do not use a gas burner in a biosafety cabinet.

General procedure to follow:

- record use of the cabinet in log book, if provided
- turn off UV lamp, if the unit has one, and turn on the fluorescent lamp
- check air grilles for obstructions, switch on blower
- allow air to purge the workspace for 5 minutes
- clean all interior surfaces with an appropriate disinfectant, and allow to air dry
- assemble only the material required to do the procedure in the cabinet (if using tissues, do not let them be sucked up into the fan!)
- clean materials and contaminated materials must be placed so that they do not come in contact
- allow air to purge the workspace for 5 minutes more
- wear protective clothing as appropriate
- introduce hands into the workspace, working methodically from clean to work areas to the discard area
- remove all contaminated protective clothing (e.g. gloves), as appropriate
- with fresh gloves, clean the workspace and disinfect as before
- after completion, allow air to purge the workspace for another 5 minutes
- turn off blower and fluorescent lamp (and turn on UV lamp, if the unit has one)

Laminar flow cabinets/ clean-air benches

These units are designed to protect the product *but not personnel* from contamination. Intake air is filtered through a HEPA filter, blown over the work surface, then exhausted into the laboratory. Contact Lynn Elmes (AF 4-04; 2-5785) for more information. [As of January 2009 units were in: AF 1-20E, 1-20F, 1-25, 1-51, 2-50, 3-42, 3-52, 4-64.]

Working with animals

- Working with animals exposes workers to zoonoses (diseases transmissible from animals to humans) and sensitization (allergy development).
- Generally, the more similar a species is to man, the greater the risk of acquiring a severe zoonosis; the more dissimilar, the more likely allergies will develop.
- For further information contact JoAnne Seglie, Environmental Health & Safety, phone 2-5378.

(1) Tetanus / hepatitis

- Tetanus immunization may be required for those working with animals.
- Hepatitis B immunization is required for those working with or potentially exposed in the workplace to human body substances (see Appendix 6, part 4).

(2) Teaching and research animal records

- An *approved* Animal Use Protocol is *required* in advance of starting work with animals.
- The University Animal Policy and Welfare Committee (UAPWC; phone 2-4817) requires that records *must* be kept on individual animals from arrival in the Department to departure, including dates, where located, researcher, procedures done, illnesses, and drugs administered (these records must be kept on file for a minimum of 3 years).

(3) Course required for those who work with animals

- All those who work with animals and are listed on Animal Use Protocols must take the course offered by UAPWC. One day is spent covering lab safety, diseases, biosecurity, etc.; the second day covers species-specific matters.

Personal protective equipment ('PPE')

Safety apparel

Wear lab coats, gloves, eye protection, boots, hearing protection (e.g. when using grinders or blenders), etc., as required. Contact Laura Smith (AFNS Stores, AF 3-51) or appropriate off main campus personnel to acquire the necessary items. AFNS provides lab coats, eye and ear protection, dust masks, etc.

Note that sandals and shorts should not be worn in laboratories or any other hazardous work area. Also note that *lab coats are not to be worn in 'public areas'* (e.g. SUB; lounges).

Eye protection

Use appropriate eye protection (e.g. safety glasses, goggles, face shield) in situations where eye injury is possible (including when others are working on experiments nearby). [Note: contact lenses are not a form of eye protection (they can even be hazardous since they prevent proper

rinsing of the eye).]

You can *not* simply bandage an eye injury!

Gloves

Remove disposable gloves and wash your hands before leaving a laboratory or other work area. Do not contaminate door handles, instrument controls, keyboards, phones, etc. Disposable gloves, if contaminated, *must be safely decontaminated before being placed in the garbage*, else they must be collected and disposed of separately as waste.

Pipetting Do not mouth pipet.

Food or drink

Food or drink must not be consumed in labs (unless *specifically* allowed). Store foods only in *food* fridges or areas. Never dispose of pop cans, food wrappers, or any evidence of food consumption, in lab garbage cans. Cups and drinking glasses must not be out on lab benches or lab desks.

Food-grade chemicals

Food-grade chemicals must be used for any experiments in which a product will be consumed.

Equipment use & problems

Whenever equipment is to be operated, *before* using it seek assistance (training) and consult the manual. Use equipment only for its intended purpose.

Please report accidents with, damage to, or inoperative equipment. Do *not* use defective equipment. In general and where applicable, report equipment problems to a Dept tech, or directly to Will Cornet, if in the Ag/For Ctr (3-05; fill out a repair request form).

Electrical equipment / hazards

Only qualified staff are permitted to modify, extend or disconnect any permanently connected electrical circuit or device.

Extension cords should not be used for most lab equipment, especially ovens, hot plates, etc.

Frayed cords or electrical sparks can be a source of ignition, e.g. of flammable vapours. To have cords repaired, if in the Ag/For Ctr, contact Will Cornet (AF 3-05; fill out a repair request form), elsewhere contact your Unit Manager. Will can supply proper electrical leads and inspect electronic circuitry, and can advise on power requirements, proper grounding and shielding, etc.

If electrical equipment is grounded via a three-pronged plug, do not remove the 'third prong'.

Compressed gas cylinders

Compressed gas cylinders, whether or not they contain flammable or explosive gases, are potentially dangerous due to high pressure. Rupture or sudden discharge can turn them into lethal projectiles. Never move a gas cylinder with the regulator attached (safety cap must be in place).

Cylinders are heavy and unstable, so they *must* be secured to a cart when moved (carts are in AF 3-49—return them ASAP; record gas taken on sheet). Solidly anchor cylinders before removing the safety cap and attaching a regulator. If the application permits, close the main cylinder valve between uses.

Be sure to use *only* the *appropriate regulator* for the cylinder. Never use oil or grease on an oxygen regulator/cylinder (explosion may result).

When finished with a cylinder, e.g. it is nearly empty (leave at least 100 psi), put a piece of *tape* on it with 'MT' or 'EMPTY' printed on it, and transport it *to the loading dock*, or designated area off-campus. There is a monthly charge on cylinders—it may be cost-effective to return a 'dormant' cylinder and reorder when needed.

Liquid nitrogen

Liq. N₂ can *flash freeze* flesh. Take appropriate precautions (impervious gloves and clothing; regular shoes; full face shield). When dispensing liq. N₂, put your container on the *floor*.

If liq. N₂ is used with a vacuum system, it must be a high vacuum system. Beware of condensation of O₂ from air into liq. N₂ and its subsequent concentration by loss of N₂, forming a highly explosive mixture (indicated by it turning blue).

Do not mix liq. N₂ with an organic solvent (condensation of O₂ from air and subsequent concentration produce a highly explosive mixture).

Do not use liq. N₂ to cool a tube prior to sealing unless the tube is attached to a high vacuum line, otherwise air might condense in the tube and cause an explosion.

The pressure inside containers cooled in liq. N₂ will rise as the external temperature rises—wear eye protection in case the container shatters.

Dewar flasks *intended for* liq. N₂ should be used, *not* domestic thermos bottles.

Blenders

Do not blend flammable materials.

Ovens

Do not put flammable materials/liquids in an oven (this includes materials, e.g. filtrates, that are not 'flammable solvent'-free).

Gas (Bunsen) burners

Tubing used with gas burners must be of good quality and in good condition, and should be secured with clamps. The gas supply must be turned off when the burner is left unattended.

Dewar flasks, vacuum racks & desiccators

Tape Dewars and glass bulbs on vacuum systems to prevent 'explosive' shattering in case of breakage. Glass vacuum desiccators should also be taped. Check glassware for cracks before applying vacuum.

Proper use of refrigerators, cold rooms & freezers

In refrigerators, cold rooms or freezers do *not store: flammable materials; food items* (unless a unit is designated for food); *chemicals which may give off corrosive or other dangerous fumes; dry ice* (the CO₂ concentration in a walk-in cold room, freezer or chamber will likely reach dangerous levels; also, the drop in pH in ultralow temperature freezers could be lethal to enzymes, cells, etc.).

Units used for storing potential biohazards/pathogens are identified by a Biohazard symbol, and those for radioisotopes by a Radioisotope symbol.

Wear appropriate clothing when working in a cold room or walk-in freezer.

Defrost freezers on a *regular* basis.

Proximate analysis

Contact Joan Turchinsky (AF 4-32/780-974-5293) about proper and safe use of apparatus for determination of: fat and fibre (AF 3-60), and minerals by atomic absorption (AF 2-58C). Contact Gary Sedgwick (AF 1-20K or 1-11A/2-6966) about calorimeter use (AF 3-60). For N/protein (AF 3-60), contact Will Cornet (AF 3-05A/2-7662). For Kjeldahl N/protein determination contact Steve Melnyk (ERS Metabolic Research Unit/2-7692). Standard/Safe Operating Procedures (SOPs) are available for most methods.

Spectrophotometers

Follow proper operating procedures and treat with care. Avoid spills (e.g. rinse and fill cells *away from* the unit). If a sipper is installed, it must be rinsed with water and left filled with water after use.

Steam & steam hoses

Steam must be treated with respect—it will cause damage to flesh very quickly. Inspect hoses, etc. before use—report defects.

Autoclaves

- Sterilization is done using steam.
 - Pressure (20 psi), temperature (121°C), and time are controlled to optimize sterilization.
 - Seek technical assistance, if required.
1. As of January 2009 units were in: AF 1-20G, 1-52, 2-50(2), 4-32M(2), 4-60, 5-17.
 2. The most common injuries are heat/steam related:
 - Always stand to the side, back from the autoclave door. Open the door *slowly* and *partially* after an autoclave cycle (when the door is opened, steam escapes and rises).
 - Always use thermal-lined mitts when handling autoclaved materials.
 - Be especially careful with liquids.
 - Note: *cellulose nitrate tubes* may *explode* if autoclaved, and may produce harmful nitrogen oxide fumes if heated >60°C.
 3. Always wait until the temperature and pressure have stabilized before leaving an autoclave, in case any problems develop.
 4. Preparation of items to be put into autoclave:
 - Avoid stacking or crowding.
 - Liquids should be 50% or less of a container's capacity. Cap containers containing liquid loosely or use self-venting containers.

Disposal of glass

All glassware waste (including disposable pipets, capillary tubes, test tubes), must be placed in containers set aside in labs for glassware disposal (typically "yellow labeled pails"). Do not put such glassware in regular trash containers.

Glassware must be cleaned and decontaminated before going into the glass-only waste. Bottles must be *empty, cleaned out and rinsed* finally with water, and labels must be removed or defaced (see Appendix 9 for further information).

Disposal of 'sharps'

A separate, labelled container must be used for disposal of syringe needles, razor blades, and other sharp metal objects. These items should be decontaminated, if required (see Appendix 9 for further information).

Heating mantles

A heating mantle must be placed on a *heat-safe surface*, not on a regular lab bench, and must not be plugged directly into a power outlet (use a rheostat). 'Brittle' and/or significantly discolored (on the bottom) mantles should be disposed of. Arrange equipment so that the heating mantle can be removed quickly.

Centrifuges

Failure to operate centrifuges correctly can be very dangerous. The first time you use a particular centrifuge, ask for assistance.

Use instrument-compatible rotors only. Make sure the rotor is correctly placed on the spindle. Bottles put in centrifuge rotors must be balanced properly (ask if you are not absolutely sure how to do this) and must be appropriate both for the contents in the bottle and the speed selected. Wait until the maximum speed has been reached before leaving a centrifuge unattended.

If a log book is provided with a centrifuge, especially ultracentrifuges, record the use for each rotor. The maximum permissible speed for rotors is downrated with time (generally do not operate above 90% of the maximum rated rpm; even slower if the rotor is 'well used').

Centrifuge rotors (and chambers) must be kept clean and dry. Check for liquid or deposits immediately after use. ***Clean up spills in the chamber. Clean and dry a rotor after use*** to avoid corrosion (dish soap is OK; do not use abrasive cloths or wire brushes; use plastic-coated brushes).

Types of centrifuges: microfuge (max. ~10,000 rpm); bench-top (max. speed varies); basic floor model (max. ~5,000 rpm); high- or superspeed (max. ~25,000 rpm); ultracentrifuge (max. ~100,000 rpm).

The relative centrifugal force (RCF or **g** force), as related to rotational speed (RPM), depends on the rotor used (consult the rotor manual).

Spraying thin-layer chromatograms

Spray chromatograms in a fume hood, also using a supplementary container, e.g. a box, to keep the spray off fume hood surfaces.

Glass tubing / sealed ampules or test tubes

Exercise caution when snapping off lengths of glass tubing, or opening sealed ampules or tightly-capped test tubes (e.g. wear heavy cloth gloves). If a sealed container is under pressure, open it only after cooling it appropriately.

Distillation, extraction, evaporation

Perform these procedures in a fume hood whenever possible. If using water for cooling, e.g. a condenser, fasten tubing with band clamps, not wire. See also 'Unattended experiments' (p. 5).

Ledges under sinks (Ag/For Centre)

Some ledges are not fastened down. Place items to the back. Do not store chemicals under sinks. Do not use unfastened ledges as 'foot rests'.

Appendix 1

Due Diligence (part 1)

*The information on this page is excerpted from
“Workplace Health & Safety, Legislation January 2000”
Alberta Human Resources and Employment*

Why care about Due Diligence?

Commonly referred to as the “General Duty Clause”, every province in Canada has similar occupational health and safety legislation that describes the obligations of employers and workers. Alberta’s Clause (i.e. section 2, Alberta Occupational Health and Safety Act, 1980) reads:

(1) Every employer shall ensure, as far as it is reasonably practicable for him to do so,

(a) the health and safety of

(i) workers engaged in the work of that employer, and

(ii) those workers not engaged in the work of that employer but present at the work site at which that work is being carried out, and

(b) that the workers engaged in the work of that employer are aware of their responsibilities and duties under this Act and the regulations.

(2) Every worker shall, while engaged in an occupation,

(a) take reasonable care to protect the health and safety of himself and of other workers present while he is working, and

(b) co-operate with his employer for the purposes of protecting the health and safety of (i) himself,

(i.1) other workers engaged in the work of the employer, and

(ii) other workers not engaged in the work of that employer but present at the work site at which that work is being carried out.

(3) Every supplier shall ensure, as far as it is reasonably practicable for him to do so, that any tool, appliance or equipment that he supplies is in safe operating condition.

(4) Every supplier shall ensure that any tool, appliance, equipment, designated substance or hazardous material that he supplies complies with this Act or the regulations.

(5) Every contractor who directs the activities of an employer involved in work at a work site shall ensure, as far as it is reasonably practicable to do so, that the employer complies with this Act and the regulations in respect of that work site.

By including the words “reasonably practicable”, legislators make the Occupational Health and Safety Act “strict liability” legislation and introduce the possibility of a “due diligence defence.”

Strict liability laws express the possibility of rational decision making. You have the option of deciding if you do or do not proceed with a particular action depending upon the circumstances. Instead of complying with the specific provision of the law, you could do everything “reasonably practicable” and demonstrate “due diligence”. Due diligence is demonstrated by your actions before an incident occurs, not after the fact.

“Due diligence is the level of judgement, care, prudence, determination, and activity that a person would reasonably be expected to do under particular circumstances.”

At first glance “reasonably practicable” looks like a pretty subjective way of determining someone’s guilt or innocence. However, “reasonably practicable” is a legally defined term which is measured by the “reasonable person test”. To use this test, consider what a dozen of your peers would consider reasonable in a similar set of circumstances. Your peers would likely review what you did and compare it against what they do in their operations. Some of them may have done more and others may have done less. The result would be a balanced and wise judgement that could be defended to others.

Practical Steps for Implementing Due Diligence

Be Aware Be Objective Be (Pro)Active Take Note Take Care

(further information about “Due Diligence” is presented on the next page)

Due Diligence (part 2)

The information on this page is excerpted from a presentation to AFHE on 22 February 2000 by Dr. Lynn Skillen and JoAnne Seglie, on behalf of the U of A's General Occupational Health & Safety Committee

What is Due Diligence?

- **ensuring that every level of the organization can clearly relate to the legal, ethical, and moral responsibilities or obligations of individuals, e.g. employees, students, visitors, and contractors**
- taking all reasonable care
- taking the steps that a reasonable person would take, given the circumstances
- knowing responsibilities under the law and taking all reasonable steps to comply
- consciously exceeding generally accepted practice standards
- actively identifying hazards related to specific practices, procedures, and circumstances
- taking active measures to prevent loss/injury/illness/disease
- communicating proactive measures to employees and students
- documenting actions taken

Why Due Diligence?

- potential for liability of individuals as well as a corporation or institution
- liability for environmental, health, and safety losses or offenses, based on common law principles
- new standards of loss control and risk management
- ignorance of the law is no defense (Occupational Health & Safety Act; Alberta Environmental Protection & Enhancement Act)
- proactive management
- corporate accountability
- individual accountability
- community concern
- loss prevention

Due Diligence How?

- acquainting employees and students with hazards and their risks
- providing employees and students with the mechanism or forum for communication of concerns re health and safety
- providing protective equipment and materials appropriate to the hazard
- ensuring materials are reliable, serviceable, properly maintained, and in sufficient supply
- providing training by competent instructors for

- employees and students who use equipment and materials
- ensuring employees and students are competent for tasks and that they understand all instruction, information, and supervision
- meeting or exceeding generally accepted practice standards
- exhausting all reasonable resources to mitigate an event which would result in losses to individuals, property, environment, production, or service
- keeping records of training, workshops, inspections, safety meetings, equipment maintenance, incidents, and investigations
- developing written policies and procedures
- conducting job demands analysis before designing training program

Due Diligence in Summary:

- **Provision and maintenance** of required equipment and materials
- **Development** of specific **policies, procedures and practices** for specific hazards
 - good procedures are the best training tools
- **Communication** of policies, practices and procedures
- **Training** of employees and students in safe policies, procedures and practices
 - training is job specific, area specific, and conducted after job demands analysis
- **Verification** that employees and students are **competent** to carry out the practices and procedures
- **Monitoring of adherence** to safety policies, practices and procedures
 - conduct **regular inspections**, audits; **performance evaluations** include health and safety responsibilities of all levels of management (first line supervisor to Division Directors, Chairs, Deans, Vice-Presidents, President)
- **Enforcement of compliance** with regulatory requirements and internal procedures
 - create **consequences** (consistent and impartial) for noncompliant individuals
 - develop discipline policy and reward program
 - establish **ground rules** for job expectations
- **Documentation** of preventive activities
- **Modelling** of the expected behaviours by supervisors and administrators
- Striving for **continuous improvement**

Sources of Safety Information

In AF 1-30 ('computer room')

- *Material Safety Data Sheets* (on-line computer access and some printed copies)
- *WHMIS and other safety information*

In AF 2-58

- *AOAC Official Methods of Analysis, 17th Ed., 2003. Appendix B: Laboratory Safety.*
- *Hazardous Chemical Safety* (J.T. Baker)
- *Hazardous Chemicals Information & Disposal Guide* (M.A. Armour, L.M. Browne, G.L. Weir)
- *Emergency action guide*

Research Station Units

- *Material Safety Data Sheets* (check with Unit Manager for availability of printed copies; computer access may be an alternative).
- *Site-specific safety materials.*

World-Wide Web (Internet)

Our Safety web site has a variety of information and links such as MSDS sources:

<http://www.safety.afns.ualberta.ca>

There is also the Office of Environmental Health and Safety (107 Educ. Car Park; 492-1810):

<http://www.ehs.ualberta.ca/>

Handbook of laboratory safety

Furr, A. Keith (ed.); CRC Press; 3rd ed.

UA Cameron Flr1 SciTech Ref

QD 51 S814 1990

Laboratory safety in practice: a comprehensive compliance program and safety manual for industrial, diagnostic and clinical, research and development, academic (school, college, university), quality control, analytical and testing laboratories

Gershey, E.L.; Party, E.; Wilkerson, A.

Van Nostrand Reinhold

UA Scott Health Sci

Q 183 A1 G382 1991

Laboratory safety: principles and practices

Miller, B.M. & Groschel, D.H.M. (eds.)

Amer. Soc. Microbiology.

UA Cameron Flr3 SciTech

QR 647 L12 1986

Laboratory safety: theory and practice

Fuscaldò, A.A.; Erlick, B.J.; Hindman, B. (eds.);

Academic Press

UA Scott Health Sci

QH 323.2 L12 1980

Guide to safe practices in chemical laboratories

Royal Soc. of Chemistry (Great Britain)

UA Cameron Flr3 SciTech

QD 51 R888 1987

Laboratory safety: principles and practices

Fleming, D.O. (ed.) et al.;

Amer. Soc. Microbiology; 2nd ed.

UA Scott Health Sci

QR 64.7 L33 1995

Introduction to safety in the chemical laboratory

Freeman, N.T.; Whitehead, J. Academic Press

UA Cameron Flr3 SciTech

QD 51 F855 1982

Safety in academic chemistry laboratories

Amer. Chem. Soc. Committee on Chemical Safety. 5th ed.

UA Cameron Flr3 SciTech

QD 51 S128 1990

Hazards in the chemical laboratory

Bretherick, L. (ed.); Royal Soc. Chem.; 4th ed.

UA Cameron Flr1 SciTech Ref

QD 51 H42 1986

The Merck index: an encyclopedia of chemicals, drugs, and biologicals

Budavari, S.; O'Neil, M.J.; Smith, A.; Heckelman, P.E.; Kinneary, J.F.; Whitehouse, N.J. (eds.): 12th.

UA Cameron Flr1SciTec InfoDesk

UA Scott Health Sci

RS 356 M55 1996

Chemical technicians' ready reference handbook

Shugar, G.J.; Ballinger, J.T.; consulting editors:

Shugar, R.A.; Bauman L.; Shugar Bauman, R.

McGraw-Hill; 3rd ed.

UA Cameron Flr1 SciTech Ref

Appendix 2, continued

QD 61 S565 1990

Fire and explosion hazards handbook of industrial chemicals

Davletshina, T.; Cheremisinoff, N.P.; Westwood, N.J.: Noyes Publications

UA Cameron Flr1 SciTech Ref

TP 149 D34 1998

Bretherick's handbook of reactive chemical hazards

Bretherick, L.; Butterworths; 4th ed

UA Cameron Flr1 SciTech Ref

T 55.3 H3 B84 1990

Handbook of safety, health, & environmental data for common hazardous substances

Genium Pub. Corp.; McGraw-Hill; 3 v.

UA Scott Health Sci Ref

T 55.3 H3 G46 1999 — v.1-3

Occupational toxicology

Stacey, N.H. (ed.); Taylor & Francis Publ.

UA Scott Health Sci

RA 1229 O28 1993

Destruction of hazardous chemicals in the laboratory

Lunn, G.; Sansome, E.B.; Wiley

UA Cameron Flr2 SciTech

TD 1050 S24 L944 1990

Chemical properties handbook: physical, thermodynamic, environmental, transport, safety, and health related properties for organic and inorganic chemicals

Yaws, C.L.; McGraw-Hill, c1999.

UA Cameron Flr1 SciTech Ref

TP 200 Y35 1999

Safe handling of chemical carcinogens, mutagens, teratogens, and highly toxic substances

Walters, D.B. (ed.); Ann Arbor Science Pub.

UA Cameron Flr3 SciTech

RC 268.6 S12 1980 — v.1 & 2

Compendium of hazardous chemicals in schools and colleges

Forum for Scientific Excellence, Inc.; Lippincott

UA Cameron Flr1 SciTech Ref

T 55.3 H3 C736 1990

Manual for spills of hazardous materials

Ottawa, Ont.: Environmental Protection Service

UA Cameron Flr1 SciTech Ref

T 55.3 H3 M29 1984

How to work safely with flammable and combustible liquids

Lowther, M.;

Canadian Ctr Occ. Health & Safety

UA Cameron Flr2 SciTech

T 55.3 H3 L934 1988

How to work safely with dangerously reactive liquids and solids

Lowther, M.;

Canadian Ctr Occ. Health & Safety

UA Scott Health Sci

RC 967 L922 1989

How to work safely with oxidizing liquids and solids

Lowther, M.;

Canadian Ctr Occ. Health & Safety

UA Cameron Flr2 Sci Tech

T 55.3 H3 L938 1989

How to work safely with organic peroxides

Lowther, M.;

Canadian Ctr Occ. Health & Safety

UA Cameron Flr2 SciTech

T 55.3 H3 L94 1989

Occupational hazards of pesticide exposure: sampling, monitoring, and measuring

Ecobichon, D.J. (ed.); Taylor & Francis Publ.

UA Scott Health Sci

RA 1270 P4 O226 1999

Herbicide handbook of the Weed Science Society of America

Humburg, N.E., Colby, S.R. et. al.;

Weed Sci. Soc. of America; 6th ed.

UA Cameron Flr1 SciTech Ref

SB 951.4 W39 1989

Safe Handling of Some Chemicals

This information does **NOT** replace the detailed information on *Material Safety Data Sheets—MSDSs* should always be consulted. Remember, when using any chemical it is important to wear/use the proper personal protective equipment (e.g. goggles or face shield, disposable or heavy rubber gloves, lab coat), and use a fume hood or other containment device, as required. Chemicals must be stored safely and appropriately (e.g. segregate incompatible chemicals; do not place containers of dangerous chemicals on open bench shelves; store chemicals in cupboards or behind glass doors, if possible). Chemicals must also be transported safely between and within a lab, for example using a ‘rubber’ carrier available at AFNS Stores and in some labs.



Acids (pH ~1-6) and **Bases** (alkalies; caustics; pH ~8-14) are corrosive. Generally, the farther the pH is from neutral (i.e. pH 7), the more corrosive the chemical. Heat is often liberated when combined with water—when diluting, *always add corrosives to water, with mixing.*

Acids

An effective fume-removal system should be used when heating acids or generating acid fumes. Add acid to water when diluting, unless otherwise directed in a method. Avoid skin contact and wear eye protection. In case of contact, wash immediately with large amounts of water. Store separately from bases. Keep mineral acids (e.g. sulfuric, hydrochloric, nitric, perchloric) separate from solvents and other combustibles (e.g. organic acids).

- **Acetic acid.** Vigorous reaction with strong oxidizers, e.g. chromic acid or hydrogen peroxide. Store separately from nitric acid. Also incompatible with: acetaldehyde, acetic anhydride-water, hydroxyl-containing compounds, ethylene glycol, perchloric acid, peroxides and permanganates.
- **‘Chromic acid’** (H_2CrO_4 ; CrO_3 is chromic acid anhydride). Irritating to skin. Poisonous. Potential for explosive reaction with acetic acid, acetic anhydride, ethyl acetate, isoamyl alcohol and benzaldehyde; less hazardous with ethylene glycol, furfural, glycerol and methanol. Other incompatibilities: alcohols, camphor, flammable liquids, naphthalene. Reactions should be behind a safety shield.
- **Formic acid.** Strong reducing agent. Vigorous or explosive reaction with oxidizing agents. Irritating to skin (may form blisters).
- **Fuming acids.** Use or prepare in a fume hood.
- **Hydrochloric acid.** Aqueous solution is corrosive, irritating and poisonous. Fumes are corrosive and irritating to mucous membranes. Incompatibilities include: sulfuric acid, alcohols, metals, permanganates.
- **Nitric acid.** Corrosive. Vigorous or explosive reaction with aniline, hydrogen sulfide, flammable liquids and gases, hydrazine, metal powders and many other compounds. Nitrogen oxide fumes from nitric acid can severely damage lungs. Use in fume hood. PVC, not rubber, gloves should be used. Incompatibilities also include: acetic acid; chromic acid; hydrocyanic acid; phosphorus. *Consult MSDS for further details.*
- **Oxalic acid.** Explosive compounds form with silver and mercury. Oxalates are toxic. Avoid skin contact/ingestion. Incompatible with urea and sodium chlorite.
- **Perchloric acid.** Corrosive. Fire or explosion can occur upon contact with oxidizable or combustible materials, or with dehydrating or reducing agents. Contact of perchloric acid with strong dehydrating agents, e.g. phosphorus pentoxide or conc. sulfuric acid can form anhydrous perchloric acid, which reacts explosively with organic matter and with reducing agents (special care required with such analyses). Incompatibilities also include: acetic anhydride, alcohol, bismuth and its alloys, and organic materials such as wood, paper, grease, and oils. Clean up small spills immediately and thoroughly with lots of water. *If perchloric acid vapour will be evolved, use only the special fume hood in AF 3-60 and operate the wash mechanism daily* (note: organic vapours must not be generated in the perchloric acid hood). Polyvinyl chloride, not rubber, gloves should be used. If doing wet combustions with perchloric acid, treatment first with nitric acid to destroy easily-oxidizable matter is recommended. *Do not evaporate to dryness. Note: 72% perchloric acid is extremely sensitive to shock and heat. **Mark date opened on the bottle—opened bottles of 72% perchloric acid older than one year or contaminated should be sent for disposal.** Consult MSDS for further details.*
- **Picric acid.** Highly sensitive to shock in dry form (maintain at least 15% ‘wetness’ with water). Contact with metals and ammonia forms picrates (even more sensitive to shock than picric acid). Absorbs readily through skin; irritating to eyes. Incompatible with heavy metals, bases, aluminum/water.
- **Sulfuric acid.** Corrosive. Add sulfuric acid to water (not the reverse) when diluting. Do not mix with hydrochloric acid. Incompatibilities also include: acetaldehyde, potassium chlorate, potassium perchlorate and potassium permanganate (and compounds with similar ‘light metals’, such as sodium and lithium). *Consult MSDS for further details.*

Bases (Alkalies)

Alkalies can severely burn skin, eyes and respiratory tract. Heavy rubber gloves and face shield should be worn when using concentrated alkali liquids. Use in a fume hood if alkali dusts or vapours are present.

- **Ammonia (anhydrous).** Extremely caustic liquid and gas. Wear skin, eye and respiratory protection. Vapours are flammable. Reacts violently with strong oxidizing agents, strong acids and halogens. Other incompatibilities: mercury, calcium hypochlorite, hydrogen fluoride, hydrocarbons. *Consult MSDS.*
- **Ammonium hydroxide.** Caustic. Forms explosive compounds with many heavy metals (e.g. silver, zinc, lead) and their salts, especially halide salts.
- **Calcium oxide.** Strongly caustic. Violent reaction with water. Protect skin, eyes and respiratory tract from dust. Incompatible with ethanol.
- **Sodium hydroxide/potassium hydroxide.** Extremely caustic. Can cause severe burns. Add pellets to water, not vice versa. Incompatibilities include: aluminum, arsenical materials, silver nitrate and ammonia.
- **Sodium peroxide.** Less caustic than sodium hydroxide. Reacts violently with: water, organic matter, charcoal, glycerol, diethyl ether, phosphorus. Other incompatibilities: oxidizable substances, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, ethyl and methyl acetate, ethylene glycol, furfural, ethanol and methanol.

Other Chemicals and Materials

- **Acetone.** Highly flammable. Explosive peroxides form with oxidizing agents. Incompatibilities include: conc. sulfuric and nitric acids, mixtures of chloroform and bases, bromine, and chlorine. Use in fume hood.
- **Acetonitrile.** Toxic. Avoid contact with skin and eyes. Use in fume hood.
- **Acetylene.** Incompatibilities include: copper (e.g. tubing), halides (e.g. chlorine, bromine), silver, mercury and their compounds, nitric and perchloric acids.
- **Alkaline metals** (e.g. powdered aluminum, or magnesium, sodium, potassium, lithium, calcium). Strong caustic action. May cause severe burns. Avoid contact with water, chlorinated hydrocarbons, CO₂, halogens, strong acids, aldehydes and ketones. Prepare alcoholates using *dry* alcohol, adding small metal pieces one at a time. Corrosive fumes when burned.
- **Ammonium nitrate.** Keep out of contact with acids (e.g. acetic acid), metal powders (e.g. zinc, aluminum), flammable liquids, chlorates, nitrates, sulfur, finely-divided organic or combustible materials.
- **Ammonium persulfate/perchlorate/permanganate.** Incompatible with combustible materials and oxidizing materials such as acids, chlorates and nitrates.

- **Aniline.** Incompatibilities include: nitric acid, hydrogen peroxide, sodium peroxide.
- **Arsenates.** Keep out of contact with reducing agents.
- **Arsenic trioxide.** Toxic. Toxic volatile halides are formed in contact with halide acids. Volatile, highly toxic arsine is formed when reduced in acid solution. Protect skin and respiratory tract when handling. Use in fume hood when toxic volatiles may be formed.
- **Asbestos.** Dry fibers are hazardous when inhaled. Wet fibers form a mat which is not hazardous. Use a fume hood to transfer dry fibers into water, and store under water until needed. Do not dry asbestos in a forced-air oven, use a convection oven, opening the door slowly to avoid airborne fibers.
- **Azides.** Do not mix with acids.
- **Benzene.** Toxic. Highly flammable. Carcinogenic. Avoid contact with skin. Decomposes violently in presence of strong oxidizing agents. Reacts violently with chlorine. Use in fume hood.
- **Bromine and chlorine.** Incompatible with: ammonia (including vapour), acetylene, benzene, butadiene, hydrocarbons, hydrogen, sodium, finely-divided metals, turpentine, other hydrocarbons.
- **Carbon, activated** ('activated charcoal'). Avoid contact with calcium hypochlorite and all oxidizing agents.
- **Carbon disulfide.** Extremely flammable; low ignition temperature. Avoid static electricity. Toxic. Can react vigorously/violently with strong oxidizing agents, azides and zinc. Use in fume hood.
- **Carbon tetrachloride.** Reacts violently with alkali metals. Toxic. Fumes decompose to phosgene when heated strongly. Use in fume hood.
- **Carcinogens/suspected carcinogens/mutagens.** Check label and MSDS information to identify such chemicals. Take special precautions to limit exposure.
- **Cellosolves.** Examples: 2-ethoxyethanol (i.e. ethylene glycol monoethyl ether); 2-methoxyethanol (i.e. ethylene glycol monomethyl ether). Vapours can be harmful. Use in fume hood.
- **Chlorates** (e.g. sodium or potassium chlorate). Keep out of contact with ammonium salts, acids, metal powders, sulfur, and finely-divided organic or combustible materials.
- **Chloroform.** Harmful if inhaled. Carcinogenic. Forms phosgene when heated to decomposition. Use in fume hood. Can react explosively with aluminum, lithium, magnesium, sodium, potassium, disilane, N₂O₄ and sodium hydroxide plus methanol. **Note:** even when chloroform is stored properly and stabilized, it can generate phosgene (exposure to 20 ppm for 1-2 minutes can cause severe lung injury and 570 ppm for 1 minute can cause death). Chloroform comes in three basic varieties: no stabilizer, stabilized with amylene, or stabilized with an alcohol such as ethanol. Treat chloroform as a time-

Appendix 3, continued

sensitive chemical (approx. 6 months) and, if possible, buy it stabilized with alcohol as alcohol is usually added in higher concentrations than amylene, providing better protection from phosgene generation.

- **Cleaning solutions containing chromic acid, Chromerge, or dichromate.** It is best that these solutions *not* be used (if used, they must be in a fume hood). Reasons for this are: hexavalent chromium in the solution is a potent human carcinogen; addition of chloride or halogens to chromic acid cleaning solutions can generate chromyl chloride, a highly toxic, volatile carcinogen; chromium is toxic to most living organisms—trace amounts left on glassware can have an adverse effect on biological experiments; used chromic acid solution cannot be neutralized and flushed into the sewer as chromium metal remains. Most lab glassware can be properly cleaned using a non-toxic, biodegradable cleaning solution.
- **Copper.** Avoid contact with: acetylene; hydrogen peroxide.
- **Cumene hydroperoxide.** Incompatible with acids.
- **Cyanides** (e.g. potassium or sodium cyanide). React with acids to form highly toxic, rapid-acting gaseous hydrogen cyanide. Destroy residues with alkaline NaOCl. Use in fume hood.
- **Dangerously reactive materials** (WHMIS class F). This category includes a variety of chemicals which may react to jarring, compression, heat or light, or may burn, explode or release dangerous gases when mixed with other materials. Note that these chemicals may not be reactive when purchased, but may become reactive over time (e.g. diethyl ether forming peroxides, or picric acid becoming dry).
- **Diethyl ether.** Extremely flammable. Store protected from light. Unstable peroxides can form upon long standing or exposure to sunlight. Can react explosively with: Cl₂, O₃, LiAlH₄, strong oxidizers. Avoid static electricity. Use in fume hood. (*See: 'Ether/...' & p. 18, #4*)
- **Dimethylformamide (DMF).** Toxic. Flammable. Avoid contact with skin and eyes. Can react vigorously with oxidizing agents, halogenated hydrocarbons and inorganic nitrates. Use in fume hood.
- **Ether/organic peroxides.** Form in diethyl ether, dioxane and other ethers during storage. They are explosive and must be destroyed chemically before distillation or evaporation. Peroxide formation in ethers is influenced by exposure to light. Storage over sodium ribbon can retard peroxide formation (*see 'Alkaline metals...' for cautions about sodium*).
- **Ethanol.** Flammable. Use in fume hood. Incompatible with sodium peroxide.
- **Ethyl acetate.** Flammable. Irritating to eyes and respiratory tract. Use in fume hood.
- **Ferrous sulfide.** Avoid hydrogen peroxide.
- **Flammable and Combustible Liquids.** The flash point of flammable liquids is <37.8°C, and that of combustible liquids ≥37.8°C (flash point is the minimum temperature at which a liquid gives off sufficient vapour to ignite if a source of ignition is present). Do not let vapours concentrate to flammable levels. Vapours from most flammable liquids are heavier than air; ignition of vapour (e.g. by a refrigerator motor) can cause flash back to the liquid via the 'vapour trail' (note: there is a small refrigerator in AF 3-44 for highly flammable liquids). Incompatibilities of flammable liquids include: ammonium nitrate, chromic acid, hydrogen peroxide, halogens (e.g. bromine), nitric acid and sodium peroxide. *Precautions:* Minimize the amount of flammable/combustible liquids (≤250 L in the open laboratory of which ≤60 L can be flammable; includes waste solutions; quantities above these amounts must be kept in an approved flammable storage cabinet; individual cabinets can store ≤500 L, with ≤250 L flammable; max. 3 cabinets per lab; other dangerous goods must not be stored in cabinets with flammable or combustible liquids). Work in a well-ventilated area (e.g. fume hood). Do not store flammable liquids in regular refrigerators or cold rooms. Use bonding clamps ('alligator clips') to ground metal containers of flammable liquids (e.g. drums of petroleum ether in AF 1-46, solvent storage). When dispensing from such containers, it is advisable to also bond them to each other with alligator clips to help avoid static charge build-up. Handle waste flammable liquid carefully—it is still flammable and its characteristics may have changed if other chemicals have been mixed in.
- **Formaldehyde.** A suspected carcinogen. Exposure to high concentrations may cause skin irritation and inflammation of mucous membranes, eyes and respiratory tract. Use in fume hood.
- **Herbicides and Pesticides.** Follow instructions on the label, MSDS and/or 'info sheet' to ensure safe and environmentally sound usage.
- **Hexane.** Highly flammable. Use in fume hood.
- **Hydrazine.** Incompatible with: hydrogen peroxide, nitric acid, any other oxidant.
- **Hydrocarbons** (butane, propane, benzene, gasoline, turpentine, etc.). Incompatibilities include: halogens, chromic acid, peroxides (e.g. sodium peroxide).
- **Hydrogen peroxide.** 30% H₂O₂ can cause severe burns. Drying on organic material, e.g. paper or cloth, can lead to spontaneous combustion. Hazardous with flammable liquids, acetone, aniline, nitrobenzene, nitromethane and oxidizing gases. Copper, iron, chromium, other metals and their salts, e.g. ferrous sulfide or lead oxide/sulfide, rapidly decompose H₂O₂ (including 3%). Slowly decomposes with evolution of oxygen

Appendix 3, continued

- (stored H₂O₂ should have vent caps; store at ~4°C).
- **Hypochlorites.** Do not mix with acids. Also incompatible with activated carbon.
 - **Iodine.** Incompatible with: acetylene, hydrogen, and ammonia (aqueous or anhydrous).
 - **Lithium aluminum hydride (LiAlH₄).** Keep out of contact with air, chlorinated hydrocarbons, carbon dioxide, ethyl acetate and water.
 - **Mercuric nitrate.** Do not mix with methanol.
 - **Mercuric oxide.** Avoid contact with sulfur.
 - **Mercury.** Hazardous in contact with alkali, ammonia, acetylene, fulminic acid, and halogens. Vapours extremely toxic and cumulative. Spills on heated surfaces are extremely hazardous and must be cleaned up promptly. Handle Hg only where spills can be easily and thoroughly cleaned up. If Hg is spilled, it is important that the area not be disturbed until the spill is cleaned up. If mercury thermometers must be used, take extra care to ensure they are not broken.
 - **Mercury salts.** Quite toxic and most are soluble in water. Use skin and respiratory protection when using dry mercuric salts, and skin protection when using concentrated aqueous mercuric salt solutions.
 - **Methanol.** Flammable. Toxic. Avoid contact with eyes and breathing of vapours. Use in fume hood. Can react vigorously with sodium hydroxide plus chloroform, potassium hydroxide plus chloroform, perchloric acid, or lead perchlorate.
 - **Nitrates.** Do not mix with sulfuric acid.
 - **Nitrites.** Incompatible with acids.
 - **Nitroparaffins.** Keep out of contact with inorganic bases, and amines.
 - **Oxidizers.** Provide a source of oxygen or other oxidizing elements, e.g. chlorine. Store separately from other chemicals, preferably in a metal cabinet. Examples: perchlorates, peroxides, nitrates, permanganates, persulfates, perborates, chlorates, chlorites, chromates, bromates, iodates, conc. sulfuric acid, conc. nitric acid, perchloric acid, chromic acid. Can react violently with most metal powders, ammonia, ammonium salts, phosphorus, glycerol, many finely-divided organics, flammable or combustible liquids, acids, sulfur, and some other oxidizers. Having oxidizers in the form of solutions can reduce reactivity and release of dusts. Follow methodology exactly. Use in fume hood behind explosion-resistant barrier. Wear face shield.
 - **Oxygen.** Incompatibilities include: oils, grease, hydrogen, and flammable liquids, solids and gases.
 - **Phosphorus pentoxide.** Incompatible with water.
 - **Phosphotungstic acid.** Highly toxic fumes are emitted when heated to decomposition or in strong alkali.
 - **Permanganates.** Moderately toxic. Readily soluble in water. Strong oxidizers. May form explosive mixture with sulfuric acid or perchloric acid. If used with strong acids to destroy organic matter, perform reaction behind a safety barrier.
 - **Peroxides (organic).** Incompatible with acids (organic, mineral). Avoid friction or shock. Store cold.
 - **Pesticides.** See: *Herbicides and Pesticides*.
 - **Petroleum ether and pentane.** Extremely flammable. Use in fume hood. Avoid static electricity.
 - **Potassium chlorate and perchlorate.** Keep out of contact with sulfuric and other acids or their vapours, combustible materials (especially organic solvents), phosphorus, and sulfur. (Also see: 'Chlorates'.)
 - **Potassium permanganate.** Keep out of contact with glycerin, ethylene glycol, benzaldehyde and sulfuric acid. (Also see 'Permanganates'.)
 - **Potassium peroxide/cyanide.** Do not combine.
 - **Pyridine.** Toxic. Flammable. Use in fume hood. When heated to decomposition, releases toxic cyanides.
 - **Selenides.** Avoid contact with reducing agents.
 - **Silver and silver salts.** Incompatible with: acetylene, oxalic and tartaric acids, ammonium compounds, fulminic acid.
 - **Silver nitrate.** Powerful oxidizer. Strongly corrosive. Poisonous. Dust or solid form hazardous to eyes. (See 'Oxidizers' for handling info; see 'Silver and silver salts'.)
 - **Sodium hydrosulfite.** Keep out of contact with air (moisture) and combustible materials.
 - **Sodium nitrate/nitrite.** Do not mix dry forms together. Incompatible with: ammonium nitrate, other ammonium salts. Do not mix dry sodium nitrate and dry sodium thiosulfate together.
 - **Sulfides.** Do not mix with acids (H₂S is formed).
 - **Sulfur.** Incompatible with oxidizing materials.
 - **Tellurides.** Incompatible with reducing agents.
 - **Toxic dusts.** Use gloves and goggles to avoid contact with skin and eyes. Use in fume hood and/or with respiratory protection. Avoid contamination of work surfaces.
 - **Toxic liquids.** Vapours from some solvents are highly toxic, and some are readily absorbed through skin. Use in fume hood to remove vapours.
 - **Trichloroacetic acid/Trifluoroacetic acid.** Can cause severe burns to skin and respiratory tract. Use rubber gloves, eye protection, and a fume hood.
 - **Triethylamine/Diethylamine.** Flammable. Toxic. Corrosive to skin and eyes. Can react vigorously with oxidizing materials. Use in fume hood.
 - **Water.** Incompatible with acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, phosphorus oxychloride, phosphorus pentachloride, phosphorus pentoxide, sulfur trioxide, etc. Mineral acids must be added, with mixing, to water (not the reverse).
 - **Zinc powder.** Keep out of contact with sulfur.

Appendix 4

Recommendations—Chemicals at the University of Alberta

Based on information from the University of Alberta's Office of Environmental Health & Safety (EH&S, 1995, 1998)

1. Chemical storage in a Laboratory
 - maintain inventory of the chemicals
 - chemicals stored in all areas of the laboratory (e.g. fume hood, cupboards under hood, benches, shelves) must be segregated by classification to ensure that incompatible chemicals are not stored next to each other (avoid simple alphabetical order)
 - do not store above eye level
 - date products on arrival and, especially for peroxide-forming products, date when opened
 - check conditions of peroxide-forming products regularly
 - check that picric acid is stored under water (i.e. "moist", ~15% water)
 - stored according to instructions (e.g. fridge, freezer, away from sunlight, stored under N₂)
 - check MSDSs for additional storage information
 - use storage shelving appropriate to the chemicals
 - check compatibility of chemical with container
 - do not use fume hoods for general storage, except when necessary and only if hood is not actively used
 - send obsolete products for waste disposal/recycling
2. Waste
 - no chemicals/waste products in glass can be stored on the laboratory floor
 - all containers must be capped (do not leave funnel in neck of container), i.e. no open waste containers
 - all waste containers must be labelled prior to waste products being added and the contents *specifically listed* when adding to a container, including approximate percentages if a mixture (note: if water is present, list it as well); unknown wastes will not be accepted by EH&S
 - do not fill containers to the top; leave 5-10% free ("headspace")
 - segregation of waste into separate containers
 - **all properly identified hazardous waste/chemicals must be disposed of by creating a Chematix label for each container and submitting a waste pickup worksheet online.** Do not put hazardous waste/chemicals down the sink or in the garbage (solubility in water does *not* mean 'safe to flush down the drain'!)
 - rinse out empty containers and deface labels prior to disposal in the noncontaminated glass waste containers (usually a yellow pail)
3. Storage of Chemicals in Refrigerators and Freezers
 - no flammable/combustible materials should be stored in a regular fridge or freezer (*fridges for flammable storage in AF 1-20K, 4-35, 4-60*)
 - check fridges and freezers to ensure that odors are not overwhelming when the door is opened
 - maintain a written inventory of what is kept in fridges and freezers
 - check date and storage of products
 - food/drink must not be stored in refrigerators which contain chemicals
4. Diethyl Ether ('Ethyl Ether')
 - diethyl ether should be stored, away from heat and light, in a flammable storage cabinet or room, and must only be used in a fume hood
 - if diethyl ether is stored in a refrigerator, it must be an *explosion-proof* fridge (*see point 3 above*)
 - do not store diethyl ether in a cold room or walk-in freezer
 - on the label print date received and date opened; dispose of as waste within one year of opening
 - check for peroxide formation
 - our web page (www.afns.ualberta.ca/safety) has more information on diethyl ether and other chemicals which may form peroxides
5. Eating and Drinking in the Laboratory

Excerpt from *Occupational Health & Safety Act, Chemical Hazards Regulations 1993*:

8(1) An employer shall ensure that no worker eats, drinks or smokes in an area of work site contaminated by a harmful substance.

8(2) A worker shall not eat, drink or smoke in an area of the work site contaminated by a harmful substance.

"*harmful substance*" means a substance that by its nature, application or presence creates or could create a danger to the health and safety of any worker who is exposed to it.
6. Housekeeping
 - no unlabelled containers
 - workspace and fume hoods to be kept clean
 - floor space and aisles must be clear of clutter and no chemicals stored on floor, especially below and en route to safety showers and eyewashes

Appendix 4, continued

7. Transporting of Chemicals

- when transporting chemicals within laboratories or a building (by foot), an appropriate secondary containment vessel is required (this assists in reducing breakage and containing spilled products)
- TDG regulations must be complied with when transporting chemicals via vehicles

8. Workplace Hazardous Materials Information System (WHMIS)

- these regulations must be complied with when storing, using or handling hazardous materials
- all staff who work with or are in close proximity to controlled products must be WHMIS trained; the training, so far as is reasonably practical, results in workers being able to apply the information to protect their health and safety
- access to Material Safety Data Sheets (MSDSs), which must be read prior to working with a controlled product, be readily available to the worker at the worksite, and be current within 3 years
- proper workplace labels
- what to do in case of an emergency involving a Controlled Product
- the Chemical Spill Response procedure for the department and the University be given to staff

9. Labelling

- all hazardous products, including waste, must be clearly identified (include approximate 'percentage composition')
- the quality of the label must be appropriate for long-term storage

10. Personal Protective Equipment (PPE)

- the appropriate PPE for all the chemicals being worked with must be worn/used, e.g.: eye protection (glasses, goggles, safety shield); lab coat; no open-toe shoes; gloves (check with the manufacturer/supplier to ensure they have been tested for all the chemicals being used)

11. Use of Equipment

- read and follow instruction manuals for the safe use and maintenance of equipment
- extension cords should not be used for refrigerators or freezers

12. Safe Operating Procedures (SOPs)

- should be established for working with hazardous products and include departmental procedures to be followed

13. Working Alone (see Appendix 10, p. 26)

- do not work alone when using hazardous products
- during and after regular working hours set up a 'buddy system'

14. Ethanol and Pure Alcohol

- must be kept under lock and key, and accurate records kept as required by Customs, Transportation and GST, U of A Supply Management Services

15. Chemical Spills

- clean-up supplies and procedures to be in place (see p. 3, 27 and [34](#) of this Handbook).

16. Compressed gases

- handle cylinders safely
- secure full and empty cylinders at all times
- protective caps must be in place when storing or transporting cylinders
- use a cart to move cylinders and have them secured on the cart
- read the corresponding MSDS prior to using the cylinder



Management of Biohazardous Waste

1. Biohazardous waste requiring autoclaving must be packaged in *clear autoclave-grade plastic bags*. Do **not** package the waste in bright orange biohazard bags (they must not enter the University waste stream). Once the contents of these bags are autoclaved they are no longer biohazardous and are safe to handle. Therefore, keeping the waste in the orange bags after autoclaving is misleading and can cause unnecessary anxiety in personnel handling the waste downstream of the autoclave.
2. Transportation of waste to an autoclave outside the immediate laboratory must be on a cart in double bags, inside a leakproof tray (not overloaded such as overhanging or stacked), or other alternative means of transportation approved by the Biosafety Office. The bags must be clearly marked with the name and room number of the principal investigator, and the cart and/or trays clearly labelled with the biohazard symbol.

A piece of *indicator tape* **must** be attached to every bag of waste placed in an autoclave. Upon autoclave treatment a chemical reaction occurs on the tape and it develops a distinct white and black striping pattern. This black and white striped tape is the most reliable indicator that a bag of waste has been decontaminated in an autoclave. Condensation will only appear inside a bag after autoclaving if there was liquid waste inside the bag. Bags of latex gloves and plastic solids may not generate condensation. Petri plates may suggest that waste originated from a biomedical research lab, but such plates are used for more than just holding biohazardous material.

Once a load of waste is removed from an autoclave, personnel should wait until the waste has cooled to room temperature before disposing of it in garbage bins or dumpsters. This helps prevent scalding or burning of personnel and melting of garbage bags and other heat-sensitive containers.

One of the issues contributing to leakage from autoclaved waste bags is that these bags are required to be left open during autoclaving to allow the steam generated by the autoclave to permeate into the waste. After autoclaving, personnel may not reseal the bags with twist-ties or tape and, as a result, they spill when placed inside garbage bins or dumpsters. Double bagging would only work if performed after autoclaving and once the waste had cooled. Although this waste is safe to handle after autoclaving, cleaning staff should still wear latex gloves and an overcoat when cleaning out garbage cans containing autoclaved waste in order to stay clean.

3. All needles/syringes must be disposed of in a sealable, puncture-resistant sharps container, labelled with the principal investigator's name and room number, and the contents. When the container is 2/3 full, it must be sealed, and a waste form completed. The form is sent to the Office of Environmental Health and Safety and Mr. Tony Selinger will periodically pick up the container(s) from the laboratory along with the rest of the chemical/radioactive waste.
4. In the case of mixed waste materials (e.g. biohazards with chemical and/or radioactive waste), the general procedure is to inactivate the biohazard(s) first, ensuring that there are no chemical incompatibilities with the decontaminating solutions and waste material, then to treat the remainder as a chemical hazard, and allow any radioactivity to decay in a proper storage facility. Consultation with the appropriate officer in the Office of Environmental Health and Safety is advised.
5. Liquid wastes must be decontaminated and/or detoxified before release into the sewage system. (For large bioreactor quantities, one must ensure that current legislated levels of allowable material release to sanitary sewer systems are not exceeded.)

Under no circumstances can a needle, syringe, or needle/syringe assembly be put into the regular or broken glass waste, even if they are NOT contaminated. Needles must NOT be deliberately removed, clipped, bent, or broken prior to disposal.

Appendix 6

New AFNS Staff Member/Student Biosafety Form

To: _____ (your name)	Date: _____
	File: _____
From: Don Koziol, Biosafety Technologist (Office of Environmental Health & Safety, Biosafety Division)	
Subject: New Staff Member/Student	

In order to comply with WHMIS legislation, the Biosafety Office maintains a registry of all staff and students who work with or are potentially exposed to biohazards in the course of their work or studies on or off campus.

I would like to take this opportunity to welcome you as a new University staff/student recently registered with our office by Dr. _____ and ask that you take a few minutes to answer the questions below.

Once you have completed this questionnaire, please date and sign it below, and return it to the Biosafety Office, 107 Education Car Park. If you have any questions, please do not hesitate to contact me at 2-0122 or the Biosafety Officer, Dr. Dan Dragon, at 2-3142. Thank you for your assistance.

Mr. Don Koziol
Biosafety Office

1. On what date did you commence work for Dr. _____? _____
(Date)
Tech__ Res. Assoc./PDF__ PhD student__ MSc student__ Other _____
(summer student, project student, etc.)
2. Have you received a WHMIS-mandated, lab-specific biosafety training session? _____
(Date)
3. Are you aware of the location of the Biohazard (D3) Material Safety Data Sheets for your lab? _____
Have you read them? _____
4. The Biosafety Office periodically conducts an in-depth biosafety course for staff and students of the University. If you wish to register for the next course, please go to our website www.ehs.ualberta.ca, and click on "Training", then "Concepts in Biosafety" for further information and registration details.

Complete the question below if applicable

5. Does any of your work involve the use of human body substances, or are you potentially exposed to these substances (this includes shared space/equipment)? _____
If yes: Are you immunologically protected against Hepatitis B? _____
Have you submitted immunization documentation to Environmental Health & Safety? _____
If you have been immunized, **when** and **where** was this done? _____
Have you signed a Hepatitis B immunization refusal form? _____
(Date)

If you are not protected against Hepatitis B, or have not signed the refusal form, as soon as possible please contact our Occupational Health Nurse, Joanne Seglie (2-5378) to make arrangements for this to be done.

Name: _____ (print)	_____ Date: _____ (signature)
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Termination of Laboratory Use of Hazardous Materials

*University of Alberta
Office of Environmental Health & Safety
Standard Operating Procedure (January 2000)*

Proper disposal of all hazardous materials used in laboratories is, in the first instance, the responsibility of the principal investigator or researcher to whom a laboratory is assigned. Ultimate responsibility for hazardous materials management lies with each department. Proper disposal of hazardous materials is required whenever an individual responsible leaves the University or transfers to a different laboratory. ("Individual Responsible" can include faculty, staff, post-doctoral fellows and graduate students.)

If improper management of hazardous materials at closeout requires additional services from the Office of Environmental Health & Safety or from an outside contractor, the department responsible will be charged for this service.

Any regulatory action or fines resulting from improper management or disposal of hazardous materials will accrue to the department responsible. The Office of Environmental Health & Safety will not be responsible for loss incurred by individuals or departments as a result of regulation-mandated removal of hazardous materials.

Closeout Procedures for Hazardous Materials in Laboratories

The following procedures should be completed when the individual responsible leaves the University or transfers to a different laboratory.

CHEMICALS

- Ensure that all containers of chemicals are labelled with the name of the chemical. All containers must be securely closed. All glassware and containers, including beakers, flasks, evaporating dishes, etc. should be emptied. Hazardous chemical wastes must not be sewered or trashed; the waste must be collected for disposal. Check refrigerators, freezers, fume hoods and bench tops as well as storage cabinets for chemical containers.
- Determine which chemicals are usable and transfer responsibility for these materials to another individual or department responsible who is willing to take charge of them. If a new user cannot be found, the materials should be sent for disposal.

- All other chemicals should be prepared for disposal. Telephone Ext. 20144 to obtain forms and/or advice. This process may take some time and should be started at least one month prior to laboratory closure. Chemical pickup should be completed before the laboratory is vacated. Waste collection may take a week after notification that waste is ready for pickup.
- Wash off fume hood surfaces and counter tops.
- Notify Department Head when laboratory has been cleared.

GASCYLINDERS

- Remove gas connections, replace cylinder caps, and return cylinders to suppliers.
- If cylinders are non-returnable, contact Facilities Management (Agnelo da Silva; phone 24071).

RADIOACTIVE MATERIAL

- Ensure that all radioactive stocks and second generation radioactive products have been either transferred to an authorized radioisotope permit holder or arrangements have been made for their disposal.
- Update radioactive inventory sheets to reflect the disposition of the radioactive material. These records must be retained by the University of Alberta for three years and should either be retained by the faculty member who plans to remain at the University or transferred to the Department should the faculty member leave the University of Alberta.
- A thorough contamination survey using the wipe test technique must be performed on all surfaces of the laboratory where radioactive material was stored or used. This includes floors, handles, bench tops, fume hoods, sinks, equipment, refrigerators and freezers, etc. Any radioactive contamination that is found must be removed by using standard decontamination techniques (refer to the Code of Practice for the Protection of Persons from Radioactive Material and Radiation Emitting Devices). The acceptable level of contamination is less than twice the background count rate on a wipe test.
- After all radioactive material and waste has been disposed and the laboratory has been surveyed, decontaminated if necessary, and declared free of any radioactive contamination, contact the Radiation Safety Office at ext 25655 and request that the laboratory be decertified. Radiation Safety staff will arrange to perform a decertification contamination survey, remove all radioactive stickers and perform a general walk through of the laboratory. Any contamination which is found by Radiation Safety

Appendix 7, continued

staff will be the responsibility of the lab occupants to decontaminate.

- Following the successful completion of the radioisotope lab decertification, the Radiation Protection Officer will issue a notice of laboratory decertification to the Radioisotope Permit Holder, along with a notice cancelling the permit, if appropriate. Copies of these notices will be sent to the department and to the Building Superintendent.

TISSUES & TRANSGENICS

- If tissue is held in a liquid preservative, the tissue is non-hazardous biologically but saturated with chemical preservative; disposal should be in consultation with Chemical Safety.
- If human tissue is in a recognizable form, contact Mr. Allan Sarafinchan, 22203, Division of Anatomy, for disposal. Other tissue specimens should be placed in a biohazard bag for incineration as pathological waste.
- Animals should be sacrificed and sent for incineration in double biohazard bags or disposed of by rendering. If an appropriate disposal method is uncertain, contact the University Biosafety Office at 20122 (Don Koziol) or 23142 (Dr. Dan Dragon).
- Defrost, decontaminate and clean refrigerators and freezers if they are empty.
- If tissues or animals are to be saved, locate an appropriate person willing to take over responsibility and obtain permission from the Biosafety Office to transfer the animals or tissues.

BIOHAZARDS & RECOMBINANTS

- Notice of Human Body Substance Permit termination and Biosafety Registry de-registration must be sent to the Biosafety Office.
- Sterilize and dispose of waste or incinerate, as per University regulations.
- A request for biosafety cabinet decontamination must be sent to the Biosafety Office.
- Decontaminate and clean equipment such as incubators, ovens, refrigerators, freezer dryers and freezers.
- If samples need to be saved, locate an appropriate person willing to take responsibility for such material and obtain permission from the Biosafety Office. If transportation is required, appropriate permits must be obtained from Environment Canada, Health Canada, Canadian Food Inspection Agency, etc. The consignee as well as the final destination details should be forwarded to the Biosafety Office for approval.

MIXED HAZARDS

- Occasionally it is necessary to dispose of materials that contain more than one hazard. Contact the appropriate Office of Environmental Health & Safety division for chemical, radioactive or biological agent for assistance.

EQUIPMENT

- If laboratory equipment is to be left for the next occupant, clean or decontaminate it before departing the laboratory. If exhaust or filtration equipment has been used with extremely hazardous substances or organisms, alert the appropriate Office of Environmental Health & Safety and Physical Plant personnel for clearance.
- If laboratory equipment is to be discarded, be aware that capacitors, transformers, mercury switches, mercury thermometers, radioactive sources and chemicals must be removed before disposal. Contact Office of Environmental Health & Safety for advice and clearance.
- Equipment potentially contaminated with radioisotopes should be surveyed by Office of Environmental Health & Safety.

SHARED FACILITIES

- One of the most problematic situations is the sharing of storage units such as refrigerators, freezers, cold rooms, stock rooms, waste collection areas, etc., particularly if no one has been assigned to manage the unit. Departing researchers must carefully survey any shared facility in order to locate and appropriately dispose of their hazardous materials.

REGULATORY IMPACT

- Mishandling of hazardous materials can result in fines and/or loss of right to use hazardous materials. Adverse publicity is also a frequent result.

*See the next page for a copy of the
Hazardous Materials
Close-out Procedures Check-list*

Appendix 8

**Hazardous Materials
Close-out Procedures Check-list**

See the foregoing Policy Statement for details.

This Check-list is to be completed & returned to:

Office of Environmental Health & Safety
107 Education Car Park
"Attention" Laboratory Close-Out

For more information contact
Carl Schumaker, Radiation Protection Officer
phone: 2-5655
e-mail: carl.schumaker@ualberta.ca

Hazardous Material/Procedure
Indicate Date Completed or N/A for each item:

I. Radiation and Chemical Safety Office

Chemicals

- Evaluate all chemicals and label all containers _____
- Transfer responsibility for chemicals to: _____
- Prepare chemical waste for shipment; notify Chemical Waste Division _____
- Clean Laboratory surfaces _____
- **Contact Chemical Safety (2-1550) when space is ready for closure inspection** _____

Gas Cylinders - Return to supplier _____

Radioactive Material

- Dispose of all radioactive stocks and waste through the Radiation Control Office _____
- Update radioactive inventories and store for three years or transfer to department _____
- Perform thorough contamination survey of lab benches, floors, equipment, etc. and decontaminate as necessary _____
- Contact Radiation Safety Office to have laboratory decertified. _____

Mixed Hazards - Identify mixed hazards

Equipment

- Clean or decontaminate equipment to be left in place _____
- Contact Office of Environmental Health & Safety regarding disposal _____

II. Biosafety Office

Tissues & Transgenics

- Dispose of tissue by autoclaving or incineration _____
- Dispose of preservative (consult chemical safety) _____
- Transfer responsibility of samples (within U of A only) to: _____

Biohazards & Recombinants

- Send notice of de-registration to Biosafety Office _____
- Send notice for termination of Human Body Substance Permit to Biosafety Office _____
- Send completed EH&S requisition to Biosafety Office for cabinet decontamination _____
- Obtain Biosafety authorization for biohazard disposal (Biosafety Form #J11) _____
- Apply for Canadian Food Inspection Agency Permit to transport/export biohazards _____
- Apply for Health Canada Permit to transport/export biohazards _____
- Transfer responsibility of samples to: _____

Institution name, Address, Bldg. & Room #

- Transfer responsibility of samples (within U of A) to: _____
- Obtain Biosafety clearance for Laboratory Decontamination (Biosafety Form #J12) _____

III. Shared Storage Areas

- Check all shared storage areas for hazardous materials _____

Department Sign-Off

Submit completed check-list to Department Head for signature

Department/Faculty Name:

Researcher Name. Date _____

- Signature & Printed Name _____
- _____

Department Head. Date _____

- Signature & Printed Name _____
- _____

Laboratories Closed Out (Bldg. & Rooms - List ALL):

Guidelines for the Disposal of Chemical/ Radioactive/ Biohazardous Waste

Office of Environmental Health & Safety
107 Education Car Park
University of Alberta

Please minimize volume of waste.

Bags should be closed and ready for pick-up by
8:30 a.m. on the scheduled day of removal.

Bags with holes, sharps sticking through, wet on
the outside, etc., WILL BE REFUSED.

Biohazardous Waste

See Appendix 5.

Solid Radioactive Waste

Clearly label with isotope and activity.

Use only clear plastic bags

—do not use orange biohazard bags.

Deface ALL radioactive labels inside the bag.

Large numbers of vials should be double bagged.

Perform contamination survey and
decontaminate outside of bag, if necessary

Liquid Radioactive Waste

Clearly label isotope and activity.

Lids must be tight fitting.

Do not overfill 5 gallon or glass containers.

Leave approximately 10% air space.

Combined waste

Use clear plastic biohazard bags with isotope
and activity clearly labeled. Also see Appendix 5.

*Be sure Activity is Recorded
on Waste Disposal Requests!!*

Chemical waste

Old and unused chemicals are to be
properly labeled and either bagged or boxed.

Perform contamination survey and
decontaminate outside of bag, if necessary.

Carcinogenic Waste

Orange biohazard bags are NOT to be used.

Be sure that waste is securely packaged.

Clearly label waste as carcinogenic.

Also see Appendix 5.

For more information contact:

Carl Schumaker (2-5655)

Radiation & Chemical Protection Officer
or

Tony Selinger (2-0144)

Radiation Safety Technician

More about Waste Disposal and Precautions

Waste chemicals and contaminated materials
(including gloves) must **not** be thrown into the
garbage or down the drain, or be allowed to
accumulate in labs.

Wastes that can't be disposed of safely by other
means must be collected in *appropriate containers*
(e.g. labelled bottles). Put waste containers in an
appropriate storage area, not on the floor.

When possible, *collect each type/class of waste in a
separate container. Leave ~10% freespace in bottles
(do NOT fill to top).* Never combine materials which
may react explosively or generate heat, excessive
pressure or toxic fumes. *Disclose the contents fully.*
Clearly indicate if there are halogenated solvents
(e.g. chloroform), other solvents, acids, bases,
oxidizers, water, etc. Give the approximate amount/
proportion of each component. *If you know of
special hazards, print them on the container.*

Department or trust techs may be arranging for
waste chemical collection in your area—if not,
contact Laura Smith (AFNS Stores) for assistance.

Expired chemicals, waste mercury, reagent bottles
which cannot be cleaned safely, etc. will also be
collected for disposal. Check for safe handling
procedures. Contact Laura Smith (Stores) if there
is any doubt or you require assistance.

**Remove/deface labels on reagent bottles when
they become empty.** Used bottles should be *cleaned
out* (if contents can be safely removed and disposed
of), rinsed, and placed in a *glass only* waste pail.

All radioactive waste must be properly pack-
aged for disposal through Environmental Health
and Safety. *Safe disposal is the responsibility of
permit holders and their users.* Users must specify
radioisotopes and total microcuries in packages
sent for disposal. [See Appendix 5 regarding safe
disposal of **biohazardous waste**.]

Animal wastes: Off the main campus, check the
Unit's policies. In the Ag/For Ctr, whole animals/parts
must be bagged, labelled (labels in AF 3-60E cold
room), then placed in a disposal bin in the first
freezer (*e-mail lynn.elmes@ales.ualberta.ca to
tell her what you have placed there*). Animal
blood must be rendered non-identifiable and fluids
must be decontaminated (autoclave or bleach),
then discarded down the drain.

**When you have completed your work in AFNS,
before you leave you must clean up your
chemicals and other materials** (*including in
cold storage*). If some *properly-labelled* items
remain, transfer them to your supervisor or some-
one in your group (see App. 7 and 8 for related info).

Appendix 10

WORKING ALONE PROTOCOL for FACILITIES IN THE AGRICULTURE/FORESTRY CENTRE

With the exception of the Human Nutrition Research Unit and the Greenhouse areas (*each of which has its own Working Alone Protocol*), and a few scheduled evening courses, AFNS staff and students are not required to work alone outside of normal hours. The Agriculture/Forestry Centre has been made secure in accordance with University standards, and most offices and laboratory areas have a phone (and there are payphones that have a direct line to 911 and Campus Security in case of emergency). The nature of teaching and research is such that at times staff (graduate students, lab technicians, lab assistants, post-doctoral fellows, research associates, principal investigators, administrative staff) will need to be on the premises outside of regular working hours, for example, to follow up on experiments. Anyone who chooses to work outside regular hours must know what to do in an emergency situation, and their employer must ensure there is an effective communication system, including regular contact appropriate to the situation. Employers should conduct a hazard assessment as per the Appendix to this Working Alone Protocol.

Department/Faculty	Room and Building Location	Supervisor/Principal Investigator	Phone #
Agricultural, Food and Nutritional Science (AFNS), in the Faculty of Agricultural, Life and Environmental Sciences	AFNS laboratories and offices in the Agriculture/Forestry Centre, and offices in the General Services Building	Lynn Elmes, Laboratory Manager	4925785
		John Bell, Asst Chair, Admin	4981907
		Erasmus Okine, Chair	4927666
		or:	4922131

In a **FIRE/LIFE/POLICE EMERGENCY** situation,
call **911**
and identify yourself, what the emergency is, and the location

EMERGENCY PROCEDURES

MEDICAL

- If a medical/life emergency, dial **911** (and thereafter, if circumstances permit, phone the U of A Control Centre at 4925555 and give details).
- The Lab Manager, Lynn Elmes, or the Asst Chair Admin, John Bell, should be informed of any serious injury or illness (a report will have to be filed).
- “Large” (No. 3) first aid kits are located in 4-35 (NE area) and directly inside 2-58, while “medium” (No. 2) kits are on the table outside Stores (3-51) and in the central area of 1-20. Those 4 kits have forms to be filled out in the event of an incident where first aid treatment was required for an injury which has the potential to be a “lost time injury” (in general, simple scratches and minor cuts need not be reported). Many labs have basic kits.
- A list of first aiders is available via the AFNS safety web page (www.safety.afns.ualberta.ca), is included in or near the large and medium first aid kits mentioned above, and is posted in the mail room (4-10A).
- Campus Security personnel (4925050) are trained in first aid.

FIRE

- If a fire emergency, exit the area, closing the door, and **pull a fire alarm**. If possible from a safe location, dial 911 and give details (the U of A Control Centre, 4925555, could also be informed).
- Only attempt to put out a fire with a fire extinguisher if it is safe to do so (e.g. a small fire in a waste basket).
- Check page 3 of the AFNS General and Laboratory Safety Handbook for additional information.

CHEMICAL SPILL

- Only attempt to clean up the spill if it is safe to do so.
- If an emergency situation, warn others, evacuate the area, and phone 4925555 and give details.
- If a hazardous chemical is spilled on one's body and/or clothes (all contaminated clothing should be removed), for many chemicals flushing with water for about 15 minutes is commonly recommended, e.g. after contact with corrosives. More specific information will be in the MSDS.
- Check the MSDS for any clean-up procedures specific to the spilled material (MSDSs should be read *before* commencing work with a new chemical).
- Check p. 34 of the AFNS General and Laboratory Safety Handbook for additional information.
- If metallic mercury is spilled, e.g. from a broken thermometer, do not allow anyone to disturb the area. Contact Lynn Elmes for clean-up assistance.
- See Emergency Phone Numbers below for AFNS staff members "on call".

BIOHAZARD SPILL

- Only attempt to clean up the spill if it is safe to do so.
- If an emergency situation, warn others, evacuate the area, then phone 4925555 and give details.
- All users of biohazardous materials will have taken the University of Alberta Biosafety course and/or have been trained by supervisory or technical staff in the laboratory, thus they should be familiar with proper biohazardous spill containment and clean up, and proper steps to take if one's body and/or clothes have come in contact with a biohazardous material.
- Check the MSDS for any procedures specific to the spilled material (MSDSs should be read *before* commencing work with a new biohazardous material).
- Check p. 34 of the AFNS General and Laboratory Safety Handbook for additional information.
- See Emergency Phone Numbers below for AFNS staff member "on call".

RADIOACTIVE SPILL

- Only attempt to clean up the spill if it is safe to do so.
- If an emergency situation, warn others, evacuate the area, and phone 4925555 and give details.
- All users of radioisotopes must have taken the University of Alberta Radiation Safety course (or acceptable equivalent) and must have passed the U of A radiation safety exam, thus users should already be acquainted with proper handling of radioactive materials, clean up of spills (followed by confirmatory "swipes"), and proper steps to take if one's body and/or clothes have come in contact with a radioactive material.

EMERGENCY AND OTHER PHONE NUMBERS

Number	Contact	For
911 →	Edmonton Emergency Services (24 hr)	Fire/Life/Police Emergency.
4925555 →	University Control Centre (24 hr)	Hazardous spill; follow-up on above emergency.
4925050 →	Campus Security (24 hr)	Suspicious persons, non-emergency situations.
4925252 →	Campus Security (24 hr)	General inquiries.
4925563 →	Campus Safewalk (time varies within year)	Coed escorts on- and off-campus.
4924833 →	Facilities Management Maintenance (24 hr)	Maintenance emergencies.
4172986 →	Lynn Elmes (4-04; 4925785)	Spill of biohazard, or of hazardous chemical, and general safety matters.
4921810 →	Office of Environmental Health and Safety. 7:30 a.m. to 4:00 p.m.	Information/assistance/advice.

LOCATIONS OF RESOURCES IN THE AGRICULTURE/FORESTRY CENTRE

Fire Alarm Pull Stations

First Floor: hallway west of east washrooms; opposite main elevator; outside west washrooms; inside southwest entrance; outside 1-12; across from 1-63; loading dock; by freight elevator.

Second Floor: hallway south of 2-58; west of east washrooms; east of central doors in main hallway; outside 2-14 to the west; outside west washrooms; by freight elevator.

Third Floor: by southwest stairway; east of central doors in main hallway; inside east hallway doors; inside west hallway doors; across from main elevator; by freight elevator.

Fourth Floor: outside west washrooms; across from main elevator; by west staircase doors; east of central doors in main hallway; hallway across from 4-73; west end of north hallway; across from 4-31; by freight elevator.

Fifth Floor: just inside south doorway of 5-17; across from main elevator; by west staircase doors; by freight elevator.

Fire Extinguishers

Most laboratories and in hallway “fire cabinets”.

Eye wash Stations / “Drench Hoses” (low pressure, high volume, hand-held)

Many laboratories (mostly “drench hoses”) and east hallway of 2nd & 3rd floors.

Emergency Showers (“Overhead”)

1-20E & 1-20F, and east hallways of 2nd & 3rd floors.

Material Safety Data Sheets (MSDSs)

Some printed chemical MSDSs can be found in 1-30 (the “computer room”), and some printed biohazard MSDSs in biohazard areas. The principal means to access current MSDSs is through an on-line computer search. The AFNS Safety Program web site (www.safety.afns.ualberta.ca) has links and instructions for MSDS searching, including a link to biohazard MSDSs on the Health Canada website.

First Aid Kits and List of First Aiders

“Large” kits are in 4-35 (NE corner) and 2-58 (just inside the door). “Medium” kits are outside 3-51 (on a table), and in the central area of 1-20. Basic supplies are in many laboratories. A list of first aiders is available on the AFNS safety website, and in or near the four main first aid kits.

Small Chemical Spill Clean-Up Kits. Bottles of Spill Clean-Up Mixture.

“Kits” are in 1-20, 2-58, 3-51 and 4-35. Bottles of clean-up mix are in most laboratories. A metallic mercury clean-up “kit” is in 2-58. See p. 34 of the AFNS General and Laboratory Safety Handbook for information on clean up of spills.

Telephones.

Most offices and laboratories have telephones. On-campus numbers generally begin with “2” followed by four digits. Off-campus local numbers are reached by dialing “9” then the 10-digit number.

Telephone back up.

Pay phones are at the east and west ends of the second floor main hallway. There are emergency no-fee buttons for **Campus Security** and **911** (if possible, also report life/fire emergencies on campus to **4925555**).

HAZARD ASSESSMENT

HAZARDS

ACTIONS TO MINIMIZE

Laboratories: Hazardous chemicals, biohazardous materials, radioactive materials, flammable and combustible materials, preparation of reagents and mixtures, sharps, Bunsen burners, compressed gases, electrical equipment, pressurized equipment, computers and computerized instruments, hot plates, glassware, liquid nitrogen, dry ice, vacuum systems and chambers, UV lamps, noxious odours, animal waste (e.g. fecal samples), grinding and blending equipment, mercury thermometers, ovens, muffle furnaces, hot materials, cryogenic materials, water, steam and chilled baths, stirrers and rotators, etc.

- All lab workers must be trained in site- and task-specific standard and safe laboratory operating procedures and protocols to ensure that they are capable of properly handling the various hazards and equipment within a lab. Only persons so trained are permitted to work in a lab.
- All lab workers must be familiar with the AFNS General and Laboratory Safety Handbook.
- Proper personal protective equipment (e.g. goggles, face shields, lab coat, gloves, masks, ear protection) is available and must be used by workers wherever and whenever appropriate.
- All workers must know the location of first aid kits, spill kit and supplies, fire alarms, fire extinguishers, emergency showers/eye wash stations, and telephones.
- Procedures which require such protective devices as “blast shields” or “glove boxes”, or the use of the perchloric acid hood in 3-60, or are Biohazard Level III or above **must not be carried out when alone** (there must be at least one other person nearby).

Use of ladders, electrical equipment/power tools.

- In general such activities should not be carried out alone. In any case, workers must exercise due caution and must be properly trained on the equipment used.

Security of laboratories and offices.

- Office areas, hallway entry doors, and lab doors must be closed and locked outside of regular hours.
- If a person is acting suspiciously, Campus Security should be called at 4925050.
- Anyone attempting to access work areas without prior approval of the supervisor should not be allowed entry (however, do not risk a physical confrontation).

Accessing transportation home after dark or underground parkade outside regular hours.

- Campus Safewalk escort (4925563; hours vary depending on the time of year).
- Campus Security officer escort (4925252).

Use of vehicles.

- Occasionally vehicles will be operated when alone, for example, when traveling to a store to secure supplies for a teaching laboratory, or to an off the main campus location to obtain materials or carry out some work. Drivers should proceed with due care and attention at all times.
- Hazardous goods should only be transported in accordance with TDG regulations.

Appendix Working Alone

Checklist for Employees Who Perform Hazardous Work

This checklist is intended to help employers implement best practices for employees working alone at hazardous jobs without routine interaction with the public. The questions in bold reflect mandatory requirements. Other questions suggest recommended practices that are highly desirable.

Yes	No	N/A	EMPLOYEE TRAINING
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do you ensure employees are trained and competent to work alone safely?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are employees aware of the increased risk from carrying out the hazardous work alone?
Yes	No	N/A	SAFE WORK PROCEDURE
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do you have a safe work procedure for the hazardous work?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Did the employer develop the safe work procedure with the involvement of the affected employees?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is there a procedure requiring employees to sign out before a job, and to provide information on a travelling plan and an estimated time of return?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is there a procedure for the employee to check-in prior to and at the end of the planned activities at the site?
Yes	No	N/A	EQUIPMENT SAFETY
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do you ensure equipment is in good working condition prior to being used on a work site?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Does all equipment and machinery used by employees meet regulatory standards?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Are equipment and machinery being used in accordance with the manufacturer's specifications?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is a dead-man switch used in high hazard machinery to prevent continued activation?
Yes	No	N/A	EQUIPMENT AND SUPPLIES
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do you equip employees with the appropriate first aid supplies?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do employees carry the required first aid supplies?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do employees carry the necessary personal protective equipment?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do employees carry emergency supplies if they are to work in remote areas with inclement weather?
Yes	No	N/A	COMMUNICATION
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Do you have an effective means of communication for employees to contact persons capable of responding when employees need immediate assistance?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<i>Does the method of communication involve one or more of the following:</i>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Regular telephone, cell phone, or radio contact?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Schedule check-in points with other employees?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Alarm system that could alert other employees?
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Others? Specify: _____
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Is there an "overdue employee" procedure to initiate searches for employees who fail to report?

WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM (WHMIS)



Department of Agricultural, Food and Nutritional Science
University of Alberta

→ [Most people must complete our [Safety/WHMIS Quiz](http://www.safety.afns.ualberta.ca/Index.asp?page=safety_quiz) at: www.safety.afns.ualberta.ca/Index.asp?page=safety_quiz]

Why WHMIS?

The Workplace Hazardous Materials Information System (WHMIS) is the ‘law of the land’—compliance is not optional.

In Alberta WHMIS is part of the Chemical Hazards Regulation under the Occupational Health and Safety Act. If found in violation, the employer, the supervisor, and/or the worker might be held liable.

The **institution** must put in place a program in compliance with WHMIS—this involves at the highest level the University, through its Office of Environmental Health and Safety, but the practical

adoption of programs to ensure compliance with WHMIS requirements falls upon each Department.

The **employer/supervisor** has an obligation to provide for the safety of workers, making available to them proper information and education.

Workers (*all those working where hazardous materials are present, not just ‘employees’*) **have an obligation** to make use of available information (e.g. know what WHMIS Hazard Symbols mean; know what information is in a Material Safety Data Sheet *and* make use of it), and to comply with safe practices and safety legislation.

A Worker's ‘Right to Know’

WHMIS promotes safety through a worker's ‘right to know’. It has three components: labels; Material Safety Data Sheets (i.e. MSDSs); worker education. It is designed to ensure that employers obtain information to train employees properly about workplace hazardous materials.

For each controlled product (as defined by the federal Hazardous Products Act; see criteria on the ‘WHMIS Hazard Symbols, Classes...’ sheet) suppliers must provide purchasers with hazard information by meeting WHMIS labelling requirements, and by providing detailed information on an MSDS.

Controlled products must be labelled according to WHMIS standards. This may mean replacing lost or damaged supplier labels, making worksite labels for bottles into which controlled products are placed, or updating labels on products manufactured prior to WHMIS implementation.

Our workers, be they staff, students or other researchers, must have ready access to hazard information. This is achieved primarily through ensuring access to MSDSs (see next page).

The Ag/For Centre (AFC) WHMIS Designate is [Lynn Elmes](#) (AFC Lab Manager; 4-04, 2-5785). If ‘off the main campus’, contact your Unit Manager.

*If your work area has ‘hazardous materials covered by the legislation’, you must: read this WHMIS section; complete our Safety/WHMIS Quiz (see ‘→’ above); and attend a ‘safety seminar’ (offered twice a year in the AFC). *Supervisors* of those working in areas where hazardous materials are found *must also be familiar with WHMIS and departmental safety programs, and must ensure provision of additional safety-related education specific to their lab areas and projects and keep written records of training provided.**

‘WORKERS’ ARE EXPECTED TO...

- **read instructional material** provided (and attend training sessions, as required)
- **know where to find and how to use WHMIS information**, such as MSDSs
- **follow safe procedures** when handling, using, storing or manufacturing controlled products
- **use control measures** (e.g. ventilation, fume hoods) provided at the worksite
- **use the right, properly maintained, personal protective equipment** (‘PPE’), e.g. to limit exposure to a controlled substance (eye protection, dust masks, gloves, aprons, etc.)

‘Controlled’ Products and Other Products

There is no detailed list of products which are controlled under WHMIS legislation. The determination is ‘performance based’, i.e. it depends on the behaviour of a material, not simply on its name. For example, sulfuric acid is a controlled product, not because it is ‘on a list’, but because it is corrosive, and corrosives are controlled products.

Some products covered by other legislation may be exempt from WHMIS legislation (*of course, this does not mean they are hazard-free!*). Such exemptions may be included under:

- Explosives Act
- Food and Drug Act
- Pest Control Products Act
- Atomic Energy Control Act
- Restricted Product (HPA)
- Wood & products made of wood
- Manufactured articles
- Tobacco products
- Products under Transportation of Dangerous Goods (*see the TDG section*)
- Hazardous Waste

Information on a Material Safety Data Sheet

An MSDS (*see sample MSDS*) has valuable information you should check before using a controlled product or a mixture which contains controlled products:

- product identification and use (synonyms, supplier’s name/emergency phone number)
- hazardous ingredients
- physical data
- fire and explosion data
- reactivity data
- toxicological properties/health hazard data
- first aid measures
- preventive measures (including handling, storage, waste disposal, spill/leak cleanup)
- preparation information (e.g. revision date)

How Current is an MSDS?

Canadian legislation still requires that an MSDS be created or revised within the past three years. If information about a new hazard becomes available, a supplier must provide an updated MSDS the next time a controlled product is ordered.

Where can You find an MSDS?

The main AFNS collection of printed MSDSs is in AF 1-30 (‘computer room’), along with other WHMIS and safety information. *Facilities not in the Ag/For Centre may have their own file of printed MSDSs—check on-site for location.*

While a fair number of printed MSDSs are in AF 1-30, **the principal means of access to current MSDSs is via an on-line computer search**. For quick access to many company sites, enter: **www.safety.afns.ualberta.ca** in your web browser, then click on the ‘MSDS Sources’ link under ‘More Safety Links’. Printed instructions for viewing and printing MSDSs are in AF 1-30 (the document is also available as a PDF file on the MSDS web site, but it doesn’t include our Sigma i.d. and password).

Areas keeping MSDSs on file should check that each MSDS is dated/revised within the past 3 years.

Note that MSDSs for biohazardous infectious materials (WHMIS category D3) are usually kept in or near biohazard areas, not in the main file.

Lists of our Inventoried Chemicals

In a binder in AF 1-30 there's also a list of chemicals inventoried in AFNS (other copies in AF: 1-20K; 2-58, shelf outside 3-51, 4-32). The areas or research groups that had a chemical—at the time of their last inventory—are shown. Please ask the person(s) responsible for ‘exact location’, and borrow *only with permission*.

Also shown for each chemical are ‘MSDS date’ and catalog # of a supplier. If the most current version of an MSDS is available online, the ‘date’ will be ‘**www**’ (world wide web; note: there may also be a ‘valid printed MSDS’ in AF 1-30).

The first page in each binder has detailed information about the inventory list.

What About ‘New’ Chemicals and Reactions?

When using a new reagent (or performing a new reaction), **check the MSDS** for toxicity, flammability, incompatibilities, storage, disposal, etc. Safety information may also be on the container label, or in the Merck Index, the Hazardous Chemical Information and Disposal Guide, a source in Appendix 2 of this Handbook, etc.

Labelling of Chemicals, Solutions and Mixtures

Upon receipt of a new reagent, on the label print the month and year received and your supervisor's initials or name (e.g. 'June 2007 AZ').

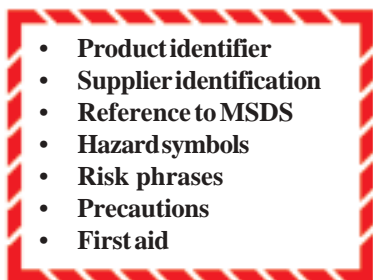
Chemicals purchased since October 31, 1988 should meet WHMIS labelling requirements. Most chemicals from before that time in AFNS are 'laboratory reagents' (see the next column) and will often meet WHMIS laboratory reagent labelling requirements, except for the need for a reference to the MSDS.

Containers of prepared solutions and mixtures (*and waste*) must be properly labelled as to contents and owner.

There are two categories of labels under WHMIS legislation: Supplier Labels; Worksite Labels

Supplier Labels — Required Information

Supplier labels have a distinctive 'hatched' border, in which there must be no extraneous information. The following must be included on the standard supplier label:



For small quantities of a controlled product (<100 mL), the label need only include:

- Product identifier
- Hazard symbols
- Supplier identifier
- Reference to MSDS

'Laboratory reagents' are chemicals which originate from a lab supply house, are packaged in quantities of under 10 kg, and are intended for laboratory use only. Labels for laboratory reagents need not have a hatched border (though they still may have one), but must include:

- Product identifier
- Risk phrases
- Precautionary measures
- First aid
- Reference to MSDS, if available

Worksite Labels — Required Information

There are situations where there will not be a supplier label, so a worksite label must be prepared by the end user. Such a label will be required:

- When the supplier label has been lost or destroyed
- On individual containers which are part of a bulk shipment
- For decanted ('poured out') product
- For controlled products produced and used at the worksite
- On controlled products from before October 31, 1988

The information printed on a worksite label need not be as extensive as that listed on a supplier label. There are 3 requirements on a worksite label:

- Product identifier
- Information for safe handling (e.g. 'keep away from heat, sparks and flame', 'avoid breathing vapour')
- Reference to the MSDS

There are even more relaxed requirements for worksite 'laboratory labels'. Covered under these provisions are:

- Decanted products (e.g. 6 M HCl)
- Lab intermediates synthesized in and intended for use in a laboratory
- Reaction vessels

These 'laboratory labels' require only:

- Clear product identification (could just be printed on the bottle using a felt marker; please also include the owner's name)

Labels on lab samples, if controlled products, sent out for analysis or use elsewhere must meet the requirements below. [Note: Transportation of Dangerous Goods (TDG) requirements may also have to be met. You can check with Laura Smith (AFNS Stores), who has TDG certification.]

- Product identifier
- Chemical identity or generic identity of ingredients, if sample is sent outside of Alberta
- Supplier identifier
- The statement 'Hazardous Laboratory Sample. For Hazard Information or in an Emergency Call 492-___' (appropriate U of A #).

If Hazardous Material is Spilled or Released

CHEMICAL SPILLS

To report a spill and for spill clean up assistance:

- *In the Ag/For Ctr* contact a ‘small chemical spill clean-up designate’: Lynn Elmes (4-04; 2-5785; res: 780-417-2986), Laura Smith (3-51; 2-7663), Kelvin Lien (1-20K; 2-6966).
- *At a Research Station* contact: the Unit Manager, or personnel designated by the U.M.

If there is a spill which you think is *very dangerous*, i.e. one which requires *evacuation of an area*:

- Warn others. Close door(s) into the area as you leave. Do not let anyone enter the area.
- Inform personnel as outlined above.
- If none of the above responders is readily available, call the Control Centre (2-5555) and give details.

Otherwise, if spill cleanup personnel are not yet present, and *there is no significant danger to yourself or others*, start to contain and clean up the spill [How? See: below; spill mix bottle label; MSDS; EH&S Chemical Spill Response Guideline].

For acids/acid derivatives, solvents, peroxides, and many other spills a ‘spill mix’ such as 1:1:1 (by wt.) *soda ash* (= Na₂CO₃) + *clay* (e.g. kitty litter) + *sand* is generally effective (kitty litter alone can be used if mix is unavailable; soda ash alone can be used for acid spills). **Cleanup kits/supplies are in AF 1-20, 2-58, outside 3-49 and in 4-35**, and spill mix and/or kitty litter in most Ag/For Ctr labs. If spill clean-up material is used, inform a spill designate.

If using spill *mix*, shake the bottle well. Start from the spill’s outside edge, and apply the material liberally and uniformly (if using spill containment ‘pillows’, position them around the spill). Wait for the spill to be adsorbed. Carefully collect the contaminated adsorbent into a suitable container (e.g. garbage pail, or bag), then put it in a safe place (e.g. fume hood), and label it specifically. Inform a spill designate or supervisory personnel.

Metallic mercury spills (e.g. broken thermometer): A *general cleanup kit* is not suitable. A mercury cleanup ‘kit’ is on the ‘safety shelf’ in AF 2-58 (contact Lynn Elmes). *Do not allow anyone to disturb the area of the spill.*

RADIOISOTOPE SPILLS [and RADIOISOTOPE USE]

Spill clean-up and *subsequent verification* are *responsibilities of permit holders and users* - in the Ag/For Ctr, Urmila Basu (4-32A; 2-8712) can provide assistance. [Use radioisotopes *only* in approved areas. Users *must* first pass a U of A radiation safety exam, usually after taking the U of A radiation safety course.]

BIOHAZARDOUS/MICROBIOLOGICAL SPILLS

In case of a biohazardous/microbiological spill (e.g. dropped tube of human blood; broken flask of a pathogenic culture) *leave the area for 30 minutes* to allow the aerosols to settle. *Do not allow anyone to enter the area during that time.*

Cover the spill with paper towels and pour decontaminant (1% sodium hypochlorite; note: ‘household bleach’ is a 4-5% solution) around the perimeter (the liquid should then soak toward the center). Let stand for 20 minutes for adequate contact time. Transfer the material to an autoclave pan and complete decontamination in an autoclave.

Contact, if practical, Lynn Elmes (see below), a tech in the area, or your supervisor to oversee appropriate disinfection procedures. Report *any and all* biohazard spills/exposures to the EH&S Biosafety Office (Don Koziol; 2-0122).

Biosafety and WHMIS

Biosafety applies to substances of biological origin. WHMIS requires an MSDS for all class D3 biohazardous infectious materials. *D3 MSDSs are usually kept in or near each biohazard area.*

The D3 classification covers organisms (or their toxins) which cause or are reasonably believed to cause disease in humans and/or animals. The D3 designation is equivalent to organisms in containment Level II or higher (per U of A guidelines).

This appendix does not provide extensive coverage of the D3 aspect of WHMIS—your supervisor must ensure you receive proper training.

Biosafety designates in the Ag/For Ctr are: Lynn Elmes (4-04; 2-5785; res: 780-417-2986); and, for ‘human body substances’, Dana Wilkinson (3-11B; 2-6668). For *Research Station* biosafety concerns, contact the Unit Manager.

On the following pages you will find:

- A sample Material Safety Data Sheet [note: ‘LC50’ and ‘LD50’ are Lethal Concentration (amount inhaled over a time period) and Lethal Dose (amount ingested) required to kill 50% of the test subjects (typically rats)].
- Transportation of Dangerous Goods (TDG)’ TDG is *not* ‘part of WHMIS’ (it operates under separate legislation). Basic TDG information is presented to give workers some familiarity with TDG classes and package labels.
- WHMIS Hazard Symbols, Classes and related Safety Information—*you must be familiar with the meaning of each symbol/class.*

EM Science

MATERIAL SAFETY DATA SHEET

Section I. Product Identification and Use

Manufacturer: EM Science P.O. Box 70, 480 Democrat Road, Gibbstown, NJ 08027

Emergency: 416-201-6383 (24hr; CANUTEC) **Information:** 856-423-6300 (0800-1700M-F; Tech. Service)

Product Name: Sodium hydroxide

Product Code(s): ACS816,B10252,B30167,B45212,K92768,SX0593,XX0443,006482,...

Chemical/Other Name: Sodium hydroxide; caustic soda; lye; sodium hydrate; natrium hydroxide; soda lye

Chemical Formula: NaOH

Chemical Family: Alkali hydroxide

TDG Shipping Name/UN: Sodium hydroxide, solid UN 1823 **TDG Classification/Packing group:** 8 PG II

Use: Laboratory reagent, industrial processes

Section II Hazardous Ingredients

<u>Chemical name</u>	<u>CAS No.</u>	<u>%</u>
Sodium hydroxide	1310-73-2	100

Section III Physical Data

Physical State: Solid

Appearance and Odour: White hygroscopic, pellets; odourless **Odour Threshold:** Not applicable

Specific Gravity: 2.13 **Vapour Pressure:** 1.0 mmHg at 739°C

Vapour Density: Not applicable **Evaporation Rate:** Not applicable

Boiling Point: 1390°C

Freezing Point: 318°C

pH: 12 (0.05% w/w solution), 13 (0.5% w/w solution), 14 (5.0% solution)

Coefficient of water/oil distribution: Not available

Section IV Fire or Explosion Hazard

Conditions of Flammability: Noncombustible

Extinguishing Media: Use an extinguisher appropriate to the surrounding material that is burning. Sodium hydroxide and its solutions will not burn or support combustion. However, reaction of sodium hydroxide with a number of commonly encountered materials can generate sufficient heat to ignite nearby combustible materials. Water can be used to extinguish a fire in an area where sodium hydroxide is stored as long as the water does not come into contact with the sodium hydroxide.

Flash point / method: None

UEL: Not applicable **LEL:** Not applicable

Autoignition Temperature: Not applicable

Hazardous Combustion Products: Na₂O

Explosion data: - sensitivity to mechanical impact: No - sensitivity to static discharge: No

Section V Reactivity Data

Conditions of instability: Normally stable, rapidly absorbs carbon dioxide from the air

Incompatibilities: Strong acids, metals, organohalogen compounds, nitro, chloro-organic compounds, peroxides, flammable liquids, chloroform/methanol mixtures

Conditions of reactivity: Normally stable

Hazardous decomposition products: Na₂O

Section VI Toxicological Properties / Health Hazard Data

Route of entry:

-**skin contact:** Causes severe burns

-**skin absorption:** No information available

-**eye contact:** Causes severe burns

-**inhalation:** Causes burns

-**ingestion:** Harmful

LC₅₀: Not available

LD₅₀: 500 mg/kg (orl-rat)

Exposure Limits: TLV-TWA: 2 mg/m³

Affects of Acute Exposure: Inhalation of sodium hydroxide will cause burns to the nose, throat and lungs. The onset of these affects may be delayed. Contact with eyes will cause irritation or severe burns depending on the concentration and duration of exposure. In severe cases, ulceration and permanent blindness may occur. Skin contact will cause severe burns, with deep ulceration, and penetration to the deeper layers will occur. Corrosion will continue until sodium hydroxide is removed. Ingestion may cause severe pain, burning of the mouth, throat and esophagus, vomiting, diarrhea, collapse and possible death.

Affects of Chronic Exposure: Prolonged or repeated overexposure to this product causes tissue destruction.

Irritancy: Standard Draize test: skin, rabbit 500 mg/24H - severe; eye, rabbit 50 ug/24H - severe

Sensitization to Product: No information available **Carcinogenicity:** No information available

Reproductive Toxicity: No information available **Teratogenicity:** No information available

Mutagenicity: No information available **Toxicologically Synergistic Products:** None found

Section VII First aid measures

Skin: Flush the contacted area with lukewarm running water for at least 15 minutes. Remove contaminated clothing, taking care not to spread the chemical. If contamination is extensive, remove clothing under running water. Discard or decontaminate clothing before re-use. Unless contact has been slight, seek medical attention. Seek medical attention if irritation persists.

Eye: Flush the contaminated eye(s) for at least 15 minutes with lukewarm running water, holding the eyelids open. Take care not to rinse contaminated water into the non-affected eye. Always seek medical attention for accidents involving the eyes.

Inhalation: Take proper precautions to ensure your own safety before attempting rescue. Remove source of contamination or move victim to fresh air. If breathing has stopped, trained personnel should begin artificial respiration, or if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately. Seek medical attention.

Ingestion: Never give anything by mouth if victim is rapidly losing consciousness, or is unconscious or convulsing. Rinse mouth thoroughly with water. Do not induce vomiting. Have victim drink 200-400 mL of water to dilute. If breathing has stopped, trained personnel should begin artificial respiration, or if the heart has stopped, cardiopulmonary resuscitation (CPR) immediately. Seek medical attention.

Section VIII Preventive Measures

Engineering Controls: Engineering control methods to reduce hazardous exposures are preferred. Methods include mechanical ventilation (dilution and local exhaust), process or personnel enclosure, control of process conditions, and process modification. Administrative controls and personal protective equipment may also be required. Use a corrosion resistant ventilation system separate from other exhaust ventilation systems. Exhaust directly to the outside.

Personal Protective Equipment:

- gloves:** Rubber, neoprene, nitrile, PVC or equivalent
- respiratory protection:** Approved respirator, fume hood as appropriate
- eye protection:** Chemical safety goggles or face shield
- clothing:** Plastic apron, sleeves and boots as appropriate

Storage Requirements: Store in suitable labelled containers. Keep containers tightly closed when not in use and when empty. Protect from damage. Store away from incompatible materials.

Handling Procedures and Equipment: Avoid generating dust. Follow routine safe handling procedures.

Leak or Spill Clean-up: Before dealing with spillages take necessary protective measures, inform others to keep at a safe distance and, for flammable materials, shut off all possible sources of ignition. Transfer carefully into container and arrange removal by disposal company. Wash site of spillage thoroughly with water and detergent.

Disposal: Follow all federal, provincial and local regulations for disposal. Use only licensed disposal and waste hauling companies. Disposal of small amounts of spilled material may be handled as described under "Leak or Spill Cleanup". Large spills must be dealt with separately and must be handled by qualified disposal companies.

Special Shipping Information: Follow all TDG regulations and see classification in Section I.

Section IX Preparation Information

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Transportation of Dangerous Goods (TDG)

TDG and WHMIS are covered under *separate* legislation. **TDG package labels ('diamonds') should not be confused with the circular WHMIS symbols (which are on the next page).** This page provides basic knowledge of TDG classes and symbols.

TDG regulations cover shipment of dangerous goods on land, e.g. roadway (including between university buildings), and via airplane. Persons with TDG training should receive and open, or supervise opening of, items covered under the TDG Act, and should be consulted to ensure 'dangerous goods' are shipped properly (in the Ag-For building contact Laura Smith, who has a TDG certificate). When a TDG-labelled package is received, it should be verified that it conforms to TDG specifications. TDG regulations don't apply when moving a package within a building, once it has been properly received. **Note: dangerous goods should not be transported 'on the road' by personal vehicle or by bicycle.**

TDG labels are diamond shaped, are usually numbered to indicate the class, typically include descriptive symbols, and often have a distinctive color. The class number on the label denotes the only (or the primary) hazard for a substance, as defined by TDG regulations. When a substance has two or more different hazards, the class number is omitted on the TDG label corresponding to a 'secondary hazard'. On the package there will also be more specific identification of the hazardous substance(s), e.g. 'UN 1823 Sodium Hydroxide 1 kg'. A package may have a number of TDG labels, e.g. if it contains different substances in at least two different classes.

Under TDG there are 9 classes of dangerous goods:

Class 1—Explosives



Orange labels, but with different symbols and division ('sub-class') numbers to indicate the type of explosion hazard. 'EXPLOSIVE' may be printed on some labels.

Class 2—Gases



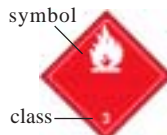
A red label with a 'fire symbol' and the number 2 denotes Class 2.1 (flammable gas).



A green label and a white compressed gas cylinder symbol is 2.2 (non-flammable, non-poisonous, non-corrosive gas).

A white label with a 'skull and crossbones' symbol; the words 'Poison gas' may optionally appear on it. Class 2.4 (corrosive gas; recognized for land shipments only) has a white label with a black compressed gas symbol. Finally, oxygen (for land shipments) has a special yellow label with an 'oxidizer symbol'.

Class 3—Flammable liquids



Red label, with a fire symbol and the number '3' (i.e. the class) at the bottom of the diamond. Flammable liquids have 'a closed-cup flash point not greater than 61°C'.



Class 4—Flammable solids; Substances liable to spontaneous combustion; Substances that on contact with water emit flammable gases (water-reactive substances). Divisions: 4.1 ('a solid that under normal conditions of transport is readily combustible...'; label has red vertical stripes on a white background, and a 'fire symbol'); 4.2 ('substance liable to spontaneous combustion..., or in contact with air, liable to spontaneous heating to the point where it ignites'; bottom half of label red, fire symbol in the top half); and 4.3 ('...contact with water emits dangerous quantities of flammable gases...'; blue label, with fire symbol).

Class 5—Oxidizing Substances & Organic Peroxides



Yellow label with fire-oxidizing symbol.

If 5.1 is printed on the label, the substance 'causes or contributes to combustion of other material...'

Organic compound that contains the bivalent -O-O- structure ... strong oxidizing agent and may be liable to explosive decomposition, be sensitive to heat, shock or friction...'

Class 6—Toxic (Poisonous) & Infectious Substances



White label, various symbols, e.g.: 'skull and crossbones' (toxic/poisonous), or 'biohazard symbol' and 'INFECTIOUS' on the label.



Class 7—Radioactive Materials



Labels have the 'radioactive symbol' and the word 'RADIOACTIVE'; may have a yellow top half as background to the radioactive symbol.

Class 8—Corrosives



Black and white label. A corrosive substance is defined as one which '... causes visible necrosis of skin or corrodes steel or non-clad aluminum'.

Class 9—Miscellaneous Products or Substances











Miscellaneous dangerous goods not covered in any other class, e.g. dry ice. If air transport included, white label, with black vertical lines in the top half. If only via land, red '!', not stripes.

Other TDG Labels

Package orientation (), magnetized material (if by air), etc.



WHMIS Hazard Symbols, Classes, and related Safety Information

Symbol	Class	Description	It means that the material...	And that you should...
	A	Compressed gases	<ul style="list-style-type: none"> • poses an explosion danger because the gas is held in a cylinder under pressure • may cause its container to explode if heated in a fire • may cause a dropped container to explode 	<ul style="list-style-type: none"> • handle with care; do not drop cylinder • keep cylinder away from potential sources of ignition • store the containers in a designated area
	B	Combustible and flammable materials	<ul style="list-style-type: none"> • is one that will burn and is therefore a potential fire hazard • may burn at relatively low temperatures; flammable materials catch fire at lower temperature than combustible materials • may burst into flames spontaneously in air; or emit flammable gas on contacting water • may cause a fire when exposed to heat, sparks or flames, or via friction 	<ul style="list-style-type: none"> • keep the material away from heat sources and other combustible materials • never smoke when working with or near the material • store the material in a cool, fire-proof area, as designated by your supervisor
	C	Oxidizing materials	<ul style="list-style-type: none"> • poses a fire/explosion risk in the presence of flammable/combustible material • may cause fire if it comes into contact with combustible materials, e.g. wood • may react violently or cause an explosion if it comes into contact with combustible materials such as fuels • may burn skin and eyes upon contact 	<ul style="list-style-type: none"> • keep the material away from combustible materials, and store in a designated area • keep the material away from sources of ignition • never smoke when working near material • wear the proper protective equipment, including eye, face and hand protection and protective clothing
	D1	Poisonous and infectious materials: Immediate and serious toxic effects	<ul style="list-style-type: none"> • is a potentially fatal poisonous substance • may be fatal or cause permanent damage if it is inhaled or swallowed, or if it enters the body through skin contact • may burn eyes or skin upon contact 	<ul style="list-style-type: none"> • handle material with extreme caution • avoid contact with the skin or eyes by wearing proper protective equipment, including eye, face and hand protection, and protective clothing • avoid inhaling by working in well-ventilated areas and/or wearing respiratory equipment • wash and shower thoroughly after use • store material in designated areas only
	D2	Poisonous and infectious materials: Other toxic effects	<ul style="list-style-type: none"> • is a poisonous substance that is not immediately dangerous to health • may cause death or permanent damage as a result of repeated exposures over time • may be a skin or eye irritant • may be a sensitizer which produces a chemical allergy • may cause cancer • may cause birth defects or sterility 	<ul style="list-style-type: none"> • avoid skin and eye contact by wearing all protective equipment necessary, including eye, face and hand protection, and protective clothing • avoid inhaling by working in well-ventilated areas and/or wearing respiratory equipment • store material in designated areas only
	D3	Poisonous and infectious materials: Biohazardous infectious materials	<ul style="list-style-type: none"> • may cause a serious disease, resulting in illness or death 	<ul style="list-style-type: none"> • take every measure to avoid contamination • handle material only when fully protected by the proper, designated equipment • handle material in designated areas where engineering controls are in place to prevent exposure
	E	Corrosive materials	<ul style="list-style-type: none"> • causes severe eye and skin irritation upon contact • causes severe tissue damage with prolonged contact • may be harmful if inhaled 	<ul style="list-style-type: none"> • keep containers tightly closed • avoid skin and eye contact by wearing all necessary protective equipment, including eye, face and hand protection, and protective clothing • avoid inhaling by using in well-ventilated areas only and/or wearing the proper respiratory equipment
	F	Dangerously reactive materials	<ul style="list-style-type: none"> • is very unstable • may react with water to release a toxic or flammable gas • may explode as a result of shock, friction or increase in temperature • may explode if heated in a closed container • may undergo vigorous polymerization 	<ul style="list-style-type: none"> • keep material away from heat • open containers carefully; do not drop them • store material in a cool, flame-proof area, as designated by your supervisor