

# Laboratory Safety

## Introduction

Health and safety hazards in laboratories are often overlooked. However, many of the hazards encountered in an industrial plant may exist in laboratories. Because of the nature of laboratory operations, and the type of equipment used, the results of exposure to these hazards may be more serious.

Health and safety hazards differ from laboratory to laboratory, depending upon the type of work carried out. This guideline will give you an overview of common laboratory hazards, and some measures to eliminate or minimize them.

## Hazards

### Chemical and Biological Agents

- Chemicals in the laboratory can present a variety of health and safety hazards. For example:
  - toxic chemicals such as benzene, arsenic, and cadmium can cause short or long term disease, if inhaled, ingested or absorbed through the skin
  - acids and bases can cause irritation and burns of the eyes, skin or respiratory passages
  - cryogenic chemicals such as liquid nitrogen can cause cold burns and asphyxia
  - organic solvents are a fire and explosion hazard

- contact with compressed gases such as nitrogen and oxygen may cause bodily injury. The violent reactions or explosions that occur when reactive chemicals contact each other may result in burns and other injury

*Check your suppliers' material safety data sheets for detailed hazard information.*

- Viruses, bacteria and fungi, most often present in microbiological or health care laboratories, can cause infections and disease

### Physical Agents

- Ionizing radiation from X-ray machines and radioisotopes can cause cancer
- Non-ionizing radiation can cause injuries to the eyes and skin. Lasers are a common source of non-ionizing radiation
- Noise and vibration generated by machines such as stirrers and centrifuges can cause hearing loss and stress

### Equipment and Apparatus

- Unguarded laboratory machines (such as centrifuges and stirrers) can cause
  - bodily injury
  - Electrically powered equipment (such as hot plates) can cause burns or electric shock if not properly maintained or used
  - Glassware is common in laboratories. Cuts, and contact with spilled liquids, may occur if glass apparatus are dropped, bumped or subjected to excessive pressure or vacuum

## Ergonomics

- Working in fixed or awkward positions (i.e. Standing or bent over a laboratory bench) for prolonged periods of time
- Repetitive motions from pipetting/transferring fluids and lab samples

## General

- Trips, slips and falls on cluttered, slippery floors can result in bodily injury
- Blocked exits hamper evacuation during emergencies

## Controls

Measures to eliminate or minimize the different types of laboratory hazards are outlined below. They are often a combination of engineering controls, administrative controls and work practices.

## Chemical and Biological Agents

Supplier material safety data sheets are an important source of information on the hazards of chemicals, and the precautions necessary when handling and storing them. Check these carefully. Many chemicals used in laboratories may be toxic and/or flammable, and also incompatible with each other. Control measures may include:

- Isolation. Appropriately contain a bench model centrifuge that is being used to centrifuge a flammable or infectious material
- Proper identification. Make sure that:
  - containers of hazardous materials have the appropriate WHMIS labels
  - the contents of piping systems and the flow of direction are properly identified
  - a legible warning sign is posted where a flammable or infectious material is being centrifuged
  - hazardous waste is appropriately identified
- Strict personal hygiene practices. Provide washbasins, showers, separate locker rooms for street and work clothes, proper laundering of work clothes, and eating areas separate from the laboratory
- Personal exposure monitoring of laboratory workers. Keep records of employee exposure to toxic materials
- Medical surveillance and immunization of laboratory workers, where necessary
- Control of all ignition sources (open flames and sparks) by:
  - grounding of dispensing containers
  - providing and ensuring the use of bonding wires and clamps
  - providing steam heaters or electric mantles
  - banning smoking in the laboratory
- Proper dispensing facilities and equipment. Ensure that:
  - portable containers of flammable liquids are equipped with spring-loaded caps and flame arrestors
  - dispensing containers are equipped with pressure relief valves
  - there are no ignition sources in or near the dispensing area
- Proper transportation of chemical containers within the laboratory:
  - provide material handling equipment, such as dollies or trucks, for heavy materials such as compressed gas cylinders
  - provide unbreakable portable containers for hazardous liquids
- Disinfection procedures
- Strict housekeeping
- Proper and adequate storage facilities
- Proper waste disposal facilities and procedures

## Physical Agents

- Ensure that equipment emitting ionizing radiation is properly installed and maintained
- Place radiation-warning signs where radiation hazards are present
- Institute a radiation safety program, if necessary
- Isolate noisy equipment, if possible
- Proper work procedures. The load in a centrifuge must be balanced to minimize vibration during operation
- Identify areas where a noise hazard may be present and post warning signs

## Equipment and Apparatus

- Provide pans or containers under reaction vessels to confine liquids in the event of glass breakage
- Ensure that machinery and equipment are properly guarded and shielded (for example, centrifuge access doors must be interlocked) so that moving parts, equipment or material do not endanger workers
- Ensure that electrical equipment is suitable for its use, and certified by the Canadian Standards Association or the Electrical Safety Authority as defined in the Ontario Electrical Safety Code
- Provide ground fault circuit interrupters where electrical equipment or the person using it may come in contact with moisture
- Develop operating procedures for machinery and equipment based on manufacturers' recommendations
- Institute an inspection, cleaning, and maintenance program for all machinery and equipment used in the laboratory

## Ergonomics

- Design work area to reduce musculoskeletal disorder (MSD) risk factors
- Organize work to minimize repetitive motions

## General Hazards

- Establish and enforce good housekeeping practices (see Housekeeping)
- Provide adequate space around workbenches, shelves, fume hoods and safety cabinets to allow workers to work safely

## Personal Protective Equipment

There are some hazards you may not be able to eliminate or minimize by engineering or administrative controls. In some instances, these controls may not be practicable, for example, in emergencies and when doing maintenance work. Provide and enforce use of the appropriate personal protective equipment, as needed. In the laboratory, these may include eye/face protection, gloves, lab coats, aprons, respirators, and earplugs or muffs.

## Housekeeping

Good housekeeping in the laboratory is an important fire prevention measure. It also helps control slip and fall hazards. It is essential, therefore, that you establish and maintain good housekeeping standards. To encourage good housekeeping practices:

- Provide proper and adequate storage for hazardous materials (for example, separate storage areas for incompatible chemicals), compressed gas cylinders and glassware
- Provide proper and adequate waste disposal equipment (for example, separate containers for toxic and flammable wastes, and puncture-resistant containers for glass)

## Maintenance

A planned maintenance program helps to ensure that control equipment and machinery are working properly. When establishing maintenance procedures, take into account the health and safety hazards that may be created during maintenance.

Establish a maintenance schedule and procedures for your ventilation systems, and for your equipment and apparatus, which will include the following:

### Ventilation Systems

- Regular inspection and testing for airflow (proper velocities and volumes), duct work (free of corrosion, leaks, and dents), and fans (working properly)
- Regular cleaning (for example, empty collection bags, clean or replace filters)

### Equipment and Apparatus

- Periodic checks and repairs, as needed, of electrical equipment and supplies by a qualified electrician
- Tagging, removing from service, and servicing of defective equipment
- Servicing of gas lines by qualified agents
- Lockouts to ensure worker safety during maintenance or cleaning

Keep records of all maintenance work done.

## Emergency Plan and Equipment

The handling of emergencies will often require more emphasis in a laboratory than in other places. Make sure that your emergency plan covers emergencies such as fires, explosions and chemical spills that may occur in the laboratory.

Install eye wash fountains and deluge showers in the laboratory, as there is always the danger of hazardous materials contacting the eye or skin.

Make sure that other emergency equipment is available, such as:

- fire extinguishers
- fire blankets
- appropriate respirators
- emergency spill kit
- first aid supplies

## Working Alone

Institute a procedure for the safety of employees who may be required to work alone in the laboratory. This may be something as simple as frequent scheduled contact with security or other staff.

## Training

Laboratory workers have specialized education, knowledge, and skills, but quite often may not be qualified in health and safety. Train all laboratory workers so that they are able to:

- Recognize the health and safety hazards of their work
- Use established work practices and procedures to protect their health and safety and that of their co-workers
- Take special care when working with new materials

Specifically, instruct laboratory workers in:

- Hazards of the materials, machinery and equipment used
- Ergonomic hazards
- Use of ventilation systems (i.e. fume hoods)
- Inspecting glassware before use for nicks and scratches, tagging and removing defective glassware
- Use of aspirator bulbs during pipetting
- Disinfecting pipettes after use
- Handling of sharps (syringes)
- Safe use of machinery and equipment
- Housekeeping practices
- Personal hygiene practices
- Safe use, handling and storage of hazardous materials
- Spill control procedures
- Safe disposal of hazardous waste
- How to control ignition sources
- Selection, use, care and limitations of personal protective equipment
- Emergency procedures and use of emergency equipment
- Hazard and accident reporting

## Related Legislation

The following regulations made under the *Occupational Health and Safety Act* apply to laboratories:

- Regulations for Industrial Establishments
- Regulations respecting Control of Exposure to Biological or Chemical Agents
- Designated Substances Regulations (as applicable)
- Workplace Hazardous Materials Information System Regulation
- Regulation respecting X-Ray Safety
- Regulation respecting Health Care and Residential Facilities (Applicable sections including 59, 60, 108 & 109)

Sections of the following also apply to laboratories:

- Ontario Fire Code, (O. Reg. 213/07)
- Reg. 220/01 Boilers and Pressure Vessels, made under the Technical Standards and Safety Act
- Environmental Protection Act (R.S.O. 1990)
- General Waste Management Regulations (R.R.O. 347/90 )

## Additional Resources

- American National Standard Institute, Laboratory Ventilation (ANSI/AIHA Z9.5 – 2003)
- Public Health Agency of Canada, Laboratory Biosafety Guidelines 3rd Edition, 2004  
[www.phac-aspc.gc.ca/ols-bsl/lbg-ldmbl/index.html](http://www.phac-aspc.gc.ca/ols-bsl/lbg-ldmbl/index.html)

## Inspection Checklist

*This is a sample checklist for laboratories that covers some potential problems. Modify it to suit your needs. It may also be used as a pre-shift check.*

Department	Dates of Inspection											
	<input checked="" type="checkbox"/> Acceptable	<input checked="" type="checkbox"/> Unacceptable										
Ventilation System												
Hazardous products labelled												
Handling procedures												
Work station layout/ergonomic safe work practices												
Waste disposal procedures												
Compressed air procedures												
Cryogenic process/storage												
Cylinders containing gases												
Safety showers/eye baths												
Radioactive material storage/control												
Personal protective equipment												
Electric wiring/equipment												
Centrifuge process												
Burners/hot plates/ovens												
Glassware procedures/disposal												
General housekeeping												
Conditions of floors												
Storage areas/cupboard/shelves												
First aid supplies												
Alarm systems												
Emergency procedures												
Fire exits												
Sign-off: (Initials of person making inspection)												
Notes:												

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Industrial Accident Prevention Association

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