

Laboratory safety

Selvaluxmy Chelvendran

Industrial Technology Institute, Bauddhaloka Mawatha, Colombo 7, Sri Lanka; sevaluxmy@iti.lk

Abstract

The laboratory environment can be a hazardous place to work and workers are exposed to numerous potential hazards including chemical, biological, electrical, physical and radioactive hazards. The US Occupational Safety Health Act (OSHA) 1970 serves to assure safe and healthful working conditions for the worker by authorizing enforcement of the standards developed under the Act and by providing for research, information, education, and training on occupational safety and health.

When considering chemical safety, only the required amount and the alternative for highly toxic chemicals, the less toxic ones should be bought. Laboratory workers should be aware of hazardous chemicals (corrosive, irritant, flammable, toxic, reactive, infectious, radioactive and cancerous), states (solid, liquid, vapour and gas), route of exposure (inhalation, ingestion, absorption and injection) and symbols. They should be able to read Material Safety Data sheets (MSDS) or Dangerous Goods Regulation (DGR) certificates, handle and store accordingly. Every container should be labeled to show date received and opened. Flammable chemicals should be stored in metal cupboards to avoid fire. Highly toxic chemicals, concentrated acids and bases should be stored on sand filled trays at the bottom shelf with reactive chemicals segregated. General safety tips, chemical symbols and first aid measures should be displayed in the laboratory. Combustible materials like paper, wood and cardboard should be removed from the laboratory immediately and if possible can be reused or recycled. Fire extinguishers should be placed in easily accessible places.

Accidents can occur through electric short circuits caused by working in energized equipment. The equipment should be placed in a safe area with clear operating instructions.

For biosafety, the exposure of individuals and the environment to potentially hazardous biological agents must be reduced. Biosafety committee should implement various degrees of laboratory control and containment through laboratory design and access restrictions, personnel expertise and training, use of containment equipment, and safe methods of managing infectious materials in a laboratory. Infectious samples should be analyzed in a safe manner and discarded after sterilization. Laboratory workers should be vaccinated against potential hazardous infection.

Physical hazard can occur during pipetting, wrong sitting posture, crowded laboratory, eye strain and handling with hazardous chemicals outside the safety cabinet.

Laboratory workers should wear personal protective equipment. Waste, whether chemical or biological, has to be stored in separate containers with the correct label and treated before disposal. Radioactive chemicals should be stored in closed containers. The correct laboratory management will reduce many accidents and save the precious life of the laboratory worker.

Introduction

The laboratory environment can be a hazardous place to work and the workers are exposed to numerous potential hazards including chemical, biological, electrical, physical and radioactive hazards. The US Occupational Safety Health Act (OSHA) 1970 serves to assure safe and healthful working conditions for the worker by authorizing enforcement of the standards developed under the Act and by providing for research, information, education, and training on occupational safety and health. The standards designed for laboratories with different environment coming under the principal OSHA standard are categorised below:

- The Occupational Exposure to Hazardous Chemicals in Laboratories Standard (29 CFR 1910.1450) - developed for work places where relatively small quantities of hazardous chemicals are used on a non-production basis.
- The Hazard Communication Standard (29 CFR 1910.1200) - designed to protect against chemical source illnesses and injuries by ensuring that employers and workers are provided with information to recognize, evaluate and control chemical hazards and take appropriate protective measures.
- The Personal Protective Equipment (PPE) Standard (29 CFR 1910.132).

- The Eye and Face Protection Standard (29 CFR 1910.133).
- The Respiratory Protection Standard (29 CFR 1910.134).
- The Hand Protection Standard (29 CFR 1910.138).
- The Control of Hazardous Energy Standard (29 CFR 1910.147).
- The Blood borne Pathogens Standard (29 CFR 1910.1030) - designed to protect workers from health hazards of exposure to blood borne pathogens.

Chemical safety

When considering chemical safety the required amount of chemicals and the alternative for highly

toxic chemicals, the less toxic ones should be bought. Laboratory workers should be aware of hazardous chemicals (corrosive, irritant, flammable, toxic, reactive, infectious, radioactive and cancerous), states (solid, liquid, vapour and gas), route of exposure (inhalation, ingestion, absorption and injection) and symbols. They should be able to read Material Safety Data sheets (MSDS) or Dangerous Goods Regulation (DGR) certificates, handle and store accordingly. OSHA hazard communication standard pictogram (Fig. 1) and label of a chemical container (Fig. 2) are given below.






		
• Oxidizers	• Flammables • Self Reactives • Pyrophorics • Self-Heating • Emits Flammable Gas • Organic Peroxides	• Explosives • Self Reactives • Organic Peroxides
		
• Acute Toxicity	• Corrosives	• Gases Under Pressure
		
• Carcinogen • Respiratory Sensitizer • Reproductive Toxicity • Target Organ Toxicity • Mutagenicity • Aspiration Toxicity	• Irritant • Dermal Sensitizer • Acute toxicity (harmful) • Narcotic Effects • Respiratory Tract • Irritation	• Environmental Toxicity

Fig.1. Hazard communication standard pictograms and hazards

The Basic Parts of A GHS-Compliant Label

1 → **n-Propyl Alcohol**

UN No. 1274
CAS No. 71-23-8

2 → **DANGER**

3 → Highly flammable liquid and vapor. Causes serious eye damage. May cause drowsiness and dizziness.

4 → Keep away from heat/sparks/open flames/hot surfaces. No smoking. Avoid breathing fumes/mist/vapours/spray. Wear protective gloves/protective clothing/eye protection/face protection. IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present. Continue rinsing.

5 → Fill Weight: 18.65 lbs. Lot Number: B56754434
Gross Weight: 20 lbs. Fill Date: 6/21/2013
Expiration Date: 6/21/2020 See SDS for further information.

Acme Chemical Company • 711 Roadrunner St. • Chicago, IL 60601 USA • www.acmechem.com • 123-444-5567

6 → 

1. **Product Identifier** - Should match the product identifier on the Safety Data Sheet.
2. **Signal Word** - Either use "Danger" (severe) or "Warning" (less severe)
3. **Hazard Statements** - A phrase assigned to a hazard class that describes the nature of the product's hazards
4. **Precautionary Statements** - Describes recommended measures to minimize or prevent adverse effects resulting from exposure.
5. **Supplier Identification** - The name, address and telephone number of the manufacturer or supplier.
6. **Pictograms** - Graphical symbols intended to convey specific hazard information visually.

Sample label courtesy of Weber Packaging Solutions • www.weberpackaging.com

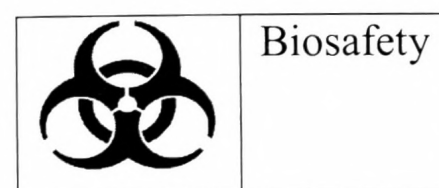
Fig. 2. Compliant label for n-Propyl alcohol

Electrical safety

Accidents can occur through electric short circuits caused by working with energized equipment, unprotected plug points, excess heat generation, and contact with explosive or reactive chemicals. The equipment should be placed in a safe area with the operating instructions. Electric shock occurs when the human body becomes part of a path through which current flows. The indirect effect of this can be an injury resulting from a fall or a movement into machinery following a electric shock. Burns can result when a person touches electrical wiring or equipment that is energized.

Biosafety

For biosafety, the exposure of individuals and the environment to potentially hazardous biological agents must be reduced. Biosafety committees should be appointed and their members should implement various degrees of laboratory control and containment through laboratory design, access restrictions, personnel expertise and training, use of containment equipment, and safe methods of managing infectious materials in a laboratory.



Infectious samples like blood, urine, respiratory tract samples, faeces, forensic samples and environmental samples should be analyzed in a safe manner and discarded after sterilization. Laboratory workers should be vaccinated against potential hazardous infection.

Table. 1. describes the relationship between the biosafety levels due to the practices and the equipment used in the laboratory.

Precautions to be taken in the biological laboratories are: avoid working with large volumes or high concentrations of microorganisms, overcrowding, unauthorized entrance, and infestation with rodents.

Table 1. Relation of risk groups to biosafety levels, practices and equipment

RISK GROUP	BIOSAFETY LEVEL	LABORATORY TYPE	LABORATORY PRACTICES	SAFETY EQUIPMENT
1	Basic – Biosafety Level 1	Basic teaching, research	GMT	None; open bench work
2	Basic – Biosafety Level 2	Primary health services; diagnostic services, research	GMT plus protective clothing, biohazard sign	Open bench plus BSC for potential aerosols
3	Containment – Biosafety Level 3	Special diagnostic services, research	As Level 2 plus special clothing, controlled access, directional airflow	BSC and/or other primary devices for all activities
4	Maximum containment – Biosafety Level 4	Dangerous pathogen units	As Level 3 plus airlock entry, shower exit, special waste disposal	Class III BSC, or positive pressure suits in conjunction with Class II BSCs, double-ended autoclave (through the wall), filtered air

Source: Biological safety cabinet (BSC); Good Microbiological Techniques (GMT) (part IV).

Physical hazard can occur during pipetting, wrong sitting posture, crowded laboratory, eye strain and handling of hazardous chemicals outside the safety cabinet.

Laboratory workers should wear personal protective equipment to reduce risk caused by accidents. Waste, whether chemical or biological, has to be stored in separate containers with the

correct label and treated before disposal. Radioactive chemicals should be stored in closed containers. Correct laboratory management will reduce many accidents and save the precious life of the laboratory worker.

Reference

1. OSHA, Laboratory safety guidance, 2011, OSHA 3404-11R.



Fig. 3. Personal protection equipment

Table 2. Personal protective equipment and safety measures.

EQUIPMENT	HAZARD CORRECTED	SAFETY FEATURES
Laboratory coats, gowns, coveralls	Contamination of clothing	<ul style="list-style-type: none"> • Back opening • Cover street clothing
Plastic aprons	Contamination of clothing	<ul style="list-style-type: none"> • Waterproof
Footwear	Impact and splash	<ul style="list-style-type: none"> • Closed-toe
Goggles	Impact and splash	<ul style="list-style-type: none"> • Impact-resistant lenses (must be optically correct or worn over corrective eye glasses) • Side shields
Safety spectacles	Impact	<ul style="list-style-type: none"> • Impact-resistant lenses (must be optically correct) • Side shields
Face shields	Impact and splash	<ul style="list-style-type: none"> • Shield entire face • Easily removable in case of accident
Respirators	Inhalation of aerosols	<ul style="list-style-type: none"> • Designs available include single-use disposable; full-face or half-face air purifying; full-face or hooded powered air purifying (PAPR); and supplied air respirators
Gloves	Direct contact with microorganisms Cuts	<ul style="list-style-type: none"> • Disposable microbiologically approved latex, vinyl or nitrile • Hand protection • Mesh