C02 General Laboratory Safety Guidelines

1. Introduction

Science laboratories of various disciplines are being operated at the Science Park either by HKSTP or its clients. Laboratory personnel shall adopt appropriate safety measures to ensure their health and safety at work in the laboratories. This document delineates the very basic safety guidelines applicable to all laboratories at the Science Park. For laboratory operations involving specific hazardous sources such as chemicals, biological agents, radioactive substances, irradiating apparatus, lasers, etc., laboratory personnel are recommended to refer to other relevant guidelines in the "SHE Handbook".

2. Laboratory Safety Management

A framework of safety management should be established for each client's laboratory. This includes the delegation of personnel to be responsible for different laboratory safety issues. Laboratory safety committee or group should be established to include different levels of laboratory personnel. Regular meetings should also be held to enhance communication on laboratory safety issues.

According to HKSTP's "Laboratory and Research Safety Policy", a Laboratory Person In-Charge must be assigned to oversee laboratory safety. S/he would be the key person to assist in managing the laboratory following the basic safety requirements laid down in this policy.

3. Laboratory Safety Orientation and Training

It is the employers' responsibility to provide safety information, instruction, and training to their employees in the workplaces. In the laboratories at the Science Park, all new laboratory personnel are required to attend safety orientation arranged by their corresponding Laboratory Persons In-Charge before commencement of works in the laboratories. The purpose of safety orientation is to provide new laboratory personnel with basic information about their job hazards and the corresponding safety preventative measures. The need for further safety training should also be identified in the orientation. To facilitate the implementation and recording of such orientation, Laboratory Persons In-Charge are recommended to make use of HKSTP's Safety Orientation Checklist for New Laboratory Staff.

Moreover, Laboratory Persons In-Charge should also ensure that all laboratory personnel receive the necessary safety training depending on their scope of works. Safety orientation shall not substitute training on general and specific topics regarding laboratory safety.

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4. Risk Assessment

In the environment of a research laboratory, there are frequent changes in experimental works and facilities alongside with the current research fields and technologies. As new facilities, equipment and technologies may pose new health and safety hazards to laboratory personnel, it is essential for the concerned laboratory personnel to conduct risk assessment:

a) Before using any new or modified facilities
b) Before commencing any new or modified experimental works
c) Whenever there are significant changes in the laboratory environment
d) Whenever deemed necessary by the concerned laboratory personnel

A simple risk assessment method having five steps is suggested:

i. Look for the hazards
ii. Decide who might be harmed
iii. Evaluate the risks
iv. Record the findings
v. Review the assessment

Laboratory personnel is recommended to use HKSTP's Risk Assessment Form to conduct the risk assessment and record the results. For certain laboratory activity which encompasses a series of steps or actions, the assessment can be accomplished using HKSTP's Job Hazard Analysis Form.

5. Laboratory Safety Rules and Procedures

Each laboratory is unique in its operation and has its own risk. Yet there are many safety concerns which are common to most laboratories. The followings are rules or standard procedures that are applicable to almost every laboratory.

a) Read all fire alarms and safety signs and follow the instructions in the event of an accident or emergency.
b) Know the laboratory's emergency escape routes and evacuation procedures.
c) Know the locations for the laboratory's safety equipment, including firefighting equipment, emergency shower and eyewash unit, spill kit, first-aid kit, etc.
d) Know the emergency phone numbers to use to call for help in case of an emergency.
e) Laboratory areas containing hazardous materials such as chemicals, biological agents, lasers, radiation sources, etc. should be properly marked with appropriate warning signs or symbols.

f) Avoid the use of open flames in the laboratory as far as possible.
g) Always work in properly-ventilated areas. Hazardous chemicals shall be handled in fume cupboards.
h) Never eat, drink, smoke or use make-up in the laboratories.
i) Handle glassware with care. Check for any damaged glassware before use and dispose of them properly.
j) Never leave any ongoing experiments unattended.
k) Never pipette by mouth.
l) Long hair and loose clothing should be properly confined.
m) Wear proper personal protective equipment.
n) Clean the laboratory benches, workstations or equipment wherever necessary after experiments.
o) Wash hands before leaving the laboratories.

Laboratory Persons In-Charge are advised to formulate general safety rules for their laboratories and/or Standard Operating Procedures (SOP) for specific laboratory operations.

6. Personal Protective Equipment (PPE)

Personal protective equipment (PPE) refers to clothing or equipment that is designed to protect the wearer's body from injury or infection. PPE commonly used in the laboratories includes laboratory coats, gloves, safety glasses, face shields, respirators, etc. The types and their applications are briefly described in the following table.

Type	Protection	Use
Lab coat	Serves as additional layer of protection for skin Covers the wearer to the knees	Handling chemicals, biological agents/animals, and radioactive substances, etc. Should choose the lab coats of appropriate materials (e.g. cotton for common lab works or flame resistant materials for handling pyrophoric chemicals)
Safety glasses / spectacles	Protect eyes against spills and flying objects	Handling small quantities of common chemicals, biological agents/animals or operating equipment having potential splashing hazards

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Type	Protection	Use
Chemical goggles	Protect eyes against splashing of hazardous chemicals	Handling hazardous chemicals
Face shield	Protects the face from flying objects and splashes	Working with large amount of hazardous chemicals Face shields must be worn over safety glasses or goggles
Disposable gloves	Provide hand protection against hazardous substances	Working with apparatus or equipment potentially contaminated with hazardous substances Serve for single use only
Chemical resistant gloves	Provide hand protection against hazardous chemicals	Working with hazardous chemicals or heavily contaminated apparatus or equipment
Cryogenic gloves	Provide hand protection against cryogens or materials of very low temperature	Working with cryogens such as liquid nitrogen, or handling materials in the freezers, etc.
Heat resistant gloves	Provide hand protection against apparatus or materials of very high temperature	Retrieving items from the ovens, furnaces, autoclaves or handling very hot materials, etc.
Surgical mask	Protects against large droplets and splashes	Working with live animals
N-95 mask	Protects against dust, fumes, mists or microorganisms	Working with live animals or infectious materials Working in the environment with fine particles or nanomaterials
Respirator (half-face or full face)	Protects against a variety of particulates, vapors, dust, mists, fumes; depends on the filter cartridge used	Working in the environment with particulates, chemical vapors or infectious materials

Laboratory personnel should observe the followings before or when using PPE in the laboratories:

a) Choose the suitable types of PPE taking into consideration of the work environment, properties of the potential hazardous sources and personal factors such as fitness, comfort, etc.
b) Use and maintain the PPE properly in accordance with the manufacturer's instruction.
c) Regularly inspect the PPE and replace them whenever necessary.
d) Bear in mind that PPE should be used only as the last line of defense when engineering and administrative controls are not feasible or effective.

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7. Laboratory Safety Facilities

Essential laboratory safety facilities or equipment, including but not limited to fume cupboards, biosafety cabinets, gas sensors, firefighting equipment, emergency showers and eyewash units shall be properly maintained and certified by competent parties following recognized standards or schedules recommended by the respective manufacturers.

Maintenance or certification records shall be properly displayed or kept readily available for inspection.

8. Electrical and Mechanical Safety

Laboratory equipment may pose electrical and mechanical hazards to laboratory personnel. Safety rules and procedures as delineated in relevant chapters of SHE Handbook shall be followed.

9. Pressure and Vacuum Systems

High pressure vessels and vacuum systems are frequently employed in laboratory operations. The following safety requirements shall be observed:

a) Pressure vessels must be registered, tested and certified in accordance with local legislation.
b) High pressure operations should be performed only in pressure vessels appropriately designed and manufactured for the operation, properly installed and protected by pressure-relief and necessary safety devices.
c) The vessels must be strong enough to withstand the stresses encountered at the intended operating temperatures and pressures and must not corrode or otherwise react when in contact with the materials it contains.
d) Equip systems designed for use at elevated temperatures with a positive temperature controller. Avoid using a manual temperature control. The use of a back-up temperature controller capable of shutting the system down is strongly recommended.
e) Use personal protective equipment, such as safety glasses or chemical goggles, face shields, and/or explosion shield to protect against the hazards of vacuum procedures, and the procedures should be carried out inside a fume hood.

f) Do not allow water, solvents and corrosive gases to be drawn into vacuum systems. Protect pumps with cold traps and vent their exhaust into an exhaust hood.
g) Assemble vacuum apparatus in a manner that avoids strain, particularly to the neck of the flask.
h) Avoid putting pressure on a vacuum line to prevent stopcocks from popping out or glass apparatus from exploding.

10. Glassware Handling

Glassware should be handled with care in the laboratories following the below precautions:

a) Do not use laboratory glassware to contain foods or drinks.
b) All glassware should be inspected for cracks and contamination before use. Avoid using cracked or contaminated glassware.
c) To avoid accidents and injuries, broken and waste glassware should be discarded in a proper container specially marked to indicate its contents.
d) Containers for broken glassware should be packed when they are about 80% full. Packed broken glassware containers should then be disposed of as general refuse.
e) Glass reagent bottles should be cleaned by rinsing with water thoroughly when the reagents have been used up and then placed into proper broken glassware containers for disposal.
f) Glass reagent bottles with safety designed plastic coating should be purchased as far as possible. In case of breakage, the content would be contained by the plastic coating.
g) Store glassware properly when not in use. Replace caps or stoppers on reagent bottles and cover open vessels, especially when working with volatile solvents.
h) Only round-bottomed or thick-walled (e.g. Pyrex) evacuated glass vessels specifically designed for operations at reduced pressure should be used.
i) Pressure and vacuum operations in glass vessels should be conducted behind adequate shielding.
j) Glassware should be vented when heating to avoid over-pressurization and possible explosion. Keep stoppers loose when autoclaving or during procedures that require heating.
k) Wear protective gloves to wash laboratory glassware or pick up broken glass.
l) Wear safety glasses to prevent eye damage from broken glassware.
m) Glass-blowing operations shall only be carried out by competent personnel with proper annealing facilities.

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11. Housekeeping

Good housekeeping in laboratories reduces risks and protects the integrity of laboratory operations. The following general housekeeping practices shall be adopted in the laboratory areas:

a) Access to emergency equipment including firefighting equipment, showers, eyewash units, and exits must never be blocked;
b) Keep all work areas clear of clutter and obstructions;
c) Keep all aisles clear of chemicals and other obstructions, and properly store items when not use;
d) Avoid stacking chemicals or storing chemicals on the floor;
e) Keep cabinet doors and drawers closed;
f) All work surfaces and floors should be cleaned regularly (cleaning shall be supervised by the Laboratory Person In-Charge or delegated persons if carried out by cleaning staff);
g) Clean up work areas at the end of the operation or day;
h) Sink traps and floor drain traps (if available) should be filled with water at all times to prevent the escape of sewer gases into the laboratories;
i) Reduce the risk of slips, trips, and falls by cleaning up liquid or solid spills immediately;
j) Keep frequently used materials and bench apparatus well away from any edges and secured whenever possible;
k) Avoid keeping excessive combustible materials including cardboard boxes, equipment boxes, Styrofoam, etc. in the laboratories;
l) Sharps should be properly stored or disposed of in the sharp boxes;
m) Clothing should be hung in proper locations and not draped over equipment or the benches;
n) Properly dispose of hazardous wastes (including chemical waste, clinical waste and radioactive waste) following statutory requirements and HKSTP's respective guidelines.

12. Working Alone

In general, working alone with hazardous materials or hazardous processes in laboratories at the Science Park is discouraged. If working alone is deemed necessary under certain conditions, laboratory personnel shall observe the following rules:

a) The work hours must be approved by the respective supervisor or Laboratory Person In-Charge;

b) The person working alone shall make arrangements with other persons either in the same building or in other buildings to check with each other periodically;
c) Dangerous experiments such as, but not limited to, working with pyrophoric, explosive, or highly toxic materials shall not be allowed.

13. Unattended Operations

In general, all laboratory operations should be conducted carefully in the laboratories with constant monitoring by the operators. Occasionally, laboratory operations are carried out continuously or overnight. For these situations, laboratory personnel shall observe the following rules:

a) Operations shall be designed to be safe in case of failure of utility services such as electricity, water, vacuum, compressed air, etc.;
b) Water cooled operations should utilize recirculating refrigerated water baths to conserve water and protect against floods;
c) Regulate the water pressure automatically via the installation of a water pressure regulator to avoid surges that might rupture the water lines; and monitor the water flow so that in the event of interruption, electricity and water supply can be turned off;
d) Whenever possible, arrange periodic inspections to the operations;
e) The laboratory lights should be left on and appropriate sign should be posted on the door.

14. Emergency Preparedness

Emergency preparedness for laboratory accidents or incidents is essential for each laboratory in response to accidents or incidents. Laboratory Person In-Charge or other responsible person shall establish an emergency response plan for the various situations and features of individual laboratory. This plan should include contact details for emergency contact persons and delineate the emergency response procedures in cases of minor and major laboratory incidents or accidents such as fire, explosion, gas leakage, hazardous substances spillage, etc.

Necessary emergency facilities and equipment shall be in provided and maintained in good conditions readily available for use. Personnel delegated to respond to laboratory emergency situations shall be properly trained. Drills for emergency situations are also highly recommended to be conducted regularly.

In addition, adequate resources shall be allocated by the management of individual laboratory to guarantee the emergency preparedness plan can be effectively executed.

15. Reporting of Laboratory Accident and Incident

In case of any laboratory related accidents or incidents, the Laboratory Person In-Charge or his/her delegates shall notify HKSTP in a timely manner following the requirements as laid down in “Accident and Incident Reporting Procedures” of the SHE Handbook. Investigation shall be carried out where appropriate and remedial measures shall be taken in order to avoid recurrence of similar cases.