

The logo for Ryerson University, featuring the text "Ryerson University" in white on a blue rectangular background, with a yellow vertical bar to its right.

**Ryerson
University**

Department of Chemical Engineering
Faculty of Engineering & Architectural Science

Laboratory Safety Manual

Last updated:
September, 2020

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Foreword

This manual deals with the safety requirements that you must comply with while undertaking laboratory and workshop activities in the Department of Chemical Engineering.

All teaching assistants (TAs), graduate or undergraduate students, and any other research personnel are required to have taken on-line safety training and received Department authorization before starting experiments in our laboratories.

You must acquire a basic knowledge and understanding of the properties of chemicals involved in your laboratory work. This is important because chemicals could be toxic, flammable, explosive, and/or carcinogenic. In addition, you must also understand the types of hazards that exist as well as the accidents and injuries that can result from improper handling of chemicals and equipment.

Note that safety in the laboratory is an individual responsibility. It is your duty to ensure that your work environment is conducive to good occupational health and safety at all times. Your co-operation is absolutely essential in this regard.

Please take time to read this manual carefully and direct your safety questions to the professor in charge of your laboratory and to the Department Safety Officer (DSO). The professors are responsible for the provision of adequate training in the safe handling of chemicals and in the safe operation of equipment and instruments in the laboratories.

The professors and technical staff in charge of the laboratories are listed in the next section.

1. CONTACTS

Laboratory/Support	Room	Professors/Technical Staff
<i>Undergraduate Teaching Laboratories:</i>		
Computer Lab	KHN 105	Dr. Farhad Ein-Mozaffari, Dr. Henry Chang, Dr. Ramdhane Dhib, Dr. Argang Kazemzadeh Dr. Dae Kun (Rilla) Hwang Dr. Chil-Hung (Henry) Cheng
Fluid Mechanics Lab	KHE 031	Dr. Philip Chan
General Chemistry Lab	KHN 207	Mr. Shawn McFadden
Instrumentation & Analytical Lab	KHN 213	Mr. Wei Zhang
Organic Chemistry Lab	KHN 217	Mr. Robert Denning
Process Measurements Lab	KHN 102C	Dr. Huu Doan
Thermodynamics II lab	KHN 201	Dr. Ramdhane Dhib
Unit Operation Lab	KHN 002, KHN 004	Dr. Mehrab Mehrvar, Dr. Ramdhane Dhib, and Dr. Nariman Yousefi
<i>Research Laboratories:</i>		
Advanced Functional Materials Lab	iBEST,7th floor	Dr. Dae Kun (Rilla) Hwang
Cartilage Tissue Engineering Lab	EST,7 th floor	Dr. Stephen D. Waldman
Complex Fluids & Advanced Materials Lab	KHN 107 A&B	Dr. Philip Chan
Environmental & Biochemical Eng. Lab	KHN 109	Dr. Jiangning (Jenny) Wu
Fluid Mixing Technology Lab	KHN 001	Dr. Farhad Ein-Mozaffari
Membrane Bioreactors Lab	KHN 111	Dr. Manuel Alvarez Cuenca
Membrane Technology Lab	KHN 113	Dr. Huu Doan
Microporous Materials Lab	KHE 132	Dr. Chil-Hung (Henry) Cheng
Nano-composites & Biomaterials Eng. Lab	KHE 130	Dr. Yaser Dahman
Nano-Eng. Lab for Energy & Environmental Technologies	KHE 132A	Dr. Hadis Zarrin
Plastic and Diffusion Lab	KHE 131	Dr. Ali Lohi, Dr. Simant Upreti
Polymer Reaction & Process Control	KHN 113C	Dr. Ramdhane Dhib
Transport Modeling Lab	KHE 133	Dr. Ali Lohi, Dr. Simant Upreti,
Wastewater Treatment Technologies Lab	KHN 001	Dr. Mehrab Mehrvar
Yousefi Lab for Self-assembled Nanomaterials	KHN 113	Dr. Nariman Yousefi
<i>Support:</i>		
Computer and Electronic Support	KHN 102	Mr. Tondar Tajrobehkar
Laboratory and Research Support	KHE 116	Mr. Ali Hemmati, Mr. Daniel Boothe
Department Safety Officer / Fire Warden	KHE 116	Mr. Daniel Boothe, Mr. Ali Hemmati
<i>Departmental Health & Safety Committee:</i>		
Mr. Ali Hemmati (Chair)		
Dr. Huu Doan	Mr. Daniel Boothe	
Dr. Ramdhane Dhib	Dr. Henry Cheng	

2. GENERAL LABORATORY SAFETY RULES

Any person who fails to comply with the safety rules will not be allowed to work in the laboratory.

All people working in laboratories are required to:

- Read this safety manual thoroughly prior to commencing their laboratory work.
- Obtain online training on WHMIS prior to commencing work in any Ryerson laboratory
- Follow any reasonable instruction given by the professor in charge and/or TA.
- Use personal protection equipment for health and safety purposes, ie: safety glasses, gloves, safety shoes, hard hat, lab coats, etc.
- Determine the potential hazards (e.g., physical, chemical, and biological hazards) and take appropriate safety precautions and protection.
- Treat all chemicals as potentially dangerous substances, and all microorganisms as pathogenic substances.

Acceptance form will be in Appendix-1 and **must be** submitted before working in laboratories.

2.1 PERSONAL PROTECTION

The requirements for personal protection are as follows.

Eye Protection

- Approved safety glasses or goggles must be obtained by each staff and student, and must be worn at all times in all laboratories.
- The safety glasses or goggles must be worn over any prescription glasses unless the latter are manufactured to the relevant safety standards.
- Contact lenses are not recommended for laboratory work as some materials (e.g., solvents, corrosive liquids) if splashed into eye and/or vapour would cause the lens plastic to adhere to the cornea.

Safety Wear

- Safety hats must be worn in all Unit Operation Labs.
- Laboratory coats of good fit and good condition must be worn in all laboratories at all times.
- Students must bring their own laboratory coats. Laboratories do not provide lab coats to students.
- A knee-length (or longer), long sleeved laboratory coat is recommended. Lab coats should be buttoned up, and sleeves should not be rolled up.
- Wearing of short trousers or skirts is not allowed.
- Long hair must be tied back.

Shoes

- Closed footwear must be worn in all laboratories at all times.
- Where safety footwear is required for a particular hazardous activity, appropriate safety footwear in accordance with standards will be provided.

Wearing open-toed shoes, sandals, high heeled shoes, thongs, or with bare feet will be prohibited entering the laboratories. Safety Matters.

Gloves

Gloves of suitable material for hand protection should be worn at all times when handling chemicals. The professor in charge or TA will advise the correct type of gloves to be used.

Respirators

Dust masks and face respirators must be used where dust and chemical fumes are handled in the laboratory. Specific respirators will be provided in the laboratories where hazardous substances or poisons are handled.

Hearing Protection

Hearing protection in accordance with relevant standards should be worn when using equipment that may damage or impair hearing.

Other Personal Protection

Other safety equipment such as face shields, heat-resisting gloves, and special helmets will be provided if necessary.

Hygiene

Everyone should

- Change protective gloves at regular intervals as instructed, and wash hands each time after removing gloves.
- Always wash hands thoroughly before leaving the laboratory.
- Avoid the use of solvents for washing as they can cause skin irritation or inflammation (in some cases, washing with a solvent may facilitate absorption of a toxic chemical).

2.2 HOUSEKEEPING

Everyone should

- Keep the floor and working benches free from any spills and non-essential material at all times.
- Treat all bench tops and other surfaces as potential sources of contamination.
- Clean their working area, glassware and equipment thoroughly after use.
- Keep the fume hood and nearby areas clean, and clear from obstructions.
- Never block doors and exits since they provide emergency escape routes.

2.3 PREVENTION OF FIRE

Everyone should

- Use a carbon dioxide-fire extinguisher to put out small fires.
- Never leave any open flames unattended.
- If possible, remove any flammable solvents near fire.
- Keep the fire escape routes clear at all times.

2.4 FOOD AND DRINK

No foods or drinks are allowed in any laboratory.

2.5 WORKING BEHAVIOR

Everyone must obey the following rules in the laboratories:

- Working under the influence of narcotic or intoxicating drugs is prohibited.
- Climbing on any equipment or structure is strictly forbidden, except with the permission of TA and technical staff.
- Sitting on laboratory benches, or running in the laboratory is not allowed.
- Reckless behavior, practical jokes, horseplay, etc. in the laboratory are prohibited.
- Distracting or startling other students or staff is to be avoided.
- Bringing anyone to the laboratory who is not involved in the work is not allowed.
- Playing or listening/watching to audio/visual equipment during lab work is not permitted.
- Personal belonging must not be placed on work benches or floor but should be stored in designated places.

Anybody who does not comply with the aforementioned work behavior WILL be excluded from laboratory and workshop.

2.6 HANDLING OF CHEMICALS

Everyone must

- Carefully read the Material Safety Data Sheets (MSDS) of all involved chemicals before commencing any experiment.
- Label all containers of chemical solutions prepared for their laboratory work.
- Not wear hand jewelry since it may get damaged, or cause injury after coming in contact with chemicals.
- Use safety carriers (placed near storage cabinets) to transport glass or plastic containers of more than one litre capacity.

Chemical Spills

Everyone must

- **Immediately report any chemical spills**, or related accidents/near-misses to the professor in charge, TA, or DSO. Students and staff will be given quick assistance to clean up spills safely.
- Clean mercury spills only with the mercury spill kit (spill kits that are provided in laboratories must be used).
- Safely collect and dispose of toxic substances, or poisonous spills under the direction of DSO.

Disposal of Waste Chemicals

Waste chemicals (solids and liquids) must be disposed of in a proper manner. For the disposal of any chemical or toxic substance, consult the professor in charge or DSO. See Appendix 2 for more details.

2.7 WORKING TIME IN LABORATORIES

Undergraduate students should note that

- their laboratory working times are allocated in their academic timetables.
- they are allowed to work in laboratories only under the supervision of the professor in charge or TA.
- They are not permitted to work in laboratories outside their allocated schedules, except after obtaining permission from the professor in charge, TA and the Chair of the Department.

2.8 SAFETY FACILITIES

Each laboratory is equipped with various safety facilities including eye wash station, shower station, fire extinguisher, and first aid boxes.

Eye Wash

In the event of a chemical splash in the eye, it should be immediately washed keeping eyelids widely open with copious amounts of water for at least 15 minutes. The injured person must seek immediate medical attention.

Shower

Chemical spills on body must be immediately flushed with large quantities of water for at least 15 minutes, and all contaminated clothes should be removed.

Fire Extinguishers

Carbon dioxide fire extinguishers should be used to put out small fires resulting from chemical incidents. Halo-hydrocarbon extinguishers should only be used when no chemicals are involved. Only trained persons, professor in charge, TA, or staff can use fire extinguishers.

First Aid Boxes

These should be used when necessary.

In general,

- Everyone working in the lab must familiarize themselves with the location and proper use of the aforementioned facilities.
- Anyone with cuts, abrasions, or other open wounds should see their lab professor or TA
- For any emergency requirement, contact the Ryerson Health Clinic.

In case of Emergency,

activate fire alarm by raising the break-glass

3. COVID-19 Prevention

KEEP YOURSELF & OTHERS SAFE

The COVID-19 pandemic is a concern for all of us and we all have a key role to play. Students should continue to think ahead about the actions they take to stay healthy and prevent the spread of the virus.

If you have fever, cough, shortness of breath, muscle aches or tiredness, please STAY HOME and contact Tele-Health at 1-866-797-0000 or your health care provider to let them know.

A MASK OR FACE COVERING MUST BE WORN AT ALL TIME IN THE ENCLOSED SPACES

The best way to prevent infection is to avoid being exposed

In an effort to prevent the spread of COVID-19, students are advised to:

- Limit non-essential trips out of your home
- Avoid closed spaces, crowded places, and close contact
- Keep two meters or 6 feet distance from others
- Wear a mask or face covering in indoor public spaces and when you can't keep physical distance
- Clean your hands often. Use soap and water or an alcohol-based (70-90 per cent) hand sanitizer
- Avoid touching your face with unwashed hands
- Cover your cough or sneeze with your elbow or a tissue. Immediately throw the tissue in the garbage and wash your hands.
- Clean and disinfect frequently touched objects and surfaces
- Avoid close contact with people who are sick
- Stay home if you are feeling unwell
- Download the COVID-19 ALERT APP, so you can be notified directly if you have been in close contact with someone who was contagious with COVID-19.

Refer to Appendix-4 for more COVID-19 information and contacts.

3. GENERAL LABORATORY PRACTICE

Everyone must adhere to the general laboratory practice outlined in this section.

3.1 BASICS

Everyone must read all Material Safety Data Sheets (MSDS) relevant to their laboratory work. An MSDS folder for all chemicals used and stored in a laboratory is present in each laboratory. Elaborate lists of MSDS are also accessible through the following websites:

- <https://www.msdsonline.com/sds-search/> (MSDS website online)
- <https://pubchem.ncbi.nlm.nih.gov/> (National Library of Medicine online)

3.2 LABORATORY ORGANIZATION

Everyone must

- Carry out their laboratory experiments in a safe and tidy manner; clean up spills immediately, and keep their workspaces free of non-essential material at all times.
- Properly label all prepared chemical substances according to the requirements.
- Handle all glassware with care, and dispose of broken glassware in specific containers located in each laboratory.
- Clean all used glassware and return them to appropriate cabinets.
- Clean the bench and remove all chemical solutions, materials, etc. from working areas.
- Report any breaking of glassware to the professor in charge or TA.

3.3 USE OF EQUIPMENT

Any damaged or faulty equipment must be reported immediately to the professor in charge or the TA

Everyone must

- Undergo proper training with the professor in charge or TA on the operation of all equipment and instruments they will work with in the laboratories.
- Have authorization from the professor or TA to operate hazardous equipment in a laboratory.
- Use equipment and instruments in a laboratory only for the designed purposes.
- Handle all electrical and heating equipment carefully to prevent any shocks and burns.
- Never use makeshift tools and shortcut methods, which can damage equipment and cause injuries.

Running Equipment Unattended

Laboratory equipment must never be run unattended unless the professor in charge has given permission and proper safety precautions have been taken. Contact information of all involved personnel must be displayed on an equipment when being run unattended.

3.4 WORKING ALONE

In general, nobody should work alone in a laboratory.

In the event that someone is required to work alone for a period of time, s/he must always inform the professor in charge.

3.5 PERSONAL ILLNESS

Prior to working in a laboratory session, everyone should notify the professor in charge or TA about any medical condition (e.g., allergic reaction, diabetes, etc.), which may get worse during the session.

3.6 HAZARD AWARENESS

Everyone must

- Be alert to any unsafe conditions/activities in their working area, and bring these to the attention of the professor in charge, TA, or DSO for prompt corrective action.
- Report any dangerous laboratory situations or incidents that they experience or observe to the professor in charge, TA, or DSO who will initiate preventative action as necessary.

Chemical Hazards

Everyone should

- Always consult MSDS for chemicals before using them in their laboratory work.
- Keep in mind that some chemicals are toxic, and may cause severe health problems through skin contact, inhalation or swallowing.
- Immediately wash all affected body parts of any chemical spills using the eye wash or shower station, and call for help from the professor in charge, TA, or DSO.
- Quickly report any possible exposure of toxic substances to the professor in charge, TA, or DSO.
- Never use any toxic substances without permission from the professor in charge, TA, or DSO.

Biological Hazards

Everyone should note that

- When handling biological materials, especially microorganisms, there is a possibility of exposure to infection through eyes, nose, mouth, or cuts on skin.
- Infectious agents such as bacteria, fungi, viruses and parasites can cause allergies and diseases.
- Professors in charge must be consulted for sterilization and disinfection procedures, and to obtain training for handling of these agents, prior to lab work.
- Environmental samples such as pond water and wastewater from sewage may contain organisms that cause serious diseases. These samples must be treated as containing pathogenic organisms.
- Those who have to work with pathogenic organisms should have a suitable vaccination before starting their work.
- Specific personal protection equipment for pathogenic organisms should be worn when required.

3.7 HAZARD ANALYSIS

The Department has a duty to provide a safe working environment for all staff and students. In laboratory and workshop sessions, all students are trained to have a professional approach to safety, and its awareness.

Risk Assessment

A risk assessment, or hazard analysis, must be conducted before starting any laboratory work. The objectives are as follows:

1. To identify all hazards associated with a particular activity, situation, or chemicals.
2. To assess the seriousness of the associated risk.
3. To identify protective or control measures to reduce the risk to a reasonable level.
4. To comply with any safety standard as required by legislation.
5. To adopt safe working practices, including change of work methods to minimize exposure to hazards.

See Appendix 3 for a risk assessment form that must be submitted by graduate students and any research personnel to the research professor in charge of that laboratory.

4. EMERGENCY PROCEDURES

In all cases of emergency, everyone must obey the directions of the professor in charge, TA, DSO, and Fire Warden.

4.1 GENERAL PROCEDURE

1. Upon hearing the emergency alert signal, everyone must
 - Turn off all equipment, and prepare to evacuate.
 - Be ready for instructions from your professor in charge, TA, DSO, fire warden, or emergency speaker system.
2. When an evacuation tone is sounded, everyone must
 - Observe the evacuation procedure/map provided for the building, and evacuate immediately.
 - Exit the building through the fire exits, or stairs. Elevators should not be used, unless directed by the fire warden, or security personnel.

4.2 HELPING DISABLED PERSONS

Two persons should be asked to assist any disabled person.

The DSO must be notified to arrange adequate evacuation of any disabled person.

APPENDIX 1: ACCEPTANCE FORM

This form must be carefully read and signed by each person who will be working in a laboratory. The original must be submitted, and a copy must be attached to your laboratory manual.

1. Undergraduate students must submit their signed form to the professor, or the TA in charge of their laboratory section before the first experiment starts.
2. Graduate students and other research personnel must submit their signed form to the research professor in charge of their laboratory before the beginning of experiments.

I, _____,

Please PRINT your name

Undergraduate student, or graduate student, or research personnel

declare that:

1. I have read the Chemical Engineering Laboratory Safety Manual
2. I have read the relevant MSDS for each chemical to be used
3. I have understood the importance of being safe in the laboratory
4. I will abide by all guidelines and rules listed in this manual

Signature of student or research personnel

Date

Signature of course professor or research professor

Date

Course number (for undergraduate student): _____, or

Laboratory room number (for research personnel): _____

APPENDIX 2: DISPOSAL OF WASTE CHEMICALS

Proper disposal of the wastes from an experiment should be determined before the experiment is started.

1. Volatile compounds should be properly labeled and stored in a fume hood until disposal.
2. Waste chemicals should never be disposed of in sinks or drains. Store waste chemicals in waste containers.
3. Hazardous materials include such things as strong acidic or basic solutions, concentrated solutions of hazardous metals or other inorganic compounds, and toxic organic compounds. If in doubt, ask your professor in charge.
4. Organic liquid wastes must never be mixed with aqueous wastes like acids.
3. Speak to your professor in charge to request waste containers from the DSO.
4. Label each waste container with your name, name of supervisor, date, and the type of waste.
5. Keep waste containers in a safe place (a chemical cabinet) in the lab, at all times.
6. Keep waste containers capped between uses, and do not overfill them.

When finished, someone must date waste containers, and arrange with their professor in charge or TA to have the containers removed promptly by the DSO. Waste chemicals must be cleared every month, regardless of volume.

BIOLOGICAL WASTE MATERIALS

Students or research personnel should contact their professor in charge for advice on the storage and disposal of biological materials. The use of any biologically active material (such as sewage and microorganisms) must be

1. discussed with the professor in charge prior to the commencement of lab work, and
2. declared to the DSO.

Non-conformance WILL result in penalties to anybody working in the laboratory and, if necessary, in more serious disciplinary procedures.

Failure to comply with the aforementioned requirements is a violation under the laboratory safety rules?

APPENDIX 3: RISK ASSESSMENT FORM

This form must be completed for each chemical, mixture or preparation used in your laboratory work, and for each hazard (fire, steam pressure, glass debris, etc.) It must be submitted to the professor in charge of your lab before starting research work. Add as many rows as needed to cover each potential risk in your laboratory.

Chemical or hazard type	Consequence(s) of risk	Level of risk ¹	Likelihood of occurrence ²	Action to control risk during experiment

¹L = low; M = moderate; H = high; E = extreme

²H = highly unlikely; U = unlikely; L = likely

GRADUATE STUDENT OR RESEARCH PERSONNEL DETAILS

Name: _____

Supervisor/Professor: _____

Laboratory Location: _____

Dates of laboratory use: _____

Signature of student or research personnel

Date

Signature of research professor in charge

Date

APPENDIX 4: COVID-19 INFORMATION AND PREVENTION

WEARING A MASK OR FACE COVERING IS MANDATORY AT ALL TIME IN THE ENCLOSED SPACES

If you have fever, cough, shortness of breath, muscle aches or tiredness, please STAY HOME and contact tele-health at 1-866-797-0000 or your health-care provider and let them know.

For COVID-19 update and resources for students, faculties and staff visit Ryerson website at:
<https://www.ryerson.ca/covid-19>

For COVID-19 report of Toronto Public Health update, and more details cases in Toronto, please refer to the following website three times per week on Monday, Wednesday, and Friday:
<https://www.toronto.ca/> , COVID Update.

For COVID-19 report of Canada Public Health update, visit the following website:
www.canada.ca/ , COVID Update.

Contact Information

Telehealth Ontario

Call if you develop symptoms.

Telephone: 1-866-797-0000

Toronto Public Health Hotline

8:30 a.m. – 8 p.m.

Call if you have questions about COVID-19. Translation is available in multiple languages.

Telephone: 416-338-7600

TTY: 416-392-0658

Email: PublicHealth@toronto.ca

311 Toronto

Outside City limits: 416-392-2489

Call if you have questions about City services.

Telephone: 311

TTY: 416-338-0889

Email: 311@toronto.ca

Emergency Services

Call if you're having difficulty breathing or experiencing other severe symptoms.

Telephone: 911

KEEP YOURSELF & OTHERS SAFE