RESEARCH REGISTRATION FORM 1

Filing Date: RRF Number:

Revised Submission Date: Signature of Issuer:

Approval Date: Expiry Date:

Researcher's Name: Researcher's Signature:

Email Address (UofT Preferred):

UTORid: Student/Personnel #:

Your Home Department:

Supervisor's Name: Supervisor's Signature:

Supervisor's Home Department:

Office Room Number: Office Phone Number:

Lab Room Number: Lab Phone Number:

Researcher's Status (check one):

Student:

- ☐ M.Eng
- ☐ MASc
- ☐ PhD
- ☐ 4th Year
- ☐ Summer
- ☐ Other (Specify: volunteer, visiting, exchange, etc.):

Research Staff:

- ☐ Lab Technician
- ☐ Res. Assistant
- ☐ Res. Associate
- ☐ Post Doc
- ☐ Visiting Researcher (Long-term)
- ☐ Visiting Researcher (Short-term - less than 1 month)
- ☐ Other:

2 RESEARCH REGISTRATION FORM

SECTION 1: GENERAL INFORMATION ABOUT THIS FORM

All students, researchers and research staff that are registered in or working in the Department of Chemical Engineering and Applied Chemistry must complete this form. The form must be reviewed by their supervisor and approved by the Department's Health & Safety Committee. ***Completed forms should be submitted to the Department's H&S email (safety.chemeng@utoronto.ca).*** A research registration number will be issued when the form is approved; NO experimental research work can be conducted until this number is received. It is expected that the student/researcher and supervisor will meet to discuss the form content in detail and do a site visit to review all safety aspects of the experimental apparatus or procedure(s).

A new student/researcher who needs to job-shadow their trainer while they learn techniques and/or complete their required safety training is considered "In-Training". They are to fill out this form in as much detail as possible and submit it for temporary approval. ***They cannot conduct research in the lab by themselves while "In-Training",*** but can conduct laboratory work if they are continually accompanied by an experienced researcher who also has an approved experimental research form for the designated tasks**.** Once the required safety training and in-lab training period is completed, they are required to complete the form in full and submit it for final approval.

A short-term visiting researcher is considered "In-Training" and can job-shadow someone in the lab to learn techniques. ***They cannot conduct research in the lab by themselves*****.** If a short-term visiting researcher is expecting to work independently on experiments, they must complete this form and sufficient/appropriate safety training. Their full safety training record from their home facility is required prior to doing work here. The Health and Safety Coordinators will review the safety training and determine if further training is required. This will be determined on a case-by-case basis.

For most researchers and graduate students, this form expires annually on July 31st. The same form may be submitted for renewal if the work remains unchanged or has only minor changes. Please note minor changes in different coloured ink. A new form MUST be submitted whenever experimental procedures are significantly changed or new procedures are being planned.

For all 4th year thesis students, this form expires on April 30th. It must be resubmitted for extension until August 31st should the student stay on as a summer student.

For all summer students, this form expires on August 31st. It must be resubmitted for extension until April 30th should the student stay on as a 4th year thesis student.

Failure to submit a form at the beginning of the research project or for annual renewal could result in suspension of lab privileges until this has been rectified, or other sanctions as deemed necessary by the Department Chair.

☐ **If research involves Computer Work Only, check here. Please complete only Sections 2 and 3 of this form.**

☐ **If research involves Full Laboratory Work, check here. Please complete ALL Sections in Full (no TBD – to be determined).**

☐ **If this is an "In-Training" form, check here. Please complete Sections 2 to 4 of this form in detail and provide as much detail as possible in all other sections. Where you do not know full details yet, mark as TBD – to be determined.**

Target Date for Completion of Lab Training :

SECTION 2: SAFETY TRAINING REQUIRED

Please attach a copy of your UofT EH&S Training Record confirming completion of all required and supplemental EH&S courses.

WHO NEEDS TO TAKE SAFETY COURSES	COURSE CODE	TRAINING COURSE DESCRIPTION	DATE OF COMPLETION
New Grad students PDFs Lab Techs Res. Assocs/Assists Visiting Researchers Research Admin Staff	o CHE2222 o EHS002 o EHS101 o IAR	CHE Departmental Orientation & Safety EH&S Basic Health and Safety Awareness EH&S WHMIS Identify Assist Refer	
CHE Summer Students	o CHE Summer o EHS002 o EHS101	CHE Summer Student Safety EH&S Basic Health and Safety Awareness EH&S WHMIS	
4th YR Students	o CHE 4th Yr o EHS002 o EHS101	4th Yr Student Safety EH&S Basic Health and Safety Awareness EH&S WHMIS	
New Department Faculty	o CHE2222 o EHS002 o EHS101 o EHS009 o EHS536	CHE Departmental Orientation & Safety EH&S Basic Health and Safety Awareness EH&S WHMIS EH&S Lab Academic Supervisor Safety Office Ergonomics	
New Department Administrative Staff	o EHS953 o EHS101 o EHS536	Health & Safety Awareness in Labs for Non-Lab Users EH&S WHMIS EH&S Office Ergonomics	
All returning Faculty, Department Administrative Staff, Grad students, PDFs, Lab Techs, Res. Associates/Assistants, Visiting Researchers, Research Admin Staff		CHE Annual Department WHMIS Refresher. Those taking CHE2222 or CHE 4th Year Safety during current year are exempt from current year WHMIS Refresher.	

Job Specific Supplemental Safety Training	o EHS601	EH&S Laboratory Biosafety	
	o EHS602	EH&S Biosafety Refresher	
	o EHS603	EH&S Blood-borne Pathogens	
	o EHS709	EH&S Radiation Safety	
	o EHS710	Awareness EH&S Sealed Sources	
	o EHS739	Safety EH&S Laser Safety	
	o EHS741	Awareness EH&S X-ray Safety	
	o EHS751	UV Radiation Safety Awareness	
	o Extras	Compressed Gases	
	o External/Other		

SECTION 3: GENERAL EMERGENCY CONTINGENCY PLANS

3A. Working Alone and Using the Buddy System:

For personal safety and protection, researchers working outside normal University operating hours of Monday to Friday, from 8:00 am to 5:00 pm, whether in a lab or office area are expected to follow the buddy system. Researchers must also discuss the Job Safety Analysis and Risk Assessment prepared by the PI or lab management.

If experimental work involves extremely hazardous materials, the buddy system should be used at all times when working in the lab.

1. Job Safety Analysis (JSA) discussed with PI /Management? Yes ○ No ○
2. Working alone requirements for this project

   Visual buddy check in required ☐ Verbal / text communication ☐
3. Risk Level of Activities:

   Low Risk ○ Moderate Risk ○ High Risk ○

3B. Location Specific Emergency Information:

1. How many entry points are there to the lab/office:
2. Exact location of nearest fire alarm(s):
3. Exact location of nearest fire extinguisher(s):
4. Fire extinguisher type(s):

3C. UofT Emergency Numbers:

1. UofT Emergency Number: 82222
2. UofT Spill Cleanup Number: 87000
3. UofT Facilities/Services Emergency Number: 83000
4. UofT WalkSafe / Travel Safer : 87233

3D. Basic Procedures: What procedure would you follow in the case of each of the following?

1. Fire alarm sounds:

2. First aid required:

3. Chemical odour detected:

SECTION 4: BRIEF DESCRIPTION OF PROJECT OPERATIONS

4A. Title:

4B. Duration:

If **"In Training",** describe the equipment and work you will be trained on:

Name of Trainer: RRF # of Trainer:

Status of Trainer:
(Supervisor, senior grad student, senior post doc or senior lab tech)

Trainer Signature:
(I have read the description of the work that my trainee has written. To the best of my ability, I will train them and be responsible for their safe practices in the lab)

Complete the remainder of this form to the best of your ability, If unknown, mark as TBD (To Be Determined). **You cannot conduct research in the lab by yourself while "In-Training".**
You must work directly with your trainer and they must be present at all times.

4C. Description:

Briefly describe your experiment, including all chemicals and equipment and how they will be used; identify any hazardous or noxious products or by-products, gases or chemicals that may be formed during the project experiments. Also include a sketch of the experimental setup.
Attach additional pages if needed. (SOP, diagrams, detailed description, etc.)

SECTION 5: DETAILED DESCRIPTION OF PROJECT OPERATIONS

5A. Apparatus:

5A.1 Equipment: (attach a sketch of the experimental setup)

Item	Material of Construction	Capacity	Operating Temperature (Min/Max)	Operating Pressure (Min/Max)

5A.2 Connections Between Vessels, Valves, Inlets/Outlets, etc:

Connection/Joint Type	Material of Construction	Dimensions	Operating Temperature (Min/Max)	Operating Pressure (Min/Max)

5A.3 Electrical Requirements: (other than standard 115V/15A):

Equipment	Frequency	Voltage	Wattage	Phase

5A.4 Storage Vessels: (include gas cylinders):

Item	Material of Construction	Capacity	Material Stored	Operating Temperature	Operating Pressure

SECTION 5: DETAILED DESCRIPTION OF PROJECT OPERATIONS cont'd.

5B. Potential Hazards Involved in the Project:

Check off all that apply to the experiment. Answer this section keeping in mind the worst-case scenario that could happen while running the experiment.

☐ **5B.1 Biohazard:**

Animal Usage ☐ Biological Agent ☐

Means of transmission: Portal of Entry:

Common Name: Scientific Name:

Mass, volume use per day:

Volume you keep in the lab:

What are the consequences of exposure?

Do you use BSC? Yes ☐ No ☐ If yes, what type, class? SOP's for using BSC:

Disinfection method:

Disposal method:

SOP's for spill of Biological agent:

Other Control Measures:

UofT Biosafety Training: Yes ☐ No ☐ EH&S Training Certificate Attached ☐

☐ **5B.2 Laser Hazards:**

Type: Class:

Control Measures:

UofT Laser Training: Yes ☐ No ☐ EH&S Training Certificate Attached ☐

☐ **5B.3 Radiation Hazards:**

Ionizing ☐ Non-ionizing ☐
Source: Open ☐ Sealed ☐

Type of Emission: Source Strength:

Control Measures:

UofT Radiation Protection Training: Yes ☐ No ☐ EH&S Training Certificate Attached ☐
UofT Sealed Source Training: Yes ☐ No ☐ EH&S Training Certificate Attached ☐

☐ **5B.4 Fire Hazards:**

Ignition Sources: List all potential ignition sources in lab (not just for project):

☐ Heaters:
☐ Electrical equipment:
☐ Open flame:
☐ Other (list here):

Sources of Combustible Materials: List all potential sources of combustion in lab:

☐ Flammable gases/liquids (oils, solvents, paints)
☐ Natural gas (supplied through building in some labs)
☐ Chemicals
☐ Other (list here):

Control Measures Used for Items Checked Above:

SECTION 5: DETAILED DESCRIPTION OF PROJECT OPERATIONS cont'd.

5B. Potential Hazards Involved in the Project cont'd.:

Check off all that apply to the experiments. Answer this section keeping in mind the worst-case scenario that could happen while running the experiments.

☐ **5B.5 Equipment/Storage Vessel Hazards:**

List all potential hazards present or that could occur in equipment used in project:

- ☐ Equipment malfunction/failure
- ☐ Noise
- ☐ Over-pressurization
- ☐ Overheating
- ☐ Pinch points
- ☐ Tension load
- ☐ Moving parts
- ☐ Sharp objects
- ☐ Trip hazard
- ☐ Disconnect of connections between vessels, valves, etc.

☐ Flooding from water use:
Purpose:
Source : ○ recirculating ○ mains/tap ◉ no running water

☐ Natural gas:
Purpose:
Connections:

☐ Compressed air:
Purpose:
Pressure:
Connection material:

☐ Others (list here):

Control Measures Used for Items Checked Above:

Will equipment be running overnight?
Includes waterbaths, shakers, GC's, rotoevaporators, etc. Does not include fridges, freezers, incubators, etc. that remain on in lab 24/7.

☐ Yes
☐ No

If yes, a permit is required. Attach a separate page and explain the control measures:
Permit is attached ☐

SECTION 5: DETAILED DESCRIPTION OF PROJECT OPERATIONS cont'd.

5B. Potential Hazards Involved in the Project Experiments cont'd.:

Check off all that apply to the experiments. Answer this section keeping in mind the worst-case scenario that could happen while running the experiments.

☐ **5B.6 Chemical Hazards:**

List all potential hazards present or that could occur with chemicals/reactions in the project:

- ☐ Chemical burns
- ☐ Toxic/poisonous chemicals
- ☐ Incompatible chemical waste
- ☐ Runaway reaction
- ☐ Corrosion
- ☐ Explosion
- ☐ Fire
- ☐ Nanomaterial
- ☐ Designated substances
  (Permit is required) Permit is attached ☐
- ☐ Oxygen deficient conditions (use of Liq N_2)
  (Complete Gas Law calculation sheet) Calculation Sheet attached ☐
- ☐ Hazardous or noxious off-gases/by-products:
  List them:

  Identify hazard:
- ☐ Others (list here):

Control Measures Used for Items Checked Above:

SECTION 5: DETAILED DESCRIPTION OF PROJECT OPERATIONS cont'd.

5C. Personal Protective Equipment (PPE) Required: (check all that apply)

Protection Area	PPE	Type	Purpose
Legs, arms, etc.	☐Lab Coat		
Eyes, face	☐Safety Glasses ☐Goggles ☐Face Shield		
Head	☐Hard Hat		
Hands	☐Chemical-resistant Gloves ☐Insulated Gloves		
Feet	☐Steel-toed Shoes		
Lungs	☐Respirator ☐Dust Mask Fit tested? ◯ Y ◉ N		
Noise	☐Ear Plugs		

Note: General safety practice while working in a laboratory is to wear proper Personal Protective Equipment (PPE) at all times. An injury may occur due to an accident with your work, or from someone working nearby. Researchers are required to use appropriate PPE and apparel when working in a laboratory. The following basic guidelines must be adhered to:

- **Contact lenses** are not recommended in any laboratory. If contact lenses must be worn, safety goggles must also be worn.
- **Safety eyewear** is required when working in labs. This may consist of safety glasses with sideshields, safety goggles, or a full face shield, depending upon the degree of hazard.
- **Lab coats** Lab coats provide an excellent barrier (both in terms of safety and cleanliness) between you and your experiment. If you are working with highly flammable chemicals or open flame, you are not allowed to wear polyester lab coat.
- **Shorts/skirts/dresses** may not be worn in any chemical laboratory, as they provide no protection to your legs in the event of a chemical spill.
- **Closed-toed shoes must be worn in all laboratories. Open toed shoes or sandals** may not be worn in laboratories.
- **Roller blades** may not be worn in any University building.
- **Hard hats** may be required in certain working areas or for certain activities in any lab where there is the potential for objects falling from overhead.
- **Oven mitts/gloves** are required when handling extremely hot or extremely cold substances.
- **Special gloves** may be required when handling dangerous chemicals. Note that **the use of the incorrect type of gloves may increase the danger**; please check with a member of the safety committee for up-to-date guidelines regarding the types of gloves to be used. The Fisher and Revere-Seton catalogs provide a comprehensive list of glove types and their compatibility with a range of chemicals.
- **Hearing protection** may be necessary if working for extended times near noisy equipment (>80dBa).
- **Dust masks** may be required if working with small particulates, etc. You should contact EHS to get fit tested.
- **Cartridge-type Respirators** may be necessary if working with asphyxiants or other substances that are hazardous if inhaled. You should contact EHS to get fit tested.

SECTION 6: PROJECT OPERATIONS EMERGENCY CONTINGENCY PLANS

6A. What procedure would you follow in the case of each of the following:

1. Fire in lab:

2. Chemical spill:
   Small:

   Large:

3. Chemical exposure (inhalation; ingestion; chemical on skin or in eyes; gas/odour release; etc.):

4. Physical hazard accident (cuts; crushes; slips/falls; etc):

6B. Location Specific Emergency Information:

1. Exact location of eye wash station:
2. Exact location of safety shower:
3. Exact location of spill kit(s):
4. Exhaust:
   a. Fumehood — Present in lab ☐ — Required for work ☐
   b. Canopy hood/elephant trunk — Present in lab ☐ — Required for work ☐
   c. Glovebox — Present in lab ☐ — Required for work ☐

SECTION 7: DETAILED LIST OF CHEMICAL SUBSTANCES USED/PRODUCED IN PROJECT EXPERIMENTS

Please list ALL Chemicals and Gases being USED, and all HAZARDOUS Chemicals, By-Products, Off-gases PRODUCED. Do not just attach the laboratory chemical inventory. You must look up MSDS for all chemicals in your list. **Attach additional pages if necessary.**

(Note: The following substances have been designated by the Department as presenting particular hazards. Their use ***or production*** requires a permit which should be appended to this form: acrylonitrile, arsenic asbestos, benzene, carbon disulfide, carbon tetrachloride, ethylene oxide, formaldehyde, isocyanates, lead, mercury, silica, styrene, vinyl chloride monomer, H_2S (hydrogen sulfide gas), cyanide, cadmium, HF).

Name	Quantity mass or vol/yr	TLV[1] or LD_{50}	Route of Entry[2] (& Health Risk)	Corrosion Hazard	Flammability (Flash Point)/ vapour pressure	Autoignition Temperature	Reactivity Hazard or Incompatibilities

Total Number of **Departmentally Designated Substances** Used or PRODUCED (attach a permit application for each one):

Disposal Arrangements for Chemical Wastes

Type of waste container(s): Classes of Waste (e.g. flammable organic solvent, etc.):

Size(volume): Bottle Codes (Supervisor's initials-room #-waste code: i.e. RRF-419-Da):

Disposal Collection Room: Waste Disposal Location (WB16 for labs in Wallberg Bldg).

SECTION 8: SUGGESTED REFERENCES

1. A.C.G.I.H., "Threshold Limit Values" (1991 or 1992).
2. N.J. Sax, "Dangerous Properties of Industrial Materials".
3. H.H. Uhlig, "Corrosion & Corrosion Control".
4. H.F. Coward and G.W. Jones, "Flammability Limits of Gases and Vapours", Bureau of Mines\Bulletin 503.
5. N.V. Steere, "Handbook of Laboratory Safety".
6. National Fire Protection Association, "Fire Protection Guide on Hazardous Materials".
7. University of Toronto Environmental Health and Safety, "Handling Procedures for Chemical Wastes".
8. L. Bretherick, "Handbook of Reactive Chemical Hazards".
9. National Fire Protection Association, "Manual of Hazardous Chemical Reactions".
10. SDS Links:
    a. http://ccinfoweb.ccohs.ca/msds/search.html
    b. UofT EH&S MSDS suggested sites
    c. http://www.hazard.com
11. Job Safety Analysis Form
    a. https://ehs.utoronto.ca/wp-content/uploads/2014/06/Job-Safety-Analysis-Form-November-2019.pdf
12. Working Alone Guidelines
    a. https://ehs.utoronto.ca/wp-content/uploads/2020/03/Working-Alone-Guidelines.pdf

LEAVE ON OVERNIGHT PERMIT

** POST COPY AT SITE OF USE **

EQUIPMENT: _____

(PLEASE DO NOT TOUCH THIS APPARATUS)

IN CASE OF EMERGENCY OR POWER FAILURE, TURN OFF SERVICES AT THE FOLLOWING LOCATIONS:

ELECTRICITY AT _____

WATER AT _____

GAS AT _____

IN EMERGENCY CONTACT

	NAME	EMERGENCY CONTACT PHONE #
RESEARCHER:	_____	
SUPERVISOR:	_____	

PERMIT NUMBER: _____ **SUPERVISOR'S SIGNATURE:** _____

SAFETY REGISTRATION NUMBER: _____ **DESIGNATE OF SAFETY COMMITTEE** _____

EXPIRY DATE: _____

** POST COPY AT SITE OF USE **

DESIGNATED SUBSTANCE PERMIT
(APPLICATION FOR PERMISSION TO USE)

The following substances have been designated by the Department as presenting particular hazards. Their use ***or production*** requires a permit which should be appended to Research Registration form.

Acrylonitrile, Arsenic, Asbestos, Benzene, Carbon disulfide, Carbon tetrachloride, Ethylene oxide, Formaldehyde (includes para), Isocyanates, Lead, Mercury, Silica, Styrene, Vinyl chloride monomer, H_2S (hydrogen sulfide gas), Cyanide, Cadmium, HF

<table>
<tr><td colspan="2">Substance:</td></tr>
<tr><td>Researcher's Name:</td><td>Supervisor:

Research Registration No. :

How long do you plan on using the substance:</td></tr>
<tr><td>Quantity:

Ceiling:

TLV:

PEL:

Is the quantity you use less than above limits? If yes, explain why.</td><td>Control Procedures:

SOP in case of spill:</td></tr>
</table>

Date of Issue: _____ Expiry Date: _____

Signatures: _____ Applicant

_____ Supervisor

_____ Designate of Safety Committee

CRYOGENICS – GAS LAW CALCULATION
(REQUIRED FOR USE OF LIQUID NITROGEN IN EXPERIMENTS)

Worst-case Scenario in Oxygen depletion by liquid nitrogen spill: the entire contents of the Dewar or storage tank are lost to the room immediately after spilling (100% of the vessel contents).

Example Calculation:

V_N = Total volume loss of Liq. N_2 (100%) = 1.0

V_R = Total room volume (m^3)

V_D = Dewar or Vessel capacity (litres)

F_G = Gas Factor for N_2 (683 for N_2)

0.21 = Normal concentration of O_2 in air (21%)

V_{OX} = Total volume of O_2 in room (m^3) = $0.21 \times \{V_R - [(V_N \times V_D \times F_G)/1000] \}$

C_{OX} = Total concentration of O_2 remaining in room after 100% L. N_2 container spill = $100 \times V_{OX}/V_R$

For a room size 71m^3, and a 100% Liq. N_2 spill of 41 litres:

The total vol. of O_2 in room = $V_{OX} = 0.21 \times \{71 - [(1.0 \times 41 \times 683)/1000] \} = 9.03\ m^3$

Total conc. of O_2 remaining in room = $C_{OX} = 100 \times 9.03/71 = 12.71\%$

Requirements: In a worst-case scenario where all of the Liq. N_2 container spills, the total concentration of O_2 remaining in the room must be 20% or more. Otherwise the following is required:

- Room equipped with O_2 detector that sounds an alarm when the O_2 concentration falls below 20%
- Warning signs are displayed both on door to lab and next to L. N_2 dewar or dispenser
- Proper mechanical/non-mechanical ventilation must be installed within lab

Recommended alternative action: Reduce the size/volume of the Liq. N_2 dewar, to ensure that the O_2 concentration exceeds the minimum, and an oxygen-deficient atmosphere is avoided.

<u>Your Calculation:</u>

For a room size (X) _____ m^3, and a 100% Liq. N_2 spill of (Y) _____ litres:

The total vol. of O_2 in room = $V_{OX} = 0.21 \times \{$**X** $- [(1.0 \times$ **Y** $\times 683)/1000] \} =$ **Z** m^3

The total vol. of O_2 in room = Vox = $0.21 \times \{$_____ $- [(1.0 \times$ _____ $\times 683)/1000] \} =$ _____ m^3

Total conc. of O_2 remaining in room = $C_{OX} = 100 \times$ **Z/X** = **????** %

Total conc. of O_2 remaining in room = $C_{OX} = 100 \times$ _____/_____ = _____**%**