

Faculty of Engineering and Applied Science

SAFETY MANUAL

Revised: January 2023

INTRODUCTION AND PURPOSE

The purpose of this manual is to provide faculty, staff, students, research supervisors and researchers with a single source which outlines their responsibilities and duties under the Ontario Occupational Health and Safety Act (OHSA) and Faculty and University safety policies and procedures.

Safety is the first priority at all times and in every task we undertake at Ontario Tech University, whether individually or in teams. Under no circumstances are activities to be conducted without understanding the relevant hazards, ensuring that the environment is safe, and that everyone involved in a task has the necessary skills, procedures and equipment that ensure the safety of everyone concerned.

Every individual has a personal legal obligation under health and safety legislation to ensure that all work is conducted in a safe manner and in accordance with applicable legislation and regulations. Supervisors, in particular, have a duty to be aware of all hazards in areas under their supervision or control, to establish procedures to deal with these hazards, and to ensure that workers are aware of these hazards and provided with appropriate training and equipment to work safely. Supervisors are required to take every reasonable precaution for the protection of workers. Fines and/or jail sentences have resulted from violations of the OHSA.

Laboratories can be hazardous places. They may contain a wide variety of hazardous chemical, biological or physical agents. Research, by its very nature, involves many unknowns. However, these hazards can be managed through careful planning, identification and assessment of the risks and the institution of proper control measures. It is the policy of the Faculty of Engineering and Applied Science to take every reasonable precaution to create a safe and healthy work and study environment for all of our faculty, staff and students.

Dr. Hossam Kishawy, Dean Faculty of Engineering and Applied Science



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1 HEALTH AND SAFETY POLICY

The Ontario Tech University is committed to providing a safe and healthy work and learning environment for its employees, students, visitors and contractors. The prevention of occupational illness or injury is a major continuing objective at the University, and the university will take every reasonable precaution to provide and maintain a safe and healthy work and learning environment. As a minimum standard, the university shall comply with all statutory requirements, including the Ontario Occupational Health and Safety Act, the Environmental Protection Act and other applicable federal and provincial legislation and local statutes and by-laws.

The university is responsible for establishing, maintaining and communicating a safety program to implement this policy. The university shall develop, document and implement hazard specific safety policies, regulations and procedures and shall ensure that all employees and students are aware of these safety policies and of their rights and responsibilities for maintaining safe working conditions.

Every employee and student has a responsibility to work safely in accordance with both the statutory requirements and the university safety policies and procedures and to report any unsafe acts or conditions.

Employees in a supervisory position have an additional responsibility to ensure that persons under their supervision are made aware of any hazards in the workplace and that these individuals comply with all applicable safety policies and procedures. Supervisors are responsible for ensuring that any hazards or safety violations in workplaces under their control are investigated and corrected promptly.

Contractors and sub-contractors performing work for the university must, as part of their contract, comply with all relevant workplace and environmental health and safety statutes and to meet or exceed the university's safety program requirements.

It is the intent of the University that a commitment to health and safety form an integral part of the culture of the institution and all its activities.

The University shall establish a Joint Health and Safety Committee, as required by the OHSA, to identify and evaluate potential hazards, recommend corrective actions to the employer and to monitor implementation of the corrective actions.

This policy will be reviewed on an annual basis.

The Health and Safety Policy was approved by the Board of Governors in June 2012 and last updated on February 18, 2020.

For more information please refer to <u>https://usgc.ontariotechu.ca/policy/policy-</u> library/policies/legal,-compliance-and-governance/uoit-health-and-safety-policy.php



2 WORKER RESPONSIBILITIES

A worker, as defined in the OHSA, is a person who performs work or supplies services for monetary compensation. For issues respecting health and safety within the Faculty, students, even if not paid, will be afforded protection equivalent to that provided by law to workers.

Under Ontario health and safety law, every worker has three basic rights with respect to health and safety in the workplace:

The Right to Know – You have a right to know of any hazards in the workplace and to be given information and training to deal with these hazards and to perform your work safely. Your supervisor is the first point of contact with respect to workplace hazards. You may also direct questions to your health and safety committee representative.

The Right to Participate – You have a right to participate in decisions affecting your health and safety. You should feel free to discuss any health and safety concerns with your supervisor. You are also represented on the Ontario Tech Health and Safety Committee and you have a right to participate in the selection of your representative. Elections are held in July of each year. The names and affiliations of the committee members are posted locally and are on the health and safety website.

The Right to Refuse Unsafe Work – You have a right to refuse to perform work which you believe to be unsafe. The procedures to follow in exercising this right are in the Ontario Occupational Health and Safety Act and are also posted on the health and safety website.

Just as the law gives you certain rights it also places on you certain duties with respect to health and safety. Workers have to work in accordance with the provisions of the Occupational Health and Safety Act (OHSA) and regulations and with University safety policies and procedures. In order to ensure worker and student safety, it is the Faculty policy that a) all undergraduate students must write and pass an online Laboratory Safety Test before they can conduct any experiment in the laboratory for each course that they enroll in, b) all graduate students and TAs follow the training schedule as outlined in Section 5 of this document.

Workers and students have the following specific duties:

- To work in accordance with the provisions of the Occupational Health and Safety Act (OHSA) and regulations and with University safety policies and procedures.
- To follow the policies, rules and procedures set down by their supervisor (see Section 9). Undergraduate students who will be using the laboratory must pass an **online** Laboratory Safety Test which will be made available for ENGR1015U (including WHMIS);
- To use the protective clothing, equipment and devices specified by their supervisor;
- To immediately report any unsafe acts or conditions and violations of safety regulations to their supervisor or to the Faculty Health and Safety Coordinators;
- To not work alone especially when high voltages, high pressure, or hazardous materials are involved (see Section 9.9.2 for details);
- To not tamper with nor remove any protective devices required by the Act or by the University;



- To not work in a manner which endangers themselves or any other worker;
- To not engage in any horseplay, pranks or other potentially dangerous conduct.

3 SUPERVISOR RESPONSIBILITIES

A supervisor, as defined in the Occupational Health and Safety Act is a person who has charge of a workplace or authority over a worker. The Act requires supervisors to take every precaution reasonable in the circumstances for the protection of a worker.

All members of the Faculty and research supervisors have the following specific duties:

- To be familiar with the Occupational Health and Safety Act and regulations and any University and Faculty policies which apply to the workplace and workers under their supervision (see Section 9);
- To be aware of any health and safety hazards, actual or potential, in the work or workplaces under their supervision and to advise workers of these hazards;
- To ensure that workers under their supervision are provided with appropriate training, supervision, procedures and protective equipment and devices to enable them to work safely and to ensure that any protective equipment provided is properly maintained;
- To ensure that workers under their supervision properly use the safety equipment and follow the safe working procedures provided to them;
- To maintain an up-to-date inventory of all hazardous materials and hazardous physical agents in the workplace;
- To ensure that all hazardous materials are properly identified and labeled and that Safety Data Sheets are readily available for all hazardous materials;
- To ensure that workers under their supervision receive and participate in appropriate safety training sessions;
- To ensure that hazardous materials are disposed of in accordance with the appropriate University policies and procedures.
- To ensure that experiment registration and safety analysis forms are duly filled out.

4 FACULTY HEALTH AND SAFETY COORDINATOR

The Faculty will have a designated Health and Safety Coordinator who will be the point of contact for the registration (see Section 6) of all experiments in the research labs. The research lab experiment registration and safety assessment will be carried out by the Research or Lab Supervisors. The undergraduate teaching labs experiment registration will be coordinated by the Faculty Health and Safety Coordinator. The registration of undergraduate experiments will be carried out by the designated lab instructors or technicians. The Faculty Health and Safety Coordinator will coordinate with Faculty of Engineering and Applied Science and Ontario Tech's Health and Safety Committee in carrying out routine inspection, situational inspection, preventive maintenance, implementation of safety policies, promotion of safety procedures, and other related subjects. The names and contact information of the Faculty Health and Safety Coordinator is listed in <u>Table 1: Faculty Health and Safety Coordinator</u> in Section 10 below.



5 TRAINING REQUIREMENTS

All members of the Faculty of Engineering and Applied Science (FEAS) must participate in safety training before they begin work. The specific training requirements will vary depending on your position within the Faculty and the type of work you are undertaking. The general training schedule is given in <u>Table 4</u> in Section 10.2 below.

6 REGISTRATION OF TEACHING AND RESEARCH EXPERIMENTAL WORK

It is Faculty policy that all teaching experimental work be registered prior to commencing work on the project. The purpose of registration is to ensure that all actual and potential health and safety hazards involved in the work have been identified and measures taken to eliminate or properly manage these hazards. The review will also ensure conformance with any relevant health and safety regulations.

An **Experimental Registration/Safety Analysis Form** (see Section 0 and 10.4) must be completed, reviewed and signed by the lab instructor or supervisor and submitted to the Manager Technical Services for review and final authorization. The form will be returned to the submitter if it has any missing information or requires revisions. Work may not begin until the form has been properly authorized.

The authorized Registration forms must be reviewed on an annual basis and may be re submitted for extension if the work is ongoing. If there is any substantive change in the chemicals, equipment or procedures used, a new form must be submitted before making the changes.

It is also recommended that all new experiments or equipment related to research should undergo similar registration with the lab supervisor, and a copy of the registration be sent to one of the Health and Safety coordinators. It is recognized that in research activities, modifications are continually made. Hence, the equipment and its general operating procedure should be registered instead of the day to day experimental variations. It will be the responsibility of the research lab supervisor to ensure that the experiments and any variations to the experimental procedure conform to the safety standards.

7 HAZARDOUS MATERIALS INFORMATION

All hazardous materials brought within the Faculty must be accompanied with an SDS. All "Designated Substances" defined in the Occupational Health and Safety Act (OHSA) and other hazardous materials designated by Ontario Tech (see Section 0) brought within the Faculty must be reported to Faculty Health and Safety Coordinators along with a copy of the SDS. The coordinators will keep this information within easy access of all faculty members (i.e. through its website). A copy of the SDS should also be placed at a designated area in the lab where materials are stored. For more information about the requirements for management and use of hazardous materials in research and teaching laboratories at Ontario Tech, please refer to **Laboratory Safety Manual for General Laboratory Operations**:

https://shared.ontariotechu.ca/shared/department/healthandsafety/documents/lab-safetymanual.pdf



8 HEALTH AND SAFETY COMMITTEE

Ontario Tech has a legislated Health and Safety Committee which ensures safe and healthy work conditions at the campus, and therefore, has jurisdiction over these matters as they apply to the Faculty of Engineering and Applied Science.

The names and contact information of the Health and Safety Committee members can be found on the Ontario Tech Health and Safety website: <u>https://healthandsafety.ontariotechu.ca/</u>

9 FACULTY POLICIES

The Faculty will follow the Ontario Tech health and safety policies. The safety guidelines, procedures, and references for Ontario Tech's workplace, laboratory, and materials storage are provided on the Ontario Tech Health and Safety Policies website: <u>https://healthandsafety.ontariotechu.ca/</u>

Faculty of Engineering and Applied Science has its own laboratory policies and safety protocols, which are described in the **Engineering Laboratory Policies and Safety Protocols Reference Manual**, which can be downloaded from the Faculty of Engineering and Applied Science website: <u>https://shared.ontariotechu.ca/shared/faculty/feas/documents/FEAS-Lab-Policies-and-Protocols-Manual-Current.pdf</u>

All the safety protocols and policies outlined in this reference manual should be considered as the minimum requirements for maintaining a safe and hazard-free workplace.

To effectively implement the safety policies into practice, laboratory and workplace must be inspected and maintained on a routine basis and such responsibility must be delegated by the Lab Directors/Coordinators/Supervisor for both Teaching and Research Labs. All sorts of incidents, accidents, equipment failures, and hazards must be identified by the lab user and reported immediately to the designated personnel.

9.1 Accident/Injury Report

All accidents involving a personal injury must be reported immediately to the Human Resources Department using the Online "Accident Injury Form" (https://healthandsafety.ontariotechu.ca/forms/accident-injury-form.php). Copies of this form are available in all First Aid Boxes, from Department and School Offices, the Campus Health Centre, the Security/Main Reception area in the Gordon Wiley Building and from the Human Resources Department in the Simcoe Building and from the Faculty office. For all accidents or incidents which could potentially have caused health and safety concerns, these forms must be duly filled out and submitted to the Faculty office. The Faculty office will bring these to the notice of the Faculty Health and Safety Coordinators, and the Dean and forward these to the HR department. For more information, please refer to the Accident Reporting Procedure on the Ontario Tech Health and Safety website under the heading **Policies + Procedures.**



9.2 Incident/Equipment Failure Report

All equipment failures or potential hazards must be reported to the laboratory supervisor or Technical Services and Laboratory staff wherever applicable immediately. The undergraduate students must report the equipment failure to their teaching assistant (TA) or Laboratory Instructor who must complete and submit the **Incident/Equipment Failure Report Form** (see Section 10.5). The TAs should submit reports to their supervisor i.e. lab supervisor or one of the Technical Services staff. For researchers and graduate students, they must fill out the report and submit it to their supervisor(s). All such forms, relating to teaching labs, should finally be submitted to the Manager Technical Services. This procedure should also be followed for research labs, if the incident/failure had health and safety implications. The Manager Technical Services will bring these to the notice of the Dean, and forward these to the HR department, if warranted.

Teaching assistants can normally be reached by their emails or phone numbers (if available). Safety hazards may also be reported to the Health and Safety Committee by sending an email message to <u>healthandsafety@ontariotechu.ca</u>

The contact information for our Technical Services and Laboratory Staff is listed in <u>Table 3</u> in Section 10.1 below.

9.3 Corrective Action Plan Procedures

If warranted, a copy of the accident or incident report will be forwarded by the Dean to the relevant teaching or research lab supervisor for corrective/follow-up actions such as equipment lockout, inspection, and maintenance, so that recurrences may be prevented. In response, a report of corrective measures, or the reasons why they are not necessary must be submitted to the Dean. The Dean may require a final sign off by another designated person (i.e. inspector) if he deems it necessary.

9.4 Equipment Lockout Procedure

Equipment lockout is part of the Corrective Action Plan Procedures (see Section 9.3), where the situation so demands. Upon hazard assessment and identification of the laboratory, individual equipment may require undergoing a lockout state if a health and safety-related problem persists or cannot be solved immediately, and the responsible supervisor thinks that a lockout is warranted. In such cases, the individual equipment must be shut off from power, disconnected from the main power panel, and tagged with a lockout label. It is recommended that **a Laboratory/Equipment Lockout Form** (see Section 0) be filled out by the laboratory supervisor so that follow-up actions can be properly documented, particularly in matters involving teaching laboratories. Without further notification from the appropriate supervisor, the lockout label must never be removed and the equipment must remain in a lockout state.

9.5 Workplace Inspection

It is strongly suggested that each lab director/research lab supervise setup a system of regular



internal inspections, and keep a documented record of the inspection dates and any concerns found during the inspection. Things to observe are: safe and proper operation of the equipment; appropriate materials storage; proper utilization of all safety precautions; clear identifications of any hazardous materials and situations etc.

Bi-annual workplace inspection is conducted in conjunction with the Health and Safety Committee. The members of the Health and Safety Committee and the Faculty Health and Safety Committee volunteer to participate in the inspections. Members who conduct the inspection should carefully examine the potential hazards in the workplace and laboratory and fill out a **Workplace Inspection Form** (see Section 10.6). When the form is completed, it should be submitted to the Health and Safety Committee for assessment and evaluation.

9.6 Preventive Maintenance Scheduling

Preventive maintenance should be conducted on a routine basis to ensure that equipment always operates in a safe and proper working condition. Such work is normally done by the Technical Services staff unless otherwise specified by the manufacturer that the equipment requires specially trained person(s) to perform the task. It should be noted that all hard-wired equipment and facilities such as fume hoods, fire alarms, fire extinguishers, safety showers, toxic gas detectors, carbon monoxide detectors, elevator, non-portable transformers, non-portable compressor in compressor room...etc. should be maintained by the Facilities Management. Requests of such maintenance should be directed to the Facilities Management Help Desk at ext. 2326 or servicedesk@dc-uoit.ca.

All preventive maintenance should be conducted during non-lab sessions and regular work day hours unless an authorization is given by the Dean to do so. This is to ensure the safety of the instructor, teaching assistant, and students who are using the laboratory.

For more information, please refer to Section 7.1 of the Engineering Laboratory Policies and Safety Protocols Reference Manual for the Preventive Maintenance Safety Protocols description.

9.7 Protective Clothing and Equipment

The use of protective clothing and equipment, if warranted, is mandatory. It is the responsibility of the instructor or teaching assistant to ensure that adequate Personal Protective Equipment (PPE) are always available for all persons present in the laboratory if they are required by the experiment. The **Experimental Registration/Safety Analysis Form** (see Section 10.3) must clearly indicate the type of PPE required to conduct each experiment. Section 10.7 provides a general guideline of the PPE types and usage. Anyone who has questions about the use of PPE should contact the Faculty Health and Safety Coordinators.

9.8 Hazardous Waste Disposal

Hazardous waste such as scrap metal, solvents, petroleum-based products, biohazardous and radioactive materials etc. must be handled with special care. Our Faculty has designated



Hazardous Waste Coordinators, (refer to <u>Table 2</u> for contact information) to assist workers of our Faculty to deal with the disposal of such hazardous waste. For the disposal and handling of radioactive materials, please refer to Radiation safety program: <u>https://healthandsafety.ontariotechu.ca/programs/radiation-safety-program/index.php</u>

9.9 Special Working Situations

9.9.1 Working with Radioactive and Hazardous Materials

Special permits must be obtained for persons who will be conducting experiments with radioactive and hazardous materials. For further details, please refer to: Radiation safety program: <u>https://healthandsafety.ontariotechu.ca/programs/radiation-safety-program/index.php</u>

9.9.2 Working Alone

Working alone should never be allowed, and if necessary, a **buddy system** should be strictly enforced, particularly, when working with machine tools, high voltage or high-pressure equipment, radioactive or hazardous materials. Laboratory supervisors (or another buddy) located in other parts of the building are responsible for checking to see that the laboratory users are safe at all times. A buddy system can be put to practice as follows: The "buddy" could call the users every 15 minutes or so to check on their safety. If the "buddy" does not get a response, he/she would then immediately go to the laboratory or call security to check on the users. As part of this system, a sign-in sheet may be placed at the laboratory entrance such that the users would fill in to indicate when they enter and leave the area. If during weekends or holidays or during off normal working hours, a buddy system cannot be put in place, the laboratory user must inform Security Desk (ext. 2400) when they enter and leave the laboratory and make arrangement so that the security staff can visit the lab, say at half-hourly intervals, to ensure worker safety. Refer to the University's Working Alone Procedures for more details: <u>https://hr.ontariotechu.ca/health-and-safety/procedures/working-alone-procedures.php</u>

9.9.3 Running Unattended Experiment

If a machine or equipment is to be run unattended, the users must inform Security Desk of the room number, location, emergency contact numbers, and the start and finish time of the task. In addition, a tag must be placed on the equipment indicating that it has been left running on purpose.

10 APPENDIX

10.1 Contact List

Table 1: Faculty Health and Safety Coordinator

Name (Position)	Office	Email
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	(Extension#)	
Govind Rehal (FEAS, Manager Technical Services)	ENG 1023 (ext. 3526)	Govind.Rehal@ontariotechu.ca
Sharman Perera (Associate Teaching Professor)	ERC 4028 (ext. 5505)	Sharman.Perera@ontariotechu.ca

Table 2: Faculty Hazardous Waste Coordinators

Name (Position)	Office (Extension#)	Email
Robert Ulrich	UB 3034	Robert.Ulrich@ontariotechu.ca
(Engineering Lab Specialist)	(ext. 2650)	
Russell Papadimitriou	SIRC 2032	Russell.Papadimitriou@ontariotechu.ca
(Engineering Lab Specialist)	(ext. 7357)	

Table 3: FEAS Technical Services and Laboratory Staff

Name (Position)	Office	Email	Phone		
Govind Rehal (Manager, Technical Services)	ENG 1023	Govind.Rehal@ontariotechu.ca	ext. 3526 or 905- 809-0256		
Hidayat Shahid (Assistant Dean for Engineering Laboratories, Associate Teaching Professor)	ENG 1021	Hidayat.Shahid@ontariotechu.ca	ext. 2791		
Peter Kahr (Engineering Lab Specialist)	ENG 1045A	Peter.Kahr@ontariotechu.ca	ext. 3647		
Russell Papadimitriou (Engineering Lab Specialist)	SIRC 2032	<u>Russell.Papadimitriou@ontariotec</u> <u>hu.ca</u>	ext. 7357		
Ali Ismail (Engineering Lab Specialist)	ENG 1050 A	Ali.Ismail@ontariotechu.ca	ext. 5714		
Leon Wu (Associate Teaching Professor)	ENG 2045 A	Leon.Wu@ontariotechu.ca	ext. 3784		



Qi Shi (Associate Teaching Professor)	ENG 2040 A	Qi.Shi@ontariotechu.ca	ext. 2868
Masoud Farzam (Associate Teaching Professor)	ENG 3040 A	Masoud.Farzam@ontariotechu.ca	ext. 2851
Sharman Perera (Associate Teaching Professor)	ERC 4028	Sharman.Perera@ontariotechu.ca	ext. 5505
Khalid Rizk (Engineering Specialist)	UB 3034	Khalid.Rizk@ontariotechu.ca	ext. 2042
Robert Ulrich (Engineering Lab Specialist)	UB 3034	Robert.Ulrich@ontariotechu.ca	ext. 2650

10.2 Safety Training Requirements

Table 4: Safety Training Schedule

Training	Status/Position	Schedule
General Safety Orientation	All staff	Provided by HR
WHMIS 2015	All full-time and limited term faculty and staff, including student employees, Teaching Assistants, Research Assistants, supervisors and invigilators.	Provided by HR
Health and Safety Awareness Training	Anyone who performs work or supplies a service for the university	Provided by HR
Handling Flammable and Combustible Materials	All persons working with flammable and combustible materials	As required
Laboratory Hazards and their Control	All persons handling with hazardous chemicals	As required



Radiation Safety	All persons working independently with radioactive materials	As required
Biosafety	All persons working with biological agents	As required
Compressed Gas: Safe Storage and Handling	All persons working with Compressed gases	As required



10.3 Experimental Registration/Safety Analysis Form (Sample)

ONTARIO TECH UNIVERSITY FACULTY OF ENGINEERING AND APPLIED SCIENCE														
	EXPERIMENTAL REGISTRATION / SAFETY ANALYSIS FORM													
Date Filed			10	0/31/2006 Expe		perin	nental Re	gistı	ration	TH-	-TD-	·01		
(mm/dd/yyyy):				Nu	mbe	r:							
Expiry Date			10	/31/2007	Sig	gnatu	re of							
(mm/dd/yyyy	<i>(</i>):				Iss	uer:								
				CONTA	\C]		FORMA	ΓΙΟ	N					
Department Faculty of Engineering and Applied Science														
User:	er: Staff X Contractor		Visiting			Teaching		2 nd	¹ -year S	Stud	ent			
						Res	searcher		Assistant					
	C	Other ()											
User's Name	S	Students	fron	n course XX	XX	U		Us	ser's Office:	N/.	A			
User's	N	N/A		User's Ema	ail:		N/A							
Telephone #:								-						
Supervisor's								Su	Supervisor's					
Name:								Of	Office:					
Supervisor's				Supervisor's										
Phone #:			Email											
Emergency l	Phon	e #: Ext	. 24	00 (Security	De	sk)					1			
Successful co	mple	etion of V	WH	MIS training	and	l safe	ety course	?				Yes	Х	No
Is the experin	nent	under clo	ose s	supervision?	If s	o, wł	10?	Tea	aching Assist	ant	Х	Yes		No
Is the Buddy	Syste	em requi	red?	' (Required v	when	n woi	rking any	time	e with hazard	ls)		Yes	Х	No
Will apparatu	s be	running	ove	rnight?								Yes	Х	No
1. LOCATIO)N O	OF EXPE	ERI	MENT										
Room #: El	NG 1	040		Entry Point	ts:		Door of	EN	IG 1040					
Exhaust:	Fum	e Hood		Canopy	Ho	od	Glove	e Bo	ox X Ge	neral	Roo	om Ve	ntila	tion
Alternate Fire		Door of	ENG	G 1040		Loc	ation of		Near ENG I		1040 Door			
Escape Route	s:					Nearest Fire								
					FG	Alaı	m:							
	6.47	· · ·	• •	D	EC		ATION		6 11	1	1	1.4		11
The purpose potential haz	of th ards	his form s are ide	is to ntifi	o ensure that ied and app	it al rop	l exp riate	steps are	are e tal	e carefully p ken to elimi	lann nate	ed s	uch th ontrol	at a the	ll se
signed by the	at pe	rson's ir	nm	ediate super	viso	or. T	he form i	s to	be submitte	ed to	the	appro	pria	ite
Faculty Heal	th ai	nd Safet	y C	oordinator f	tor 1	tinal	approva	l. 			,		• -	
This form m	ust b	e compl	leteo	and an exp	beri	ment	tal registi	ratio	on number i	ssue	by	the Fa	cult	У.
Health and S	afet	y Coord	inat	tor before A	NΥ	expe	erimental	l WO	ork can be co	ondu	cted	l. This	tor	m is
valid for a m	axin New	num of o form M	us]	year, with re I be submit	esul ted	omis: wher	sion of sa iever exp	me erii	form for rem mental proc	newa edur	es a	work re cha	rema ngeo	ains d.



Signature of User:									
Signature of Instructor/Supervisor:									
Signature of Faculty Health and Safety Coordinator:									
2. BRIEF DESCRIPTION OF EXPERIMENTAL METHODS (Describe all chemicals,									
equipment and their	equipment and their use)								
Title:	Study of Refrigeration Unit (GUNT ET 102)								
Duration	1 hr per lab session								
(i.e. hr per lab									
session):									
D									

Description:

To study some important aspects of the common refrigeration system and illustrate how it is modeled thermodynamically. Measurements are to be performed for calculation of key thermal performance indicators and theoretical thermodynamic relationships.

To conduct the experiment, the Circulation Pump will be turned on, followed by the Evaporation Fan, and the Compressor at last. By adjusting the opening of the water flow regulator (flowmeter), the cooling temperature of the refrigeration cycle can be varied. The unit takes approximately 30 to 40 minutes to reach thermal steady state. Thereafter, measurements will be taken for the calculation of steady-state refrigeration performance.

Note: During the course of the experiment under normal operation, noise should not be a hazard. However, some parts of the unit (i.e. piping of the compressor, expansion valve¹, and condenser¹) during normal operation may generate heat and coldness which will cause injury to the body skin. Therefore, precaution should be taken when working near the unit. Users are not allowed to touch the unit at any time. Also, ensure that there is sufficient clearance between the system and walls or other objects.

The compressor, pump and fans are operated with an electrical voltage of 120V. Therefore, do not make any changes to the electrical supply to the refrigerant circuit. Electrical switches should be protected from water. In the case of a hazardous situation, isolate the system from the mains by unplugging it.

The working medium (refrigerant R134a) is a pollutant and can escape. Therefore, when making repairs, have the working medium properly drained. Do not, under any circumstances, make and modifications to the working medium circuit (undo threaded connections or similar) since the system is pressurised! Do not change the limits set on the pressostats¹ and expansion valve! If the compressor thermal cut-out trips, leave the system to cool down. Then, check the working pressure on restarting! Commission the system after transportation only after leaving it to the stand for a long period. If air does not flow over the finned pipe heat exchanger, there is a risk that the evaporator will ice up. When operated for long periods without external water cooling, the pressure in the refrigerant circuit will rise significantly and the compressor will be switched off by the pressostats on the high pressure side.

3. SERVICES REQUIRED

Electricity

Purpose: General



Frequency 60 Voltage (V) (Hz):			/oltage (V):	12	120Phase:Single					ngle		
Max. Allowable	Current	6		Wattage (W): ~450								
(A):					0 ()							
Natural Gas												
Purpose:	N/A			Connection N/A								
Other Gases	T											
Purpose:	N/A			-								
Pressure (kPa):	N/A			Co	onnection		N/A					
~				Μ	aterials:							
Compressed Ai	r											
Purpose:	N/A						37/1					
Pressure (kPa):	N/A				onnection		N/A					
XX7 4				M	aterials:							
Water	Ton Wet											
Purpose:	Tap wat	er m Tai	- an Cintr									
(Decine)	Main Irc	m Taj	p on Sink									
(Recirculating												
Chilled Weter												
Durnose:	N/A											
Fulpose.	N/A			Connection N/A								
Source.	N/A				Materials:							
Others	N/A			111								
Purpose [.]	N/A			Connection N/A								
r urpose.	1.011			M	aterials:		1 1/1 1					
4. SPECIAL H	AZARDS	(Pern	nit specific to) ha	zard must h	e atta	ched or f	orm	ı wil	l not l)e	
approved. Rese	archer's i	iame	must be offic	ciall	v added to r	oermit	t if names	rec	uir	ed to l	be	
listed.)									1			
Biohazard												
Biological Agen	t: N/.	4		Per	rmit #:							
Containment Lev	vel:						Level 1			Level 2		
Copy of Biosafe	ty Certific	ate At	tached?				Yes				No	
Radiation												
Radiation Emitti	ng	N/A		Per	rmit #							
Non-	Ionizi	na	Open		Sealed		I Iltrovial-4		V D			
ionizing	IOIIIZI	ng	Source		Source		Onavio	Jiet		71-110	ı y	
Isotope(s) Source				tv	Source		Frequer	ICV				
Used (Ra).							(Hz):	.~ y				
Conv of Permit Attached?								No				
Fire and Explos	sion							L			<u> </u>	
List explosive m	aterials us	ed in	experiment a	nd iı	1 close proxi	mitv i	n the labo	rato	rv:			
N/A			1		·	- 5 -			5-			



List potential N/A	sources	of ig	niti	on:										
Fire extinguishing Materials: Fire extinguisher and Sprinkler														
Method of he	ating Op	erati	ng	N/A	4	guibiler e	, iii (iii (iii) (opinn						
Vessels:	8 1		0											
Laser														
Туре:				N/4	4									
Class I		Cla II	iss		Class	IIIA		Clas IIIB	s		Class IV			
Noise														
Sound Levels	Likely (Great	ter]	Than 85 dB.	A?						Ye	es	X	No
Sound Level applicable)	Sound Levels > 85 dBA require hearing protection (Please refer to attached Noise Survey if applicable)													
Temperatur	e													
Cryogenic Li	quids:	N/2	A	Dry Ice:	N/	'A	Oth	ner:	N/A	L				
Low Tempera	ature				Elevated May o				occur	occur at piping near				
(<0°C):					Temperature compr (>37°C):				pressoi	•				
High Voltage	e						<i>.</i>							
Voltage	N/A		Ma	х.	N/A	N	Max. Wattage (W):					N/A	ł	
(V):			Cui	rrent(A):									-	
Special Grou	nding Re	equire	ed?									Yes	Х	No
Power Tools														
Use of Power Tools Required? Yes X No							No							
II Yes, List I	00IS:													
Training Prov	vided?											Yes	Х	No
Compressed Gases														
Are Compres	sed Gass	es U	sed	?							X	Yes		No
If Yes, complete Section 7.														



5. CHEMICAL SUBSTANCES USED IN PROJECT: Please list ALL chemicals used (Attach another page if necessary).

Note: The following substances have been designated by the Faculty as presenting particular hazards. Their use requires a permit which should be appended to this form. These substances include acrylonitrile, arsenic, asbestos, benzene, carbon disulfide, carbon tetrachloride, ethylene oxide, formaldehyde, isocyanates, lead, mercury, silica, styrene, vinyl chloride monomer, H₂S (hydrogen sulfide gas), cyanide, cadmium.

Name	Quantity (Mass/yr or Vol/yr)	TLV	Route of Entry (& Health Risk)	Corrosion Hazard	Flammability (Flash Point)	Autoignition Temperature	Reactivity Hazard or Incompatibilities
R134a	Sealed						
Total N	umber of Fac	culty De	signated Sub	stances Used	l: 1		



6. DISPOSAL ARRANGEMENTS FOR CHEMICAL WASTES							
Type of Waste	N/A	Classes of Waste	N/A				
Container(s):		(e.g. Flammable organic					
		solvent, etc.):					
Size (volume):	N/A	Label and Bottle Codes	N/A				
		(ref. University					
		Hazardous Waste					
		Manual):					
Disposal Collection		Waste Storage Location:					
Room:							
7. STORAGE VESSELS (Includes gas cylinders)							
Please describe: pressure and temperature, volume (litres), material of construction, material stored,							
potential hazard ³ (e.g. corrosion, fire, explosion, toxicity).							

The compressor is fitted with an overload protection device that is triggered if the compressor overheats. Should it become necessary to drain or refill the system with refrigerant, then this must be performed in the correct manner via the filler valve (1) on the compressor! The refrigerant is a

pollutant and must not be released into the atmosphere.







Describe: e.g material of construction, capacity (dimension), corrosion hazard³, if any, operating pressure, operating temperature, etc. Provide a sketch of the apparatus.



State: i.e. biohazard, corrosion, explosion, fire, incompatible chemical storage^{8,9}, over-pressurization, overheating, oxygen deficient conditions, radiation, runaway reaction, noise, etc.

Some parts of the unit (i.e. pipings of the compressor, expansion valve, and condenser) during normal operation may generate hear and coldness which will cause injury to the body skin.

11. PERSONAL PROTECTION AND SAFETY EQUIPMENT								
A) Personal Protective equipment Required:								
Gloves	Purpose:	N/A	Ту	ype:				
Respirator	Purpose:	N/A	Ту	ype:				
Eye Protection	Purpose:	N/A	Ту	ype:	Lab			
Lab Coat	Purpose:	N/A	Ту	ype:	Ear			
Ear Protection	Purpose:	N/A	Ту	ype:				
B) Safety Equipmen	t Locations	(List where in the la	b these are four	nd; if	not in your lab, list nearest			
location):								
Eye Wash Station:	Sink I	Next to ENG 1040 I	Entrance					
Shower Station:	Hallw	Hallway Next to ENG 1040 Entrance						
Spill Kits:	N/A	N/A						
Fire Extinguishers:	Near	Near ENG 1040 Main Door & Near Door of Combustion Facility						
	Enclo	Enclosure						

12. SPECIAL HANDLING, OPERATING PROCEDURES AND EMERGENCY CONTINGENCY PLANS

In case of an emergency, CALL Switchboard ('0') or 911 IMMEDIATELY. If you think the laboratory is not a safe place to be in case of an emergency, LEAVE the laboratory IMMEDIATELY, CALL Switchboard at ('0') and state which service you require: Police, Fire, or Ambulance. Alternatively, you can call 911 directly (i.e. use the phone booth next to the building exit and dial 911 directly) Advise the operator of :Building Name (OPG Engineering Building: 60 Founders Drive, UA:31 Avenue of Champrops), Room Number or Location, Phone Number and Extension, Outline of The Emergency Situation. By calling the Switchboard directly, on-site emergency response procedures can be initiated immediately (When Switchboard is closed, all calls are automatically routed to the Security Desk). If you have called 911 directly and you are still on the line with the 911 operator, have someone else contact Switchboard at '0' or Security Desk at 2400 and advise them that you have called 911 services.

SUGGESTED REFERENCES

- 1. Prudent Practices in the Laboratory: Handline and Disposal of Chemicals (1995). National Academy Press, National Research Council.
- 2. Hazardous Waste Manual, Ontario Tech University.
- 3. N.J. Sax, "Dangerous Properties of Industrial Materials".
- 4. Material Safety Data Sheets <u>https://www.ccohs.ca/oshanswers/legisl/msdss.html</u>
- 5. CRC Handbook of Laboratory Safety, Norman V. Steere
- 6. Industrial Accident Prevention Association <u>http://www.iapa.ca/</u>
- 7. G.U.N.T., "Instruction Manual ET 102 Heat Pump Training System" (July, 1998)



10.4 Experimental Registration Numbering System

ONTARIO TECH UNIVERSITY FACULTY OF ENGINEERING AND APPLIED SCIENCE EXPERIMENTAL REGISTRATION FORM NUMBERING SYSTEM

Purpose:

A standardized numbering system is developed to identify and organize experimental apparatus registration conveniently

Definition:

The **Experimental Registration Number** used on, for example, **Experimental Registration** / **Safety Analysis Form** and other related documents is a 6-digit code which indicates the purpose of the experiment, subject of the experiment, and the assigned experiment number, respectively. The Experimental Registration Number is illustrated as follows:





10.5 Incident/Equipment Failure Report Form

REPORT – Incident / Equipment Failure

For TA: Please submit the report to your Technical Services staff For Researcher or Graduate Student: Please submit the report to your supervisor

Person Reporting the Equipment Failure or Hazard					
Name					
E-mail					
Date and Time					
	Description of the Problem				
Room #: Location:	Description:				
Bench#:					
Course / Experiment					
Equipment / Hazard					
Corrective Actions Taken					
Signature of TA/Te Laboratory Staff/Su	echnical Services and apervisor:				
Date:					



10.6 Workspace Inspection Form

ITEM TO CHECK	REMARKS(e.g.)
General	
General Laboratory Appearance	Tidy and uncluttered
Bench Tops	Tidy and uncluttered
Exits	Unobstructed and in working order
Aisles	Unobstructed and uncluttered
First Aid Kit	Identified and stocked
Fire Extinguisher	Identified, correct type and serviceable
Safety Shower	Identified, accessible and serviceable
Eyewash Units	Present and working
Emergency Procedures	Prominently Posted
WHMIS Poster	Prominently Posted
No Eating or Drinking in Lab Sign	Prominently Posted; no evidence of food or drink
Protective equipment signage	Requirements identified and posted
Protective equipment	Used as per posting
Electrical extension cords	Temporary only; not a trip hazard
Security	Laboratory locked when not in use
Security	Lab supervisor name and contact details posted
Fumehoods/BiologicalSafetyCabinets	
Alarming Flow Monitor	Working and indicating proper air flow
Equipment and materials in hood	Minimum 6 inches back from front
Equipment and materials in hood	Not used for storage of unnecessary equipment
Interior of Hood	Neat and tidy
Electrical cords inside hood	In good condition and properly grounded
Fumehood sash or doors	Closed when not in use
Chemicals	
Chemical Containers	Labelled with supplier or workplace label
Storage of chemicals	Orderly and safe
Storage of chemicals	Incompatible chemicals not stored together
Flammable chemicals	Minimum amount used on benches
Flammable chemicals	Stored in flammable storage cabinets
Flammable chemicals	Total Quantity in lab less than
Flammable chemicals	Maximum container size is 5 L
Flammable chemicals	No more than 50 L in open area of lab
Material Safety Data Sheets	Available in lab
Gases	
Gas cylinders	Secured to wall or bench
Gas cylinders	Capped or with regulator
Gas cylinders	Labelled properly with name of gas
Cryogenic liquids (O2,N2, He)	Away from high traffic areas
Cryogenic liquids (O2,N2, He)	Gloves provided for handling
Cryogenic liquids (O2,N2, He)	Proper containers
Waste	
Chemical Waste	Containers segregated and labelled
Sharp Waste	Containers segregated and labelled

10.7 Personal Protective Equipment Guideline

10.7.1 Eye Protection

Appropriate eye protection must be worn in laboratories at all times. Eye protection must be appropriate to the specific hazard and must provide a comfortable and secure fit. Table 1 provides a description of the common types of eye protection and Table 2 their recommended uses.



Contact Lenses

In recent years the recommendations with respect to the wearing of contact lenses in laboratories has changed. The American Chemical Society has reversed its earlier advice recommending against the wearing of contact lenses in laboratories and now agrees that *"contact lenses can be worn in most work environments provided the same approved eye protection is worn as required of other workers in the area"*.

Current evidence indicates that the use of contact lenses does not place the wearer at additional risk of eye injury. Concerns associated with an increased risk of eye injury due to chemical splash or absorption and retention of gases and vapors by the contact lens materials have not been supported by scientific evidence or human experience. There are some obvious advantages to contact lenses including increased visual acuity and better fit of protective eyewear than with eyeglasses.

It must be stressed, however, that contact lenses are not protective devices and must be used in conjunction with appropriate protective eyewear in eye hazard areas.

Table 5 Types of Protective Eyewear

Spectacle Type Safety Glasses

Safety glasses have lenses that are impact resistant and frames that are stronger than those of regular eyeglasses. Safety glasses come in a variety of lens materials, shades and tints. Lens materials include polycarbonate, plastic or glass each of which varies in strength, impact resistance, scratch resistance and weight. They can also be to prescription for those who need corrective lenses. Safety glasses must comply with CSA Standard Z94.3-92.

Safety glasses with permanently attached side shields must be worn by those who require protection against flying particles.

Safety Goggles

Safety goggles offer greater eye protection than safety glasses by providing a secure shield around the entire eye area to protect against hazards coming from any direction.

Safety goggles may have direct or indirect ventilation to prevent fogging. Goggles with direct ventilation allow heat and humidity to dissipate, but do not protect against splash hazards. Goggles with indirect ventilation are designed to protect against dust and splash hazards.

Safety goggles must be worn where there is a danger of liquids being splashed into the eye.

Face Shields



Face shields worn alone are not considered protective eyewear. They are designed to provide general protection to the face and the front of the neck; they do not fully enclose the eyes and must be used in conjunction with primary eye protection such as safety glasses or goggles. Full face shields are often used to protect against chemicals, heat or glare hazards.

Welding Helmets

Welding helmets are used when welding or working with molten materials. They are designed to provide protection to the face and the front of the neck from heat, glare, weld splatter and impact hazards.

Specialty Filter Lenses

Protective eyewear (goggles, helmets) equipped with appropriate filter lenses must be used to protect against harmful radiations such as infrared, ultraviolet, and laser light.

NATURE OF HAZARD	EXAMPLES	RECOMMENDED EYE PROTECTION				
	Flying objects such as large chips,	Spectacles				
Impact	fragments, particles, sand and dirt	Goggles				
		Face Shields*				
Dust	Harmful dust	Goggles				
		Spectacles				
Heat	Anything emitting extreme heat	Goggles				
		Face Shields*				
Chemicals	Splash, fumes, vapors and	Goggles				
	irritating mists	Face Shields*				
Optical Radiation	Radiant energy, glare and intense	Depends on the wavelength				
	light (lasers, welding)	and intensity				
*Face shields are not primary protection; they must be worn in conjunction with the primary						
protection of spectacles or goggles.						

Table 6: Usage of Protective Eyewear

10.7.2 Protective Clothing

Appropriate protective clothing must be worn in laboratories where chemical, biological or radioactive materials are used and stored. In most cases a laboratory coat will suffice. Coats must be made of material suitable for the work environment (e.g. cotton or cotton/polyester). They must fit properly, be fastened when working and provide appropriate flexibility to carry out tasks. Laboratory coats must be regularly cleaned and maintained, and replaced when worn. Laboratory coats must only be worn in the laboratory and must be left in the laboratory. They must not be worn in eating areas, in offices or in public areas.



Because of the limited protection afforded by laboratory coats, other clothing which affords a greater degree of protection may be warranted in some circumstances. Plastic or rubber aprons should be used when handling larger quantities of corrosive materials such as acids and bases.

Depending on the hazards in the laboratory, clothing which protects against other hazards such as cold, heat, moisture or electrical shock may also be needed.

Guidance on particular types of protective clothing can be obtained from the Material Safety Data Sheet and through consultation with the University Health and Safety Coordinator.

Foot Protection

Appropriate footwear must be worn at all times in laboratories where chemicals are used and stored. Sandals, open-toed shoes and the like must not be worn as they expose the foot to chemical spills and broken glass. Appropriate shoes must cover and protect the entire foot.

Depending on the type of hazard in the laboratory, footwear which provides additional protection may be required. Chemically resistant boots may be needed when working with large quantities of corrosive materials or solvents which might penetrate normal footwear (e.g. during spill cleanup). Where there is a risk of foot injury from impact of heavy objects, steel-toed safety shoes may be needed. Where the potential exists for electrical shock, appropriate electrically-resistant footwear may be appropriate. In these cases, appropriate CSA-approved footwear must be worn.

Hand Protection

Appropriate protective gloves must be worn where the hands are potentially exposed to chemicals, infectious agents, cuts, lacerations, abrasions, punctures, burns and harmful temperature extremes.

Choosing the appropriate glove can be a challenge in a laboratory setting. Considering the fact that dermatitis or inflammation of the skin accounts for 40-45% of all work- related diseases, selecting the right glove for the job is important.

Of particular concern is the increasing incidence of latex allergies. Allergic reactions due to the natural latex proteins or to the chemical additives added to the latex during the manufacturing process can present a serious health risk to a significant number of workers who need to wear glove protection. Symptoms can range from local skin reactions to more serious health effects such as rhinitis, conjunctivitis, asthma, and even rarely life-threatening anaphylactic shock. It is recommended that exposure to latex be minimized by either substituting other materials for latex, or if that is not possible, by using reduced-protein, powder free latex gloves.

Not only can many chemicals cause skin irritation or burns, but also absorption through the skin can be a significant route of exposure to certain chemicals. Dimethyl sulfoxide



(DMSO), nitrobenzene, and many solvents are examples of chemicals that can be readily absorbed through the skin into the bloodstream, where the chemical may cause harmful effects.

There are a number of sources available on the internet which provide guidance in the election of proper materials for protective gloves. In addition to the Material Safety Data Sheet for the chemical one can consult the following sources.

- Best Manufacturing: <u>https://www.chemrest.com/</u>
- Canadian Centre for Occupational Health and Safety: <u>https://www.ccohs.ca/oshanswers/prevention/ppe/gloves.html</u>
- US National Institute for Occupational Safety and Health (NIOSH): <u>https://www.cdc.gov/niosh/</u>

Respiratory Protection

A respirator should only be used when engineering controls, such as general ventilation or a fume hood, are not feasible or do not reduce the exposure of a chemical to Acceptable levels. Even in this case respiratory protection should only be considered to be a temporary measure and if the exposures are to be ongoing, appropriate engineered controls should be put in place or the process changed to eliminate the offending chemical.

In the event that respiratory protection is required, the employee must have appropriate training and be properly fitted with the appropriate respirator. Contact the University Health and Safety Coordinator for assistance in this regard.

Hearing Protection

Most laboratory equipment and operations do not produce noise levels that require the use of hearing protection. Hearing protection may be required if the noise levels exceed 85 dBA, depending on the exposure time.

There are many types of hearing protectors available, including disposable or reusable plugs, headband plugs, and muffs. Reusable hearing protectors should be cleaned often and replaced when the plugs or muff cushions become hardened or discolored. It is important that the plugs are seated properly in the ear, that the muffs form an adequate seal around the ear and that the headband is not bent. All of these precautions will improve the noise attenuation (reduction) achieved by the hearing protection.

Contact the University Health and Safety Coordinator to determine if ear protection is required and for assistance in selection and fitting of appropriate hearing protection.



10.8 Laboratory/Equipment Lockout Form

Location:	ocation: Time:												
Department	:		Dat	te:									
IMMEDIATE ACTION(S)						1	FOLLOW	-UP ACT	ION(S)				
Equipment	Hazards	Hazard Classes (see	Repea Item	at 1	Lockout Required		Supervisor's	Recommended	Ву		Action	Date	Supervisor's
Item	Observed	below)	Yes	No	Yes	No	Signature	Action	Whom	When	Taken	Completed	Signature
	A céic m):							Annual Dr. (Deserve					
Copies To (For Action):				Approved By (Dean):									
Copies To (For Information):				Approved By (Inspector):									
Issued By:													

Class A Hazard: A condition or practice with the potential for permanent disability, loss of life or body part, and/or extensive loss of structure, equipment or material.
Class B Hazard: A condition or practice with the potential for serious injury or illness (resulting in serious or temporary disability) or property damage that is disruptive but less so than Class A.
Class C Hazard: A condition or practice with the potential for injury or illness, or disruptive (non-disabling) property damage.



10.9 Designated Substances Regulated by OHSA and Ontario Tech University

Table 7: Occupational Health and Safety Act (OHSA) Designated Substances

Acrylonitrile
Arsenic
Asbestos
Asbestos on Construction Projects and in Buildings and Repair
Operations
Benzene
Coke Oven Emissions
Ethylene Oxide
Isocyanates
Lead
Mercury
Silica
Vinyl Chloride

Table 8: Ontario Tech University Particularly Hazardous Chemicals

Diborane
Cyanides
Fluorine
Hydrofluoric Acid
Hydrogen Cyanide
Perchloric Acid
Phosgene
Silane
And other dangerously Reactive Substances listed in Section 8
of the Ontario Tech University Laboratory Safety Manual For
General Laboratory Operations

11 REVISION HISTORY

Revision	Summary of Changes	Edited By:	Date Issued
R1	Initial Revision	Hidayat Shahid Cliff Chan	Nov. 2004



R2	Added information on ENGR1015U, Updated broken links	Cliff Chan Hidayat Shahid	Dec. 2015
R3	Updated Health and Safety Policy, Updated Links, Updated University branding and updated list of staff members in the Technical services team. Added link to the University's Working Alone Procedure., Updated the WHMIS 2015 and added Compressed Gas Training.	Govind Rehal Russell Papadimitriou	Jan. 2023