University of Ontario Institute of Technology

Faculty of Engineering and Applied Science

Safety Manual

Date of Last Revision: October 31, 2006

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.

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.

Marc Rosen, Dean
Faculty of Engineering and Applied Science

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1. Health and Safety Policy

The University of Ontario Institute of Technology (UOIT) has a vital interest in the health and safety of its employees, students, visitors and contractors. The prevention of occupational illness or injury is a major continuing objective and UOIT will make every reasonable effort 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, provincial and local statutes and bylaws.

The university is responsible for establishing, maintaining and communicating a safety program to implement this policy. Specific safety policies, regulations and procedures shall be developed, documented and implemented in order to ensure that employees and students are aware of their rights and responsibilities and to facilitate the maintenance of 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 or unhealthy 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 Health and Safety Policy was approved by the Board of Governors on November 12, 2003

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 UOIT 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 on the relevant course WebCT page (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 9.8.2 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 material 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 Coordinators

The faculty will have two coordinators who will deal with registration (see section 6) of all experiments in the research labs and the teaching labs. The Faculty Health and Safety Coordinators will coordinate with Faculty of Engineering and Applied Science and UOIT'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 Coordinators are listed in Table 1.

Table 1 – Faculty Health and Safety Coordinators

Name (Position)	Office (Extension#)	Email
Ghaus Rizvi (UOIT FEAS Professor and Faculty Health and Safety Coordinator)	ENG 1021 (ext. 2964)	ghaus.rizvi@uoit.ca
Cliff Chan (UOIT FEAS Laboratory Specialist and Faculty Health and Safety Coordinator)	ENG 2020 (ext. 2951)	cliff.chan@uoit.ca

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 Table 2.

Table 2 – Safety Training Schedule

Training	Status/Position	Schedule
General Safety Orientation	All staff	Available on ESAO CD-ROM
WHMIS – General	All staff	Available on ESAO CD-ROM
WHMIS - Laboratory	All persons working with control of hazards and materials	As required
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
Handling Radioactive Materials	All persons working with radioactive materials	As required
Handling Biohazardous Infectious Materials	All persons working with biohazardous infectious materials	As required

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 10.1 and 10.2) must be completed, reviewed and signed by the course instructor or supervisor and submitted to the faculty office 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.

Registration forms are normally authorized for a period of one year 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 within the authorized time period, 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 a MSDS. All "Designated Substances" defined in the Occupational Health and Safety Act (OHSA) and other hazardous materials designated by UOIT (see Section 10.8) brought within the faculty must be reported to faculty health and safety coordinators along with a copy of the MSDS. The coordinators will keep this information within easy access of all faculty members (i.e. through its website). A copy of the MSDS 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 UOIT, please refer to **Laboratory Safety Manual for General Laboratory Operations** (http://www.uoit.ca/assets/Section~specific/Faculty_Staff/Services/Human~resources/Policies_Procedures/PDF/laboratory_safety_manual.pdf).

8. Health and Safety Committee

UOIT 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 Faculty of Engineering and Applied Science.

The names and contact information of the Health and Safety Committee members are listed in Table 3 or can be found on the UOIT Health and Safety Committee website: http://www.uoit.ca/EN/main/11259/11270/16583/16592/health_safety_committee_members.html

Table 3 – Health and Safety Committee members

Richard Bartholomew (co-chair)	905.721.3111	ext. 2435	UA 4031	richard.bartholomew@uoit.ca
Brian Marshall (co-chair)	905.721.3111	ext. 2584	I 200	brian.marshall@uoit.ca
Beth Partlow (secretary)	905.721.3649	n/a	1210	beth.partlow@uoit.ca
Doug Moon	905.721.3111	ext. 2997	UA 4012	doug.moon@uoit.ca

David Gorman	n/a	n/a	n/a	david.gorman@uoit.ca
Valeri Kapoustine	905.721.3111	ext. 2990	UA 4033	valeri.kapoustine@uoit.ca
Sylvie Bardin	905.721.3111	ext. 2128	UA 4032	sylvie.bardin@uoit.ca
Janice Cramer	905.721.3111	ext. 2436	UA 3013	janice.cramer@uoit.ca
Doug Lucyk	905.721.3111	ext. 3017	UA 434	doug.lucyk@dc-uoit.ca
Kathy Lazenby	905.721.3038	n/a	G 127	kathy.lazenby@dc-uoit.ca
Cliff Chan	905.721.3111	ext. 2951	ENG 2020	cliff.chan@uoit.ca
Ghaus Rizvi	905.721.3111	ext. 2964	ENG 1021	ghaus.rizvi@uoit.ca
Linda Lyons	905.721.3111	ext. 2105		linda.lyons@dc-uoit.ca
Wesley Crichlow	905.721.3111	ext. 2651	UA 2011	wesley.crichlow@uoit.ca
Deb Kinkaid	905.721.3111	ext. 3016	UA B439	deborah.kinkaid@dc-uoit.ca
Debora McKay	905.721.3111	n/a	n/a	debora.mckay@uoit.ca
Belinda Bambrick	905.721.3111	ext. 2836	UB 2037	belinda.bambrick@uoit.ca

9. Faculty Policies

The Faculty will follow the UOIT health and safety policies. The safety guidelines, procedures, and references for UOIT's workplace, laboratory, and materials storage are provided on the UOIT Health and Safety Policies website: http://www.uoit.ca/EN/main/11259/11270/16583/health_safety.html

Faculty of Engineering and Applied Science has its own laboratory policies and safety protocols, which have been approved by the UOIT Health and Safety Committee and described in the **Engineering Laboratory Policies and Safety Protocols Reference Manual**, which can be downloaded from the UOIT Faculty of Engineering and Applied Science Health and Safety website under the heading **Policies, Programs and Procedures:** http://www.engineering.uoit.ca/safety/policies.php. 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 for Teaching Labs and by supervisors for Research Labs. All sorts of incidents, accidents, equipment failures, and hazards must be identified and reported immediately to the designated personnel.

9.1 Accident/Injury Report

All accidents involving a personal injury must be reported to the Human Resources Department using the **Durham College/UOIT "Accident/Injury Report Form"** (see Section 10.3). 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 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 H&S Coordinators, and the Dean and forward these to the HR department. For more information, please refer to the **Accident Reporting Procedure** on the UOIT Health and Safety website under the heading **Policies + Procedures**: http://www.uoit.ca/EN/main/11259/11270/16583/16592/13550/accident_reporting_procedure.html

9.2 Incident/Equipment Failure Report

All equipment failures or hazards must be reported to the laboratory supervisor or laboratory specialist wherever applicable. For undergraduate students, they must report the failure or hazard to their teaching assistant (TA) and have the TA filled out the **Incident/Equipment Failure Report Form** (see Section 10.4). For TAs, they must complete the report and submit it to the course supervisor or one of the lab specialists if the supervisor is not available. 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 faculty office. This procedure should also be followed for research labs, if the incident/failure had health and safety implications. The faculty office will bring these to the notice of the Dean, and forward these to the HR department, if warranted.

The office of teaching assistants is located in UA4061 and they can be reached by their emails or office number ext. 3420. The contact information for our Technical Services staff is listed in Table 4 below:

Table 4 – FEAS Engineering and Laboratory Specialists

Name (Position)	Office (Extension#)	Email
Hidayat Shahid (Manager of Technical Services)	ENG 2020 (ext. 2791)	hidayat.shahid@uoit.ca
Cliff Chan (Laboratory Specialist)	ENG 2020 (ext. 2951)	cliff.chan@uoit.ca
David Gervais (Laboratory Specialist)	ENG 1026 (ext. 2067)	david.gervais@uoit.ca
Qi Shi (Laboratory Specialist)	ENG 3025 (ext. 2868)	qi.shi@uoit.ca
Masoud Farzam (Engineering Specialist)	ENG 1026 (ext. 2851)	masoud.farzam@uoit.ca

Safety hazards may also be reported to the Health and Safety Committee by sending an email message to healthandsafety@uoit.ca

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, 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 10.7) 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 10.5). 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 operate in a safe and proper working condition. Such work is normally done by the laboratory specialists 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, 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 helpdesk-facilities@dc-uoit.ca.

All preventive maintenance should be conducted during non-lab sessions and regular work day hours (9 am to 5 pm) 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 VI.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 10.1 and 10.2) must clearly indicate the type of PPE required to conduct each experiment. Section 10.6 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 Special Working Situations

9.8.1 Working with Radioactive and Hazardous Materials

Special permits must be obtained for persons who will be conducting experiments with radioactive and hazardous materials. These permits must be issued by the laboratory supervisor and be approved by the Dean.

9.8.2 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 supervisor (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.

9.8.3 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 Experimental Registration/Safety Analysis Form (Sample)

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY
FACULTY OF ENGINEERING AND APPLIED SCIENCE
EXPERIMENTAL REGISTRATION / SAFETY ANALYSIS FORM

Date Filed (mm/dd/yyyy): 10/31/2006 Experimental Registration Number: TH-TD-01

Expiry Date (mm/dd/yyyy): 10/31/2007 Signature of Issuer:

CONTACT INFORMATION

Department: Faculty of Engineering and Applied Science

User: ☐Staff ☐Contractor ☐Visiting Researcher ☐Teaching Assistant ☒2nd-year Student ☐Other ( )

User's Name: Students from course XXXXU User's Office: N/A

User's Telephone #: N/A User's Email: N/A

Instructor's/Supervisor's Name: Dr. XYZ Instructor's/Supervisor's Office: UA XXXX

Instructor's/Supervisor's Telephone #: XXXX Instructor's/Supervisor's Email: XYZ@uoit.ca

Emergency Phone #: Ext. 2400 (Security Desk)

Successful completion of WHMIS training and safety course? ☐Yes ☒No

Is the experiment under close supervision? ☒Yes, who? Teaching Assistant ☐No

Is the Buddy System required? ☐Yes (Required when working anytime with hazards) ☒No

Will apparatus be running overnight? ☐Yes ☒No

1. LOCATION OF EXPERIMENT

Room #: ENG 1040 Entry Points: Door of ENG 1040

Exhaust: ☐Fume Hood ☐Canopy Hood ☐Glove Box ☒General Room Ventilation

Alternate Fire Escape Routes: Door of ENG 1040 Location of Nearest Fire Alarm: Near ENG 1040 Door

DECLARATION

The purpose of this form is to ensure that all experiments are carefully planned such that all potential hazards are identified and appropriate steps are taken to eliminate or control these hazards. The form is to be completed by the person conducting the experiment and reviewed and signed by that person's immediate supervisor. The form is to be submitted to the appropriate Faculty Health and Safety Coordinator for final approval.

This form must be completed and an experimental registration number issued by the Faculty Health and Safety Coordinator before ANY experimental work can be conducted. This form is valid for a maximum of one year, with resubmission of same form for renewal if work remains unchanged. New form MUST be submitted whenever experimental procedures are changed.

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 use)

Title: Study of Refrigeration Unit (GUNT ET 102)

Duration (i.e. hr per lab session): 1 hr per lab session

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. pipings of the compressor, expansion valve[1], and condenser[1]) 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 any modifications to the working medium circuit (undo threaded connections or similar) since the system is pressurised! Do not change the limits set on the pressostats[1] 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 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 (Hz): 60 Voltage (V): 120 Phase: Single

Max. Allowable Current (A): 6 Wattage (W): ~450

Natural Gas

Purpose: N/A Connection Materials: N/A

Other Gases

Purpose: N/A

Pressure (kPa): N/A Connection Materials: N/A

Compressed Air

Purpose: N/A

Pressure (kPa): N/A Connection Materials: N/A

Water

Purpose: Tap Water

Source (Recirculating or Mains): Main from Tap on Sink

Chilled Water

Purpose: N/A

Source: N/A Connection Materials: N/A

Others: N/A

Purpose: N/A Connection Materials: N/A

4. SPECIAL HAZARDS (Permit specific to hazard must be attached or form will not be approved. Researcher's name must be officially added to permit if names required to be listed.)

Biohazard

Biological Agent: N/A Permit #:

Containment Level: ☐Level 1 ☐Level 2

Copy of Biosafety Certificate Attached? ☐Yes ☐No

Radiation

Radiation Emitting Device: N/A Permit #:

☐Non-ionizing ☐Ionizing ☐Open Source ☐Sealed Source ☐Ultraviolet ☐X-ray

Isotope(s) Used: Source Activity (Bq): Frequency (Hz):

Copy of Permit Attached? ☐Yes ☐No

Fire and Explosion

List flammable and combustible materials used in experiment and in close proximity in the laboratory:

N/A

List explosive materials used in experiment and in close proximity in the laboratory:

N/A

List potential sources of ignition:

N/A

Fire Extinguishing Materials: Fire Extinguisher and Spinkler

Method of Heating Operating Vessels: N/A

LASER

Type: N/A

☐Class I ☐Class II ☐Class IIIA ☐Class IIIB ☐Class IV

Noise

Sound Levels Likely Greater Than 85 dBA? ☐Yes ☒No

Sound Levels > 85 dBA require hearing protection (Please refer to attached Noise Survey if applicable)

Temperature

Cryogenic liquids: N/A Dry Ice: N/A Other: N/A

Low Temperature (< 0°C): Elevated Temperature (> 37 °C): May occur at piping near compressor

High Voltage

Voltage (V): N/A Max. Current (A): N/A Max. Wattage (W): N/A

Special Grounding Required? ☐Yes ☒No

Power Tools

Use of Power Tools Required? ☐Yes ☒No

If Yes, list tools:

Training Provided? ☐Yes ☒No

Compressed Gases

Are Compressed Gases Used? ☒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, H_2S (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 Number of Faculty Designated Substances Used: 1

6. DISPOSAL ARRANGEMENTS FOR CHEMICAL WASTES

Type of Waste Container(s): N/A Classes of Waste (e.g. flammable organic solvent, etc.): N/A

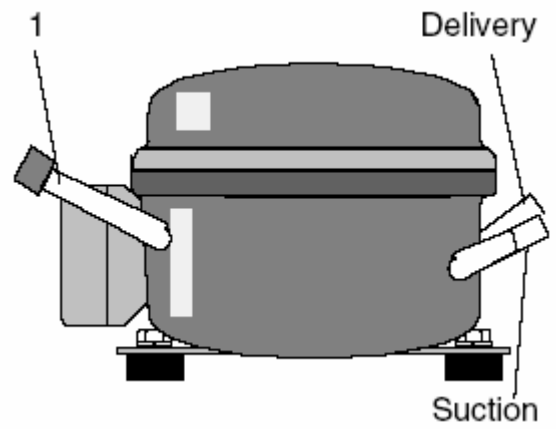
Size (volume): N/A Label and Bottle Codes (ref. University Hazardous Waste Manual): N/A

Disposal Collection Room: Waste Storage Location:

7. STORAGE VESSELS (Includes gas cylinders)

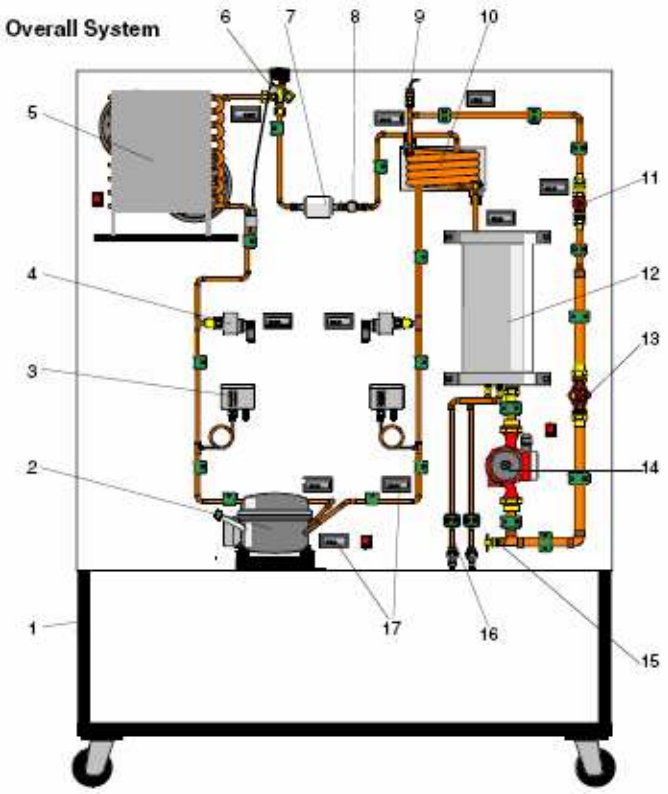
Please describe: pressure and temperature, volume (litres), material of construction, material stored, potential hazard[3] (e.g. corrosion, fire, explosion, toxicity).

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.



8. EXPERIMENTAL APPARATUS

Describe: e.g. material of construction, capacity (dimension), corrosion hazard[3], if any, operating pressure, operating temperature, etc. Provide a sketch of the apparatus.



1. Trolley
2. Compressor
3. Pressostat
4. Pressure Transmitter
5. Evaporator with Fans
6. Expansion Valve
7. Filter / Dryer
8. Sight Glass (Refrigerant)
9. Temperature Sensor
10. Coaxial Condenser
11. Flowmeter (Water)
12. Tank
13. Control Valve
14. Circulation Pump
15. Drain Valve
16. Cooling Water Connection
17. Digital Displays

9. CONNECTIONS BETWEEN VESSELS, VALVES, ETC.

State material of construction, dimensions, type of joint, pressure, temperature, and insulation if any:

Connections and piping between vessels and valves are made of copper

10. POTENTIAL HAZARDS INVOLVED USING THE APPARATUS OR CHEMICALS

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 heat and coldness which will cause injury to the body skin.

11. PERSONAL PROTECTION AND SAFETY EQUIPMENT

A) Personal Protective Equipment Requred:

Gloves	Purpose: N/A	Type:
Respirator	Purpose: N/A	Type:
Eye Protection	Purpose: N/A	Type:
Lab Coat	Purpose: N/A	Type:
Ear Protection	Purpose: N/A	Type:

B) Safety Equipment Locations (List where in the lab these are found; if not in your lab, list nearest location):

Eye Wash Station: Sink Next to ENG 1040 Entrance

Shower Station: Hallway Next to ENG 1040 Entrance

Spill Kits: N/A

Fire Extinguishers: Near ENG 1040 Main Door & Near Door of Combustion Facility 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 Champions), 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 the Switchboard is closed, all calls are automatically routed to the Security Desk). If you have called 911 directly and you are still on 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

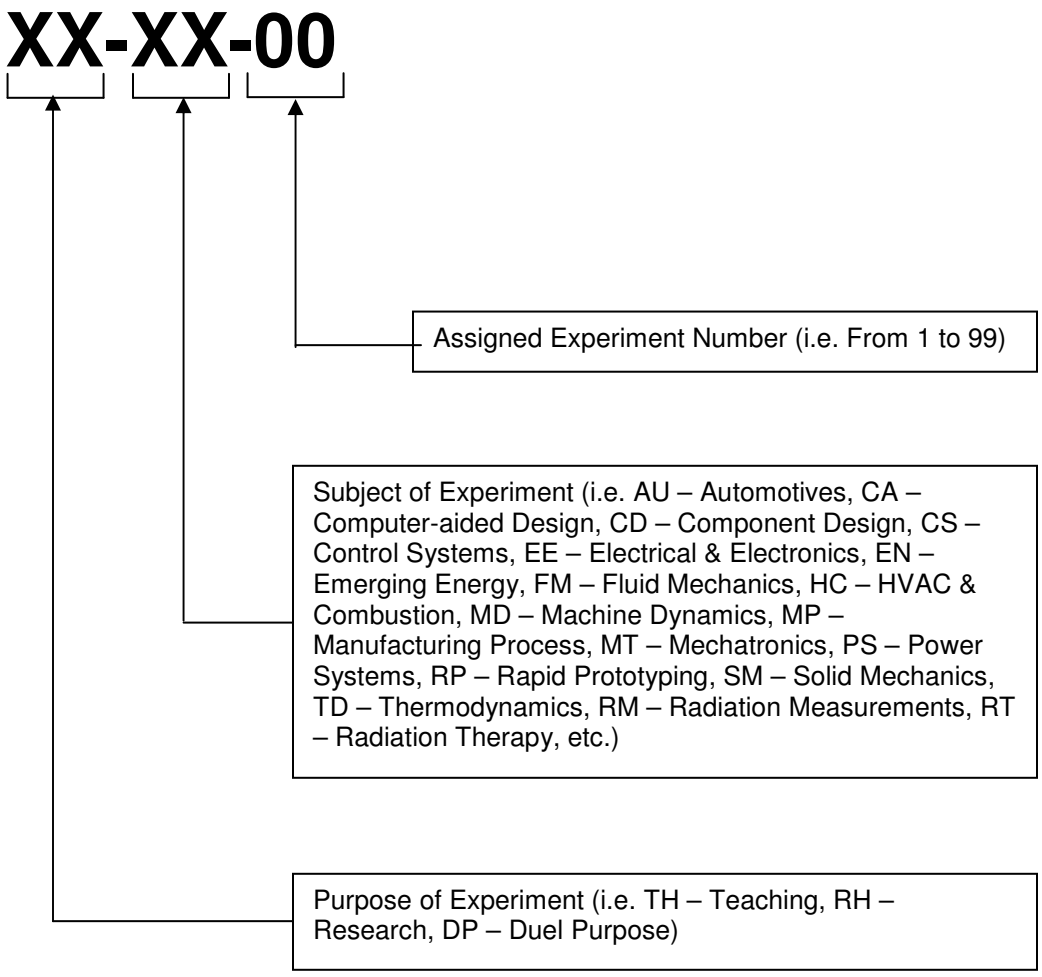
1. Prudent Practices in the Laboratory: Handling and Disposal of Chemicals (1995). National Academy Press, National Research Council.
2. Hazardous Waste Manual, University of Ontario Institute of Technology.
3. N.J. Sax, "Dangerous Properties of Industrial Materials".
4. Material Safety Data Sheets (http://itsosepx01.mycampus.ca:2048/login?url=http://ccinfoweb.ccohs.ca/asp)
5. CRC Handbook of Laboratory Safety, Norman V. Steere.
6. Industrial Accident Prevention Association (http://www.iapa.ca/resources/resources_downloads.asp#hazards)
7. G.U.N.T., "Instruction Manual ET 102 Heat Pump Training System" (July, 1998)

10.2 Experimental Registration Numbering System

UNIVERSITY OF ONTARIO INSTITUTE OF TECHNOLOGY
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:



10.3 Accident/Injury Report Form

University of Ontario
INSTITUTE OF TECHNOLOGY

ACCIDENT/INJURY FORM

Fill out report at time of accident/incident. Please print clearly.

A **STATUS WITH THE UNIVERSITY**

Employee: ❒ Full-time ❒ Contract ❒ Third Party ❒ Part-time ❒ Sessional

Other: ❒ Visitor ❒ Student *(Is this a paid position at time of injury?)* ❒ Yes ❒ No

Name of company/Placement/Program: _____

_____

Name: _____ Phone: _____

Address: _____ _____ _____

Street Apt. City/Town Province Postal Code

B

EMPLOYEES ONLY TO FILL OUT THIS SECTION

S.I.N #: _____ Date Employed: _____ Occupation at time of injury: _____

Years of experience at that occupation: _____ If seen by a Physician, please advise: _____/_____

Date/Time

Name of Physician: _____

Address of Physician: _____ Phone: _____

C

Date and hour accident/injury occurred: _____ Date and time this form is filled out: _____

Who did you report this accident/injury to? _____

How did the injury occur? _____

Explain what the person was doing, and the effort involved: _____

Identify the size, weight, and type of equipment or material involved: _____

Where did this occur? Specify which campus, building, room #, and address location: _____

_____

What conditions contributed to the accident and what steps have been taken to prevent reoccurrence? _____

_____

D

DESCRIBE INJURY, PART OF THE BODY INVOLVED AND SPECIFY <u>LEFT</u> OR <u>RIGHT</u> SIDE

Wound (cut, bruise, puncture): _____ Eye: _____

Fracture (broken bones): _____ Poisoning, stings, bites: _____

Muscle, ligament, joint injury (sprain):_____ Head/spine (back injury): _____

Burns: _____ Medical (asthma, chest pain, seizure, etc.): _____

First Aid or medical attention given (indicate what, where, when, and by whom): _____

_____

E

State any knowledge of previous injury or relative medical condition: _____

List names and addresses of witness or person(s) witnessing the accident/injury that occurred: _____

_____

Report prepared by: _____ Phone #: _____ Date:_____
Status: _____ Signature of injured person: _____

Please forward a copy to Human Resources no later than 24 hours of the injury. Another copy should be sent to the injured party, Health Nurse, and Immediate Supervisor.

F

TO BE FILLED OUT BY HUMAN RESOURCES

Date and hour report received by Human Resources: _____ Initials: _____

This form can also be downloaded from the following link:
http://www.uoit.ca/EN/main/11259/11270/16583/16592/13550/accident_reporting_procedure.html

10.4 Incident/Equipment Failure Report Form

REPORT – Incident / Equipment Failure

For TA: Please submit the report to your Laboratory Specialist
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:** **Bench #:**	**Description:**
Equipment / Hazard	
Course/ Experiment	

Signature of TA/Lab Specialist/Supervisor:

Date:

10.5 Workplace 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 evdence 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/Biological Safety Cabinets	
Alarming Fow Monitor	Working and indicating proper air flow
Equipmemt and materials in hood	Minimum 6 inches back from front
Equipmemt 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

* Adopted from the Health and Safety Committee Lab Inspection Checklist (Mar 21, 2005)

10.6 Personal Protective Equipment Guideline

PERSONAL PROTECTIVE EQUIPMENT

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 1
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 sideshields 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.

TABLE 2
USAGE OF PROTECTIVE EYEWEAR

NATURE OF HAZARD	EXAMPLES	RECOMMENDED EYE PROTECTION
Impact	Flying objects such as large chips, fragments, particles, sand and dirt	Spectacles Goggles Face Shields*
Dust	Harmful dust	Goggles
Heat	Anything emitting extreme heat	Spectacles Goggles Face Shields*
Chemicals	Splash, fumes, vapors and irritating mists	Goggles Face Shields*
Optical Radiation	Radiant energy, glare and intense light (lasers, welding)	Depends on the wavelength and intensity

***** Face shields are not primary protection; they must be worn in conjunction with the primary protection of spectacles or goggles.

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: http://www.chemrest.com/ .**
- **Canadian Centre for Occupational Health and Safety: http://www.ccohs.ca/oshanswers/prevention/ppe/gloves.html** .
- **US National Institute for Occupational Safety and Health (NIOSH): http://www.cdc.gov/niosh/ncpc/ncpc1.html** .

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.

10.7 Laboratory/Equipment Lockout Form

LAB/EQUIPMENT LOCKOUT FORM

Location:	**Time:**
Department:	**Date:**

IMMEDIATE ACTION(S)								**FOLLOW-UP ACTION(S)**						
Equipment Item	**Hazards Observed**	**Hazard Classes (see below)**	**Repeat Item**		**Lockout Required**		**Supervisor's Signature**	**Recommended Action**	**By**		**Action Taken**	**Date Completed**	**Supervisor's Signature**
			Yes	**No**	**Yes**	**No**			**Whom**	**When**			

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.

10.8 Designated Substances Regulated by OHSA and UOIT

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

University of Ontario Institute of Technology (UOIT) 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 **UOIT Laboratory Safety Manual For General Laboratory Operations**