College/Unit:	**Department of Biomedical Engineering**
Procedure Title:	**Standard Operating Procedure #TE0001** **Tissue Engineering Laboratory Practices**

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Contents

Revision History

Revisions to this procedure are to be documented in Table 1, Revision History.

Table 1: Revision History

Document Section	Details of Amendments	Date	Author (Initials)

1 Introduction

This Standard Operating Procedure (SOP) provides guidelines for use of the Tissue Engineering Laboratory (1A26). It applies to all research/testing being conducted in the laboratory. This includes, but is not limited to, under-graduate and graduate students, post-docs, faculty, staff and visiting scholars. All personnel doing work in this laboratory must read, understand and sign Section 11 of this SOP before they can begin work.

Non-University personnel who use equipment in the lab will be required to read, and understand only the sections of this SOP that are relevant to their work, at the discretion of the Departmental Assistant. Non-University personnel will be required to sign Section 12 of this SOP before they can begin work.

At the discretion of the Departmental Assistant, a researcher may be asked to repeat training on this SOP, if the researcher has failed to adhere to some of the policies outlined. All users will be required to repeat training on this SOP every three years from the date of the original training.

Persons who do not follow this and other required Mechanical Engineering SOPs will lose lab privileges (this may mean the inability to conclude research that is required for your degree).

This SOP provides requirements for the following:

- General use of the laboratory,
- Personal Protective Equipment (PPE),
- Working alone/after hours,
- Use of equipment and tools in the laboratory,
- Use of chemicals and hazardous substances in the laboratory, and
- Use of compressed gases in the laboratory.

This SOP does not attempt to address the appropriate procedure or the required PPE for the use of any chemicals or specific equipment in the laboratory. The applicable Safety Data Sheets (SDS), SOPs and other relevant documentation must be considered before performing any task involving chemicals or equipment in the laboratory. Any questions should be directed to the Departmental Assistant in charge of the laboratory.

Relevant information can be found on the Department of Mechanical Engineering's safety webpage: https://engineering.usask.ca/departments/mech.php#Safety.

Some of the forms can be found on the *Engineering Student Resources* channel in PAWS.

All users of any ME laboratories (and their supervisors) MUST be familiar with the expectations listed on the safety website. In particular, all users of any ME labs are required to read, understand and sign SOP #ME0001 – Department of Mechanical Engineering General

Requirements, available in room 3B48 (Mechanical Engineering Office). All users are required to have taken the Laboratory Safety, Biosafety and WHMIS training courses offered by the University of Saskatchewan before working in the laboratory, and are required to keep these up-to-date. These courses must be renewed every three years. In addition to these courses, users may be asked to take additional safety courses related to their research, such as laser safety, etc.

2 Definitions

GHS:	Globally Harmonized System of Classification and Labelling of Chemicals
TAL:	Training Acknowledgement Log
SOP:	Standard Operating Procedure
SDS:	Safety Data Sheet
WHMIS:	Workplace Hazardous Materials Information System 2015
PPE:	Personal Protective Equipment

3 Safety & Hazards

- The Departmental Assistants are the main contacts for safety issues in the laboratories. They have the authority to enforce safety compliance including denying access to equipment and facilities to anyone that poses a risk to themselves, others or equipment.
- If an emergency occurs and neither of the Departmental Assistants is available, contact Protective Services directly at 306-966-5555.
- All personnel working in an area designated as a ‘Work Area’ in the tissue engineering laboratory must wear appropriate PPE for the task they are doing. At a minimum, long pants and closed toe/heel shoes must be worn when working in the laboratory.
- PPE including gloves, safety glasses and lab coats are available in the laboratory. Personnel should be familiar with the location of PPE in the lab they are working in.
- Personnel must read all relevant SDSs, SOPs and applicable operating manuals before beginning any work for the first time.
- All chemicals must be properly labeled, stored and disposed of.
- Students who wish to work outside of regular departmental hours must complete a formal working alone/after-hours plan, as per University of Saskatchewan guidelines.

4 Equipment and Materials

- Appropriate PPE
- SOPs or TALs for individual equipment
- SOP for research test facility (if applicable)
- SDS sheets for any chemicals being used
- WHMIS workplace labels or temporary labels
- Coloured storage classification stickers
- Proper containers for chemical mixing and storage

5 Procedure

5.1 General Laboratory Procedures

- All personnel must ensure that their conduct in the laboratory is consistent with general laboratory safety practices.
- No food or drink is allowed in any of the laboratories with the exception of the graduate student desk areas in 1A26.
- No new research activity can be started in the Tissue Engineering laboratories without the approval of the Faculty Supervisor and Departmental Assistant (based on the research area).
- All research work must be performed in the space that has been assigned to you by the Departmental Assistant or Faculty Supervisor. If you require more space, you must discuss this with the appropriate Departmental Assistant or Faculty Supervisor. While effort will be made to accommodate everyone, there may be limits placed on how much space each researcher can have.
- All new personnel (graduate students, summer students, etc.) are required to complete the New Employee & Graduate Student Orientation Checklist before working in the laboratory. This includes a Lab Safety Orientation, specific to the lab where the research will take place.
- All Mechanical Engineering laboratory spaces are inspected by the Mechanical Engineering Safety Committee twice a year and by the Local Safety Committee annually. All personnel are required to address any safety issues that arise during these inspections pertaining to their work or work area. The Departmental Assistant will relay the results of any inspections to the laboratory personnel.
- All personnel are responsible for keeping their research area clean and tidy. At the end of each day a quick clean-up should be performed. This includes keeping the floor clear of debris and tripping hazards, keeping table tops clean of debris and spills, disposing of all

garbage and recyclable materials, and putting away tools and other laboratory supplies (tape, rulers, glue, etc.).

- All personnel are required to complete the Researcher & Graduate Student Exit Form upon completion of their work in the laboratory. Depending on the type of research activity, this may include decommissioning of test facilities, cleaning of laboratory space and/or disposal of chemical waste.

5.2 Personal Protective Equipment (PPE)

- PPE, including disposable gloves and safety glasses are available in the laboratory.
- If you find that any PPE is missing or that stock is running low, inform the Departmental Assistant so that the required items can be restocked.
- Lab coats are available on the hooks in 1A26. A lab coat should be worn when working with hazardous materials.
- Lab coats are not to be worn outside of the laboratory. If any of the lab coats need to be cleaned inform the Departmental Assistant so that they can be laundered.
- Disposable gloves are meant to be single use only. Throw them away after use. If they are contaminated with a hazardous substance they must be disposed of through Chemical Waste (see Section 6.5). Always remove gloves before opening doors or touching computers, sinks, and other equipment.

5.3 Working Alone/After Hours

The College of Engineering has a working alone and/or after hours policy that must be followed by any personnel wanting to work outside of regular departmental hours. This relates to working **before 8:30 AM or after 4:30 PM Monday to Friday; and anytime on holidays or weekends**. The purpose of this policy is to ensure the safety of all personnel. Outside of regular working hours assistance in the event of an injury or emergency is not readily available. In these situations, additional precautions are necessary to minimize the risk of a workplace injury as well as to ensure a reasonably appropriate response to an emergency.

A formal working alone/after-hours plan is required in these situations. This policy can be found on the *Engineering Student Resources* channel in PAWS. The plan is to be filled out by the researcher and the Departmental Assistant together. The plan must be signed by the supervisor and a member of the Local Safety Committee (LSC). Your supervisor and the appropriate Departmental Assistant will keep a copy of the completed form.

If an injury or emergency occurs after hours contact Campus Safety (306-966-5555) and/or call 911. Any incidents, near-misses, injuries or emergencies must be reported to a Departmental Assistant as soon as possible **(within 24 hours).** See the following for more information on filling out an incident report: http://safetyresources.usask.ca/incident-staff.php

5.4 Equipment/Tools

- Most of the existing equipment/tools located in the laboratories have an associated SOP or TAL. The equipment will be marked with 'SOP Required' if an SOP exists. All personnel that want to use this equipment must first speak to a Departmental Assistant to obtain proper training and to sign the appropriate SOP/TAL. The binder for the SOPs/TALs is on one of the shelves in the laboratory. The binder contains lists of all equipment/tools that have SOPs. This list is also available on the ME Safety website. You should check this list to determine if there is an SOP to be read.
- Some of the equipment in the laboratories do not have SOPs or TALs. All personnel must still speak to a Departmental Assistant to obtain proper training on the applicable equipment/tool.
- If an SOP/TAL is created for an existing piece of equipment/tool, all personnel that are currently using the equipment/tool will be asked to read and sign the new SOP/TAL. Work on the equipment cannot resume until the SOP/TAL has been signed.
- The Departmental Assistant will determine if an SOP/TAL or hazard assessment is required for any new research equipment or test set-up. If the Departmental Assistant decides that an SOP is in fact necessary, the personnel will be responsible for creating the SOP for their test set up and having it approved by the Departmental Assistant before using it..
- For an in-house built research set-up, a brief SOP is all that is required. A blank SOP form is attached in Appendix A. This will help the researcher and Departmental Assistant identify any safety hazards related to the facility, as well as the appropriate PPE to be used. This form also helps to ensure that all necessary information is passed on from the creator of the facility to any other researchers using it. Copies of the research SOP must be given to the appropriate Departmental Assistant and your supervisor. A copy should also be kept with the facility for easy reference.
- No piece of laboratory equipment/tool can be removed from the lab without consent from a Departmental Assistant. A loan sheet must be completed for all equipment/tools that are borrowed from the laboratory.
- Any equipment/tools that are not functioning properly should be brought to the attention of the Departmental Assistant. Other personnel should not attempt to fix or perform maintenance on any laboratory equipment.
- All tools and other supplies (tape, glue, markers, etc.) that are the property of the Tissue Engineering Laboratory must be returned at the end of each day. These items are shared among all personnel using the laboratory and must always be returned to their proper storage location so others have access to them.

5.5 Chemicals and Hazardous Substances

The University is required by law to follow all WHMIS 2015 requirements. Any personnel that refuses to comply with these rules will lose their lab privileges. WHMIS 2015 is based on the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

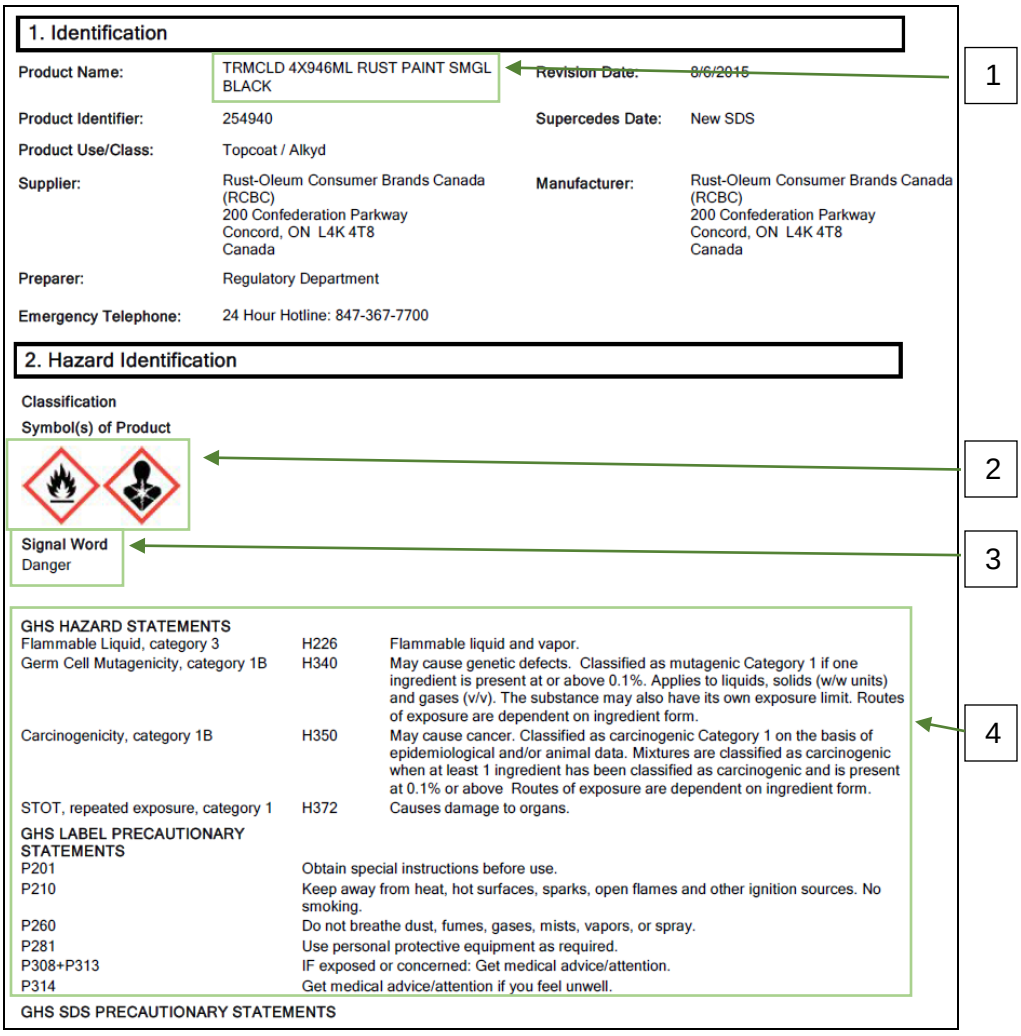
All users of the labs MUST consult the SDS prior to working with a hazardous substance, and be familiar with the hazards, safe handling practices and PPE required to work with the substance. Hardcopies of the SDS for all chemicals in the Tissue Engineering labs is found in the red binder located on one of the bookshelfs in 1A26.

Any user wishing to order a new chemical must complete a Chemical Order Form (available from a Departmental Assistant or on the ME Safety website). The form must be filled out completely and signed by your supervisor. Give the completed form to the appropriate Departmental Assistant to complete the order.

Any substances brought into the Tissue Engineering lab must be approved by the appropriate Departmental Assistant. The Departmental Assistant will need to add the substance to the chemical inventory list for that lab, ensure that it is properly labeled and determine an appropriate storage space for the chemical.

Labeling of WHMIS and Non-WHMIS Substances

- The SDS will state whether or not the substance is a WHMIS (or GHS) controlled product (Section 2 of the SDS). If it is a WHMIS (or GHS) controlled product, it must have an appropriate WHMIS label. Most chemicals ordered from a laboratory supply company will already have this, however chemicals purchased at retail stores (such as Canadian Tire) will generally not. If you are unsure, ask a Departmental Assistant for help.
- Substances brought into the laboratory have to be properly labelled. Labels are available from the Departmental Assistant. These includes blank WHMIS labels with pictograms, temporary labels, coloured storage classification stickers, pens, and markers.
- Non-WHMIS controlled substances (even water) **MUST** still be labeled. A WHMIS label is not required; a temporary label, or the original manufacturer's label is acceptable. The words 'Not WHMIS regulated' should be written on the container. A storage classification sticker is required.
- All WHMIS controlled substances **MUST** be labeled with a proper WHMIS label and a coloured storage classification sticker. Blank WHMIS labels and pictograms are stored in one of the drawers of 1A26. Labels may be hand written and the colored pictograms attached, or the whole label may be computer printed. An example SDS is shown in Figure 1, and the corresponding WHMIS label is shown in Figure 2. The important aspects of the label are outlined below Figure 2.



1. Identification

Product Name:	TRMCLD 4X946ML RUST PAINT SMGL BLACK	**Revision Date:**	8/6/2015
Product Identifier:	254940	**Supercedes Date:**	New SDS
Product Use/Class:	Topcoat / Alkyd		
Supplier:	Rust-Oleum Consumer Brands Canada (RCBC) 200 Confederation Parkway Concord, ON L4K 4T8 Canada	**Manufacturer:**	Rust-Oleum Consumer Brands Canada (RCBC) 200 Confederation Parkway Concord, ON L4K 4T8 Canada
Preparer:	Regulatory Department		
Emergency Telephone:	24 Hour Hotline: 847-367-7700		

2. Hazard Identification

Classification

Symbol(s) of Product

Signal Word
Danger

GHS HAZARD STATEMENTS

Flammable Liquid, category 3	H226	Flammable liquid and vapor.
Germ Cell Mutagenicity, category 1B	H340	May cause genetic defects. Classified as mutagenic Category 1 if one ingredient is present at or above 0.1%. Applies to liquids, solids (w/w units) and gases (v/v). The substance may also have its own exposure limit. Routes of exposure are dependent on ingredient form.
Carcinogenicity, category 1B	H350	May cause cancer. Classified as carcinogenic Category 1 on the basis of epidemiological and/or animal data. Mixtures are classified as carcinogenic when at least 1 ingredient has been classified as carcinogenic and is present at 0.1% or above Routes of exposure are dependent on ingredient form.
STOT, repeated exposure, category 1	H372	Causes damage to organs.

GHS LABEL PRECAUTIONARY STATEMENTS

P201	Obtain special instructions before use.
P210	Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P260	Do not breathe dust, fumes, gases, mists, vapors, or spray.
P281	Use personal protective equipment as required.
P308+P313	IF exposed or concerned: Get medical advice/attention.
P314	Get medical advice/attention if you feel unwell.

GHS SDS PRECAUTIONARY STATEMENTS

1
2
3
4

Figure 1: An example of an SDS for a WHMIS controlled substance.

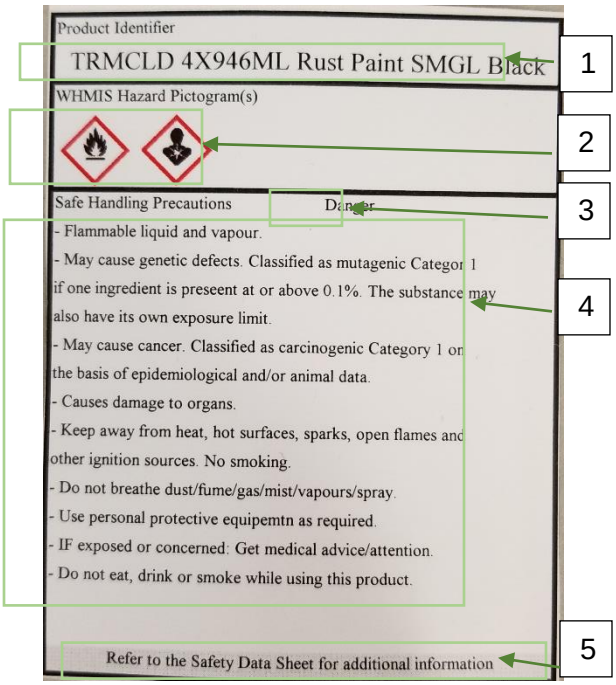


Figure 2: An example of a WHMIS Label for the product shown in Figure 1.

- The following items are required for WHMIS labels (container size > 100 mL)
  1. Product Identifier – This is the name of the product, as written on the SDS form. It must EXACTLY match the name on the SDS form.
  2. WHMIS Hazard Pictograms – This identifies the potential hazards of the product. These must be printed in colour. Note that some WHMIS controlled substances do not have pictograms. In that case, leave this section empty. If attaching a pictogram sticker to a hand written label, make sure to cut around the red diamond, this must be included in the sticker.
  3. Signal Word – this will either be Danger or Warning.
  4. Hazard Statements and Precautionary Statements – These are standardized statements on the hazards and precautions for the product. These must be copied from the SDS. Be aware of the size of the container before making the label, to ensure that it fits. It may be necessary to make the font smaller to fit all of the appropriate statements.
  5. Reference to the SDS for more information.
- If the container size is < 100 mL only items 1, 2 and 3 are required on the label.
- All labels must be placed on the container itself and not on the lid of the container.
- If the substance is dispersed into multiple containers from the original container, each container must have the same label. The subsequent containers do not need to be added to the chemical inventory, as long as the original container is included.

- If more than one substance is mixed together the label must include the information for all substances in the mixture.
- If you are unsure of how to properly label a container ask one of the Departmental Assistants for help.
- If a label begins to wear off over time or becomes difficult to read it must be replaced. The labels are printed on chemical resistant paper, so this should not happen often.
- An unlabeled container must be disposed of as unknown hazardous waste, and as such is subject to a service charge from Waste Disposal Management. This service charge will be billed to the researcher's supervisor, or in the event the supervisor cannot be identified, it will be split between the most likely supervisors. Unlabeled containers are not allowed in the laboratory at any time.

Storage of Substances

- All substances must be stored with compatible substances only. The storage stickers provide an easy reference for storage of substances. **Substances with different colored stickers MUST NOT BE STORED TOGETHER.** They may be stored in the same cupboard but not on the same shelf.
- Hazardous substances cannot be stored underneath sinks.
- WHMIS controlled substances cannot be stored above eye level or where food products are used/stored.
- Any liquids stored in containers on the floor must be placed in secondary containment. This is to ensure that any leaking chemicals are caught and do not flow down the drain in the floor. Plastic bins are available for secondary containment. Ask the Departmental Assistant for any containers you may need.

Cleaning Glassware, Containers and Utensils.

- A supply of glassware, containers and utensils for mixing and storage of chemicals is available in 1A26.
- All glassware, containers and utensils that have come into contact with WHMIS substances, either during mixing or containment, must be rinsed three times. The rinse water must be collected and stored in an appropriately labeled waste container. DO NOT dump the rinse water down the drain.
- After cleaning, items should be placed on a sorbent pad or drain pan to dry and then returned to the proper storage location.
- Any items that cannot be cleaned must be disposed of with the chemical waste. Label the item with the substance that has contaminated it and place it in the waste disposal collection area.

Waste Disposal

- All chemicals and hazardous substances must be disposed of properly through the University's Waste Management Facility. This includes any chemical that has a WHMIS rating or hazardous symbol of any kind. This applies to empty containers as well, such as empty glue bottles or paint cans.
- Under no circumstances can chemical waste be washed down the sink or contaminated waste be placed in the garbage. If you are unsure of the proper disposal method, ask one of the Departmental Assistants.
- Disposal of hazardous waste is done by the Departmental Assistants. Notify the Departmental Assistant when you need to dispose of hazardous waste.
- All waste containers must be properly labeled (with the full chemical name) so the Departmental Assistant can identify the substance when they dispose of it. All constituents, including waste water must be labeled on the container. A WHMIS label is not required for waste chemicals, a temporary label is acceptable.
- Contaminated items, such as gloves, paper towel, utensils, etc. must be placed in a sealable plastic bag (like a Ziploc bag) and labeled with the substance that has contaminated them.

5.6 Sharps Disposal

- Broken glass, razor blades, box cutter blades, and other sharp objects must be placed into a sharps disposal container and not in the garbage. There are sharps disposal containers located in 1A26.
- Any syringes that contain sharps (needles) must be disposed of in the sharps disposal bin. Syringes that do not contain sharps can be disposed of in the regular chemical waste bin.
- When the sharps disposal bin is full, the bin can be taped shut and placed in the normal garbage.

5.7 Compressed Gases

- Transportation of compressed gas cylinders is to be completed by trained individuals only. Talk to one of the Departmental Assistants to receive training on this if necessary.
- Compressed gas cylinders must be properly restrained to a wall or table. The restraint must be tight and located at 2/3 of the height of the cylinder.
- Regulators should be removed from compressed gas cylinders that are not being used frequently.
- Compressed gas cylinders are considered to be empty when there is 30 psi remaining. This is required for safe transportation of the cylinders back to the supplier. If you have an empty gas cylinder, alert one of the Departmental Assistants to arrange for pick up.

6 Emergency Response Procedure (ERP)

- All personnel must be familiar with the Emergency Response Plan located at the entrances of each laboratory, as well as the locations of fire extinguishers and first aid kits. All personnel must be familiar with the Lockdown Procedure for their laboratory and/or office space.
- All personnel are responsible for alerting a Departmental Assistant to any unsafe equipment or situation that they notice in the laboratories.
- All chemical spills, injuries and near misses must be reported to a Departmental Assistant as soon as possible (**within 24 hours**). The appropriate paperwork must be completed. See the following for more information on filling out an incident report: http://safetyresources.usask.ca/incident-staff.php
- Any time that a first aid kit is used (even for Band-Aids) a record of the incident and what items were used from the first aid kit must be made in the log book inside the kit. This helps the Departmental Assistant keep track of what is used and restock items as necessary.

Revisions to the procedure should be reviewed and approved by the person having overall authority over the procedure.

7 Regulatory / Standards

Government of Saskatchewan, 2013. *The Saskatchewan Employment Act*. Publications Saskatchewan, Regina, SK, **Part III Division 7**, sections 3-47 to 3-51. Accessed July 4, 2017. http://www.qp.gov.sk.ca/DOCUMENTS/ENGLISH/STATUTES/STATUTES/S15-1.PDF

Government of Saskatchewan, 1996. *The Occupational Health and Safety Regulations*. Publications Saskatchewan, Regina, SK, **Part XXII**, sections 315 to 329. Accessed July 4, 2017. http://www.qp.gov.sk.ca/documents/PIT/Regulations/O/O1-1R1-2003-04-30.pdf

Government of Saskatchewan, 2016. *The Occupational Health and Safety (Workplace Hazardous Materials Information System) Regulations*. Publications Saskatchewan, Regina, SK. Accessed July 4, 2017. http://www.qp.gov.sk.ca/documents/English/Regulations/Regulations/S15-1R6.pdf

University of Saskatchewan, 2017. Hazardous Waste Disposal Standard. Safety Resources, Saskatoon, SK. Accessed July 10, 2017. http://safetyresources.usask.ca/procedures_forms/documents/Hazardous%20Waste%20Disposal%20Standard.pdf

8 Trouble Shooting

Any equipment that is not working properly should be reported to a Departmental Assistant for maintenance.

9 References

Mechanical Engineering Safety Page: http://engineering.usask.ca/mech/safety/index.php

College of Engineering Safety & Security Page: http://www.engineering.usask.ca/service-and-support/safety-security.php

University of Saskatchewan – Safety Resources: http://safetyresources.usask.ca/

10 University Personnel

Persons authorized to perform this SOP:

By signing this form I acknowledge that I have read and understand this SOP, as well as the applicable SDS's and that I will conduct myself in accordance with this SOP and the general laboratory rules. I also acknowledge that I have received training by a qualified trainer, who has initialed this SOP acknowledging that training has been conducted.

List of Qualified Trainer(s)

1. Doug Bitner
2.
3.

NOTE: ALL SIGNATURES MUST BE PRESENT ON THE SOP LOCATED IN THE YELLOW BINDER IN ROOM 1A26. Digital copies of SOP's are made available for reference and convenience only. Printed SOP's are valid for 24 hours only, after that time their accuracy must be verified with the **OFFICIAL HARDCOPY VERSION**.

Name (Print)	Date	Dep't	Signature	Trainer's Initial

Name (Print)	Date	Dep’t	Signature	Trainer’s Initial

11 Non-University Personnel

Persons authorized to perform this SOP:

By signing this form I acknowledge that I have read and understand this SOP, as well as the applicable SDS's and that I will conduct myself in accordance with this SOP and the general laboratory rules. I also acknowledge that I have received training by a qualified trainer, who has initialed this SOP acknowledging that training has been conducted.

List of Qualified Trainer(s)

1. Doug Bitner
2.
3.

NOTE: ALL SIGNATURES MUST BE PRESENT ON THE SOP LOCATED IN THE YELLOW BINDER IN ROOM 1B39.1.1 OR IN ROOM 1B30.1 – the Departmental Assistant's offices. Digital copies of SOP's are made available for reference and convenience only. Printed SOP's are valid for 24 hours only, after that time their accuracy must be verified with the **OFFICIAL HARDCOPY VERSION**.

Name (Print)	Date	Company	Signature	Trainer's Initial	Required Sections

Name (Print)	Date	Company	Signature	Trainer’s Initial	Required Sections

APPENDIX A: Standard Operating Procedure for Research Facilities

Name and location of research facility: _____

Primary Researcher:	
Email:	
Phone:	
Secondary Researcher (if applicable):	
Email:	
Phone:	
Supervisor Name:	
Supervisor Email:	
Supervisor Phone:	

Brief description of the research facility:

List potential hazards that might occur during the use of the facility (e.g.: physical hazards, environmental concerns, chemical hazards, biological hazards). Add as many points as needed.

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-

List the Personal Protective Equipment (PPE) required to use the facility (e.g.: gloves, dust mask, lab coat). Be as specific as possible.

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Attach a brief step-by-step procedure of how to use the research facility. Add as many points as needed.

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RESEARCHER (signature): _____ DATE: _____
DEPARTMENTAL ASSISTANT: _____ DATE: _____