Autoclave Operation

Standard Operating Procedure (SOP)

Type of SOP: ☒ Process/Equipment ☐ Hazardous Chemical

All personnel who are subject to these SOP requirements must review a completed SOP and sign the associated training record. The most current version of the SOPs is located in electronic form on the University's Share Drive. Follow the link below.

S:\University Info\General Information\Emergency Information\Standard Operating Procedures

In addition to the electronic copies, hard copies of the SOPs can be found inside the laboratory, if the SOP pertains to something within a laboratory.

Date SOP Written: 10/10/22	**Approval Date:** 07/26/2023
SOP Prepared By: Michi Dubes	
SOP Reviewed and Approved by CHO (signature): Rose Rakers	
☒ **Department: Biology**	☐ **Campus Wide** ☒ **Lisle** ☐ **Mesa**
Principal Investigator (PI):	**Phone:**
Principal Investigator (PI):	**Phone:**
Chemical Hygiene Officer (CHO): Dr. Rose Rakers	**Phone:** 630-829-6571
Emergency Contact: Campus Safety Dispatch	**Phone:** 630-829-6122
Location(s) covered by SOP: Building and Room #(s): Birck 315 and 363	

1. **HAZARD OVERVIEW** (What are the hazards?) (i.e., hazards associated are chemicals, fire/explosion, electrical, ergonomic)

REQUIRED – Add a brief description of the process involving hazardous chemicals or equipment covered by this SOP.

Autoclaves use high pressure and high temperature steam (121°C at 15 psig) to destroy microbiological contaminants on laboratory items (or wastes) treated in the chamber. These devices have hot surfaces that can easily burn skin when energized. The treatment process can expose operators to hot liquids, pressurized steam, and hazardous fumes (if incompatible materials are treated). Autoclaves can be an explosion hazard if the seal of the door malfunctions or when the autoclave in loaded improperly (e.g., certain chemicals or materials that are not heat resistant).

2. HAZARDOUS CHEMICAL(S)

REQUIRED – If the SOP is for a process involving a hazardous chemical(s), provide a list of those chemicals and important properties and signs/symptoms of exposure. List any expected by-products produced if this SOP covers a laboratory process.

N/A

3. WHAT ACTIVITIES COULD POSE A RISK?

Activities that could pose a health hazard include:

REQUIRED – Bullet any health hazards associated with the process this SOP is detailing.

N/A

Activities that could pose a physical hazard include:

REQUIRED – Bullet any physical hazards associated with the process this SOP is detailing.

Potential risks for operators include: • Heat burns • Steam burns • Hot fluid scalds • Hand and arm injuries • Body injuries • Explosion hazard • Heavy lifting hazard

4. HOW CAN EXPOSURES BE MINIMIZED?

Elimination/Substitution – **REQUIRED** – If there is another chemical or piece of equipment that can be used which is a safer option but that would have a negative effect on the experiment detail why this is not an option.

N/A

Engineering Controls – **REQUIRED** – Insert descriptions of lab-specific engineering or ventilation controls used to reduce chemical exposures (i.e., fume hoods, glove boxes, biosafety cabinets, etc.) or specific equipment safety features. Refer to Section 7 and/or 8 of SDS for proper use.

• Run self-checks to ensure all seals are working properly. • Run vacuum checks to ensure all air is removed from autoclave. • Run a lock check to see if the door is locked properly. • Have interlocking doors so they cannot be opened during a cycle.

Administrative Controls

The following elements are required:

1. Complete the Hazard Communication and/or Laboratory Safety training prior to working in the laboratory;

2. Complete laboratory-specific safety orientation and training on laboratory-specific safety equipment, procedures, and techniques to be used, including a review of the Chemical Hygiene Plan, prior to receiving unescorted access to the laboratory;
3. Sign off that you read and understand the Chemical Hygiene Plan and what is expected while working in the laboratory;
4. Be familiar with the location and content of any applicable Safety Data Sheets (SDSs) for the chemicals to be used;
5. Implement good laboratory practices, including good workspace hygiene;
6. Inspect all equipment and experimental set-ups prior to use;
7. Follow best practices for the movement, handling, and storage of hazardous chemicals. An appropriate spill clean-up kit should be located in the laboratory. Chemical and hazardous waste storage must follow an appropriate segregation scheme and include appropriate labeling. Hazardous chemical waste must be properly labelled, stored in closed containers, in secondary containment, and in a designated location;
8. Do not deviate from the instructions described in this SOP without prior discussion and approval from the PI and CHO; and
9. Notify the PI, CHO and Emergency Preparedness Manager of any accidents, incidents, near-misses, or upset conditions (i.e., unexpected rise or drop in temperature, color or phase change, evolution of gas) involving the process or hazardous chemical(s) described in this SOP.

REQUIRED – Add any additional administrative controls specifically related to the process, procedure, and restrictions, including controls that may be chemical-specific.

- Safety training is given
- Good housekeeping is performed
- PPE is worn
- Emergency procedures in place
- Good records are kept (use, maintenance, clean-up and calibration logs)
- Do not stand in front of the autoclave when opening, stand to the side
- Required annual maintenance for replacing the gaskets and door hinges, as advised by the manufacturer
- Complete log book with every use and annual maintenance

Personal Protective Equipment (PPE)

At a minimum, long pants (covered legs) and closed toe/closed heel shoes (covered feet) are required to enter a laboratory or technical area where hazardous chemicals are used or stored. In addition to the minimum attire required upon entering a laboratory, the following PPE is required for all work with hazardous chemicals:

A. Eye Protection
    a. Eye protection must be ANSI Z87.1 compliant.
    b. At a minimum, safety glasses are necessary.
    c. Splash goggles must be substituted for safety glasses in chemistry laboratories, and are required for processes where splashes are foreseeable or when generating aerosols.
B. Body Protection: At a minimum, a chemically-compatible laboratory coat that fully extends to the wrist is necessary.
    a. If a risk of fire exists, a flame-resistant laboratory coat that is NFPA 2112 compliant should be worn.
    b. For chemicals that are corrosive and/or toxic by skin contact/absorption additional protective clothing (i.e., face shield, chemically-resistant apron, disposable sleeves, etc.) are required where splashes or skin contact is foreseeable as per the SDS.

C. Hand Protection: Hand protection is needed for the activities described in this SOP. Define the type of glove to be used based on the following:
    a. Chemical(s) being used;
    b. Anticipated chemical contact;
    c. Manufacturer' permeation/compatibility data; and
    d. Whether a combination of different gloves is needed for any specific procedural step or task.

REQUIRED – Add any descriptions of PPE and hygiene practices used with each process or hazardous chemical(s), including any specialized PPE needed for a procedural step/task.

Equipment to protect against scalds and burns include:

- Heat-insulating gloves that provide complete coverage of hands and forearms
- Lab coat
- Eye protection (safety googles)
- Apron and face shield (if working with liquids)
- Closed-toe footwear

5. ADDITIONAL GUIDANCE

Spill and Emergency Procedures

Follow the guidance for chemical spill clean-up from the SDS, unless specialized clean-up procedures are described in detail below.

INSERT – Descriptions of any specialized spill clean-up procedures for the hazardous chemicals used in this SOP. Additional details of lab-specific spill clean-up should be provided.

Spill Procedures

- Spills may occur from a boil-over or breakage of containers.
- No operation of the autoclave is allowed until the spill is cleaned up.
- The operator is responsible for clean-up of spills.
    - Wait until the autoclave and materials have cooled to room temperature before attempting clean-up.
    - Contain the spilled material using paper towels.
    - Use the laboratory's spill kit if necessary.
- Review SDS, if appropriate, to determine appropriate PPE, spill clean-up, and disposal protocols that are necessary.
- Dispose of the waste following the protocol appropriate for the material.
- Cracked glassware must be disposed of properly.

Emergency Procedures

- All incidents, including a spill or release of biohazardous materials or recombinant DNA must be reported to the CHO and Emergency Preparedness Manager.
- If any injury occurs:
    - Seek first aid for minor injuries.
    - If injury is more severe, dial 911.
- If clothing is soaked in hot water/steam, remove the clothing and place the injury in cool water.
- Place a notice on the autoclave indicating that it is not to be used until the cause of the incident is determined and the autoclave is deemed safe for operation.

Disposal and Decontamination Procedures

Hazardous waste must be properly labeled and removed from your laboratory within six (6) months of the accumulation start date. Hazardous waste should be brought down to the Chemical Stockroom. Speak with the CHO prior to bringing the waste.

REQUIRED – Add descriptions of laboratory-specific information on the waste streams generated, storage location, and any special handling/storage requirements.

- Ensure that the material being placed in the autoclave is safe for this process.
- Inspect all glassware for cracks before placing in the autoclave.
- Autoclaved sharps must still be disposed of as biohazard.
- Autoclaved glass serological pipets must all be disposed of as biohazard.

REQUIRED – Add descriptions of decontamination procedures for equipment, glassware, and controlled areas (i.e., glove boxes, fume hood).

- Prior to decontamination, all potentially biohazardous material shall be kept in secondary containment containers to protect against leakage.
- Prepare and package material suitably:
    - Loose, dry materials must be wrapped or bagged in steam-penetrating paper or loosely covered with aluminum foil. Wrapping too tightly will impede steam penetration, decreasing effectiveness of the process.
    - Loosen all lids to prevent pressure build-up. All containers must be covered by a loosened lid, steam-penetrating bung, or with aluminum foil.
    - Containers of liquid must not exceed 80% full, with lids loosened.
    - Glassware must be heat-resistant borosilicate.
    - Plastics must be heat-resistant, i.e., polycarbonate (PC), PTFE (Teflon), and most polypropylene (PP) plastics.
    - Discarded sharps must be in a designated “Sharps” container.
    - Autoclave tape is recommended for each separate container in each load.
- Place items in secondary containers to secure and contain spills:
    - Items should be place in a stainless-steel pan or other autoclave-safe container for their stability and ease of handling.
    - Place containers of liquid, bags of agar plates, or other materials that may boil over or leak into a secondary pan.
        - Pan must be large enough to contain a total spill of the contents
        - Pan must sit flat in the autoclave (no leaning or tilting)
    - Bags must not be tightly sealed as steam cannot penetrate.
- Biohazardous waste must be processed according to recommended lab guidelines.
- All decontaminated solid biohazard must be placed in an opaque garbage bag and taken to the outside garage receptacle by the individual responsible for that decontaminated biohazard.
    - Housekeeping does not handle decontaminated biohazardous waste.

Upon completion of work with hazardous chemicals and/or decontamination of equipment, remove gloves and/or PPE to wash hands and arms with soap and water. Additionally, upon leaving a designed hazardous chemical work area remove all PPE worn and wash hands, forearms, face and neck as needed. Contaminated clothing or PPE should not be worn outside the lab. Grossly contaminated clothing/PPE and disposable glove must not be reused.

Shipping and Transportation

Follow the Shipping Hazardous Materials policy found at **S:\University Info\General Information\Emergency Information**.

Fires

INSERT – Add descriptions of what to do in case of a fire as described by the process mentioned in this SOP.

The autoclave is not designed for flammables and this may cause a fire or explosion. When sterilizing liquids, use liquid cycle only and do not agitate containers of heated liquids, place containers in an autoclavable tray. Jarring containers can cause hot-bottle explosions.

Exposure Requiring the Use of Emergency Shower and/or Eyewash/Drench Hose

- Have someone call 911 (report the building name, street address (located near the door to the room on the Emergency Procedures sheet) and room number.
- Contact Campus Safety at 630-829-6122 to report the incident and let them know you called 911.
- Have someone obtain the SDS for the material and provide it to the first responders upon arrival.
- Assist the affected individual to position their head over the eyewash/drench hose located in the laboratory and activate it if the eyes or face are affected. If the exposure is on the body assist the affected individual to the emergency shower in the hallway and activate it. The activation of either the eyewash or shower located in the hallway will trigger an alarm notifying Campus Safety. Ensure your own safety before helping others. Only help if it is safe for you to do so.
- Instruct the affected individual to open their eyes and roll them around while the water is flowing or to stand under the shower with the affected area being covered in water.
- Flush the affected area for 15 minutes with water.
- Notify the Emergency Preparedness Manager as soon as possible and complete the Accident/Incident Form.

6. TRAINING

To teach and learn inside a laboratory, certain training must take place. All individuals must take a Laboratory Safety online course. If your laboratory involves chemicals for chemistry or biology, individuals must also take the Hazard Communication online course. These two online courses are set up with the Emergency Preparedness Manager.

Refresher training for the Hazard Communication course will be taken if the individual completed the full three-part course within six (6) months. If it has been close to or over one (1) year, the full three-part course will need to be repeated. The Laboratory Safety course will be repeated if the individual completed the course over one (1) year prior.

In addition to the online courses, students are required to complete laboratory-specific training to be able to stay in the laboratory.

7. SOURCES AND ADDITIONAL RESOURCES

List all sources and additional resources that contributed to the creation of this SOP.

Vanderbilt https://www.vumc.org/safety/sites/default/files/public_files/bio/autoclave-safety.pdf University of Wyoming https://www.uwyo.edu/safety/_files/Docs/Procedures/SOPs/Biosafety/Autoclave_SOP.pdf Boston University https://www.bu.edu/researchsupport/forms-policies/autoclave-safety-guidelines/ University of Illinois Champaign-Urbana Safety Poster https://www.drs.illinois.edu/site-documents/Autoclave%20Poster-Final%20(8.5x11).pdf

All personnel shall read and fully adhere to and acknowledge the contents, requirements, and responsibilities outlined in this SOP.

☐ I have read and acknowledge the contents, requirements, and responsibilities outlined in this SOP.

Print Name:	Signature:
BenU ID:	Date: