ENVIRONMENTAL HEALTH & SAFETY

Autoclave Safety Protocol

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Document: **Autoclave SOP**

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ACRONYMS & DEFINITIONS

EHS	Environmental Health and Safety
Near-Miss	A narrowly-avoided incident or accident
PPE	Personal Protective Equipment
SOP	Standard Operating Procedure
UNM	University of New Mexico

TABLE OF CONTENTS

1. Purpose

Safety is a core value of the University of New Mexico (UNM) and UNM is committed to creating and promoting a culture of safety within the University community. Part of demonstrating this commitment is providing Standard Operating Procedures (SOPs) on the safe operation and maintenance of equipment such as autoclaves.

Autoclaves are used to sterilize equipment and supplies so that these items may be safely reused. Autoclaves are also used to sterilize liquid media prior to use. Use of this SOP, combined with a lab-specific autoclave SOP and hands-on training by an experienced autoclave user, will ensure the safety and health of autoclave users and others who work in the vicinity of autoclaves at UNM.

2. Scope

This SOP applies to all faculty, staff, students and visitors who utilize autoclaves at UNM. All autoclave users must read, understand, and comply with the requirements of this SOP. A template for creating a lab-specific autoclave SOP is included as Attachment A.

3. Roles and Responsibilities

3.1. Environmental Health & Safety

- Periodically review and update this SOP as needed.
- Distribute this SOP to Dean, Directors, and Department Chairs.

3.2. Supervisors and PIs

- Ensure compliance with this SOP.
- Develop and implement a training program for autoclave operation, and maintain training logs.
- Operate autoclaves per manufacturer's instructions.
- Designate a responsible person to ensure this SOP and departmental SOPs are being followed.
- Provide appropriate PPE as necessary.

3.3. Autoclave Owners

- Ensure compliance with this SOP.
- Develop lab-specific SOPs for operation and maintenance of autoclaves.
- Develop and implement a training program for autoclave maintenance, and maintain training logs.
- Maintain autoclaves per manufacturer's instructions.
- Designate a responsible person to ensure maintenance is being completed.

3.4. Autoclave Users

- Review this SOP and SOPs specific to the autoclave being used.
- Complete autoclave training.
- Maintain autoclave log sheets or book.
- Operate and maintain autoclaves per manufacturer's instructions.
- Perform safety checks prior to each use.
- Notify supervisor if any safety or functional issues arise.
- Wear appropriate PPE, when necessary for the task.

4. Hazard Identification

An autoclave is essentially a pressure cooker that uses heat, steam, and pressure to render its contents sterile. In addition to these physical hazards, there may be biological hazards associated with the contaminated equipment being sterilized.

4.1. Physical Hazards

- Heat – Autoclaves reach temperatures from 250-752°F (121-400°C)
- Steam – The maximum temperature of the steam generated is 275°F (135°C)
- Pressure – Pressures range from 15-30 psi

4.2. Biological Hazards

- Biological material (blood, tissue, cells, DNA, mRNA) adhering to equipment to be autoclaved may contain infectious agents or pathogens that, if exposed, could cause illness or disease.

5. Hazard Control

To reduce the likelihood of incidents, illness, and injuries from autoclave use, implement the following hazard controls, in the order in which they appear:

5.1. Engineering Controls

- Door interlocks
- Autoclave self-checks (Seals, Vacuums, Locks)

5.2. Administrative Controls

- Creating and abiding by lab-specific Standard Operating Procedures (SOPs)
- Training
- Good Housekeeping

- Recordkeeping – Training, Maintenance, Calibrations, Usage Logs
-

5.3. PPE

- Lab coat
- Goggles or face shield
- Heat-resistant gloves
- Apron

6. TRAINING

- Autoclave users must be trained on how to use the different types/models of autoclave they use.
    - Training must include reading this SOP, the lab-specific autoclave SOPs, and hands-on training by an experienced autoclave user
- Keep training logs available for inspection by EHS or an outside agency. A sample training log is provided as Attachment C.

7. STANDARD OPERATING PROCEDURES

PIs, supervisors, and/or lab managers must develop SOPs for each of the autoclaves used by their lab personnel. SOPs for autoclave operation & maintenance must include:

- Cycle time
- Temperature
- Pressure

NOTE: On units with pre-programmed cycles, Cycle time, Temperature, and Pressure may not be necessary. In this case, specify the programs used.

- Equipment type
- Containers used
- Whether containers are open or closed
- Loading pattern
- Water content
- Maximum load capacity

An SOP template is provided as Attachment A.

8. Operation & Maintenance

NOTE: Autoclaves must not be used to render infectious material non-infectious; this is considered a form of treatment, for which a permit from the State is required.

For all autoclaves, follow the manufacturer's instructions for selecting or programming a cycle.

- Certain loads may require increased temperatures or cycle times based on size, shape, weight, density and/or material composition.

8.1. Prior to Use

- Inspect the door gasket for cracks or bulges.
- Inspect inside the autoclave for spills or debris.
- Clean the drain screen.
- Contact the designated responsible person or your supervisor if any problems are found.
- Where applicable, allow time for the autoclave jacket to reach sufficient temperature and pressure.
    - Dependent on model; may not require this.
- Ensure that plastics are compatible with the autoclave being used.
- Inspect glassware for cracks. **Do not** autoclave cracked or compromised glassware.
- Leave caps loose on liquids to prevent explosion.
- Cover uncapped bottles or flasks with foil.
- For bagged items, loosely tape or tie closed. Leave an opening to allow for steam to penetrate the bag.

8.2. Loading

- Place items in an autoclave tub or rack. Do not place items directly on the bottom of the autoclave.
- Allow sufficient space between items; do not overload.
- If your autoclave does not connect to a water system, add water to appropriate level if necessary.
- Use secondary containment (open bags, trays, tubs) to contain potential spills in the event the primary containers fail.

8.3. Operating

- Follow the manufacturer's user manual and the lab-specific SOP for operating the autoclave.
- Close and lock the door; ensure the door is secure before starting a cycle.
- Select the appropriate cycle.
- Ensure that a sufficient pressure has been reached.
- Record required information on log sheet. A sample log sheet is included as Attachment B.
- Do NOT open the door during a cycle.
- If the cycle fails, notify the designated responsible person or your supervisor.

8.4. Unloading

- Verify that the chamber temperature has dropped and the pressure is zero (0).
- Wear the appropriate PPE (heat-resistant gloves, lab coat, safety glasses) to protect yourself from heat and steam.
- Slowly open the door to allow steam to escape gradually, keeping your face away from the door.
- Allow items to stand in the autoclave for at least 10 minutes.
- Cautiously remove items and place in a safe area to cool.
- Do not agitate containers; some liquids can explode if moved too quickly.
- Record required information on log sheet.
- Clean the autoclave, especially if:
    - Liquids have boiled over;
    - Bottles have broken; and/or
    - Items have melted.
    - Do not leave a dirty autoclave for the next user.

8.5. Back-up Plan for Autoclaving Biological Material

- Should a failure occur, a back-up plan must be in place. This can include:

1. An alternate autoclave
2. Transporting material to another facility
3. Storing material in a secure freezer for up to 90 days

8.6. Maintenance and Monitoring

- The responsible person should implement a regular autoclave maintenance schedule.
- Keep contact information for maintenance technician readily available.
- Recommended monitoring:
    1. Temperature:
        - Ensure autoclave has a recording and/or indicating thermometer or other method to verify temperature.
        - Check and record that the sterilization temperature was achieved and sustained for the appropriate amount of time.
        - Calibrate thermometer annually.
    2. Biological Indicator:
        - Use a biological indicator monthly to confirm the attainment of adequate sterilization conditions.
    3. Inspections
        - Visual inspections should be performed prior to each use.

9. Incidents and Near Misses

Despite our best efforts to be careful and safe, incidents and near-misses occur. In order to improve the safety of our workplace, it is imperative that incidents and near-misses be reported to EHS. Reporting is also a vital step in the process of fulfilling a Worker's Compensation claim, if necessary.

Autoclave incidents and near-misses must be immediately reported to the PI or supervisor and to EHS when safe to do so. Priority must always be the safety and health of those impacted by an incident. To report an accident, incident, spill or near-miss to EHS, fill out the form located here:

https://ehs.unm.edu/accident-incident-spill-reporting/index.html

10. Attachments

A – SOP Template

B – Sample Log Sheet

C – Sample Training Log

D – Autoclave Inspection Checklist

ATTACHMENT A

SOP Template

AUTOCLAVE STANDARD OPERATING PROCEDURE

AUTOCLAVE INFORMATION			
Make/Model:		**Building:**	
Room:		**PI/Supervisor:**	
Designated Responsible Person:		**Phone Number:**	
Email:		**Location of Autoclave Records:**	
Completed By:		**Date Completed:**	
MAINTENANCE INFORMATION			
Maintenance Schedule:		**Maintenance Contact:**	
Company:		**Phone Number:**	

PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIRED

☐ Lab Coat ☐ Safety Glasses ☐ Face Shield

☐ Heat-resistant Gloves ☐ Latex Gloves ☐ Other:

PREPARING THE AUTOCLAVE

- Inspect the door gasket for cracks or bulges. The gasket should be smooth and pliable.
- Clean the drain screen of debris.
- Turn the power on and allow time for the jacket to reach sufficient temperature and pressure.
- If any problems are found, contact the Designated Responsible Person.

PREPARING THE ITEMS

- Ensure plastic items are compatible.
- Inspect glassware for cracks.
- Leave caps on liquids loose to avoid explosion.
- Cover uncapped bottles or flasks with foil.
- For bagged items, loosely tape or tie the bag, and allow an opening for steam to enter the bag.
- Double bag agar plates to prevent leaking.
- Affix autoclave tape to items.

LOADING THE AUTOCLAVE

- Place items into tubs and/or on a rack.
- Always use secondary containment in case of spillover.
- Add water if necessary.
- Do not overfill the autoclave.

OPERATING THE AUTOCLAVE

- Close and lock the door. Ensure the door is secure before starting a cycle.
- Select the appropriate cycle.
- Record run on autoclave log sheet.
- Do not open the door during a cycle. If necessary, abort the cycle and wait until the chamber depressurizes.
- If the cycle fails, notify the designated responsible person and follow the back-up plan.
- Cycle failure includes:
    - Autoclave tape did not change color.

- Cycle did not maintain sterilization temperature for the required time.
- Biological indicator test failed.

Content Type	Cycle Number	Liquid/Dry	Sterilization Time	Sterilization Temperature
☐ Bagged				
☐ Liquid				
☐ Glass				
☐ Plastic				

UNLOADING THE AUTOCLAVE

- When the cycle is complete, verify that the chamber temperature has dropped and the pressure is zero (0).
- Wear appropriate PPE to protect from heat and steam.
- Slowly open the door to allow steam to escape gradually. Keep your face away from the door.
- Allow items to stand in the autoclave for 10 minutes.
- Visually inspect bags, boxes, and containers for protruding objects.
- Cautiously remove items, and place them in a safe area to cool. Do not agitate.
- Record run information on autoclave log sheet.

INCIDENTS AND NEAR MISSES

- In the event of an accident, provide first aid and get help.
- Report any incidents or near misses to the designated responsible person, your supervisor, and EHS at https://ehs.unm.edu

BACK-UP PLAN

□ Use an alternate autoclave. Location:

□ Transport material(s) to:

□ Store material(s) in a secure freezer for up to 90 days. Location:

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I have read and understand the content of this Standard Operating Procedure:

Name	Signature	Date

ATTACHMENT B

Sample Log Sheet

AUTOCLAVE LOG SHEET

Autoclave Make/Model:		Room:	
Responsible Person:		Phone Number:	

Date	Contents	Cycle Number	Program Number	Sterilization Time (min)	Pressure (psi)	Max Temp Reached	Tape Result (Pass/Fail)	Biological Indicator Used? (Y/N)	Operator	Comments

ATTACHMENT C

Sample Training Log

AUTOCLAVE TRAINING LOG

Autoclave Make/Model:		Building:	
Room:		PI/Supervisor:	

Training Date	Name	Signature	Trained By:

ATTACHMENT D

Self-Inspection Checklist

AUTOCLAVE SELF-INSPECTION CHECKLIST

Auditor/Title:				**Date:**
Building:				**Room:**
PI or Owner:				**Email:**
Administrative				
	Yes	**No**	**N/A**	**Comments**
SOP				
Training Records				
Updated Logs				
Maintenance Records				
PPE				
Temperature/Pressure Records				
Blowdown performed at least weekly				
Type(s) of Material(s) Autoclaved				
Use Frequency				
Last Professional Inspection	**Date:**			**Vendor:**
External				
	Yes	**No**	**N/A**	**Comments**
Coverings such as insulation and corrosion resistant coatings in good condition				
Free of cuts, dents, or gouges				
Free of distortion, deformation, or other defects				
Free from erosion				
Free from leakage of gas, vapor, or liquid				
Free of cracks, blisters, bulges, and other evidence of deterioration/corrosion				
Door gasket free from cracks or deformations				

Internal				
All openings leading to any external fittings or controls are free from obstructions				
Free of corrosion and/or cracks				
Special closures are adequate				
Free from deterioration				

Contactors tight and free from pitting, heat damage, or excessive arcing				
Chamber drain strainer is clean				
Chamber is clean and free from spills				

Autoclave Safety Protocol

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