

A. Purpose:

This policy is designed to serve as a guidance document to identify and communicate the hazards associated with operating laboratory autoclaves and automated equipment washers (AEW). This policy is meant to supplement, not substitute, safety and operational training provided by the laboratory supervisor, PI and/or manufacturer or service provider.

B. Applicability/Scope

This policy applies to those Columbia University trained employees who are operating laboratory autoclaves or automated equipment washers. This policy is meant to supplement the information provided in training and serve as a guidance document and risk assessment regarding hazards associated with operating a laboratory autoclave or AEW.

C. Definitions

AEW: Automated equipment washer, which includes rack washers, commercial dishwashers and cage washers used to clean and wash items in laboratories, research areas or clinical areas

kPa: kiloPascal. A unit of pressure measurement equivalent to 0.145 psi or 0.00987 atm

PI: Principal Investigator

PPE: Personal Protective Equipment

Hazardous material: a substance or material that the Office of the Secretary of the US Transportation Department has determined is capable of posing an unreasonable risk to health, safety and property when transported in commerce. It includes hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table, 49 CFR 172.101 and materials that meet the defining criteria for hazard classes and divisions in 49 CFR 172, Subchapter C.

RASCAL: Research Compliance and Administration System

D. Procedures

Introduction:

Widely used in microbiology, medicine and veterinary medicine sterilization autoclaves are pressure chambers working at high temperature and pressure to kill or deactivate biological agents (viruses, bacteria, spores, fungi etc.) resistant to the boiling water method. They are used to sterilize equipment (such as surgical instruments, laboratory glassware), supplies (for example growth media) and to decontaminate regulated medical waste.

Sterilization in a laboratory autoclave is achieved by subjecting materials to high-pressure steam at 121°C (249°F) and 100 kPa for 15-20 min, and therefore their use involves safety hazards. In order to mitigate the risks associated with those hazards, personnel operating laboratory autoclaves must follow specific operating procedures.

Automated equipment washers (AEW) include: rack washers, commercial dishwashers and cage washers used to clean and wash items in laboratories, research areas or clinical areas. They typically are used with a detergent or cleaning agent which are often caustic and/or corrosive and may cause skin damage if proper Personal Protective Equipment (PPE) is not used.

Laboratory Autoclave and AEW Hazards:

Do not put chemicals inside a laboratory autoclave or AEW.

Chemical hazards may include chemical burns to the skin may be caused when changing detergent or cleaning agent containers. Detergents or cleaning agents may be caustic or corrosive.

Biological hazards may include exposure to contaminated materials, bacteria, viruses or blood borne pathogens. Such exposures may occur as a result upon contact with materials that have not yet been washed or autoclaved. Therefore, these materials are still potentially infectious. Sharps injuries may occur if sharp objects are not properly containerized prior to placing them in the laboratory autoclave or AEW.

Physical hazards include potential heat burns caused by the laboratory autoclave or AEW chamber doors, walls and hot autoclaved or washed materials. Steam burns can be caused by: residual steam released from the laboratory autoclave chamber or AEW, steam from the actual materials at the end of a cycle, or technical malfunctions that may arise during autoclaving or washing cycles. Hot liquid scalds caused by boiling liquids or liquid spills in the unit. Hand and arm injuries may occur when opening or closing the unit door. Bodily injuries can occur in the event of:

- theoretical risk exists with over pressurization or bursting of the unit during a potential operational malfunction. However, safety devices and measures are typically in place as prevention measures.
- entrapment in walk-through style, large, laboratory autoclave units and rack washers
- trip hazards such as cluttered surroundings and protruding wires, pipes or
- slip hazards such as slippery floors or lose floor mats near the laboratory autoclave door
- electric shock/electrocution due to exposed wiring and circuitry
- cuts and puncture wounds caused by broken glass containers or improper sharps management

Risk Mitigation:

Training is strongly encouraged for employees operating a laboratory autoclave or AEW. Training should include this EH&S-provided safety awareness training and Supervisor/service provider operational training. Service provider training may be arranged through your Supervisor or direct through the service provided by calling their service number. An initial, live, training session provided by EH&S, upon request, should be attended prior to starting operation. The attendees of the live EH&S training session will then be entered into RASCAL which then will prompt users for future, biannual training sessions online. Additionally, Supervisors should maintain manufacturer's procedural and instructional documents, which should be readily available and/or posted and followed.

PPE must be used when operating a laboratory autoclave and AEW. AEW users should wear gloves appropriate to protect against the chemical detergent or cleaning agents used for AEW. Refer to the product Safety Data Sheet (SDS) for the manufacturer's recommendation regarding appropriate gloves. Refer to the PPE section in this policy for additional details.

Periodic inspection should be performed by the manufacturer or authorized service provider and laboratory autoclave user including:

- a basic visual inspection should be performed monthly by the responsible party
- operating instructions and precautionary statements may be posted to inform the user visual inspection prior to each use is recommended (see Laboratory Autoclave and AEW User Checklist in Section J. Forms)
- inspection, service, and repair records should be available upon request
- service provider contact information should be posted on site

Personal Protective Equipment:

PPE required when operating a laboratory autoclave or AEW includes:

- Long pants (or equivalent)
- Closed-toe shoes
- Lab coat
- Splash apron (better protects from steam than a fabric lab coat)
- Heat-insulating gloves (for laboratory autoclave operations) instead of chemical resistant gloves which are not heat resistant
- Chemical resistant gloves (for AEW operations)
- Face shield (for protection from steam or chemical splashes during AEW cleaning agent change out). Face shields better block steam sprays than safety glasses.

Operation Safety Guidelines:

1. As a reminder, do not eat or drink in areas where laboratory autoclaves are operated.

2. Confirm that materials are safe for autoclaving or placing in AEW:
 - inspect glassware for integrity (cracks) and do not autoclave or place in the AEW damaged items
 - do not place chemicals inside containers in laboratory autoclaves or AEW units
 - glassware must be made of heat resistant borosilicate
 - plastics must be heat resistant: polypropylene (PP), Teflon (PTFE), polycarbonate (PC)
 - samples containing solvents, radioactive materials or hazardous materials that may emit toxic fumes must not be autoclaved. Do not autoclave bleach. Generally, growth media, water or other nonhazardous liquids can be autoclaved.
 - biohazardous waste must be processed according to recommended lab guidelines
 - refer to Section I. Appendices for additional guidance on autoclave safe containers
3. Don appropriate PPE as indicated in this Section. To prevent entanglement during door operation, remove loose or dangling personal items such as lanyards, jewelry or neck ties. Tie back long hair.
4. Do not overload the laboratory autoclave or AEW to ensure adequate circulation within the units.
5. Close and latch the door firmly.
6. Prepare and package materials safely. For laboratory autoclaves:
 - loose, solid items must be wrapped or bagged in steam permeable materials
 - lids must be loose in order to prevent pressure buildup
 - containers must be loosely covered with aluminum foil
 - bags must not be tightly sealed
 - discarded sharps must be in a proper sharps container for autoclaving
 - all packages/items must be marked with Lead-free, autoclave indicator tape
 - check that recorder paper is present (if equipped with recorder).
 - place items in secondary containers, such as:
 - Stainless steel pans or racks for ease of handling (such as those used to hold surgical instruments).
 - Secondary containment trays used for liquids or agar plates should be large enough to contain the total contents of a potential boil-over or spill.
7. Choose the appropriate cycle (solid, liquid, dry etc.) for the items being sterilized in a laboratory autoclave. Choose the appropriate heating and drying cycle for AEW.
8. Periodically check the unit during operation. For laboratory autoclaves, do not leave before it reaches the “sterilize” step of the cycle.

9. Ensure that the laboratory autoclave cycle was completed and the pressure inside the chamber has dropped to normal atmospheric level before attempting to open the door. When opening the door, stand behind it instead of in front of the open chamber to avoid burns caused by residual steam.
10. Leave autoclaved items for a few minutes in the chamber before attempting to remove them. Unload the autoclaved materials wearing the appropriate PPE and place them on a stable, heat-resistant table or lab bench to allow them to cool.

Quality Assurance:

Maintain a service contract or service provider contact number for routine maintenance needs for laboratory autoclaves and AEW. Schedule routine maintenance by a service provider. Maintain manufacturer's equipment purchase records, operator manuals and reference guides.

For laboratory autoclave operations, there are chemical and biological indicators which can ensure that the right temperature was reached for the correct amount of time during the autoclaving process. Autoclave tape and chemical indicators on special packaging, change color when the correct conditions were achieved, but do not indicate complete sterility. When selecting autoclave tape, please select Lead-free autoclave tape. Biological indicators containing spores of a heat-resistant bacterium can be used to verify sterility. If the laboratory autoclave does not reach the right temperature, the spores will [germinate](#) when incubated and their [metabolic](#) product will change the color of a [pH](#)-sensitive chemical. Biological indicators consist of heat-resistant bacterial spores. If the selected autoclave cycle does not reach the adequate temperature to kill those spores they will germinate when incubated after the end of the cycle. The spores of a heat-resistant bacterium can be used to verify sterility. They should be placed in the most challenging place in a load (e.g. in the middle of the laboratory autoclave with the bags surrounding the load).

E. Responsibilities

Columbia University, lab managers, supervisors and PIs are responsible for the safe use of laboratory autoclaves and AEW.

F. Emergency Contact

In case of a fire call Public Safety at:

- Medical Center, 212-305-7979
- Morningside, 212-854-5555
- Manhattanville 212-853-3333
- Lamont, Safety Department, 845-359-2900 or x555
- Nevis, 911

In case of a medical emergency call Public Safety at the numbers listed previously or seek medical treatment directly at:

- Medical Center, during business hours, Workforce Health & Safety Harkness Pavilion 1st Floor 212-305-7580 or Student Health Services, 60 Haven Ave 212-305-3400. After business hours, NYPH Emergency Dept. 1st floor of Vanderbilt Clinic.
- Morningside and Manhattanville, Mt. Sinai St. Luke’s Hospital, 1111 Amsterdam Ave and W. 114th St. or Student Health Services, John Jay Hall, 3rd and 4th floors.
- Lamont, Nyack Hospital, 160 North Midland Ave, Nyack.
- Nevis, St. John’s Riverside Hospital, 128 Ashford Avenue, Dobbs Ferry.

G. Medical Surveillance

Not required.

H. Recordkeeping

Not required.

I. Appendices

- [Nalgene® Plastic ware Chart](#)
- [ThermoScientific Nalgene Bottles and Carboys Technical Brochure](#), “Not all containers are created equal”

J. Forms

- [Laboratory autoclave and AEW User Checklist](#)

K. References

- [Nalgene® Plastic ware Chart](#)
- [ThermoScientific Nalgene Bottles and Carboys Technical Brochure](#), “Not all containers are created equal”
- Arizona State, Environmental Health and Safety
- Iowa State, Environmental Health and Safety

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