Overview
An autoclave is a piece of equipment widely used in biomedical laboratories at Weill Cornell Medicine (WCM). Autoclaves pose many hazards, including potential physical harm (e.g. heat, steam, and pressure) and biological risks. This Update provides guidance on the usage of autoclaves on campus and off-site locations.

Each autoclave has unique characteristics. Review and understand the owner’s manual before using any autoclave for the first time and as needed thereafter, and contact the manufacturer to request on-site training as needed. Ensure the owner’s manual is readily available in case questions arise during operation. EHS can be contacted for general autoclave safety training and guidance.

Maintenance is vital to the effective and safe use of an autoclave. Follow the manufacturer’s recommendations for preventative maintenance and ensure all contractors are approved by the manufacturer. Maintenance should include periodic efficiency tests (e.g. Bacillus stearothermophilus spore testing) to ensure the autoclave is functioning properly.

Applicability
Supervisors and personnel using autoclaves.

Responsibilities
Environmental Health and Safety (EHS) provides assistance and training for autoclave safety as requested, and updates informational resources as necessary.

Principal Investigators and Laboratory Managers establish and update policies and procedures for their personnel. They also ensure that laboratory staff is properly trained in and compliant with safety requirements, and familiar with this Update.

Laboratory Personnel working with autoclaves must follow these guidelines, and contact Environmental Health and Safety for any needed assistance and training.

Procedure
Utilize the following autoclave safety practices.

1. GENERAL PRECAUTIONS
   - LABORATORY SUPERVISION: Autoclaving is considered a laboratory operation and must be supervised by an FDNY C14 Laboratory Certificate of Fitness holder. Please consult the EHS website for more information.
   - TRAINING: All autoclave operators must receive training on safety practices prior to using the equipment. Training may be delegated to a qualified individual, but it remains the responsibility of the supervisor to ensure their personnel is adequately trained. Training requirements may include annual completion of Laboratory Safety or Clinical Safety programs, depending on the department. This Update should be reviewed as well.
     - Know the location of nearest safety shower and eyewash station in the event of accidental exposure to steam or hot water.
     - Review the owner’s manual and understand the proper operating instructions for the specific autoclave unit and safety procedures. Do not use an autoclave for other than its intended purpose.
   - PERSONAL PROTECTIVE EQUIPMENT (PPE): Wear suitable personal protective equipment when loading, operating or retrieving materials from an autoclave:
     - Standard PPE: Closed toed shoes, lab coat, safety glasses, and heat-resistant insulated gloves.
     - When Autoclaving Liquids: Standard PPE plus face shields, liquid-resistant apron, and sleeves.
     - When Autoclaving Sharps: Standard PPE plus cut-resistant gloves when removing items from the autoclave.
   - IN THE EVENT OF INJURIES:
     - Immediate First Aid: If accidental exposure to steam or hot water occurs, immediately use safety shower or eyewash to cool the affected area.
CONTINUED:
Autoclave Safety

Seek Medical Assistance: Based on the severity of injuries, contact NYP EMS at 212-472-2222 to have emergency medical services brought to the autoclave room. Additional medical assistance can be obtained from NYP Emergency Department (24/7) or Workforce Health and Safety and Student Health Services (during business hours) for less severe injuries.

Inform: Report any injuries to the appropriate supervisor and Environmental Health and Safety.

PROHIBITED ITEMS: Autoclaves must not be used with the following:
- Corrosives (e.g. acids, bases, phenol, etc.), solvents (e.g. ethanol, methanol, chloroform), or radioactive materials: Contact EHS or review the EHS Program Manual, Section 5.2 - Waste Disposal Procedures for proper decontamination and disposal procedures.
- Vertebrate animal carcasses: should be disposed of via the Research Animal Resource Center (RARC).

Inform:
Report any injuries to the appropriate supervisor and Environmental Health and Safety.

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2. BEFORE USING AUTOCLAVE

AUTOCLAVE PRE-CHECK BEFORE LOADING:
- Check gaskets and seals to ensure they are undamaged and free of dirt and debris. Wipe with a soft cloth to clean as needed.
- Check inside for any items left by the previous user that could pose a hazard (e.g. sharps).
- Clean the drain strainer.
- Refer to owner’s manual for other autoclave pre-checks for the specific unit.

LOOSEN CAPS TO RELEASE PRESSURE: Prevent bottles from shattering during pressurization by loosening container caps before loading; this includes both empty and liquid-filled bottles. Expanding vapor in bottles during heating can also lead to rupturing. Containers should only be ½ - ¾ full to allow for vapor expansion.

AUTOCLAVE-SAFE CONTAINERS: Only use autoclave-compatible plastics. Certain plastics cannot be autoclaved. Plastic types are identified by manufacturer’s initials imprinted on the container bottom.
- Use: Polypropylene (PP, recycle #5); Polycarbonate (PC). Nalgene Labware/Thermo Scientific’s Autoclaving web page provides additional plastic considerations.
- Do Not Use: Polyethylene (PE, recycle #1); High-density polyethylene (HDPE, recycle #2).

3. AUTOCLAVE CYCLES

CHOOSE THE CORRECT AUTOCLAVE CYCLE: there are two basic autoclave cycles.

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<tr>
<th>Cycle</th>
<th>Materials</th>
<th>Description</th>
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<tbody>
<tr>
<td>Gravity or “fast exhaust”</td>
<td>Dry goods, glassware, etc.</td>
<td>This cycle charges the chamber with steam and holds it at a set pressure and temperature for a fixed time. At the end of the cycle, a valve opens, and the chamber rapidly returns to atmospheric pressure. Drying time may also be added to the cycle.</td>
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<tr>
<td>Liquid or “slow exhaust”</td>
<td>Liquids</td>
<td>This cycle prevents sterilized liquids from boiling over. Steam is exhausted slowly at the end of the cycle, allowing the pressure in the containers to reach equilibrium without causing the liquid to overflow.</td>
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4. PACKING AUTOCLAVE BAGS INTO THE AUTOCLAVE

- Use only autoclave-rated bags with an autoclave. Standard red bags provided by Housekeeping are not approved for autoclaves and will melt during autoclave operations.
- Avoid packing bags tightly within the autoclave to ensure that heat & steam can circulate.
— Seal bags loosely to allow for effective steam penetration.
— Do not allow bags to touch the interior walls of the autoclave.
— Ensure sufficient liquid is packed with contents of autoclave bags if dry (e.g. 10 ml of water; a zip lock bag containing water).

**AUTOCLAVE INDICATOR TAPE:** Place autoclave tape on the material being autoclaved (e.g. bag; bottle; or tray; etc.) as an additional verification of sterilization by the autoclave.

— **Use only lead-free autoclave tape.** Replace lead-containing autoclave tape with lead-free alternatives. Typically, tapes with stripes (/\_/) contain lead. Tapes which display the word "Autoclaved" as an indication of steam sterilization are lead-free. Lead-free options are available from WMC Preferred Vendors, such as VWR and Fisher-Scientific. Unused rolls of lead-containing autoclave tape should be disposed of via EHS as chemical waste.

**CONFIRM THAT DOOR IS PROPERLY CLOSED:** Make sure the door of the autoclave is fully closed (latched) and sealed before starting the cycle.

5. **OPENING THE AUTOCLAVE DOOR AND UNLOADING ITEMS**

— **ZERO PRESSURE BEFORE OPENING:** Wait until the pressure gauge reads zero before opening the autoclave door.

— **PUT ON PPE BEFORE OPENING THE AUTOCLAVE:**

— **OPEN DOOR CAUTIOUSLY:** Stand behind the door (if possible) and slowly open it. Allow 30 seconds to let steam escape before reaching inside.

— **ALLOW LIQUIDS TO COOL PRIOR TO REMOVAL:** Let liquids sit for 10-20 minutes prior to removal from the autoclave. This allows the liquid to cool enough to avoid any boil over while removing.

— **ALERT** others in the area that a heat hazard is present.

**References**

EHS Program Manual, Section 5.2 - Waste Disposal Procedures

Nalgene Labware - Technical Data: “Autoclaving”

University of California at San Diego - Autoclaving Guidelines for Sterilization of Lab Equipment

University of California at Berkley – “Safe and Effective Use of Autoclaves”