

Western Carolina University

Standard Operating Procedure for Safe Autoclave Operation

CONTACT INFORMATION

Procedure Title **Safe Autoclave Operation**

Procedure Author Safety and Risk Management

**Date of
Creation/Revision**

**Name of
Responsible Person**
*(PI, Supervisor, or
Autonomous
Researcher)*

**Location of
Autoclave** *(Building
and room)*

**Autoclave
Make/Model:**

Safety Office Phone 828-227-7443

HAZARD RISKS

Autoclaves use high pressure and high temperature steam for sterilization. The potential safety risks for the operators include:

- Heat burns from hot materials and autoclave chamber walls and door.
- Steam burns from residual steam coming out from autoclave and materials on completion of cycle.
- Hot fluid scalds from boiling liquids and spillage in autoclave.
- Hand and arm injuries when closing the door.
- Body injury if there is an explosion.
- Inadequate decontamination poses biological hazards to personnel and environmental contamination.
- Ergonomic and pinch hazards from the large heavy doors and loading carriages.

AUTOCLAVE SAFETY GUIDELINES

To ensure the health and safety of personnel using the autoclave, it is important for each department to maintain autoclaves and to train personnel in their proper use.

- The name of the person responsible for the autoclave shall be posted near the autoclave. This SOP should be posted in the autoclave room.
- All operators must receive hands-on training on the safe operation of any autoclave that they will use prior to using the equipment. It is the supervisor's responsibility to ensure their personnel are adequately trained and understand proper packaging, loading, labeling, operating procedures, and risks associated with autoclave use.
- Personal protective clothing and equipment must be worn when loading and unloading the autoclave.
- Autoclave operating instructions should be posted near the autoclave and an operations manual available for review.
- Biohazardous materials should never be left in hallways, next to the autoclave on the floor or in other public spaces prior to autoclaving. Biohazard bags should remain in the laboratory until they are ready to be placed in the autoclave.
- Biohazardous materials should be sterilized by the end of each work day, or must be secured appropriately.
- Biohazardous materials should not be left in an autoclave overnight in anticipation of autoclaving the next day.

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- Do not autoclave toxic, volatile, or radioactive materials.
 - For the autoclave process to be effective in achieving sterilization, sufficient temperature, time and direct steam contact are essential. Air must be completely removed from the sterilizer chamber and from the materials to allow proper steam penetration to every part of the waste load. If all the air is not allowed to escape from the waste during the autoclave cycle, then steam will not replace the air and proper sterilization will not be achieved. Factors that affect air removal include type and quantity of material to be autoclaved, packaging, load density and configuration, and container type, size, and shape.
 - Make sure autoclave doors and gaskets are firmly locked into place before operating the autoclave.
 - The plug screen or drainer should be removed with heat-resistant gloves, checked, and cleaned frequently to ensure that it is free of dirt, dust, or sediment which may collect and cause a clog.
 - Gaskets, doors, shelves, and walls should be visually inspected on a regular basis for residue buildup and wear. Interior surfaces should be cleaned of any residues that collect over time.
 - Autoclaves must be inspected at least annually. Inspection services may be managed by your manufacturer's preventative maintenance contract. The inspection, service and repair records should be available upon request.
 - Spore strips may be used to validate autoclave effectiveness.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Clothing and equipment to protect against scalds and burns include:

- Heat-insulating gloves that provide complete coverage of hands and forearm
- Lab coat and splash apron
- Long pants
- Eye protection
- Closed-toed footwear

OPERATING PROCEDURES

Material Preparation:

- Ensure the material is safe for autoclaving. Oils, waxes, some plastics, flammable materials, radioactive materials, and samples containing solvents or substances that may emit toxic fumes **should not be** autoclaved.
 - Ensure that the correct autoclave bag is used. Do not use red biohazard bags or regular trash bags.
 - Glassware should be heat-resistant (Pyrex or Kimax) and inspected for cracks prior to autoclaving.
 - Plastics should be heat-resistant, for example, polycarbonate (PC), PTFE ("Teflon") and most polypropylene (PP) items.
 - Loose dry materials should be wrapped or bagged in steam-penetrable paper or loosely covered with aluminum foil. Wrapping too tightly will impede steam penetration and decrease efficiency of the process.
 - Never overfill the bags or sharps containers, they should be autoclaved when they are 2/3 full.
 - Containers of liquid should be filled to a maximum 2/3 volume. DO NOT autoclave containers that are filled past 2/3 as this increases the likelihood of an overflow of hot liquids.
 - All containers should be covered by a loosened lid or steam-penetrable bung to prevent pressure buildup and avoid having bottles shatter during pressurization.
 - Do not seal the bags too tightly, as this will impede penetration of steam into the bag. Bag should be at least three fingers wide at the opening of the taped bag.
 - Place liquids, bags of agar plates, or other materials that may boil over or leak in secondary containers (autoclave plastic or stainless-steel bins) to secure and contain spills. The pan must be large enough to contain a total spill of the contents. Open, shallow metal pans are more effective in conducting heat and allowing air removal than tall, plastic tubs.
 - Adding some water to the secondary pan will help to heat items more evenly. DO NOT overfill the secondary container as this poses a spill/splash risk when removed from the autoclave.
 - Indicator tape should be placed in an "X" pattern over the biohazard symbol. Autoclave temperature tape must be used to keep track of autoclaved and non-autoclaved items.
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Loading the Autoclave:

- Ensure the drain strainer in the bottom of the autoclave is clean before loading the autoclave.
- Use a cart to transfer items to be autoclaved, particularly if fragile/breakable (e.g. glass flasks and beakers) items are being transferred. To avoid back injuries, push the cart up to the autoclave door and gently slide the load into the autoclave.
- Never place autoclave bags or glassware in direct contact with the bottom of the autoclave. Place the secondary pan containing the items to be sterilized on the shelf or rack of the autoclave.
- Do not overload the autoclave. It is important to leave sufficient room for thorough steam circulation. Do not allow material to touch the sides or top of the chamber.
- Firmly lock the autoclave door prior to starting the run to prevent sudden release of high-pressure steam. If the autoclave does not have interlocking mechanisms, take additional precautions to ensure the door is closed.

Operating the Autoclave:

- Choose the appropriate cycle (gravity, liquid, or dry cycle) for the material. Consult the autoclave manual for assistance in choosing a cycle. Manuals should be located near the autoclave.
- Set appropriate time and temperature if using a customized cycle.
- Start the cycle and fill out the autoclave user log with your contact information. A completed cycle usually takes 1-1 ½ hours.
- Do not attempt to open the door while the autoclave is operating.
- If a problem occurs, abort the cycle and report it to the supervisor immediately.

Unloading the Autoclave:

- Before opening the door, ensure that you have on all required PPE (lab coat, closed-toed shoes, long pants, eye protection, and heat-resistant gloves).
- The pressure gauge must read zero before attempting to open the door. Verify cycle conditions were met.
- Carefully crack door open to release residual steam and allow pressure within liquids and containers to normalize. Be sure to stand away from the door so as not to be exposed to steam escaping the autoclave.
- Verify that heat sensitive tape has changed color or the word “autoclaved” has appeared.
- Wait a full five minutes if the autoclave load contains only dry glassware, and no less than 10 minutes if autoclaving liquids before removing the items.
- Use caution when removing liquids, molten agar, etc. Liquids, especially large volumes, may continue to boil for some time after autoclaving.
- Do not agitate containers of super-heated liquid or remove caps before unloading to avoid getting splashed with scalding liquid.
- When removing biohazard bags, always pick up from the top, taped area of the bag. Never handle the biohazard bags by the sides or bottom.
- Slide a cart to the opening of the autoclave and pull the autoclave secondary container onto the cart for transport.
- Place the cart in a low traffic area that is clearly identified as “hot materials” while additional cooling occurs.
- Let the glassware cool for 15 minutes and liquid loads for a full hour before touching the items with ungloved hands.

NOTE: If a faulty condition exists (e.g., sterilizer did not finish the cycle, or water leaks out when the door is unlocked), contact the service company. Place a sign on the autoclave that it is out of use. Do not continue to use the autoclave until it is operating correctly.

AUTOCLAVE USE LOG

Entries must be placed in the log book each time the autoclave is used. These records are used for maintenance/service schedules and reporting any incidents. Entries should include: operator's name, date, time, and duration. The log book should be kept adjacent to the autoclave.

INCIDENT RESPONSE AND SPILLS

All incidents, including a spill or injury, must be reported to your supervisor. If necessary, seek medical assistance from WCU Health Services or dial 828-227-8911 for an emergency.

- If clothing is soaked in hot water/steam, remove clothing and place the injured area in cool water.
- Place a notice on the autoclave indicating it is not to be used until the cause of the incident is determined and procedures enacted to prevent future incidents.
- Spills can occur from boil-over or breakage of containers. Spills must be cleaned up as soon as the temperature has cooled and it is safe to do so.
- Contain the spilled material using paper towels. Use appropriate PPE and follow proper disposal protocols. Broken glass must be disposed of in a sharps container or glass disposal box as appropriate.
- Record the spill and clean-up procedure in the log book.

MAINTENACE AND REPAIR

No person shall operate the autoclave unless the autoclave is in good working order. Only qualified professionals are permitted to make repairs. Repairs are performed by your service contract or any other contractor you choose to hire. Report any possible malfunction immediately to the responsible person listed for the autoclave. Post a sign on the autoclave indicating that it is not to be used until the problem is diagnosed and corrected.

TRAINING REQUIREMENTS

All personnel who use autoclaves must have successfully completed a training session on the safe operating procedures. This requirement applies to both new and experienced personnel.

- Training must be documented and records kept by the lab.
 - Autoclave users must read and sign this SOP.
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